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E N D O F P R O J E C T R E V I E W

USAID SUDAN ENERGY PLANNING & MANAGEMENT

PROJECT #650-0059 (1983-1989)

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PREFACE

This review up-dates the findings of the formal Mid-term Evaluation of the Sudan Energy Planning and Management (EPM) Project (1987) and focuses on EPM's accomplishments, particularly with regard to indications of a strengthening of energy institutions in Sudan. With only three person weeks available for this review and with the absence from Sudan of many EPM project participants on the A.I.D. and contractors' sides, a number of issues normally examined in some detail in a formal Final Evaluation are not directly addressed in this End-of-Project Review, and some points are addressed with only a limited perspective. For example, the contractual relations between USAID/Sudan and the EPM contractors are not directly considered.¹

In short, this End-of-Project Review should not be considered as an thorough assessment of EPM from an administrative perspective. Rather, it is an attempt to identify what Sudan got out of the project directly (i.e., near-term specific outputs) and in longer-term impacts on Sudan's ability to more efficiently manage its energy activities.

¹ The formal Mid-Term Evaluation (Ref. 1) conducted in early CY 1987 provides a good treatment of the early contractual issues on the project and how they were being resolved up to the time of that Evaluation. This description is generally accurate for the remainder of the project. The reader is referred to the Mid-Term evaluation for information on this topic.

LIST OF ACRONYMS

AID	Agency For International Development
BNG	Blue Nile Grid
CETP	Conventional Energy Training Program
CIP	Commodity Import Program
COP	Chief of Party
CY	Calendar Year
E/DI	Energy/Development International
EPM	Energy Planning & Management (project)
FY	Fiscal Year
GNP	Gross National Product
GOS	Government of Sudan
GPC	General Petroleum Corporation
ISTI	International Science & Tech. Inst.
MEM	Ministry of Energy and Mining
NEA	National Energy Administration
NEC	National Electricity Corporation
NEP	National Energy Plan
NRC	National Research Council
PIR	Project Implementation Review
SEPAP	Sudan Energy Policy & Planning Project
S&T/EY	Sci. & Tech. Bureau, Office of Energy
PP	Project Paper
TA	Technical Assistance
UNDP	United Nations Development Program
USAID	The A.I.D. Mission in a particular country

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3 Comparison of Blue Nile Grid Performance:
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SUMMARY

Significant activities under the Sudan Energy Planning and Management Project (EPM) began in 1984 and most were completed by mid-1989. EPM was intended to strengthen the institutional capability of National Energy Administration (NEA) and the National Electricity Corporation (NEC) to deal respectively with national energy planning and power sector planning and to do so in a manner which provided near-term benefits in the form of useful energy plans and analyses and up-graded power system performance. EPM was to do this by providing funds for long-term advisors, for short-term consultants, for short-term training, and for the purchase of commodities.

The long term advisors were central to the project and their management approaches had a profound impact on the course of EPM. When the advisors and consultants worked poorly with their counterparts (as was largely the case for both the NEC and NEA in the first year and more of EPM), project activities were viewed by the counterpart organizations and USAID/Sudan in generally negative terms. When relations between the long-term advisors and counterparts became mutually supportive (as was the case for the last two years or so of EPM), project activities were viewed generally favorably.

The EPM reflects mixed goals for a development assistance effort. While it was aimed primarily at strengthening NEA and NEC planning capabilities, it also included highly ambitious specific goals for near term measurable outputs. For example, goals for NEA included higher GNP in energy sensitive sectors, more efficient energy use by public corporations, government institutions and large private companies and Government of Sudan (GOS) implementation of policies/plans recommended by NEA. For NEC goals included an improved organization and management structure, and at least a 60% increase in NEC revenue collection by the end of the project. Of these, only the last was fully achieved (and, in fact, substantially exceeded) within the project period.

Under the contract objectives, the firm of Energy/Development International (E/DI) was to assist in the institutional development of NEA so that NEA could serve as the policy and planning arm of the Ministry of Energy and Mining (MEM). Originally, E/DI was also to provide institution-building assistance to the General Petroleum Corporation (GPC) under EPM, but this was dropped at the request of USAID due to concerns over purchasing irregularities at GPC. The Technical Assistance (TA) to NEC was provided by Harza Engineering Inc. The objective of the Harza contract was to assist NEC in becoming an organization capable of providing more reliable electricity service, better able to manage its systems, and in a stronger financial position with regard to its cash flow and collection. Harza was supposed to do whatever it could to make NEC into a "effectively run business".

Clearly, both the E/DI and the Harza contracts had very ambitious goals, and, if taken too literally, unrealistic goals. NEA in the early 1980s was a new organization, still relatively small and having only very limited trained manpower. Yet, over the next several years it was supposed to move into the center of GOS energy sector decision-making, taking the lead from the much larger, long established and powerful (if not necessarily well managed) organizations such as NEC, GPC, as well as with the less powerful, but still well established organizations such as the Central Forestry Administration. Harza was to take NEC (an organization with thousands of employees, a long history of pervasive, poor management, entrenched labor unions resistant to change, and a public sector agency which never had to seriously worry about its own financing) and to turn it around in the space of a few years into "an effectively run business"!

The Mid-term Evaluation's general critique (February 1987) of the Logical Framework (Log-Frame) of the EPM's formal design document (i.e., the Project Paper or "PP") noted,

Overall, the higher goals of the project were appropriate to Sudan's circumstances, but the specific outputs were naively high ...

Despite the overly ambitious nature of the short-term goals, the Mid-term Evaluation found that the higher goals (i.e., institution-building for NEA and NEC) were fundamentally sound. Further, the Mid-Term Evaluation Team found that at nearly three years into the project, there were sufficient indications of progress in institution-building and adequate signs of measurable near-term impacts. In light of this and the importance of the need for stronger energy sector institutions in Sudan, the Team strongly urged continuation of both the NEA and NEC components of EPM.

Early in the EPM project, NEA felt that a number of the E/DI consultants were not working sufficiently closely with NEA staff on the actual analytic work. The Mid-Term Evaluation Team also concluded that as of early Calendar Year (CY) 1987, nearly three years into the project, the contractor was not succeeding in transferring the needed skills to NEA. Even more basic to working relations at the start of the EPM assistance to NEA was NEC dissatisfaction with the first E/DI Chief of Party (COP), who they felt was not working in their interests. In 1985 the first E/DI COP for the NEA component was forced to leave the project. Under the term of the second permanent COP conditions between the E/DI advisors and consultants and NEA improved considerably. NEA was particularly pleased with emphasis placed by the new long-term advisors and consultants on the transfer of technical skills to NEA staff.

This transfer of skills to NEA staff appears to have been

reasonably successful, though one must recognize that gaps still exist and that this is an almost inevitable condition in a country facing the continuing problems of Sudan. Compared to many other low income developing countries, Sudan seems to be doing rather well in terms of indigenous capacity for integrated energy analysis and planning.

E/DI provided various simple and relatively complex modelling frameworks and structured Models to NEA over the course of EPM. NEA appears to be making good occasional use of some of these tools, with the major exception being the comprehensive integrated energy planning accounting system - RES-SUDAN. RES-SUDAN is not being used by NEA, although NEA says it has considerable need for the model to assist in its work on the up-dating of the National Energy Plan (NEP). According to NEA there was insufficient guided hands-on work with the model before the end of the EPM assistance to NEA. E/DI feels that the training provided to NEA on RES-SUDAN was adequate and that NEA should be able to use its own resources to overcome any remaining problems it is having in using RES-SUDAN. Getting RES-SUDAN operational should be a high priority for NEA and USAID (or other donors).

As noted in the Mid-Term Evaluation, early in the EPM, the counterparts wanted additional training in economics and nearly three years into EPM the Mid-Term Evaluation found that "the level of economic and financial analysis by NEA staff is weak." The Mid-Term Evaluation recommended that E/DI provide better training in the area of economic analysis for NEA. This weakness appears to have been at least partly addressed over the next two years, in part due to short-term courses provided by E/DI consultants, and in part to the return of more NEA staff with masters degrees in energy planning.

NEA is working on various areas of the up-dated National Energy Plan for Sudan and continued to undertake analyses in a wide range of areas. For example, NEA is responsible for coordinating, reporting and follow-up activities on each of the subcommittees for the NEP up-date. Under directives from the GOS, NEA is evaluating renewable energy options, with an emphasis on gasification and briquetting. NEA is also working on the 1988 Energy Handbook, an annual compendium of energy data and brief reviews of trends in energy supply and consumption, and information on energy-economy interactions and related statistics (e.g., price indexes).

Although A.I.D. support has ended, NEA is beginning to work more with other donor agencies. For example, NEA will be working with the United Nations Development Program (UNDP) on a Rural Energy Program for Sudan. The proposed World Bank Technical Assistance Project Four includes assistance to NEA. NEA is also expected to participate in the World Bank-funded Forestry project when this is approved. NEA helped to coordinate the planning for this project. Working with the Forestry Administration, NEA staff would be

responsible for the fuelwood supply data and conservation potential. Another donor assisted effort is a French-funded project to evaluate gasification options, with NEA evaluating the economics and technical feasibility. The NEA's Techno-economics Section is engaged in a number of essentially technical process studies associated with coal, peat, agricultural wastes and other indigenous fuels. Presently, the Section is working with the Planning Section of NEA on an assessment of fuelwood use by bakeries and, in conjunction with NEA's Project Implementation Section, continues to look at biogas possibilities. The future role of the Techno-economics section within NEA is a major organizational issue for NEA. USAID and other support proposals to remove the Techno-economic section from NEA so that the remaining components of NEA can be more clearly directed toward policy matters.

The present NEA staff have a reasonably good understanding of the nature of energy planning and policy analysis. They are aware of the need for data collection and analyses directed toward assessment of policy options. The major question is how the NEA views its role within the larger GOS planning context, particularly the role of NEA in actively raising policy issues and providing independently verified sets of data for the energy sector. Since E/DI departed in August 1988, NEA has continued on its own to carry-out a number of energy data collection and analytic activities. While not all of this work is up to desired standards of completeness and penetrating critical analysis, the NEA is contributing in important ways to the understanding of energy issues and options in Sudan.

NEA is, in the eyes of these observers, an organization which may collect information in a reasonably effective manner and may carry-out reasonably good analyses of noncontroversial issues. However, they see it as one which does not actively assess the wider range of energy issues in an attempt to set the national energy planning agenda, particularly as this might deal with the activities of the major parastatals. NEA's response is that it is helping to bring about such integration, but that in Sudan this is best done in a cooperative, and clearly non-confrontational manner. NEA stresses that it can be most effective by assisting other agencies to carry out work to meet their own perceived analytic needs.

In its work with NEC, Harza focused on up-grading the NEC computer center and firmly establishing it as the centerpiece for reform of the financial system within NEC. Changes were implemented in the computer billing and collection data accounting system which highlighted errors in the existing data, and which necessitated changes in the manner in which meter readings were made and how records were kept. Success in this and related areas was initially slow in coming. The first Harza COP had a difficult time getting activities moving and he left after 17 months. Under the second Harza COP relations between NEC and Harza steadily improved. By

late CY 1986 and early 1987, it was becoming clear that the work with the computerized billing system was paying off with direct and substantial increases in revenues for NEC. Indeed, the pace of revenue improvements far exceed the planned accomplishments. By FY 1987-88 NEC revenues were approximately 75 million Sudanese pounds, more than three times the level of FY 1984-85.

The computerized billing system has been operating effectively for roughly the past 1 to 2 years. Although operational for some time, improvements continue in such areas as identifying and correcting past data entry errors, instituting procedural changes in the meter reading and recording systems to more closely suit the needs of the computer system procedures, and carrying out detailed surveys in specific areas to check on accounting records and gather current and accurate information with regard to individual consumers. Improvements in the billing and collection system should be an on-going process, since only a portion of the areas in and around Khartoum have been adequately surveyed.

The Harza work also included up-grading of systems dealing with delinquent accounts, service orders, billing corrections, payroll, and general accounting. Like the billing work, the system up-grading in these other areas was not without difficulty, but appears to have resulted in what should be reasonably self-sustaining improvements. The EPM also funded substantial amounts of formal long and short-term training for the NEC.

The second Harza COP to NEC effectively used the work of the computer center in the billing area to help spur a thinly spread, but capable and motivated core group within the middle and upper technical management levels of NEC. He and this informal core group used the prospect of much improved revenues to enlist the support of top NEC management for the introduction of needed changes in the meter reading and reporting systems. In this, the success was limited, but it also clearly helped to encourage the more reform-minded elements within the NEC.

Both the NEC and NEA EPM project components are viewed as valuable institution-building exercises by their counterparts. The technocratic levels of NEC and NEA see the A.I.D.-funded assistance under EPM as an important asset in their on-going attempts to influence their own organizations and the larger energy sector in Sudan. For the NEC counterpart staff the struggles are largely ones of internal management within NEC. At least in the eyes of the NEA counterparts the objectives have largely moved on from being ones of internal management to ones of NEA's influence in the larger setting of energy sector decision-making in Sudan. Whether outside observers fully share their counterparts' perceptions about the value of the EPM in the process of institution-building remains an open question. However, it is clear that the counterparts themselves believe that their organizations are stronger and more effective today as a direct result of EPM assistance.

To an outside observer, it still appears that in 1989, as the Mid-term Evaluation found in 1987, "the intended role of EPM to promote the development of NEA into a central policy player in the energy has not been fully realized." However, as the Mid-term Evaluation went on to note, "it was unrealistic to expect a new organization to achieve full institutional maturity and political influence over a four to six year period." Again, looking at NEA after seven years of AID assistance, it is clear that to achieving the central goal set out for NEA in the EPM will take much longer still and it was naive to believe otherwise.

The EPM-funded assistance to NEC appears to have strengthened the organization in a least two partly related ways. First, through provision of a much up-graded (physically and operationally) Computer Center, EPM has helped make the Computer Center into a force for putting NEC on a much stronger financial footing. Second, the Harza COP became an important link with an informal group of committed and capable NEC middle and upper level staff, and a partner with them in pushing for reforms within the organization. The success of the EPM computerized billing system and subsequent increase in collections is used as a prime example by this group of the potential for near-term benefits to NEC of implementing reforms in a number of areas. In addition, there have been widely acknowledged benefits stemming from the work in such areas as computerized budget control and accounting, inventory control, and cash remittance control, distribution system loss reduction. Still, as anyone who visits Sudan realizes, the NEC remains a very long way from being an efficiently run organization. Considering the pervasive nature of the problems within NEC and the forces resistant to change, the success of the Harza work should probably be viewed primarily in terms of a clear demonstration of the potential for basic improvements and for localized near and medium term direct returns resulting from effective TA.

CONCLUSIONS

1. The EPM contributed to the process of economic development in Sudan.
2. EPM is a relative success in terms of its overall goals.
3. EPM demonstrated that Technical Assistance such as that provided by EPM can have highly cost-effective impacts on the counterpart organizations.
4. The impact of EPM in-country activities was considerably increased through the formal training course offered in the U.S., Egypt and elsewhere.

5. Projects of several million dollars and of the last several years can have important benefits, but except under the most fortunate of circumstances, such projects cannot by themselves entirely build a counterpart organization.

RECOMMENDATIONS

1. USAID should continue to look to the energy sector in Sudan as a crucial area of the economy and should continue to look for ways to meet assistance needs which fit within the Mission's funding capabilities and basic development objectives.
2. USAID should continue to closely monitor the work of NEC Computer Center, and in particular to track NEC revenues.
3. USAID should do whatever it can to provide assistance to NEA to get the RES-SUDAN model running.

I. INTRODUCTION

A. PROJECT PURPOSES

The general purposes of the EPM Project were to:

(1) increase short-term reliability of the Blue Nile Grid (BNG) and to improve the managerial and financial capability of the national Electricity Corporation (NEC) to generate, transmit and distribute power; and

(2) strengthen the capability of the National Energy Administration (NEA) to analyze and plan for the more efficient energy use in Sudan.²

The EPM was intended to strengthen the institutional capability of NEA and NEC to deal with energy matters in their respective areas and to do so in a manner which provided near-term benefits in the form of up-graded power system reliability and useful energy plans and analyses. EPM was to do this by providing funds for long-term advisors, for short-term consultants, for short-term training and for purchase of commodities.

B. RELATED A.I.D. PROJECTS

The project design took into account the AID/Washington and other USAID assistance to these organizations. For example, the NEC assistance complemented the equipment and material purchases under USAID's BNG rehabilitation project and commodity import program (CIP). The NEA on-the-job training complemented the long-term training under the S&T/EY Conventional Energy Training Program (CETP). The NEA assistance was designed as a direct follow-on to the Sudan Energy Policy and Planning (SEPAP) project (1981-83), a project which began working with NEA soon after its formal creation and at a time when its analytic capabilities were still in an embryonic stage. Under the S&T/EY-funded SEPAP and then under the USAID/Sudan-funded EPM, A.I.D. in-country TA to NEA spanned a period of eight years. Concurrently, CETP provided Master of Science Degrees in energy planning to a substantial number of NEA

² Originally, EPM was also to deal with the General Petroleum Corporation (GPC) as well as NEA in meeting this second purpose. However, due to irregularities in GPC's petroleum purchases early in the project, EPM activities with GPC were very limited and were later ended. In effect, institution-building and specific output goals for EPM were limited to NEC and NEA.

staff, including virtually all who presently occupy positions in NEA as Heads of Section (Feb. 1989).

C. KEY ROLE OF ADVISORS

Most of the EPM-funded resources to NEA were in the form of long-term advisors and short-term consultants who had a major role in deciding on the specific project activities. Most of the EPM assistance to NEC was also in the form of long-term advisors and short-term consultants who likewise had a major role in the design of specific material support and training.

The central role of the long-term advisors had a profound impact on the course of EPM. When the advisors and consultants worked poorly with their counterparts (as was largely the case in the first year and more of EPM), project activities were viewed by the counterparts and USAID/Sudan in generally negative terms. When relations between the long-term advisors and counterparts became mutually supportive (as was the case for the last two years or so of EPM), project activities were viewed favorably.

D. MEASURES OF PERFORMANCE

The EPM reflects mixed goals for a development assistance effort. EPM was aimed primarily at strengthening NEA and NEC planning capabilities, but also included highly ambitious specific goals for near term measurable outputs. For example, goals included,

- higher GNP in energy sensitive sectors
- more efficient energy use by public corporations, government institutions and large private companies
- GOS implementation of policies/plans recommended by NEA
- NEA would be capable to plan and advise the GOS on implementation of optimal energy policies for Sudan,
- NEC would have an improved organization and management structure

- NEC would improve its revenue collections by 60% by the end of the project.³

Of these, only the last was fully achieved (and, in fact, substantially exceeded) within the project period.

The Mid-term Evaluation's general critique (February 1987) of the Logical Framework (Log-Frame) of the EPM's formal design document (i.e., the Project Paper or "PP") noted,

Overall, the higher goals of the project were appropriate to Sudan's circumstances, but the specific outputs were naively high ...

This judgement was also reflected in the October 1986 Review of EPM by Bruce Strassburger. He noted, for example, that the specific measures of achievement for the NEC portion "seem exceptionally ambitious".

Despite the overly ambitious nature of the short-term goals, the Mid-term Evaluation found that the higher goals (i.e., institution-building for NEA and NEC) were fundamentally sound. Further, the Mid-Term Evaluation Team found that at nearly three years into the project, there were sufficient indications of progress in institution-building and adequate signs of measurable near-term impacts. In light of this and the importance of the need for stronger energy sector institutions in Sudan, the Team strongly urged continuation of both the NEA and NEC components of EPM.

The present End-of-Project Review re-examines the Mid-term evaluation's assessment of the "status of outputs" two years after the Mid-Term team's work and then looks for indications of progress in making NEA and NEC stronger institutions.

Clearly, treatment of the institution-building impacts involves much in the way of subjective judgments, and the conclusions are certainly open to further discussion. However, under the circumstances in Sudan (i.e., with an unpromising economic and social stability picture and much of the donor assistance extraordinarily poorly utilized), it is this institutional side of the economic development process which is perhaps the issue of overriding importance for the longer term.

³ For a point-by-point review of the goals, objectively verifiable indicators, and underlying assumptions see Appendix 5 of the Mid-term Evaluation.

E. REMAINING PORTIONS OF THE REVIEW

Section II of this Review presents an overview of the EPM agenda, schedule and resources. Section III up-dates the Mid-Term Evaluation in terms of the specific outputs by NEA and NEC attributable in whole or part to EPM, and their significance in terms of specific improvements in the energy picture and as indicators of advances in institutional capability. Section IV describes certain aspects of the institution-building process particularly relevant to EPM, and their consequences for the design and implementation of projects with major institution-building objectives. Section V up-dates the Mid-term Evaluation with respect to indications of institution-building in NEA and NEC. Section VI outlines lessons which A.I.D., the GOS, and contractors might learn from EPM.

II EPM PROJECT OVERVIEW

A. PROJECT FUNDING, SCHEDULE, APPROACH

The EPM Project (#650-0059) was authorized in August 1982 at an A.I.D. commitment of \$6.5 million and a contract budget of \$5.4 million. These funds were used over a period which ultimately extended to April of 1989. Four contracts were issued: E/DI (\$2.3 million), Harza Engineering (\$2.0 million), Arkel (\$0.3 million) and ISTI (\$0.8 million).

In terms of institution-building, this review concentrates on the E/DI and Harza work and deals to a much more limited extent with the work by Arkel and very little with that funded through ISTI. The Arkel work, while useful, was directed at specific activities carried out largely by expatriates. The ISTI contract provided an Energy Advisor to work at USAID (J. Carter), and in this position he evaluated a wide range of energy activities for USAID. Since he dealt largely with A.I.D. management, his work is of interest for this Review primarily in how it affected on-going mission involvement with the NEC and NEA work under EPM.

EPM project funding began in early 1983 to provide transitional support to NEA and NEC until the new contractors could field their teams. AID/W (i.e., S&T/EY) had provided TA to NEA during the first several years of NEA's existence under the SEPAP and the NEA EPM component was designed as a direct follow-on. In the case of NEC, A.I.D. continued to fund major rehabilitation of the Blue Nile grid (BNG) system. EPM was designed to ensure more efficient use of A.I.D. commodity assistance to NEC (e.g., vehicles, calibration equipment) and to help NEC up-grade its management so that it could make better long-term use of donor agency assistance.

The E/DI team arrived in March 1984 and the Harza team arrived in July 1984. Arkel began its work in January 1985. In April 1986 American personnel were evacuated from Sudan, including most E/DI and Harza advisors and consultants. Six months later, in October 1986, the Americans returned. During the evacuation period, EPM work continued at a low level.

Under the contract objectives, E/DI was to assist in the institutional development of NEA so that NEA could serve as the principal policy and planning arm of the Ministry of Energy and Mining (MEM). Originally, E/DI was also to provide institution-building assistance to the General Petroleum Corporation (GPC) under EPM, but this was dropped at the request of USAID due to concerns over purchasing irregularities at GPC.

The objective of the Harza contract was to assist NEC in becoming an organization capable of providing more reliable electricity service, better able to manage its systems, and in a stronger financial position with regard to its cash flow and collection. In short, Harza was supposed to do whatever it could to make NEC into a "effectively run business".

Clearly, both the E/DI and the Harza contracts had very ambitious goals, and, if taken too literally, unrealistic goals. NEA in the early 1980s was a new organization, still relatively small and having only very limited trained manpower. Yet, over the next several years it was supposed to move into the center of Government of Sudan (GOS) energy sector decision-making, taking the lead from the much larger, long established and powerful (if not necessarily well managed) organizations such as NEC, GPC, as well as with the less powerful, but still well established organizations such as the Central Forestry Administration.

Harza was to take NEC (an organization with thousands of employees, a long history of pervasive, poor management, entrenched labor unions resistant to change, and a public sector agency which never had to seriously worry about its own financing) and to turn it around in the space of a few years into "an effectively run business"! Clearly, these stated goals on the part of EPM for both NEA and NEC, while laudable in abstract, were (if taken at face value) either a formula for a miracle or a formula for disappointment no matter how hard the contractors and counterpart tried.

B. PROJECT IMPLEMENTATION

1. E/DI

As noted above, the E/DI work with NEA was a direct follow-on to the SEPAP support, and included some of the same personnel. With the assistance of SEPAP the NEA had gradually developed a staff familiar with the basic approaches to energy analysis and had developed the foundations of a comprehensive energy data base. However, at the start of EPM the NEA was still young and heavily dependent on outside expertise to guide the staff.

In practice, E/DI took up where work carried out under SEPAP left off, concentrating on the standard activities of energy planning, i.e., identifying data needs, initiating data collection activities and periodic data up-dating, and using this information to produce comprehensive pictures of energy flows (e.g., annual national energy balances), analyses of specific issues and development of preliminary integrated energy planning documents. This work was to be carried out in a close working relationship with the counterparts from NEA so as to maximize the potential for the

transfer of skills to the counterparts. At the same time the contractor was to build-up the material support for NEA planning by providing analytic tools (e.g., computers and software models), and reference materials.

Early in the EPM project, NEA felt that a number of the E/DI consultants were not working sufficiently closely with NEA staff on the actual analytic work. This was apparently partly a matter of the NEA's growing sense of self-confidence (since under SEPAP, the consultants often took the lead in designing and carrying out the analyses) and partly a matter of the consultants themselves believing that they would be judged by the sponsor (USAID) largely in terms of the reports produced during their time in country, rather than in terms of difficult to measure and more subtle "skills transfer". The Mid-Term Evaluation Team also concluded that as of early Calendar Year (CY) 1987, nearly three years into the project, the contractor was not succeeding in transferring the needed skills to NEA.

Even more basic to working relations at the start of the EPM assistance to NEA was the problem of the first Chief of Party (COP). The first E/DI COP saw the upper level of the Ministry of Energy and Mining (MEM) as being his chief "client", rather than the NEA itself.⁴ NEA staff felt they were not being well served by this individual and that he was not being honest in his dealings with them. In 1985 under strong and continuing pressure from NEA, and eventually with USAID and E/DI concurrence, the first COP for the NEA component was forced to leave the project.

Under the acting COP, Marc Daudon, who was already a resident advisor under the project, relations between NEA and E/DI began to improve. During the term of the second permanent COP, David Pluth, conditions between the E/DI advisors/consultants and NEA continued to improve. NEA and USAID give Pluth the highest marks for ensuring that the work of resident advisors and the short-term consultants had as its overriding priority the transfer of technical skills to NEA staff.

This transfer of skills to NEA staff appears to have been reasonably successful, though one must recognize that gaps still exist and that this is an almost inevitable condition in a country facing the continuing problems of Sudan. Compared to many other low income developing countries, Sudan seems to be doing rather well in terms of indigenous capacity for integrated energy analysis and planning.

⁴ NEA is a component part of the MEM, along with the NEC. E/DI notes that early in the project, USAID encouraged the COP to work closely with senior levels of the GOS, partly to be in a better position to deal with the then planned component for the General Petroleum Corporation.

Since E/DI departed in August 1988, NEA has continued on its own to carry-out a number of energy data collection and analytic activities. While not all of this work is up to desired standards of completeness and penetrating critical analysis, the NEA is contributing in important ways to the understanding of energy issues and options in Sudan. This is an achievement in which the particular long-term advisors and short-term consultants responsible for it can take considerable pride. Credit must also be given to S&T/EY's CETP which provided long-term training. By February 1989, nearly all of the NEA Section or Division Heads possessed masters degrees in energy planning or related fields through the CETP. The combination of the on-the-job experiences with the advisors/consultants (especially activities during 1987 and 1988) and the formal long-term training appears to have been particularly effective.

The specific accomplishments and limitations of EPM's assistance to NEA are described in section III. The more basic impacts of EPM in terms of institution-building for NEA are considered in Section V.

2. Harza Engineering

In its work with NEC, Harza focused on up-grading the NEC computer center and firmly establishing it as the centerpiece for reform of the financial system within NEC. In effect, changes were implemented in the computer billing and collection data accounting system which highlighted errors in the existing data, and which necessitated changes in the manner in which meter readings were made and how records were kept.

Success in this and related areas was initially slow in coming. The Harza work started with the disadvantage of NEC having strongly preferred another contender for the consulting contract. The first Harza COP had a difficult time getting activities moving and he abruptly resigned after 17 months of his four-year contract. Although in this case NEC (unlike NEA) was not actively trying to force out the COP, his departure did open the way to much better relations between the contractor and the counterpart organization. The first COP was immediately replaced by Shamshad Azri who was at that time on short-term assignment with the project.

Under Azri, relations between NEC and Harza steadily improved. By late CY 1986 and early 1987, it was becoming clear that the work with the computerized billing system was paying off with direct and substantial increases in revenues for NEC. Indeed, the pace of revenue improvements far exceed the planned accomplishments. The Mid-Term Evaluation noted in early 1987 that within the first year of operation for the improved billing collection system NEC revenues were up by 19%. In fact, this proved to be only the first

(and relatively modest) part of the improved revenue picture. By FY 1987-88 NEC revenues were approximately 75 million Sudanese pounds, more than three times the level of FY 1984-85. Of course, the very size of the increase indicates how unnecessarily badly off NEC had become in terms of the revenue picture.

The Harza work also included up-grading of systems dealing with delinquent accounts, with service orders (e.g., hook-ups), billing corrections, payroll, and general accounting. Like the billing work, the system up-grading in these other areas was not without difficulty, but overall it appears to have resulted in what should be reasonably self-sustaining improvements. This work included efforts by Azri and several short-term consultants.

Azri effectively used the work of the computer center in the billing area to help spur a thinly spread, but highly capable and generally well motivated, core group within the middle and upper technical management levels of NEC. He and this informal core group used the prospect of much improved revenues to enlist the support of top NEC management for the introduction of needed changes in the meter reading and reporting systems. Azri and these de-facto counterparts later used the proven success of the up-graded billing system as an argument for the introduction of further reforms.

While success in these wider areas has been minimal thus far, it is clear that Azri's work has been a welcome stimulus to those individuals within NEC who are capable and motivated. This legacy of successful activism serves as a demonstration that agitation for reform sometimes pays off. In an organization such as NEC, such signs are highly valued by those within the organization who wish to see much more pervasive reforms implemented.

3. Arkel-Talab

Arkel's work was much more focused than that of either E/DI or Harza. Arkel worked with NEC in two areas: up-grading the operation and maintenance of the telecommunications and mobile equipment provided by USAID's Commodity Import Program (CIP) and converting the programming languages in the NEC computer system.

The Arkel work with vehicle and equipment maintenance and repair had clear near term benefits in terms of improved vehicle and equipment operational levels, but it does not seem to have had a substantial impact in terms of NEC's basic procedures in this area. The Arkel work with the computer center (i.e., on converting the various programming languages in use in the early 1980s to a single language - COBOL - was subcontracted to a Sudanese firm, Sud Consult. This work was never adequately performed and Harza eventually completed the language conversion.

4. ISTI

The ISTI contract provided for the services of a long-term energy advisor to the USAID Mission. His general scope of work was to conduct technical analyses and to advise the mission on matters in the energy sector. As the Mid-Term Evaluation pointed out, the advisor's scope of work was unrealistically broad. However, despite this, and the difficulty Carter had in being able to devote adequate attention to all of his various tasks, his presence in the mission up through April 1988 is generally viewed as having been a valuable asset to the EPM project and to the work going on at NEA and NEC. Essentially, he brought to the mission an in-house understanding of the issues and objectives of the work under EPM and so helped to maintain mission support and defend the project against those who questioned its value.

C. SUMMARY OF PROJECT INPUTS

The Arkel work ended in February 1987. E/DI finished its work in August 1988. Harza was scheduled originally to end its work in April 1988, but this was twice extended. The first extension was to December 1988. At the strong urging of NEC, the Harza work was then extended to April 1989.

Overall, E/DI provided 78 person-months of long-term assistance and another 55 person-months of short-term assistance under EPM. For its part, Harza will have provided a total of 120 person months of long-term assistance and about 8 person months of short-term assistance to NEC. Arkel provided 96 person months of long-term TA and another 24 person months of short-term TA.

EPM also provided for moderate levels of commodities (particularly computers and other equipment) and moderate funding for formal training. Over the course of the contract, Harza purchased \$75,000 worth of equipment for NEC, with the largest expenditure being for instruments for calibrating electric meters and measuring line losses, and other expenses for the Computer Center and parts for project vehicles. E/DI purchased mostly personal computers, related hardware and software for a total expenditure of about \$37,000.

NEC staff received approximately 246 person months of short-term training overseas under EPM, as well as a significant amount of the long term advisors' time being devoted to on-the-job training activities. Through E/DI, NEA received a number of formal and informal short-courses on various subjects related to energy planning. Four NEA staff also received three weeks of training in the U.S. on the use of the RES-Sudan energy accounting model. (As noted below, NEA needs additional training on this model.) The

masters degrees received by NEA staff under S&T/EY's CETP greatly complemented the practical experience and training provided by E/DI.

**III REVIEW OF SPECIFIC MEASURABLE ACCOMPLISHMENTS:
UP-DATE ON THE MID-TERM EVALUATION'S FINDINGS**

A. NEA ACCOMPLISHMENTS/PROBLEMS

The Mid-Term Evaluation noted five areas of specific accomplishments on the part of NEA up to the end of CY 1986 attributable in whole or in significant part to EPM assistance. These are:

1. EPM assisted NEA in designing and implementing a reorientation toward a more task oriented organization;
2. it strengthened NEA's computer capabilities with hardware and software, a study of computer needs and the implementation of several of the study's major recommendations;
3. it brought NEA to the point of publishing the Sudan Energy News on its own;
4. it assisted NEA in data collection efforts; and
5. it has assisted NEA in the preparation of over 10 analyses of energy issues and/or policy options.

Through the interviews and review of reports two years following the Mid-Term Evaluation, it appears that, overall, the gains noted above have been maintained and extended.

1. Task Oriented Organization

E/DI prepared written job descriptions and a plan for a structural reorganization of NEA in the first part of EPM. By about 1985, the reorganization was adopted and implemented in practice, though it was never formally approved by the GOS. One possibility being discussed in early 1989 is removal of the Techno-economics sections from NEA and having the smaller NEA serve as a technical arm of the Ministry of Planning.⁵

The present NEA staff appear to have a reasonably good understanding of the nature of energy planning and policy analysis. They are aware of the need for data collection and analyses directed toward assessment of policy options. The major question

⁵ This is a move which E/DI would strongly support.

is how the NEA views its role within the larger GOS planning context, particularly the role of NEA in actively raising policy issues and providing independently verified sets of data for the energy sector.

NEA today sees itself as highly task oriented. The issue is whether the particular tasks it chooses to focus on, in practice include all those tasks which an outside agency would agree should have the highest priority. Clearly NEA is doing a lot. It is also clear that one can challenge NEA on its relative inaction in identifying issues and options with regard to the decisions of the NEC, GPC, etc. This point is considered further Section V.

2. Computer Facilities

a. Use of the Facilities

The computer facilities are now nearly complete (10 of the 11 personal computers are in place). These are extensively used by persons of various levels of computer skill and analytic capability. A series of unscheduled visits to the NEA computer center in January and February always showed at least several persons working and, at times, all of available computers being operated. Some persons were entering data into spreadsheet programs, others were using word processing, and some were using the documentation to learn specific software applications (e.g., graphics).

b. Use of Analytic Tools

E/DI provided various simple and relatively complex modelling frameworks and structured Models to NEA over the course of EPM. These include spreadsheet formats for national energy balances, and other accounting systems of various levels of detail and complexity, such as FRAP and RES-SUDAN. NEA appears to be making good occasional use of some of these tools, with the major exception being the comprehensive integrated energy planning accounting system - RES-SUDAN.

RES-SUDAN was developed by IDEA Inc. under subcontract to E/DI⁶ and introduced into Sudan in February 1988, roughly six months before the end of the project. As of February 1989, RES-SUDAN is not being used by NEA, although NEA says it has considerable need for the model to assist in its work on the up-dating of the National Energy Plan (NEP).

⁶ IDEA Inc. developed the actual model and conducted much of the U.S. and Sudan training provided to NEA under terms and a schedule set by E/DI.

According to several NEA mid-level staff persons, RES-SUDAN is not effectively operational for two reasons: (1) the three weeks training provided in the U.S., though of high quality, was not sufficient for the staff to feel they really understood all important aspects of the model, particularly the Power Module, and (2) RES-SUDAN (which is a modified version of a model designed for Pakistan) has not been fully tailored to the Sudan planning needs (e.g., the specific fuels which can be tracked for certain end-use sub-sectors), and again, the NEA staff feel their understanding of the model's programming is not adequate to re-program the needed changes themselves.

NEA staff received training on the model in early 1988 and the developer of the model, Peter Meier of IDEA Inc., came to Sudan in August 1988. Unfortunately, this was also the time of the severe flooding in Khartoum. The end result, according to NEA, is that there was not adequate time and resources for sufficient guided hands-on work with the model before the end of the EPM assistance to NEA.

According to Paul Cough of E/DI, waiting until late in the project to introduce RES-SUDAN was an appropriate move on E/DI's part. First, throughout most of the EPM project there was not a particularly strong felt need by E/DI or the NEA for a tool such as RES-SUDAN. Further, it was only toward the end of the project, when more of the NEA staff began to return from long-term training, that E/DI felt that the NEA was in a position to make effective use of a model such as RES-SUDAN. Second, E/DI feels that NEA received sufficient training and that they should have been able to make effective use of the model, using their own knowledge to overcome minor problems which may exist.

Finally, E/DI notes that RES-SUDAN was developed at relatively little cost to EPM, since it was only a moderately changed version of RES-PAKISTAN, again developed by IDEA Inc. under sub-contract to E/DI (in late 1986 through mid-1987), for a very similar energy planning project funded by USAID/Pakistan. Indeed, it was this low cost feature which was a deciding factor in whether to introduce a model like RES-SUDAN at all. According to E/DI, the NEA received the model in February 1988 and during the remainder of the E/DI contract NEA staff never raised concerns about their ability to make use of the model.

From the point of view of this End-of-Project Review, it should be noted that RES-SUDAN (like RES-PAKISTAN, and various earlier versions of this model used by E/DI in other countries) is a conceptually straightforward accounting system for persons familiar with integrated energy planning methodologies. However, it is nonetheless a very detailed, and hence intricate program, and one which requires considerable hands-on experience before most users (even ones versed in energy planning methodology) truly become familiar with it. The model is also highly data intensive. Until

a well developed set of base values for each parameter is developed, the model cannot be used with confidence.

Unlike the EPM work in Sudan, an integrated energy planning model was a central feature of the E/DI 1986-90 workplan for the Pakistan energy planning project from the start. RES-PAKISTAN is a modified version of a similar model for Morocco. Originally, RES-PAKISTAN was to have been in place within the first six months of the project. Actually, it took nearly a year to fully tailor the model to Pakistan and required two training/model development sessions in the U.S. and a number of short-term consultancies by experts familiar with this type of model before the Pakistani counterparts were genuinely in a position to make effective use of the model. With three years of the USAID/Pakistan assistance remaining by the time the model was fully operational, the counterparts also have the benefit of on-going resident and short-term technical assistance for further refinements.

The experience in Pakistan with RES-PAKISTAN suggests:

1. because the model is so large, it can take a considerable amount of varied applied use before all of the structural problems and limitations (especially minor ones which can be easily overcome by those with the needed expertise, but can be damaging until corrected) become evident and can be de-bugged;
2. it simply takes a fair amount of practice for persons to become effective users of the model, particularly if they are to understand it well enough to avoid the errors of in-putting incompatible values for various parameters in different parts of the model; and
3. the development of an adequate database to support the model can take a considerable amount of time.

It should also be noted, that once an adequate investment has been made in the above area, a model such as RES-PAKISTAN (and presumably RES-SUDAN) can become a major asset to an agency charged with integrated energy planning.

Whether E/DI is correct in its position that the introduction of RES-SUDAN in 1988 was appropriate and that the problems of NEA's present inability to use the model lie with NEA, not the contractor, remains an open question. If indeed NEA was not ready for the model earlier and only very limited resources were ever available for such a tool, then the alternative was really one of not introducing the model at all. Given the relatively low cost of RES-SUDAN, its introduction may well have been better than the option of not putting any central planning tool in place.

Yet, even so, the late introduction of RES-SUDAN was, at a minimum,

a clearly risky move, given the experiences in Pakistan the previous year. Presumably, the contractor considered its experiences in Pakistan and felt that the problems and delays encountered there could be avoided in Sudan.

Regardless of how (or even if) fault should be assigned, the fact remains that RES-SUDAN is not presently being used, and without some outside expertise, it is unlikely that NEA will make use of it soon. RES-SUDAN could be an important asset to NEA in its present work with the NEP Up-date Subcommittee for energy demand projections, and over the longer term could become a central feature of future NEP up-dating work. The resources needed to get the model running are relatively small.⁷ However, to be truly effective, longer-term guided application of the model and assistance in setting up the supporting database are likely to be required. While USAID may be able to provide the assistance to get the model running, some other donor assistance would probably be required to provide the remaining assistance.

c. Equipment Maintenance And Support

At this point all of the NEA computer center equipment appears to be running well and seems adequate for the basic needs of NEA. However, it is not clear that NEA will have access over the longer term to adequate funds for proper maintenance and repair of the computers, printers, humidifiers and other computer center equipment, or that NEA will be able to purchase newer and better software as it becomes available.

With the extremely dry and often dust-laden air of Khartoum, the continual functioning of the climate equipment is essential and routine maintenance very important. As the Mid-Term Evaluation noted, the initial failure of EPM to deal with the need for computer room climate control represented a serious problem. Although this problem was later corrected, concerns expressed in the Mid-Term Evaluation underscore the need for continued availability of such equipment. It would be very useful if a donor agency such as A.I.D., the UNDP or the World Bank would set up a fund from which NEA (and perhaps other GOS agencies) could finance on-going needs to keep their computer facilities fully functional.

The Mid-Term Evaluation Team felt so strongly about the issues of computer equipment and support facilities that it recommended that the Mission "develop improved and generalized procedures for

⁷ About 2 person weeks would probably be sufficient to get the model running, if the consultant is already familiar with this particular model. However, to help ensure its appropriate use and up-dating periodic assistance with the data base for model parameters would be useful. Perhaps such expertise could be provided under assistance from the World Bank or the UNDP.

procurement and installation of computer equipment installed in Sudan under USAID-financed projects." It further recommended that USAID require the counterpart agencies to meet certain minimal standards for installation sites prior to initiation of procurement -- for example in power supply reliability/quality, air conditioning and dust control. Certainly these measures were taken under EPM. Jay Carter noted that this recommendation had been implemented by USAID as standard mission policy.

3. Publication of Information on a Periodic Basis

The Sudan Energy News continues to be published periodically, though occasionally, other priorities cause one of the planned three issues per year to be missed. The latest issue is December 1988. (See Attachment # 1.) The publication is well designed, informative, and a forum for setting forth ideas on energy planning needs and dissemination of the results of completed analyses. It is a well deserved source of pride for the NEA staff involved.

Potentially more important and representing more difficulty is the matter of the annual Sudan Energy Handbook, a compendium of statistical information from across the Sudanese energy sector. The 1988 Sudan Energy Handbook is presently under preparation. The principal potential questions are: (1) NEA's ability to validate the data supplied by other organizations (e.g., NEC, GPC), (2) NEA's inclination to closely examine this data base for indications of needed data improvements, and (3) NEA's ability to fully exploit the data available for the Handbook as a means of identifying particular issues and analytic needs.

At this point, NEA has not yet fully utilized the data collected (or which could be collected) for the Handbook as a guide to energy planning needs by various GOS agencies or as a guide for program needs which might be met through assistance from donor agencies.

4. On-going Data Collection and Analyses

In terms of points 4 and 5 in the Mid-Term Evaluation's findings, on-going data collection and data analysis efforts continue in early 1989, six months after E/DI had left. At this time the data collection and analysis is mostly geared toward the up-date of the NEP (first produced by NEA with the assistance of EPM in January 1985). The inter-ministerial GOS committees working on the NEP were not functioning at the time of the Mid-Term Evaluation. These were, however, revised in 1988 and are continuing to function at the time of this Review. The Mid-Term Evaluation had noted that much of NEA's influence under SEPAP was derived from this work with these committees.

NEA is working under general guidance from the Steering Committee

on the NEP and is taking a major role on each of the subcommittee reports. The subcommittees are composed of persons from various agencies (e.g., NEC, GPC, Forestry Administration) and are organized along topical lines (e.g., energy demand subcommittee, energy forecast subcommittee). Altogether there are 8 subcommittees. As of early February 1989 draft reports have been developed by four subcommittees and the remainder are expected to be completed by about April 1989. NEC is responsible for coordinating, reporting and follow-up activities on each of the subcommittees.

NEA, under directives from the GOS is evaluating renewable energy options, with an emphasis on gasification and briquetting. NEA is looking at the economic and technical feasibility and social acceptability of various gasification options. In March 1987 NEA and the National Research Council (NRC) jointly produced a report entitled "Status of Biogas Technology in Sudan". In 1988 the University of Khartoum and NEA produced a report, "Biogas Feasibility Study", and in "Biogas", a report by NEA. The work initially involved an assessment of the potential for producing briquettes from groundnut shells. This fuel is smokey, and in times of adequate fuelwood or charcoal supply, is not acceptable to consumers. NEA evaluated the economics for this assessment. One possibility now being considered for further study is to carbonize the groundnut shells to reduce the smoke. (The UNDP provided equipment for this effort.)

Finally, as noted above, NEA is presently working on the 1988 Energy Handbook, an annual compendium of energy data and brief reviews of trends in energy supply and consumption, and information on energy-economy interactions and related statistics (e.g., price indexes).

5. Work With Other Donors

Although A.I.D. support has ended, NEA is beginning to work more with other donor agencies. For example, NEA will be working with the United Nations Development Program (UNDP) on a Rural Energy Program for Sudan. Funding will come from UNDP, with NEA and the Sudan National Research Institute being the implementing agencies for the GOS. This will involve a total budget of about \$1.5 million over a three year period. Phase I will study options for projects in biomass, wind and solar energy in rural areas of Sudan. Phase II will involve implementation of selected projects. The proposal for this work is presently with the Ministry of Finance for approval.

The proposed World Bank Technical Assistance Project Four includes assistance to NEA. This would amount to about \$500 K for a 1 year period and involve national energy planning, energy conservation, and regional energy planning. The project would provide for

consultants, training, and funding of report publication. Working arrangements between the consultants and NEA staff are one of the criteria which NEA will use in evaluating the various proposals submitted by bidding firms. The proposal for this project is being considered by the GOS and the World Bank. The present estimate for the start of the project is June 1989.

NEA is also expected to participate in the World Bank-funded Forestry project when this is approved. NEA helped to coordinate the planning for this project. Working with the Forestry Administration, NEA staff would be responsible for the fuelwood supply data and conservation potential.

Another donor assisted effort is a French-funded project to evaluate gasification options, with NEA evaluating the economics and technical feasibility.

The NEA's Technico-economics Section is engaged in a number of essentially technical process studies associated with coal, peat, agricultural wastes and other indigenous fuels. Presently, the Section is working with the Planning Section of NEA on an assessment of fuelwood use by bakeries and, in conjunction with NEA's Project Implementation Section, continues to look at biogas possibilities. The Government of Lower Saxony will finance a new research laboratory for NEA's use.

6. Training

E/DI provided short-term formal and informal training to NEA staff over the course of the EPM. As noted in the Mid-Term Evaluation, early in the EPM, the counterparts wanted additional training in economics and nearly three years into EPM the Mid-Term Evaluation found that "the level of economic and financial analysis by NEA staff is weak." The Mid-Term Evaluation recommended that E/DI provide better training in the area of economic analysis for NEA.

This weakness appears to have been at least partly addressed over the next two years, in part due to short-term courses provided by E/DI consultants, in part to the skills transfer from the approach to counterpart working relationships stressed by Pluth, and in part to the return of more NEA staff with masters degrees in energy planning obtained under CETP.

While there are certainly still areas in which NEA could benefit from training and areas where the contractor staff could have done a more thorough job of on-the-job skills transfer, overall NEA has received a substantial amount of vital training under EPM and CETP. In short, many, though not all, of the specific training problem areas noted in the Mid-Term Evaluation have been addressed and it is only to be expected that some would likely remain at the end of the project. Current remaining gaps appear to be manageable,

particularly if NEA is able to occasionally draw-on short-term consultancies for analytic expertise and, when appropriate, for skills transfer.

Two major contractor training-related activities toward the end of the EPM included training in the U.S. (roughly three weeks) for four NEA staff persons in the use of RES-SUDAN and a three day energy seminar held in early August 1988 as the project wrap-up. As noted above, the training in RES-SUDAN, while apparently of high quality, proved to be insufficient from NEA's perspective. The Energy Seminar is generally considered to have been a worthwhile activity, providing an opportunity for NEA and other GOS staff and outside professionals to come together to prepare and make presentations on a wide range of energy topics.

Like any relatively small organization, NEA is inherently vulnerable to weakening through the loss of key staff persons to other government organizations and the private sector. Since, it is unlikely that the extensive short and long term training opportunities provided under EPM and CPTP will continue at the levels of the past, NEA may find it very difficult to maintain the present quality of staff, if it is unable to offer competitive salaries and other benefits. As of February 1989, the prospects of NEA being able to offer salaries competitive with those of such organizations as NEC and GPC and the private sector do not appear good.

To the extent that the NEA staff members who received training make use of that training in Sudan, even if they eventually leave NEA, then the training benefits Sudan. For NEA to retain its present capability in the coming months and years, it must be recognized that continuing training opportunities are a must.

EPM's impact on NEA as an institution is considered more fully in Section V.

B. NEC ACCOMPLISHMENTS/PROBLEMS

The Mid-term Evaluation noted specific EPM accomplishments in the case of NEC in eight areas:

1. NEC is completing (Jan. 1987) computerization of a billing & collection system which has already increased NEC's collected accounts by 19% in the first year;
2. EPM financed a long-run marginal cost study for NEC and this is being implemented (Jan. 1987);

3. EPM has trained 6 NEC engineers in operation of a telecommunications system funded under other A.I.D. assistance to NEC;
4. EPM has instituted systematic record keeping at the NEC's Vehicle Maintenance Center;
5. EPM is training mechanics in the Vehicle Maintenance Center
6. EPM has increased the percentage of NEC's vehicles in operation;
7. EPM has planned and initiated installation of capacitors for NEC funded under the CIP; and
8. EPM has contributed to increased system reliability in the BNG, which has risen from 74% in 1983 to 94% in 1986.

The first part of this section reviews the work areas for which Harza has responsibility. These include items 1, 2, 7, and 8 above. The next part more briefly reviews the areas under Arkel responsibility.

1. Computer Center

Up-grading of the NEC Computer Center so that it could be more effective in billing and collections, payroll, and general accounting was the major focus of the Harza TA to NEC. This work included on-the-job and formal training of the computer programmers and other staff, design and introduction of data management systems, the purchase of appropriate hardware and software, and such activities as taking over from Arkel the work to effectively convert the various computer languages previously in use at the Computer Center to COBOL. Overall, the Computer center work has been a major success.

The computerized billing system has been operating effectively for roughly the past 1 to 2 years. Although operational for some time, improvements continue in such areas as identifying and correcting past data entry errors, instituting procedural changes in the meter reading and recording systems to more closely suit the needs of the computer system procedures, and carrying out detailed surveys in specific areas to check on accounting records and gather current and accurate information with regard to individual consumers. Improvements in the billing and collection system will be an on-going process, since only a fraction of the areas receiving electric power in and around Khartoum have been adequately surveyed. In February 1989, USAID and NEC agreed to use remaining EPM local currency accounts to carry-out an in-depth survey of

selected areas to locate and to initiate billing of unaccounted electricity consumers. This is designed as a pilot activity to test procedures for further reducing the number of unbilled consumers and to demonstrate to NEC the potential gains in collections resulting from such efforts.

Since FY 1984-85 NEC revenue collections have risen substantially and for the most part steadily. In FY 84-85 collections amounted to just under 23 million Sudanese pounds. By FY 85-86 the figure was 32.7 million. In FY 86-87 it dramatically jumped to 50.6 million and in FY 87-88 jumped impressively again to 74.5 million Sudanese pounds. For the first half of FY 88-89 (i.e., up to the end of December 1988), collections were down about 15% compared to the same period the year before. This was due to the floods of the Summer of 1988 which made it difficult for meter readers to reach some areas and because of power outages (and hence lower consumption) resulting from downed distribution lines. This problem was compounded by fears on the part of meter readers of abuse from consumers if they attempted to read meters during a time of highly unreliable power supplies.

If this problem of the fall of 1988 proves to be an anomaly, as now seems the case, then revenue potential should be great for the long term.⁶ During November and December 1988, revenues were up substantially over the same period from the previous year. As noted above, even allowing for relatively high domestic inflation and moderate escalation of foreign expenditure costs, these improvements in NEC's revenue picture are a real success story for EPM. (See Attachment # 2 for a table of NEC collections over time).

In addition to the work on billing, the Computer Center has also instituted much more effective programs and procedures in the areas of delinquent accounts, the tracking of service orders, billing error identification and corrections, and payroll records. The delinquent accounts are being gradually reduced, and old service orders are now largely caught up. Harza finished its work with the payroll in January 1989 and there's a local subcontract in place to finish this work.

2. Marginal Cost Study

The long run marginal cost study funded under EPM and carried out by Coopers & Lybrand under subcontract to Harza was not carried

⁶ Mr. Azri, the Harza COP, believes that the appropriate level of collections from NEC's present customer base is in the region of at least 150 million Sudanese pounds. Hence, while the gains have been impressive under EPM (i.e., from 23 to over 50 million in just 3 years), there's considerable room for further improvements.

out in a professionally acceptable manner in the first instance. It had to undergo considerable re-working before an acceptable version was finally produced in February 1988. NEC has since used this report as the basis for revising its tariff structure.

3. Capacitors (Mid-Term Evaluation Comment #7)

Harza's assistance in the energy efficiency area resulted in a greatly stepped-up pace for installation of capacitors provided to NEC under USAID's CIP. As noted in the Mid-Term Evaluation, since the Harza advisor working in this area left in early 1987 NEC has not installed additional capacitors, even though these are available. Capacitor installation remains incomplete (about one third installed) as of early 1989, with no sign that it will be completed soon.

4. System Reliability (Mid-Term Eval. Comment #8)

The Mid-Term Evaluation noted that during the first part of EPM system reliability of the BNG rose from 73% in CY 1983 to 94% in CY 1986. Using figures supplied by NEC in February 1989 for the period July 1986 through June 1988 (i.e., for Fiscal Year (FY) 86-87 and FY 87-88) suggests that overall, the reliability gains were maintained and increased. However, several important caveats are needed before drawing conclusions from such figures.

First, the figures supplied by NEC in early 1989 do not entirely agree with those supplied to the Mid-term Evaluation team in early 1987. (This may be in part due to later corrections.)

Second, based on the data supplied in 1989, it appears that the Mid-Term Evaluation team either was given an incorrect set of definitions or misunderstood the definitions. The figures the team used as "delivered energy" generally correspond much more to the "energy generated" figures for the same period supplied in 1989. (See Appendix 3 and Mid-term Evaluation page 88). In practice the impact on the calculation of "reliability" is small when reliability is relatively high, as it is during most of the period being considered.

Third, it should also be noted that the outages due to capacity shortages and T&D failures are by definition estimates based on what the analyst assumes the demand would likely have been during that time. There is no way of measuring the actual level of consumption which would have occurred and hence actual losses.

Finally, by far the most important point is that even if the figures supplied by NEC in 1989 can be taken at face value (showing reliability at 98% or 99% for FY 85-86 through FY 87-88), the outages were highly uneven, affecting some areas far more than

others, and often occurring at relatively frequent intervals for relatively short periods during a certain time of the year. Even an 89% reliability, as is shown for June of 1987 for example, would require many businesses to install their own back-up generation capacity, and would cause economic losses in many sectors.

Overall, it is clear that system reliability has improved, and that this is due in part to the CIP and EPM. However, significant problems remain and with Sudan's worsening economic situation and continuing political crises, system reliability might well fall at least temporarily in the coming months and years until the social and political situations improve.

5. Other Harza TA

A year after the Mid-term Evaluation Harza carried out a four month study with NEC staff on the estimation of losses and load forecasts. As part of this work NEC staff members were trained in the use of electricity measuring instrumentation and in the analysis of distribution feeder performance and in methods for analyzing load characteristics. The consultants' report noted that the work was carried out in a statistically insignificant amount of data and during a low load period (January-April 1988), and the primary emphasis was on developing the methods of analysis based on actual field conditions in Sudan. In order to realize the full benefits of this work to actually developed accurate load forecasts and loss estimates, "... it will be necessary for NEC personnel to make extensive measurements during system peak load months." Although it is not known for certain whether this work was actually undertaken, the severe floods of August 1988 would have very likely disrupted such data gathering during the peak demand period (usually May to August or September).

6. Training

In contrast to NEA, where CETP was relied upon for most of the training, the EPM itself funded substantial amounts of formal long and short-term training for the NEC. The training included accountants, engineers and administrative staff. (See Section II for total amounts provided.) The last major training efforts occurred over a four month period in late 1988 and involved courses of 5 to 12 weeks each in power station chemistry, systems operation, tariff design and power system planning. The courses were carried out in the U.S. Several of the 11 NEC participants were interviewed in February 1989 and were highly enthusiastic about the program and, in particular, the relevance of the instruction to their needs and the commitment of many of the instructors.

7. Arkel Work (Mid-Term Eval. Comments 3 to 6)

The Arkel work with the vehicle maintenance and telecommunications equipment appears to have been highly successful in terms of actual improvements implemented during the time of the contract. However, the impacts appear to have been largely confined to the activities of the expatriates themselves and their local hires. Although a number of NEC staff persons were trained in vehicle and equipment maintenance and repair, it is not clear what, if any, long-term impacts there have been on NEC procedures in the area. Indeed, during the flooding of 1988, the absence of any real change in approach to equipment maintenance on the part of NEC was much in evidence.

The Final Status report on Phase II of the BNG Rehabilitation Project (August 1988) noted a number of remaining basic problems with the vehicle maintenance activities and the lack of NEC headquarters support for the improved maintenance program. The report noted that specific problems include shortages of materials (e.g., lubricating fluid) shortage of essential spare parts and, more fundamentally, "lack of accountability for actions" and "non-utilization of provided tools".

8. Other Issues

The Mid-term evaluation noted that,

... the corporate organizational structure recommended by the Irish Electricity Supply Board is being implemented by the NEC ...

In practice, this "implementation" still remains only on paper and has yet to have a real impact on NEC organization. There are at present no indications of further movement on this reorganization.

Another problem noted in 1987 was the absence of an NEC "person assigned to monitor the EPM on a daily basis and no consistence in assigning a counterpart". At a formal level, this counterpart liaison problem remained throughout the project. While NEC did fill a number of the vacancies which USAID insisted be filled, unqualified persons were often put in these positions.

In 1988, USAID was still insisting on the formal assigning of a counterpart as part of its agreement to accept NEC's request to extend the Harza component past the original Project Activities Completion Date (PACD) of April 30, 1988.

Although NEC eventually appointed formally designated counterparts, in practice, it was the more informal relationships described above between Azri and individual members of the mid and upper level NEC which were by far the most important feature of the counterpart

relationships. One major problem faced by the EPM efforts to influence NEC at the middle and upper management levels is that over the course of EPM (1984-89), NEC has had five different Directors General, with the latest coming in February 1989.

C. MID-TERM EVALUATION RECOMMENDATIONS

The Mid-Term Evaluation report listed 14 summary recommendation points and these are shown in Appendix 4. With the exception of the provision of an accounting specialist to NEC under the Harza contract, all of recommendations were implemented, according to Jay Carter, and no indications to the contrary were found during the course of this End-of-Project Review.

The fundamental recommendations were that each of the four contracts with E/DI, Harza, ISTI should be continued, with the basic EPM project goals and activities remaining in place. (Actually this encompassed 4 of the 12 points.). The Mid-Term Evaluation Team felt strongly that, despite certain particular problems with the activities of the counterpart organizations and in some cases with contractor performance, the interests of Sudan and A.I.D. would be far better served with a continuance of the EPM project in its existing form, rather than terminating it, substantially revising it, or switching contractors. From the perspective of the relative improvements in project performance during the last two years of EPM, this recommendation was certainly one which has proven to be correct over time.

The next section provides a perspective for the review in Section V of the evidence for institutional development within NEA and NEC which might be attributed in whole or part to assistance provided under EPM.

IV INSTITUTION-BUILDING AND THE DEVELOPMENT PROCESS: CONTEXT FOR THE "HIGHER LEVEL" OBJECTIVES FOR EPM

A. APPROACH TO DONOR ASSISTANCE

Perhaps in frustration over the absence of substantial measurable progress in economic development in many parts of the world after several decades of development assistance, A.I.D. in the 1980s became increasingly concerned with measurable indicators of performance in its development activities. Yet, the sometimes almost imperceptibly slow process of promoting long-term economic development through organizational improvements, through training (and other influences on attitudes, perceptions, and technical capability of indigenous analysts, planners and decision-makers), nevertheless remained a justification for much of A.I.D.'s work. Indeed, institution-building is often identified as an area of A.I.D.'s comparative advantage, contrasted, for example, to the World Bank's comparative advantage in financing infrastructure.

Sudan desperately needs to strengthen its energy institutions so that it can better manage its internal and externally supplied resources. This effort will be, by its very nature, a long and often frustrating process. Gains will tend to be incremental and diffuse. It may take a long time before the pockets of progress (e.g., in the awareness of some Sudanese managers of the need for organization improvements and their ability to implement more efficient management procedures) can expand to the point where they begin to significantly influence important areas of decision-making.

Even when gains are made, they are not necessarily permanent. In fact, simply holding on to past gains may at times represent a significant achievement. Still, it is this change in attitudes which is probably a necessary (and perhaps even in some rare cases a sufficient) condition for sound sustainable economic development. In the meantime, it is vital that such pockets of managerial talent as exist are encouraged and strengthened, for in the end, it is the development of indigenous capability which should be the aim of most donor assistance.

The process of economic development is largely a matter of resource enhancement (i.e., broadly "capital accumulation") and organizational-structural advancements. In other words, an increase in resources available for investment (rather than for immediate consumption) and the development of the ability to utilize available resources effectively. Resource availability may include the natural resource base, financial resources, physical infrastructure such as roads, and human capital.

Institution-building involves an increase in resources (e.g., computers, databases, and trained analysts) available to an organization and an enhanced capability by that organization to mobilize those resources and to do so in a manner which is ultimately self-sustaining. Successful institution-building requires that the organization eventually reach the stage where adequate internal rewards are generated to keep a system running at a higher level than before and for the improvements to be maintained even if the outside assistance is not provided. Assessing progress in institution-building requires a realistic set of expectations and a clear historical perspective.

Both the NEC and NEA EPM project components are viewed as valuable institution-building exercises by their counterparts. The technocratic levels of NEC and NEA see the A.I.D.-funded assistance under EPM as an important asset in their on-going attempts to influence their own organizations and the larger energy sector in Sudan. For the NEC counterpart staff the struggles are largely ones of internal management within NEC. At least in the eyes of the NEA counterparts the objectives have largely moved on from being ones of internal management to ones of NEA's influence in the larger setting of energy sector decision-making in Sudan. Whether outside observers fully share their counterparts' perceptions about the value of the EPM in the process of institution-building remains an open question. However, it is clear that the counterparts themselves believe that their organizations are stronger and more effective today as a direct result of EPM assistance.

B. VALUES SOUGHT BY COUNTERPARTS

In both NEC and NEA, the counterparts make a strong distinction among the individual resident advisors and short-term consultants. Indeed, in both NEC and NEA little reference is made to the contractor organizations. Harza and E/DI are not particularly blamed for the very poor working relations during the tenure of each firm's first COP, but by the same token, they are not particularly praised for the performance of the successor COP. Association by the counterparts of the other long-term advisors and short-term consultants with the contracting firm is somewhat closer, but in the end, the references are nearly always to individuals. And these feelings about the individual advisors and consultants are rarely neutral.

The principal distinguishing features among the long-term advisors and short-term consultants noted in counterpart interviews in January and February 1989 are:

1. degree of personal integrity and honesty; the extent to which they are perceived as sharing the counterparts' goals and the desire of the person to work closely with his or her counterparts to achieve these goals; and
2. the technical skills each individual brings and how effectively those skills are employed during the in-country work.

These criteria for judging the worth of the advisors and consultants are of striking importance when it comes to the functioning of EPM. In the early part of the project both of the original Chiefs of Party, and some of the short-term consultants, were judged by their counterparts as failing on the first criterion.

Failure to meet this standard directly resulted in strained relations and the effective isolation of these persons from their counterparts. If these conditions (and in fact the individuals themselves) had not changed, it is unlikely that EPM could have accomplished much.⁹

Perhaps what makes the case of counterpart relations in EPM so striking is that it involved two different agencies and two different contractors. And just as early projects relations were exceptionally bad, those in the last several years were exceptionally good.

The counterparts have the highest praise for Pluth and for Azri. While the technical skills of both men are acknowledged and certainly appreciated, it is clear that it is the counterparts' perception of their judgement with regard to the first criterion -- integrity and truly working on behalf of the counterparts -- which is the most significant factor. (Interestingly, during the interviews for this End-of-Project Review in January and February 1989 the counterparts never referred to the technical capabilities of the first Chiefs of Party who were judged poorly on the basis of the first criterion.)

Even while the counterparts stress that they can get by without continuing resident TA, they emphasize that the final chiefs of party will be greatly missed. And what they will miss the most is the collegial relationships and the asset of having a close

⁹ Of course, donor agency-funded consultants sometimes work in virtually complete isolation from the host country personnel. Such activities can possibly produce useful results, but only if the consultants are particularly insightful or knowledgeable about the host country and if their findings are immediately useful to the donor agency itself.

association with a capable individual working closely with them on commonly perceived problems.

The situation with regard to the nature of the inter-personal relationships in the EPM project illustrates a condition which certainly does not describe all developing country TA projects. However, neither is it particularly uncommon. Perhaps somewhat surprisingly, one often finds in developing countries with generally poorly functioning public sectors a thinly spread group of highly dedicated, capable, individuals in the middle and upper levels of the public sector organizations. Such managers have often been able to assemble a small junior staff of motivated and potentially capable persons whose principal limitation is their lack of adequate formal training and guided on-the-job experience.

In such cases, the middle and upper level "technocrats" themselves, typically have advanced degrees from industrialized countries and fully appreciate the need for more efficient management within their own organizations (and the public sector at large). They often understand quite well the specific steps which need to be taken, though they may lack the technical resources in their own staffs to fully define and to carry out such improvements. Also, such progressively minded individuals often find themselves at odds with many of their organizational peers and administrative superiors -- those who either do not appreciate the need for reform or who prefer things the way they are. The "progressives" are in fact very likely to find themselves isolated within their own organizations and unable to affect policies and procedures beyond the narrow confines of their direct areas of responsibility.

Such a situation is not entirely consistent with the assumptions of many development assistance efforts, including many "institution-building" efforts by A.I.D.. Often, the underlying assumption is that the basic limitations on the counterpart side are lack of "awareness" of the nature of the needed improvements in management and the technical knowledge to identify and implement specific improvements. This presumes that there is a general willingness on the part of the larger organizational or governmental system to abandon the old ways and adopt new ones.

Crucially, reforms inspired by technical elites (either from outside or from inside the society) often involve explicit losses of privileges by identifiable groups. The projected gains are often more generally spread, though even when they are focused, those who stand directly to lose often make their case more forcefully than those who potentially stand to gain. In many situations, the process of having the need for reforms truly appreciated by the leadership and having specific reforms accepted by the interested groups is a slow and incremental one. The process may require access to the resources to make a compelling case on technical grounds, much effort put to persuasion, and a persistence in advocating change, even in the face of frequent

indifference or hostility.

To a thinly spread core group of capable and committed technocrats outside technical assistance offers the potential of additional resources which may be mobilized to press the case for reform and to build the internal capability to design and implement needed reforms through training and guided work experiences. Yet, for such assistance to be useful to the counterparts, they and the advisors/consultants must form an effective alliance, sharing basic goals and jointly deciding on strategies.

C. COUNTERPART AND ADVISOR/CONSULTANT RELATIONS

The initial question from the viewpoint of the consultant or advisor is the extent to which the counterparts already understand what efficient management means, and how committed they are to improving the management of their own organizations and that of the larger sector in which they work. With regard to the counterparts' understanding of the nature of the problem, the consultants and advisors must decide on the appropriate level of effort devoted to "education" or "consciousness raising" to bring the counterparts to such an appreciation (if it turns out they do not already have such an understanding) and what type of specific activities should be directed toward addressing the actual management problems.

With regard to the counterparts' motivation and commitment, the consultants and advisors must decide whether they and their counterparts share the same basic objectives. And if not, how it may be possible to still work with the counterparts in a manner which allows each side to get something out of the process. Alternatively, the consultants and advisors may decide it is not worth working closely together and they may seek other arrangements, either working independently, or changing personnel or organizations.

In the end, the "counterpart" relationship requires close and prolonged interactions, with each person becoming part of a highly inter-dependent team. And as with any setting involving such prolonged and frequent interaction, the personalities of the individuals involved play a key role.

The effectiveness of the last several years of EPM in the process of strengthening NEA and NEC is, in large part a matter of judgement and expectations. One's assumptions regarding a "realistic" pace for improvement is obviously crucial for judging the significance of the progress made. The point here is that the potential for progress during this period in institution-building with NEA, and those portions of NEC with which EPM worked, was largely dependent on the personal relationships between the

counterparts and the advisors and consultants. This holds whether one judges the progress made over the past several years as being significant or as being of only marginal value. Whatever progress was made required first that the counterparts and advisors/consultants formed teams with common (or at least consistent) goals.

Obviously, effective personal relations between indigenous and outside analysts and planners is not always a requirement for successful development assistance projects. However, it certainly was a requirement at NEA and NEC during the time of EPM.

**SIGNS OF PROGRESS IN INSTITUTION-BUILDING
AND REMAINING LIMITATIONS/PROBLEMS**

A. NEA

To an outside observer, it still appears that in 1989, as the Mid-term Evaluation found in 1987, "the intended role of EPM to promote the development of NEA into a central policy player in the energy has not been fully realized." However, as the Mid-term Evaluation went on to note, "it was unrealistic to expect a new organization to achieve full institutional maturity and political influence over a four to six year period." Again, looking at NEA after seven years of AID assistance, it is clear that to achieving the central goal set out for NEA in the EPM will take much longer still and it was naive to believe otherwise.

The important question then, is how far has NEA come in its development and, recognizing the constraints under which it operates, to what extent is it reaching its potential for influencing the energy situation in Sudan?

The first consideration is where does NEA stand in terms of its ability to determine the most important issues and its ability to then carryout the analytic work needed to support investigation of these issues? The Mid-term Evaluation concluded that

... although NEA's staff is, on balance relatively young and inexperienced, they appear to have reached a stage in their professional development where they can begin to produce results effectively if given sufficient incentives, support and managerial direction.

According to the Mid-term Evaluation, the poor performance of contractor up to mid-1985 contributed significantly to NEA's difficulty in setting an appropriate direction and in the NEA staff's acquiring the needed skills through on-the-job training from the advisors and consultants. The Team wrote that, "overall, the contractor's technical performance, in spite of the project's many extenuating circumstances, did not meet normal expectations for technical assistance contracts of this type" and the quality of technical assistance in specific areas (e.g., computing, energy pricing, and energy conservation) varied considerably.

It should be noted that the ability of a contractor to "re-direct" the activities of its counterpart organization and to shape its basic thinking about the appropriate direction of analysis is highly dependent upon the specific situation and cultural context. In some setting outsiders can potentially exercise such influence. In other settings the counterparts themselves tend to want (and

accept) TA in only relatively narrow terms, i.e., in terms of techniques and not for basic direction. This reviewer did not spend enough time in Sudan to even suggest an answer for the case at hand.

In any case, the ability of outsiders to transfer technical skills and to provide overall guidance to an institution in a host country is an often tricky, and as noted in Section IV, always a highly personal activity. Organizations can be supportive, indifferent or a hindrance to their staff in the field, but in the end, the capabilities of the individual field personnel are likely to be deciding factors in whether the skills transfer and other aspects of institution-building are effective.

Like expectations with the counterpart organization itself, it is necessary to keep expectations about the ultimate influence of TA contractors within realistic bounds. The Mid-Term Evaluation certainly set very high standards by which it judged E/DI's performance. Like the EPM's original goals for the impact of NEA on Sudan energy planning, for E/DI to have met the standards laid down by the Mid-term Evaluation team would have required exceptional capability and a good bit of luck.

While it is clear that the contractor never was successful in "re-directing NEA activities" (assuming this was feasible), it is evident that at least at the micro analytic level, the E/DI assistance during the latter part of the EPM was for the most part effectively re-fashioned and generally favorably received by the counterparts, who felt that they learned considerably from the TA provided during Pluth's term.

Unfortunately, with the relatively short time available for this Review, it is difficult to fully assess the technical quality of the analysis going into NEA's on-going work in 1989, and to determine accurately specific areas of strength and weakness after the completion of the TA. Preliminary examination of the available reports and documents, particularly those produced since the E/DI team left, and discussions with a number of NEA staff on technical points persons suggest several tentative conclusions.

First, since the time of the Mid-Term Evaluation, NEA appears to have further strengthened its internal technical capabilities. In part this is due to the re-direction in the TA instituted by Pluth (with the support of NEA, E/DI, and USAID) and in part due to the return of the long-term trainees, now with masters degree in energy planning under funding from S&T/Ey.

Overall, NEA staff today appear to have a good understanding of general energy data needs and are familiar with basic approaches to energy analysis in the various major energy sub-sectors. Data are collected on a regular basis and some of it is being utilized on an on-going basis to analyze energy supply and demand questions

and to examine the economic feasibility of specific technologies or resources under specific circumstances.

Second, despite its basic capabilities, NEA staff are still relatively young and have been working in a truly independent fashion for less than a year. In their work, they sometimes come up against problems not encountered before and they must face them without the support services typically available to energy planners in the industrialized countries (particularly the ability to call in specialists.)

Under the circumstances, it is expected that the published work in some instances will not be as complete or as thorough as that which would be produced by internationally recognized experts. It should also be expected that in some cases they will be overly cautious and avoid technical issues or problems which may not be in fact as difficult as they at first appear.

The point which should be stressed is that despite some limitations, the published work of the NEA indicates that the organization has a reasonably good grounding in the principles of energy analysis. NEA could, of course, still benefit from resident outside expertise. However, NEA has reached the stage where this is no longer essential, particularly if short-term outside expertise is available for NEA to call upon. Considering Sudan's overall situation of economic decline, civil war, pestilence, floods, and a rather unsettled political situation, NEA's progress over the past 8 years (i.e., with the help of SEPAP and EPM) is noteworthy, even if much more clearly remains to be done.

A concern on the part of some observers is the juxtaposition within the energy planning organization of a major component with essentially a technological development interest. In NEA's case, the Techno-economics Section is by far the largest and has perhaps the most highly trained staff of any of NEA's components. Only when compared to the other components combined, does the Technico-economics Section not appear as dominant.

The Mid-term Evaluation strongly questioned the appropriateness of mixing of planning and the laboratory/field testing activities. The basic issue is whether the often advocative role assumed by persons working on the laboratory testing, development, and field trials of specific technologies represents a conflict of interest within an organization charged with integrating options from many sectors and objectively assessing the economic and financial feasibility and benefits to the nation of one technology (or resource development option) compared to alternatives.

NEA's argument for keeping the Techno-economics Section and its staff of engineers and physical scientists, is that in many cases NEA is looking at technical process issues which no one else in Sudan is considering. And even for those activities which might

be considered by other organizations such as the NRC, "the competition with NEA is a good stimulant."

Returning again to the question of NEA's basic directions a third point arises. USAID has some concerns that NEA does not appear to be actively making itself a source of objective information data and assessment capability for energy issues related to the work of the major commercial energy organizations, such as NEC and GPC. NEA is, in the eyes of these observers, an organization which may collect information in a reasonably effective manner and may carry-out reasonably good analyses of noncontroversial issues. However, they see it as one which does not actively assess the wider range of energy issues in an attempt to set the national energy planning agenda, particularly as this might deal with the activities of the major parastatals.

NEA's response is that in fact it is helping to bring about such integration, but that in Sudan this is best done in a cooperative, and clearly non-confrontational manner. NEA stresses that it can be most effective by assisting other agencies to carry out work to meet their own perceived analytic needs. And indeed, the limited comments obtained from NEC and GPC on the role they see for NEA concurs with that expressed by NEA. NEC and GPC note there is a mutually supportive relationship which should exist between NEA as a research organization, and NEC and GPC as operational organizations.

Clearly, the basic issue is whether this cooperative approach is one in which the broader perspective of the integrated energy planning agency is given adequate consideration by the more narrowly focused line agencies which may need to modify their plans to incorporate this broader perspective. The extent to which the contractor could have (or indeed, should have) attempted to move NEA toward a more activist position in identifying energy issues remains an open question.

The point here is that, while NEA has clearly become a more technically capable organization over the course of EPM, it has not necessarily fully utilized its potential and is not visibly having a leading role in setting the national energy planning agenda. However, it should also be noted that if all A.I.D. energy planning assistance projects for young and small integrated energy planning bodies were held to the same standard, few would be considered major successes.

It is worth noting in passing that in many countries where the relatively young, and relatively small, integrated energy planning organization explicitly (or even implicitly) challenges the larger line organizations in the petroleum, electricity or even forestry areas, it typically loses. The fate of such organizations in some cases is to retreat into becoming the advocate for "renewable

energy" because this is one area where others do not have particular power or interest.

There are some signs that NEA is now beginning to get involved more in cross-cutting energy issues. For example, NEA and GPC have begun to cooperate on preliminary design work for a study to examine the transport fuel savings associated with a switch from biomass to petroleum fuels for urban households. Hopefully, it will one day take on a much greater role in identifying specific opportunities for more basic improvements in the performance of NEC, and GPC.

B. NEC

The EPM-funded assistance to NEC appears to have strengthened the organization in a least two partly related ways. First, through provision of a much up-graded (physically and operationally) Computer Center, EPM has helped make the Computer Center into a force for putting NEC on a much stronger financial footing. Second, Mr. Azri has become an important link with an informal group of committed and capable NEC middle and upper level staff, and a partner with them in pushing for reforms within the organization. The success of the EPM computerized billing system and subsequent increase in collections is used as a prime example by this group of the potential for near-term benefits to NEC of implementing reforms in a number of areas. In addition, there have been widely acknowledged benefits stemming from the work in such areas as computerized budget control and accounting, inventory control, and cash remittance control, distribution system loss reduction.

The specific accomplishments of the Computer center and other EPM assistance to NEC are described in Section III. What is of principal interest in this section is that the EPM has helped NEC to initiate a system in which the data requirements and procedures of the Computer Center are forcing NEC to clear up past errors in billing (e.g., mismatched accounts and meters numbers), to substantially improve meter reading and record keeping (despite resistance from the meter readers), and has encouraged more active enforcement of collections and penalties for delinquency. The Harza team took considerable pains to deeply embed the billing and collection reforms into the system. For example, data demands of the computer center are highly specific, with procedures for checking data consistency. Unlike the past, where errors or false data were easily introduced and difficult to detect, inappropriate data entries now draw attention. It would appear that with the built-in safeguards, any erosion of the revenue picture, if it occurs, will be a slow one, barring of course basic social upheaval. Under favorable conditions, the reforms can serve as the

foundation for further progress. The combined impact of the various project activities with billing, collections, inventory, and cash control greatly strengthened NEC's overall financial accountability.

Although the driving force behind the up-grading of the Computer Center and other Harza work has been Mr. Azri, the expectation on the part of Azri, the NEC group noted above, and USAID is that, overall, the procedures now in place will be maintained for some time and that the extreme problems of the past (e.g., where less than 40% of the customers on the books were ever billed) are unlikely to reoccur any time soon. If this proves true over the coming years, then NEC's financial picture will be much improved compared to what it would be otherwise thanks to EPM. This in turn will have benefits to NEC in terms of its ability to plan for the longer term and to finance more of its own operations.

Still, as anyone who visits Sudan realizes, the NEC remains a very long way from being an efficiently run organization. Considering the pervasive nature of the problems within NEC and the forces resistant to change, the success of the Harza work should probably be viewed primarily in terms of a clear demonstration of the potential for basic improvements and for localized near and medium term direct returns resulting from effective TA.

An impact which is based on admittedly rather subjective grounds is the liaison activities among certain of the middle and upper level staff of NEC and the role which Azri plays in this loosely knit, very informally constituted "group". These persons apparently worked cooperatively to a limited and intermittent extent before Azri arrived and are likely to continue to do so after he leaves. The persons who might be viewed as being a part of this group change as individuals move on (willingly or otherwise) to distant parts of NEC or out of NEC. Yet, a core group still seems to emerge despite such changes. What Azri has done is to link-up individually with many of the most capable and committed middle and upper level staff at NEC and formed effective working alliances with them. The success of the EPM effort to strengthen finances is used by the reform-minded managers within NEC as an argument in support of additional reforms.

Principally, Azri has been an activist, making the case for change, challenging the system, and often pushing the system in a way an insider would find difficult. The effectiveness of such an action seems to have had the effect of stimulating the most capable and interested persons within NEC to themselves become more persistent advocates for reform. If this greater activism on their part continues, even if at a lower level, then EPM will have contributed to "institution-building" in a rather indirect and possibly transitory way, but nevertheless, have potentially significant long-term benefits.

Azri will be sorely missed by the most capable and committed staff within NEC. This informal core group was itself considerably weakened in early CY 1989 by the removal of a number of the more reform minded (or at a minimum not strongly reform-resistant) upper level managers as part of GOS initiated shake-up of NEC management. Hopefully, enough such persons will survive within the organization to provide the internal foundation for potential future reforms.

As noted in the Mid-Term Evaluation, the EPM work on the vehicle maintenance operations did improve for a time the operational level of the NEC fleet. However, now that the expatriates are gone the benefits seem likely to be rapidly eroded. Certainly this activity is far weaker in its institutional impacts than much of the other EPM support to NEC and that provided to NEA. For reasons not clear, the vehicle maintenance work seemed to never generate even minimal support from more senior level counterparts.

It should be noted that NEC's top management sometimes seems surprisingly indifferent to the internal generation of funds and financial accountability within the organization. This seems to be a legacy of the GOS simply making up any deficits in NEC accounts and the absence of criticism by the GOS of continuing revenue shortfalls by NEC.

In the end, true reform must be accepted from within, even if it is encouraged from outside. If EPM has convinced some of the counterparts to become more active agents for change within their own organizations, then it has in effect helped to truly build the institution. If such impacts occurred in most donor assisted TA, it seems likely that the development process would be a noticeably faster one.

VI CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. The EPM contributed to the process of economic development in Sudan.

EPM helped Sudan help address, in a generally cost-effective manner, a number of specific pressing energy sector needs. EPM added formal training and valuable on-the-job experience to the staff capabilities of the two counterpart organizations.

There are clear indications of an overall strengthening of NEA as an institution. There are indications of a strengthening of certain parts of NEC, notably the Computer Center, but also (though more subtly) to other parts of the organization through the encouragement and demonstration of the potential for reform provided for the middle and upper levels of NEC.

2. EPM should be judged a success in terms of its overall goals.

EPM met many of its broader and specific objectives, including the major ones identified by the Mid-Term Evaluation as being actually feasible under the circumstances in Sudan during the time of EPM. Only in comparison with the overall basic problems remaining in the Sudan energy sector and in comparison with the grander goals of the EPM PP could the project be judged unsuccessful.

In terms of the overall situation, under the most favorable of circumstances EPM could not have turned around the situation in the energy sector as a whole. As the Mid-Term evaluation emphasized, many of the broader and specific goals for EPM as listed in the Logframe of the PP were simply unrealistic and virtually unattainable through the planned activities of EPM.

3. EPM demonstrated that Technical Assistance such as that provided by EPM can have highly cost-effective impacts on the counterpart organizations.

This assistance directly led to tripling of NEC revenues within three years. At the 1989 exchange rate the annual added revenue to NEC of 50 million Sudanese pounds is worth over \$4 million US per year. The benefits to Sudan in monetary terms of the assistance to NEA is more difficult to directly quantify, but even a moderate influence which NEA might exert on a single large energy

sector project could easily have benefits exceeding the roughly \$2 million devoted to NEA under EPM. Although a careful review of the impacts of the specific NEA activities over the course of EPM is beyond the scope of this Review, it seems likely that significant quantifiable impacts would be identified through such an effort.

4. The impact of EPM in-country activities was considerably increased through the formal training courses offered in the U.S., Egypt and elsewhere.

One potentially major benefit of the formal course, particularly those involving a period of months in the U.S., is the opportunity this provides for the person receiving the training to learn not just the specific technical material, but also to be exposed to the more basic approaches to problem solving, identification of issues, and decision-making.

5. Projects of several million dollars and of the last several years can have important benefits, but except under the most fortunate of circumstances, such projects cannot by themselves entirely build or largely rebuild a counterpart organization.

B. RECOMMENDATIONS

1. USAID should continue to look to the energy sector in Sudan as a crucial area of the economy and should continue to look for ways to meet assistance needs which fit within the Mission's funding capabilities and basic development objectives.

In particular, the Mission should look for needs which might be met through short-term consultants or long-term advisors where A.I.D. has a comparative advantage (in terms of developing effective counterpart relationships). By providing such TA, A.I.D. is in a position to directly or indirectly make the capital and other assistance from other donors (e.g., the World Bank) more effective.

2. USAID should continue to closely monitor the work of NEC Computer Center, and in particular to track NEC revenues.

One important question which can only be answered over time, is how long the EPM instituted reforms in the various operations of the NEC Computer Center (e.g., billing, payroll) will remain effective after the end of A.I.D. assistance. At this point, it appears that

Harza has been particularly effective in embedding the present system within NEC. However, only time will tell if this is indeed the case.

Even if the NEC revenue picture should (against expectations) suddenly deteriorate, the fact remains that EPM demonstrated that the system could change and that such reforms are potentially highly cost-effective. In addition, according to Azri's estimates, NEC is presently still only realizing about half of the revenues it should with the existing tariff structure. Using a level of 150 million Sudanese pounds (1989 pounds) as a benchmark, the Mission may wish to participate with other donors in pressing NEC for extensions of the existing reforms, with the local currency-funded work getting under way in February 1989 being an example, of the type of activities which could be extended much further.

3. USAID should do whatever it can to provide assistance to NEA to get the RES-SUDAN model running.

Until the model is operational, the investment made in it under EPM (including about 3 person months of training in the U.S.) will have been unproductive. RES-SUDAN could be an important asset to NEA, particularly in the on-going up-date to the National Energy Plan. About 2 person weeks should be sufficient to iron-out the remaining operational "bugs", to make minor changes in model structure, and to provide some additional guided hands-on work for NEA staff with the model under an experienced person. Over the longer-term NEA will need assistance in maintaining the database needed to support RES-SUDAN. It is possible that such assistance could be provided by another donor.

LIST PERSONS INTERVIEWED

(Jan. 29 - Feb. 14)

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USAID/Sudan

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James Franckiewicz, Energy Project Officer

Others

Salah Awadalla Salih, Consultant, Power Consult

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¹⁰ This list shown here simply reflects the material which was provided for this review either prior to its start or during the course of the work. A particular item's inclusion or omission from the list is not necessarily significant. This review is of necessity limited in scope due to very limited level of effort (only about 1/6 of that devoted to the Mid-Term evaluation, for example). Hence, a number of specific topics of detailed interest to certain individuals can only be covered in very broad, outline terms. With this consideration in mind, available information indicates that the most significant written information needed for the purposes of this Review is covered by the listed document.

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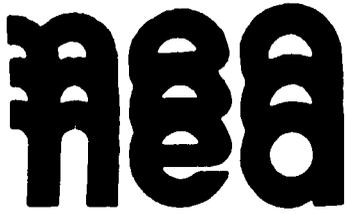
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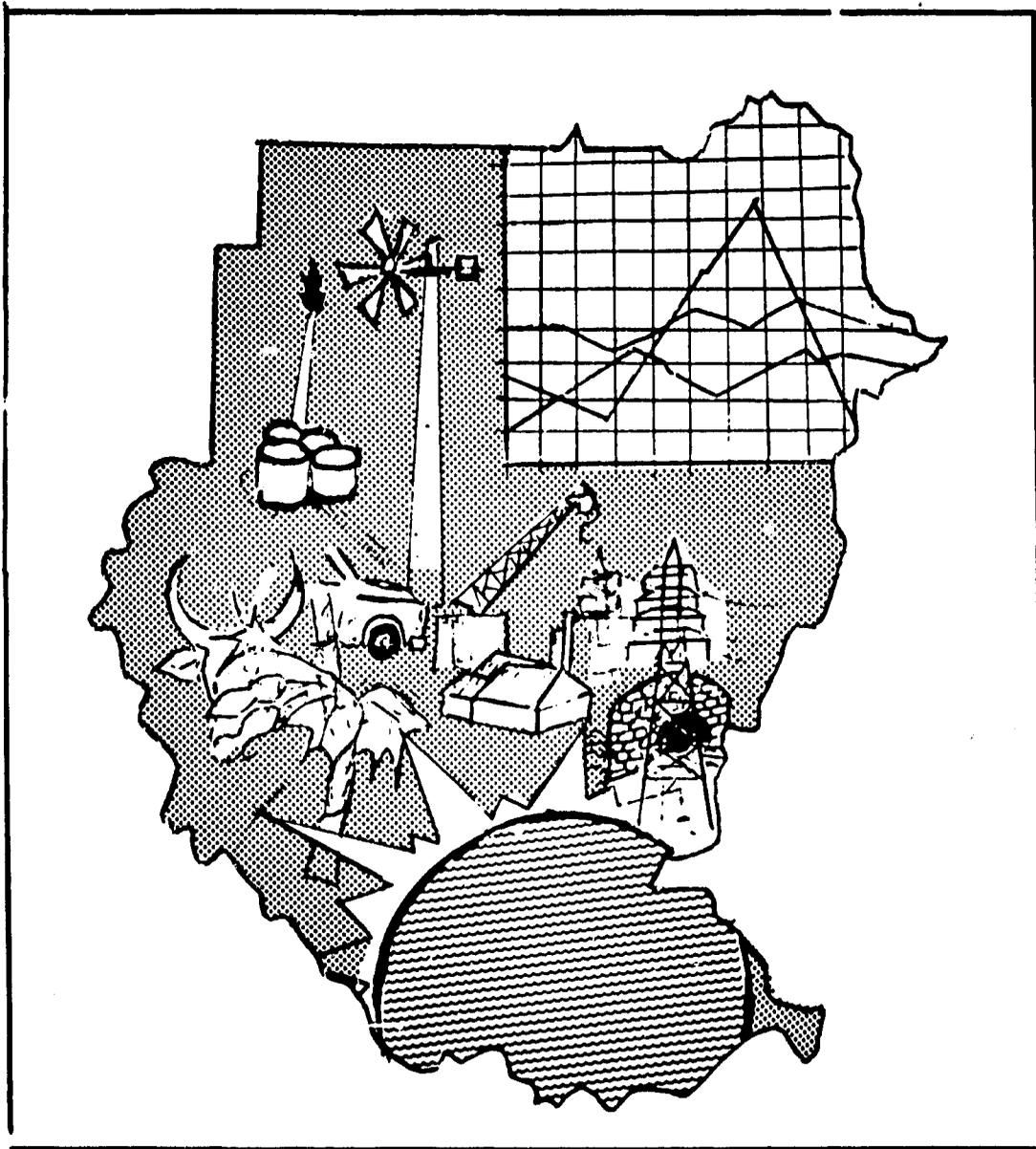
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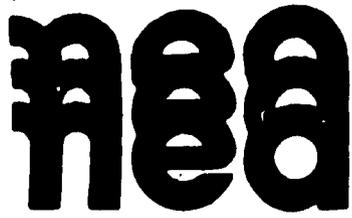


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SUDAN Energy news

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Energy Briefs

● NATIONAL ENERGY PLAN ●

The National Energy Plan Revision and Updating Steering Committee held two meetings in June 1988, in which the plan strategy, and the debottlenecking subcommittees presented their reports. The committee decided that the final report of the debottlenecking subcommittee should be submitted within a month. Priority is given, as it is in the Four Year Salvation Program, to the rehabilitation of the electricity and petroleum sectors.

★ Mr. Lovejoy Visits Sudan ★

Mr. Derek Lovejoy (UNDP energy expert) arrived in Khartoum for a short visit to discuss with National Energy Administration officials the feasibility of establishing and developing Renewable Energy Resources for rural energy needs for possible future funding.

The National Energy Administration coordinated meetings with officials from the National Research Council, the Ministry of Finance and Economic Planning, and the Public Water Corporation, as well as private investors.

Five major projects were discussed in detail and the sites were identified as follows:

1. Community size biogas units.
2. Wind mills to pump water for irrigation and to generate electricity for lighting.
3. Photovoltaic cells for power generation.
4. Mini-hydropower.
5. Combined wind and solar power generating systems.

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● WORLD BANK TO ASSIST PLANNING PROCESS ●

According to the April 20, 1987 World Bank Report - The bank's final objective is to provide additional generating capacity to the National Electricity Corporation to meet the projected increase in demand at the Blue Nile Grid by 1991, to strengthen operational and financial performance, to support the Government of Sudan in its efforts to establish, through National Energy Administration, an action-oriented long term development plan for the energy sector to review the efficiency of energy use in the transport sector, and to develop National Energy Administration capabilities. This achievement was the outcome of National Energy Administration trials to involve the World Bank in scrutinizing the planning process in Sudan, for future financing possibilities.

● ENERGY ASSESSMENT OF THE CENTRAL REGION ●

Work on the energy assessment of the central region conducted by the regional planning section was finished in May-1988. The assessment included figures of consumption in the different economic sectors such as household, industry, agriculture, transport, commercial and services sectors.

On the supply side, figures from the official entities were included. These entities include the Forestry Department, the General Petroleum Corporation and the National Electricity Corporation. On the resources side the biomass resources were assessed. A regional energy balance i.e supply and consumption was presented in the report. A projection for consumption until the year 2000 was also prepared using 1986 as base year.

The Regional Planning section will be busy in the next four months working on the central region's energy plan. The plan will comprise of projects, programs and the necessary policies needed to bridge the gap between consumption and supply until the year 2000. Projects within the region will be prepared and thoroughly studied. Conservation programs, as well as the necessary policies will also be considered.

● **TRANSPORTATION AVOIDANCE STUDY** ●

In the area of energy conservation a study has been conducted concerning the effect of the inefficient system of telecommunications in Khartoum and its effects on fuel consumption by vehicles. The results show, there is a huge amount of fuel which could be saved if the system was rehabilitated. 63% of trips could be avoided if the telephones were working.

● **ELECTRICITY DISTRIBUTION COMMITTEE** ●

The Conservation section participated in the electricity distribution committee formed by the Minister to set the priorities of industries to be supplied by electricity and the scheduled shedding of electricity from the public.

● **PUBLIC AWARENESS PROGRAM** ●

The task of transferring technical conservation information through TV to the public began this week (June 16), The program was starting with three articles. There are still five more articles forthcoming to be produced.

● **ENERGY, TECHNOLOGY** ●

In the area of energy technology the NEA work plan includes three main projects:

Project 1:

Biogas development and dissemination:

project objectives were adopt, develop and disseminate biogas technology in Sudan, The work covered until now includes the following:-

- Evaluate all previous studies.
- Prepare a work plan.
- Start the laboratory experiment.
- Begin constructing a pilot plant in Khartoum Univer-

sity.

Project 2:

Energy Conservation in Traditional Bakeries:

Project objectives are to design optimum bakeries using fuel wood efficiently. The following activities were accomplished in the last months.

- Evaluation of previous work done by others.
- Determination of the testing procedure.
- Choosing different types of bakeries including improved ones.
- Completion of the site measurement in one type of traditional bakery.

Project 3:

Energy conservation in Brick-kilns:

Objectives: Design and disseminate an efficient brick-kiln.

The above topic is proposed to be covered in two years. The work in designing the optimum kiln was finished. To do so the committee first evaluated the previous work, proposed the method of how to get the missing data, start the site and laboratory work, and finally evaluate the situation and suggest efficient design theory. The second step was to test this design practically and disseminate it over all the Sudan.

Energy Seminar

On the occasion of completion of the Energy Planning and Management project between the government of Sudan and USAID (NEA & E/DI), an international seminar was held on 2-4 August 1988.

The seminar discussed the following subjects:-

- Energy resources: Biomass, Wind and Solar Energy, in addition to Petroleum resources.
- Energy Planning.
- Debottlenecking.

The seminar was attended by representatives of all energy sectors.

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Uptodate

● CENTRAL REGION ENERGY ASSESSMENT ●

Introduction:

The energy assessment in the Central Region is a base for an energy plan to solve the energy problems in the Region, until the year 2000. Energy problems in the region, as applies to any region in the country, suffers shortages of energy supplies. These shortages result in:-

- Diminished cultivation use.
- Complete stoppage at some factories and diminished production at others.
- Desertification as a result of irrational tree cutting.

The work started with the Central Region because it is the largest energy consumer after the National Capital.

It is also rich in energy resources and it supplies other regions with biomass fuels.

The work on the assessment and the energy balance for the region has finished and the report is ready .

The work on the regional energy plan has already started. The plan will contain projects, programs and policies necessary to satisfy the region's energy need until the year 2000.

Methodology:-

The Central Region energy assessment covered the supply and consumption of the different

fuels. The supply and consumption made it possible to come up with the region's energy balance.

The resources especially the biomass were also assessed.

The data on the supply side was compiled mainly from official sources. These sources are the Forestry Administration on wood and charcoal fuel data, General Petroleum Corporation on petroleum fuels data, and National Electricity Corporation on electricity data.

On the consumption side the data was collected from official sources. The data which could not be found was collected through field surveys - the questionnaires were properly designed for these surveys. Wood figures were obtained from official sources, while agricultural and animal waste figures were obtained through field surveys.

The assessment covered the three provinces. Urban and rural areas were covered. In each province the sectors covered were households, agriculture, industry, transportation, commercial and services sectors.

Energy consumption projections were based on many projected activity levels and are closely linked to the four year economic salvation, recovery and development program which covers

the period 1987/88 - 1990/91. After the period of this economic program, projections are based on program averages, discussions, or at best guesses.

Results and Findings:-

The purpose of the assessment and energy balance of the central region is to provide estimates on the energy consumption by, province and sector, for 1986, and to project future consumption until the year 2000 so as to provide a base for the central region's energy plan, which will come up shortly. The main results as follows:

- The actual consumption of petroleum fuel, wood and charcoal far exceeds official supplies (table (1)).

- There are black (secondary) markets in which fuels are being redistributed among different sectors according to power of supply and demand and additional supplies are coming from outside the region.

- Official licensing of wood and charcoal production far exceeds allowable cut in the region except for the Blue Nile province. Therefore Region authorities are encouraging deforestation (table (2)).

- Actual consumption of wood and charcoal of the Region of far exceeds both the allowable cut and the officially licensed production (table (3)).

- Projection of wood consumption in the Region indicates that the deforestation rate is very rapid and that forest resources will be depleted by the first decade of the next century unless substantial substitutes take

place (table 3).

- Less than 10% of agricultural residues are currently being utilized by the household sector in the region. Agricultural residues are produced in quantities that will satisfy the biomass energy needs for many coming years.

- Substitution of wood fuels by agricultural residues has already taken place, especially in the Gezira province. The same thing will happen in other provinces as wood resources are depleted.

Limitation of the Findings :-

The data on electricity consumption in this work is obtained from the official records of the National Electricity Corporation. These records are compiled and prepared by the financial Planning Section.

The tables are misleading. For example; sales to heavy industry are in fact billed under tariff 4, and this includes the large agricultural schemes, Sugar estates, bakeries, hotels, universities and high institutes. Sales under tariff 3 include irrigation pumps and dairy farms with a capacity of 100 KVA (Kilo Volt Ampere) or less. Sometimes you find some establishments under two tariffs. This made it impossible to compile an electricity energy balance.

Also, the assessment consider sales, which are the billing, as the consumption and this is not always true especially if we know that meters are read from time to time (usually every 3 months) and are entered as sales in the year they were read, even if the consumption was for another previous year. So what we did in the Central Region was, we took the

Update **Table (1) ENERGY CONSUMPTION BALANCE**
CENTRAL REGION

	Wood (mt)	Charcoal (mt)	L.P.G (mt)	Benzene (mt)	Gasoil (mt)	Keros. (mt)	Furnace (mt)	Jet Al (mt)	Avagas (mt)	Ag Wastes (mt)	Ar Wastes (mt)
Survey Consumption											
hh	592,939	481,415	2,874	9,624	38,665	10,455	0	0	0	869,736	157,016
agriculture	0	0	0	0	82,762	0	0	0	0	0	0
industry (1)	202,036	0	7	607	32,489	3,909	91,120	0	0	0	0
transportation (0	0	0	25,848	70,843	0	0	0	429	0	0
commercial enter	2,395	22,476	10	85	755	603	0	0	0	0	0
other (3)	873	437	0	1	5,141	0	0	0	0	0	0
Total	798,243	504,328	2,891	36,165	230,655	14,967	91,120	0	429	869,736	157,016
Regional Supplies											
hh			547	0	0	3,252	0	0	0		
agriculture			0	0	83,818	0	0	0	0		
industry (1)			0	0	23,445	165	91,090	0	0		
transportation (2)			0	28,562	42,033	0	0	263	481		
commercial enterprises			0	0	0	0	0	0	0		
other (4)			0	0	1,593	0	42	0	0		
Total	578,332	183,719	547	28,562	150,889	3,417	91,132	263	481	10,159,328	4,805,229

GPC Khtm Allocation (excluding fuel to NEC) 7,230 139,811 186,621 1,067 93,688 77,871 3,323

GPC National Allocation (including NEC) 9,724 216,996 633,466 17,943 350,017 83,223 4,454

Ag=agricultural hh=household
 An=animal khtm=Khartoum
 furnace =furnace oil GPC=General Petroleum Corporation
 NEC=National Electricity Corporation

- (1) Includes gas oil consumed by sugar estates.
- (2) Excludes rail and river transport as these are not strictly Central Region's activities.
- (3) Includes benzene consumed in government sector for self generation, and gasoil consumed for water supply, construction, and oil exploration. All benzene and gasoil consumed for internal transport is included in the transportation sector. These figures exclude fuel consumed by decentralized NEC generation units. Data that were not available at the provincial level are recorded here.
- (4) Includes GPC allocations to construction and oil exploration only. Provincial totals do not sum to regional totals due to exclusion of "other" sector from provincial totals.
- (5) Excludes furnace oil to railroad workshops.

National Energy Corporation readings of sectors for the year 1986 as a base year and we projected them till the year 2000.

Another problem is the fact that estimates of the wood resources in the region have varied over time.

Estimates made by the National Energy Administration in compilation with the Forestry Department in 1983 were very much different from those made in 1987 by the National Resources Department (Wad Medani). Those of 1987 are almost fivefold those of 1983, and there was no real effort to satisfy the consumption during the period and increase the resource to these figures during the period 1983 - 1987.

This again brings us to the official figures and their eligibility (table 2).

Table (2)
FUEL ALLOCATION BY PROVINCE
(G.P.C 1986 - Metric Tons)

	Gezira	Blue Nile	White Nile	Central Region
butagas	540	2	5	547
benzene	21,135	2,610	4,817	28,562
gasoil	51,679	41,396	57,814	150,889
kerosene	3,298	30	89	3,417
furnace oil	17,228	4,700	69,204	91,132
jet a-1	94	0	169	263
av gas	383	81	17	481

Source: GPC

Table (3)

**TIME PATH OF WOOD RESOURCES IN THE
CENTRAL REGION
(In Absence Of Substitution)
Unit in (000 M)**

YEARS	1986	1987	1988	1989	1990
Wood					
standing stock	:123,235	127,548	132,012	136,633	141,415
renewable supply	: 4,313	4,464	4,620	4,782	4,950
consumption	: 0	0	0	0	0
net increment to stock	: 4,313	4,464	4,620	4,782	4,950
YEARS	1991	1992	1993	1994	1995
Wood					
standing stock	:146,365	151,487	156,789	162,277	167,957
renewable supply	: 5,123	5,302	5,488	5,680	5,878
consumption	: 0	0	0	0	0
net increment to stock	: 5,123	5,302	5,488	5,680	5,878
YEARS	1996	1997	1998	1999	2000
Wood					
standing stock	:173,835	179,919	186,217	192,734	199,480
renewable supply	: 6,084	6,297	6,518	6,746	6,982
consumption	: 0	0	0	0	0
net increment to stock	: 6,084	6,297	6,518	6,746	6,982



DISCUSSION

● A NEW SYSTEM FOR DISTRIBUTING ● PETROLEUM PRODUCTS

Mr. Osman ElAmin, the acting manager of the Development and Establishment Administration of The National Capital Commission and Supervisor of the Administration of Petroleum Products Distribution, has declared to the "Sudan Energy News" that:-

The first system for distributing petroleum products began in the seventies during the petroleum products crisis when it was impossible to meet the country's requirement. At that time a suitable quota was allocated to every car from the available quantities. This was achieved by using benzine and gasoil ticket-books. However, the quantities of fuels were specified in these ticket-books according to the type of vehicle and its use whether large or small, using benzine or gasoil.

Under this system of rationing a defined day was allocated for every vehicle to avoid rush in the service stations. In addition, specific service stations were allocated for taxis, private cars and vans. Aside from this there was a system to supervise the regulations to prevent illegal practices, whether committed by the owners of the service stations or the vehicles drivers. However, a lot of disadvantages emerged from the system:-

1- It caused suffering to the drivers of the vehicles to acquire their quotas from the station specified. Accordingly the car drivers was forced to move from one station to another to get his quota, and as a result he consumed more fuel.

2- Lack of information about the number of cars and types which had the right to get their daily or weekly quotas, consequently the process of revision became useless.

3- The difficulty to regulate cheating in the quotas. As result, some cars got more than their official quotas and others got nothing.

4- The ticket system was expensive with regard to the cost and effort of producing the ticket books.

To avoid these disadvantages a system of monthly cards was introduced to replace the tickets and ticket-books. The monthly card was divided to the four weeks to permit the checking of each weekly quota. On these cards the day of getting the quota was defined according to the number-plate

Discussion: //

(vehicles with even numbers had a fixed day and those with odd numbers had another). A special card was designed for the vans which receives a daily quota. Nevertheless, to avoid the disadvantages and difficulties which faced this system, it became very important to develop a new computerized system as follows:-

1- Collecting sufficient information about the cars. This will include the number-plate, the type of car and its use, the place of work and residence of the owner of the car. Then these data will be introduced into a computer.

2- The new system will allocate a certain station for every car according to the choice of the owner to secure his quota, whether daily or weekly.

3- Every station owner will have a record showing the cars which have the right to get their quotas. During the day of getting the fuel quota the owner of the station has to sign his name and return the balance record periodically to the committee to enter the information in the computer.

4- The car owner also has a card, and on the day of receiving the quota, the station worker has to sign his name. When the period of the card expires it has to be returned to the Administration to compare it with the record of the station.

5- Every car must have a prominent mark like the circular licence to denote the defined service station. The merits and advantages of this new system are:-

a. Being able to include new cars.

b. The inclusion of any required change in allocating the service station when moving from the residence or the work place, or when the car is sold.

c. The system will contribute in conserving fuel that is used in moving from one station to another.

d. The car owner will contribute in controlling his quota.

e. The serious regulations will limit the evasions expected whether from the car owner or the station.

f. The responsibility of the car owner, station owner and the company (Shell, Mobil, Total and Agip) is well defined in this system.

Since the introduction of the ration system in distributing petroleum products, only one system followed the development of the distribution system. This was the Supreme Committee for Distribution of Petroleum Products. This committee was composed of the Khartoum Commission, General Petroleum Corporation, the oil distributing companies, and some administrative institutions.

For the companies which have better capabilities and facilities than the others, a coordination was made with the GPC to transfer the allocations from one company to the other or by moving the vehicles to other stations.

In case of shortage of petroleum products, the allocations could be reduced to a half, a third or a quarter, depending on available quantities.

Discussion

The question (in your opinion, how would the proposed petroleum distribution system help in solving the fuel distribution and allocation problems ?)

Gamal Abdel Rahim Salih
General Petroleum Corporation
Computer Section

The new allocation system aims to maintain fairness in fuel distribution and reduce the black market in petroleum products.

The main objective to be achieved is to establishing a new driver-station straightforward relationship by allocating a specific station, chosen by the driver, to each car. The authorities, the third party, will then allocate the available fuel to distribution stations proportionally, since they know the exact number of vehicles allocated to each station. Consequently any shortage in the daily quota that may occur will be shared equally by all drivers.

The application of the new allocation system may have some indirect positive effects in eliminating the phenomenon of long lines at the service stations. Because each driver is attached to only one station, he knows that his right is ensured if the fuel is available.

Ibrahim Hussein
National Energy Administration
Computer Section

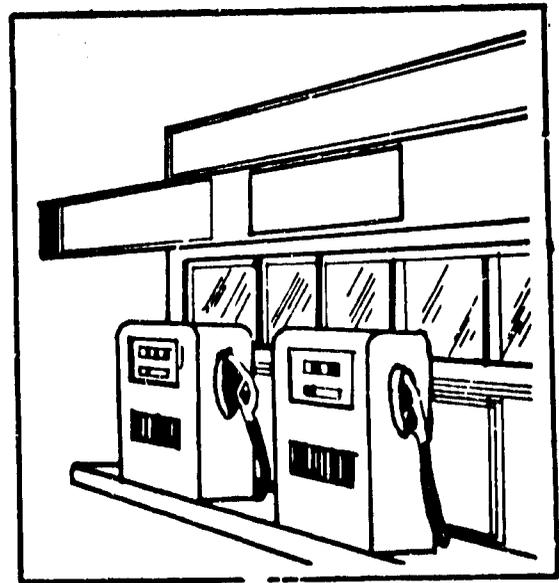
In light of this question, I believe that this new allocation system is the first stage in reviewing our petroleum distribution system in the Capital, by coming up with a proper system which will ensure equity in distribution, conservation, and reduce the black market and benzine smuggling.

Based on the proposal carried out by a responsible committee, this system is geared towards benzine distribution only, it deals with all type of vehicles except government-owned ones. Under this frame the system allocates to each vehicle a certain station, quota and date depending on the vehicle type and the owners choose by filling in the appropriate questionnaire.

Discussion: //

I personally believe that there will be some points overlooked in this system that might need to adapt to a major realignment in the final system. Significant changes that need prompt important modifications will not be reached without the start of the system; because of all this I say that, it is a stage in building our New Petroleum Distribution System. As a result, this N.P.D.S. will be able to handle all types of vehicle, government & nongovernment, diesel and benzine, private and commercial types of vehicles.

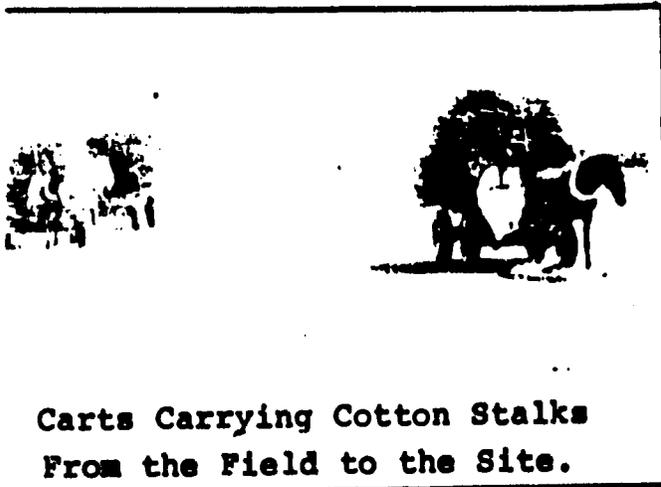
Lastly I would like to focus on the question of the system implementation and stability which leads us to the fact that the capital authorities' big effort will not succeed without the role that people have to play in securing this system. The roles of the Ministry of Energy & Mining role and the police authority, all have to be ready to face illegal actions against the systems' regulations specially in the first stage of the implementation.



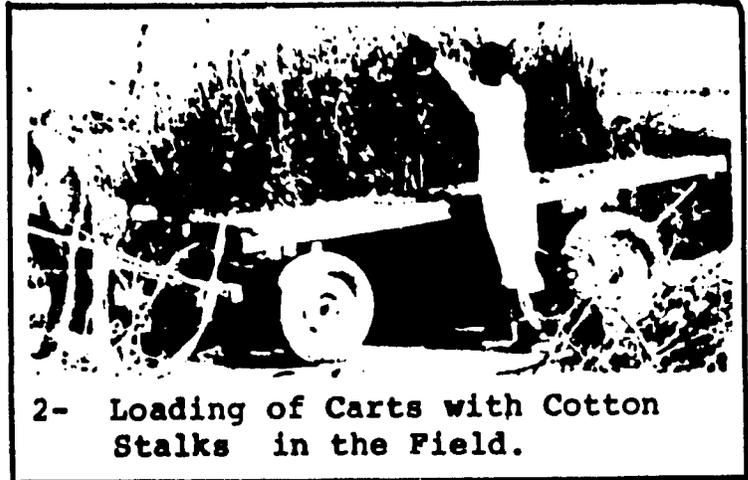
EA in action

★ Utilization of Agricultural Residues as a Source of Energy in Sudan.

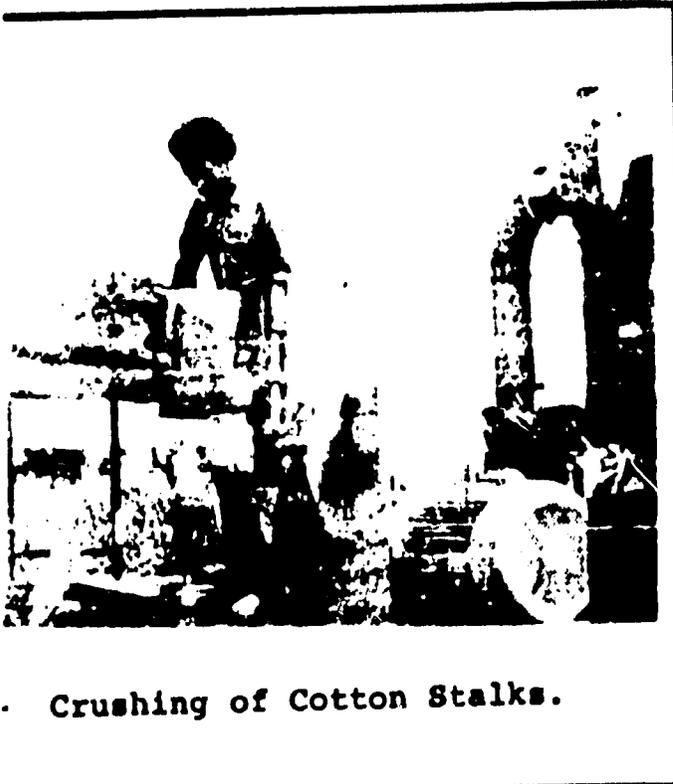
The pictures below show different stages of Cotton stalks preparation to be produced as briquets. NEA Technology Section Staff is carrying the task at Gezira Scheme. Briquetting process is being carried out to lessen the possibility of disease transfer from one season to another while enabling the utilization of the stalks.



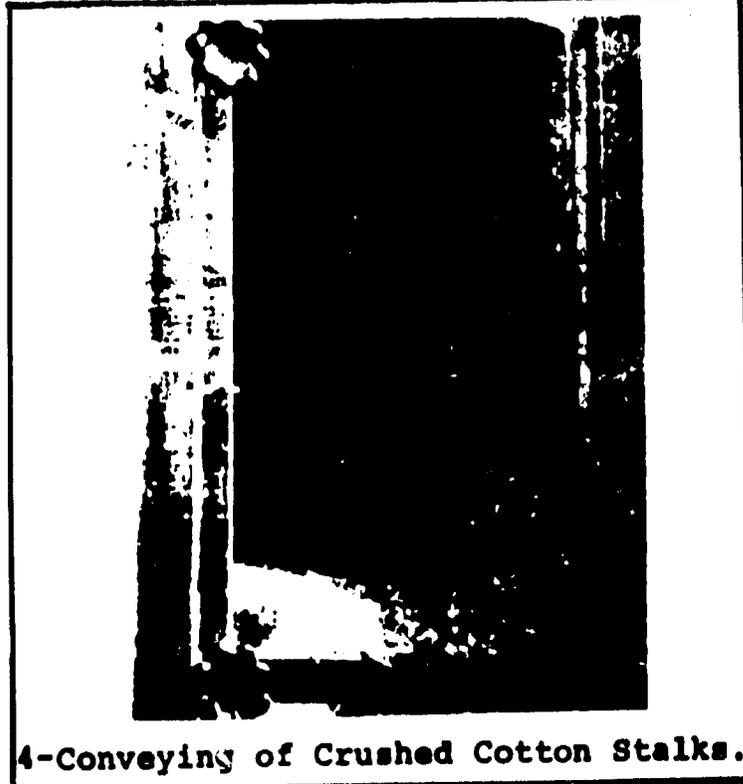
Carts Carrying Cotton Stalks
From the Field to the Site.



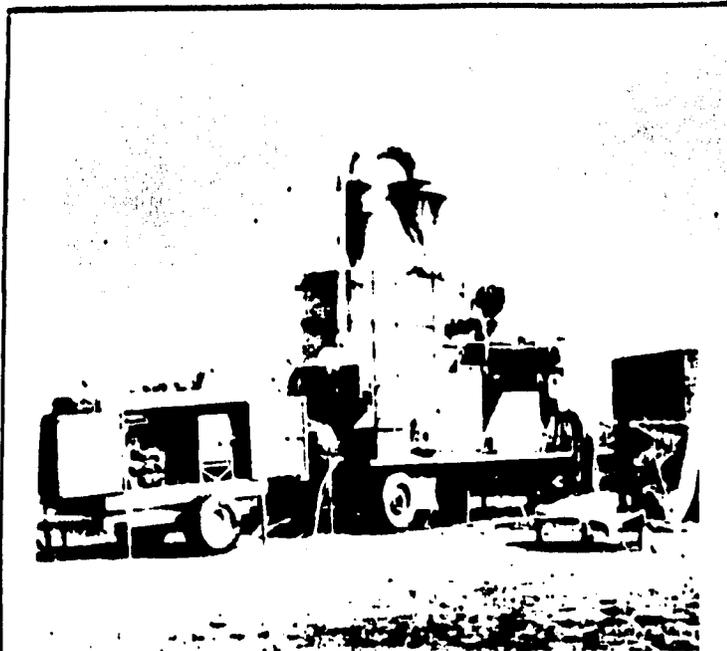
2- Loading of Carts with Cotton
Stalks in the Field.



Crushing of Cotton Stalks.



4-Conveying of Crushed Cotton Stalks.



5- The Mobile Briquetter at Wad Elbur.



6- Cotton Stalk Briquettes.



7- The Nozzle Jamming Problem.



8- Finished Briquettes Ready for Users.

● **DISTRIBUTION OF SEDIMENTARY BASINS** ●
IN SUDAN

* **A/Elzahir M. A/Elzahir**

INTRODUCTION

Sedimentary basins are the main sites for hydrocarbon and water resources exploration. It is no wonder that hundreds of millions of dollars are spent by oil companies delineating and exploring for prospective locations within them.

Sedimentary basins have been known by geologists to exist in Sudan since the start of this century. However very little was known about their boundaries, depth, composition and tectonics.

Oil exploration activities which started in South-Central Sudan in 1976 by Chevron Oil Company of Sudan, soon spread to other parts of the Sudan and added a lot to our understanding of sedimentary basins.

Three main companies acquired concession areas in interior Sudan; Chevron Oil Company in 1975, Total and Partners in 1980 and Sun and Partners in 1982.

The approach of almost all oil companies follows a standard procedure in poorly known areas; LANDSAT interpretation, surface geological mapping, aeromagnetic survey, gravity survey and finally seismic survey for a better delineation of prospective locations which could possibly be drilled. While some basins are covered by all the above, others are only half-way at present. So the state of knowledge in each basin varies.

LOCATION:

The figure attached shows the location, size and extent of sedimentary basins in Sudan. Most of them are defined by 50 m gal

bouguer gravity contour line which approx. but not necessarily coincides with a depth of one km. (see map). The boundaries of concession areas of the three companies mentioned above are shown.

Large continuous basins are approx. between lat. 7N and 13N. They are characterized by NW trend to NNW trend. Beyond the above, basins tend to be smaller in size and discontinuous.

Muglad Basin is the largest basin in Sudan. It covers a large area extending from lat. 6N (close to Bor town) up to lat. 12N, about 875 km. in length. The widest part of the basin is about 200 km. Muglad basin gets narrower southwards. The deepest parts of the basin range from 10-15 km. It is crossed at its northern end, almost perpendicular to a narrow basin running east west known as Bagarra about 30 km. wide.

Only 86 wells have been drilled in Muglad Basin, leading to the discovery of 14 oil fields of different sizes.

The main locations of those fields are shown in the attached map. It is obvious that a large portion of this basin is yet to be explored.

Barra-Melut Basin:

Barra-Melut Basin is the second largest basin. It is about 770 km. in length and ranges in width from 15 km. to 70 km. Two unsuccessful wells were drilled in the northern part of this basin while five wells were drilled in the southern part leading to the discovery of one

field.

Basins north of lat. 13N:
These basins are relatively smaller in size and extent compared to Muglad and Melut basins. Examples are Kost, Blue Nile, Khartoum, Gadaref, Atbara etc. Some of these basins were tested by drilling only one well in each, others were not.

Regional geological and gravity surveys indicated the existence of some basins in NW Sudan. Sediments as old as Lower Silurian (440 million years ago) have been reported e.g. Kofra Basin.

BASIN EVOLUTION:

The origin evolution of these basins is related to the development of the Atlantic Ocean as a result of the breaking-up of the GONDWANA paleo-continent and the sea floor spreading processes, still active today, that caused the migration of the south American and African continental plates. As a result, tensional forces were created during the formation of horst and graben structures.

Sedimentation of continental origin started at upper Jurassic time (Lower Cretaceous) some 150 million years ago. Three rift cycles have been observed in Muglad basin. Each cycle started by lacustrine deposits and ended with fluvial deposits.

According to Dr. Klitzsch, large NNW trending graben and horst structures developed during Cambrian. At Ordovician a margin transgression reached as far south as Gebel Uweinat and western part of Kufra Basin in Libya. Shallow margin Lower Silurian occurs in many locations in NW Sudan. The Devonian sea followed the same trend. Thus it could be concluded that while the NNW structural trend started develop-

ing during Cambrian in NW Sudan, Muglad Basin, Melut Basin and the others developed some 400 million years later.

POTENTIALITY:

As far as oil potentiality is concerned, sedimentary basins in Sudan could be divided into the following categories:

1/ Basins that proved, through reasonably extensive surveys and drilling to be oil potential. These are Muglad Basin and Melut Basin.

2/ Basins which have proved, through moderate geophysical surveys and drilling (one well in each basin) to have indications of hydrocarbon. These are the Blue Nile Basin and Khartoum Basin.

3/ Basins which have only one well drilled in each but with no encouraging results so far e.g. Kost Basin and Bara Basin.

4/ Some basins, after the necessary work was carried out, need more geophysical surveys before drilling can be decided e.g. Atbara Basin and Bagbag basin (west of Khartoum).

5/ Other basins are located in remote areas, (NW Sudan) thus have had little work carried out and are not accurately defined. Until now they are the highest risk areas e.g. Kofra and Meidub Basins.

Oil and gas are not the only natural resources which could possibly be located within sedimentary basins. Another important resource is water. Judging from the surface area covered by sedimentary basins it is obvious that Sudan has a tremendous amount of groundwater. More than 170 wells drilled in Muglad Basin alone have proven to have quality water.

////////////////////////////////////
CONCLUSION:-

Sudan is covered by a significant area of sedimentary basins, the main sites for hydrocarbon accumulation. These are widely scattered, relatively smaller in size and not extensive in Central and North-Western Sudan but get larger in size and extent as we move to South-West.

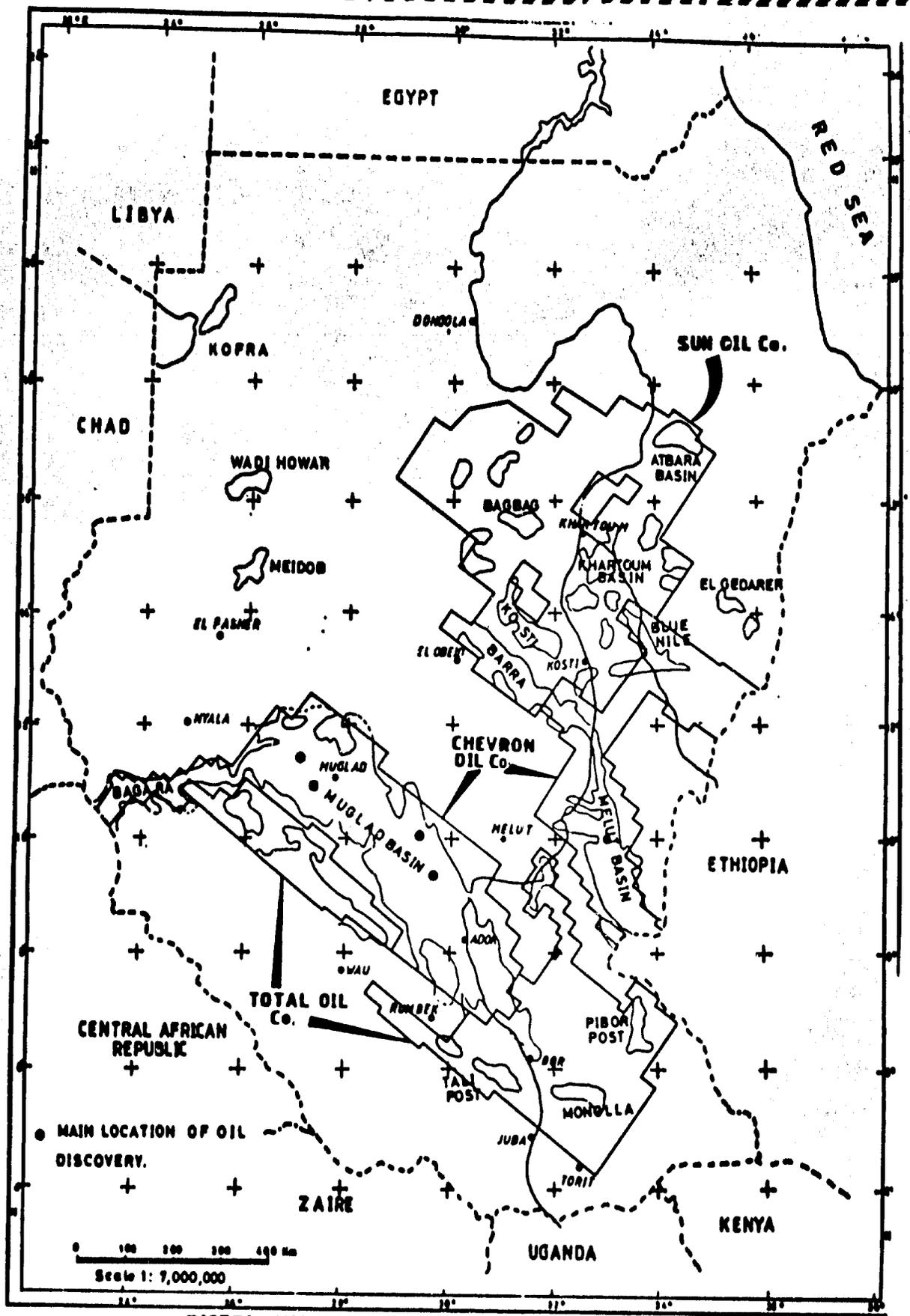
The risk of finding oil in larger basins has proven so far to be less than in small confined ones. This leads to the fact that Chevron Oil Company has the most prospective concession area compared with other companies.

A total number of 92 wells

have been drilled in all basins, resulting in the discovery of 15 fields of different sizes. The total amount of oil in place discovered is about 1.5 billion barrels. However the potentiality of all basins is clearly many times the above figure.

Oil is not the only natural resource which could be utilized. The above-mentioned basins carry a tremendous amount of water, some of which has been proven, through drilling, to be of good quality.





DISTRIBUTION OF SEDIMENTARY BASINS IN SUDAN

● MANAGEMENT AND CONTROL OF POWER CRISIS ● DURING THE LAST RAINY SEASON

By: Mohamed Ahmed Talat
Minister Tech. Bureau
Ministry of Energy & Mining

& Mohamed Mostafa A/Elsalam.
Head of Staff Relief Sub committee
(NEC)

The National Energy Corporation (NEC) was subjected to very difficult and unusual circumstances in power generation and distribution due to the heavy rains which hit the National Capital this year. The crisis started in mid July when the Blue Nile flooded earlier than usual. Due to drought which hit the area during the last four years, the Blue Nile was loaded with large quantities of silt and debris which resulted in blocking the turbine intakes at Roseires Power Station. The heavy rains of Thursday evening the 4th of August caused destructive effects both in the power station and the distribution network in the National Capital. Power station basements were flooded with water, resulting in flooding of all the station auxiliaries and control panels. Khartoum North power station although not affected by the rains, was completely isolated. No one could get into or off the station. Those who were on duty that evening were trapped inside the station without food or relief. They were forced to shut down the station due to exhaustion and fatigue.

The gas turbines at Kilo X and Kuku were already not operating due to lack of some spare parts.

In distribution, many high-voltage cables were affected by

the rain and some of them were damaged.

In addition some overhead transmission lines were affected by collapsed houses, falling beams or by wind.

Therefore, NEC disconnected the whole capital for the safety of the people for many days. When the electricity supply was resumed, it became apparent that many of the transmission cables were affected. All these problems overwhelmed NEC, therefore the Minister of Energy and Mining decided to form three emergency Committees to help NEC. The committees included Engineers in this field, from NEC and other places to restore the situation to help NEC Management. The committees were to alleviate the crisis by making a practical program to be executed immediately after investigation of all problems.

These three committees were

1. Committee for generation problems
2. Committee for distribution problems
3. Committee for staff relief and transportation.

The Generation Committee, comprises all relevant technical and decision making personnel. These personnel include all managers of thermal stations and some managers from the NEC. The

some managers from the NEC. The committees dealt with:-

1. Assessing the problem and how it occurred, by reports from station managers and by surveys.
2. Peaking problems which had already been identified.
3. Distribution of work among committee member to tackle the above identified problem.
4. Identifying needed materials and parts. The material include spare parts and cars for transportation.
5. Execution of tasks according to a specific timetable for every member.

Managers of stations do their work in the station with help from engineers, technicians and laborers of the station.

Also the committee coordinated with foreign embassies to bring foreign experts, spare parts, follow up of receiving and clearance of the spare parts from Khartoum air port or search for the material from the local market or from the public or semi public sector.

There were changes in the old program from the traditional way. i.e methods for repair and maintenance, to new shift, operating continuously and following emergency damages.

There were nightly meetings of different committees under the auspices of the Minister to report on each committee daily activities and also to coordinate between them in a joint work program and to exchange experience, ideas and problems between different members of the committees.

We believe that the main advantages of these committees were to :-

1- Reduced administration work for managers and leave ample time for them to deal with maintenance and repair issues.

2- Exchange of experience and dialogue between the engineers and technicians to solve some technical problems.

3- Daily follow-up that made it easy and possible to perform the duties within time.

4- Motivate the laborers and improve their morale which in turn made the laborers more active and enthusiastic for additional work.

5- Neutral examining of problems and focusing attention on them to be solved quickly.

6- Freedom from routine work made it easier to move between different locations.

7- It is doubtless that the enthusiasm and tireless efforts and sacrifice of the workers of NEC (Engineers, technicians and labours) who were also affected by this flood crisis, contributed a lot to solving this problem. Also the follow-up of the Minister helped a great deal in solving daily problems and make the job of the committee easier.

The electricity emergency committee dealt with the problems of transportation and accommodation of manpower at the electricity generation and distribution centers that were affected by floods and rain during last August. The total cost of transportation and accommodation amounted to approx. LS. 81,000.

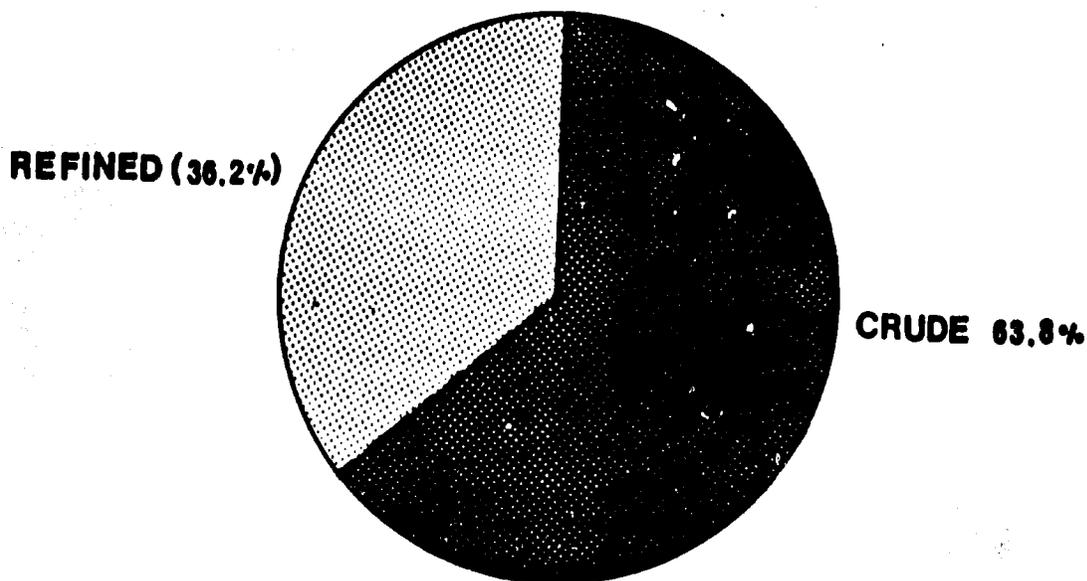
The efforts of the committee relieved NEC staff and allowed them to devote their full time to work and so help to put the electricity supply back on line again quickly and effectively. [5]

Energy Statistics

(1st Quarter)
1988

IMPORTED PETROLEUM (SUPPLY)

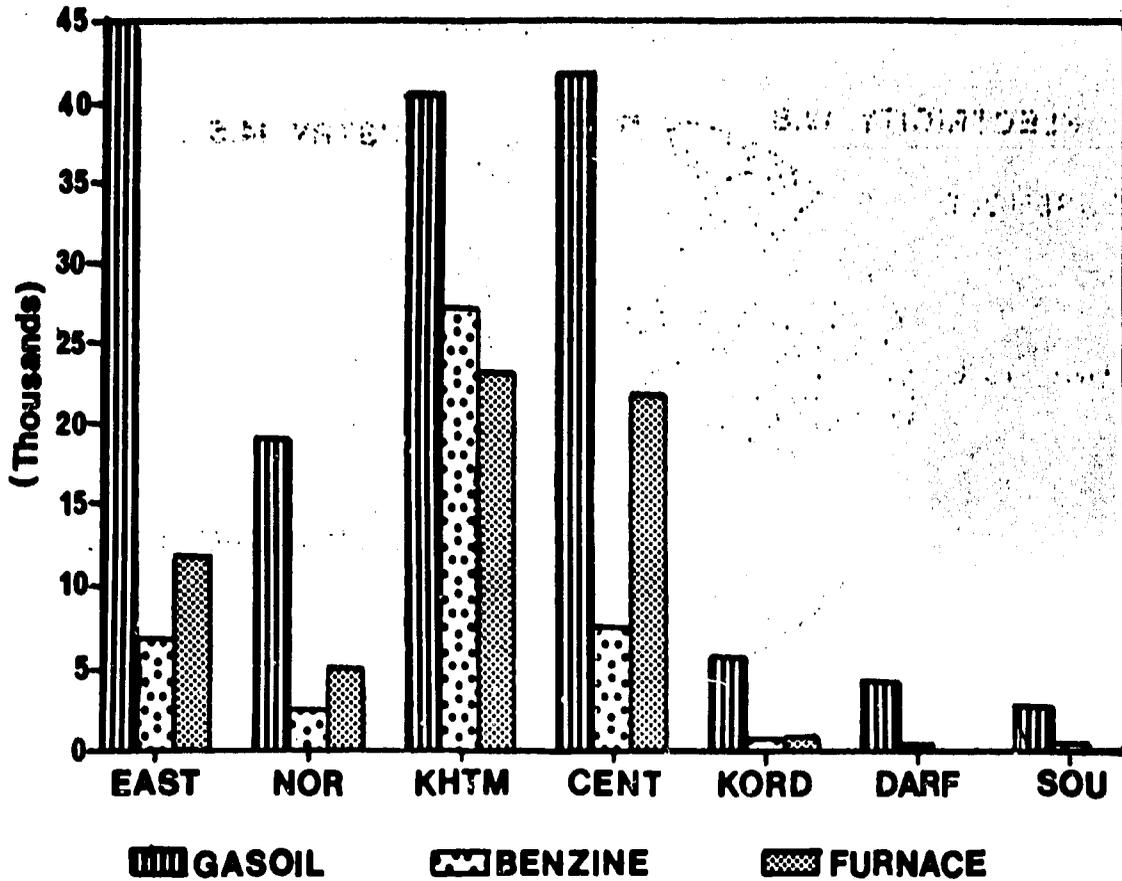
1st Q 1988



IMPORTED PETROLEUM (SUPPLY)
(Crude & Refined Product)
(JAN-MAR 1988)
in MT

	JAN	FEB	MAR	TOTAL
a. CRUDE	54656	98197	104544	257397
b. REFINED	38559	85171	22035	145765
1. LPG	0	487	0	487
2. R. BEN	7948	16637	0	24585
3. S. BEN	0	2101	0	2101
4. GASOIL	30611	58036	22035	110682
5. FURNACE				0
1500	0	7910	0	7910
6. JET-A1	0	0	0	0

**CONSUMPTION OF GASOIL BENZINE & FURNACE
BY REGION (1st Q 1988) MT**



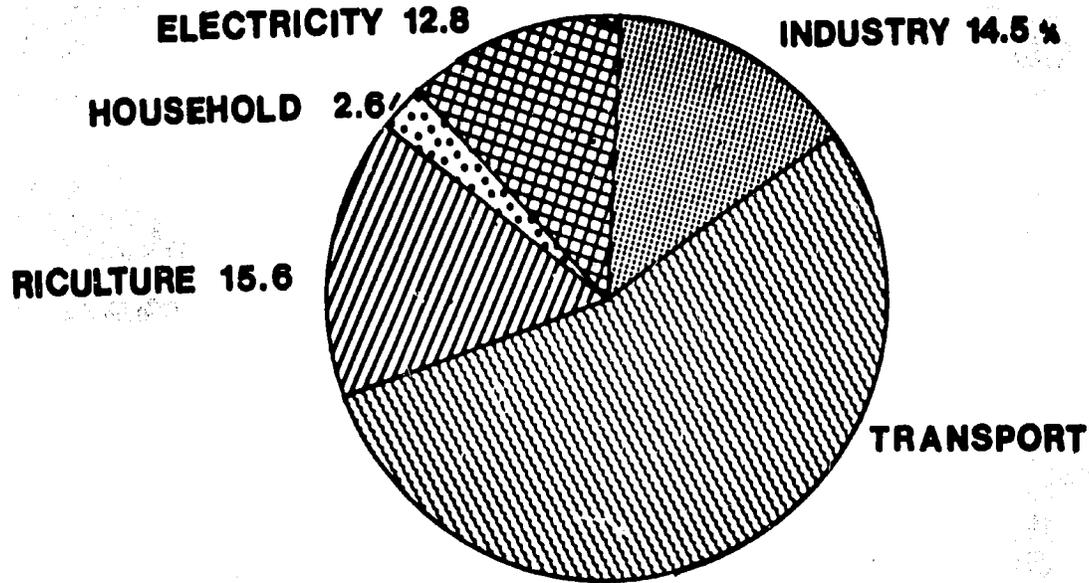
**PETROLEUM PRODUCTS CONSUMPTION BY REGION
(1st. Quarter 1988)**

PRODUCT	GASOIL	BENZINE	FURNACE	DIESEL	KEROSENE	LPG	TOTAL
REGION							
EAST	44774	6781	11679	3374	2482	662	69752
NOR	19189	2476	4982	1739	1013	63	29463
KHTM	40418	27078	23211	2747	184	1616	95252
CENT	41744	7298	21618	66	557	217	71501
KORD	5749	735	833	126	22	34	7498
DARF	4278	316	171	190	21	0	4976
SOU	2799	458	0	0	41	0	3298
TOTAL	158951	45142	62494	8243	4318	2592	281739

85

PETROLEUM PRODUCT CONSUMPTION

BY SECTOR 1st Q 1988

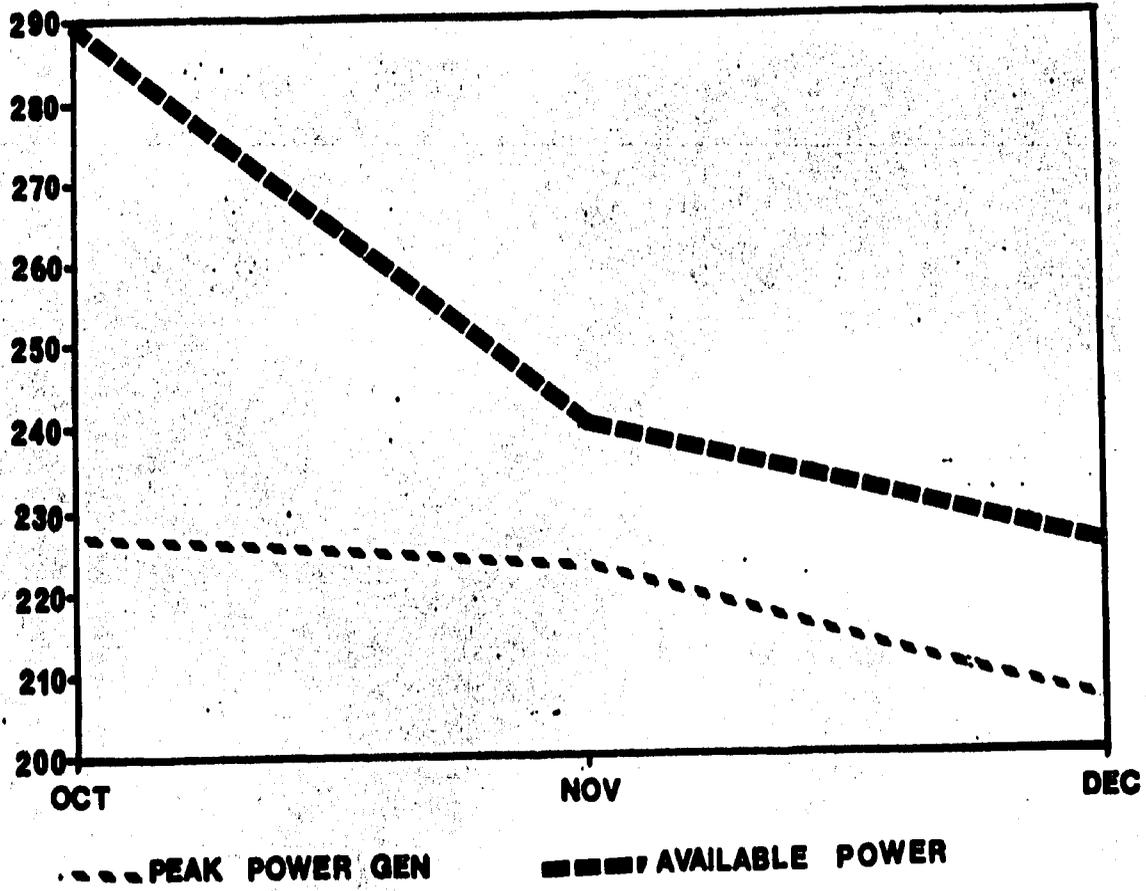


PETROLEUM PRODUCTS CONSUMPTION FOR SOME SELECTED SECTOR
(1st. Quarter 1988)
in MT

PRODUCT	GASOIL	BENZINE	FURNACE	DIESEL	KEROSENE	LPG	TOTAL
SECTOR							
INDUSTRY	18074	0	18801	650	96	0	37621
TRANSPORT	83406	50141	8338	0	0	0	141885
AGRICULTURE	40356	0	0	361	0	0	40718
HOUSEHOLD	0	0	0	0	4223	2592	6814
ELECTRICITY	5053	0	21008	7232	0	0	33293

SOURCE OF PETROLEUM DATA :
STATISTICS Dept. (GPC)

**PEAK POWER GEN & AVAILABLE POWER MW
4th Quarter 1987**



**PEAK POWER GENERATION & AVAILABLE POWER (MW)
4th Q. 1987**

	OCT	NOV	DEC
PEAK POWER	227.4	223.5	206.5
AVAILABLE POWER	290.0	240.5	225.5

**LOAD SHEDDING (GWH)
4th Q. 1987**

	OCT	NOV	DEC
DUE TO CAPACITY SHORTAGE	0.32	0.40	0.39
DUE TO TRANS. & DISTR. FAILURE	1.79	0.44	0.33

ENERGY GENERATED(GWH) & AVAILABLE POWER (MW)
FOR HYDRO POWER STATION
4th Q. 1987

	OCT	NOV	DEC	TOTAL
ENERGY GENERATED (GWH)				
ROSEIRES	85.1	82.0	76.5	243.6
SENNAR	9.6	9.8	5.5	24.9

TOTAL	94.7	91.8	82.0	268.5
AVAILABLE POWER (MW)				
ROSEIRES	210.0	175.0	170.0	
SENNAR	14.0	14.0	14.0	

TOTAL	224.0	189.0	184.0	

ENERGY GENERATED(GWH) & AVAILABLE POWER (MW)
FOR THERMAL POWER STATION
4th Q. 1987

	OCT	NOV	DEC	TOTAL
ENERGY GENERATED (GWH)				
KHARTOUM N. STEAM	16.0	12.5	5.6	34.1
BURRI STEAM & DIESEL	9.2	7.2	6.6	23.0
BURRI POWER 111	2.7	2.8	3.3	8.8
BURRI GAS TURBINE	0.0	0.0	0.0	0.0
KILO X GAS TURBINE	1.3	0.6	0.8	2.7
KUKU GAS TURBINE	0.5	0.5	1.0	2.0
WAD MEDANI	0.00	0.0	0.0	0.0

TOTAL	29.7	23.6	17.3	70.6
AVAILABLE POWER (MW)				
KHARTOUM N. STEAM	30.0	30.0	0.0	
BURRI STEAM & DIESEL	18.5	11.5	15.5	
BURRI POWER 111	7.5	0.0	16.0	
BURRI GAS TURBINE	10.0	0.0	0.0	
KILO X GAS TURBINE	0.0	10.0	10.0	
KUKU GAS TURBINE	0.0	0.0	0.0	
WAD MEDANI	0.00	0.0	0.0	

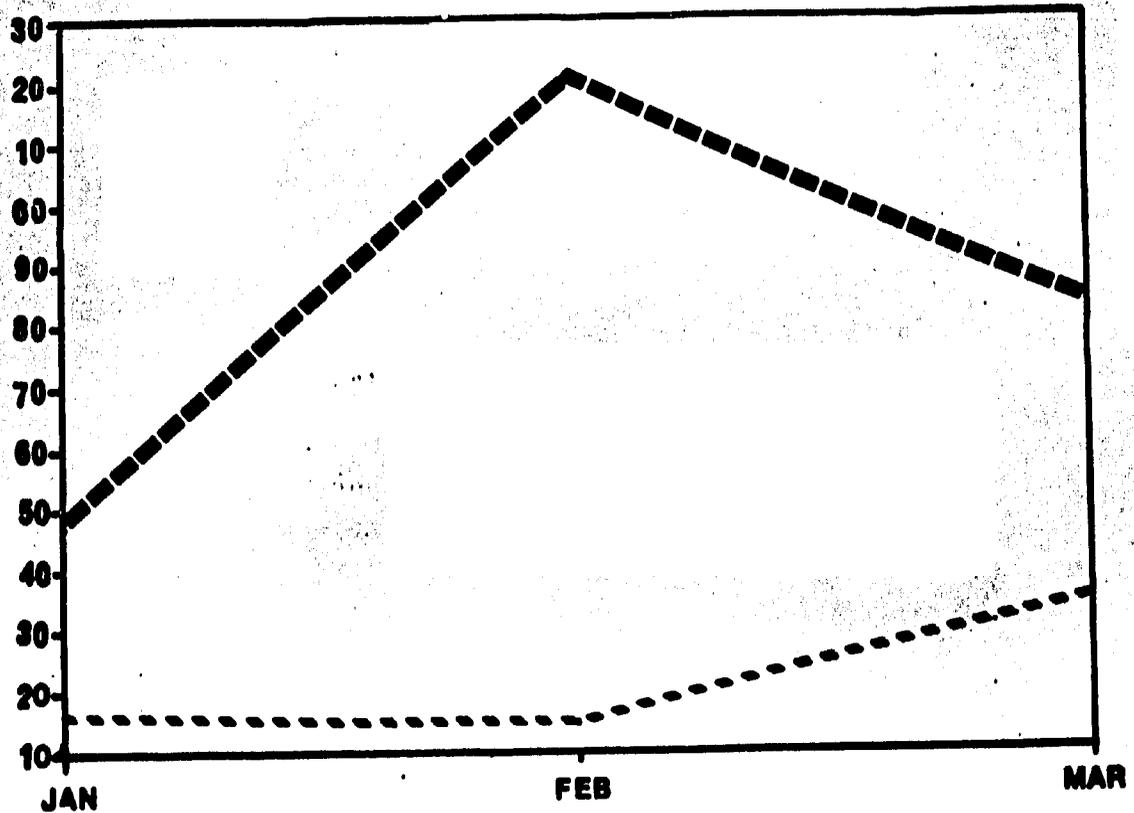
TOTAL	66.0	51.5	41.5	

Source : NEC

Energy Statistics

PEAK POWER GEN & AVAILABLE POWER MW

1st Quarter 1988



..... PEAK POWER GEN - - - - - AVAILABLE POWER

PEAK POWER GENERATION & AVAILABLE POWER (MW)
1st Q. 1988

	JAN	FEB	MAR
PEAK POWER	216.3	214.5	234.5
AVAILABLE POWER	248.0	320.5	283.5

LOAD SHEDDING (GWH)
1st Q. 1988

	JAN	FEB	MAR
DUE TO CAPACITY SHORTAGE	0.00	0.09	0.14
DUE TO TRANS. & DISTR. FAILURE	0.20	0.40	1.07

Statistics

ENERGY GENERATED (GWH) & AVAILABLE POWER (MW) FOR HYDRO POWER STATION 1st Q. 1988

	JAN	FEB	MAR	TOTAL
ENERGY GENERATED (GWH)				
ROSEIRES	69.6	53.8	54.9	178.3
SENNAR	4.4	4.7	10.0	19.1

TOTAL	74.0	58.5	64.9	197.4

AVAILABLE POWER (MW)

ROSEIRES	170.0	210.0	170.0
SENNAR	14.0	7.0	14.0

TOTAL	184.0	217.0	184.0

ENERGY GENERATED (GWH) & AVAILABLE POWER (MW) FOR THERMAL POWER STATION 1st Q. 1988

	JAN	FEB	MAR	TOTAL
ENERGY GENERATED (GWH)				
KHARTOUM N. STEAM	19.4	25.4	27.5	72.3
BURRI STEAM & DIESEL	3.6	7.4	11.8	22.8
BURRI POWER 111	0.0	3.0	6.4	9.4
BURRI GAS TURBINE	0.1	0.3	3.5	3.9
KILO X GAS TURBINE	0.4	2.1	4.2	6.7
KUKU GAS TURBINE	0.8	1.2	3.3	5.3
WAD MEDANI	0.00	0.0	0.0	0.0

TOTAL	24.3	39.4	56.7	120.4
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	OCT	NOV	DEC
AVAILABLE POWER (MW)			
KHARTOUM N. STEAM	30.0	60.0	30.0
BURRI STEAM & DIESEL	14.0	15.5	19.5
BURRI POWER 111	0.0	8.0	16.0
BURRI GAS TURBINE	0.0	0.0	14.0
KILO X GAS TURBINE	10.0	10.0	10.0
KUKU GAS TURBINE	10.0	10.0	10.0
WAD MEDANI	0.0	0.0	0.0

TOTAL	64.0	103.5	99.5

Source : NEC

APPENDIX # 2 :

National Electricity Corporation-Sudan
Revenue Collected From Computerized Billing For Khartoum Area

Month	Financial Year 1984/85 (July 1 to June 30)	Financial Year 1985/86 (July 1 to June 30)	Financial Year 1986/87 (July 1 to June 30)	Financial Year 1987/88 (July 1 to June 30)	Financial Year 1988/89 (July 1 to June 30)
	Revenue Collected LS				
July	1,366,627	2,815,607	3,178,739	6,487,822	4,107,905
August	3,051,724	2,263,951	2,147,069	3,707,911*	1,217,181*
September	1,251,729	2,640,021	5,600,561	6,086,137	3,361,797
October	2,072,663	2,554,792	5,569,144	6,334,910	4,901,395
November	1,880,786	2,260,201	4,287,919	5,852,818	6,809,590
December	2,169,045	3,286,632	5,422,726	6,313,899	9,435,609
January	1,753,509	2,253,858	3,875,583	9,238,994	
February	2,077,919	2,360,030	3,842,052	9,747,484	
March	1,838,057	5,275,939	6,011,777	7,356,365	
April	1,904,949	2,263,985	4,085,043	5,806,268	
May	2,248,885	2,393,282	2,695,153	2,837,819**	
June	1,362,826	2,340,340	3,877,572	4,760,195	
Total	LS 22,978,719	LS 32,708,638	LS 50,593,338	LS 74,530,622	

* NEC electricity operating crews too busy maintaining electricity service under unusually unfavourable conditions during the month. Not available to disconnect service of non - paying consumers. Hence low revenue collection.

** Month of Ramadan.

