
PAKISTAN
ENERGY PLANNING AND DEVELOPMENT
PROJECT EVALUATION REPORT

July 1988

CBY ASSOCIATES, INC.

PAKISTAN
ENERGY PLANNING AND DEVELOPMENT PROJECT

EVALUATION REPORT

PROJECT 391-0478

JULY 1988

Prepared by

Donald A. Beattie, Team Leader
Robert A. Archer
Peter G. Bos
Hugh Douglas
Harry R. Johnson
Saeed Ahmed Rashed
Arthur D. Rypinski

CBY ASSOCIATES, INC.
5039 Cathedral Avenue, NW
Washington, DC 20016

PREFACE

This mid-term evaluation of the Energy Planning and Development Project was prepared by CBY Associates, Inc., Washington, D.C. The Evaluation Team Leader was Mr. Donald A. Beattie with team membership comprised of Messrs. Peter G. Bos, Hugh Douglas, Harry R. Johnson, and Arthur D. Rypinski. Mr. Robert A. Archer, USAID Bureau for Asia and Near East, Washington, D.C., joined the team in Pakistan and made a substantial contribution to the evaluation.

The Evaluation Team would like to express its gratitude to the staff of USAID, Pakistan for assisting us in contacting and scheduling interviews with Government of Pakistan (GOP) agency personnel, private sector companies and AID Mission staff. Also, we wish to thank them for helping us locate and collect Project background papers, reports, memoranda and related material essential to developing our understanding of the Project. In particular, we wish to acknowledge the assistance of Mr. James A. Bever, Project Officer, who patiently guided us through the complexities of the Project and Messrs. Syed Raza Hussain and Anjum Ahmad, USAID Project Managers. Mr. Charles Bliss, and his staff, were equally helpful.

Special thanks also are due to Mr. Saeed Ahmed Rashed who joined the Evaluation Team in Pakistan. Mr. Rashed, former Additional Secretary, Acting, Planning Division, GOP, prior to his retirement, was particularly helpful in reconstructing the rationale for past actions taken. He also made important contributions to the findings and recommendations of the Evaluation of the Manpower Assessment and Training element.

In addition, we would like to acknowledge the warm cooperation and openness of the staff of GOP agencies and contractors who endured our endless questions, and thus made this evaluation possible. Mr. Ashfaq Mahmood, Senior Chief, Energy Wing, was especially helpful and devoted considerable time to the evaluation in spite of his busy schedule.

The team wants to commend also, Mr. Shahid H. Malik who patiently transcribed our mysterious and sometimes undecipherable jottings which permitted us to stay on a tight schedule.

**PAKISTAN
ENERGY PLANNING AND DEVELOPMENT PROJECT
EVALUATION REPORT**

EXECUTIVE SUMMARY

A. Introduction

The Energy Planning and Development (EP&D) Project initiated in 1983, is a seven year, \$105 million, multi-component project with the primary objective of increasing Pakistan's energy self-sufficiency. The Project is unusually complex, in that it includes such disparate elements as institution building, four completely independent technical assistance programs, a manpower development program, a coal resource assessment program, a component for the development of large-scale commercial coal mining, two major conferences, several large feasibility studies, important energy conservation activities and significant commodity assistance. The EP&D Project is thus almost a complete USAID mission portfolio in miniature.

Our findings and recommendations are as complex as the Project itself. Many of them, however, are aimed specifically at the Government of Pakistan (GOP) and USAID project managers and may not be of general interest. This executive summary details those findings and recommendations that we feel have broader policy implications for the future of the Government of Pakistan's energy policy and USAID's assistance program. Many additional findings and recommendations will be found in the body of the report.

B. General Findings and Recommendations

The Project, in general, has been a success, and money well spent by USAID and the Government of Pakistan. Having made this important finding, the Evaluation Team, as do all evaluation teams, spent the majority of its time and effort in addressing deficiencies or problems that can be corrected by the Project during its remaining lifetime. Thus, the preponderance of the report is given over to discussing these deficiencies and the Team's recommendations on how to resolve them.

The original objective of the Energy Planning and Development Project, as detailed in the Project Paper, was to increase Pakistan's energy self-sufficiency. We believe this objective to be skewed since taken in isolation could lead to high-cost projects whose sole justification would be that they use domestic resources. Nor does this objective reflect actual USAID policy as expressed in the current Country Development Strategy Statement (CDSS). **A better definition of the EP&D Project objectives would be to help Pakistan obtain the energy it needs for development at the least possible cost.**

For the future we believe that the oil and gas sector will be of increasing importance, that rapid increases in gas production offer the only possible "short-term fix" to Pakistan's energy problems, that the United States has particular expertise in oil and gas technology, and, therefore, USAID should support targeted initiatives in the oil and gas sector that will complement other, ongoing donor activities.

As a start in that direction, we recommend:

- Continued support to the Oil and Gas Development Corporation (OGDC), in coordination with the Canadian International Development Agency (CIDA), in preparing OGDC's audit of financial operations, leading to eventual privatization.
- Assisting Director General Petroleum Concessions (DGPC), OGDC and Hydrocarbon Development Institute of Pakistan (HDIP), in coordination with the World Bank, in cataloging and processing available geological, geophysical and reservoir engineering data, and, in return for this assistance, make this information freely available to private sector companies.
- Encouraging U.S. architecture and engineering (A&E) firms to address Pakistan's future refining needs.
- Assist Pakistan in developing petroleum reservoir engineering expertise.

C. Specific Project Component Findings and Recommendations

1. Energy Analysis and Manpower Development

This component provides technical assistance to develop an energy analysis capability within the Government of Pakistan. The component has been a success. The Energy Wing of the Ministry of Planning Development has a staff of 21 Pakistani civil servants, assisted by a USAID technical assistance contractor and several project direct-hire staff. The Energy Wing plays a central role in GOP energy planning, budgeting, and project appraisal. The calibre of the Energy Wing staff is excellent. USAID commodity assistance has given them a large concentration of computer equipment.

The Evaluation Team perceives that the Energy Wing has a strong technical orientation, and that management priorities emphasize project and budget cycle responsibilities. Therefore, there is a risk that the Energy Wing may not place sufficient emphasis on upgrading its planning and analysis capability for the future.

We recommend:

- That this component of the Project be extended through 1993 to cover the Eighth Plan preparation; however, the future level of technical assistance could be reduced as Energy Wing capability increases.

- That the Energy Wing make a special effort to strengthen its ability to carry out policy-oriented work; and that both technical assistance and future staff recruitment be oriented to helping Energy Wing enhance its capability to design as well as implement policy analyses.
- That manpower development efforts attempt to achieve a better balance between in-country and U.S. training, and make a special effort to recruit Pakistani women.

2. Coal Resource Assessment

The original Project Paper called for an assessment of Pakistan's total coal resources. A number of coal fields were specifically named as candidates for detailed assessments with the Lakhra field given highest priority.

Initial resource assessments at Lakhra funded by USAID estimated 385 M tonnes of coal in place. Subsequent reserves assessment drilling, also funded by USAID, identified 170 M tonnes reserve of as-mined coal with a heating value of 5950 Btu per pound. Because of the high priority given to support the reserve assessment drilling at Lakhra, planned Geological Survey of Pakistan (GSP) resource assessment activities were cut back in other parts of the country.

Resource assessment activities in other areas of Pakistan, such as Jherruk, Baluchistan and the Salt Range, also have been encouraging. Because Pakistan's total coal resource base still remains largely unknown, continued support of the GSP through the EP&D Project is warranted.

We recommend:

- The Geological Survey of Pakistan focus on resource assessment as its primary mission. USAID should continue to support this effort through 1993 by means of both practical and academic training and commodities donations. Particular emphasis should be placed on transferring all coal analysis and geologic interpretation from the United States to GSP offices in Pakistan.

3. Coal Mine and Coal-Fired Power Generation

USAID's coal development program was shaped by a donor coordination meeting held in October 1983, just after project initiation, and also by USAID's emerging interest in private sector initiatives. The USAID and other donors felt that coal reserves were insufficiently defined, and the Asian Development Bank felt that certain feasibility studies were required. Based on these requirements, USAID funded a coal reserve assessment of the "PMDC Tract" of the Lakhra field, a power plant feasibility study, an environmental impact assessment, social impact assessment, and an economic/financial analysis. By 1986, most of the major uncertainties surrounding the potential for commercial coal mining at Lakhra had been resolved sufficiently to permit the preparation of a request for proposals for coal supplies.

In early 1987, Water and Power Development Authority (WAPDA), with the assistance of a USAID contractor, released a request for tenders for 4.3 million tonnes/year (tpy) of coal production to support a 500 MW power station. Only two firms responded to the solicitation, and neither was accepted. Later in 1987, WAPDA contracted with China to supply three 50 MW fluidized bed coal-fired units, and in early 1988 issued a second, much simplified solicitation for 0.9 million tpy of coal to fuel these units.

The WAPDA power plant contract and coal supply solicitation are likely to result in private development of a coal mine(s) on the PMDC Tract. This Tract is now a valuable asset because of the reserve delineation carried out by the USAID program.

We recommend:

- USAID provide technical support to WAPDA in 1988/89 in its current coal supply procurement to help assure that appropriate health and safety standards are considered in the negotiations.
- USAID fund a small "training mine" in the Sind to begin operating by 1990 with a capacity of a few hundred tonnes per day, to train miners in safe underground mining methods and to establish a mine rescue capability (approximate cost \$3 - \$5 million).

Other USAID actions related to Coal Development and Utilization, if any, should be deferred until the outcome of WAPDA's current solicitation for coal supplies is known.

4. Coal Briquetting

Work on coal briquettes consisted principally of developing briquettes made from local coals and other materials suitable for test marketing, and conducting two market surveys. A user survey designed to test three types of briquettes was inconclusive. The primary criticism of users was that the briquettes did not provide enough heat for most cooking purposes. The briquettes could be useful for space heating in specially designed stoves but the potential market is limited. A fuel use pattern market survey was designed to determine the residential use pattern of briquettes with competitive fuels used for cooking and heating. This survey was also inconclusive because of inadequacies in the demographic samples. Based on manufacturing studies, projected briquette manufacturing costs resulted in a briquette price that would not allow competition with currently used fuels without some government subsidies.

We recommend:

- Work on the potential market for coal briquettes continue through modest funding of the Pakistan Center for Appropriate Technology to conduct tests on different types of briquettes in low income rural markets. Funding should be made through 1990 at which point an evaluation should be made. If this work proves successful, the development of suitable briquettes and test marketing could be continued or expanded as the evaluation determines.

5. Energy Conservation

Start-up of this component was delayed for 18 months until a resolution was passed by the GOP in December 1986 establishing a National Energy Conservation Center (ENERCON). With the GOP commitment to proceed with the Energy Conservation component, the USAID contractor, Hagler, Bailly and Company, initiated activities in early 1986 reporting to a GOP Acting Managing Director. The buildup in contractor activity was curtailed in September 1986 because only one full-time ENERCON professional had been hired. During 1986 and 1987 the technical assistance contractor provided, primarily, "turnkey" services with substantial technical assistance directed to private sector conservation efforts.

The extraordinary delay in staffing substantially impeded the desired institutional development of ENERCON. Despite the delay, commendable progress has been made in the development of private sector capabilities to provide energy audit technical services to private industry. ENERCON consequently has a good image among the private industrial sector and a good base exists for an expanded relationship.

A national energy conservation program is still needed and justified. To move toward that objective we recommend:

- The new ENERCON Managing Director define/confirm the ENERCON long-term role and complete staffing accordingly; assess future technical assistance needs given the proposed departure of two long-term resident advisors and the need to expand ENERCON policy analysis capabilities.
- Strengthening the major investment promotion activities by facilitating energy conservation equipment financing in the Pakistan financial community.
- Expanding the ENERCON program with the private sector with a strong effort directed toward leveraging the ENERCON resources by supporting the hiring of staff to be placed with key industrial associations and commercializing energy audits and other engineering services.
- Initiating a more effective ENERCON coordination role in public sector energy conservation. The strategy would be to stimulate Pakistan utilities' top management to commit staff and resources for conservation efforts directed to end-user customers and the Ministry of Production to improve internal energy efficiency in public sector industries.
- Extending the component to 1993 to assure establishment of a sound conservation capability and program; review the technical assistance needs in late 1989, including a careful evaluation of the long term capability of ENERCON to assume program management responsibility.

6. Renewable Energy

Government of Pakistan responsibilities for renewable energy projects are fragmented and this project component has not been a particularly high priority for USAID staff. Consequently, few concrete actions have been taken to date.

At present, there exists a tripartite difference of view between the USAID mission, the Energy Wing, and the Directorate General for New and Renewable Energy Resources (DGNRER). USAID believes that the primary objective of the program should be commercialization of renewable technologies; Energy Wing believes that a Master Plan should be the first order of business; and DGNRER believes that it should be setting up a series of regional renewable energy centers for demonstration projects.

Until this difference of view can be resolved, little progress will take place.

We recommend:

- The Government of Pakistan organize its renewable energy effort more effectively so that USAID can be of assistance.
- If there is agreement that a Master Plan is desirable (the Team thinks it is), then the job probably should be given to Mathtech as a "Special Study" under the "Energy Analysis and Manpower Development" component so that the work can be done expeditiously.
- If commercialization is the first priority, USAID should find a specialized market survey contractor, and select only the three or four most promising technologies to test for commercialization potential.
- If recommendation one, above, is followed, this element should be extended to 1993.

LIST OF ABBREVIATIONS AND ACRONYMS

A&E	Architecture and Engineering
ALL	Arthur D. Little, Inc.
bbl	Barrels
BFT	Boiler/Furnace Tuneup
Btu	British thermal unit
CDA	Capital Development Authority
CDSS	Country Development Strategy Statement
CIDA	Canadian International Development Agency
COALCON	Coal Conference
DES	Detailed Energy Survey
DGNRER	Directorate General New Renewable Energy Resources
DGPC	Director General Petroleum Concessions
DOE	U.S. Department of Energy
EAC	Expert Advisory Cell
EAD	Economics Affairs Division
EDI	Energy Development International
ENAR	ENAR Petrotech
ENERCON	National Energy Conservation Center
ENERPLAN	Energy Planning Organization
EP&D	Energy Planning and Development
EPRI	Electric Power Research Institute
ESL-1	World Bank Energy Sector Loan-1
FBC	Fluidized Bed Combustion
FBS	Federal Bureau of Statistics
GOP	Government of Pakistan
GSP	Geological Survey of Pakistan
HBC	Hagler, Bailly and Company
HDIP	Hydrocarbon Development Institute of Pakistan
HQ	Headquarters
HVAC	Heating/Ventilating and Air Conditioning
HYDEL	Hydro-electric
IBRD	International Bank for Rural Development
IIE	Institute of International Education
JICA	Japan International Cooperation Agency
KESC	Karachi Electric Supply Corporation
lb.	pound
LPG	Liquified petroleum gas
M	Million
MBA	Master of Business Administration
mfg.	Manufacturer
MW	Megawatt
NIDC/XENEL	Consortium Proposing Private Power Plant
OGDC	Oil and Gas Development Corporation
PC	Personal computer
PC-1	Planning Commission Form 1
PC/AT	IBM computer

PC-2	Planning Commission Form 2
PCAT	Pakistan Council for Appropriate Technology
PCSIR	Pakistan Council for Scientific and Industrial Research
PECC	Pakistan Energy Conservation Council
PES	Preliminary Energy Survey
PMDC	Pakistan Mineral Development Corporation
PSC	Personal Services Contractor
PSO	Pakistan State Oil
RES	Reference Energy System
REGEN	Computer Energy Model
RESPAK	Computer Energy Model Pakistan
Rs.	Rupees
SITE	Sind Industrial Trading Estate
SNGPL	Sui Northern Gas Pipeline
SQL	Structured Query Language, IBM mainframe database language
TA	Technical Assistance
TDY	Temporary Duty
TEM	Total Energy Management
tpy	Tonnes/year
U.S.	United States of American
USAID	U.S. Agency for International Development
USBM	U.S. Bureau of Mines
USGS	U.S. Geological Survey
WAPDA	Water and Power Development Authority
WASP	Power Generation Computer Model

TABLE OF CONTENTS

I. INTRODUCTION	1
A. Background	1
B. Pakistan Energy Sector	1
C. Methodology	2
D. Organization of This Report	3
II. PROJECT DESCRIPTION	4
A. Project Goal and Purpose	4
B. Planned Outputs	4
C. Project Components	6
1. Energy Analysis and Manpower Development	6
2. Coal Resources Assessment and Development	7
a. Coal Resources Assessment	7
b. Coal Mine and Coal-Fired Power Generation Development	7
c. Coal Briquetting	8
3. Conservation and Renewable Energy Technologies	8
a. Conservation	8
b. Renewable Energy Technologies	9
D. Project Modifications	9
III. OIL AND GAS IN THE PAKISTAN ECONOMY	10
A. Background	10
B. Cost of Oil Imports	10
C. Domestic Oil Supply Forecasts	12
D. Domestic Gas Supply Forecasts	14
E. Findings and Recommendations	14
IV. ENERGY ANALYSIS AND MANPOWER DEVELOPMENT	17
A. Background	17
1. Original Component Objectives	17
2. Planned Activities	17
a. Integrated Energy Analysis	17
b. Energy Database Development and Management System ..	18
c. Special Studies	18
d. Manpower Needs Assessment and Development	18
e. Technical Assistance	18
f. Training	18
3. A Slow Start: 1983-1986	18
4. The Mathtech Contract	19
5. Seventh Five-Year Plan (1987)	20
6. The ENERPLAN/Energy Section Merger	20

B. Assessment	21
1. Institutional Development of the Energy Wing	21
a. Energy Wing's Usefulness to GOP	21
b. Energy Wing's Post-Project Capability	22
c. Energy Wing Plans	22
d. Findings	23
e. Recommendations	23
2. Energy Planning	24
a. Findings	24
b. Recommendations	25
3. Model Use/Adaptation	25
a. Model Description	25
b. Energy Wing Use of the Model	26
c. Findings	26
d. Recommendations	27
4. Database Development	27
a. Findings	28
b. Recommendations	28
5. Mathtech/Energy Wing Special Studies	28
a. Findings	29
b. Recommendations	29
6. Energy Project Appraisal	30
a. Findings	30
b. Recommendations	30
7. Technical Assistance	31
a. Findings	32
b. Recommendations	32
8. Manpower Development and Training	33
a. Findings	34
b. Recommendations	34
9. Commodity Assistance	35
10. USAID Special Studies	35
a. Dhodak	35
b. Jamshoro Thermal Power Station Study	36
c. The Pakistan Oil and Gas Conference	36
d. COALCON	37
e. Conclusions	37
V. COAL RESOURCE ASSESSMENT	38
A. Original Objective	38
B. Background	38
C. Findings	40
D. Recommendations	47
VI. COAL MINE AND COAL-FIRED POWER GENERATION	49
A. Background	49
1. Activities Prior to EP&D Project Initiation	49
2. EP&D Project	50
B. Findings Relative to EP&D	53

C. Findings Relative to the Donor Agency Guidelines	55
D. Observations	55
1. Energy Prices	55
2. Combustion Technology	56
3. Future Considerations	57
E. Recommendations	57
1. Terminate Program	57
2. Technical Support to WAPDA for Coal Supply Procurement	57
3. Training Mine	58
4. Model Mine	59
F. Emerging Issues	59
1. Utility-Sized Fluidized-Bed Reactor	59
2. Mining Rules and Regulations	60
3. Full Utilization of the Coal Resources	60
VII. COAL BRIQUETTING PROGRAM	61
A. Background	61
B. Findings	61
1. Product Development	61
2. Market Studies	63
a. Residential Fuel Use	63
b. Product Field Tests	63
3. Commodity Assistance	64
C. Recommendation	64
VIII. CONSERVATION AND RENEWABLE ENERGY TECHNOLOGIES	65
A. BACKGROUND	65
B. CONSERVATION ELEMENT	65
1. ENERCON Institution Building	66
a. Findings	66
b. Conclusions	67
c. Recommendations	68
2. ENERCON And The Public Industries and Utilities	69
a. Findings - Public Industries	69
b. Conclusions - Public Industries	70
c. Recommendations - Public Industries	71
d. Findings - Public Utilities	72
e. Conclusions - Public Utilities	72
f. Recommendations - Public Utilities	73
3. ENERCON and The Private Sector	73
a. Findings - Industrial Associations	73
b. Conclusions - Industrial Associations	74
c. Recommendations - Industrial Associations	74
d. Findings - Subcontractors	75
e. Conclusions - Subcontractors	75
f. Recommendations - Subcontractors	76
g. Findings - Industrial Plant Personnel	76
h. Conclusions - Industrial Plant Personnel	77
i. Recommendations - Industrial Plant Personnel	77

4. Energy Conservation Planning/Legislation/Special Studies	77
a. Findings	77
b. Conclusions	79
c. Recommendations	79
5. Data Base Development and Management	80
a. The Planning Databases	80
b. The Operational/Project Monitoring Databases	81
c. Findings	82
d. Recommendations	82
6. Technical Support	83
a. Findings	83
b. Conclusions	84
c. Recommendations	85
7. Training and Curriculum Development	86
a. Findings	86
b. Conclusions	87
c. Recommendations	87
8. Outreach and Information	89
a. Findings	89
b. Conclusions	89
c. Recommendations	89
9. Investment Promotion	90
a. Findings	90
b. Conclusions	92
c. Recommendations	92
10. Monitoring/Evaluation/Reporting	93
a. Findings	93
b. Conclusions	94
c. Recommendation	94
11. Buildings, Agriculture and Transportation	94
a. Findings - Buildings	94
b. Conclusions - Buildings	95
c. Recommendations - Buildings	95
d. Findings - Agriculture and Transportation	96
e. Recommendations - Agriculture and Transportation	96
12. Technical Assistance, Organization and Management Issues	97
a. Findings	97
b. Conclusions	97
c. Recommendations	98
13. USAID-ENERCON-Contractor Management	99
a. Findings - USAID Performance	99
b. Findings - Hagler, Bailly and Company Performance	100
c. Recommendations	102
14. Commodity Assistance	103
C. RENEWABLE ENERGY ELEMENT	103
1. Findings	104
2. Conclusions	104
3. Recommendations	105

IX. CROSS-CUTTING ISSUES AND LESSONS LEARNED	107
A. CROSS-CUTTING ISSUES	107
1. Sustainability	107
2. Effects on Women	108
3. Environment	108
B. LESSONS LEARNED	109
REFERENCES	111
APPENDIX A. PERSONS CONTACTED BY THE STUDY TEAM	117
APPENDIX B. EP&D LOGICAL FRAMEWORK	121
APPENDIX C. SUMMARY OF MATHTECH SCOPE OF WORK	125
APPENDIX D. STATEMENT OF WORK	128

I. INTRODUCTION

A. Background

The Energy Planning and Development Project (EP&D) was initiated in 1983 within the context of an overall USAID country strategy designed to improve Pakistan's political stability and economic and social development. The Project Paper¹ pointed out that Pakistan is at an important juncture relative to its economic development and the role of energy resources in the development process. Thus, problems in its energy sector would unacceptably constrain Pakistan's economic growth and adversely effect its political stability. These impacts, in turn, would work against other U.S. assistance being proffered or contemplated.

The Project's long-range goal was to increase Pakistan's energy self-sufficiency. To accomplish this, a multi-faceted Project was created 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. As designed, the Project reinforced USAID's emphasis on technology transfer, training and an increased role for the private sector.

Interim evaluations of the Project were scheduled in 1986 and 1987, but because of delays in starting some of the Project components, these evaluations were consolidated into a mid-term evaluation in 1988. USAID Pakistan requested USAID Washington to provide an Evaluation Team to perform the mid-term evaluation, in-country, in May and June, 1988.

B. Pakistan Energy Sector

It was clear to the Evaluation Team, after a brief exposure to the problems of Pakistan's energy sector, that any conclusions or recommendations we made had to be made within the context of the overall energy demand/supply problem. To be creditable, we had to take into account such things as domestic energy sources, sector consumption, pricing, potential efficiency improvements, etc. The solutions to these complex problems will be shaped by GOP actions and the local economic structure, modified through time to reflect new realities, and driven to some degree by technological fixes. Superimposed on this background was the Evaluation Team's need to identify continuing and new energy initiatives that conform to overall USAID programmatic criteria. Although we recognize the limitations of our knowledge base, several overriding considerations became apparent and are discussed briefly below.

The obvious mid-to-long-term fix for Pakistan's electric power generation shortfall is a major increase in hydroelectric power generation. In addition to the existing hydel generating capacity, a number of small hydel systems are presently in the implementation stage and will be coming on line over the next few years. However, these projects will not make a large impact on the current and projected generating capacity shortages. There is the potential for a very large hydel generating capacity expansion but many problems--social, environmental and economic--prevent its realization. In spite of the difficulties involved in bringing more hydro electric capacity to the national grid, USAID should

continue to look for opportunities to influence the outcome. Because the EP&D Project did not encompass a hydroelectric component the team did not devote any time to developing recommendations in this area.

Imported crude oil and products now meet a substantial fraction (31%) of the commercial energy supply sector. The forecast growth in imported oil must be viewed as alarming, especially if there is a belief that major price increases may occur in the next ten years. Domestic production has increased significantly, as a percentage of total production, in the last few years. Total production, however, is still small, approximately 45,000 bbls/d. Domestic gas production is an important energy source with very large growth potential. The ability of Pakistan to increase oil and gas production significantly in the short-to-mid-term appears good, and although the EP&D project does not include an oil and gas component, the team believes some recommendations in this area are appropriate.

Domestic coal resources, as presently known, are substantial but of low quality. The quality of the coal and its occurrence in thin beds makes its large-scale economic exploitation difficult. Imported coal is not a factor, at present, but is likely to become a significant energy source in the mid-to-long-term. Despite the deficiencies of the domestic resource, coal development has been a major focus of the EP&D Project and important progress has been made toward its utilization. With continued progress, domestic coal could become an important mid-to-long-term energy source.

Overall energy sector efficiency fixes, including conservation, generation and transmission improvements, demand reduction or slowing brought about by price changes, are low-cost and potentially fast-acting. The EP&D Project is heavily involved in this area and the U.S. is the primary donor country addressing energy conservation. However, it seems evident that even if all fixes envisioned are carried out, the net result will have a small impact in the near-term. Conservation is an important activity, but in and of itself is not sufficient to resolve Pakistan's energy problems. The assessment and demonstration of renewable energy technologies, although originally included in the EP&D Project, has been deferred. As a result, we have included only a short discussion of this subject.

C. Methodology

Before assembling in Washington, D.C., the team received a limited number of reports and other documentation pertaining to the EP&D Project. Based on this material and the work statement, a preliminary report outline was developed. The Team Leader then discussed the outline by phone with team members and work assignments were made based on experience and general background knowledge. A principal rapporteur and a back-up were assigned to each of the major EP&D Project components. On May 18 and 19 the team attended a series of briefings at USAID Washington provided by USAID staff, the two major technical assistance contractors and the World Bank. These briefings and the background reports permitted the Team to clarify the issues, frame and ask questions and, in general, prepare the team for the evaluation work ahead.

On arrival in Pakistan the Team commenced to interact with USAID mission staff. This included developing GOP agency and staff interview schedules, collecting a large number

of pertinent reports, memos, contractual documents, etc., and briefings by Mission staff. (See Appendix A for list of contacts). During the interview and report reading period, the Team met regularly to discuss, collectively, our findings and preliminary conclusions.

As a result of these activities, the team was able to respond to the USAID mission request to have a first draft of findings, conclusions and recommendations by June 14, 1988. The draft was reviewed by GOP and USAID staff and their comments and response by the Evaluation Team took place before the Team departed from Pakistan. A final report, incorporating pertinent comments, was prepared by the Team after returning to the U.S.

D. Organization of This Report

This is a complex project, and the Evaluation Report is also inescapably complex. In Section II, we describe the EP&D Project, as it was envisioned in the 1983 Project Paper, and modified by later amendments. Section III describes our observations and recommendations for USAID activities in the petroleum sector, which is not yet a major part of this Project.

The heart of the evaluation is in sections IV through VIII. Each section is an Evaluation Report (in miniature) of a major component of the EP&D Project. Sections V through VII are relatively straight-forward project components. Each section discusses the background of the component, assesses its current status, and makes recommendations for the future.

Sections IV and VIII are much more complex: they are institutional assessments of the Energy Wing and ENERCON. In these sections, it is necessary to make evaluations on three levels:

- the efficiency of the USAID program;
- the institutions created with the help of USAID;
- the manifold activities of the institutions.

In each of these later sections, we first discuss the background of the component, then assess the development of the institution created under that component. We then examine the major USAID inputs to the institution and the principal activities of the institution. We have recommendations under each heading. Many of these are very specific and will be of interest primarily to Government of Pakistan officials and USAID project managers.

Finally, in Section IX, we discuss lessons learned and special cross-cutting issues. Some of these issues are specific to a Project component, but most apply to the Project, across-the-board.

II. PROJECT DESCRIPTION

The Energy Planning and Development Project (EP&D) was initiated in 1983 to address Pakistan's critical energy problems described briefly in the Background section above, and in keeping with the overall AID Country Development Strategy Statement (CDSS). Under the Project Grant Agreement, all project activities were scheduled to take place over a period of five years from the date of signing, thus establishing a completion date of July 30, 1988. (For further detail on the Project Grant Agreement, see Reference 2. The total project costs of the AID Grant over the five years were estimated to be \$30 million. The Government of Pakistan (GOP) contribution over the same period was expected to be Rs. 81.82 million. Subsequent to the initial agreement, five Amendatory Agreements were executed that added \$25 million and Rs. 52.1 million respectively and extended the Project life by two years. (For additional detail on amendments to the original Project Paper, see Reference 2.) In addition to the AID Grant Funds, \$50 million of Energy Commodity Funds also were made available to the Project.

A. Project Goal and Purpose

The goal of the EP&D Project was to increase Pakistan's energy self sufficiency and thereby improve the quality of life for its people. The purpose of the Project was to assist the 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. This was to be achieved by strengthening the capability of the GOP to: (1) undertake effective integrated and sectoral analyses of energy development strategies to support financially sound GOP energy policy and development planning; (2) develop programs in coal assessment, mining, and utilization; and, (3) adopt energy conservation and renewable energy technologies.

B. Planned Outputs

To achieve the Project goal and purpose, fifteen major outputs were delineated. The planned outputs from the original EP&D Project Paper are listed below.

- (1) Establishment of a permanent GOP Energy Analysis Group capable of carrying out integrated energy analyses and sectoral and special studies;
- (2) Establishment of an operational Energy Data Management System, including current and historical supply and demand information by fuel and by sector;
- (3) Completion of a series of Special Energy Studies to be used as reports to assist in the formulation of energy policy and in the preparation of annual, five-year, and long-term energy development plans;
- (4) Completion of a coal resource assessment which will provide a quantitative understanding of coal reserves at Lakhra, Sonda Thatta, and other coal fields in Pakistan;

- (5) Improvement of coal analysis facilities at GSP, PMDC and PCSIR;
- (6) Establishment of a Coal Projects Department within WAPDA to promote, plan and manage the development and implementation of coal-fired power generation and coal mine projects;
- (7) Completion of an assessment of the development barriers facing the private coal mining industry and of options available to that sector and the GOP to eliminate or reduce those barriers and to stimulate private investment in coal development;
- (8) Demonstration of improved mining techniques appropriate to Pakistan's coal industry;
- (9) Preparation for the implementation of Pakistan's first large scale coal-mine and coal-fired power generation project (Lakhra);
- (10) Completion of a feasibility study, test market analysis and pilot plant for producing coal briquettes for use in the residential market;
- (11) Completion of approximately 60 energy use audits and the establishment of an Industrial Energy Use Data System;
- (12) Implementation of four to eight industrial energy conservation demonstration projects;
- (13) Development of a comprehensive national industrial energy conservation program;
- (14) Completion of an energy needs survey which describes the user market for renewable energy technologies; and,
- (15) Completion of assessments of renewable energy technologies and programs and the demonstration of selected renewable energy technologies such as solar, small hydro, fuel efficient wood stoves, and biogas digesters.

Annex E of the Project Paper lists a set of important assumptions that were required if a given, planned output was to be achieved and provides a framework with which to verify accomplishment, or degree of accomplishment. This framework, as well as subjective and objective analyses, were used by the Evaluation Team in the evaluation sections of this report to assess Project accomplishments and progress. The framework is reproduced in Appendix B.

C. Project Components

The EP&D Project consists of three major components: Component 1 - Energy Analysis and Manpower Development; Component 2 - Coal Resource Assessment and Development; and, Component 3 - Conservation and Renewable Energy Technologies. Component 2 is further divided into three sub-components: 2a) Coal Resource Assessment; 2b) Coal Mine and Coal-Fired Power Generation Development; and 2c) Processed Coal Briquettes for Residential Use.

1. Energy Analysis and Manpower Development

This component is designed to strengthen the GOP's capacity to undertake integrated energy analysis necessary for sound planning. Technical assistance and training programs will provide small computer equipment for the GOP Planning and Development Division for its Energy Data System, support the development of an Energy Analysis Group, and conduct a series of special studies, manpower assessment and development programs.

Because of the importance of energy and issues related to energy in the national economy and conflicting energy supply and demand problems, Pakistan requires an integrated and effective analysis of the energy sector. This analysis will be implemented in three steps:

- Development of an adequate database to include the many factors that influence supply and demand for energy;
- Preparation of integrated energy supply/demand balances and forecasts; and
- Estimation of financial, material and manpower requirements of the energy supply sectors.

Upon completion of these three steps, the GOP will have a clear understanding of the energy implications derived from pricing policies and industrial development strategies, and the impact of energy systems on national financial management, employment and social needs.

Many organizations in the GOP currently address questions of energy supply and demand and have acquired extensive information bases. The Project will use these existing capabilities as a starting point to support the formation of the Energy Analysis Group. The Group's purpose will be to respond to energy supply, demand, and price changes both within Pakistan and outside the country, contribute to the formulation of the National Five-Year Plan and thus assist GOP policy makers. This can be achieved through seven major activities:

- Energy database development and management
- Integrated energy analysis
- Special studies
- Manpower needs assessment and development
- Technical assistance

- Training
- Commodities grants

2. Coal Resources Assessment and Development

This component will support GOP and private sector efforts to develop Pakistan's coal resources as an alternative fuel to natural gas, imported oil and fuelwood. Technical assistance, training and commodities will be provided.

a. Coal Resources Assessment

A careful assessment of the nation's total coal resources is required. To do so, the coal analysis capabilities of the GSP and PCSIR need to be strengthened. Promising areas for detailed assessment by a joint USGS-GSP effort include coal fields in Lakhra, Sonda-Thatta, Sor Range-Zarghun, Trans-Indus, Khost-Sharigh-Harni, Mach, and Northern Indus. Priority attention is to be given to Lakhra.

To accomplish the strategies for this component the following activities are necessary and need to be improved through training and equipment grants:

- Coal exploratory drilling
- Coal analysis and testing
- Data management and geophysical studies
 - Geodata Center
 - Geophysical studies
 - Photogrammetry and remote sensing
 - Publication of reports
 - Coal petrography
- Technical assistance, training and commodity inputs

b. Coal Mine and Coal-Fired Power Generation Development

As a result of work done on the Lakhra coal field and because of its potential to provide coal supplies for a thermal power plant, the GOP gave the Lakhra Project one of the highest priorities in the Sixth Five-Year Plan. To support this priority Project, USAID established a three phase effort in the EP&D Project in addition to providing technical assistance.

- Phase I. The primary focus of Phase I was to transfer coal mining technology to WAPDA coal mining projects and private miners and to transfer coal-fired power plant technology to WAPDA's Coal Projects Department. Assistance in this Phase included:
 - Commodities
 - Staff training for WAPDA
 - Engineering assistance to complement preparation of feasibility studies and response to other donor organizations requests

- Phase II. Because of severe load shedding, WAPDA requires rapid assistance to expedite implementation of the Lakhra Project. Funds in the Phase are designed to accomplish this goal by providing assistance for
 - Front-end engineering work
 - Detailed mine plans
 - Expediting orders for power plant equipment
 - Preparing invitations to bid

- Phase III. This phase includes the balance of services and equipment not met in the first two phases such as services and equipment needed to complete the Lakhra Project. Funding for these foreign exchange costs were to be sought by USAID.

- Technical Assistance
 - **General.** A long-term general advisor will be hired to supervise and guide all elements of the Lakhra Project. Short-term assignments for additional technical assistance will be provided.

 - **Mining and infrastructure.** A long-term mining and infrastructure project advisor will be hired to determine, for example, mine configuration plans, exploratory drilling, reserves estimates and general engineering plans for complete development of the Lakhra area to accommodate a major industrial complex. Additional personnel will be hired as needed and concurrent training for counterparts will be funded.

 - **Power plant.** A long-term power plant supervisor will be hired to assist WAPDA personnel in all phases of the construction project. Assistance for this sector also will include commodities.

c. Coal Briquetting

Two approaches are possible for briquetting coal: (1) coking for use in braziers, and (2) coal without coking for use in "smokeless" stoves. Activities in the subcomponent include technology assessment, briquetting tests for Pakistani coal, a test marketing program and a briquetting pilot plant (later dropped from the subcomponent). USAID will provide technical assistance, training and commodities for this subcomponent.

3. Conservation and Renewable Energy Technologies

The component consists of two subcomponents: (1) to increase the efficient use of energy in the industrial sector, and (2) to assess and develop renewable energy technologies.

a. Conservation

Energy conservation is the most promising option to deal with Pakistan's near-term energy supply and demand imbalance. This Project subcomponent will be based on extensive U.S. experience in this field and will include the following elements: energy audits, industrial

energy use data systems, training and demonstrations. A limited amount of demonstration equipment and education materials will be purchased under the commodities program.

b. Renewable Energy Technologies

This work will assist the GOP to establish a renewable resource assessment and development program to delineate the long-term role of these technologies and to accelerate the use of those that are the most promising. A staged program will be conducted following the results of an energy needs survey. In addition, technical assistance, training of project staff and related personnel, and a commodities equipment purchase program will be a part of this subcomponent.

Activities for both subcomponents will be coordinated by a full time resident advisor.

D. Project Modifications

Five amendments to the original Project Grant Agreement have been made in the intervening years. The first three amendments transferred funds to the Project. The activities planned for each component in the original Project Paper were modified slightly in the Fourth Amendatory Agreement. For example, the Coal Briquette Pilot Plant called for in the original Project Paper was deleted in the Fourth Amendatory Agreement and the Project life was extended two years to July 1990. The fifth amendment, signed on June 14, 1988, transferred funds but did not change the scope of the Project. The EP&D Project, in its amended form, is the basis of the evaluation performed in the succeeding sections.

III. OIL AND GAS IN THE PAKISTAN ECONOMY

A. Background

Although an oil and gas component was not included in the scope of the EP&D Project, the oil and gas sector was examined by the Evaluation Team to provide a context for the evaluation of the coal components. Mission management agreed with this approach since some oil and gas activities have taken place and other activities are under consideration.

The Evaluation Team reviewed the energy forecasts that are included in the draft Seventh Five-Year Energy Plan. These forecasts were then compared to the historical data series to determine important energy trends. These trends and discussions with people working in the oil and gas sector provide the context for the following evaluation of oil and natural gas in the Pakistan economy.

B. Cost of Oil Imports

The cost of imported crude oil and refined products declined for six years (1981-82 to 1986-87) thus easing the balance of payments problems. However, the costs of imported oil and products have started to increase and, in the Seventh Five-Year Plan, the costs of imported liquid fuels are projected to continue to increase. The magnitude of the problem is shown in Figure 1 and Table 1. The cost of oil and product imports fell from \$1.7 billion in 1981-82 to only \$0.8 billion in 1986-87³ and is projected to increase to nearly \$2.0 billion dollars by 1992-93⁴. Thus, the cost of oil imports is projected to rise by \$1.2 billion/year by the end of the next five-year period.

The increase in liquid imports is enormous compared with the domestic oil production base. The increase--91,000 barrels per day--is nearly two times all of the oil currently (mid-1988) produced throughout Pakistan (about 45,000 barrels per day). The total forecast amount of imported crude plus products is 231,000 bbl/day in 1992-93, or nearly four times the forecast domestic crude oil production of 62,000 bbl/day in the same period⁴.

By any standard, the quantity of future oil imports will be large. Moreover, the costs of rising oil imports will become a problem of increasing concern over time. The nation's balance of payments will be significantly, and adversely, affected. The relationship between oil imports and the balance of payments is certain to receive increasing political attention as Pakistan struggles to adjust to this changing reality.

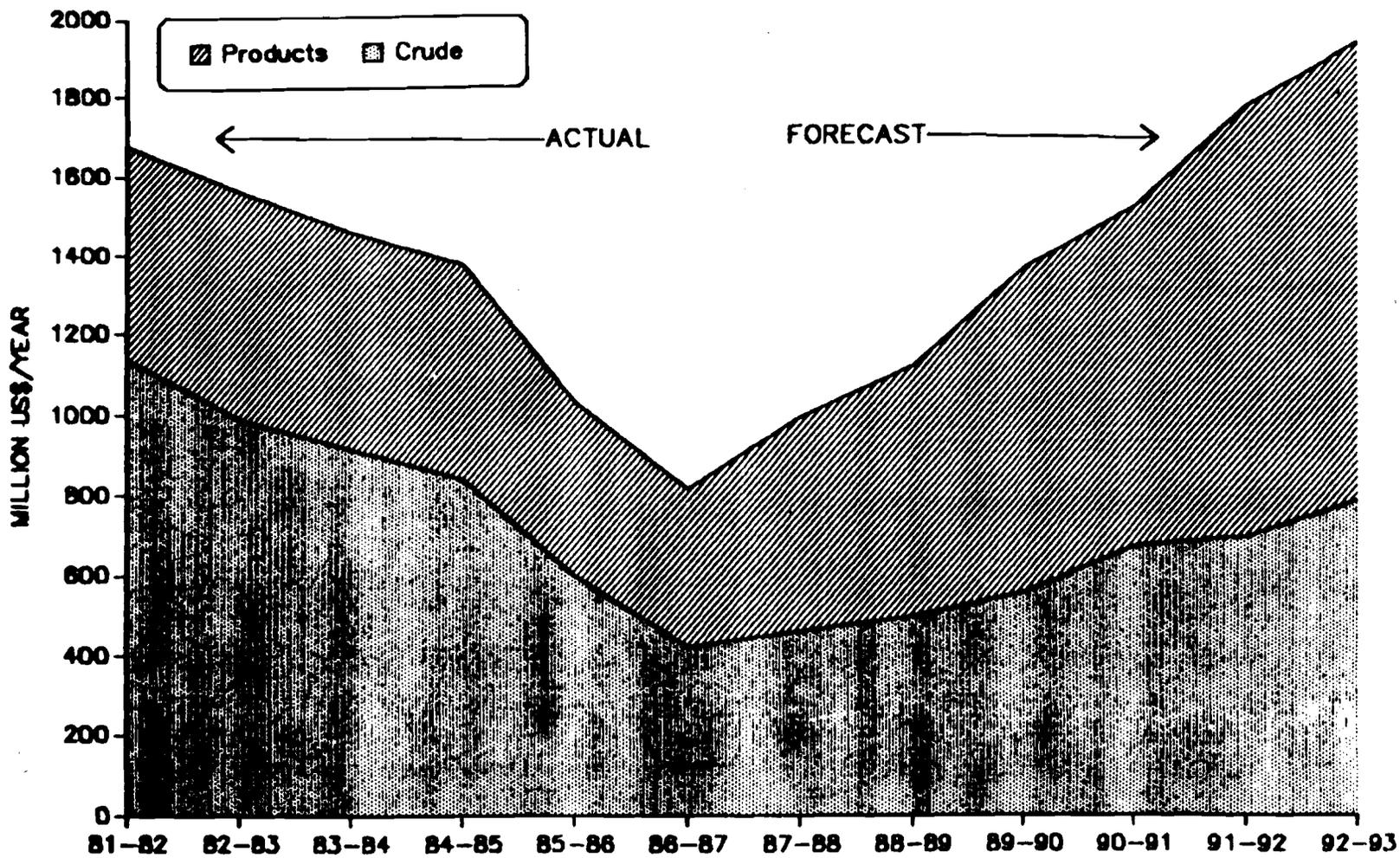


Figure 1. Value of Pakistan Oil Imports.

Table 1. PAKISTAN OIL IMPORTS AND VALUE

	MILLION TONNES			MILLION US\$		
	Crude	POL	Total	Crude	POL	Total
Actual						
1981 - 82	4.4	1.6	6.0	1139	540	1679
1982 - 83	4.2	1.9	6.1	989	574	1563
1983 - 84	4.3	2.2	6.5	916	547	1463
1984 - 85	4.0	2.3	6.3	843	538	1381
1985 - 86	3.8	2.5	6.3	602	433	1035
1986 - 87	3.7	3.2	6.9	422	397	819
Estimate						
1987 - 88	3.5	3.9	7.4	463	532	995
1988 - 89	3.6	4.4	8.0	501	622	1123
1989 - 90	3.8	5.7	9.5	562	809	1371
1990 - 91	4.4	5.7	10.1	676	854	1530
1991 - 92	4.3	7.2	11.5	698	1084	1782
1992 - 93	4.6	7.4	12.0	790	1160	1950

Sources: Actual - Energy Year Book 1987, Tables 2.13 and 2.14; Estimate -Seventh Five-Year Plan, Chapter 19, Table 11; POL - Product Imports.

C. Domestic Oil Supply Forecasts

Increased domestic oil production is one direct method of reducing the costs of imported crude and oil products. The oil and gas industry of Pakistan has made great strides over the past few years and oil production has increased from about 12,000 bbl/day in the early 1980's to 41,094 bbl/day in 1986-87. This progress is projected to continue in the Seventh Five-Year Energy Plan, with oil production forecast to reach 62,000 bbl/day by 1992-93 (Figure 2).

The basis for the forecasts was examined by the Evaluation Team. Some growth in the existing field production seems to be reasonable as projected. The significant reduction in oil production from Badin Block discoveries is reasonable and predictable. However, the Dhurnal field is projected to continue to produce a constant amount of oil over the forecast period. This is not likely to occur. This field has been placed under a water injection program that has maintained the reservoir pressure at just over the bubble point pressure. The injection program has been effective at maintaining oil production at about 15,000 bbls/day. However, the operator expects water breakthrough from the water injection wells to the oil production wells to occur by 1990. Oil production is then expected to decline at 20 percent per year to an economic limit. Using a 20 percent rate of decline, oil production will be approximately 5,000 bbl/day in 1992-93, or about 10,000 bbl/day less than the amount forecast in the Plan.

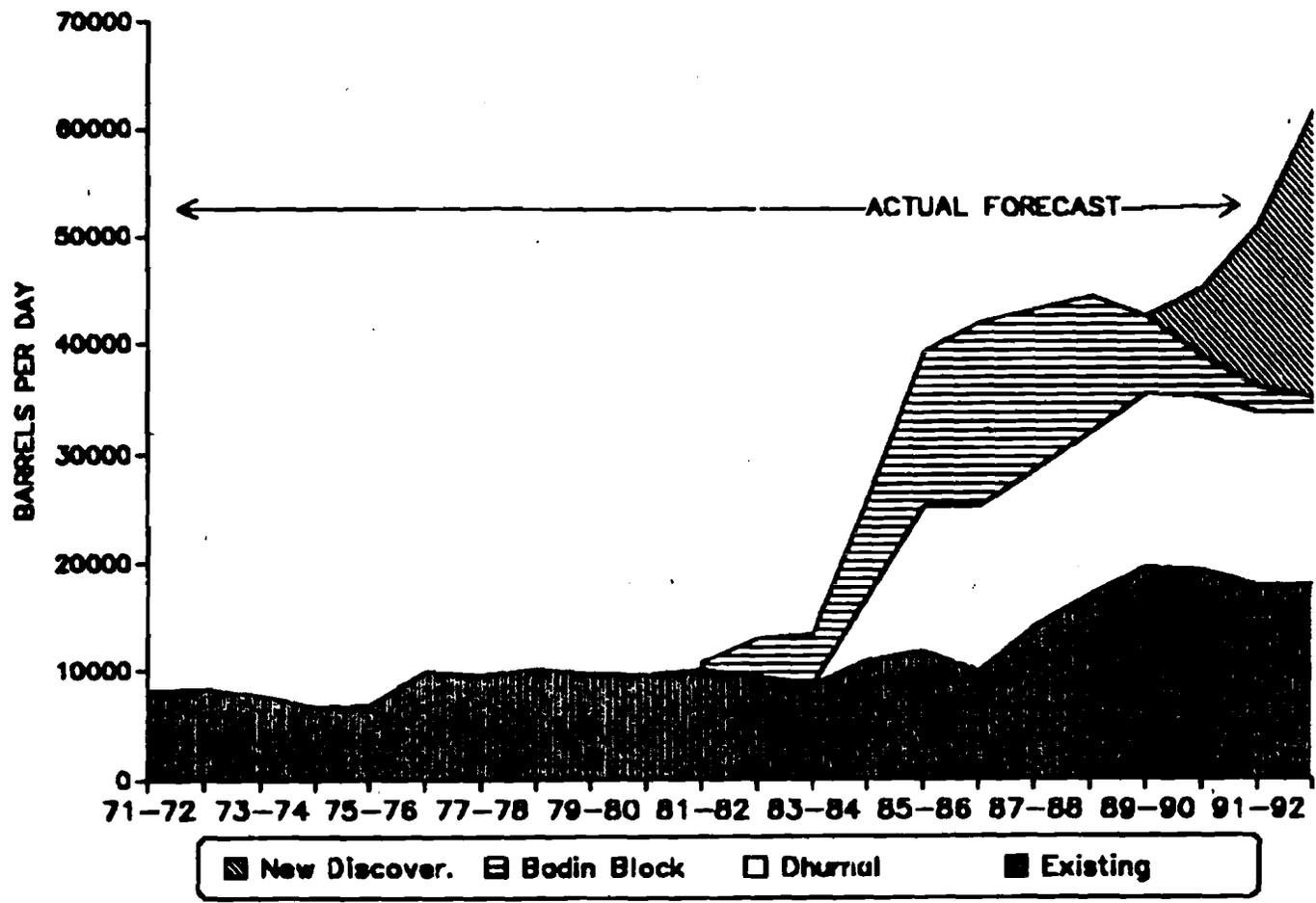


Figure 2. Seventh Five-Year Plan Projection of Pakistan Oil Production.

Another area of concern is the amount of oil forecast from new discoveries. Oil production from new discoveries is estimated to rise from none in 1989-90 to 26,900 bbls/day by 1992-93. This amount of production would represent 43 percent of the 62,000 bbl/day forecast for that period. This rate of growth suggests these discoveries have already been made and development drilling and production is all that remains. However, discussions with the oil companies operating in Pakistan do not confirm the existence of these discoveries. Thus, the projected growth in oil production from new discoveries is considered to be optimistic.

Our review of the oil production history suggests that the oil production forecasts are optimistic. A more conservative planning estimate suggests that the 1992-93 oil production level could be as much as 10,000 bbl/day to 23,000 bbl/day less than the 62,000 bbls/day level currently forecast. Failure to achieve the optimistic oil supplies contained in the Plan will add to the amount and the costs of liquid fuels that will need to be imported in the future.

D. Domestic Gas Supply Forecasts

The Seventh Five-Year Plan correctly estimates the amount of new gas that is likely to be delivered from the Badin Block as the result of new pricing arrangements for this gas. However, the Plan fails to recognize that these same pricing arrangements are likely to lead to more gas than forecast. For example, only one new discovery is forecast with production starting in the final year of the forecast period, 1992-93⁴. This is far too pessimistic since the private companies are now actively seeking gas in response to new pricing arrangements.

The Plan is too pessimistic on associated gas production, if the oil production forecasts are accepted. With adequate economic incentives, there is no reason for associated gas production to decline if oil production continues to increase⁵.

According to the established private oil companies now operating in Pakistan, future discoveries are more likely to be gas than oil^{5a}. Gas appears to be an under-appreciated fuel that can, over the short-term, probably be increased in production and, in this way, help reduce the need and costs of imported liquid fuels.

E. Findings and Recommendations

Pakistan offers an attractive investment opportunity for foreign oil and gas developers. The oil and gas policy has been stable and the concession laws have improved and are currently among the best found in any developing country. Recent discovery rates have been excellent with a success ratio reportedly approaching 1:1, discounting wells that were lost before reaching targeted horizons.

The economic climate is attractive and, along with recent discoveries, has stimulated oil and gas concession applications. Fourteen companies are now operating in Pakistan and 30 new applications for concessions have been filed.

The very success of the program will impact its long-term viability. Large quantities of technical information are now available and large quantities are being generated. The most urgent near-term need is for USAID to fulfill its promise to help Pakistani agencies organize these data for future use. The Evaluation Team recommends that priority be given to:

- Assisting DGPC, OGDC and HDIP, in coordination with World Bank, to catalog and process available geological, geophysical and reservoir engineering data so that it can be made available to private companies in a timely manner for further development of Pakistan's oil and gas reserves, and
- That, in exchange for this assistance, all information developed on concessions that is not proprietary be made available for review through DGPC, including OGDC information that in the past has been withheld from concessionaires.

It is difficult to see any rationale on the part of the GOP to withhold non-proprietary information since it is in their self interest to discover oil and gas reserves. Information withheld may prove to be the key to making such discoveries.

As the industry evolves, the role of the OGDC will be questioned if they remain on the public roles while private entities prosper. Maximum effort to create a self-sufficient, state-owned oil and gas company is recommended. The Evaluation Team recommends that USAID continue to assist OGDC, in coordination with CIDA, in producing a full audit of its financial operations by 1990.

Pakistan has approximately 6,000 to 9,000 barrels of oil currently shut in due to the lack of refining capacity. Problems related to refining capacity will continue into the foreseeable future and should be removed as a bottleneck. Therefore, the Evaluation Team recommends that:

- USAID establish a program designed to encourage U.S. A&E firms to address future refining needs. Such a program could range from information bulletins announcing anticipated GOP capacity expansions to funding for the design and construction of the required new capacity, potentially with long-term payback of borrowed funds. When additional capacity is built, USAID is encouraged to support this expansion through provision of equipment of U.S. origin.

Future oil and gas production will require increasingly sophisticated solutions that can be provided only by reservoir engineers, a subspecialty within petroleum engineering. Indigenous Pakistani reservoir engineering capability in both the public and private sectors is at a very low level. To overcome this constraint, the Evaluation Team recommends that:

- As an extension of the current EP&D training program, selected Pakistani petroleum engineers should be detailed to "internships" with U.S. reservoir engineering firms. The specific purpose of this training is to develop sufficient expertise to recognize problems requiring reservoir engineering solutions, to prepare the scope of work for such studies, to manage the studies, and to help supervise the application of the studies to existing oil fields.
- USAID encourage the formation of a "reservoir engineering cell" in OGDC or in some other appropriate Pakistani public sector organization.

IV. ENERGY ANALYSIS AND MANPOWER DEVELOPMENT

COMPONENT 1

A. Background

1. Original Component Objectives

The Energy Analysis and Manpower Development component of the EP&D Project had as its original goal "strengthening the capacity of the Government of Pakistan to undertake effective integrated and sectoral analyses of energy development strategies in order to support financially sound GOP energy policy and development planning."¹

In 1983, the expected outputs of the component were:

- The establishment of a permanent GOP Energy Analysis Group capable of carrying out integrated energy analyses and sectoral and special studies;
- The establishment of an operational energy data management system, including current and historical supply and demand information by fuel and by sector; and
- The completion of a series of Special Energy Studies to be used as reports to assist in the formulation of energy policy and in the preparation of annual, five-year, and long-term energy development plans¹.

Of the three, the first output was the most important as it was the primary mechanism by which the component objective would be achieved. The other two outputs would be separate contributions to the activities of the Energy Analysis Group.

2. Planned Activities

The original Project Paper envisioned six different activities:

a. Integrated Energy Analysis

USAID would provide a contractor to assist GOP in conducting an integrated energy analysis. The energy analysis was intended to support GOP's annual, five year, and long-term planning cycles. The energy analysis was primarily intended as a pedagogical device for the GOP, though the analysis itself also was intended to be useful.

"The project will focus on the development of GOP capabilities rather than on the energy analyses themselves . . . [because] . . . any energy plan must be continually updated and re-evaluated . . ."¹

The Project's designers intended that computer-based modelling would be one of the primary tools used by the Energy Analysis Group, and that modelling techniques would be one of the important analytical methods transferred to the GOP.

b. Energy Database Development and Management System

The project designers apparently assumed that quantities of specific information were required for energy planning, and that a special effort was needed to obtain and catalogue this information. It also was intended that the information be put into a computer. However, the Project Paper stated that ". . . the Energy Advisory Group will not conduct its own primary data collection but will rely on input from other GOP organizations."

c. Special Studies

Studies were envisioned in the use of coal, energy conservation, energy economics and management issues. However, it was intended that, as in the case of energy analysis, ". . . assistance will be provided to GOP organizations to undertake analytical studies . . . [and] . . . these studies will usually involve the use of U.S. specialists. . . who will work in a supportive role with GOP counterparts."

d. Manpower Needs Assessment and Development

The Project's designers believed that development of Pakistan's energy resources required a major effort to increase the training of Pakistanis. The first step in this effort was intended to be a Manpower Needs Assessment. This study would determine what skills the Energy Sector will need, and establish training programs across the sector, including coal development, oil and gas, renewable energy, utilities management, and energy conservation.

e. Technical Assistance

USAID would provide long-term and short-term advisors to the Energy Advisory Group. The advisors would work jointly with their Pakistani counterparts, rather than do the work themselves.

f. Training

In addition to the sector-wide training program envisioned under the Manpower Development Element, USAID also would provide training to members of the Energy Advisory Group. A mix of short courses in specific subjects in the United States and short courses and seminars in Pakistan was planned.

3. A Slow Start: 1983-1986

The Project was approved by the Governments of the United States and Pakistan in July 1983, followed by a lengthy hiatus. The Government of Pakistan did not approve its PC-2 until June 1984⁷.

The PC-2 spelled out the administrative mechanisms by which the Project would be implemented. An independent agency, to be called ENERPLAN, would be established under the direction of a Board of Governors, chaired by the Minister for Planning and Development, and with a membership composed of senior civil servants from GOP agencies concerned with energy. ENERPLAN was to have an appointed Managing Director, and a civil service staff of 14.

The Government of Pakistan required another 18 months to fulfill the legal requirements for creating a new agency. By the end of 1985, ENERPLAN had received both its charter and its first two employees, Sadaqat Mir, Managing Director, and Izharul Haq, Deputy Managing Director.

USAID then spent the next six months developing a technical tender document. The intent was to incorporate most of the major activities of the Energy Analysis and Manpower Development component into a single contract. The contractor would develop an energy model of Pakistan (RESPAK), provide short-term and long-term consultant assistance, train individual members of ENERPLAN, and conduct (or assist) special studies as needed.

A General Energy Advisor, Mr. Masood Malik, was hired under a contract dated February 1, 1986. Mr. Malik arrived in country on February 12, 1986, marking the true beginning of USAID technical assistance. The General Energy Advisor was intended to provide an administrative and management superstructure both for ENERPLAN and the USAID mission. The General Energy Advisor's office ultimately grew to four professionals, with responsibilities beyond administration.

A contract was signed with an American firm, Mathtech, in April 1986. The first Mathtech advisor arrived in Pakistan in early May.

4. The Mathtech Contract

Under its contract with USAID, Mathtech would help ENERPLAN prepare the Seventh Five-Year Plan. Originally, the Project was to prepare an integrated energy analysis in support of five year planning. However, with the delays in project initiation, the "integrated energy analysis" became the Five-Year Plan.

The last half of 1986 was occupied by Mathtech's development of its initial workplan, a series of special studies in support of the Seventh Plan and Long-Term Plan, development of the energy model, and a database.

During this period, ENERPLAN's professional staff was composed of five people, Messrs. Mir and Haq, plus three others. Mathtech staff found they had few Pakistani counterparts. This presented certain contractual difficulties because Mathtech was not required to actually perform integrated energy analysis, but to help ENERPLAN. The people who would become ENERPLAN's key technical staff began work in December 1986.

5. Seventh Five-Year Plan (1987)

By January 1987, the energy model, RESPAK, had been delivered and was running in Pakistan, and a number of key special studies for the Five-Year Plan had been completed. ENERPLAN preparation of both the 20-year perspective plan and the Five-Year Plan was underway.

The Deputy Chairman, Planning Commission, speeded up the pace, asking ENERPLAN in late December 1986, to prepare a draft plan by the end of February 1987. ENERPLAN's GOP staff was still small. The Deputy Chairman's decision settled, at least temporarily, the issue of whether the contractor staff should assist GOP or do the work themselves. If Mathtech staff did not perform the work, the schedule would not be met. The contractor dispatched eleven short-term consultants to work along with ENERPLAN staff and produced the first draft of the plan on schedule⁵.

The draft plan was forwarded to the Planning Commission's Sectoral Working Group, composed of senior officials from the relevant Government agencies, plus some private sector representatives. The Sectoral Working Group also had been at work for some months, making major resource allocation decisions and setting the broad policy parameters for the Plan. The Sectoral Working Group was further divided into subgroups for coal, oil and gas, electric power, etc. The subgroups examined the draft plan, negotiated their differences, and forwarded revisions to ENERPLAN. ENERPLAN, with Mathtech, prepared draft reports for the subgroups. The subgroups then compiled their reports, and the Sectoral Working Group debated relative priorities.

During this series of iterations, the RESPAK model proved indispensable in evaluating consequences of policies set by the Sectoral Working Group. The Plan itself, which started out as a document drafted primarily by the contractor, has gradually become a GOP document. Mathtech's current involvement in Plan revision is minimal.

6. The ENERPLAN/Energy Section Merger

In late 1986, the Government of Pakistan decided to integrate ENERPLAN into the GOP planning process by merging it with the Energy Section of the Ministry of Planning and Development. The USAID Mission also had been a strong proponent of this merger. The Energy Section, an existing body, had the primary mission of appraising all GOP capital projects in the Energy Sector, and recommending them for approval (or otherwise) by the Planning Commission. The Energy Section had been in existence, under various names, for more than 15 years, and had an existing professional staff of approximately six.

The revised organization was named "The Energy Wing of the Ministry of Planning and Development." The ENERPLAN staff was divided into two sections: Plan Formulation and Information Systems. The staff of the Energy Section became the Energy Appraisal Section of Energy Wing. Mr. Mir retired, and the Chief of the Energy Section, Mr. Ashfaq Mahmood, became head of the Energy Wing in October, 1987. He reports to the Deputy Chairman of the Planning Commission, Mr. A. G. N. Kazi.

In recent months, Mathtech has focused its efforts on developing the long-postponed long-term plan, with relatively little Energy Wing input. Concurrently, the Plan Formulation section of Energy Wing has focused on revisions of the Five-Year Plan, with little Mathtech input, while the Information Systems (formerly Data) and Energy Appraisal Sections have continued their respective duties.

B. Assessment

Appendix B to this report lists the "Objectively Verifiable Indicators" which the Project Paper suggests are the basis on which the project ought to be evaluated. All of the "objectively verifiable indicators" originally proposed for this component have been achieved or exceeded.

1. Institutional Development of the Energy Wing

The primary objective of this component--to create an energy sector analytical capability in the Government of Pakistan--has been accomplished. The Energy Wing plans for a staff of 31 with 21 positions presently filled. However, planning and analysis is notoriously difficult to institutionalize. It is not enough, in the Team's view, simply to create an institution. We, therefore, examined some further measures.

a. Energy Wing's Usefulness to GOP

The Energy Wing prepares and maintains the Five-Year Plan, has a major role in the formulation of the Annual Development Plan, and appraises all energy sector projects for the Government of Pakistan. The Energy Wing also acts as a Secretariat to the Energy Review Group, the inter-agency committee charged with overseeing project implementation and with adjudicating major inter-agency energy policy issues. The Energy Wing is the focal point for GOP's coordination with donor agencies in the energy sector. Thus, the Energy Wing occupies a central position in the Government's capital budget cycle, and in energy policy decision-making.

Senior officials of the Pakistan Government contacted by the Team were unanimous in their praise of the Energy Wing and their appreciation of its efforts. They noted that the Seventh Plan was the first energy plan prepared in Pakistan, and they were very pleased to be able to work with the Energy Wing to modify the Plan promptly.

World Bank staff also are pleased with the Seventh Plan and the work of the Energy Wing. They note that Energy Wing staff "ask the right questions," but they express reservations about the depth of analytical capability and the ability to sustain that capability after the departure of the technical assistance group.

Somewhat less favorable views of the Energy Wing's capabilities were elicited in several of our interviews. These comments ranged from "too early to tell," to "the Energy Wing lacks the capability to do strategic planning."

b. Energy Wing's Post-Project Capability

A second major question is whether the Energy Wing will collapse once USAID technical assistance is withdrawn. The Energy Wing staff interviewed by the Team did not see this as a problem. They point out that the Energy Wing is handling its routine work without input from the contractor. The contractor is not integrated into the activities of the Energy Wing, but rather acts as a "fourth section," without line responsibilities, preparing such studies as the Senior Chief may direct. This may be unfortunate in maximizing the value of technical assistance, but it does indicate that the contractor's activities are not central to the survival of the Energy Wing. The key computer models are no longer being operated by contractor personnel, but by Energy Wing personnel and USAID hired PSC staff.

In recent months, the Energy Wing has undertaken a series of special studies for the GOP, without the involvement of the technical assistance contractor. These include a study of LPG pricing, appraisals of proposals for the private sector power project, studies of power development in Karachi, Government contracting methods, and development of a GOP gas utilization policy. This work is an indication of the growing maturity of the Energy Wing as well as its growing usefulness to the Government of Pakistan.

c. Energy Wing Plans

During the team's discussions with Mr. Ashfaq Mahmood, he listed several priorities for the Energy Wing over the next few years:

- Development of the Five-Year Planning Process into rolling plans, i.e. updating the Plan and moving the Plan horizons forward one year annually.
- Development of the long-term plan;
- Development of a project monitoring/evaluation effort;
- Complete staffing of Energy Wing.

He also wished to develop a Power Systems Analysis group, with a five person staff, to run least-cost generation models, load-flow analysis models, an economic section and a coal section. In addition to these activities, he felt a high priority should be given to acquiring needed office equipment and building a small administrative support group in the wing.

Mr. Mohammed Akram Khan (Additional Secretary at the Ministry of Power and Water), in his discussion with the Team, listed as his priorities a series of special studies on issues such as integrating private sector power into the WAPDA system, and the cost of coal at Lakhra--studies with a strong policy and economic orientation.

The contrast between these two views is informative; the Energy Wing's priorities appear to emphasize process, (how the work should get done), rather than policy (the content of the work).

The Team has been advised that the Energy Wing also would like USAID to fund a new building incorporating the latest energy-conserving building techniques. The building would be a permanent home for both the Energy Wing and ENERCON. Proponents of the new building are concerned that occupying leased quarters may force the Energy Wing to relocate to inferior quarters due to budget cuts or the landlord's whim. Additionally, if the Energy Wing were to rejoin the Planning Commission, the Energy Wing's painfully acquired concentration of computer equipment would be quickly dispersed through the Ministry of Planning and Development. The Evaluation Team did not have sufficient time to fully explore these suppositions and, therefore, did not form an opinion.

d. Findings

The primary objective of this component--to build an institutional energy analysis capability within the Government of Pakistan--has been a complete success. The analytical capability exists, embodied in a functioning Government agency with a full time professional staff. This agency plays a central role in plan formulation and project appraisal within the Government of Pakistan and it shows every sign of being able to sustain its role after the end of the USAID project. Despite early staffing problems, the Energy Wing is now staffed well enough to function, and the quality of many of the new Staff is outstanding.

The advantages of the ENERPLAN/Energy Section merger outweigh the disadvantages: the merger has brought first rate leadership to Energy Wing and the combined organization has far more institutional influence than the two organizations separately. Further, the project appraisal role of the Energy Wing gives it an opportunity to enforce planning objectives during project implementation.

However, the analytical capabilities built up by Energy Wing are not exactly those anticipated by USAID at project inception. The merger with the Energy Section brought a strong technical orientation to the Energy Wing. The staff of Energy Wing is largely composed of engineers on their first non-engineering assignment. The questions that Energy Wing staff ask when faced with a situation are more likely to be technical questions than policy questions. Consequently, we believe that the Energy Wing may experience difficulty in conceptualizing and developing scopes of work for independent, in-house policy studies.

Further, management priorities emphasize project and budget cycle responsibilities at the expense of planning and policy analysis tasks. Thus, while the Energy Wing is operational, it's function has undergone a subtle mutation. There is a risk that the management of the Energy Wing will not place sufficient emphasis on developing the policy analysis capabilities that the Planning Commission needs to make informed decisions about energy issues. Despite these risks, the Energy Wing is now preparing its own, independent studies for the GOP, as well as working with the technical assistance contractor. Thus, the usefulness and sustainability of the Energy Wing's efforts seem beyond question.

e. Recommendations

- The Team believes that the Energy Wing should make a special effort to emphasize policy-oriented work.

- In this context, the Energy Wing may find it helpful, in consultation with senior Government officials, to identify critical energy policy issues requiring analysis, and to develop a workplan for preparing these reports.
- The Energy Wing should recruit staff with a broader focus than engineering, particularly persons with an economics or planning background. (We note that the next two staff that will join the Energy Wing will be an economist and a financial analyst).
- The Energy Wing should develop an explicit plan for strengthening its capabilities, specifying the manpower, equipment, and technical assistance that will be needed over the next eighteen months.
- The Power Systems Analysis Group should be formed. Its focus should be on developing estimates of the long-run marginal cost of electricity, followed by tariff reform analysis and evaluating least cost systems expansion plans.

2. Energy Planning

In this section, we turn from the institutional position of the Energy Wing to the work of the Energy Wing. We examine each major activity of the Energy Wing, and each planned activity of USAID under this component.

To date, the nature of Energy Wing's planning efforts have been defined by the very short time available to complete the initial draft of the Seventh Five-Year Plan, by data availability within Pakistan, and by the nature of the planning system in Pakistan. The Seventh Plan is primarily a demand forecast and a list of capital projects. The Plan includes sufficient data to calculate energy balances for the country and financial balances for public sector entities such as OGDC and WAPDA, but the draft examined by the Team does not include energy balances. Final decisions on policy issues and sectoral priorities come from the Sectoral Working Group, and, ultimately, the Energy Wing's political leaders. In the GOP planning process, the Energy Wing staff are technicians rather than decision-makers.

a. Findings

The Seventh Plan, originally a product primarily of the contractor, has become a product of the Energy Wing. The primary consumers of the Plan (GOP, IBRD, and USAID) have indicated they are pleased with the work of the Energy Wing, so the Plan must be judged a success. The Evaluation Team believes that the Seventh Plan could be improved by including energy balances, and providing more financial detail. For example, more detailed information on fuel and other recurrent costs would highlight the long-term budgetary impact of Pakistan's switch back toward oil-fired power generation. *Pro forma* financial balances for OGDC and WAPDA would give a clearer picture of the degree to which these agencies have become self-financing.

The staff of the Plan Formulation Section are capable of modifying and revising the existing plan. They may still need assistance in creating their own future Plans.

b. Recommendations

- Energy Wing leadership or technical assistance is needed to strengthen the Plan Formulation Section in defining policy issues and in determining the desirability of a particular policy option.
- Future draft Plans should include energy balances and more detailed financial information on the energy sector.

3. Model Use/Adaptation

The RESPAK energy model was one of the more important technologies transferred under this component. The primary objectives of the developers of the RESPAK model were "transparency" and "appropriateness." The user should clearly understand the workings of the model, and the complexity of the model should be appropriate to the nature of the problem being solved. Since the primary purpose of the model is broad, macro-planning and budgeting for the entire energy sector, minutely detailed modeling of particular supply sectors is inappropriate. The extra detail will not affect the final "answer" more than fractionally.

a. Model Description

RESPAK is written in Lotus 1-2-3, and is at the outer edge of possible complexity for a Lotus model. It comprises several large Lotus spreadsheets, linked by macros and a series of range extract and range combine commands so that data can be transported from one spreadsheet to another. The primary reason for choosing Lotus 1-2-3 was to make it easy for non-programmers to understand and to modify the model. This objective has been achieved.

Running the whole model is complex and cumbersome, though running individual components is generally easy and straightforward. The designers anticipate that most analytical effort will focus on individual elements (electric power subsector, for example), so that the complexity of performing a supply/demand integration is not an insurmountable handicap.

The demand side of the model comprises two separate approaches to estimating demand: the "econometric approach" and the "reference energy system." The Reference Energy System is not in operation at this time, though the contractor and Energy Wing hope to implement it in the next quarter. The "econometric approach" is simple. The Pakistani economy is divided into sectors; each sector has one equation for each fuel consumed. All of the equations are identical; for example, the amount of natural gas consumed by the industrial sector this year equals the amount of gas consumed last year multiplied by a sector and fuel-specific price and income elasticity. Thus, there is no mechanism within the model for substituting one form of energy for another, and no feedback mechanism for the impact of energy prices on sectoral output. The price and income elasticities were apparently intended to be estimated econometrically, but in fact, all elasticity estimates were analysts' judgments, based on work done in other countries.

On the supply side, the oil and gas production forecasts are entered into the spreadsheet. We are advised that the Energy Wing developed an external model of the oil and gas sector, and inserted the results into RESPAK. The electricity sector is fairly complex, modeling power dispatch in merit order using simplified load duration curves. Mr. Raziuddin of the Energy Wing extended this model to perform Monte Carlo simulations of forced outages to compute load shedding for the Seventh Plan. Prices are exogenous to the model, but they are the principal variables that can be manipulated to bring supply into line with demand during the process of demand/supply integration.

b. Energy Wing Use of the Model

Mr. Mohammed Raziuddin, Chief of Information Systems, and Mr. Arshad Gellani, Systems Analyst, are experts on the model. Mr. Raziuddin has made extensive modifications to the electric power generation portion of the model, and Mr. Gellani is the principal model operator. The model operates on a single PC in Energy Wing, and persons wishing to use the model provide their input assumptions, and Mr. Gellani runs the model. The model is used extensively. The very existence of the model, and the ability to get new runs, is, by itself, gradually moving the GOP in the direction of "rolling" energy planning. The model also provides a useful background case for project appraisal.

With many persons using the model a maze of different cases are stored in the computer, and it is challenging to determine which spreadsheet is the current official "base case." Also, since the model uses many numbers, no one is aware of the changes that have crept into the model.

Documentation has lagged behind model development, particularly since it has been taken over by the Energy Wing. As long as only two people are making design modifications, the problem is barely tolerable, but if model usage expands, it will become intolerable.

When they discuss the future development of the model, Energy Wing Staff and the contractor tend to talk in terms of implementing the Reference Energy System as the next step in model development. Other proposed improvements include replacing the refinery section of the model with a more sophisticated linear programming model. However, to the Team, these areas should not be given a high priority. We believe the probability of obtaining enough data to run the Reference Energy System is low. While the current refinery submodel is based on fixed coefficients, its inaccuracies in the context in which it is used are not significant.

c. Findings

The model has been an operational success. It was used extensively in developing the Five-Year Plan, and is in near continuous use now. The model is being modified and operated by Pakistanis. The model objectives of "appropriateness" and "transparency" have been achieved. Although the Team may quibble about design points, the overall design has been effective in bringing greater coherence to Pakistani energy planning.

Maintaining data integrity in the model (i.e., knowing what assumptions are being used in a particular run) is a problem now and will be an increasing problem in the future. Inadequate documentation also is a problem and will increase in the future.

d. Recommendations

- Future development of RESPAK should place a high priority on improving the estimates of energy demand functions;
- Development of the Reference Energy System (RES) should be given low priority. The Team believes that the data requirements for RES are far in excess of the data available in Pakistan or elsewhere;
- Oil and gas sector modelling, and in particular the relationship between drilling effort and oil production, and pipeline capacity modelling, should receive attention in the future. In this context, it may be desirable to acquire oil/gas pipeline network modelling software.
- The Energy Wing should consider developing a regional version of the model (as originally planned) to better study energy transportation issues.
- If the Power Systems Group is established, it will need a license for and staff training on the WASP model.

4. Database Development

The development of an energy database was one of the three original objectives of this Component. The high level of importance attached to the database was, in part, because the Project designers intended to use the data-hungry Reference Energy System as their primary energy model. When the Reference Energy System was not implemented, the importance of an energy database diminished.

At present, the curator of the database is Mr. Qaiser Sohail, Deputy Chief (Database). The database runs on a single PC, using ORACLE, a relational database manager that uses Structured Query Language (SQL). The Energy Wing commissioned a Pakistani software house, Systems, Ltd., to write a menu-driven front-end to the ORACLE database so that Energy Wing staff would not need to implement SQL for the most common queries. This front-end is complete and in operation. There is no physical or software connection between the model and the database.

For the most part, the information entered into the database is taken from (and easily available through) standard Pakistani statistical reference books. Consequently, actual Energy Wing use of the database is inconsequential. The real "databases" of the Energy Wing are the shelves of maps, reports, and statistical publications that fill the offices of Energy Wing staff. The database will not be used on a regular basis until it has information that Energy Wing needs and can get more easily from the computer than from another source.

The Rural Electrification database has been a useful project. Energy Wing and contract staff are entering data on 48,000 villages that are either electrified or are potential subjects for electrification. The information is a melding of two separate datasets, one from

WAPDA and one from the Federal Bureau of Statistics. The volume of information will be so large that it will be impossible to "look it up," thus, this database will be used frequently.

a. Findings

The Project designers seem to have confused the concepts of database, information, and library. The Project designers wanted the Energy Wing to have access to the information it needed to model the Pakistani energy system and to plan for the future. What the designers specifically asked for was a computerized database.

The computer database did not deserve the high priority the project designers gave it. The contractor and Energy Wing have spent considerable effort on developing the database. But to date, it has shown few practical benefits for them. The database effort can now serve the needs of the Energy Wing and small additional investments of effort will yield large benefits.

b. Recommendations

- The energy database should be made available to those Energy Wing staff who use computers by linking Energy Wing PCs together in a local area network. Alternatively, a small mini-computer (Micro-VAX or equivalent) can be acquired to run the database and the PCs can access it in terminal emulation mode. However, the maintenance requirements of a mini-computer (trained professional staff, technicians, etc.) may outweigh its benefits.
- Energy Wing should enhance the database by obtaining readily available data from other GOP sources, as is currently being done for the Rural Electrification database. If Energy Wing is going to launch a program of econometric estimation of energy demand functions, it will need the macro-economic data located in the Planning Commission. If the Energy Wing decides to use the Reference Energy System, considerable data on industrial energy consumption is available from the Federal Bureau of Statistics, and ENERCON.

5. Mathtech/Energy Wing Special Studies

Special studies in this component take two forms: special studies commissioned directly by USAID, and special studies commissioned by the Energy Wing, under the Mathtech contract. This section will examine the special studies done under the Mathtech contract.

The original project paper's "verifiable indicators of success" proposed seven special studies. The Mathtech contract escalated this number to "approximately 18." The Energy Wing's library lists no fewer than 20 studies commissioned under the Mathtech contract. However, many of these relate to the on-going work of long-term consultants, or were in fulfillment of other elements of the contract (i.e. database development, model development, the Five-Year Plan, etc.). The USAID Mission believes that only six studies "count" toward fulfilling the Mathtech contract requirement of 15.

The contractors for the special studies are primarily local Pakistani firms, Jafri Associates, ENAR Petrotech, and al-Technique with Mathtech/EDI individual consultants or employees performing others. The team was not able to review all of the special studies, but we did examine four or five of the major reports. These were of generally good quality.

In our discussions with Energy Wing staff, it was emphasized that inter-agency rivalries were such that the implementing agency had to "own" any study recommending a policy reform. In order that the results be considered. They believed that for a special study to be successful, it had to be performed by, or in close co-operation with, the implementing agency. We are told that the GOP considers less than half of the studies to have been useful.

The Evaluation Team believes, in Pakistan as elsewhere, that studies do not make decisions. People make decisions. Therefore, a study prepared by the Energy Wing without reference to the willingness of the Planning Commission to address the issues raised, or the willingness or ability of implementing agencies to take the recommended actions, is a pointless exercise. The political context in which studies are prepared is as important as the work itself.

a. Findings

The number of Special Studies completed exceeded project plan and contract requirements. Study quality was generally good. Many of the studies were, as hoped, influential in the development of the Seventh Five-Year Plan. Other studies have been less influential, often because they were done to satisfy contractual commitments rather than GOP requests.

It appears to the Evaluation Team that none of the decision-makers--the project designers, the Mission, the Energy Wing--has decided which studies should be done in-house, which should be done by Mathtech, and which should be done by external consultants. Without this decision, it has been difficult to properly staff the Energy Wing or request Mathtech's advisory staff.

b. Recommendations

- The Evaluation Team believes that outside contractors should be employed to do studies with a heavy data collection or engineering content, or studies with a scope of work requiring several man-years of effort. This would include any engineering feasibility studies.
- Model-building, planning and policy studies should be kept in-house. Mathtech consultants can be used to provide specialized expertise in particular areas.
- Energy Wing staff should consider attempting joint studies with implementing agencies, carried out by mixed Energy Wing-implementing agency teams.

6. Energy Project Appraisal

The Energy Appraisal Section of Energy Wing is probably the group least affected by USAID assistance. It has inherited the functions of the old Energy Section whose activities did not form part of the original project concept.

Much of the institutional influence of the Energy Wing derives from the work of the Energy Appraisal Section. Energy sector institutions such as WAPDA must submit their projects to the Energy Appraisal section for clearance in the form of a PC-1 document. The Energy Appraisal Section reviews the proposed project for technical feasibility, consistency with the Plan, availability of appropriate infrastructure, and availability of financing. The Energy Appraisal Section draws up a list of questions to ask the submitting agency. After all queries have been satisfied, the Energy Appraisal Section reports to the Planning Commission recommending the project for approval (or otherwise).

The Project Appraisal Wing of the Ministry of Planning and Development is formally responsible for economic and financial analysis. However, the Energy Appraisal Section also examines projects for economic and financial feasibility.

Energy Appraisal Section flags any inconsistencies that it detects between the projects of different organizations and forwards them to the inter-agency Energy Review Group for resolution. They are asked to prepare special studies by the Senior Chief. For example, the Energy Appraisal Section has reviewed each of the private power proposals received by the Government of Pakistan.

Direct USAID assistance has been minimal. Energy Appraisal has received two PC/AT computers and a computer program for doing load-flow analysis, which they are using to review WAPDA transmission line projects. Energy Appraisal also has a copy of WASP, which they are running independently of Mathtech's efforts.

a. Findings

Energy Wing's project appraisal function has never been an intended beneficiary of the EP&D Project. Therefore, we have not evaluated the activities of this section in detail.

Pakistani officials believe that it is easiest to enforce the policy preferences of GOP at the project level, and the Energy Appraisal staff is on the "front line" of this effort. Some USAID assistance would be both justifiable and desirable.

b. Recommendations

- Energy Wing should consider developing a computer-based tracking system to monitor the current status of projects being appraised by the Energy Wing. This system would be most useful on a networked computer system. This is a simple computer problem that could be done internally by Energy Wing staff or obtained under contract.

- Energy Appraisal staff feel comfortable with their engineering expertise but claim they could use help on the economic aspects of appraisal. This ought to be done informally by Mathtech personnel.
- The Energy Wing wishes to develop a project monitoring function on projects under construction. The Evaluation Team has reservations about the importance of this function given the scarce human resources of the Energy Wing.

7. Technical Assistance

USAID technical assistance is provided primarily through Mathtech. The Mathtech contract is a standard time-and-materials, cost plus fee contract, in which the contractor bills for the number of man-days expended. Superimposed on this structure is a five page list of specific tasks that the contractor was to perform independently or assist ENERPLAN.

The list notwithstanding, the contractor was not required to accomplish specific tasks. This was perhaps fortunate, since the list was considerably larger than the contractor could reasonably be expected to accomplish. Several of the tasks were open-ended, undefined, and impossible to execute. A summary of the contractor's scope of work is shown in Appendix C.

Despite a poorly-designed contract, common sense and rational priorities seem to have characterized the tripartite relationship between the contractor, ENERPLAN/Energy Wing, and USAID. However, there has been a continuing tension between the Pakistan Government's desire for results and USAID's view that the tasks were simply the means to obtain expert assistance.

The original concept of the contract was that Mathtech would provide senior advisors who would work jointly with Pakistani counterparts. Unfortunately, when the Mathtech personnel arrived in Pakistan, there were few Pakistani counterparts available. While the Energy Wing is better staffed today, the counterpart system is still not working well. In practice, Mathtech acts as a "fourth section" of the Energy Wing, and has been assigned primary responsibility for the development of the Long Term Plan with little Energy Wing participation. There have been significant technical assistance successes under the contract, notably the transfer of the Seventh Plan, the model, and the database to Pakistani staff operations.

A second form of technical assistance provided to the Energy Wing has been a group of four Pakistanis and Pakistani-Americans hired directly by the Project and headed by the General Energy Advisor, Mr. Masood Malik. The General Energy Advisor was originally intended to devote most of his effort to helping manage the project. In practice, some project-hired staff have acted as employees of the Energy Wing, but most of the staff have acted in an advisory capacity.

The General Energy Advisor has the unenviable position of being an Advisor to both USAID and the Energy Wing. In practice, the General Energy Advisor has been effective

in acting as liaison between USAID and the GOP for the entire project and other potential USAID energy sector projects. During 1986-87, he was instrumental in designing the organization of the Energy Wing. He has been involved in work on the Seventh Five-Year Plan and in implementing the manpower development component. GOP, USAID, Mathtech, and the General Energy Advisor himself, are satisfied with this arrangement.

a. Findings

The performance of the contractor has been generally good. The contractor's role was particularly critical in 1986-1987 when there were few Energy Wing staff. The contractor helped Energy Wing prepare the first draft of the Seventh Plan in only two months, develop the RESPAK model and the database and transfer them to the GOP. While significant successful technology transfer has taken place in the past, there is less today. This is due, in part, to the increasing maturity of the Energy Wing. Another factor is the lack of teaching skills among the present cadre of advisors.

The work of the General Energy Advisor and his staff have been useful. With the imminent change in USAID Project Officers, the next USAID Project Officer will need to rely on the institutional memory of the General Energy Advisor.

b. Recommendations

- USAID technical assistance is worthwhile based upon both its past performance and future prospects and should be continued through 1993 to support Eighth Five-Year Plan preparation. Appropriate long-term staffing would be two senior advisors plus one or two junior staff for turnkey work as needed, plus a budget for short-term consultants for projects and special studies.
- Just as we recommended in Section 1.e., a change in emphasis of the Energy Wing's efforts, we would also suggest a reorientation of the contractor's efforts towards finding staff with broader experience, who can help Energy Wing set their analytical agenda and conceptualize solutions.
- If the GOP decides they want Mathtech to do "turnkey" studies, Mathtech may wish to recruit more junior staff.
- The Energy Wing will never have the capability to conduct every study needed by the GOP; some studies should be on contract. The Energy Wing should develop expertise in defining, contracting, and managing the analytical efforts of contractors. In order to develop this capability, the Energy Wing should assume more responsibility for defining and managing contract studies, even those performed by Mathtech.
- Energy Wing management should make an effort to encourage combined efforts by the contractor and Energy Wing's staff.
- The General Energy Advisor and his staff should be continued in place through 1993.

8. Manpower Development and Training

The EP&D Project recognized that development of Pakistan's energy resources necessitated a major effort to increase the training of Pakistanis in the planning, management, and implementation of energy projects. The items identified for support under this component were:

- A manpower needs assessment to determine the range of technical, managerial, and analytical skills necessary to accomplish the goals of this project;
- An analysis of the supply and demand for engineering graduates in energy-related fields;
- Programs where training can be accomplished;
- Actions necessary to improve Pakistani education and training programs;
- Programs of short-term training in specific subsectors, mostly through on-the-job internships with U.S. companies and special courses available with U.S. companies and universities.

The short-term training program was expected to complement the project-specific training identified in Components 2 and 3 and was intended to strengthen the overall capability of the energy sector. Depending on the needs assessment, USAID and GOP could concentrate resources to train people to work in subsectors where shortage of skilled personnel might be a critical constraint.

In 1985, Arthur D. Little, Inc. (ADL) made a preliminary energy sector needs assessment. Based on this assessment, and with additional inputs from GOP institutions and USAID staff, another USAID contractor, the Institute for International Education (IIE), developed a training program for the Pakistan energy sector. The first plan, covering 1986/87, was circulated to GOP agencies with a request for nominees. Nominations were submitted through the Economic Affairs Division (EAD) of the Ministry of Finance, for approval and submission to USAID. This process resulted in the program being under-subscribed. Recently, Energy Wing has been given an increased role in the approval process. This change has accelerated the process of candidate selection. It is expected that the program will be fully subscribed in 1988. A total of 52 trainees have been sent to the U.S., and the first woman candidate will participate in the training program this year.

To date, the analysis of the supply and demand for engineering graduates has not been completed. However, USAID plans to conduct a total manpower assessment this year through an add-on to the IIE contract. The add-on will provide for a more in-depth analysis of the manpower training needs of the energy sector. It will review other donor programs and look carefully at Pakistani institutions, such as universities and polytechnic centers, for the contributions they can make.

a. Findings

The original EP&D training plans were not met for several reasons. Some of the training elements in the individual components were discontinued (renewables, coal briquetting, Lakhra), and the problem of processing nominees by GOP has already been discussed.

Although the training activities started slowly, momentum has been building and substantial progress is likely. The program Office responsible for this assessment believes that approximately 33% of the targeted goals have been achieved if the sections dropped are excluded from the calculation. The initial goals were too ambitious in view of the inherent inertia to be overcome in starting new programs. Provision for follow-up (e.g., student/institution feedback) is inadequate, and the opportunity will be missed to make improvements in the programs offered or in student selection criteria. U.S. based training appears to be receiving appropriate emphasis; a better balance between U.S. and in-country training is needed.

b. Recommendations

- GOP agencies should make a concerted effort to identify and nominate women for training opportunities. USAID should work closely with GOP to determine if special criteria should be developed that will assist in the selection of women. It may be necessary recruit outside Government agencies to find qualified female candidates, even though opening up the process may create bureaucratic problems. It also may be necessary to provide additional guidelines to contractors to ensure that courses and curricula reflect any special requirements to attract professional Pakistani women e.g., guidelines concerning accompanying spouses. In particular, training in building energy conservation for architects and urban and rural household energy conservation may be areas that will appeal to woman candidates.
- A monitoring and evaluation process should be undertaken with students and teaching institutions to determine the effectiveness of the training. This evaluation should include pre- and post-interviews and analysis by the Mission as well as the training contractors.
- A general upgrading of in-country curricula from high school through University and post-graduate studies is needed. Such upgrading should include polytechnic institutions to assure a supply of trained technicians. This upgrading would directly support the USAID Institutional Excellence Project currently under review. While upgrading the entire Pakistani educational system is beyond the capability of this Project, we cannot state too strongly the urgent need throughout the energy sector for technicians with some "hands-on" experience. This need has been communicated repeatedly in our interviews. The manner in which it should be done, if it can be done, we leave to those with greater insight into Pakistani institutions.

- The training element of the EP&D should be continued at least through 1993 and full advantage taken of the recent, major reprogramming of funds for this element.

9. Commodity Assistance

Commodity assistance under this program has been modest. About \$200,000 has been allocated primarily for computers and software but also including office furniture and a few vehicles.

The commodity assistance was essential to furnish the ENERPLAN's offices and provide computer equipment to run the RESPAK model. Given the difficulty in procurement of materials through GOP sources, this component would probably have been seriously hampered without the benefit of commodity assistance.

10. USAID Special Studies

A second group of special studies was undertaken under Component 1 of the EP&D project, commissioned directly by the USAID mission. The underlying purpose of these special studies was generally to advance some particular aspect of the Mission objectives for policy reform in Pakistan, especially privatization.

a. Dhodak

Dhodak is a retrograde gas/condensate field, discovered in 1977 by OGDC, but never produced. In 1985, eight years after the initial discovery, USAID suggested that OGDC allow the private sector to develop Dhodak since OGDC lacked the technical capacity to do so.

The mission agreement from GOP and OGDC to this approach, and USAID commissioned Arthur D. Little, Inc. to review the economics of Dhodak and propose a contract for development by the private sector⁹. The total cost of the work was about \$200,000, of which \$50,000 came from this project, with the balance provided from USAID Washington funds.

Unfortunately, OGDC did not fully accept the concept of privatization. Arthur D. Little prepared an invitation to tender for private sector development issued in the fall of 1986¹⁰. OGDC agreed, but posed impossible conditions (OGDC wanted to be refunded for all its 1977-1985 exploration expenses) which doomed any private sector interest.

While the privatization of Dhodak was set aside through OGDC resistance, the ADL studies were not built on a strong technical base. The technical alternatives and production profiles used in the ADL study were based on reservoir engineering work done in 1981-82. OGDC drilled a fourth appraisal well in 1983 which proved to be dry. A reinterpretation of the field may reduce both reserves and forecast production, perhaps substantially.

The Evaluation Team reviewed the Arthur D. Little study, and found it generally acceptable. The major uncertainties at Dhodak were technical, rather than economic, and the ADL study did nothing to resolve these uncertainties. The money could have been better spent on further reservoir engineering work, though reservoir engineering work would not necessarily have advanced USAID's privatization objective.

b. Jamshoro Thermal Power Station Study

During the mid-1980's, WAPDA proposed to expand the capacity of its Jamshoro thermal power station by about 1200 MW. USAID expressed an interest in this project and funded a pre-feasibility study, feasibility study, and environmental impact assessment by Bechtel National, Inc¹¹. The cost of the Jamshoro study was about US\$ 1 million. The intent was that the project would eventually be funded by the World Bank.

By the time the study was completed, enthusiasm for a large oil-fired expansion of the Jamshoro station had cooled, both on the part of the World Bank and the Pakistan Government. The emergence of a private-sector proposal to construct a 1200 MW oil fired power station may have caused some persons to view private power as an alternative to Jamshoro. In any event, expansion of Jamshoro beyond units 1-3 already under construction has been deferred. Mission officials, however, claim the Bechtel study was eventually used as a baseline for evaluating the 1200 MW "private power" plant proposed by NIDC/Xenel.

The Evaluation Team examined the four volume feasibility study, but cannot comment on Bechtel's power station design. It is difficult to extract economic data (power station cost, heat rate, possible O&M cost) from the report though computations within the report show that Bechtel made such estimates.

c. The Pakistan Oil and Gas Conference

The Conference was held on 28-30 January 1988 in Islamabad, hosted by the Ministry of Petroleum and Natural resources and jointly sponsored by USAID and the Fredreich Ebert Foundation. President Zia Ul Haq addressed the session, and attendance, particularly from international oil companies, was heavy. The cost of the conference to USAID was approximately \$50,000, though the Ministry picked up a portion of the bills.

Subsequent to the Conference, there has been a major upsurge in interest in oil concessions in Pakistan by international firms and more than 30 new applications for concessions have been received by the Ministry of Petroleum and Natural Resources. The GOP is considering a new petroleum policy to encourage more private investment in the sector.

The Team believes that the Oil and Gas conference was an effective mechanism for informing the world oil industry about Pakistan's improved concession terms and favorable petroleum prospects.

d. COALCON

COALCON, the Pakistan Coal Conference, was held in Karachi in February 1986. It was hosted by the Pakistan Government with the assistance of USAID. Attendees--over 500 people--included numerous Government officials and interested Pakistani and international businessmen. Speakers presented some 48 papers, many of them excellent. The cost to USAID for this conference was about \$150,000.

COALCON was an effective forum for spreading information developed by the EP&D Project to potential coal developers. Contacts between a Chinese team at the conference and Pakistani businessmen and officials led to the November 1987, WAPDA contract to purchase Chinese coal-fired fluidized bed boilers.

e. Conclusions

The success of the two conferences indicates that similar conferences should be held in the future. It is noteworthy that the timing of the conferences was as important as their content. Conferences are most useful when there is "news" to be reported. In the case of the coal conference, the results of the USAID/GOP drilling programs; in the case of the oil and gas conference, revised Pakistani concession laws. By providing new information, or information not widely known, the conferences can be catalysts for further action.

Although the Jamshoro and Dhodak studies, did not lead to projects, the Evaluation Team remains convinced that commissioning special studies from time to time can be an effective means of influencing policy decisions and facilitating desirable actions by the Government of Pakistan.

V. COAL RESOURCE ASSESSMENT

COMPONENT 2A

A. Original Objective

To support the overall goals of Component 2, this subcomponent had as its objective to strengthen the capability of and assist the Geological Survey of Pakistan (GSP) to carry out an assessment of Pakistan's total coal resources. The original plan stated:

"Coal fields and areas identified by a joint USGS-GSP team as promising for more detailed assessment include Lakhra, Sonda-Thatta, Sor Range-Zarghun, Trans-Indus, Khost-Sharigh-Harnia and Northern Indus. Priority attention will be given to the Lakhra field." (See Figure 3).

To accomplish this assessment, coal exploratory drilling, coal analysis and testing, and data management and geological study activities would be carried out. In addition, training and commodities support would be undertaken to support the subcomponent.

The expected outputs of this subcomponent were:

- The completion of a coal resource assessment which would provide a quantitative understanding of coal reserves at Lakhra, Sonda-Thatta, and other coal fields in Pakistan.
- Improved coal analysis facilities at GSP, PMDC and PCSIR.

B. Background

An intensified assessment of Pakistan's coal resources, included with other minerals, began in 1956 and continued to about 1967 by means of a joint United States Geological Survey and Geological Survey of Pakistan Program funded by the United States. The early work in the 1950s and 1960s¹² laid the foundation for carrying out the current program by: 1) accomplishing on-the-job training, 2) conducting academic training in the U.S., 3) offering management training, 4) establishing a mining engineering section assisted by USBM, and 7) sponsoring symposiums. Most observers say that this original program was highly effective. (For additional detail, see Background in Section VI).

The momentum of those early years was lost when U.S. assistance was withdrawn from Pakistan. When assistance was reinstated in July 1983 as the EP&D Project, it focused on defining Pakistan's coal resources. During the current coal resources assessment program, the USGS has again provided the primary guidance and technical assistance to the GSP for implementation of this component of the Project.

A detailed report to support the objectives of Coal Resources Assessment was provided in December 1986 by A. K. Reinemund, formerly chief of the original USGS mission¹². The key recommendations he made that affect the current program were: 1) establish a centralized group responsible for coal resources, 2) conduct a coordinated assessment

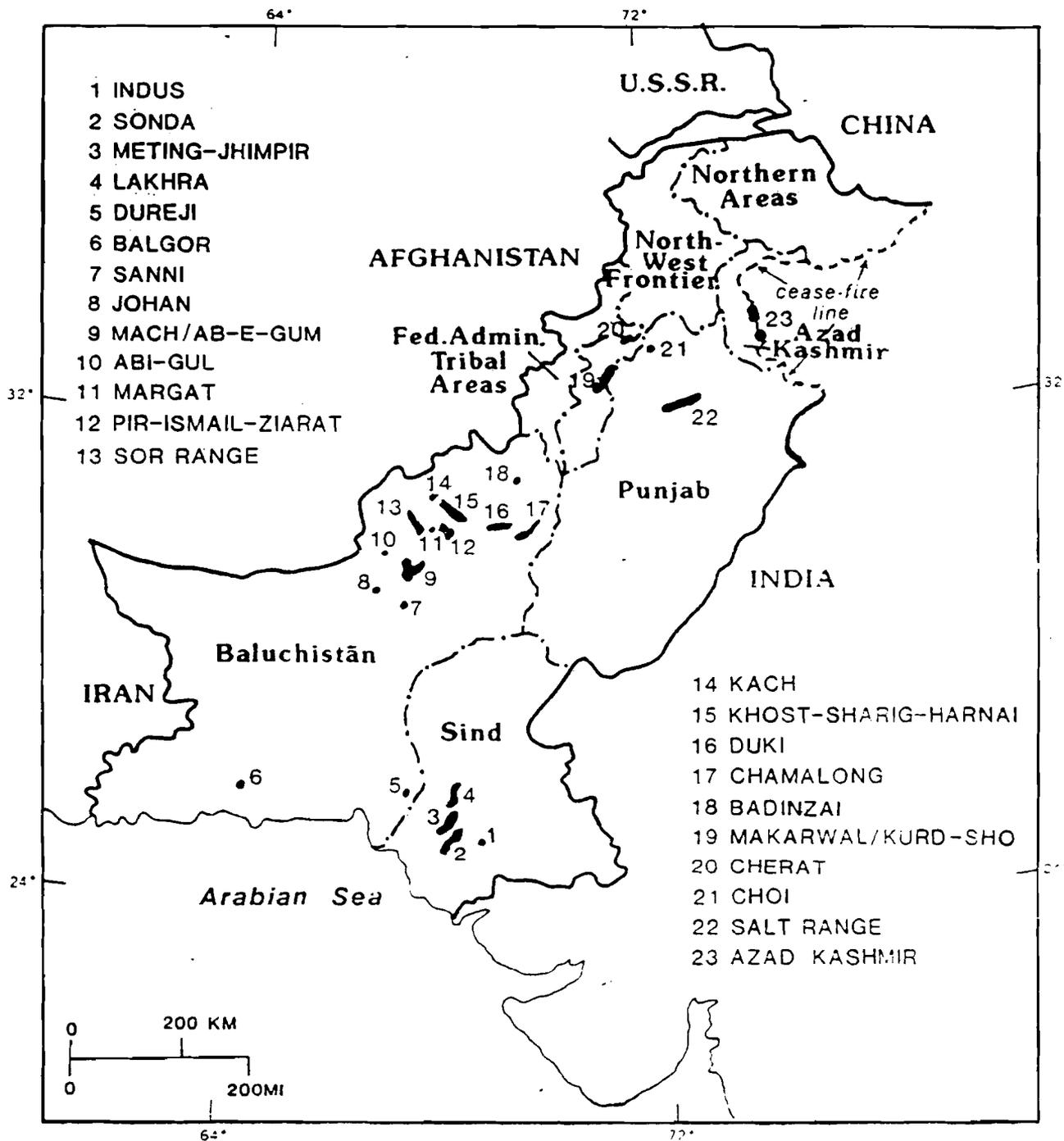


Figure 3. Location of Pakistan Coal Fields and Occurrences.

program, 3) provide adequate communications equipment, 4) provide a bonus for field work, 5) assess the coal resources in each field, 6) use consultants as needed--both long-term and short-term, 7) provide long-term and short-term training in the U.S., 8) assist GSP in defining and reviewing overall programs. Some, but not all, of these recommendations have been followed and work is continuing as will be discussed later.

The GOP has strongly supported the coal resource assessment program and desired to expand this program with the understanding that the interests of both the public and private sectors will be kept in mind. The draft Seventh Five-Year Plan calls for:

- Aggressive coal exploration in the public sector in unexplored areas of Lakhra and additional drilling in the Sonda-Thatta area to increase total reserves to 500M tonnes.
- Private sector promotional measures for financial assistance to coal miners with soft loans and technical and drilling services assistance provided by GSP on a non-profit basis.
- High priority to be given to coal exploration especially in previously unexplored areas.
- Allocation of Rs. 416M for coal exploration to be divided between GSP, PMDC, and provincial governments.

C. Findings

USAID and the GOP understand the importance of determining as soon as possible the potential coal resources in all of Pakistan's coal basins. It is clear that, in spite of many years of effort, the coal resources base is not fully known. Only through regional mapping, with close attention to such techniques as lithologic and tectonic interpretation, will the resource base be known with the potential that better coals than those currently mined might be discovered. Looking at the broad tectonic and lithologic picture and knowledge gained to date from known coal fields, one could predict that higher grade coals will be found in Baluchistan, the Tribal Areas, Northwest Frontier and Northern Areas. Whether this will be borne out awaits further exploration, but these areas should receive a higher priority as the program proceeds.

We find that there has been a lack of focus on goals and objectives related to coal resources assessment. However, a year ago a National Coal Exploration Plan was developed by the GSP¹³. Exploration and manpower priorities and investment requirements have been identified and a document printed which is currently being revised. The GSP has not had a dedicated program director in the coal assessment program to make decisions and carry the program forward as a national objective. We understand that the GSP has just appointed a Central Exploration Officer to coordinate all coal activities that will rectify this problem. Lack of funds has been a serious constraint and breaking the agency into five offices further exacerbated both organizational and budget problems.

Many field and staff geologists working for GSP have insufficient practical training in identification of rock types, structure, mapping and other rudiments of the profession. Limy sandstones have been identified as shaly limestone and limestone completely overlooked. In some cases the location of drill holes were not noted nor had they been surveyed. Cores and chip samples often are not tagged and stored. The absence or presence of coal was based on the sum of observations. Insufficient field supervision by HQ staff is noted. Those with field experience are not passing it on to others.

Training has taken place. Some 99 GSP geologists and geophysicists have received on-the-job training from USGS experts^{13,14}. In our opinion, this does not adequately meet the requirements of tutoring, pedagogic relationships, or long-term training. Similarly, a five-week course in the U.S. attended by 33 geologists does not fully meet the objectives of producing a "hands on" field geologist. These courses might better be used as a follow-up for those geologists who pass field standards. Overall, the practical training of field geologists has not been emphasized. It is not observable that this academic accreditation expedites the transfer of acquired knowledge to other staff members. For example, there is little evidence that short courses, seminars, and other training meetings are given by these newly-trained geologists upon their return to Pakistan. Some GSP personnel have been sent to the U.S. for training when training might have been done better in Pakistan in association with U.S. professionals.

Up to the present time, with two exceptions, the day-to-day working together of a USGS field geologist with GSP geologists is absent; the same can be said at the staff-to-staff level in GSP HQ offices. Since the inception of the program in 1984, USGS Reston has been able to send only a few permanently based geologists to Pakistan because of constraints on their manpower levels¹³. Instead, TDYs have been sent on an "as available" basis for short terms. As a result, the long-term professional relationships that should develop through daily interaction on geologic questions and practical transfer of field techniques has not taken place.

We find that the real decision-making center is not in Pakistan, but in Reston. The decisions made are disassociated from day-to-day working activities with GSP HQ. This diffusion of decision-making, plus not closely working with the GSP, has created a climate of distance and, perhaps, unreality. One of the objectives, if not the objective of coal resources assessment, is to set in place the institutions and professionals to do the job after USAID support comes to an end. While a great deal has been accomplished, the job is not nearly complete. To fulfill the objective some very fundamental changes in methodology must be made.

Incentive programs are not being used. Headquarters staff spend a minimum number of days in the field with field staff. GSP has few funds for per diem or incentive payments for field visits.

The coal analysis laboratory run by the GSP is not yet fully effective, although there are plans to test its capabilities in the near future by processing samples already analyzed in the United States. Coal samples are sent back to USGS and other labs in the U.S. and results are returned in two months or more. For geologists in the field, this delay can be disheartening. If a professional is assessing the extent of a coal field or determining the next best place to drill, timely analysis results are essential. Delays in receiving coal analysis

results lead to inefficiencies in locating the next drill holes.

Funds are a constant problem for GSP because it is a staff agency that is dependent on budget allocations from the government. The agency is underfunded and frequently cannot achieve all of its goals. Office space is overcrowded and, in some locations such as Karachi, work is scattered among five buildings, some of which are not in the same general area.

A Geodata Center is located in Islamabad. The original plan (1986) was to staff the center with one systems analyst, 2 data technicians, 1 data systems geologist, 1 economic geologist and 1 systems administrator¹⁶. Training in the U.S. for some of the staff was anticipated. Air-conditioned offices and a library (2400 square feet) plus power systems to handle computers were recommended. Although the GSP plans to meet these objectives, to date only one systems analyst has been hired, approximately 1200 ft² of air-conditioned space has been rented, and 3 IBM micro-systems with hard disk drives are operational. A plotter has not yet been installed. A bibliography of GSP publications using key word retrieval from a database is being added using a powerful database program called REVELATION. A database for maps is being installed that will indicate status of geological mapping by quadrangle, drilling, etc.

The databases are not readily available to other GSP offices and other centers of geological activity. The Center has the potential of providing additional useful services for developing exploration strategies and enhancing GSP management decisions, but since the Center was designed for national planners in the Capital, its resources may not be used on a continuous basis.

Drilling support as outlined in the original EP&D Project Paper has been met. One Acker rig is active, one is stacked at Quetta, and spare parts for six existing Longyear rigs and geophysical well-logging equipment have been delivered¹³. Two rigs have been in storage since completion of the Lakhra reserves assessment drilling. Drilling targets (specified in meters) have been met or exceeded under all plans using GSP rigs plus outside contractors. Results are satisfactory. Meters-drilled objectives include development drilling to identify economic coal reserves and resource evaluation drilling.

After the J.T. Boyd Company completed the reserve assessment drilling at Lakhra, GSP continued to drill in the area to further delineate the reserves beyond the PMDC tract. In 1987 drilling was suspended in the Lakhra area because of dacoit activity and operations were moved to Sonda-Thatta.

A 20-hole drilling program was started at Jherruk in January 1988 and drilling encountered a coal seam that is 6.3 meters thick, low in ash and sulfur, and higher in Btu than Lakhra. Additional drilling indicated a resource of 250M to 350M tonnes of coal with 6900 Btu per pound. There is insufficient hole data to determine economic reserves (see Table 2). A report is being prepared on work-to-date. Additional drilling is planned for the 1988-89 season.

Table 2. RESERVES AND COAL QUALITY AT LAKHRA AND JHERRUK

	PMDC Tract	Jherruk
Resources (M tonnes)	385	250-350
Reserves (M tonnes)		
Recoverable	300	na
Mined	170	na
Moisture	32%	32%
Ash	20%	32%
Volatile matter	26%	28%
Sulfur	5.2%	2.8%
Btu/pound	5950	6950
In place		
As burned	5750	na

Source: USGS and GSP

Sixteen holes were added to explore the northern extension of the Jherruk discovery at Indus East. This work has indicated an extension of the coal seam but it is not as thick as indicated at Jherruk.

GSP first began drilling in the Salt Range coal field in the 1920's. Additional work was done in the 1960's with 10 holes drilled and recently a 20-hole program commenced in the 1987-88 season with the assistance of a USGS geologist¹³. Twenty more drill holes are planned; holes are 2-4 km apart depending on topography. During this current project, 28 samples from mines and 6 from core drills have been collected; assay results from the US have not yet been received. The coal bed, including parati (coal shale), is 2 to 4 feet thick, averages about 9200 Btu per pound, contains 25 - 30% ash, 9 - 14% moisture and 3-5% sulfur. A study just completed by Southern Illinois University on samples taken from Salt Range and other coal fields states that the Salt Range coals are ranked as bituminous. Estimates of reserves will be made by the end of this year. GSP is operating one rig on the project; another rig is used for spares. Severe budget restrictions for both equipment and payment of per diem and field expenses prevent rapid completion of the project.

Private mining in this area has been by adits driven into the coal seam exposures along as escarpment. The GSP/USGS resource assessment is core drilling on about a 1 kilometer grid behind the coal outcrops in an area of relatively flat-lying beds. The coal horizons are usually a few hundred feet below the surface. While the grid spacing is not close enough for a coal reserves estimate, which would normally be done on a 400 meter grid, this work will provide a rough economic reserves estimate.

The GSP is able to drill legally on either public or private leases with due consideration given for surface rights users. The program cannot be completed rapidly because of lack of drilling equipment and operating funds.

A U.S. company, Hadson Petroleum of Oklahoma City, has opened a local office in Lahore and is negotiating with private companies for concessions as well as applying for leases on its own. The company is favorably impressed with the area's potential and plans to mine coal (should exploration and development be successful) and work with other private interests to build a private power plant. Consortiums, such as Bechtel/Pyropower/Pakland and Siemens/Habibullah, have similar views and are submitting proposals to develop Pakistan's coal resources.

The Seventh Five-Year Plan goal of developing 500M tonnes of proven reserves will undoubtedly be met. Coal reserves in Pakistan by coal field are shown on Table 3. Table 4 shows the quality of these coals by field.

Several observations are pertinent to Table 3. Measured reserves are those reserves that are "mineable;" but, if underground mining methods are employed normally, only 50% of these stated reserves can be recovered. If open-pit mining is used, essentially 100% of the reserves will be recovered. To develop a coal reserves estimates, the average thickness of the coal seam, as measured in core holes and extrapolated over the whole field, is the basis for the estimate. If parati occurs with the coal, either above, below or inter-bedded with the coal seam, it is usually ignored in the reserves estimate. Because Fluidized Bed Combustion (FBC) systems can now be used in power plants, this parati also can be mined and burned if it does not exceed a certain percentage of total coal feed. The GSP should take into account parati as part of the economic reserve based on using FBC technology in future power plants. Thus, coal reserves, if they were to be measured on a Btu basis, are probably understated.

The coal reserve base in Pakistan has been increased sufficiently to attract private interest in developing these reserves. This interest is reinforced by the new FBC technology which is a classic example of a new technology turning uneconomic resources into economic reserves.

Approximately \$700,000 of commodity assistance funds have been spent to date on this subcomponent as compared to the original life-of-Project estimate of \$2.62 million. These funds were used to procure laboratory equipment, computers and other Geodata Center equipment including drawing equipment. We understand the drill rigs furnished by the Project were not funded by the commodities assistance program.

Utilization of equipment furnished to date is spotty. The coal analysis laboratory is just becoming operational and it is our understanding that other types of equipment, such as petrographic microscopes, are under-utilized. Drill rigs, although in short supply, are also under-utilized with one rig stacked in Quetta. Equipment deficiencies have been cited as one of the reasons for slow progress in the resource assessment. If this is so, attention should be given to developing an equipment needs/utilization plan tied to future exploration plans. If this is done, continued commodity assistance support will be essential if the GSP is to meet its programmatic goals.

Table 3. COAL RESERVES IN PAKISTAN

COAL RESERVES IN MILLIONS OF TONNES

Region/Coal Field	Measured	Indicated	Inferred	Total Potential	Data Source
Baluchistan					
Mach-Abegum	-	-	22.5	22.5	1
Sor Range-Deghari (Public)	0.9	5.7	4.9	11.5	2
Sor Range-Deghari-Sinjidi (Private)	-	-	2.6	22.6	1
Khost-Sharigh-Harnai (Public)	1.8	2.6	-	4.4	2
Khost-Sharigh-Harnai (Private)	-	-	42.6	42.6	1
Pir Ismail Ziarat	-	-	11.0	11.0	1
Duki (Public)	12.8	10.0	20.6	43.4	1
Duki (Private)	0.2	2.1	3.9	6.2	1,4
Chamalang-Bala Dhaka	-	-	5.0	5.0	1
Subtotal	15.7	20.4	133.1	169.2	
Punjab/NWFP					
Eastern-Central Salt Range (Public)	0.5	1.0	6.2	7.7	3,1
Eastern-Central Salt Range (Public)	4.0	36.0	13.0	53.0	1,4
Makerwal-Gullakhel (Public)	3.0	7.0	9.6	19.6	2
Western Salt Range	-	-	0.4	0.4	1
Subtotal	7.5	44.0	29.2	80.7	
Sind					
Lakhra (Public)	143.3	30.7	-	174.0	5
Lakhra (Private)	-	-	-	300.0	1
Sondra-Thatta	31.0	93.0	376.0	500.0	1
Jhimpir-Meting	-	-	25.0	25.0	1
Subtotal	174.3	123.7	701.0	999.0	
GRAND TOTAL	197.5	188.1	863.3	1248.9	

Data Source:

1. GSP - Geologic Survey of Pakistan
2. PMDC - Pakistan Mineral Development Corporation
3. PUNJMIN - Punjab Mineral Development Corporation
4. CHEMCON - Chemical Consultants, Inc.
5. WAPDA - Water and Power Authority

Table 4. QUALITY OF PAKISTAN COAL RESERVES BY FIELD

FIELD	PROXIMATE ANALYSIS				ULTIMATE ANALYSIS	HEATING VALUE	ANALYZED BY
	Moisture	VCM	Ash	FC	% Sulfur	Btu/lb	
Punjab							
Makerwal	3.6	37.6	20.8	38.0	6.11	10057	(A2)
Padhrar (Central Salt Range)	4.2	33.5	21.5	38.7	9.96	9934	(A2)
Katha (Central Salt Range)	5.2	31.8	32.0	31.0	5.64	8017	(A2)
Nili	3.5	25.0	47.0	24.5	5.26	6116	(A2)
Ratucha	3.9	23.2	50.0	22.9	7.82	5143	(A2)
Sind							
Lakhra (North)	26.9	25.9	24.3	22.9	4.3	6000	(A1)
Lakhra (Central)	24.9	30.3	17.4	27.5	4.2	7067	(A1)
Lakhra (South)	22.7	32.0	14.2	31.2	6.1	7726	(A1)
Jhimpir-Meting	12.25	33.98	31.23	22.54	-	7130	(A3)
Sonda	13.4	30.3	27.5	26.7	N.A.	N.A.	GSP
Lakhra (high VCM)	6.5	49.5	12.5	31.7	N.A.	N.A.	(A4)
Baluchistan							
Sor Range	14.7	36.4	7.1	41.8	5.0	9961	(A1)
Sinjidi	10.6	35.9	19.8	33.7	4.0	8737	(A1)
Deghari	12.1	35.5	18.0	34.4	2.2	8833	(A1)
Pir Ismail Ziarat	10.7	38.1	8.1	43.1	4.1	10557	(A1)
Duki	6.2	33.4	17.6	42.9	6.0	10028	(A1)
Sharigh	2.19-2.40	33.39-43.11	19.36-43.47	20.74-35.34	2.90-4.44	8379-11371	(A3)
Harnai	3.98-6.41	32.97-44.24	25.64-43.62	17.42-27.59	5.32-5.40	4986- 9797	(A3)
Khost	3.76-8.60	24.70-43.33	22.35-34.46	27.37-33.34	4.03-6.63	9203-10832	(A3)

Notes: VCM - Volatile Matter
 FC - Fixed Carbon
 Analyzed by: (A1) - Holderbank A.G. Switzerland
 (A2) - N.C.B. Yorkshire Regional Laboratory UK
 (A3) - PCSIR Lahore
 (A4) - L&C Steinmuller G.m.b.H. Germany

Source: Geological Survey of Pakistan

D. Recommendations

The long term objective of defining Pakistan's coal resources base is an important national goal. Only by making a commitment to this program will the GOP obtain a complete understanding of the possible coal reserves on which to plan intelligently for using coal as a future energy source.

- We recommend that USAID continue to support this activity through 1990 and, if good progress is being made, consider support through 1993. An important component of this support will be commodities donations to enhance the GSP's ability to complete the coal resource program as quickly as possible.

Coal analysis of high caliber must be rapidly established in Pakistan as the pace of coal exploration work increases.

- We recommend that USAID contract with the private sector for a full-time specialist to work in the GSP laboratory until such time as the lab is self-sufficient and make follow-up visits after initial training of GSP laboratory staff. The core GSP technician should be trained to prepared to transfer his/her experience and training to colleagues.

Interpretative work based on coal analysis and logs should NOT be done by USGS exclusively in Reston. Most interpretive work is conducted by USGS geologists not working closely with Pakistan geologists. The coal samples are analyzed in Reston; the base maps are prepared there as are the interpretive maps such as lithofacies and isopacks using computer-controlled plotters. These activities should be done in Pakistan by GSP geologists assisted by a full-time U.S. geologist.

- We recommend that GSP field and staff geologists receive incentive bonuses to encourage the best geologists to stay in the field and to pass on their knowledge to the junior field staff. A reward system can be further expanded to those of high achievement to attend short courses in the U.S. Professionals with an aptitude for teaching should be encouraged to pass on their experiences and knowledge by means of in-house seminars.
- Academic study in the U.S. under the current EP&D Project should be continued for those who have achieved a level of practical application in their specialty. Too often, an advanced degree does not necessarily add to field working abilities. Rather, the degree has been a passport to an office-bound job and the practical experience has not been passed on.
- To further focus the work of coal assessment, the publication of an information bulletin would be an effective way to disseminate news on activities and accomplishments of the group. To build cohesiveness and a sense of participation in the decision-making process, an annual meeting of

all geologists should be funded by USAID. At this meeting colleagues could present their findings, exchange ideas, compare field experiences and discuss the next year's programs.

As interest in coal mining to supply coal for power plants grows, reserves assessment drilling becomes more imperative for both the public and private sectors.

- The team recommends that USAID continue to help GSP carry out reserves assessment for PMDC.

GSP has stated that it intends to support the assessment of reserves but is not clear whether this support includes the private sector. A means must be found to allow GSP to undertake the same work for the private sector when requested.

- We recommend that GSP be encouraged to undertake private sector work for a fee plus 10% (excluding capital recovery of the donated equipment).

Drilling for resource and reserve assessment has been well-supported by USAID.

- We recommend that this work be continued.

Additional rigs and spares are required. Additional training for drillers is not needed as there appears to be a good pool of well-trained drillers in Pakistan, although the pay for drillers at GSP does not attract the best who may be in the private sector.

- We recommend that GSP, with USAID support, consider hiring private contractors to do the drilling.

VI. COAL MINE AND COAL-FIRED POWER GENERATION

COMPONENT 2B

In the Seventh Five-Year Energy Plan, coal supplies are projected to increase from a present level of about 4 million tonnes (both reported and unreported) to 6.9 million tonnes by 1992-93. All of the growth in demand is projected for the generation of electricity¹.

The projected increase of 2.9 million tonnes of coal is not likely to be achieved in the forecast period. At best, only about 900,000 additional tonnes of coal will be required for a 3 x 50 MW fluidized-bed facility that may be operational by the end of the forecast period.

Over the short-term, increasing supplies of gas and oil imports will make it more difficult to substitute coal for these fuels in electricity generation. Over a longer term, as energy demands increase and the costs of oil imports becomes unacceptable, coal will become an increasingly important component of domestic energy supplies.

To provide a context for the recommendations contained in this analysis, the Evaluation Team has reviewed the activities that shaped coal development in the Sind Province of Pakistan over the past 30 years. While lengthy, the background contains the information needed to fully understand the many issues that are associated with this program.

A. Background

1. Activities Prior to EP&D Project Initiation

In the 1960's cooperative efforts between the Geologic Survey of Pakistan and U.S. Geological Survey were undertaken to establish the magnitude of the coal resources in and around the Lakhra area. Thirty-four widely spaced holes were drilled in an area of about 250 sq. km. and the coal resources were conservatively estimated at more than 240 million tonnes. Part of the area assessed included a 79 sq. km. tract now known as the PMDC Tract.

During the 1960's and 1970's, West Pakistan Industrial Development Corporation and various consultants supported topographical and geological mapping of an 155 sq. km. area arranged with German and Japanese assistance. They concluded that Lakhra coal is suitable for thermal power generation. The size of the unit that may be supported was estimated by Polish consultants to be 250 MW based on underground mining. However, further drilling and characterization of the coal deposits were required^{17,18}.

The Pakistan Mineral Development Corporation (PMDC) was created in 1974 and obtained coal leases in the Lakhra area. Subsequently, 19 holes were drilled on 52 sq. km. of the PMDC Tract. Using these data and information from the prior holes drilled on this tract, PMDC prepared a plan for a 1 million ton per year coal mine¹⁹. At about the same time, WAPDA prepared a plan for a 2 x 125 MW power plant. The Government of Pakistan

decided that the mine and plant should proceed as an integrated system and WAPDA was appointed as the lead agency in 1976.

In 1977, WAPDA and CIDA completed a reconnaissance study and concluded that the coal resources of the Lakhra area were adequate to support a 250 MW power plant. However, the data to determine actual coal reserves were inadequate and further study was recommended²⁰.

In 1979, WAPDA and the Japan International Cooperative Agency (JICA) undertook a coal development feasibility study. Fifty holes were drilled on a 26 sq. km. part of the PMDC Tract. Coal reserves were estimated at 54 million recoverable tonnes which was adequate to supply a single 300 MW power plant²¹. The projected overall capital cost of the project was unacceptably high and the project was not implemented.

In 1981, USAID was requested by the GOP to review the coal development feasibility analysis conducted by JICA. Stone and Webster, an A&E contractor, was engaged to conduct the review; no new drilling was undertaken. This contractor found that the design, construction, and operation of the Lakhra facility was technically feasible and economically competitive with other power generation alternatives for meeting Pakistan's growing electric requirements²². This study was completed in April 1983.

2. EP&D Project

With the above as background, USAID initiated the Energy Planning and Development Project in July 1983²³. The expected outputs from the Coal Mine and Coal-Fired Power Generation subcomponent of the Project, were:

- Establishment of a Coal Projects Department within WAPDA to promote, plan and manage the development and implementation of coal-fired power generation and coal mine projects;
- Completion of an assessment of the development barriers facing the private coal mining industry and of options available to that sector and the GOP to eliminate or reduce those barriers and to stimulate private investment in coal development;
- Demonstration of improved mining techniques appropriate to Pakistan's coal industry; and
- Preparation for the implementation of Pakistan's first-large scale coal mine and coal-fired Power Generation Project (Lakhra).

In October 1983, a meeting was held in Washington, D.C. with other donor agencies to consider coal development in Pakistan. Policy guidance was provided by each organization as follows:

World Bank: Reserves are not adequately defined, therefore, additional holes are needed. Also, the Bank required that the Lakhra Power Project be a component of the least-cost power generation program of WAPDA.

Asian Development Bank: Detailed feasibility study was required before Lakhra Power Project would be considered for financing. In the study, siting of the power plant and the environmental impact should be re-examined.

USAID: The coal mine should be developed by the private sector.

In response to the 1983 Project Paper prepared by USAID and the subsequent Donor Agency guidelines for coal development at Lakhra, USAID let a number of individual contracts that were managed and the results integrated by USAID personnel. These studies are summarized as follows:

Mine Feasibility - J.T. Boyd Company: Drilled 106 additional core holes, bringing to 178 the number of holes drilled on a 54 sq. km. investigation of the 79 sq. km. PMDC Tract. This density is internationally accepted for the purpose of feasibility studies. All 106 of the Boyd drill holes were logged with electric logging equipment from the U.S. Aerial photography was completed and 200 coal and related core samples plus a 1,800 kg. (4,000 lb.) bulk sample were collected and shipped to the U.S. for detailed chemical analysis and coal washability studies.

Proven recoverable coal reserves on the PMDC Tract were estimated at 123 million tonnes which are adequate to support 2 x 350 MW power generation units over nearly a 30 year period using the quality of the coal expected to be mined at Lakhra. Alternative mine plans and transportation systems were developed and costed out. Using a combination of open-pit and underground mining, the 2 x 350 MW plant would require 4.3 million tonnes of coal per year. The cost per tonne of coal was estimated at \$30, which includes the construction of a town and related infrastructure and the amortization of capital at five percent.

Power Plant Feasibility - Gilbert Commonwealth International: This study* encompassed a wide range of activities, including system planning, site selection, testing of the coal for boiler design, coal washing tests, and estimated capital costs. The combustion technology was pulverized coal with uncontrolled stack emissions. These studies were later incorporated into an overall system costs study conducted by a separate contractor.

Environmental Impact Assessment - Environmental Sciences and Engineering: Detailed air modelling was conducted for a number of cases using the 2 x 350 MW power-generating units which corresponded to the maximum capacity of the PMDC Tract²⁵. Two of the cases resulted in SO₂ concentrations that were near or exceeded the World Bank guidelines. One case, using one large stack for both units, resulted in near vicinity ground level impacts significantly below the maximum standards. This case was used to argue that flue gas desulfurization equipment was not needed, but the question of the ultimate impact of the materials vented was not addressed. Ultimately, 500 MW without scrubbers was approved by the World Bank.

Social Studies - Personal Services Contract: Three social studies* experts were engaged to study the impact of development at Lakhra. The development of the infrastructure associated with this project was judged to be positive.

Economic and Financial Analysis - ICF Inc.: This analysis²⁷ evaluated the costs of the Lakhra project and compared these costs to alternative means of generating electric power. The analysis showed that the Lakhra development could compete, marginally, with both imported coal and with imported oil using assumptions concerning the future price of these imported fuels.

A decision was made to seek private sector development of the PMDC Tract. Accordingly, a comprehensive request for the development of the Lakhra coal mines by the private sector was prepared by the Bank of America International, London, and issued by WAPDA in January 1987. The request addressed many of the concerns identified in the prior studies²⁸ and called for development of the PMDC Tract along the lines detailed in the Boyd report, e.g. using either surface and/or underground mine development. The mine was to be sized to produce sufficient coal for 2 x 250 MW power units. However, at the time of the request, no contract had been let for the construction of these power units. Therefore, the proposers had to assume that such units would indeed be constructed.

Thirteen international and Pakistan firms had prequalified to receive the solicitation and each received a copy of the request. WAPDA received two proposals when the bids were opened on June 30, 1987. One was from an international consortium led by Bechtel and Peabody Coal Company of the U.S. and the second from a local coal mining firm Mohammad Amin Bros., Pvt., Ltd. The Bechtel proposal was incomplete; several volumes were not submitted. This proposal insisted that the entire coal supply and power plant construction be in one pair of hands, Bechtel's, before they would complete their submission. The Amin Brothers proposal was apparently complete, but omitted some required technical details.

USAID provided the WAPDA evaluation panel with the services of two competent international mining engineers. WAPDA eventually received the missing volumes of the Bechtel proposal and made a continuing effort to secure missing information and clarifications from the two proposers. Despite some success in obtaining missing proposal information, WAPDA, in February 1988, formally declared both proposals non-responsive and rejected both offers.

In September 1987, WAPDA signed a contract with the Dong Fong Electric Corporation for the construction of 3 x 50 MW fluidized-bed power plants to be built near the Lakhra coal field. Foster Wheeler Corporation of the U.S. has been working with the Chinese in design of the units. Funds for this design were released by WAPDA in May 1988 and the detailed design is reportedly now underway. The origin of this development appears to be in contacts made during the 1986 USAID-supported First Pakistan National Coal Conference.

Following rejection of the two previous proposals to supply coal for a 2 x 250 MW power plant, WAPDA decided to issue a call for coal supplies for the 3 x 50 MW units now under design. The earlier proposal, prepared by the Bank of America International, London, was used as a guide to create the new request which was issued in February 1988²⁹.

This new request was considerably condensed in content from the original and important changes were made. For example, the mining method was not specified although it is

expected that underground mining will be proposed. Additionally, the proposer is expected to "comply with all applicable safety and health laws, rules and regulations," but the quantified standards developed for the prior request have been omitted from the new request.

The request was submitted to a short list of prospective bidders selected by WAPDA. All international firms were omitted from the list while PMDC was added. The proposal is receiving serious consideration and WAPDA believes that at least two viable bids will be received by the September 29, 1988 closing date.

B. Findings Relative to EP&D

The studies supported by USAID were directly related to the stated program objectives of USAID and to the donor agency guidelines. Management was effective in the use of resources in program implementation. The management strategy adopted for the Lakhra project studies used independent contractors whose findings were integrated by USAID personnel. An alternative approach had been identified which was the use of a prime contractor and subcontractors.

- Because of the diversity and number of individual contracts let under this program, the overall effort would have probably appeared to be better organized and managed using one prime contractor. This might have been effective if the appropriate prime contractor had been selected. However, using a prime contractor could have restricted the number of issues that would ultimately be raised for management consideration. For example, numerous contractors were involved in addressing questions associated with sulfur dioxide impacts. Ultimately, a management decision was made to endorse a 500 MW unit without stack gas scrubbers. This same degree of interaction with management would not likely have taken place if only one prime contractor had been used, since this contractor would tend to internally resolve these problems and present only findings and recommendations to management.
- The question of management approach is related to the complexity and urgency of the problem. The contractors selected by USAID are among the best in the world for the types of studies undertaken. That contracting required extra USAID management time does not seem to be relevant compared to the complexity of the coal issue and the importance of coal to the future of Pakistan. USAID was the decision maker, not a prime contractor, and thus was able to make informed decisions due to the process selected. In this case, a decision was made to prepare and issue a request for coal supplies. Since an informed decision was made, the Evaluation Team concludes that the procedure that was adopted was effective.
- Despite the studies, USAID has not yet met its major objective to assist the GOP mobilize the private sector in coal development and utilization.
- While the private sector approach adopted by USAID did not work as

designed, the approach has provided the foundation for the likely development of coal mines by the private sector. For example, in response to the WAPDA solicitation, PMDC is forming a joint venture with private firms to bid on the contract. They will be directly competing against at least one strong private sector company already mining coal in the Lakhra field. The results of this competition will be known after September 29, 1988. The likely result will be a strong private sector involvement in Lakhra coal mine development either directly and/or as a joint venture company with PMDC involvement at the PMDC Tract and possibly at other locations.

- Coal resource assessment work has been concentrated in the Sind Province. The coal reserves on the Lakhra PMDC Tract have been defined with acceptable accuracy. In addition, a major new coal resource has been identified at Sonda Thatta (field has been named Jherruk) and additional drilling by the Geological Survey of Pakistan, supported with operating funds by USAID, is currently underway. The objective of a quantitative understanding of the coal resources/reserves in this area has been achieved.

Work to define the coal potential outside of the Sind area has not been a priority effort. Thus, the broader objective of defining coal fields in other provinces in Pakistan has not yet been achieved.

- WAPDA has established the position of Chief Engineer for Coal Power Projects³⁰. This relatively new cell, Coal Power Projects, was set up specifically to plan, design, and manage Pakistan's coal-based power plants. In addition, WAPDA still has lead agency responsibilities for coal development in Lakhra in accordance with the 1976 GOP decision. This coal cell has designed and implemented WAPDA's current efforts to obtain the 3 x 50 MW fluidized-bed combustors and has prepared the solicitation for coal supplies. These actions show that this cell has acquired substantial technical knowledge as the result of the prior USAID supported studies and coal supply solicitation. The USAID objective, to establish this cell within WAPDA to promote and plan the development and implementation of coal-fired power plants and coal mine projects, has been successful to date. Effective management of these activities is yet to be demonstrated.
- The USAID studies have documented the barriers facing the private coal mine industry. However, these studies have failed to stimulate private investment in coal mine development. Although much activity by private coal mine owners is evident, this objective has not yet been achieved.
- Improved mining techniques appropriate to Pakistan's coal industry have not been demonstrated. Therefore, this objective has not been achieved.
- The USAID efforts have prepared the way for the implementation of Pakistan's first large-scale coal mine and coal-fired power generation project. This objective is being achieved.

- Approximately \$1.2 million of commodity assistance funds of the original estimated life-of-Project \$2.146 million have been spent to date. Equipment procured includes drill rigs, logging trucks, vehicles and drilling consumables.

The equipment and consumables procured for this subcomponent were utilized during the coal resources and reserve assessment work at Lakhra. These funds were well-spent resulting in the delineation of a large coal resource at Lakhra that is now the basis of a WAPDA coal mining solicitation. We assume that now that the Lakhra work is completed all usable equipment will continue in use in the GSP coal resource assessment activities.

C. Findings Relative to the Donor Agency Guidelines

- World Bank: Reserves on the PMDC Tract are now accurately established. As of February 1986, the Lakhra Project was stated to be a component of the least-cost power generation program of WAPDA³⁰. This World Bank guideline appears to have been observed since a request for coal supplies was prepared in 1986 and issued in January 1987.
- Asian Development Bank: Detailed feasibility studies have been completed for the Lakhra Project. Questions related to siting and environmental impact have been thoroughly examined.
- USAID: No new coal mine has been developed at Lakhra by either the public or private sector. This USAID guideline has not yet been met.

D. Observations

The Coal Mine and Coal-Fired Generation program was developed in the early 1980's during a period of high energy prices. Pulverized coal technology was selected for coal combustion. Two significant events have impacted the program since that time: (1) declining energy prices, and (2) evolving fluidized-bed combustion technology. Each of these events is considered below in the context of the USAID program.

1. Energy Prices

Declining energy prices have made it nearly impossible to justify the Lakhra project as among the least-cost options currently available to WAPDA. Both imported oil used with steam turbines and imported coal using conventional pulverized coal units are probably, in mid-1988, lower cost alternatives than the start of a new industry based on Lakhra coal. Thus, the Lakhra project probably cannot be justified at this time for World Bank and Asian Development Bank funding using their criteria of least cost.

2. Combustion Technology

Conventional pulverized coal combustion technology is well established and is commercially available in standard unit sizes. In the 1960's, this technology was assumed for use in Lakhra using one 250 MW unit. As the resource was better defined, the total power expected to be generated from Lakhra was increased to 700 MW using 2 x 350 MW units without scrubbers. Total generating capacity was, therefore, increased or decreased using a multiple of a standard coal-fired unit.

The 250 MW unit requires about 1.5 million tonnes per year of Lakhra coal. This quantity of coal represents nearly a ten-fold increase over the production from the largest private operator in the Lakhra coal field (one mine owner produces about 180,000 tonnes per year). The requirements for the 250 MW unit also represent a 50 percent increase in the total coal mined from all mines in the Lakhra field (currently about 1 million tonnes per year). Moreover, the coal supply for power generation must be continuously and reliably produced on a daily basis. Given the existing primitive conditions of seasonal coal mining by migrant labors at Lakhra, reliable mining operations became a significant constraint because of the amount of coal needed for even the smallest commercial pulverized coal combustion unit.

Fluidized-bed combustion technology has advanced from experimental operations in the 1970's to commercial applications in the industrial sector in the 1980's³¹. Industrial-sized units of 50 MW are now commercially available and utility-sized units of 110 MW to 160 MW are now being demonstrated in the United States. This evolving technology is ideally suited for the type of coal found at Lakhra, for the following reasons:

- fluidized-bed combustors can burn lower-quality fuels such as that found at Lakhra, including the coal and, possibly, parati which is a shaly carbonaceous material that is interbedded with the coal seams,
- it has the capability of controlling sulfur emissions using absorbent materials in the bed, thus eliminating the need to add costly flue gas desulfurizing equipment after combustion takes place,
- the wastes are in a dry, solid form easily removed from the bed and may be further useful as construction materials, and
- the units can burn liquid fuels as well as solid fuels.

As of 1985, over 160 industrial fluidized-bed boilers were in service in the Western nations and many more are in use in China. Additionally, six utility-scale demonstration plants will be in operation by 1990.

The purchase of 3 x 50 MW fluid-bed reactors by WAPDA is appropriate for the initial startup of the development of a new industry based on Lakhra coal. Each unit will require only about 300,000 tonnes per year of coal--about twice the amount currently produced by the largest private mine owners. Three small units provide flexibility so that at least one unit will most likely continue to produce electricity if the coal supplies to the other two units

are not available from existing mines or those mines that may be developed in response to the WAPDA solicitation. Additionally, oil can be substituted for coal to keep all three units operating in the event coal is unavailable. The advent of fluidized-bed combustion technology has, therefore, become the technology of choice for the Lakhra project.

3. Future Considerations

Release of the WAPDA request for coal supplies for the 3 x 50 MW units is viewed by at least one local coal mine owner as a business opportunity and by others as a potential threat to the existing *status-quo*. One operator has reportedly hired one of the international mining consultants used by WAPDA for the review of the prior solicitation. The intended purpose is to improve the bidder's technical plan and respond to the solicitation. Other mine owners, as represented by the Pakistan Mine Owners Association, wrote to USAID on May 24, 1988, stating that they are in a position to bridge this energy gap, if the necessary infrastructure, technical and financial help is extended to them. We presume that USAID can play a major role to this end.

Mine development, based on modern concepts of roof support, ventilation, and coal haulage systems to efficiently move the coal mined, is expected to evolve from the current solicitation. This will likely take years to materialize, but once started, new mining methods are expected to be adopted by other mine owners in an effort to increase profits or stay competitive.

E. Recommendations

1. Terminate Program

An option is under consideration by USAID to terminate all programs to develop coal mine and coal-fired power generation. Adoption of this option may result in a coal mine industry that develops in a manner that is environmentally unsound and without adequate protection for worker health and safety. The Evaluation Team does not recommend USAID follow this option.

2. Technical Support to WAPDA for Coal Supply Procurement

The WAPDA Request for Proposal for coal supply for fluidized-bed units asks the proposer to "... comply with all applicable safety and health laws, rules and regulations." However, the quantified standards developed for the prior request for coal supplies were omitted from the new request.

These quantified standards were based on mining practices in Europe. Over the long-run, reliable coal supplies will depend on maintaining safe mine conditions. Therefore, it is in the best interests of WAPDA to support the adoption of minimum standards for miners' health and safety.

- We recommend USAID support this effort in 1988/89 and help assure that the most critical of the standards are considered in the negotiations that will take part as the result of the WAPDA solicitation. This will require

assignment of USAID experts and/or outside international consultants to WAPDA during the proposal evaluation and contract negotiation periods. The future development of the coal mining industry in Pakistan may be shaped for many years by this single procurement. USAID has the background to help assure that appropriate standards are considered as a necessary part of this development.

3. Training Mine

The Evaluation Team has identified a critical need to improve the skills-base of the personnel who will work in a totally new mine environment. Training at the practical level is needed if this new industry is to evolve in a manner consistent with concern for the health and safety of its workers.

- The Team Recommends a training mine for USAID funding. This mine would be characterized by the smallest scale needed to train mine workers and operators in the use of underground mining equipment. The size of the mine is on the order of a few hundred tonnes of coal mined per day. As a part of the training mine, a mine rescue training station also should be established and training undertaken for personnel to deal with emergency situations. Part of the training should focus on mine surveying to make accurate mine plans and maps on the day-to-day workings of mines. This training mine should be located near the existing coal mines in the Lakhra area. Such a location will facilitate practical experience for the mining engineers now being trained in Jamshoro near Hyderabad (Mehran University of Engineering and Technology).

This training mine could be established as a separate corporation under the Pakistan Mine Owners Association of which PMDC is a member. In this way, graduates of the training would be free to work in any of the existing mines as well as in the mines that may be opened as the result of the WAPDA solicitation. Startup costs are estimated at \$3-\$5 million. Net operating revenues from the sale of coal is expected to be sufficient to sustain the training program without further donor financing.

A training mine is currently being opened at KATAS near Choasaiden Shah, Salt Range, in Punjab Province under a German Technical Assistance Program. A similar facility is justified in Sind Province due to the importance of its current coal production (about the same as Punjab) and because of the future coal potential in Sind. Drilling on the PMDC Tract has established the tract as the largest known minable coal deposit in Pakistan. In addition, the new discovery at Jherruk, just south of the PMDC Tract, offers a potential at least equal to that of the PMDC Tract, and private industry is reportedly very interested in the development of coal resources north of the PMDC Tract.

USAID is in the best position to implement this recommendation compared with other potential supporters. Two very experienced USAID mining engineers have been working on the Lakhra project for a number of years. The experience of this existing staff is unique among the donor agencies. One of the engineers has a detailed knowledge of modern

mining methods as practiced in the U.S. and elsewhere in the world. The second mining engineer has extensive, direct experience in the Lakhra private and public mines.

The Evaluation Team's recommendation for USAID to develop a training mine in Sind does not depend on progress made on the WAPDA solicitation for coal supplies. It should be considered on its own merits and, if approved, this recommendation should be implemented by USAID as soon as possible. If an immediate start can be made, USAID involvement would be required from startup of this activity through about 1990-91.

4. Model Mine

A model mine is a full-scale working mine producing 300,000 to 500,000 tonnes of coal per year using modern methods of mine development and haulage. Support of a model mine is not recommended for USAID funding at this time for two reasons: (1) USAID support for a model mine may deter the private sector funding of a mine under the WAPDA solicitation, and (2) if such a mine were placed on the PMDC Tract, its development may adversely impact the mining plans that may be proposed to WAPDA.

F. Emerging Issues

The Evaluation Team has identified a number of issues that will impact the future development of coal-based power generation in Pakistan. None of these issues will require resolution in the near-term, but should be considered in the preparation of future USAID plans related to coal development and utilization.

1. Utility-Sized Fluidized-Bed Reactor

In response to the current WAPDA solicitation for coal supplies, the proposers will likely design for a mine size of 1.5 to 2.0 million tonnes of coal per year. Since the 3 x 50 MW power units to be installed at Lakhra will require only 900,000 tonnes per year, additional power-generating capacity will be needed to fully utilize this potential.

USAID has, in the past indicated its interest in funding a power generating unit and, in a letter from the Mission Director dated 30, November 1987 to WAPDA's Member Power and Managing Director, stated that ". . . it is our intention to seek funding (or partial funding as the case may be) for a 200 MW fluidized-bed power plant which, under current plans, would be run by WAPDA and use coal from the PMDC tract at Lakhra."

The U.S. companies have a clear lead in the development of utility-sized fluidized-bed reactors. Leadership in this development is being provided by the U.S. Department of Energy (DOE) and the Electric Power Research Institute (EPRI). With EPRI's involvement, three utility-sized boilers of 110 MW to 160 MW size are in, or are close to, commercial demonstration. The information generated by these demonstrations will be used in the subsequent design of improved commercial units.

- The Evaluation Team recommends that basic information on the DOE/EPRI programs be obtained as an aid to considering the future merits of supporting the construction of a utility-sized fluidized-bed reactor in Pakistan. As briefly

discussed in an earlier section, the introduction of fluidized-bed reactor technology into Pakistan has long-term environmental significance. As Pakistan begins large-scale exploitation of its coal resources, it will become increasingly important to be able to burn this coal (some with a high sulfur content) in an environmentally safe manner. Fluidized-bed reactors provide for this clean burning with minimum additional cost.

2. Mining Rules and Regulations

As a coal mine industry evolves in Pakistan, rules and regulations related to mining will need to undergo certain changes. Some of these changes have been identified in the Draft Seventh Five-Year Plan⁴ as follows:

"Mining rules and regulations will be amended to allow (a) use of coal mines as collateral against loans; (b) merger of smaller units into bigger economic units for purposes of mining on a cooperative basis; and (c) enhancement of lease tenure."

- The Evaluation Team recommends that USAID support appropriate regulatory changes at both the Provincial and central government levels as a necessary step in the orderly development of the coal industry in Pakistan.

3. Full Utilization of the Coal Resources

A representative of the Sind Province has identified an issue that will become increasingly important with time--conservation of the coal resource.

The likely initial development of the PMDC Tract will use underground methods rather than open pit mines. An underground mine can be developed at lower costs and in a shorter time than a surface mine thus accelerating the net cash-flow from operations. Surface mines depend on very large investments in equipment, and this equipment must have replacement parts readily available or the continuous supply of coal will be interrupted. The smaller underground openings using local labor do not have this constraint.

Underground mines can only recover about half of the coal in place while surface mines may achieve almost complete recovery. Therefore, the use of surface mines to fully utilize the coal resources will become an increasingly important issue over time. The Evaluation Team recommends that this emerging issue be examined as a part of the future planning by USAID under this component.

VII. COAL BRIQUETTING PROGRAM

COMPONENT 2C

A. Background

Firewood accounts for 70% of the fuel used in residential cooking and heating in Pakistan. As the rural population grows, the demand for wood exceeds the capacity of Pakistan's forests to supply the demand and forests are being denuded. Kerosene substitutes for firewood in many households but it is imported and must be paid for with foreign exchange. (Household kerosene accounted for 11% of total petroleum products consumed in 1986-87). For these reasons coal briquettes are under consideration as a substitute for fuel wood and kerosene.

PMDC has been manufacturing coal briquettes at Quetta and selling up to 10,000 tonnes per year to the Pakistan Army. The coal source is from PMDC mines in the Quetta area. The Army equips bunk houses in the northwestern frontier areas with a small stove used for space heating in winter time.

In 1986 USAID commenced a briquette development and marketing studies program. Since that time, the following agencies and groups have been involved in briquetting activities:

- Pakistan Council for Scientific and Industrial Research (PCSIR)
- Pakistan Minerals Development Corporation (PMDC)
- ENERPLAN
- Private sector companies

EP&D Project-sponsored studies included:

- Researching briquette formulation at PCSIR
- Assisting a private company to produce their specialized briquette for a market test and analysis
- Assisting PMDC in delivering a formulated briquette for a market test and analysis
- Contracting with Oak Ridge National Laboratory (ORNL) to supervise a fuel-use market survey conducted by Aftab Associates of Lahore, supervise a briquette field test by Aftab, and write a complete report on the outlook for briquettes. The final ORNL report²² was submitted in March 1988.

B. Findings

1. Product Development

Three types of briquettes were tested in the market-use study:

- A PCSIR-manufactured briquette that was a hand-compressed, tennis ball size, carbonized product based on Lakhra coal.
- A briquette produced by a private sector company, Charnia of Karachi, that used a proprietary binder. The briquette was rectangular, 5" by 3" by 3/4", and high in biomass.
- A special pillow-shaped briquette about 1 1/4" thick formulated by PMDC at its plant in Quetta.

The analysis of these briquettes are summarized in Table 5.

Table 5. Analysis of Briquettes

	PMDC	PCSIR	Charnia
Type	Smoky	Smoky, carbonized	Non-smoky, high biomass
Source	Sharigh/Sor	Sor	Lakhra
Primary Use	Heating	Cooking	Cooking
Shape	Small pillow	Tennis ball	Rectangular
Binder	Molasses	Molasses	Proprietary
Ash	25 - 42%	10%	10%
Sulfur	6 - 9%	1%	1%
Volatile matter	37 - 42%	32%	32%
Btu per pound	7200 - 9600	11500	9200
Relative manufacturing cost	low	high	medium

Source: Coal Briquetting in Pakistan, Oak Ridge National Laboratory, March 1988.

The Evaluation Team found that the PCSIR laboratory to be well-equipped. A large briquette manufacturing machine was being unloaded at the end of May. However, PCSIR had no clear idea of how the briquette will be used or what is required to make the briquette marketable.

PMDC continues to supply the Army with briquettes for heating and states that they remain interested in producing briquettes for the consumer market using Lakhra and other coals.

The private company, Charnia, was interviewed by the Team. The company stated that they are no longer interested in developing briquettes for the domestic market and believe that the ORNL market study suggests that consumers reject briquettes. In addition, their estimated costs of making the Charnia briquette (including a 50% profit margin) were about 20% higher than the price of wood charcoal selling in markets that would compete with the briquette. In this company's opinion it would be very difficult to break into the consumer market on the basis of estimated costs. Charnia is continuing to explore briquettes, but not

for household consumers. The briquette, using their proprietary binder and imported coke breeze from China, will be sold in Pakistan to steel mills, foundries and sugar mills.

ORNL estimated the cost of manufacturing PMDC or Charnia briquettes at about 620 Rs. per tonne. The costs were based on using a molasses binder and did not include transportation of coal to a plant. Additionally, no costs were added to accommodate that the manufacturer may not own the coal mine. Costs attributable to these factors would add an estimated Rs. 830. The total costs would be about Rs. 1450. With other markups, the total price to the consumer would be Rs. 2205, just barely competitive with wood charcoal.

2. Market Studies

Two types of market studies were conducted: (1) a market assessment of residential fuel use based on household incomes, fuel prices and demographics, and (2) a field test of three different briquettes^{33,34,35}.

a. Residential Fuel Use

The market fuel use assessment surveyed 387 households from 38 locations and the data were combined with the field test survey. Some of the discrepancies in the survey were:

- Some geographical areas were over-represented; for example, Afghan refugees were included in Baluchistan but the number of refugees was not stated.
- Rural areas (small villages) were under-represented and rural/urban respondents were not categorized.
- While the survey was intended for low-income households, the survey sample varied in income. Higher income groups were over-represented in the surveys conducted in the Northern provinces.
- In some cases in the provincial surveys, households using firewood were not surveyed.
- In the fuel-use survey, not all of the respondents actually purchased the fuel.

b. Product Field Tests

The consumer field test survey was conducted during March 1987 in six cities comprising 77 households and 29 commercial enterprises (small tiki shops, etc.). As mentioned, three different briquettes were used. The samples used were products that were under development. The survey sample was very small. The primary observation of users was that the briquettes did not deliver heat quickly enough for most cooking purposes.

The overall conclusions of the ORNL report are as follows:

- Only urban consumers exhibited a willingness to pay high enough prices for other fuels to allow the briquettes to compete.

- The difference between economic viability and non-viability for various locations and coal sources depends on the presence or absence of government subsidies.
- Market uncertainties remain that can only be resolved by testing the acceptability of one coal source, process and market. The best source coals are mined in Baluchistan (i.e., the highest Btu content).
- To determine market penetration, further attention is required on specifications for ignition, smokiness, flame, and briquette strength.

Marketing studies had many discrepancies that suggest the fuel-use survey was not indicative of the potential or lack of potential for briquettes. The results of the test market studies of the three briquettes do not indicate that the briquettes used in the surveys had a potential market. The conditions for the optimal development of a briquette have not been identified for either households or commercial users except for one point--the inability of the tested briquette to rapidly reach a high heat needed for tiki cooking and bread baking.

3. Commodity Assistance

To our knowledge, no Project commodities assistance funds have been used to date for this subcomponent. However, coal briquetting equipment, costing approximately \$3 million, was purchased with ECI funds. This equipment was just being installed at PCSIR, Karachi at the time the Evaluation Team was in Pakistan. Future plans for this equipment are not known.

C. Recommendation

- The Team recommends that additional studies and intensive work be deferred. USAID should consider funding only the Pakistan Center for Appropriate Technology, a group that is knowledgeable in using low-technology methods to improve living standards. The PCAT group can seek assistance from PMDC, or any other group they believe worthwhile. Acceptability of a well-formulated briquette might begin with the low income urban sector of Pakistan.

A Briquette Conference to disseminate lessons learned is not recommended at this time but might be planned after the initial work of the PCAT is completed.

VIII. CONSERVATION AND RENEWABLE ENERGY TECHNOLOGIES

COMPONENT 3

A. BACKGROUND

Component 3 of the Energy Planning and Development Project consists of two sub-elements: 1) an energy conservation program to increase the efficiency of energy use and 2) a program to assess and develop renewable energy technologies. The Ministry of Planning is responsible for implementing the Conservation element under a National Energy Conservation Center (ENERCON) established in December 1986 by GOP. Implementation of Renewable Energy technologies is the responsibility of two Ministries, the Ministry of Petroleum and Natural Resources and the Ministry of Science and Technology.

Start-up of the conservation element was delayed for 18 months during which time sporadic discussions were held between USAID and GOP counterparts. In early 1985 the GOP established a Working Group on energy conservation consisting of GOP and USAID personnel, to develop a national program. The Working Group designed a National Energy Conservation Program with two major components: 1) A GOP energy conservation office (ENERCON) and, 2) a technical assistance contractor. The U.S. technical assistance contractor, Hagler, Bailly and Company (HBC), was selected at the end of 1985 and started work in-country in early 1986. ENERCON was set up by GOP Resolution signed by the Prime Minister in December 1986.

ENERCON operated for an extended period with one full-time professional, on loan from ENERPLAN. Staff have been added since and, at present, seven of the allocated twelve professional positions have been filled. On June 16, 1988 a permanent Managing Director was appointed. He is expected to take office shortly.

The Renewable Energy Element has yet to get underway. As a result, the Team spent only a short time reviewing the few activities that are presently under consideration.

B. CONSERVATION ELEMENT

Specific conservation element outputs defined in the EP&D Project Paper are:

- the completion of approximately 60 energy audits and the establishment of an industrial energy-use data system,
- the implementation of four-to-eight industrial energy conservation demonstration projects, and,
- the development of a comprehensive national industrial energy conservation program.

Soon after initiation, industrial sector activities were expanded into a "crash program" which broadened the effort to include buildings conservation and the development of other program plans. In addition, a modest program, aimed at including Pakistani women and households in fostering energy conservation also was undertaken.

To achieve the outputs called for in the EP&D Project Paper, eight functional areas were established in the RFP for the technical assistance contract:

- Institutional Development Support
- Energy Conservation Planning
- Data Base Development and Management
- Technical Support
- Training and Curriculum Development
- Outreach and Information
- Investment Promotion
- Monitoring/Evaluation/Reporting

The technical assistance contractor is presently working under a detailed work plan for the eight functional areas. Under the detailed work plan each functional area is further divided into specific task areas with results expected in two phases over a four and one-half year (4 1/2) year period. The first phase, now completed, ran for 18 months; the second phase is scheduled to last three years.

The findings, conclusions and recommendations contained in the conservation element are grouped by the eight functional areas; however, the industrial sector activities are addressed separately because of the major conservation effort devoted to that sector. Several additional topics of concern to the Evaluation Team have been added to the end of the conservation element evaluation.

1. ENERCON Institution Building

a. Findings

ENERCON, the Pakistan Energy Conservation Council (PECC) and Advisory Committee of the Council were established on December 23, 1986, by GOP Resolution signed by the Prime Minister.

GOP delay in staffing of ENERCON was substantial; eighteen months after the start of the technical assistance contract there was still only one full time professional. During the startup period the Acting Managing Director and Deputy bore dual responsibilities for ENERCON and ENERPLAN, the latter receiving higher priority because of the development of the Seventh Five-Year Plan. In addition to the delays, the initial staffing target of 18 was eventually revised downward to 12.

The contractor was in place in early 1986 and undertook a major effort to initiate energy conservation activities primarily in the industrial sector. Efforts began in the buildings sector and, to a lesser extent, in other sectors where program plans were developed.

From June 1986 through June 1987, only one ENERCON professional, supplemented temporarily by several ENERPLAN staff, worked with the contractor team. As a consequence the contractor performed largely on a "turnkey" basis, e.g., carrying out specific tasks as opposed to providing technical assistance to ENERCON staff. To a substantial degree the technical assistance was directed to the private sector participants in the project, e.g., the subcontractors and others.

At present, as ENERCON staffing has progressed, it appears that almost all the ENERCON staff (and long-term contractor staff) have engineering backgrounds and experience. Few staff have economic or policy analysis experience.

A PECC Executive Committee has been established and is supposed to meet monthly to provide oversight to ENERCON; however, meetings are sporadic. Private sector representation on the PECC and Advisory Committee has been minimal; a representative of the Federation of Chambers of Commerce and Industries is included. The Advisory Committee has not met yet but a private sector Chairman has been appointed.

In 1986 there was minimal public sector response to the plan to establish energy conservation cells in the Ministries. As a result the idea was dropped.

Although the December 1986 GOP resolution spells out the ENERCON role, given the long delay in appointing a Managing Director, there remains some ambiguity about its role. Clarification of the role and functions will have implications for the type of staff and organization structure needed by ENERCON.

The existing staff have taken management responsibility for only a limited part of the program activities already implemented. There is no management action or work plan for the ENERCON organization itself to guide the staff on a day-to-day and week-to-week basis. As a result, the effectiveness of the staff is reduced, and their progress in assuming management responsibility for components of the program has been slow.

b. Conclusions

Delays in staffing have set back the schedule for achieving ENERCON staff development and experience necessary to conduct a National Energy Conservation Program. With the Contractor carrying out energy conservation programs in the first year with minimal counterpart ENERCON staff, a key objective--development of ENERCON institutional capability--did not get started. Consequently, there has been inadequate involvement of ENERCON staff in the private sector industrial energy conservation program.

There is not sufficient understanding or support from the top levels of government as indicated by the limited activity of the PECC and Advisory Committee, although the Executive Committee has been quite active and instrumental in accelerating staffing and other issues. Similarly, there is no structured systematic program input and review from the major recipients of the conservation program services, e.g., private sector industrial engineers, managers and owners.

Absence of economic, financial and policy analysis capability on the staff raises questions about the long-term capability of performing required policy analysis and finance/investment promotion roles.

Although the ENERCON program has a work plan and timetable for accomplishing its objective, the ENERCON organization has no specific action plan and timetable for its assumptions of program management. As a result, if contractor support is terminated in 1990, the ENERCON program would likely suffer significantly.

There is a legitimate question as to how much of the program the projected ENERCON staff of 12 members can manage in the long term. Currently, through HBC and its subcontractors, there are 25-30 professionals, foreign and local, who have significant experience in developing, managing, and implementing program activities. Undoubtedly, selected contractor support will be needed to assist ENERCON for many years, even if ENERCON can assume management control of the program. The key questions are: which activities ENERCON should carry out and which activities should be spun-off to the private sector or contracted out on a one-time or periodic basis?

c. Recommendations

- Now that the new Managing Director is in place, a special effort should be to define ENERCON's long-term role and determine what activities can be retained in ENERCON, which should be spun off and which can be contracted out when needed. Based on interview discussions, the following long-term roles should be considered:
 - Management of training and outreach activities, some internal and some contracted out.
 - Energy conservation policy analysis, not only responses to other governmental initiatives, but pro-active policy analysis leading to energy conservation policy recommendations. An ability to work smoothly with Energy Wing is important in this role.
 - The initial phase of private sector energy conservation development work in new sectors where ENERCON has identified energy conservation improvement opportunities. The objective of these activities would be to ultimately spin-off activities in a self-sustaining manner within each sector.
- A special effort, probably using HBC or other general management contractor, should be made to develop a detailed ENERCON staff work plan that focuses on program management "modules" and lays out specific accomplishments and end-products on a weekly basis for each staff member. Part of this action plan should incorporate general management training for ENERCON staff on such fundamental activities as how to organize, how to delegate, how to effectively chair meetings, how to make summary presentations to groups, and other work

planning and productivity activities. This work should be reviewed and updated by an outside party once per month. The plan should be based on the new Managing Director's priorities, and have his complete support.

- To foster the technology transfer process, we recommend consideration be given to the physical integration of the contractor and ENERCON staffs.
- In July 1989, USAID should carry out a special evaluation of the ENERCON staff's capability to meet its long-term program management responsibilities. If the staff has been unable to perform against the management action plans developed jointly with them over the prior 12 months, serious consideration should be given to changing the institutional responsibility for the ongoing program. The Evaluation Team believes that this will be the most significant evaluation issue and decision to be made by USAID in the remaining two years of the four and one-half year program.

2. ENERCON And The Public Industries and Utilities

The role of ENERCON *vis-a-vis* the public sector entities should be considered separately for (1) the 70 public industries and (2) the public utility sector (WAPDA, KESC, SNGPL, PSO). Conservation efforts to be stimulated by ENERCON should focus on savings in the public institutions, while for public utility section, efforts should focus on end-user conservation as will be discussed below.

a. Findings - Public Industries

The 70 public industries are under the jurisdiction of the Ministry of Production. Basic industry predominates but there are also textiles, pharmaceutical, etc. Twelve companies are scheduled for divestiture to the private sector including firms involved in manufacturing textiles, chemicals, and home appliances.

The draft Seventh Five-Year Plan indicates that the public industries consume approximately half the energy in the industrial sector. In the early 1980's a GOP policy was established that there would be no further expansion of the public sector industries. Instead, effort would be focused on improving the operation of existing facilities. If this policy is followed, public industry energy consumption will consume a diminishing percentage of overall industry energy consumption as the private industrial sector expands over the next decade.

Overall planning, monitoring and evaluation of performance is carried out by the Experts Advisory Cell (EAC) within the Ministry. It consists of approximately 30 staff with primarily finance, economics and computer backgrounds. About three years ago, the EAC began to incorporate energy consumption goals (reductions) into the planning process. A profit target is established for each firm along with four input targets: (1) materials, (2) labor, (3) finance costs, and now, (4) energy. Energy targets are negotiated with each firm based on past performance, Pakistan and international energy/output standards, etc. The EAC has discussed ENERCON's provision of computers to facilitate analysis and planning of the energy targets.

Technical services are frequently provided to the industrial plants by ENAR Petrotech (ENAR), a firm under the purview of the EAC. ENAR has provided audit services to about 20 public industries as part of a World Bank loan.

The EAC views the steel, cement and fertilizer industries to be the primary energy conservation targets. With approximately 20 audits completed, only two or three remain among the primary energy consumers. Energy conservation efforts for the next year would include follow-up on eight to nine of the initial audits to determine what has happened and if the three to four year old audits remain valid. In addition, the EAC (with ENAR) will try to encourage incorporation of energy conservation into the five-year corporate planning exercise in the public industries.

The World Bank has provided a \$5 million line of credit for the public industries, \$3 million managed by the Ministry of Production and \$2 million by ENERCON. It is not clear who is managing the funds or what use has been made of them; several inquiries did not ascertain the status of the funds. Preliminary planning for the proposed World Bank Energy Sector Loan II indicates that up to \$35 million potentially could be provided for public industry energy conservation related activities.

There have been discussions between ENERCON, EAC and ENAR concerning their respective conservation role. Provision of ENAR audit data to ENERCON is to occur but has been delayed.

The USAID policy guidance on the use of the consultants provided under the EP&D Project is that they should be utilized primarily for private sector conservation activities particularly with regard to the industrial sector. However, catalytic and policy advice and assistance also may be appropriate for public entities at a low level of effort.

b. Conclusions - Public Industries

The primary vehicle for increasing public sector industry energy awareness and conservation is by setting energy targets during the planning process. At this point the process of setting such targets is inexact and it is unclear whether such a process is effective. The use of international private sector plants as models for projecting potential energy savings is useful only as a broad guideline; plant specific characteristics can substantially affect energy use which makes the establishment of realistic targets for individual plants a difficult task.

The top-down planning approach raises the basic issue of whether there are sufficient incentives in the structure of the public industry sector to stimulate energy efficiency. Although there is considerable energy use in the public industries, this alone is not justification for commitment of the limited resources available to ENERCON; what is realistically achievable, given the environment in which many of the industries operate, must be assessed.

To date there have not been many actions implementing energy conservation in the public industries. The planned assistance via audits and other technical services as anticipated by the EAC is rather modest in the year ahead although the capacity to provide services exists

in ENAR (and the private subcontractors working for ENERCON) and the resources to purchase greater services potentially could be provided from the public industries or World Bank funds.

Lacking a clear agenda or set of objectives, communication and coordination between ENERCON and the public sector industries has been somewhat lax. The lack of clarity of the objectives and role of ENERCON in the eyes of Ministry of Production personnel may create obstacles to cooperation, particularly given ENAR's technical role.

In summary, given the objective of ENERCON to establish a National Energy Conservation Program, ENERCON can play an important role in the coordination and stimulation of energy conservation activities by the public industries.

c. Recommendations - Public Industries

- The examination of the size and resources of ENERCON compared to the public industry sector indicates that ENERCON should foster energy conservation through the coordination and stimulation of the resources available to the public industries. In addition, the current and potentially future availability of World Bank assistance to the sector suggests that the current allocation of effort should be maintained. We recommend that the USAID technical assistance remain focused primarily on private industry, while other donors support the public-sector as appropriate.
- ENERCON staff should continue discussions with the EAC and explore the establishment of an informal working group involving the EAC, ENERCON and ENAR. We recommend that ENERCON's role include coordination and advisory functions on such issues as promotion and outreach techniques and programs, training programs and performance monitoring for energy conservation results. Such activities should be encouraged, developed and carried out by the Ministry of Production (EAC, ENAR or industry groups themselves) rather than by ENERCON.
- ENERCON should try to stimulate greater commitment for energy conservation in the public industry sector through the PECC, and we recommend that ENERCON install a well-respected senior industry executive on the PECC to bring special expertise to the Committee.

To as great an extent as possible, ENERCON staff should execute a coordination and advisory function drawing upon the experience developed to date through the private sector industrial energy conservation program (without detracting from the overall focus on the private sector). Consultant resources redirected to provide technical assistance support for the public industries quite likely would dilute the effort to establish a sound foundation among the private industries. Training programs have accepted and should continue to accept public sector personnel.

- We recommend ENERCON discuss with EAC staff economists and financial experts the analysis of the overall framework within which public industries

consider energy conservation investments including tax, tariff, credit, pricing, planning and other factors that create or reduce incentives to undertake energy conservation investments. These discussions should explore the interest of the EAC in focusing on the industries targeted for divestiture if it appears that such incremental conservation assistance would enhance the possibility of achieving the GOP goals.

- Some facilities (e.g., refineries, steel plants) could benefit from the materials and approaches developed for the private sector. The ENERCON contractors could be encouraged to approach designated high-impact public facilities to sell their services for a market or near-market fee.

d. Findings - Public Utilities

WAPDA has undertaken several internal measures to improve the energy efficiency of its operations. Among the activities is an \$80 million thermal rehabilitation program aimed at upgrading the operation of the thermal power plants they operate. This was undertaken as part of a multi-donor effort led by the World Bank and spurred, to a large degree, by the USAID EP&D Project-sponsored \$500,000 feasibility study undertaken by Stone and Webster in 1985. In addition, USAID works with WAPDA to reduce its distribution line losses through the Rural Electrification Project.

WAPDA's effort to initiate energy conservation programs directed at customers appears considerably less developed with marginal resources dedicated to the effort. USAID has supported such WAPDA efforts under the Rural Electrification Project including analysis of industrial and commercial end use and training of five WAPDA staff through the Sister Utility Program (with American Electric Power) in utility end user conservation programs.

WAPDA has not yet formalized its energy conservation capabilities as anticipated. However, we anticipate it in a Division with three components: Theft Reduction, Outreach, and Conservation.

It is no secret that relations between private industry and WAPDA are strained. Electricity theft combined with the unreliable provision and the rising cost of power provided by WAPDA does not create an environment conducive to cooperation.

The Pakistan State Oil Company and Sui Northern Gas Pipeline actively stress conservation in newspaper advertisements and have agreed orally with their Federal Secretary to cooperate on an outreach energy conservation program.

e. Conclusions - Public Utilities

There does not appear to be a substantial commitment by WAPDA senior management to support end use conservation efforts at this point as indicated by the lack of creation of an energy conservation cell and limited assignment of staff and resources.

There is inherent conflict in the provision of conservation services directly to industrial facilities given the relations that exist; still there are clearly roles that WAPDA can play to facilitate conservation.

f. Recommendations - Public Utilities

- We recommend ENERCON's role *vis-a-vis* the public utilities be primarily advisory. ENERCON should facilitate the development of outreach, promotion and training programs by and within these organizations. A primary ENERCON objective should be to stimulate the public utilities to initiate and finance conservation efforts--not to carry out the actual work given the limited ENERCON staff resources and the much larger resources available to such organizations as WAPDA, SNGPL, PSO etc. For example, ENERCON and its consultants should try to foster within the public utilities the interest and capability to design and distribute energy conservation materials and to develop energy awareness campaigns for the public. ENERCON can foster the same model it is developing--small talented utilities staff using, to the extent possible, private sector capabilities in audits, publicity, and training. ENERCON's role must be carefully defined and consideration given to the impact of a perceived close ENERCON/WAPDA collaboration on ENERCON's good and growing relationship with the private industrial sector.
- We recommend that ENERCON explore the establishment of a Utilities Energy Conservation Group (including organizations such as WAPDA, KESC, SNGPL, PSO, etc.) to promote and coordinate the initiation of energy conservation efforts by these major organizations and aimed at end users (their customers). Through such a Group, ENERCON could stimulate the use of the private subcontractors currently carrying out ENERCON work.
- We recommend that ENERCON explore, with private industry and WAPDA, off-peak pricing experiments.

3. ENERCON and The Private Sector

a. Findings - Industrial Associations

There are three major types of private organizations ENERCON can work with and through: 1) Chambers of Commerce and Industry (e.g., Lahore, Karachi, etc.); 2) trade associations (e.g., textile, steel, sugar, etc.); and, 3) industrial estate associations, e.g., Sind Industrial Trade Estate (SITE) Association.

Industrial associations vary considerably in size and staff resources. The Lahore Chamber, for example, has 5,000 members, approximately one-quarter of whom represent industry, and a research staff of 11, several of whom hold advanced business administration degrees. Most of the associations address commercial issues of concern to their members; a few other services are provided such as seminars or technical training. These organizations are aware of the impact of energy costs, power and gas load-shedding and the need for expanded energy conservation.

To date, the ENERCON program has established a good image with associations; it has used associations' mailing lists, received support for training and promotion, etc. ENERCON is exploring an intensive program with the All Pakistan Textile Mills Association. Other Associations are showing considerable interest in expanding collaboration with ENERCON.

b. Conclusions - Industrial Associations

A good base for expanded collaboration between ENERCON and Associations exists, due to the focus on the private industry sector through the provision of audits, training and promotion materials. Potentially the associations provide a vehicle for expanding the impact of the industrial conservation effort, for establishing a long-term commitment to conservation within industry, and for developing a constituency for ENERCON.

c. Recommendations - Industrial Associations

- We recommend the ENERCON Industrial Energy Conservation program include, as a major strategy component, expanded institution building in the industrial organizations by building upon their past achievements and present reputation. A strategy should be developed in cooperation with the associations that supports the associations in their efforts to 1) stimulate energy conservation among their members, 2) develop energy conservation policy analysis capabilities, and 3) establish or expand their ability to provide or facilitate energy conservation technical assistance, training, promotion and/or demonstrations, as appropriate.

To implement the strategy, the development of a two-year program in collaboration with four or five industry organization should be given strong consideration. The objective would be to fund the appointment of a full time conservation staff person to develop a conservation program tailored to the needs of the organization and its industrial members, and to expand the reach and impact of the ENERCON program by fostering commitment and long-term support for energy conservation in industry. Such a program should initially include at least one organization from each of the three groups: a Chamber, trade association and industrial estate association.

For example, ENERCON could fund 75% of the cost of an energy conservation engineer on the staffs of the Lahore Chamber of Commerce and Industry and the SITE Association of Karachi immediately, with a commitment of one year. If, after six months of activity, this proves to be a worthwhile use of ENERCON's resources, the commitment should be extended for one additional year. Similar staff members should be supported in other private sector associations.

- To complement and expand ENERCON's current activities that cut across many industries, we recommend an effort be undertaken that focuses along industry lines to:

- provide in-depth technical and audit assistance for the specific industry subsector (such as textiles where ENERCON has initiated discussions), and,
- broaden the TEM approach within the subsector to examine process and management efficiency as well as technology energy efficiency.

d. Findings - Subcontractors

The use of private subcontractors to carry out the audit function has resulted in four of the five private subcontractors trained to perform energy conservation services (DAHEG, Zelin, Technoconsult, and Intrag). Feedback is positive from recipients of the services offered. Additional private sector capability is being developed through the extensive involvement of the HBC Pakistani staff.

Despite the development of this capability, there is not a clear strategy for market development and eventual commercialization of services. There is a school of thought that the detailed energy surveys are too expensive and won't be commercial which may be part of the rationale for their decreased emphasis. There is, however, evidence of some industry willingness to pay for audits based on limited past experience (before free audit services became available from ENERCON).

The subcontractors have received mixed signals about the acceptability of marketing their services while performing ENERCON audit services. There are indications that the subcontractors were told not to advise the clients of their capabilities or try to stimulate follow-on business to the Detailed Energy Surveys that they were conducting. A possible indication of this ambivalence is the minor display given to the name of the subcontractor on the final ENERCON report prepared for the firm. In some cases industrial plant engineers and managers did not have a clear image or recollection of the firms that did the energy audits. At this point, there is excessive dependence on ENERCON-sponsored work by the subcontractors.

The focus of the program has shifted from doing Preliminary Energy Surveys, Detailed Energy Surveys and Feasibility Studies to short-term (one day), immediate results activities such as the Boiler/Furnace Tuneup (BFT) program which is targeted at 600 firms.

e. Conclusions - Subcontractors

A significant private sector energy services capability has been established in some firms and enhanced in others. Longer-term effectiveness of the firms to perform and provide energy services is being retarded by constraints on their self-marketing while doing ENERCON audits.

It is premature to conclude that DES's are not or cannot become marketable at commercial rates for some segments of industry, perhaps large companies. Fragmentary evidence indicates some willingness to pay for these surveys.

f. Recommendations - Subcontractors

- We recommend that ENERCON develop, in collaboration with subcontractors and industrial clients, a clear strategy for reaching commercial marketability of all energy audit services. This could include a well-advertised, staged audit fee increases over a 30 month period.
- To facilitate commercialization of services, training on communications/presentation methods should be provided to the subcontractors and conservation equipment firms to increase the firms' ability to market their energy services.
- In addition, clear guidelines should be provided to the subcontractors that encourage them to solicit energy conservation follow-on work on a commercial basis. This is particularly true for the boiler/furnace tuneup program. The name of the subcontractor performing the service should be prominently displayed on the front cover of the report to enhance the subcontractors' visibility.
- To enhance commercial competitiveness, ENERCON should consider occasional competitive bidding among the subcontractors for some future pieces of ENERCON work.
- ENERCON should insure that requirements for ENERCON staff to travel with local contractors on certain visits do not constrain the progress of the contractor. In general, the local contractors should be given the freedom to carry out their job efficiently. The contractors should keep ENERCON informed about visits and ENERCON staff should have the option of attending.
- HBC should hold joint local contractor meetings at least every six months to ensure communication about the ENERCON program and permit the very valuable interaction among local contractors and with HBC and ENERCON staff that such meetings provide.

g. Findings - Industrial Plant Personnel

Many training activities, e.g., audit training, boiler maintenance, have been undertaken that attracted significant numbers of industrial plant engineers. Some training has occurred on-site at cooperating industrial plants that have been open to all participants. There is also some interest in in-plant seminars and training for employees of a single company.

During the performance of energy audits, The Total Energy Management (TEM) approach tries to involve the plant engineer and stresses the appointment of a person responsible for plant energy management; this is occurring to some extent. A Pakistan Energy Engineers and Managers Association is being proposed to facilitate the establishment of the concept of an energy manager,

While there has been substantial technical training, less attention is being given to plant owners and investment decision makers in seminar/training effort.

h. Conclusions - Industrial Plant Personnel

A significant number of technical people have been trained who have day-to-day operational responsibilities directly affecting energy use; conservation awareness has been expanded considerably.

i. Recommendations - Industrial Plant Personnel

- We recommend an assessment be made of the need for conservation training of non-technical, decision-making personnel through workshops and seminars.
- We recommend deferring establishment of a Pakistan Energy Managers Association and, instead, recommend exploring whether the functions of such an organization could be carried out by the Pakistan Engineering Council or Institute of Engineers or other suitable organization with a national scope. To establish such a function within an organization already well-accepted in Pakistan industry may be a better way to generate the professional, technical impact intended by a Pakistan Energy Managers Association.
- We recommend maintaining, to the extent possible, (despite the more difficult logistics) training presentations in the industrial plant facilities.

4. Energy Conservation Planning/Legislation/Special Studies

Initially the focus of this element was on preparation of information and analysis to feed into the Seventh Five-Year Plan preparation. Attention has turned now to the discussion of the development of draft legislation to establish ENERCON in law. Lesser attention has been paid to Special Studies given the emphasis on the initiation of conservation services to achieve tangible results and publicity.

a. Findings

The analysis prepared on energy conservation opportunities and issues for the development of the Seventh Five-Year Plan required several revisions due to the changing macro-economic assumptions that emerged as the Plan was developed. With the completion of the Five-Year Plan work, it is expected that minimal effort will be expended on the preparation of the conservation input to the Annual Plan.

In addition to the macro-plans, a detailed Workplan was prepared for the overall program of contractor activity, transportation and agriculture programs and a draft multi-year plan for industrial programs.

A draft National Energy Conservation and Management Law has been prepared, revised and reviewed by the PECC and again by the PECC Executive Committee. The law would expand the role and authority of ENERCON through the inclusion of regulatory authority in some manner and would establish ENERCON in law as a permanent body.

Only a few special studies have been undertaken. This is probably a reflection of the initial program focus on high profile implementation activities. (NOTE: The Special Studies Program does not include audits, feasibility studies or program plans.) A draft multi-year plan was prepared and discussed in December 1987, nearly two years into the Project activity. A meeting of ENERCON and contractor staff was held to review Special Studies Options and develop priorities for analysis. Review of the draft list of special studies indicates 13 would be undertaken in industry, 12 in buildings, five in agriculture, three in transportation, four in equipment, and one policy study which is cross sectoral. Almost all of the proposed studies are technical in character, e.g., evaluation of reflective coatings, costs of ghee versus non-hydrogenated oil, boiler heat recovery, steel mill upgrading, etc.

Some initial work has been done that has policy elements and begins to examine the obstacles to energy conservation investments in industry (a finance and impediments study and several investment case studies). Despite this work, there is no sound analytical basis that defines the investment decision making behavior, incentives and disincentives in any of the sectors--industry, buildings, agriculture or transportation--although there is no shortage of opinions and observations on why energy conservation investments are and are not made.

The Federation of Pakistan Chambers of Commerce and Industry participates in approximately 40 consultative bodies. By law, all private sector associations in Pakistan must be represented in the Federation. Many of the advisory councils have a scope of responsibility important to energy conservation--e.g., standards, import policies, indigenous technology, income tax, locally manufactured machinery, and conservation. Beyond the Federation, there are several well-organized and influential associations or chambers. Two of the more significant are the Lahore Chamber of Industry and Commerce and SITE Association of Karachi. These associations have staff who can help in a number of ways, e.g., distribution of information, introductions, seminar facilities, energy surveys, governmental interaction, special policy analyses.

Progress in energy conservation planning and the development of key policies needed to stimulate energy conservation are closely related to the establishment of the governmental institutions. Despite the lack of progress in governmental institutional development, some activity has taken place in the planning and policy area, largely accomplished by Hagler, Bailly and Company and its contractors. An achievement of major potential importance is the development of a coherent five-year energy conservation plan for the Seventh Five-Year Plan.

Initial development of draft building codes, equipment standards, and estimates of conservation potential in agricultural, buildings, and transportation sectors have been undertaken. As discussed earlier, a capability to assure that these codes, standards, and other governmental actions are implemented is essential to achieving any value from these efforts.

Significantly, energy pricing actions have not been part of the ENERCON planning and policy analyses. Technically, these actions are within the scope of the Energy Conservation Program, but have not received any direct efforts. However, steady increases in prices to achieve cost-based electric power and fuel prices is as essential to future energy conservation as any single factor.

b. Conclusions

There has been significant and useful input into the Seventh Five-Year Plan process which contributed to the accomplishment of a GOP commitment to energy conservation. Although the substantial report was reduced to two or three pages in the Draft Seventh Plan, the document provides a good source of information for developing and defending conservation program planning and for promoting greater awareness of the need for and potential of energy conservation.

There are significant issues embedded in the draft legislation that will affect the role of ENERCON and its relationship to industry, e.g., the role of regulation and enforcement. It is not clear that there has been sufficiently wide review of the proposed law by affected parties (private industry, the buildings community, etc.)

The Special Studies component does not give sufficient attention and priority to the need for policy analysis and the analysis necessary to expand the understanding of investment decision-making behavior in the target groups--private industry and the buildings industry.

c. Recommendations

The proper long-term role of ENERCON should be defined and agreed upon. Further, agreement should be reached on the content of the draft law that will define the role and authority of ENERCON. Greater input from affected parties should be sought as part of the preparation of the draft legislation.

- As part of the Special Studies effort, we recommend ENERCON and the contractor develop a policy analysis agenda (including discussion of staffing requirements to carry out the analytical work in the short and long term). At a minimum, the objectives of the analytical work should be to:
 - Develop a good understanding of the investment decision-making process and factors influencing it in the industrial, buildings, agricultural and transportation sector (e.g., plant owners and managers in the industrial sector, building architects, contractors, financiers, developers and owners in the buildings sector, farmers utilizing pumping systems, and private taxi, bus, and truck owners).
 - Analyze the factors that influence investor decisions, e.g., electricity, oil and gas tariff levels and structure, import tariff and taxes, traditional, social or other behavior patterns.

Without a sound understanding of the environment in which the decisions are being made, the risk exists that the program designed to

encourage conservation (pricing, promotion, training, audit services, development of standards, etc.) may not address the key factors that either impede or accelerate energy conservation by the decision-makers.

- We recommend ENERCON identify how the activities of each of the 40 consultative private sector bodies can incorporate specific energy conservation policies or regulatory actions. Collectively, over time, these bodies could markedly influence the national energy conservation progress, including the public sector.

5. Data Base Development and Management

ENERCON's database effort has taken two forms: 1) the development of energy conservation databases, used primarily for planning purposes; and 2) project monitoring databases, used in support of ENERCON's activities.

a. The Planning Databases

The planning databases were intended to cover four sectors--industry, transportation, buildings and equipment with a fifth (agriculture) expected to be added later. At project inception, the contractor gave high priority to developing the databases because the data were needed to make estimates of possible gains from energy conservation investment in the Seventh Five-Year Plan. After completion of the Seventh Plan, the database work received a much lower priority. Over the past six months, database work has come to a near standstill.

Database design was done by HBC, while the actual code and documentation was done by subcontractors. All of the databases are written in dBASE III+, and run on a PC in the HBC office. The original software documentation is superb. It includes complete source code, program flow charts, and definitions of all tables and variables used in the program. All of the databases have very good menu-driven data entry routines, but no reporting routines. Consequently, to prepare a report, an analyst must make the necessary queries in the dBASE III query language.

The data in ENERCON's databases are collected as an adjunct to other ENERCON activities. There have been no pure data collection efforts. This is intended by the Project Paper, and we think that it is a sensible decision.

The Industry Database is designed to absorb data collected in the course of ENERCON's detailed energy surveys. To date, ENERCON has done 43 such surveys, and data for these 43 plants has been entered in the database. However, the Federal Bureau of Statistic's manufacturing census indicates that there are about 5000 plants in Pakistan, of which about half are of sufficient size to be of interest. The 43 plants surveyed by ENERCON are by no means a representative sample of this population, so it is hazardous to draw inferences from these data.

The database makes provision for collection of monthly energy consumption data for each plant, but these data will not be entered in the database unless the industries concerned are regularly contacted, and this has not occurred.

Collection of future data depends on ENERCON's energy survey program. Limited data about boilers will continue to be obtained from ENERCON's boiler tune-up program. About 60 boiler tune-ups have been done, and information from this exercise entered in the database.

The World Bank has funded an industrial energy survey as part of one of its electricity sector loans through the Ministry of Industry. (USAID was instrumental in getting this started in the formative stages in 1985-86.) ENERCON is attempting to ensure it can obtain access to these data, and that they are compatible with the ENERCON database. Hopefully, this will add another fifty plants to the industry database.

The Ministry of Production has just started providing to ENERCON data on public sector plants.

The Power Database comprises two sections:

- A list of power generation stations in Pakistan, compiled from available information and the Stone and Webster survey;
- A list of power transmission and distribution lines down to the feeder level. The transmission line database is empty, as WAPDA has never provided any detailed data.

The power database is not being used at present as it contains only information readily available from standard reference sources.

The Buildings Database contains detailed data on some 60 buildings in Karachi and Lahore representing diverse types of buildings, from five-star hotels to single family dwellings. The dataset is designed for compatibility with a set of U.S. Department of Energy building simulation models that allow ENERCON to model the results of various energy conservation investments.

Further data collection on the building database depends on ENERCON's future activities in building surveys. However, given the enormous number and diversity of structures in Pakistan, this database should not be expanded beyond representative types.

The Transport Database is divided into four subsectors: air, road, rail and sea. There are no data in any of the sectors, and this database is not in use.

b. The Operational/Project Monitoring Databases

In recent months, ENERCON has developed a series of operational/monitoring databases that serve as reminders and provide status reports on such activities as the boiler tune-up program. This update is a desirable exercise, a good management tool, and a good use of computer resources, but not of major programmatic importance.

c. Findings

There are approximately 43 records in the industry database, 60 records in the buildings database, no records in the transport database, and records for power stations only in the power database. The samples are too small and insufficiently representative to make inferences about the population from which they are drawn.

The databases developed during the early part of the program were used to produce estimates of the gains from conservation and are being used, in a limited way, to track the benefits of conservation. However, for the most part the databases are not in current use by anyone.

The high priority given to database work at the beginning of the Project is probably due to an initial overly optimistic estimate of the importance of the database by the Project designers. The lower current priority probably reflects a more realistic appraisal of the importance of this work. A collection of data on energy consumption in Pakistan has proved most useful in "selling" decision-makers on the benefits of energy consumption, but is much less important to ENERCON.

The software development of the databases was professionally done and the quality of the documentation is excellent. However, no mechanism for easily extracting data from the reports has been developed.

ENERCON participation in database work is nil. No civil servant has any expertise in the databases. One HBC Pakistani contract employee is knowledgeable about the databases.

d. Recommendations

- We recommend ENERCON examine the database program in the light of actual data requirements. If more data are required, they should be obtained through contracts for surveys.

As an alternative, ENERCON should consider using data available from other GOP agencies. Two examples will suffice:

- The Federal Bureau of Statistics (FBS) annually surveys some 4000 industrial units, mostly by mail. The results are published, with a five-year lag, in the Census of Manufacturing. However, the raw survey data can be obtained from FBS (in machine readable form) with about a one-year lag. By using prior years' surveys, consumption time series can be constructed for each plant.
- Public sector output and energy consumption data at the individual company level can be obtained from the Annual Report of the Public Sector Industries, prepared by the Ministry of Production's Experts Advisory Cell. These data could be incorporated in the ENERCON database.

- If ENERCON's review of the database program shows that it has utility, then ENERCON should make efforts to develop the reporting functions of the databases, and to train ENERCON staff on their use.

6. Technical Support

a. Findings

The major activity undertaken by the Project to date has been the development of technical energy audit capability and the delivery of the energy audit services to the private industrial community. As shown in the tables below the Project has provided significant technical services through the subcontractors and main contractor. To accomplish this a Total Energy Management (TEM) approach was initiated. It involves identifying prime audit targets, performing preliminary energy surveys (PES), detail energy surveys (DES), feasibility studies, follow-up visits and demonstrations, all of which is designed to foster implementation of and investment in energy conservation measures.

SUMMARY OF INDUSTRIAL CONSERVATION ACTIVITIES

Category	Jan. 86-June 87 Completed	Jan. 86-June 88 Completed	Project Goal
PES	57	80	100
DES	24	42	70
Feasibility	6	8	22
Follow-up	-	20	70
Demonstration	-	-	8

Having completed over half the Project goal of 70 DES by April, 1988, a major revision was made in the technical services strategy. Instead of the extensive detailed audits, a program of short-term interventions targeted at high-savings opportunities was developed. Based on the results of the DES, it was possible to identify those points in the industrial processes that held the best promise of accomplishing immediate savings. The initial effort focuses on the provision of a free one-day Boiler/Furnace Tune-up (BFT) service that provides immediate savings. About 60 have been completed to date with another 600 planned.

The monitoring reports and industry interviews indicate a period of four to six months has generally been taken to present the findings of the in-plant audit work to the firm.

Based on follow-up visits and reporting, estimated energy savings through April 1988 were:

ESTIMATED ENERGY SAVINGS

	Identified Rs.	Implemented (Est.) Rs.
DES	117,331,000	31,958,000
Feasibility Study	45,300,000	0
BFT	6,335,000	6,335,000
Total	168,969,000	38,293,000

The shift to the short-term high savings strategy meant less follow-through on the preparation of feasibility studies. Only 13 out of planned 20 were initiated by mid-1987. Until industries that have feasibility studies approach financing institutions, it may be premature to conclude whether the studies constitute "bankable proposals". However, the capability of many plants to self-finance capital investments may provide an opportunity to monitor the effectiveness of some studies.

b. Conclusions

The provision of technical services is reasonably on target and the progress made and potential for further private sector actions can result in a ten percent improvement in energy efficiency in the industrial sector in Pakistan (an initial program objective). It may be achieved even without the major equipment investments that can have significant impacts, but this is a judgment that requires more analysis to be confirmed.

It is premature to conclude that the TEM approach including the Detailed Energy Survey (DES) is not relevant or productive. The underlying reasons why capital investments are not forthcoming remain unclear: the initial contractor analysis is a good start at understanding the investment behavior. The total cost of the TEM approach may mean it is relevant to firms above a certain size; the lack of energy conservation capital investments may be due to the sequencing of industrial investment decisions--low-cost investments first (up to Rs. 100,000), observation of results, and then consideration of higher capital cost options. Because firms are still considering the capital investment options, it is premature to make benefit/cost judgments about the DES at this point.

Too much time is taken to prepare and present final audit reports, resulting in less than optimal follow-up, decision-making and implementation by plant management.

Overall, it does not appear, thus far, that a market oriented approach has been adequately created in the local contractors and the companies receiving the ENERCON services, mainly because no fee for the services has been required. Ultimately, the willingness of the private sector to pay an adequate fee for outside services, and the ability of energy conservation service firms to provide these services in an efficient, cost-effective manner, will determine

to a large degree how successful the ENERCON program will be. A good test over time will be whether ENERCON is able to phase out its services to various sectors and have the private sector sustain itself.

c. Recommendations

- For larger companies (energy bills of more than 10M Rs./year), a detailed energy survey is recommended, with a requirement that the company pay some portion (initially 25-50%) of a market fee for such services. Even for the "smaller" areas of a large plant, the energy savings may be more significant than the main areas of small plants. A wholesale termination of detailed energy surveys does not make sense in light of the variation in the energy-user universe in Pakistan. The DES work, resumed at a low level, also should have the objectives of reducing the audit costs, moving them toward commercial sustainability, and gathering information on industrial energy use and investment decision-making.
- The Total Energy Management approach should be continued in a modified form. A brief or preliminary energy-use analysis is worthwhile for any company, even though the new focus on conducting boiler tune-ups and achieving near-term results is appropriate.
- The Evaluation Team strongly endorses the audit follow-up implementation program recently emphasized by USAID and ENERCON. Not only will this identify the practical factors involved in long-term implementation and keep the ENERCON program oriented on the "real world," but it also differentiates the ENERCON program from programs in other developing countries where the resources provided have generally not covered follow-up support activities. The follow-up activities may show, for plants that are short on cash, that financing constraints (including the administrative process) will prove to be a barrier worth addressing in the program.
- ENERCON should identify the need for advanced, process-specific audits and related courses for more sophisticated (Phase 2) conservation efforts in plants that have moved successfully through earlier implementation plans. These courses may require that engineers attending earlier audit courses be returned for further training. An example of such an area could be sophisticated boiler controls and automation.
- ENERCON should stimulate installation of energy-use measurement equipment in as many industrial plants as possible where measurement gaps exist. A contingency payment program similar to the combustion analyzer program would be an excellent approach. Plants that can measure energy use properly will save more. Further, plants that could not do a good audit previously will be ripe for a preliminary (or detailed) audit once such measurement equipment is in place. A good example of the need for an energy-use measurement before implementation can occur is the Shabbir Tiles demonstration project, which involved a later inclusion of a gas flow meter along with its heat recovery equipment. If provision of the equipment under

subsidy poses a legal problem with USAID, a "package" could be sold to the plant where the energy-use measurement equipment and a preliminary audit is provided for a single sum. The total cost for this package could equal, at least, the full cost of the equipment, and it would not matter to the plant manager whether he was getting equipment free and paying for the audit or vice versa.

In light of comments by at least one company that the equipment cost estimates from the cost directory proved to be low, a quick check should be made of the numbers (or the guidelines for their use) to assure they are helpful and not misleading to all the users who now have these directories.

- A strategy for commercialization of the technical services should be developed so that services eventually are provided by the private firms at market rates. For example, ENERCON should start charging users a fee for all future audits and focused services, starting at 25-35% of the market rate. This rate should be increased over the next two years to at least 75% of the market rate. Once this is accomplished, ENERCON should begin a phasedown and/or spinoff of program services. This action must be coordinated with the institutional development action of helping local contractors market their services and become free-market-dependent.
- ENERCON should consider a small charge (perhaps 1,000 Rs.) for each of the roughly 100 companies who have responded but not yet received boiler tune-up services. This would initiate the process of putting the service on a self-sustaining basis provided by the private subcontractors.

7. Training and Curriculum Development

a. Findings

A substantial training effort has been designed and implemented. One hundred and twenty-seven people were trained in energy audits and, more recently, technical workshops have been developed for over 1400 predominantly private sector individuals. Future short courses planned include Electrical System Efficiency, Waste Heat Recovery, Cogeneration and Air-Conditioning. Most training has been technical in character; little has been done on investment decision-making or with the finance community. There is industry interest in more industry-specific training (e.g., sugar, steel, textiles); ENERCON is exploring a direct, broader process modernization approach with the textile industry. In addition to the directly sponsored training, efforts are being made to incorporate Energy Conservation into the university engineering curriculum.

After giving several free conferences, ENERCON has successfully initiated a charge for some courses of approximately 200 Rs. per attendee. For the sake of illustration, if it is reasonable to assume a cost of Rs. 8,000 - 10,000 to put on a workshop for 30 (Rs. 4,000 - 5,000 for consultant instructors, Rs. 100/person for food and facility, and Rs. 1200 for course manuals), a break-even point which would allow the workshop to be done entirely by a private sector firm at or above Rs. 300/person. Despite this movement toward putting

the courses on a paying basis, there is no long-term strategy for how the courses will be continued on a self-sustaining basis, i.e. taken over and sponsored by private entities.

It is important to note that the private engineering subcontractors have given the seminars in many cases--particularly in the technical short courses (Boiler Maintenance and Operation, Steam Systems, Instrumentation). Also, the training program has been conducted with an industry association or professional engineering organizations and many of the technical courses have been given in industrial plant facilities. Both are indicators of the industrial community receptivity to the ENERCON program.

The Training/Outreach Long Term Advisor intends to depart in September, 18 months in advance of his four year commitment. There is a serious need for a plan to continue the technical assistance and for the incremental expansion of ENERCON staff in the training, development and implementation activities leading to eventual full takeover of the functions now carried out by the contractor.

b. Conclusions

Training has played a significant role in establishing a positive image of ENERCON in private industry. It is a high value activity as indicated by the attendance and willingness to pay. A lot of training has occurred; it is time for ENERCON to undertake an evaluation of the training effectiveness.

The financial sector, essentially a non-participant to date, can play an important role in stimulating energy conservation.

It is necessary to define ENERCON's long-term role in training and to develop a strategy aimed at sustaining the on-going development and presentation of workshops.

c. Recommendations

- The Team recommends commercialization and spin-off of the short-term training courses. A possible strategic approach would be for ENERCON to serve a catalytic role as developer and initiator of workshops and courses with the objective of spinning them off to private entities when a market has been established (e.g., sub-contractors or others). ENERCON should experiment with fee schedules and test spinning off one of the short workshops to a private sector subcontractor to execute on its own for profit.

As part of the private sector institutional development, the subcontractors involved in presenting the workshops should be given more exposure and credit in the promotion and presentation of the workshops; approaches might include greater prominence in the workshop promotion literature, discussion or distribution of subcontractor capability statements or brochures at the workshops.

- Prepare for the intended departure of the Long Term Advisor as soon as possible so that there will be contractor and ENERCON continuity after his departure.

- Maximize the use of industry associations (e.g., SITE) to host training courses and seminars. This will gain the attention of association companies and serve to obtain public commitment of the association executives who are opinion-leaders in Pakistan industry.
- Involve WAPDA, KESC, the state oil company, and gas companies in ENERCON seminars on electric power and other fuel-saving matters. KESC has stated to SITE officials that it would even pay for seminars relating to electric power load-management and conservation.
- A special effort should be made to develop electric power cost-reduction audit courses and seminars. We understand such programs are being planned. Their implementation should be accelerated as this effort is a major government priority.
- Because energy use measurement and reporting is the cornerstone of a good audit and implementation, ENERCON should initiate a seminar on measurement instruments and techniques. These seminars might be along industry lines, since measurement of energy-use within components of an industrial process is difficult, yet key to energy conservation success in many plants.
- For public support and demographic reasons, the home energy seminar effort should be continued; a follow-up program should be explored, possibly as part of the buildings component.
- ENERCON should prepare and initiate financing seminars for banking and financial institution managers that focus on the nature of energy conservation investment requirements and identify procedures by which loans at various levels can be applied for and obtained in an administratively smooth manner. Mainly, this seminar should sensitize the financial institutions to the need for activity to pursue energy conservation loans. The training program should target top executives, loan officers and technical staff. The program should be developed in collaboration with a representative bankers group.
- ENERCON should initiate periodic seminars for top company management only to focus on the financial results of energy conservation, and communicate (perhaps through participation by high government officials) the high priority given to energy conservation. These seminars probably should be carried out through the Chambers of Commerce and Industry or other powerful associations, with the backing of the association executives who would lead off and close the seminars.
- Given that implementation of cogeneration feasibility studies is proceeding slowly, this subject area should be included in a owner and top management seminar for industry. Attendance at this seminar by top officials of the Ministry of Water and Power or WAPDA/KESC might be useful.

8. Outreach and Information

a. Findings

Public awareness of energy conservation comes about through promotion/education efforts, training and in-plant audit-related activities. Based on interviews with industrialists, it was evident that there was a growing awareness of energy conservation and of the ENERCON activities. ENERCON "Conserve Energy" signs were evident in various plant locations. Senior management and plant engineers receive, read and circulate the Newsletter. There was no indication of their awareness of other sources of information (e.g., radio, newspapers or TV). Most training has been technical training aimed at plant engineers.

Over three hundred requests have been received predominantly from private sector individuals and organizations in the last five months for materials or assistance from ENERCON. The documents, roughly priced at cost of production, have resulted in sales of over Rs. 20,000--a good indicator of the utility of the documents and the growing awareness of ENERCON's presence and activities.

b. Conclusions

The Newsletter is very well received and reaches an audience considerably larger than its circulation. It reaches broad and diverse industry audiences (ghee, paperboard, steel plants, and academics.).

c. Recommendations

- Expand and refine the Newsletter circulation; expand its technical content; consider targeted biannual papers for industrial subsectors at some point in the future for key target industries (e.g., paper, steel, bulbs, etc.). Target some awareness effort at plant owners through seminars, training or targeted special mailings. Expand the amount of information provided in Urdu since the majority of plant operating personnel do not read English.

ENERCON should expand the use of the newsletter in soliciting ideas and special responses from energy users. Publicize selected, but simple energy use or conservation results surveys.

ENERCON should "advertise" more prominently its reports and information pamphlets for sale in each edition of the newsletter. Companies are now paying for copies of such information, and this practice should continue.

- Similar to the recommended action for training, ENERCON should use industry associations for outreach and information dissemination. There was very strong commitment by the Lahore Chamber of Commerce and Industry and the SITE Association of Karachi to provide such support.

- A strategy has been prepared for a National Energy Conservation Awareness Campaign. The need for this was supported many times in the interviews carried out by the Evaluation Team (e.g., SITE Association of Karachi). This complex program will need forceful and sustained management during implementation. The Evaluation Team recommends that a competent manager within ENERCON be assigned this program from the start, and that it be a good test of ENERCON's capability to carry out what should be one of its major long-term roles.
- ENERCON should approach the Ministry of Information and Broadcasting to provide free television and newspaper advertising for the National Energy Conservation Awareness Campaign. If any fee is required, it should be low, given the national priorities for energy conservation. Such advertising could make a significant impact on the public. The ENERCON managing director should approach WAPDA and KESC to get them to pay for some television advertising on electric power conservation. KESC told the SITE Association of Karachi that it would be willing to pay for some TV advertising.
- ENERCON should encourage and sponsor, as necessary, industry technical meetings on energy conservation. These would be similar to an energy conservation conference, but organized along industry lines, so that the technical content would be of relevance to all attendees of any particular meeting.
- Some part of the outreach and information services function should provide a ready information source of private engineers and vendors who can provide energy conservation services. This source should strive to identify every possible firm in Pakistan that can address areas of energy conservation (e.g., electric power efficiency specialists). This might be coordinated through the professional associations.
- SITE Association has requested one set of ENERCON's complete training and information materials. ENERCON should send these to SITE as soon as possible. Further, ENERCON should consider sending such a set to other major industry and commercial organizations. The libraries of these organizations should have a complete reference set of ENERCON materials.

9. Investment Promotion

a. Findings

The initial component goals were to complete 20 bankable feasibility studies of private industrial plants and implement eight industrial energy conservation demonstration projects in the first 18 months of the program. In addition, feasibility studies for four cogeneration projects in selected industrial plants were to be completed, and then implemented and evaluated in the remaining three years of the program.

Limited resources (compared to plan) were applied to this area. Because companies for whom detailed energy surveys had been completed were mostly considered for feasibility studies, the number of worthwhile equipment investment opportunities identified were limited, and 20 worthwhile feasibility studies could not be accomplished. To date, eight have been completed, and two more are in progress. Further progress by the companies in pursuing the feasibility studies has been limited, in some cases because of short-term priorities, and in some cases by an outside financing requirement and process that requires sustained management time.

The overall goal is to implement eight demonstration projects out of the 20 feasibility studies to be done. This goal still remains, but is behind schedule. The resources required to make these projects happen have not been adequate. In particular, the foreign subcontractors are essential to this work, and their level of activity has been less than 1/2 of the budgeted activity through April 1988. Linked to this more limited use of resources has been the inability of USAID and ENERCON to jointly agree on additional task orders utilizing the foreign consultants. As a result, limited new work has been initiated since June 1987. In the subsection on program management, this is discussed further.

USAID and ENERCON are aware that this area has fallen short of the initial program goals for the first 18 months. What is not clear to the Evaluation Team is whether the cause of this limited action is the limited resources that have been put into this area, or whether there was a cutback on resources because USAID or ENERCON perceived other factors limiting progress. Other factors that may be limiting major investments include:

- The bare bones, low-cost design of many plants that did not allow the installation of good energy-use measurement equipment.
- Lack of a conservation focus (or ethic) by plant owners and management.
- Subsidized energy costs, resulting in marginal payback on total investment (i.e., without any outside financing).
- Some cases of stricter investment criteria for cost savings investments (e.g., energy conservation) than for main plant capacity investments.

For cogeneration feasibility studies in particular, the simple payback on total investment has frequently been estimated at 4-5 years, putting these investments at the margin in terms of go/no-go decisions by plant owners and management.

The follow-through and implementation of cogeneration projects is proceeding too slowly. The cause may be historical interest by plant management in their main business activities, but there are also institutional constraints. Currently, WAPDA and KESC do not allow parallel interconnection with their system. This means that an industrial cogenerator must either supply all of its power internally, with no instantaneous backup from the electric system, or divide plant electric power system in two pieces, each of which is separately served by its different power sources (one external and one internal). Further, there is no consideration for supply of excess power, even though the electric power system badly needs it. This is because no price has been set for the purchase of excess cogenerated power; therefore, such a technical configuration cannot be meaningfully evaluated by company

managers. This institutional constraint is an important one that is part of the scope of the USAID private power program now near initial implementation.

As mentioned, there is not sufficient understanding of the industrial decision-making process; this is critical to successful investment promotion. The absence of a policy analysis agenda directed to energy conservation decision-making contributes to the problem (see Special Studies section).

b. Conclusions

To develop a sound investment promotion program and an effective and efficient overall industrial energy conservation program, it is necessary to have a solid understanding of how industrial (and energy conservation) decisions are influenced and made.

Despite the feasibility studies and the study on impediments to cogeneration, there is not a clear strategy on how to address the lack of progress on this significant conservation technology.

Over all, without a well-established outside financing process specifically for energy conservation projects, institutional and administrative financing barriers will likely constrain major investments to an unacceptably low level. A more proactive effort by Pakistan financial institutions is needed to support meaningful investment activity in energy conservation because these types of investments are inherently different than major plant investments that produce capacity for manufacturing or the processing of goods.

c. Recommendations

- A research plan should be developed targeted at understanding the investment process and the key factors that influence it (e.g. energy prices, access to capital, taxes/tariffs, competing expansion investment opportunities, and payback periods). Based on the results of the investment research, the investment promotion and other energy program components (training, audits, outreach) should be reviewed and modified as necessary. As mentioned earlier under Special Studies, a policy analysis agenda should be developed based on the results of the investment research.
- Either through the boiler tune-up contacts or a separate effort, a greater number of medium-to-large plants should be contacted for identification of large investment opportunities. During boiler tune-ups, potential major investments should be identified by asking plant managers what opportunities they think exist.
- Support implementation of large project investments through a proactive effort by Pakistan financial institutions. This effort would involve seeking out and financing energy conservation equipment investments as a goal of the institution and the particular loan officer(s). Bank loan officers must do this to remove the outside financing barriers that many industrial company

managers perceive. This, in turn, requires that top bank officials and loan officers be trained and persuaded to carry out such an effort. See the training seminar recommendation in the training and curriculum development section.

- Given that the cost of electric power is rising, ENERCON should review the previous cogeneration feasibility studies and reevaluate its strategy. Given the emergence of the GOP private power program, ENERCON should analyze the benefits and cost of steam-electric cogeneration power sale rates by size of facility. These rates can potentially be lower than those for all-electric plants. The recent approval for an expatriate consultant activity will address this.

Cogeneration in industry and buildings is a specific area where public policy has not yet been effected, and where significant improvements in the efficiency of energy-use can occur. Many companies would consider sizing their cogeneration plants larger if excess power sold to the utility were profitable. For this to be determined, the sale price of this excess electricity to WAPDA must be established. USAID should assure that its private power program specifically encourages a policy for standard rates for cogenerators. These could be lower than the all-electric private power rates now being negotiated by the GOP.

- Since the Federal Trade Center cogeneration plant is now installed and operating, ENERCON should attempt to use this project as a demonstration test for operating in parallel with the electric power system. Currently, parallel operation is not allowed, and serves as a constraint to cogeneration development, even for internal power supply only. This could be a significant stimulus to privately-owned power development in Pakistan.

10. Monitoring/Evaluation/Reporting

a. Findings

One fundamental principle is important in carrying out the monitoring and evaluation function of the program--the act of making companies aware of energy use is the first step in stimulating implementation actions for energy savings. This is difficult to achieve in many plants due to the lack of good energy-use measurement equipment for key components in the plant. As a result, management is not aware of its energy use relative to that required for an efficient plant operation.

Monitoring of the 43 detailed audits has been undertaken through periodic follow-up visits; the data from the audits and follow-ups has been entered into the database. It has been useful in targeting the short-term interventions (such as the Boiler/Furnace Tune-up Program). There is some indication that there may be less emphasis on follow-up given the magnitude of the BFT program effort.

There is very substantial reporting on activities undertaken and planned; project status and activities are included in program and operation plans, results reported in monthly and quarterly reports and analytical or documentation work is published in the numerous "red cover" reports.

b. Conclusions

The database entry of the audit information and monitoring of actions taken by industry provides a important (and almost unique) base of information that is crucial to achieving long-term program objectives. The database documents results which help assess program effectiveness and provides information that gives invaluable insights into the industrial investment decision-making process. This critical information-gathering effort is not being duplicated in any other country to our knowledge. At this point, the conservation efforts of other countries are more fragmented and, when conservation investments do not occur, there is no basis for analyzing and understanding the set of problems inhibiting conservation. Continued monitoring and analysis are critical to assuring that program activities and policies affecting conservation are efficient and sound.

The reporting and documentation of activities (not including audit reports) is extensive and appears to be more than adequate for management purposes. The extensive documentation via "red cover" reports is particularly valuable given the lack of interaction between the contractor and ENERCON due to the slow staffing of ENERCON. Although a lot of technology transfer opportunity has been lost, the reports provide a bridge between what has happened in the first two years and what will take place in the future.

c. Recommendation

- The Team believes it is important to continue some level of preliminary and detailed audit activity in addition to the intensive BFT and subsequent short-term programs. Follow-up and monitoring of past work should be given a high priority. The information collected will increase understanding of the problems and what program and policy initiatives are needed over time.

11. Buildings, Agriculture and Transportation

a. Findings - Buildings

The buildings sector has received the second highest emphasis. A long-term Resident Advisor worked on buildings conservation most of the period from September 1986 to February 1988 without a full time counterpart in ENERCON.

A variety of activities were initiated including the development of a draft buildings energy conservation code, collection and publication of available weather data, 43 audits on a variety of building types, initiation of some limited building conservation demonstrations and collaboration with the Capital Development Authority (CDA) of Islamabad to initiate energy conservation measures. In addition, computers will likely be provided to organizations interested in the buildings energy conservation issues such as universities

(particularly schools of architecture) and the Pakistan Institute of Architects. The computers will be used to initiate the utilization of building modelling computer codes such as DOE-2. No training on the models appears to have been provided at this point in time.

A series of household energy conservation seminars was held in collaboration with a businesswomen's organization in several urban areas. It focused on teaching energy conservation tips that women could implement in the home.

b. Conclusions - Buildings

There is a no evidence of a systematic assessment of the characteristics and factors in the buildings sector that influence construction and operation decisions. It is not clear what incentives and disincentives influence the architects, builders, investors, lenders and occupants (owners or tenants) as they participate in new building construction, the operation of existing buildings and the decision to incorporate or ignore energy conservation measures.

There has been less attention to and awareness of the energy conservation issues in the buildings sector than in the industrial sector. Consequently there are no capable, established counterpart entities for ENERCON to work with at this time. There is a clear need for expanded capability to collect and analyze building-related data to provide an adequate and defensible basis for establishing buildings and equipment guidelines and standards.

There is a need for more analysis to understand what the savings and costs implications are of the elements that may eventually enter into standards and guidelines such as design, building materials, windows, infiltration, HVAC systems, etc.

c. Recommendations - Buildings

- The staffing level for both the contractor and ENERCON to deal with buildings should be resolved as soon as possible.
- There should be a primary emphasis on establishing the basic data and analytical capabilities before proceeding to implementation of the proposed buildings standards. Data collection (weather, commercial buildings, energy-use, equipment performance, etc.), training, and analyses of building energy use on the DOE-2 and other models if appropriate. The risks of proceeding with building standards that may not be based on sufficient weather and building data derived in Pakistan may outweigh the value of having standards in place.
- Training should be initiated in DOE-2 for ENERCON, university and the private architect community to the extent possible. There is a need to identify people who will be able to carry out buildings energy conservation research needed to support buildings policy development (including standards). This process is underway and should be completed so training can be undertaken. Consideration should be given to exploring the possibility of sending a group to Singapore to examine their experience and to receive short-term (2 week) training in the use of the DOE-2 model. Singapore has established a building code (for new and existing buildings) based on DOE-2 analysis. Based on that

experience they carried out a training course for 16 participants from Thailand, Indonesia, Malaysia and The Philippines.

- A more comprehensive approach to the buildings sector is recommended beyond the development of standards. The assessment of the sector recommended above may indicate other directions for action as well, such as tax or electricity tariff reform, that can have significant impact on building design and operation.
- The process for development of policy actions such as the buildings standards should be examined to assure that there is sufficient review by those affected, e.g., building owners, architects. An informal working group of architects might be considered at the start. Major public buildings projects should be reviewed for energy conservation design by the Physical and Housing Planning Unit in the Planning Commission.
- The program should include actions designed to focus on the residential end-use. The rapid increase in residential electricity use over the past five years dictates follow-on to the household energy conservation seminars directed toward women in the home.
- There should be a conscious effort to include specific renewable energy options in the buildings and residential use program such as passive solar design, solar hot water systems and, potentially, improved cook stoves.

d. Findings - Agriculture and Transportation

Little work has been undertaken to date in these sectors partly because there has been no long-term advisor or ENERCON staff (until recently) who were responsible for these sectors.

An initial assessment of opportunities in the agricultural sector was performed by a short-term technical assistance team and identified work on tubewells as a primary activity. As a consequence, a survey is being planned as an initial step.

Work in the transport sector has also been limited to a short-term technical assistance effort that identified conservation opportunities. No activity was pursued in the absence of ENERCON counterpart staff. With the hiring of ENERCON staff a reassessment is underway that should lead to a redefinition of a draft program plan potentially including activities that relate to transportation planning and policies on a broader scale.

e. Recommendations - Agriculture and Transportation

- Clarify the ENERCON future role and staffing and develop a detailed Workplan for both contractor and ENERCON staff. It is important to establish, particularly for transportation, a sound understanding of operations, particularly in the private sector. It is necessary to define the current

practices, incentives and disincentives at work on those who may make energy conservation decisions so that the program decisions made by the new Managing Director are well-founded and can be executed successfully.

12. Technical Assistance, Organization and Management Issues

a. Findings

As discussed, there has been substantial delay in staffing ENERCON. The Contractor staff has been targeted for six long term advisors--three for four years and three for two years. In addition to these positions there are seven Pakistani professionals working in training, outreach, database and industrial programs.

The uncertainty and delays in staffing ENERCON have created substantial problems in program planning, management and technology transfer. The rapid increase in contractor staffing and level of effort in the March-September 1986 startup period was dramatically reduced pending GOP action on the establishment and staffing of ENERCON. The long-term U.S. buildings conservation advisor was without a counterpart from September 1986 to February 1988. The major contractor-executed industrial effort did not involve sufficient ENERCON counterparts for the first two years. Consequently, the technology transfer function from the long-term advisors has not occurred to the extent planned *vis-a-vis* ENERCON (although it has with respect to the private subcontractors).

There is a mismatch of current ENERCON-contractor staff. At the present time ENERCON has full time Deputy Chiefs for Agriculture and for Transportation; there are no contractor long-term advisors at this time for these activities. Neither ENERCON nor the contractor have full time resident staff to work on buildings conservation. The long-term resident advisor for database will depart next month and there is no ENERCON counterpart hired at this time (one is pending).

The definition of the future role of ENERCON may result in a need for modified staffing capabilities. If, for example, it is determined that policy related work should be expanded in pricing, tax, tariff, standards, etc., staffing needs may not be met by the current configuration.

The technical assistance to date has been provided by a combination of long-term U.S. resident advisors, short term U.S. experts and Pakistani technical staff. The level and mix of future staff needs to be determined in the context of achievements to date, plans for the future and the current and future character of ENERCON.

b. Conclusions

While progress has been made, particularly in the industrial sector, the delay in staffing ENERCON has clearly delayed the establishment of the GOP capability to develop and operate a national energy conservation program over the long term. However, the long term need for a concerted conservation effort remains. Consequently, there is a need to extend the technical assistance beyond the July 1990 completion date to 1993.

c. Recommendations

There are two technical assistance options to consider: 1) the length of time technical assistance should be provided; and 2) the mix of staff among long-term U.S. advisors, short-term U.S. advisors, and long-term Pakistani advisors.

- The Team recommends that the Project completion date and technical assistance be extended to July 1993 given the activities and achievements to date in the industrial sector, the initial delays in staffing ENERCON, the recent hiring of a Managing Director and additional staff, and the substantial energy conservation opportunities that can be implemented with establishment of a national energy conservation program.

Following are some options for provision of technical assistance over the life of the project if extended to July 1993.

Chief of Party: Maintain a long-term U.S. Resident Advisor through 1993; review status in late 1989 and define characteristics of Chief of Party for final three years of project (from July 1990 to 1993).

Technical Programs: These programs have been focused predominantly on industry to date): Maintain long-term U.S. Resident Advisor through July 1990; review needs and characteristics of continued assistance in late 1989, and at that time consider the viability of a long-term Pakistani Advisor combined with short-term U.S. advisors.

Buildings Sector: Consider a two year U.S. Resident Advisor contingent upon (a) hiring of the ENERCON buildings staff person, and (b) establishment of a draft Buildings Conservation Program with short-term U.S. assistance (preferably from the long-term Resident Advisor candidate). This is an area where qualified women architects should be sought as candidates.

Transportation and Agriculture Sectors: Initiate a sector survey to determine conservation opportunities already partially initiated, incentives and impediments, and to establish a realistic assessment of achievable results given the environment and institutions in each sector. Based on the survey, develop and/or confirm a draft program plan for each sector (including technical assistance needs) specifically defining the need and justification for a long-term U.S. Resident Advisor, if necessary.

Database: Continue with long-term Pakistani Advisor supplemented with short-term U.S. advisors as necessary through July 1990; assess needs for 1990-1993 in late 1989.

Training/Outreach: Consideration should be given to a long-term U.S. Resident Advisor through July 1990, to replace the Advisor departing September 1988. An alternative is to utilize the contractor's existing long-term Pakistani Advisors--one for training and one for outreach. Assistance will be needed beyond 1990 as the conservation programs evolve in the non-industrial sectors. If the long-term U.S. Resident Advisor is not replaced, a program plan should be prepared that describes the role and amount of U.S. short-term

technical assistance. Long-term assistance will be necessary at least through 1990 for the development of training courses and university curricula in particular. Assistance needs beyond July 1990 should be assessed in late 1989.

Policy/Special Studies: Continued effort to develop a Special Studies Agenda is necessary to define the policy analysis that can be undertaken. Once done, technical assistance needs can be defined. A possible option is for the contractor to hire a long-term Pakistani Advisor with an economics/policy analysis background supplemented by short-term U.S. technical assistance. Such an arrangement would likely be needed for the life of the project.

It is important to note that no U.S. short-term technical assistance has been utilized in the last three quarters. This situation should be expected to change since there are now more counterpart ENERCON staff and two long-term advisors are leaving..

13. USAID-ENERCON-Contractor Management

The ENERCON program initiated by USAID in Pakistan represents a new effort of great breadth and depth. The objectives for the program are comprehensive, and the management tasks required to achieve those objectives are demanding and complex. At the same time, the program managers are challenged to develop a technical assistance effort that, in four and one-half years, will create a Pakistani organization capable of managing and upgrading the program on an ongoing basis. The demands of the management tasks and the development tasks are enormous. The ambitious objectives for progress in private sector implementation of energy conservation actions pose an inherent conflict with the need to develop a local Pakistani management capability through technical assistance activities. The following evaluation of program management should be reviewed in this perspective.

a. Findings - USAID Performance

USAID has taken a joint management approach where USAID and ENERCON agree on program objectives and make joint decisions to manage the program. This includes joint review and approval of task orders, invoices, reports, and other activities.

The joint USAID/ENERCON management approach has been management intensive, very detailed and time consuming in its approval and review of task orders, invoices, and reports. It has entailed very significant management reporting requirements for HBC.

USAID has funded the program through short-term allocations. Sometimes funding decisions have been seriously delayed causing HBC (and indirectly its subcontractors) to operate on the verbal assurance that funds will be provided from other sources or will be available in the future. This has eroded the feeling of long-term commitment by HBC and subcontractor staff. The purpose of the incremental funding may have been to tie periodic funding decisions to ENERCON's staffing levels as an incentive for ENERCON to push the GOP bureaucracy to obtain staff. If so, it did not work in the first two years of the program.

Limited new work has been approved by USAID/ENERCON for foreign consultants since mid-1987. Some new task orders have been denied approval, including some in areas that

have failed to meet their objectives (e.g., activities related to investment promotion and equipment financing). This gap in resource utilization was caused, at least in part, by the refusal by the head of ENERCON to approve task orders that USAID was willing to approve. Regardless of the reasons for the limited use of foreign subcontractor resources, the low level of new task orders had a negative impact on the program. It is not clear whether management impasses simply developed, or whether important political considerations were considered by USAID in accepting this situation.

One of the frustrations noted by all contractors is the joint approval role the USAID has pursued with ENERCON. Under this approach, either USAID or ENERCON can effectively veto a task order. Despite the opportunity for USAID or ENERCON to express its disagreement with the other, or its preferences or aversions to the uses of certain contractors through disapproval of any particular task order, the Evaluation Team believes this approach is necessary as a fundamental part of a technical assistance effort. To be successful, the Managing Director of ENERCON must be viewed as having integrity and being results-oriented in order to achieve the goals of the program.

b. Findings - Hagler, Bailly and Company Performance

HBC's performance should be measured in two ways: 1) substantive program progress and, 2) program administrative performance. Regarding substantive program progress, the concept, work plan, and range of results appears quite responsive to the needs of Pakistan, and the program would likely be judged quite successful compared to other developing country programs.

The long-term technical assistance team contains a breadth of technical and management experience, including relevant developing country experience, that has brought about economies of operation in such areas as training and outreach.

The Evaluation Team believes the resources provided were sufficient for the accomplishments to date, and might have allowed better performance if the management approach had been less administratively oriented and more substance-oriented. While part of HBC's increased administrative activities may have been required by the USAID/ENERCON management approach and requirements, we have the following specific observations, based on discussions with HBC and local contractors.

- Local contractors have felt whipsawed between overall program objectives and priorities. They do not feel that their contract position (funding level and continuity of effort) has been adequately considered or protected by HBC. This has occasionally bordered on anger and resentment by the local contractors, not a healthy situation for a foreign contractor to have. Despite pressures on HBC by USAID or ENERCON, the Team feels that HBC has an obligation to strongly support its subcontractors.
- While many of the earlier audits required a high level of resources, the local contractors believe that insufficient funds are allocated for current task orders to cover logistical and administrative inefficiencies not under the control of the local contractors (e.g., missed appointments by the client, USAID driver logistics, extra travel costs to return for client company information not

prepared on time, etc.). This problem may occur, in part, because private companies have not paid for audits and other services to date. If they had, the company personnel might be more conscious of their part in these administrative delays.

- Local contractors do not feel well-informed about overall developments in the ENERCON program despite administrative contact with HBC.
- The departure of the long-term Resident Advisor puts the well-regarded Training and Outreach Program under some uncertainty until a new, qualified manager takes over.
- Local contractors have been constrained from pursuing private business using USAID-supplied audit equipment. At least one contractor was successful in selling audit services to two private companies using this equipment before HBC ordered them to stop such activities. While this was an USAID Policy that HBC was enforcing, a better solution would have been a creative response by HBC to allow sale of the equipment or rental payment of the equipment by the contractor (e.g. the current combustion analyzer approach), so that the contractor could have continued to expand its services.
- The subcontracting requirements by HBC have threatened, for at least one contractor, to cause withdrawal of the contractor from the program. Specifically, the requirement to monitor the actual salaries of the engineers working on the job (as opposed to a class of engineers) has posed a conflict. With all contractors, detailed reviews of their books have occurred. On the surface, it is hard to understand the administrative detail involved here. If HBC was simply reflecting an USAID/ENERCON contracting approach, a better response may have been for HBC to find a reasonable compromise (e.g., classes of engineers). As a contractor with more experience in developing countries than either the ENERCON staff or some of the USAID staff overseeing the program, HBC should have the ability to better address and resolve some of these problems.

At the same time that the above contract management problems have occurred, the local contractors feel insufficiently informed about the development and new decisions regarding the ENERCON program. This has been more the case in the past year than in the first year, when joint meetings with local contractors were occasionally held, and good communication and interaction occurred. Perhaps a joint meeting of all local contractors and HBC with USAID and ENERCON management might have had an impact on how USAID/ENERCON administered the program.

With respect to Program Planning, there has been substantial effort by HBC in the development of the Detailed Work Plans and Program Work Plans (Buildings, etc.). The development of the plans provides a vehicle for communication and definition of roles between ENERCON, the contractor, subcontractors and USAID.

Currently the Detailed Work Plan needs updating. This should be a high priority for the new Managing Director. It appears timely to initiate preliminary work on the updated Plan to define the key issues that can be resolved by the Managing Director.

For the initial 18 months of contractor activity (through mid-1987) there was an increasing degree of management intensity in the Project which consumed a disproportionate amount of contractor time and intensive USAID involvement. Discussions among ENERCON, USAID and the contractor resulted in a modified project management approach including the development of a quarterly workplan which formed the basis for contractor activities.

The quarterly approach for task order approval has been effective in scheduling activities but appears to require a relatively high level of time for development, review, approval, and monitoring.

c. Recommendations

The above findings reflect the reality of a new and quite complex program concept in a developing country. The considerable accomplishments achieved thus far are testimony to the quality of USAID's program planning. It would be surprising if there were no program management improvements to be made. In this light, we offer the recommendations below.

- Given the anticipated USAID staffing constraints, every effort should be made to identify redundant or unnecessary management activities and to identify less management intensive methods of maintaining oversight responsibilities rather than reduce project activities.
- Because of the extensive status reporting requirements placed on the contractor by the contract, it is recommended that USAID review its overall management and oversight efforts to identify if the current level of reporting can be reduced while maintaining its oversight requirements.

USAID and ENERCON could authorize work and control the program on a quarterly objectives versus resource-use basis similar to what is in place but with less detailed involvement in the implementation. Under this approach, once the quarterly objectives are approved by USAID and ENERCON, HBC should be free to issue task orders to local and foreign contractors in accordance with the total budgets authorized. USAID and ENERCON should decide, based on the performance of HBC against successive quarterly budgets, whether it is satisfied with overall program progress. Each year, when the incremental funding is approved, USAID and ENERCON should review the general management approach, and revise it, if the performance of HBC or the local subcontractors warrants any changes.

- USAID/ENERCON should consider operating like the private sector when contracting with local subcontractors. Once the total rate by class of engineer is established for all of the subcontractors, the detail required on specific individuals should not be necessary. Private sector confidentiality (while subject to audit) and profit of local contractors should be respected.

Ultimately, USAID/ENERCON should consider competitive bidding for some ENERCON services, which will assure reasonable hourly rates for work conducted.

- USAID should incrementally fund the program for at least one year at a time. This will avoid the administrative and motivational problems that have occurred to date. If USAID desires to have some quick response capability for unforeseen activities, it should provide for a reserve budget for crisis-management efforts.
- HBC should hold joint contractor meetings at least once every six months to assure that all participants clearly understand the overall objectives of the program, progress, program priorities, and program problems. Further, this meeting could allow for useful and creative inputs from the local contractors. In particular, it is critical that local contractors be aware of and can articulate the achievements and energy savings realized by the program to date. Currently, this is not the case.
- USAID/ENERCON should encourage local contractors to seek other paying work using AID equipment. Regardless of government policies on use of such equipment, there should be a positive approach to seeking a way to do this, as opposed to using such policies as a reason to constrain such activity.

14. Commodity Assistance

Approximately \$400,000 of commodity assistance funds have been spent to date on the conservation subcomponent compared to the original life-of-Project estimate of \$900,000. Equipment procured includes audit kits, instrumentation packages, computers and combustion analyzers.

The availability and usage of the energy conservation equipment has been instrumental in permitting ENERCON and its contractors to carry out the objectives of the Program. The many energy surveys conducted in private sector industrial plants, as well as the boiler tune-ups, could not have been accomplished without it. In the remaining years of the Project, this equipment will continue to be used. Any additional needs should be modest with the originally forecast funds sufficient to meet these needs.

C. RENEWABLE ENERGY ELEMENT

Since this element has not yet started, only a cursory evaluation was possible. However, a review of the proposed solicitation for a U.S. renewable energy technical assistance contractor has led to two specific recommendations. Also, two general recommendations have been made on a possible assignment of commercialization responsibilities for renewable energy work within the GOP bureaucracy and the time extension of the element.

1. Findings

Based on a review of the renewable energy activities in Pakistan, it is clear that programs are scattered among a number of agencies with several different agencies involved in advancing these technologies. DGNRER, PCSIR, ENERCON and the Pakistan Council for Appropriate Technology (PCAT) are the most prominent with Energy Wing also playing a role. DGNRER is currently undergoing a major personnel upheaval and restructuring and its future is uncertain.

The ENERPLAN Renewables Special Study, done by Mathtech in 1987, is a very credible compilation of the status and potential for renewable technologies³⁶. Tables 3.17 and 4.1 from the project report nicely summarize the study.

A draft solicitation to select a U.S. renewable energy technical assistance contractor has been circulating for some time in USAID and the GOP. Energy Wing in its comments suggested that development of a GOP Master Plan to define the role of renewable energy technologies in meeting Pakistan's future energy needs should be emphasized. This latest version of the solicitation focuses on commercialization of renewable energy technologies³⁷.

DGNRER has requested that funds from this subcomponent be used to establish four regional renewable energy demonstration centers in addition to funding the technical assistance contractor.

2. Conclusions

Since there is not yet agreement on what the next steps should be in developing renewable energy technologies, the USAID solicitation and all other activities have been placed on hold.

The commercialization of renewable energy technologies will be a long, uphill struggle because of the dispersed responsibilities. Although there is potential to utilize a number of renewable energy technologies throughout the economy, many will find only special applications with relatively small energy impacts and, because of the limited market, may never become commercially viable. A few technologies, such as water heaters, could potentially have wide-spread commercial application, and passive solar energy building design could have universal application. To take advantage of the nearer term, larger impact technologies, a more focused approach is required. Additional experimentation is not required; a limited number of demonstrations will be useful for those technologies with potential for commercialization.

After careful reading of the proposed renewable energy solicitation, The Team concluded:

- If the solicitation, as written, moves smoothly, the contractor cannot begin work before January 1989. The probability is that the date will be later.
- If the goal is commercialization of selected renewable technologies, then the first step should be a market analysis/market survey. The characteristics of renewable technologies are well enough understood that there is no need for

a scattershot approach. The infrastructure necessary to ensure commercial development (governmental, industrial, consumer awareness) should be tailored to the specific technology(s) shown to have a market niche. Each renewable technology is sufficiently different that no one approach will suffice.

- As written, only companies presently doing business in Pakistan probably can be judged responsive to the solicitation. This conclusion is based on the requirement that the proposal must include the names of the proposed Pakistani professional staff.

3. Recommendations

- If the solicitation is released, it should be limited to a well-organized market analysis/market survey of the few technologies judged in the Renewables Special Study to have a high ranking: 1) efficient cook stoves, 2) thermosyphon hot water heaters, 3) micro/mini hydro systems, and 4) photovoltaic systems for health clinics and special applications. Evaluation Team experience agrees that these technologies have the best potential for commercial development with the smallest, initial subsidization. To be creditable, the market survey should invite participation of U.S. and Pakistani manufacturers to ensure that the survey addresses the questions that would be of greatest concern to them if they were to try to commercialize these technologies. If the market analysis/market survey confirms the strong commercial potential of these renewable technologies, an overall program should be developed to encourage private sector participation and to overcome institutional barriers that may penalize the introduction of new technologies.
- If development of a Master Plan is agreed to be a high priority (the Evaluation Team would support such a priority), the present technical assistance contractor to Energy Wing should receive the contract for the job. The Master Plan should take into account other USAID projects already underway, such as the Rural Electrification and Forestry Planning and Development Projects, to ensure that complementary activities are coordinated.
- Consideration should be given to consolidating the commercialization of renewable technologies under one agency. Although admittedly not a perfect fit, our recommendation is ENERCON. DGNRER is a second candidate but does not appear, at present, to be properly staffed to do the job.

Conservation and the application of renewable technologies, especially the more likely large-impact technologies such as solar water heaters and passive building design, have a natural home together. The outreach programs presently underway in conservation could be expanded to include renewable energy systems with a minimum impact on the overall program. The constituency presently targeted by the ENERCON program is the same constituency that should embrace renewable technologies when they make economic sense.

- Since the implementation of this component is getting a late start, useful results cannot be achieved by 1990. If the GOP reaches agreement on how it wants to proceed, this component should be extended until 1993, and possibly, beyond. With focused objectives, such as suggested above, Mission staffing needed to monitor and coordinate renewable activities could be kept to a minimum.

IX. CROSS-CUTTING ISSUES AND LESSONS LEARNED

A. CROSS-CUTTING ISSUES

As requested in the Work Statement, we have examined several cross-cutting issues and discuss them briefly in this section.

1. Sustainability

If all USAID support to the Energy Wing, ENERCON, and GSP were withdrawn, the Team concluded that these institutions would survive. GSP is an organization with a long history in the GOP and fills an acknowledged niche whereas Energy Wing and ENERCON are products of the EP&D Project with very short traditions and, thus, are of questionable durability. If this conclusion is accepted, the issue then becomes what are the gains or losses that will occur if USAID continues or drops the Project.

For GSP, discontinuation of the Project will probably mean a very lengthy and drawn-out assessment of Pakistan's natural resources, especially coal, resulting in the under-utilization of an important energy resource. There seems to be little evidence that any donor would take up the slack and provide the broad support needed, notwithstanding the fact that the German Technical Assistance Program and World Bank have funded modest activities in the past. GSP scientific and technical traditions have been shaped for the past 30 years by U.S. support and training and these early efforts have resulted in placing senior GSP management predisposed to work with the United States. Equipment and training deficiencies are universal weak points in building scientific institutions in all developing countries. The USAID program addresses and can continue to address these deficiencies over the next two to five years with relatively small amounts of funding and with the strong likelihood that USAID efforts will succeed in making a positive impact.

In our evaluation of Component 1, we have discussed at length our findings on the Energy Wing's present capabilities and perceived deficiencies. The EP&D project clearly has been successful in helping put in place an important new branch in the GOP. As we have stated, we believe the Energy Wing will be a permanent institution. However, its full strength and usefulness is yet to be realized. Continued support by USAID will ensure the Energy Wing's growth to maturity and, at the same time, develop a voice in the GOP that will be able to influence policy decisions in directions of interest to the U.S.

ENERCON's sustainability is most open to question for the many reasons discussed in the body of the evaluation. Our recommendations are to continue to support ENERCON with an important evaluation milestone in about one year's time. Here again, USAID advocacy will be critical if the full potential of ENERCON is to be realized, with continued support to the new Managing Directory the key to ENERCON achieving its stated goals.

2. Effects on Women

Household energy use represents a significant fraction (approximately 15%) of total energy consumption in Pakistan's energy sector and is growing rapidly. Firewood and kerosene are the major sources of cooking fuels and electric power used for all applications such as ventilation, cooling and small appliances is perhaps the fastest growing segment of electricity consumption. The EP&D project addresses the role of women and the impact of energy consumption and conservation on households and is discussed in the evaluation of Component 3. As living standards improve, it will become increasingly important to involve Pakistani women in addressing issues such as fuel switching and conservation as Pakistan strives to provide a rational mix of fuels for residential consumption.

A major concern for Pakistan must be the scarcity of properly trained and qualified people to fill positions required by an expanding economy. Although cultural traditions mitigate against the influx of large numbers of women into the workforce, more and more women are being employed. The Evaluation Team members were impressed with the talents and capabilities of the professional Pakistani women with whom they came in contact. Women are an obvious potential source of skilled labor, including professional and managerial, that must be utilized in the future. Suggestions and recommendations on how such utilization could be approached are contained in the evaluation of Components 1 and 3.

3. Environment

As energy use increases on a per capita basis, environmental concerns associated with providing the needed additional energy will also increase. Air pollution from the transportation sector is already a problem in some cities and, in areas where coal utilization is high, air quality is seriously degraded. Increased use of Pakistan's hydroelectric potential alleviates some environmental concerns but introduces others.

To date, the environmental impact of energy generation and use has not been a major focus of the EP&D Project. Emphasis on and awareness of environmental problems should be elevated during the Project's remaining lifetime. In particular, the coal sector is a good candidate for the introduction of U.S. technology to promote the clean burning of coal and we have made a recommendation in our evaluation of Component 2B to this effect. Other parts of this Project, such as Component 3, have direct or indirect effects on reducing environmental problems and deserve continued support.

Energy Wing should strengthen its ability to assess the environmental impacts of GOP energy decisions. At the present time, staff capabilities in this area are minimal. Advantage should be taken of the Training element to ensure that there are staff members in the Energy Wing with formal training in environmental issues.

B. LESSONS LEARNED

Distinct from the evaluation of individual project components is a series of conclusions reached by the Evaluation Team that we have grouped under the title, *Lessons Learned*. These conclusions, to some degree, synthesize findings, conclusions and recommendations found in the body of the report that did not lend themselves to inclusion within an individual component.

- The project, as designed, was too complex. As a result, AID project management was placed under a severe strain to keep track of all the multifarious activities, and at the same time expand a staff from a few individuals to its present size. As an example, the original implementation schedule showed more than 40 activities being initiated in the first 18 months. *Conclusion:* Future projects should carefully assess complexity versus projected achievements and assure that they are attainable.
- Related to the above observation, the project had unrealistic expectations of what could be accomplished in a given period of time. As a result, schedule slipped, some costs increased and general frustration ensued. Since major portions of the project involved institution building on the part of the GOP, experience or insight was apparently lacking as to what was involved in bringing new GOP institutions to life. *Conclusion:* Future projects should closely coordinate with the host country to be sure normal bureaucratic procedures and time frames are fully understood before project schedules are developed.
- The degree of host country interest in a given project must be carefully assessed, especially at the level where the "Doers" or "Implementers" reside. If it isn't clear that a high priority is assigned by the host country to the project, the prospects of its timely execution are small. *Conclusion:* Do the necessary homework at the appropriate levels of the host country bureaucracy during project design.
- To provide the correct type and level of expertise needed in a Technical Assistance (TA) contract, agreement must be reached between the host country and USAID before a contractor is selected. We appreciate that such needs are not always easy to foresee, however, candid discussions are required between both sides at an early date. *Conclusion:* TA contracts are especially difficult to formulate to the satisfaction of all parties and extra effort is needed to ensure both sides are in agreement.
- To be effective, TA contractors must be able to work closely with their host country counterparts. This involves, among other things, congruence of capability, proximity on a day-to-day basis, and ability and willingness on the part of contractor personnel to teach. *Conclusion:* Selection of TA contractor personnel should include criteria that will ensure that the selected staff has the ability and disposition to perform as teachers and, when in-country, will be co-located with host country counterparts.

- The Lakhra Project would have benefitted from an earlier evaluation. An evaluation team, removed from the day-to-day pressure of management, may have been able to focus the effort into more productive channels if they had been called in at the point when all the recommended donor studies had been completed. *Conclusion:* Complex projects, involving large funding commitments, should be scheduled for independent evaluations, as early as possible.

REFERENCES

1. USAID, "Project Paper: Energy Planning and Development Project 391-0478," (Washington, DC: July 1983), p. 61.
2. USAID/GOP, "Project Grant Agreement between GOP and USA for Energy Planning and Development (conformed copy);" July 30, 1983 and First through Fourth Amendatory Agreements.
3. GOP, DGNRER, Ministry of Petroleum and Natural Resources: DGNRER, Energy Yearbook 1987, (Islamabad, May 1988).
4. GOP, "Draft 7th Five-Year Plan, Chapter 19 Energy" (Islamabad, February 1988).
5. Hardy, J.W.J., "Union Texas Pakistan - A Exploration Success in the Province of Sind," International Symposium on Petroleum for the Future, Islamabad, January 1988.
6. Brady, Thomas J., "Oxidental of Pakistan - Current Operations and Future Plans," International Symposium on Petroleum for the Future, Islamabad, January 1988.
7. GOP Ministry of Planning and Development, "ENERPLAN: Energy Planning and Development (PC-II)," (Islamabad, June 1984) p. 5.
8. Mathtech, Inc., "Quarterly Progress Report," various dates, April/June 1986 through January/March 1988.
9. Arthur D. Little, Inc., "Contract Options for the Development of the Dhodak Gas Field," (February 1985), p. 9.
10. GOP, OGDC, Ministry of Petroleum and Natural Resources, "Invitation to Bid: The Development and Operation of the Dhodak Field," (Islamabad: June 1986).
11. Bechtel National, Inc., "Jamshoro Power Generation Complex-Phase II: Feasibility Study," (five volumes) (December 1986).
12. Reinemund, J. K., "Recommendations for Strengthening the Geological Survey of Pakistan," (USGS: December 1986).
13. Geological Survey of Pakistan, Memorandum on Meeting with USAID Evaluation Team on May 29, 1988, Muhammad Ali Mirza, Director, Planning and Information.
14. USGS, "Coal Resources and Assessment Program in Brief," (May 1988).
15. USGS, "Status of Coal Resources and Assessment Program," (May 1988).

16. Razzaq, Abdul, "Interim Report on National Geodata Center," December 1987.
17. Biuro Projectow Gliwice Poland, "Feasibility Report on Development of Brown Coal Deposit Lakhra for Mining" (1967).
18. Zemek Poland, "Feasibility Report with Technical and Economical Features of a Power Plant Base on 2 X 120 MW Generating Units with Lignite for Lakhra Area in West Pakistan," (1967).
19. Pakistan Minerals Development Corporation, "Geological Report on Part of Lakhra Coal Field, near Khanot, District Dadu, Sind," (1976).
20. Canadian International Development Agency/Montreal Engineering Company Ltd., "Reconnaissance Study and Evaluation of Lakhra Lignite Deposits and Associated Thermal Power Station, Hyderabad Area, Sind, Pakistan," (1977).
21. Japan International Cooperation Agency, "Feasibility Report for Lakhra Coal Mining and Power Station Project," (1981).
22. Stone and Webster Engineering Corporation, "Lakhra Coal and Power Development Project Review," (1983).
23. Malik, Masood, "Training Component for EP&D," [memo to James Bever, November 12, 1987].
24. Gilbert Commonwealth International, Inc., "Lakhra Power Feasibility Reports," nine volumes (1986).
25. Environmental Sciences and Engineering, Inc., "Environmental Assessment Lakhra Project," (1986).
26. Three Individually Contracted Anthropologists, "Social Soundness Analysis: Lakhra Project," (1985).
27. ICF, Inc., "Economic and Financial Feasibility Lakhra Project," (1986).
28. Bank of America International Ltd., "Financial Advisory Services in Preparation of Request for Proposals for Private Sector Participation in Development of Lakhra Coal Mines in Sind Province," (January 1987).
29. WAPDA, "Request for Proposals for Coal Supply to the WAPDA 3 X 50 MW FBC Power Plant near Khanot from the PMDC Lease as Well as the Rest of the Coal Field at Lakhra," (February 1988).
30. Ilias, G.M., "WAPDA's First Large Thermal Power Station Based on Domestic Coal," Proceedings of the First Pakistan National Coal Conference (February 1986).
31. Ehrlich, S., "Status of Fluidized Bed Combustion for Electric Utilities," Proceedings

- of the First Pakistan National Coal Conference (February 1986).
32. Oak Ridge National Laboratory, "Coal Briquetting in Pakistan: A Market and Business Assessment," (Tennessee: March 1988).
 33. Aftab Associates (Pvt.) Ltd., "Survey of Fuel Prices in Pakistan: Task I, Final Report," (November, 1986).
 34. Martin, Luann, "Major Findings of the Residential Fuel Use Survey and their Implications for the Development of Coal Briquettes in Pakistan," (12 April 1987).
 35. Martin, Luann, "Results and Implications of the Consumer Test of Coal Briquettes," (May 1987).
 36. Mathtech, Inc., "Renewables Special Study," (January, 1987).
 37. USAID PIO/T 391-0478-3, Energy Planning and Development: Component 3B, Renewable Energy Technologies; 5/11/88

OTHER DOCUMENTS EXAMINED BY THE EVALUATION TEAM

- Abdel Wahid, Syed, "Mine Labor of the Lakhra Field," (Memo: 14 October 1987).
- Arthur D. Little, Inc., "Preliminary Energy Sector Manpower Needs Assessment," (May 1985).
- author unknown, "Report on Reorganization of Geological Survey of Pakistan," (February 1987).
- Bever, James, "Institutional Excellence Project," [memo to J. Gant dated 19 March 1985].
- Bliss, Charles, "Did Lakhra Fail?" [memo: 25 May 1988].
- Durrani, N. A., "Chemical Analysis and Physical Properties of Coal Samples from Lakhra Coal Field," (October 1985).
- ENAR Petrotech Services (Pvt.), Ltd., "Balance of Payment Implications of Fuel Oil, HSD Intensive vs Natural Gas Intensive Power Generation During the 1987-93 Period," (Lahore: May 1987).
- ENERCON, Detailed technical assistance workplan; April 12, 1987.
- Energy/Development International, "Private Power in Pakistan: Project Paper Economic Analysis," (New York:, March 1988).
- Energy/Development International, "The Coal Industry in Pakistan: Requirements for

Growth," (New York, February 1985).

GOP Ministry of Planning and Development, "ENERCON Project Document," (December 1987).

GOP Ministry of Planning and Development, "Energy Planning and Development Project (EP&D) - (Revised)," [Draft PC-2] (Islamabad: undated, ~mid-1988).

GOP Planning Commission, "The Sixth Five-Year National Energy Plan, 1983-1988," (Islamabad, 1983).

GOP, Federal Bureau of Statistics, Survey of Self-Generating Electricity Undertakings: 1985-1986, (Islamabad: January 1988).

GOP, GSP, "PC-I Form and Scheme: Establishment of National Geodata Center at Islamabad, Pakistan," (Quetta, December 1984).

GOP, GSP, "PC-II Form and Scheme: Establishment of a Geodata Centre at Islamabad," (Islamabad, May 1980).

GOP, GSP, "Project Document of Coal Resource Assessment: Sub Component 2(a) of Energy Planning and Development Umbrella Project - ENERPLAN," (Quetta: September 1984).

Griffiths, Joyce, "Pakistan's Mineral Potential: Prince or Pauper?," Industrial Minerals, July 1987.

Hagler, Bailly and Co. and USAID, "Hagler Bailly Contract"

Hagler, Bailly and Co., "ENERCON Technical Assistance Project: Quarterly Report," numbers 1-7 (various dates).

Hagler, Bailly and Co., "Technical Program Review (draft report)," (16 July 1987).

John T. Boyd Company, "Lakhra Coal Mine Feasibility Reports," Eleven volumes (1986).

Mathtech, Inc. and USAID, "Mathtech Contract," April 1986.

Mathtech, Inc. "Baluchistan Integrated Valley Development Plan," (May 1988).

Mathtech, Inc., "List of Technical Reports: ENERPLAN Technical Assistance Project," (16 May 1988).

Mathtech, Inc., "Mathtech Project Evaluation Expectation," [Memo: 22 May, 1988].

Mathtech, Inc., "Seventh Plan Database: Functional Requirements Definition," (Islamabad, November, 1986).

Mathtech, Inc., "Work Plan: January, 1988 - July, 1988," [April 10, 1988 draft].

Mathtech, Inc., "World Petroleum Outlook," (Islamabad: January, 1988).

Palmedo, Peter, "Design Considerations for the Long Term Plan," [Energy Wing Memorandum, March 3, 1988].

Palmedo, Peter, "Design of an Analytical System for Energy Planning in Pakistan," (July, 1986).

Rashid, Saeed Ahmed, "Pakistan's Energy Budget 1983-1984," (Islamabad: Institute for Policy Studies, 1983).

Shafi, M., "Mining Labour Code," (Karachi: Bureau of Labour Publications, 1981).

Stone and Webster Engineering Corporation, "Karachi Electric Supply Corporation, Ltd: Executive Summary for Program Design for Efficiency Improvement of Thermal Power Plants in Pakistan," (Boston: October 1985).

Stone and Webster Engineering Corporation, "Water and Power Development Authority: Executive Summary for Program Design for Efficiency Improvements of Thermal Power Plants in Pakistan," (Boston: October 1985).

USAID, "Action Memorandum; Pakistan: EP&D Project (391-0478): Authorization Amendment," Feb. 6, 1987.

USAID, "Briefing Paper for Dr. Lion's Discussion with Dr. Mahbubul Haq," May 10, 1984.

USAID, "Country Development Strategy Statement: FY 1988 - FY 1993," (April, 1987).

USAID, "Draft Energy Sector Strategy Paper, "Office of Energy and Environment, Islamabad, (May 1988).

USAID, "ENERCON Project: Project Review Meeting," (September 1986).

USAID, *Evaluation Handbook*, (Washington, DC: GPO, April 1987).

USAID Pakistan Contract with Hagler, Bailly and Company; Part I-Section C description/specs/work statements; Feb. 5, 1986.

USAID Statement of Work, "Oil-fired Power Generation Complex at Jamshoro -Phase 2, Assessment of Feasibility," WAPDA-Lahore, Pakistan; July 30, 1986 (won by Bechtel National).

USAID/GOP, "Minutes of GOP-USAID Meeting on the Energy Planning and Development Project," June 6, 1984.

USAID/Masood Malik, "Contract to Provide General Energy Advisor to GOP Ministry of Planning and Development," (February 1986).

USGS/USAID, "PASA between USAID and Department of the Interior," IPK-0478-P-IC-5068-DD Funding Period 8-1-85 through 7-31-82, (1985).

World Bank, "Report and Recommendation of the President of the International Bank for Reconstruction and Development: Proposed Loan to the Islamic Republic of Pakistan for Energy Sector Loan I," (Washington, DC: May 6, 1985).

World Bank, Energy Operations Division, "Staff Appraisal Report Pakistan: Private Sector Energy Development Project," (draft), (Washington, DC: May 1, 1988).

APPENDIX A
PERSONS CONTACTED BY THE STUDY TEAM

APPENDIX A

PERSONS CONTACTED BY THE STUDY TEAM

In Washington:

Ichord, Robert F.	USAID	Technical/Asia
Archer, Robert	USAID	Technical/Asia
Adams, Garry	USAID	Islamabad/E&E
Butler, Trish	USAID	Program Evaluation Staff
Palmedo, Philip	ED/I	President
Elwan, Ibrahim	IBRD	EMENA Energy
Bailly, Henri Claud	Hagler Bailly	President
Exstrum, Bruce	Hagler Bailly	Senior Associate
Terman, Maurice J.	USGS	Chief, Asian & Pacific Geology
Schweinfurth, Stanley P.	USGS	Deputy Chief, Coal Programs
Simon, Frederick O.	USGS	Int'l Geology, Asia

In Islamabad:

Guedet, Paul	USAID	Acting Mission Director
Davis, Peter	USAID	Deputy Mission Director
Johnston, David	USAID	Chief/E&E
Bever, James	USAID	Division Chief/E&E
Bliss, Charles	USAID	Division Chief/E&E
Husain, Syed Raza	USAID	Program Manager/E&E
Ahmed, Anjum	USAID	Program Manager/E&E
Asrarullah	USAID	Program Manager/E&E
Hassan, Anwarul	USAID	Program Manager/E&E
Mir, Attiya K.	USAID	Program Assistant/E&E
Huber, Douglas	USAID	Mining Advisor/E&E
Sufi, Osma	USAID	Human Resources Division
Mathia, Robert P.	USAID	Asst Program Dev. Officer
Fuchs-Carsch, Marian	USAID	Technical Writer
Noble, E. A. (Ned)	USGS	Chief-of-Party
Warwick, Peter	USGS	Geologist
Durrani, Nisar	USGS	
Mahmoud, Ashfaq	Energy Wing	Senior Chief
Sindhu, M. Iqbal	Energy Wing	Plan Formulation/Power
Akram, Mohammed	Energy Wing	Plan Formulation/Petroleum
Sohail, Qaiser	Energy Wing	Deputy Chief, Database
Rezauiuddin, Mohammed	Energy Wing	Acting Chief, Plan Formulation
Sabih, Farhan	Energy Wing	Asst Chief (Economics)
Waraich, Aslam	Energy Wing	Deputy Chief/Administratio
Ziauddin, Mohammed	Energy Wing	Asst Chief (Energy Appraisal)
Zuberi, Noorul Arffen	Energy Wing	Asst Chief (Energy Appraisal)
Mahmood, Sabir	ENERCON	Chief In-Charge

Qureshy, Tariq	ENERCON	Deputy Chief, Transport
Saqib, Ghulam Sarkar	ENERCON	Deputy Chief, Agriculture
Abdul-Jabbar, M.	ENERCON	Chief, Evaluation
Abdul-Razzaq	GSP	Systems Analyst, Geodata Center
Malik, Massoud	EP&D Project	General Energy Advisor
Hashmi, Shabir	EP&D Project	Energy Advisor
Gettani, Arshad	EP&D Project	Systems Analyst
Frits, James	Academy for Educational Development	
Paz-Castillo, Janet	Academy for Educational Development	
Westfield, James	Mathtech	Vice President/Chief of Party
Masoud, Enver	Mathtech	Advisor
Malik, Krishen	Mathtech	Advisor
Armstrong, John	Hagler Bailly	General Manager
Applebaum, Bruce	Hagler Bailly	Manager, Data & Analysis
Oven, Mark	Hagler Bailly	
Zacaria, Vacar	Hagler Bailly	Senior Engineer
Khan, Mohammed Akram	Min. Power	Additional Secretary
Khan, Mohammed Nawaz	Min. Petrol.	Secretary, Minerals Council Bd.
Raza, Hilal A.	Min. Petrol	Director General, HDIP
Ahmed, Shahid	Min. Petrol.	Dir. Gen. Petrol. Concessions
Qureshi, Shakoor Ahmad	WAPDA	General Manager (Thermal)
Kemal, Arif	OGDC	General Manager (Technical)
Junejo, Anwar A.	PCAT	Chairman
Asifullah, Khawaja	PMDC	Director (Technical)
Siddiqui, M.	PMDC	
Memon, Abdus-Sattar	PMDC	Sind Province Representative
Beg, Dauod	al-Technique	General Manager
Hak, Shahid K.	PARCO	General Manager
Mir, Sadeqat	Retired	Former Senior Chief
Sharma, Mahesh	World Bank	EMENA Energy
Oduolowu, Akin	World Bank	EMENA Energy
Ali, Gauhar	World Bank	Islamabad Office
Smith, C. Kevin	CIDA	First Secretary (Development)
McDonald, Robert	CIDA	Sr. Financial Advisor, OGDC
Breadner, Barry	CIDA	Project Co-ordinator, OGDC
Ernsting, Richard	Am. Elec. Pow. Advisor,	
	Electricity End Use	
Selinger, J. David	Occidental Petroleum	

In Peshawar:

Rafiuddin, Mohammed	Adamjee	Paper General Manager
Khan, M. M.	Adamjee	Paper Chief Engineer
Qureshi, Nazir	Spinzer Indus. Production	Manager

In Karachi:

Chaudry, Mohammed Bashir	NDFC	Sr. Vice President, Projects
Siddiqui, Iqbal Zafir	Shabbir Tiles Plant	Manager
Mistry, Nassirudin	Pakland Cement General	Manager
Abdullah, M. M.	Pakland Cement	
Waheed, Asad	Pakland Cement	
Waheed, Arshad	Pakland Cement	
Faruqi, Azimuddin	ENAR/Petrotech	Manager, Energy Management Sys.
Jafri, Amjad J.	Hadson Pakistan	
Holton, Raymond	Hagler Bailly	
Jiwani, Tajuddin	Charnia	Int'l Director
Charnia, Anis	Anis Tyre	
Allawala, M. A.	Emman Assoc.	Chairman
Hardy, J. W.	Union Texas	Vice President
Martin, Luann	USAID	re Briquette Study
Kazmi, Amir H.	GSP	Director General
Ahmad, Nisar	PCSIR	Director, Fuel Research Center
In Lahore:		
Ilyas, G. M.	WAPDA	Chief Engineer, Coal Power
Eida, M. Yousef	WAPDA	Director, Coal Power Project
Haq, Moinul	WAPDA	Director, Mining f/ Coal Power
Ahmad, Mahmood	Dawood Herc.	General Manager
Ahmed, Ijaz	Dawood Herc.	Senior Engineer
Salahuddin, Mir	Lahore CC & I	President
Hayat, Sikandar	Lahore CC & I	Vice President
Elahi, Suleiman	Packages, Ltd. Tech.	Manager
Butt, Khalid Mahmood	Packages, Ltd.	Senior Engineer
Yahya, Lugman	SITE Assoc.	Chairman
Haji, Nazim	SITE Assoc.	Senior Vice Chairman
Shaffi, Ejaz	SITE Assoc.	
Karim, M. Yarub	SITE Assoc.	
Aziz, Majyd	SITE Assoc.	
Daud	Star Textile	Director
Modi, Shabir T.	Star Textile	Engineer
Ahmed, Saeed	Techno-Consult	
Khan, Sultant	Techno-Consult	Head, Energy Division

APPENDIX B
EP&D PROJECT LOGICAL FRAMEWORK

Reproduced from the Project Design Summary
USAID PROJECT PAPER
ENERGY PLANNING AND DEVELOPMENT PROJECT
July 1983

ENERGY PLANNING AND DEVELOPMENT PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
<p><i>Program or Sector Goal: The broader objective to which this project contributes:</i></p> <p>-To increase Pakistan's energy self-sufficiency</p>	<p><i>Measures of Goal Achievement:</i></p> <p>-Imported oil provides smaller percentage of total energy use -Decrease in power outages-shortages -Decrease in rate of consumption of fuelwood -Indigenous coal provides larger percentage of total energy use</p>	<p>--Pakistan's energy balance sheets --Data collected by the Energy Analysis Group --Project evaluations --Data collected and records kept by relevant GOP Ministries --Studies and surveys undertaken by project staff --Facility inspections</p>	<p><i>Assumptions for achieving goal targets:</i></p> <p>--GOP policies will continue to encourage reduced fuel imports, increased exploitation of indigenous sources of energy, and increased energy efficiency</p>
<p><i>Project Purpose:</i></p> <p>-To assist the GOP to formulate and implement plans and programs to assess, develop and use Pakistan's indigenous energy resources and to improve the efficiency of energy use</p>	<p><i>Conditions that will indicate purpose has been achieved: End of project status.</i></p> <p>-GOP plans place increased emphasis on energy efficient programs and projects -Improved GOP knowledge of availability of domestic sources of energy -Coal mining industry capable of meeting increased demand generated -Increased reliance on domestic sources of energy -Reduced consumption of energy per unit production -Increased use of alternate fuels for wood including marketing and acceptance of coal briquettes - Increased use of renewable and alternative energy sources</p>	<p>--Pakistan's energy balance sheets --Data collected by the Energy Analysis Group --Project evaluations --Data collected and records kept by relevant GOP Ministries --Studies and surveys undertaken by project staff --Facility inspections</p>	<p><i>Assumptions for achieving purpose:</i></p> <p>--GOP policies will continue to encourage the involvement of the private sector, especially in the coal industry and renewable energy areas --GOP will revise price structure for fuels to reflect their real cost of production and give preference to Pakistan's large but as yet unproven coal reserves --GOP will utilize the analyses, studies, and other planning tools generated by the Energy Analysis Group for policy formulation in the energy sector --Agencies involved in renewable energy programs will coordinate and integrate their activities and only those technologies which are socially and economically sound will be pursued --Coal briquetting will be economically and socially acceptable in Pakistan</p>

Source: AID Project Paper, EP&D Projects, 391-0478, July 1983.

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
<i>Outputs:</i>	<i>Magnitude of Outputs:</i>		<i>Assumptions for achieving outputs:</i>
<i>Component 1: Energy Analysis and Manpower Development</i>	<i>Component 1:</i>		
<ul style="list-style-type: none"> -A perceived GOP Energy Analysis Group (EAG) established within the Ministry of Planning and Development and capable of doing integrated analyses and sectoral and special studies. -An Energy Data Management System within the EAG established -A series of special energy study reports completed and used in formulating energy policy and in preparing annual, mid-term and five year development 	<ul style="list-style-type: none"> -An operational analysis group exists within EAG with 3 to 6 persons qualified full-time analysts -An operational Data Management System exists within the EAG equipped with computers and software -EAG, P&D, and other energy sector officials trained -Manpower assessment completed and training plan developed -7 special study reports covering energy pricing and demand by sector, energy forecast, manpower assessment, etc. 	<ul style="list-style-type: none"> -Pakistan's energy balance sheets -Data collected by the Energy Analysis Group -Project evaluations -Data collected and records kept by relevant GOP Ministries -Studies and surveys undertaken by project staff -Facility inspections 	<ul style="list-style-type: none"> -Qualified participants are selected for training -Technical consultants are effective in working with their counterparts -Training programs will effectively transfer skills and technology -Adequate personnel and budgeting support will be provided by the GOP -The Pakistani private sector will be responsive to and participate in new initiatives in energy conservation, coal development, and renewable energy
<i>Component 2: Coal Assessment and Development</i>	<i>Component 2:</i>		
<ul style="list-style-type: none"> -A Coal Project Department established in WAPDA capable of planning and managing development of coal-fired power plants -Coal resource assessment completed which will provide a quantitative understanding of local reserves -Coal analysis facilities upgraded at GSP, PMDC, and PCSIR -Completed assessment of the development barriers facing public and private coal mining industry and options available to GOP to reduce those barriers and stimulate private investment in coal -Completed design and demonstration of improved mining techniques appropriate to Pakistan coal industry. -Design manual completed containing all the field investigations and analytical data necessary for the design of surface and/or underground mines at Lakhra to produce at least 1.4 million tons per year coal for a 300 MW electric power station -A feasibility study, test market analysis and pilot plant for producing coal briquettes for the residential market 	<ul style="list-style-type: none"> -WAPDA, GSP, PMDC, and PCSIR employees and private sector participants trained in U.S., Pakistan and third countries -Report completed; laboratory installed. -- Recommendations prepared and implemented including incentives for the development of a modern coal mining industry -Demonstration mine operating including truck-mounted drill, geophysical truck, electric mine locomotives, underground rail, conveyers and other equipment -25 ton per day briquetting plant tested and operating 		

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
<i>Outputs:</i>	<i>Magnitude of Outputs:</i>		<i>Assumptions for achieving goal targets:</i>
<p><i>Component 3: Conservation and Renewable Energy</i></p> <ul style="list-style-type: none"> --Energy audits completed and Industrial Energy Audit Data System established --Industrial efficiency increased as a result of energy conservation measures --Industrial energy efficiency demonstration projects implemented --Energy needs survey describing the user market for renewable energy technologies completed --Technology assessments and demonstrations of renewable energy technologies (solar, small hydro, efficient wood stoves, and biogas digesters) completed 	<p><i>Component 3:</i></p> <ul style="list-style-type: none"> --50 completed audits --10 percent overall increase in efficiency --4 to 8 --1 --6 solar monitoring stations installed --Long-term solar plan completed and 3 or more solar demonstration systems in place and 2 to 4 small hydro generators with test instrumentation installed --Wood survey report completed and up to 50 demonstration high-efficiency stoves in operation --Up to 20 DGER and AIDO personnel trained in U.S. 		
<i>Inputs:</i>	<i>Implementation Target:</i>		<i>Assumptions for Providing Input:</i>
<p>1. AID</p> <ul style="list-style-type: none"> --Short- and long-term expatriate and Pakistani technical assistance --Short- and long-term U.S. and third country training --Vehicles, computers, coal exploratory equipment, renewables and coal briquettes commodities, and energy audit and conservation equipment --Renewables and energy conservation demonstrations and pilot briquettes plant <p>2. GOP</p> <ul style="list-style-type: none"> --Staff salaries and operating expenses --Land royalties --In-country training --Office space for expatriate advisor --Locally-procured commodities (e.g. mining camp and water truck) --Recurrent costs of renewables demonstrations and pilot briquettes plant --Local consultants to undertake energy audits and to design and install renewable demonstrations --Salary of participants while in training 	<ul style="list-style-type: none"> --see Financial Analysis, Implementation Schedule, and Proposed Technical Assistance, Commodity, and Training Plans in the Project paper 	<ul style="list-style-type: none"> --AID and GOP project records and financial reports --Project evaluations 	<ul style="list-style-type: none"> --AID and GOP proposed funding levels are approved by their respective governments and disbursements are made on a timely basis --Appropriate overseas training programs can be identified --The GOP meets the conditions precedent for this project --Appropriate consultants can be recruited to provide the required technical assistance

APPENDIX C
SUMMARY OF MATHTECH SCOPE-OF-WORK

APPENDIX C
SUMMARY OF MATHTECH SCOPE-OF-WORK

May 1986

1. Develop an Energy Analysis Group and Energy Data Systems Unit; assist ENERPLAN in defining the roles and resource needs of these units; define their relationships with the rest of the GOP;
2. Prepare with ENERPLAN a preliminary Long Term Energy Plan before July, 1987;
3. Prepare with ENERPLAN a draft of the Seventh Five-Year Plan by July, 1987;
4. Survey and document the current state-of-the art in energy analysis and data systems in developing countries;
5. Develop and implement a plan for upgrading the capabilities of current centers of analytical strength within Pakistan;
6. Assist ENERPLAN and other institutions to strengthen their modeling capabilities.
7. Assess the financial requirements of major Pakistani public sector energy organizations under different scenarios, and determine their required physical, financial, material, and manpower resources for energy projects;
8. After preparing the Five-Year Plan and Long-Term Plan, prepare a report identifying and assessing key planning issues in Pakistan, recommend solutions, and then implement them;
9. Develop an energy project/program monitoring and evaluation system;
10. Conduct a comprehensive inventory of existing energy data-bases in Pakistan, find gaps, recommend strategy for filling gaps;
11. Design and assist in implementation of standard formats for energy data collection, storage and presentation;
12. Develop and initiate an information dissemination program, making data available to the public;
13. Design a computer-based system for energy data, and then assist ENERPLAN in implementing it;
14. Prepare approximately 18 special studies, with a concentration of these studies in the initial stages of the contract;

15. Organize and conduct in-country short courses and seminars on selected topics;
16. Identify suitable sites for training, help ENERPLAN in identifying suitable individuals for training, and help ENERPLAN in improving the stock of reference materials available to ENERPLAN.

APPENDIX D
STATEMENT OF WORK

UNITED STATES OF AMERICA
AGENCY FOR INTERNATIONAL DEVELOPMENT

Consulting Services: YES [] NO [X]

1. Countries of Performance: Pakistan
2. Indefinite Quantity Contract: PDC-5530-1-00-6109-00, Delivery Order No.: 02

<p>3. CONTRACTOR (Name and Address): CBY Associates, Incorporated 5039 Cathedral Avenue N.W. Washington, D.C. 20016</p> <p>DUNS NO.: 116208554</p>	<p>4a. ISSUING OFFICE: Agency for International Development Overseas Division/ANE Office of Procurement Washington, DC 20523</p> <p>4b. ADMINISTRATION OFFICE: Same as 4a.</p>
<p>5. PROJECT OFFICE: David Johnston USAID/Pakistan</p>	<p>6. SUBMIT VOUCHERS TO: Controller USIAD/Pakistan</p>
<p>7. EFFECTIVE DATE: <u>May 13, 1988</u></p>	<p>8. ESTIMATED COMPLETION DATE: <u>August 5, 1988</u></p>
<p>9. ACCOUNTING AND APPROPRIATION DATA: Amount Obligated: \$114,478.00 Total estimated Costs: 114,478.00 Appropriation No.: 72-117/81037</p>	<p>PIO/T No.: 391-0478-3-70331 Project No.: 391-0478 BPC No.: QES7-87-27391-KG-13</p>
<p>10. The United States of America, represented by the Contracting Officer signing this Order, and the Contractor agree that: (a) this Order is issued pursuant to the Contract specified in Block 2 above and (b) the entire Contract between the parties hereto consist of this Work Order and the Contract specified in Block 2 above.</p>	
<p>11a. NAME OF CONTRACTOR: CBY ASSOCIATES, INCORPORATED</p>	<p>11b. UNITED STATES OF AMERICA AGENCY FOR INTERNATIONAL DEVELOPMENT</p>
<p>BY: <u>Charles A. Bankston</u> (Signature of authorized individual)</p>	<p>BY: <u>Morton Darvin</u> (Signature of Contracting Officer)</p>
<p>TYPED OR PRINTED NAME: <u>Charles A. Bankston</u></p>	<p>TYPED OR PRINTED NAME: MORTON DARVIN (WG)</p>
<p>TITLE: <u>President</u></p>	<p>TITLE: CONTRACTING OFFICER</p>
<p>DATE: <u>May 16, 1988</u></p>	<p>DATE: <u>May 16, 1988</u></p>

ARTICLE I - TITLE

Energy Planning and Development (EP&D) Project.

ARTICLE II - BACKGROUND

Background

The goal of the energy planning and development project is to increase Pakistan's energy self-sufficiency and thereby improve the quality of life for its people. The purpose of the project is 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. This is being achieved by strengthening the capability of the GOP to, amongst other things, (1) undertake effective integrated and sectoral analyses of energy development strategies in order to support financially sound GOP energy policy and development planning, (2) develop programs in coal assessment, mining, and utilization; and (3) adopt energy conservation and renewable energy technologies.

The project is divided into four major technical Energy Planning and Development (EP&D) components:

(1) Energy Analysis and Manpower Development; (2A) Coal Resource Assessment, (2B) Coal Development and utilization and (3) Conservation and renewable energy technologies. There is also a special energy commodities component.

Under the energy analysis and manpower development component (1), the objective is to strengthen GOP's energy planning and analysis capabilities for its annual, five year and long-term planning activities. This is to be achieved through (A) establishment of an indigenous energy analysis group, (B) establishment of a national energy database, (C) provision of funds for special energy sector studies and (D) establishment of an energy sector manpower development training program consisting of short and long term courses in the energy field.

The energy analysis group has been established with the formation of the Energy Wing in the Ministry of planning and Development consisting of plan formulation, information and project appraisal sections. The first draft of the seventh five year energy plan has been submitted to the government. This has been the major activity in 1987 and work on some of the other activities could not proceed as was originally anticipated. A prototype of the National Energy Database and Energy Planning Model (RESPAK) has been developed and is in use. The major special study has been the Jamshoro Power Plant Feasibility study to assist World Bank's appraisal of units 5, 6, and 7. Other special studies has recently been initiated.

-3-

To date, 38 participants have been trained in the areas of energy management, energy planning and policy, investment appraisal and management program, utility and industry energy conservation, advance power systems engineering, petroleum management, coal petrology, coal analysis and applied petroleum exploration and production technology. A National Manpower needs assessment is planned for early 1988.

The coal resource assessment component (2A) supports GOP and Private Sector efforts to develop Pakistan's coal resources as an alternative to natural gas, imported oil and firewood. The major activities that have been taken place to date are (A) development of a National Coal Exploration Plan, (B) preparation of a reorganization plan for GSP, (C) delineation of major coal resource area in Sonda, (D) development of a geophysical logging of boreholes facility for the first time in Pakistan, (E) establishment of a National Geodata Center and computerization of data and (F) geological logging techniques imparted to GSP trainees.

The coal development and utilization component (2B) aims at increasing the use of indigenous coal by undertaking detailed investigations and feasibility studies for developing mines at Lakhra to provide the coal and at constructing a 500 MW coal-fired power generation plant. The project has assisted WAPDA to undertake exploratory and survey work at the Lakhra deposit so that engineering work, procurement and construction of a large mine and power plant complex could proceed if capital financing is available. Amongst the achievements made to date: a Coal Power Projects Department has been established within WAPDA to manage all coal mining and power plant projects; social soundness analysis, environmental assessment, coal mining feasibility, power plant feasibility, economic and financial feasibility studies have been completed. USAID assistance has been contingent on substantial private sector participation. A private sector RFP was issued in January 1987 for the supply of coal to the Lakhra power plant. Thirteen companies (five foreign and eight Pakistani) were prequalified. Two responses were received which WAPDA is evaluating.

Another important area of development for Pakistan's coal industry is the introduction of the use of processed coal for household use as substitute for firewood. Under the coal briquetting component (2C), a market assessment, consumer tastes, fuel price survey, and fuel use survey have been conducted. Policy reforms were recommended, and commercial scale production costs were assessed. The results are being processed in order to transfer them to the private sector, along with study tours, to encourage private investment. The PCSIR Fuels Research Center is experimenting to develop and indigenous manufacturing technology.

131

Under the Energy Conservation Component (3A), the objective is to assist GOP to develop, institutionalize and effectively implement a National Energy Conservation program which will reduce waste and improve the efficiency of energy use. A national energy conservation center (ENERCON) has been established under a resolution signed by the prime minister. The Pakistan Energy Conservation Council has been formed. The National Energy Conservation Legislation has been drafted and will be presented before the Parliament shortly. The first National Energy Conservation Plan has been published and integrated into the seventh five year energy plan. Several training programs such as the Energy Efficiency Management courses primarily for the private sector companies have been conducted. About 100 preliminary and 38 detailed Private Industrial Energy surveys have been completed. Eight Private Sector surveys have been completed. Eight Private Sector Bankable Feasibility studies have been completed.

Also under this component, the thermal power plants efficiency improvement program was designed in 1985. WAPDA is proceeding with the implementation with co-financing from World Bank, USAID and ODA.

The major GOP implementing agency for the project is the Planning and Development Division of the Ministry of Planning and Development. A project coordinator was appointed in the Planning and Development division for coordinating the overall project. He is the Senior Chief of the Energy Wing, which was established under the project and is also implementing the energy analysis and manpower development component of this project. The Ministry of Planning is also responsible for implementing the energy conservation component under the National Energy Conservation Center (ENERCON). Within the Ministry of Water and Power, the Water and Power Development Authority (WAPDA) has the lead for all coal development activities under this project through its coal projects department.

The Pakistan Council for Scientific and Industrial Research (CSIR) in the Ministry of Science and Technology is responsible for implementing the coal briquetting activities. The Ministry of Petroleum and Natural Resources is responsible for the coal resources assessment work. Within the petroleum ministry, the Geological Survey of Pakistan (GSP) is responsible for the coal resource assessment component to implement the coal development component with private sector involvement. The Directorate General of New and Renewable Energy Resources (DGNRER) in this ministry will assume overall technologies component of this project. All of these agencies shall appoint and delegate authority to full-time officials and assign to them adequate staff to implement, with the assistance of expatriate advisors their respective components of the project.

More detailed information is found in the project paper and in other project related documents. Prior to departure for Pakistan, the team members will be provided copies of the project paper, project agreements, contracts, work plans, work assignments, project implementation letter (PIL'S), working project documents, and PC-II's.

ARTICLE III - STATEMENT OF WORK

The evaluation will include but shall not be limited to the questions listed below. The evaluation team will also make recommendations aimed at improving project implementation and impact in light of these questions. (Additional questions to be addressed for each component are given in paragraph E of this section).

A. Energy analysis and manpower development program (component I).

Evaluate the effectiveness and capacity of the energy analysis group (Energy Wing) to (A) Carry out data collection and analysis, (B) adapt and operate energy modeling tools and produce useful outputs, (C) integrate national energy analysis and planning activities with special attention to the seventh five year energy plan, and (D) set priorities for and execute special studies undertaken to address key energy sector issues for the seventh plan and beyond.

Assess the progress in developing and implementing a manpower development program for the energy sector. Review the effectiveness of the training programs and technical assistance support in improving the GOP's capability to undertake economic and technical analyses required to effectively use resources in energy sector development.

Evaluate the energy data and information systems and models developed under the activity, and assess to what extent they are being used as an input to decision-making in planning and analysis.

Assess the institutional development of Energy Wing and recommend measures necessary for its permanence as an effective energy planning unit within the GOP in such a manner as to maintain its current administrative support flexibility. Briefly discuss the impact of other special activities supported by the project under this component, including design of the Jamshoro Power Project expansion, Dhodak Gas Field Privatization, the National Coal Conference, and the National Oil and Gas Symposium.

-6-

Determine the views of pertinent donors with respect to the effectiveness of the planning effort undertaken to date. In addition, analyze the technical assistance needs for the future, based upon the directions set by the draft Seventh Five year plan and also indicate what issues the Energy Wing needs to consider to program for the future (A.I.D. took the lead for energy planning assistance based on a consensus among donors. This led to certain assumptions about technical assistance needs which influenced the project design.)

B. Energy Conservation Program (Component 3A)

Evaluate the progress of the institutional development side: formation and staffing of ENERCON; Pakistan Energy Conservation Council, its advisory committee, and the Energy Conservation Law.

Evaluate the energy conservation databases developed under the activity and assess to what extent they are being used as an input to decision-making in planning and analysis.

Evaluate if the activity has been able to achieve its objective of assisting the GOP to mobilize the private sector in energy conservation activities, and the private sector response to these initiatives.

Review the Progress of the WAPDA Thermal Power plants efficiency improvement program implementation, which was designed under this component.

C. Coal Resource Assessment & Coal Briquetting Program
(Components 2A, & 2C).

Evaluate the progress in establishing and implementing a coherent and feasible coal resource assessment and development program in Pakistan and the extent of private sector participation in this program.

Evaluate the progress with coal briquette development and market assessment. Review the GOP's future plans with respect to coal briquetting activities in Pakistan, including the response of consumers and the private sector to this initiative supported by the project.

Evaluate the data collection efforts and information systems developed under these activities and to what extent they are being used as an input to decision-making in planning and analysis.

D. Coal Development and Utilization Program (Component 2B)

Assess management effectiveness and use of resources in implementing this program, including lessons learned for future USAID involvement in similar activities elsewhere.

134

Assess the extent to which the outcome of the component has been sound enough to attract adequate financing to develop the Lakhra Power Plant and its associated mines.

Evaluate if the activity has been able to achieve its objective of assisting the GOP to mobilize the private sector in coal development and utilization activities, and the private sector response to these initiatives.

Evaluate the procedure adopted for the Lakhra study under independent contracts for specific areas and its impact on evolving a co-ordinated overall project. Evaluate whether the scope of work was comprehensive enough to include study of all relevant options. Identify shortcomings and their impact on the project.

Evaluate whether the approach of formulating the project on the concept of WAPDA/PMDC venture could yield better tangible results as against the private sector.

E. General questions applicable to all components.

Identify the policy changes which have been supported as a result of this activity (through conditions precedents, TA, etc.)

Assess the end-use of commodities procured and in-country and overseas training provided to date under this activity.

Review the design strategy, the implementation plan, the funding requirements, the time schedules and the technical and institutional support of all activities pertaining to this component, listed in the project paper and other relevant documents, with a view to determining their adequacy to best accomplish the project's objectives (as originally stated, as modified, and as may be recommended for modification by this evaluation).

Review A.I.D. and GOP project management and monitoring for this activity in terms of adequacy and effectiveness.

Assess the amount, type, and quality of technical assistance provided by the contractor(s) for timeliness, appropriateness and effectiveness. Assess the adequacy or lack of counterpart staffing and consequent impact on institution building, revised role of contractor and future technical assistance requirements if any.

Identify and analyze key factors contributing to or inhibiting the achievement of the project's objectives for this activity and make recommendations as to future directions and strategy which can enhance this activity.

Comment briefly on major "Cross-Cutting" issues included in all USAID evaluations; effects on women; environmental issues; sustainability; and lessons learned.

135

ARTICLE IV - REPORTS

A. Format of the report

The evaluation team shall prepare a written report in accordance with Agency guidelines discussing issues described in the statement of work and containing the following sections:

1. Basic project identification data sheet (mission to provide format).
2. Executive summary of not more than four single spaced typed pages (mission to provide format).
3. Body of the report (the report is to include a description of the country context in which the project was developed and carried out, and provide information including both evidence and analysis on which the conclusions and recommendations are based).
4. Conclusions and recommendations (conclusions should be short and succinct, with the topic identified by a short sub-heading related to the questions posed in the statement of work. Recommendations should correspond to the conclusions. Whenever possible, the recommendations should specify who, or what agency, should take the recommended actions).
5. Appendices (these are to include as a minimum the evaluation scope of work, the pertinent logical framework with a brief summary of the current status/attainment of original or modified inputs and outputs if these are not already indicated in the body of the report; a description of the methodology used in the evaluation; a list of agencies and individual consulted; and a bibliography of documents consulted).
6. A completed evaluation summary format (A.I.D./Washington to provide format).
7. Team members will submit their reports to the team leader as instructed by the team leader.
8. 20 copies of the final report shall be provided to the mission.

B. Timing of reporting

The draft report shall be submitted to USAID and the GOP representatives at the end of the fourth week for joint review. The final report shall be completed by the team leader review within two weeks of receipt of Mission and GOP's final comments.

C. Other considerations

Members of the team will meet in Washington prior to leaving for Pakistan. Individual members of the team will make every effort to coordinate simultaneous arrival times, to ensure that all members are involved in conducting the evaluation, and preparing the final draft report. The Team Leader will present the findings of the final report to AID/W upon Mission submission of a final evaluation. The Team Leader may, at Mission request, return to Pakistan to present the final report findings.

ARTICLE V - TECHNICAL DIRECTIONS

Technical Directions during the performance of this delivery order will be provided by the A.I.D. Project Officer pursuant to Section F.3 of Contract PDC-5730-I-00-6109-00.

ARTICLE VI - TERMS OF PERFORMANCE

- A. The effective date of this delivery order is May 13, 1988 and the estimated completion date is August 5, 1988.
- B. Subject to the ceiling price established in this delivery order, and with prior written approval of the Project Manager (see Block No. 5 on the Cover Page), Contractor is authorized to extend the estimated completion date, provided that such extension does not cause the elapsed time for completion of the work, including the furnishing of all deliverables, to extend 30 calendar days from the original estimated completion date. The Contractor shall attach a copy of the Project Manager's approval for any extension of the term of this Delivery Order to the final voucher submitted for payment.
- C. It is the Contractor's responsibility to ensure that Project Manager-approved adjustments to the original estimated completion date do not result in costs to be incurred which exceed the ceiling price of this delivery order. Under no circumstances shall such adjustments authorize the Contractor to be paid any sum in excess of the ceiling price.
- D. Adjustments which will cause the elapsed time for completion of the work to exceed 30 calendar days beyond the original estimated completion date must be approved in advance by the Contracting Officer.

137-