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**OVERVIEW REPORT ON
TECHNICAL ASSISTANCE IN ENERGY ANALYSIS AND
POLICY EVALUATION PROVIDED BY U. S. A. I. D. TO THE
GOVERNMENT OF LIBERIA
(NOVEMBER 1983 to OCTOBER 1985)**

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Report Submitted to U. S. A. I. D.

by

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FOREWARD

This report reviews major activities and developments as part of the U. S. Agency For International Development's (U. S. A. I. D.) technical assistance to the Government of Liberia's (GOL) National Energy Committee (NEC) and its member agencies from November 1983 to October 1985.

The energy sector assistance to the GOL represented the collaborative efforts of several branches of U. S. A. I. D. The principal form of assistance was a Resident Energy Advisor under funding from the Energy Initiatives For Africa (EIA) Program, Africa Bureau AID/Washington. The EIA regional office in Abidjan, Ivory Coast also provided the assistance of project staff on several short-term visits.

The Energy Office of the Science and Technology (S&T) Bureau (AID/Washington) provided funding for a number of short-term consultants to work with the Resident Energy Advisor and his Liberian counterparts. The Africa Bureau also funded short-term working visits by the Bureau staff and contractors. The USAID Mission in Monrovia provided valuable back-up support throughout the period and financed an Energy Program Implementation Workshop, the final major project activity.

Under contract to U. S. A. I. D., Oak Ridge National Laboratory (ORNL) staff filled the Resident Energy Advisor position and provided most of the short-term consultants.

The GOL provided the services of various individuals from the member agencies of the NEC, including the Secretary of the NEC, who served as principal counterpart to the Resident Energy Advisor. The GOL also provided material support in the form of office space, some secretarial and photocopy services, a project vehicle and a portion of its transport fuel requirements.

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GLOSSARY

BMC	Bong Mining Company
ECOWAS	Economic Community of West African States
EEC	European Economic Community
EIA	Energy Initiatives For Africa (USAID Program)
GOL	Government of Liberia
INEP	Integrated National Energy Program For Liberia
LEC	Liberia Electricity Corporation
LPRC	Liberian Petroleum Refining Company
MLM&E	Ministry of Lands, Mines and Energy
MPEA	Ministry of Planning and Economic Affairs
MW	Megawatt (i.e., one thousand kilowatts power)
NEC	National Energy Committee
NIOC	National Iron Ore Company
ORNL	Oak Ridge National Laboratory
S&T	Science & Technology Bureau (U.S.A. I.D.)
UNDP	United Nations Development Program
UN/DTCD	United Nations dept. of Tech. Co-operation for Development
U.S.A. I.D.	United States Agency For International Development -- also identified by central office as AID/Washington, and by field office as USAID Mission

S U M M A R Y

This report reviews the activities and consequences of the U.S.A.I.D.-funded energy sector technical assistance to the GOL from November 1983 to October 1985. The emphasis here is on describing the process of energy resource/technology assessment and policy evaluation as it occurred within the context of other energy assessment work, and the larger planning/decision-making context in Liberia. The results of the energy analyses and the specific recommendations made by the NEC to the GOL on energy policies are described briefly in this report. More complete descriptions can be found in the NEC's comprehensive "Integrated National Energy Program for Liberia" and in the other references identified in the full report which follows this Summary.

The period covered in this report represents a "second phase" of U.S.A.I.D.'s energy sector technical assistance in Liberia. The "first phase" occurred from April 1982 to March 1983 when U.S.A.I.D. provided about one and half person years of short-term technical assistance. During the second phase (November 1983 to October 1985) the assistance was in the form of a resident advisor to the NEC for two years and an additional one and a half person years of short-term technical assistance.

The NEC, an interagency body of the GOL with responsibility for evaluating energy policy options, served as the counterpart agency. The resident energy advisor and the short term consultants worked through the Secretariat of the NEC with

counterpart staff persons from agencies of the NEC.

A substantial energy data base was developed during the first phase of the joint GOL/U.S.A.I.D. energy assessment and the World Bank carried out its own independent Liberian energy assessment soon after the start of the second phase of the GOL/U.S.A.I.D. energy sector work. The World Bank's assessment built on the earlier one, extending the analysis in certain vital subsectors, particularly petroleum importation and public electricity generation. Utilizing the information from these other research and policy evaluation programs, activities during this second phase were directed primarily toward developing better technical information about particular policy options and formulating specific program recommendations.

Major project activities are described under six general headings:

- A) Data Collection and Technical Analyses
- B) Policy Evaluations and Liberian Counterpart Recommendations to the GOL
- C) Reviews of the Liberian Energy Policy Process
- D) Liaison Activities with Other Donors
- E) Formal and Informal Professional Development Activities for GOL Counterparts
- F) Other, Related Activities

Following the summary descriptions of these activities, developments with regard to the goal of institution building are considered.

MAJOR PROJECT ACTIVITIES

A. Data Collection and Technical Analyses

- 1) A study of public sector building electricity conservation potential
- 2) Examination of the economics of industrial scale wood energy supply
- 3) Development of a 1984 energy balance
- 4) Examination of aspects of the LEC management information system
- 5) Up-grading of the transport and electricity subsector descriptions
- 6) Start of work on a 1984 energy balance
- 7) Other, short-term preliminary investigations

(A.1) Public Sector Building Electricity Conservation

The public sector building electricity conservation study was carried out by Gerald Pine (ORNL) and R. Emile Rhineland (Dept. of Energy). It concluded that even substantial investments in building repair (e.g., fixing broken windows, adding sun screens) would not result in significant reduction in electricity use, though comfort levels would be improved. Thus, conservation potential lies in short-term measures such as mandatory emergency energy conservation and over the long term, in energy efficiency standards for new public sector buildings and appliances.

(A.2) Economics of Industrial Scale Wood Energy Supply

Robert Perlack (ORNL), worked with William Barron (Resident Energy Advisor/ORNL), Garland Samuels (ORNL) and Rhineland on a

study of the economics of industrial scale wood energy supply in Liberia. The study concluded that use of standing biomass (i.e., secondary forests and retired rubber trees) offered the lowest cost resource base, but even wood energy plantations appear likely to be cost competitive (on a technical basis) with petroleum fuels for rural station electricity supply.

(A.3) 1982 Liberian National Energy Balance

Barron, Samuels, Rhineland, and G. Melvin Smith (Dept. of Energy) developed a 1982 energy balance for Liberia, showing that approximately 13 million barrels of crude oil equivalent were utilized. Roughly two thirds of this energy was in the form of fuelwood and wood utilized to make charcoal. About 29% was in the form of petroleum, with mining operations and electricity for the associated mining communities accounting for about 60% of all petroleum use. Hydroelectric power accounted for the remainder of energy supply.

(A.4) LEC Management Information System Review

Barron worked with two teams of Liberia Electricity Corporation (LEC) staff persons to evaluate the information system for data needed to determine optimal operation and maintenance of existing electrical generation equipment and investment options in new equipment. The teams recommended a number of specific changes, including creation of two "investment analyst" positions (to be filled with existing staff) and the placing of a senior advisor in the Corporate Planning and

Development Department of LEC. (The recommendations of these reviews were formally accepted by top LEC management, but no action has been taken.)

(A.5) Up-dates For Transport and Electricity Descriptions

Rhineland and Smith worked under the general supervision of M.H. Neufville (Ast. Minister for Energy - Head, Dept. of Energy, and Secretary of the NEC), and Barron to up-date and extend the transport and electricity subsector descriptions first developed in 1982. The transport report was completed in March 1985 and the electricity report is in draft as of October 1985.

(A.6) Start of Work On a 1984 Energy Balance

In July 1985 Rhineland and Smith, again working under the supervision of Neufville and Barron, started working on a 1984 energy balance for Liberia. (The World Bank had produced a 1983 balance.) Work is presently stalled because of inconsistencies in the data supplied by the Liberian Petroleum Refining Company (LPRC). Work is expected to resume on this in October 1985, if the LPRC data problems can be resolved.

(A.7) Other Short-term Preliminary Investigations

Barron carried out a preliminary study of the role of electric hot water heating in total and peak demand on LEC. The conclusion was that it probably accounted for between 3% and 8% of demand total and peak and that any shift to alternative tech-

nologies, such as solar energy, should be left entirely to the market factors.

Barron also worked with data from the Liberian Rubber Planters' Association to develop preliminary estimates of the size and location of the rubber tree resource base which might possibly be utilized for energy purposes.

B. Policy Evaluations And Liberian Counterpart Policy Recommendations To The GOL

The studies covered in part A and others noted in the full text were designed to develop the technical background for specific recommendations from the NEC to the GOL. Major recommendations were in the following areas:

- 1) public sector responses to shortfalls in electricity supply
- 2) evaluation of major hydroelectric proposals
- 3) evaluation of the viability of the Liberian petroleum refinery
- 4) reviews and comments on the World Bank's draft version of its Liberian Energy assessment
- 5) development of a comprehensive energy planning document for Liberia

(B.1) Public Sector Responses To Electricity Shortfalls

Based in part on a study by Lucille Kawan (LEC) and Barron showing public sector contribution to demands on LEC, the Secretariat of the NEC recommended that government ban the use of air-conditioners in public sector buildings and change office hours

during periods of load shedding. (This recommendation was widely discussed within the GOL, but no action has been taken.)

(B.2) Evaluation of Major Hydroelectric Proposals

During the first phase assessment, the Secretariat of the NEC recommended against the proposed massive development of the hydroelectric potential of the St. Paul River, arguing that the proposed project's nearly order of magnitude increase in generation capacity above established demand represented an unacceptable risk. On the basis of further evaluations by Neufville and Barron during the second phase, the Secretariat also recommended against the proposed Mano River hydroelectric development (again because of the economic risks associated with its large size), but supported a much scaled-down version of the St. Paul development proposal submitted to LEC in mid-1984. (By 1985 LEC's and the GOL's financial positions were so strained that even funding for the scaled-down version of the St. Paul proposal -- about \$100 million -- seems out of reach for at least the next several years.)

(B.3) Further Evaluations of the Liberian Petroleum refinery

The viability of the LPRC refinery was a major issue toward the end of the NEC's first phase assessment. Debates and further evaluations continued throughout the second phase. In late 1983 LPRC brought in its own consultants who produced a report favorable to refinery reopening (with an \$80 million investment

requirement). Neufville and Barron prepared a review of the consultants' report, pointing out problems with its assumptions and rejecting its findings.

In early 1984 the World Bank also examined the refinery issue and supported the NEC position. (While the refinery remains closed due to offshore liquidity problems, no final decisions have been made by the top levels of the GOL to permanently shutdown the refinery, redeploy staff, and restructure LPRC into an efficient petroleum product importer. LPRC itself continues to publicize plans for eventual restarting of refining operations.)

(B.4) Review and Comment On Draft World Bank Assessment

In June 1984 the draft version of the World Bank's "Liberia: Issues and Options in the Energy Sector" was received by the GOL. The Secretariat of the NEC served as the principal agency for coordination of the GOL response to the draft report. The Secretariat and several member agencies of the NEC provided detailed comments, some of which were reflected in the final version of the report issued by the World Bank in December 1984.

(B.5) The NEC's Comprehensive Energy Planning Document

The Secretariat of the NEC began work on its comprehensive national energy planning document for Liberia in November 1984. In January 1985 Neufville and Barron worked with James Guseh (Min. of Justice), Kawai, and Thomas Wilbanks (ORNL) to finalize a

draft version of the document for review by the member agencies of the NEC. Comments were received from a majority of the NEC's members and from several other organizations. A revised version was distributed in April 1985 under the title "An Integrated National Energy Program For Liberia" (INEP). The INEP summarizes the NEC's recommendations to the GOL for investments and institutional reforms in each energy subsector.

In September 1985 an Energy Program Implementation Workshop was held by the NEC to discuss and publicize the recommendations contained in the INEP. Attendees at the three-day Workshop included senior GOL personnel, senior representatives of donor agencies and foreign embassies, and representatives from the major industrial firms in Liberia.

C. Reports On The Process of Energy Policy Development

In May 1985 Neufville and Barron and Patrica Koshel (AID/Washington) finished a paper entitled "The Evolution of Energy Planning In Liberia", describing the creation and evolution of the NEC, its achievements, limitations and possible future developments. The paper also describes the vital role of outside technical assistance in strengthening the NEC.

In June 1985 Barron and Neufville also wrote two detailed case studies. One paper describes the history of the evaluation process for major hydroelectric development proposals between 1981 and 1985. The second reviews the policy debates over the LPRC refinery and the technical arguments of the several studies

carried out as part of the evaluation process.

D. Major Liaison Activities

During 1984 and 1985 the Secretariat of the NEC became the focal point for coordination of energy sector inquiries and activities by the World Bank, the United Nations (UN), and the Delegation of the European Economic Community (EEC). As part of the Energy Program Implementation Workshop the Secretariat also worked with representatives of other embassies and potential donor agencies (e.g., the embassies of China, France, and Sweden and Italy).

E. Formal And Informal Professional Development Activities

From the beginning of the U.S.A.I.D.-funded energy sector technical assistance to Liberia, data collection and analysis activities were carried out in a manner designed to maximize the training experiences for the counterpart staff. In some cases this meant Liberian project staff from the member agencies of the NEC working under the direction of more experienced outside technical persons, and in other cases, the Liberian staff having major or total responsibility with occasional advice from the outside experts.

To complement the "hands-on" training, Barron developed the curriculum for a short course in project evaluation methodology and taught the course to 14 persons from six member agencies of the NEC. Near the end of the project a second, briefer course

was taught by Barron and Carl Petrich (ORNL) for staff of the Dept. of Energy.

F. Other Related Activities

On an intermittent basis, the Secretariat of the NEC, its resident advisor and short-term consultants provided assistance of various types to LEC, Ministry of Planning and Economic Affairs (MPEA), the National Iron Ore company (NIOC), and U.S.A.I.D.

Over the course of the project short-term visits were made to Liberia by EIA/Abidjan staff, AID/Washington staff and consultants. Ed Karch, Asif Shaikh, and Kjell Christopherson (EIA/Abidjan) made trips to Liberia to discuss possible areas of EIA support. Near the end of the project, a charcoal export study through EIA was agreed upon as a useful follow-on activity. Other visits included those by Wes Fisher, AID/Washington Africa Bureau Energy Advisor to discuss activities and possible areas of assistance; by Frank Denton (AID/Washington) to discuss rural electric system technology and institutional possibilities; and by Shirley Burchfield (consultant to AID/Washington Africa Bureau) to review the energy data bases and collection systems of various Liberian agencies.

Barron made a consultation trip to ORNL, Washington (U.S.A.I.D., World Bank) and New York (UN) to help facilitate coordination of energy sector donor agency activities in Liberia.

INSTITUTION BUILDING

The major aims of the U.S.A.I.D.-funded energy sector technical assistance are to strengthen the capability of the GOL to systematically evaluate the nation's energy options, and after decisions have been made on appropriate policies, to effectively implement programs to improve the energy situation. "Institution building" involves development of pools of local technical expertise and creation of effective organizational structures, procedures, and responsibilities on the part of agencies designated to evaluate options, make decisions and implement programs.

The NEC made highly effective use of these outside technical resources to improve the energy information base, identify the nature of Liberia's energy problems, to formulate well designed programs to address Liberia's growing modern sector energy problems and to strengthen the analytic capabilities of its own staff. Over the course of the two phases of U.S.A.I.D. assistance, considerable improvements were made in the technical ability of Liberian project participants in the area of energy analysis. The active GOL participants in the work (about 15 persons) have gained considerably in their understanding of the nature of energy problems and opportunities facing Liberia. In several cases, participants have also gained a much better understanding of program evaluation methods. The availability of substantial outside technical resources opened-up possibilities for specific lines of analytic inquiry and served as a catalyst for the more active investigation of energy options by the NEC.

It is probably fair to say that in Liberia the energy situation is reasonably well understood, the nature of the particular problems has been adequately identified, and realistic set of programs to address these problems have been proposed. The soundness of program recommendations cannot, of course, be finally judged until they have been adopted and implemented.

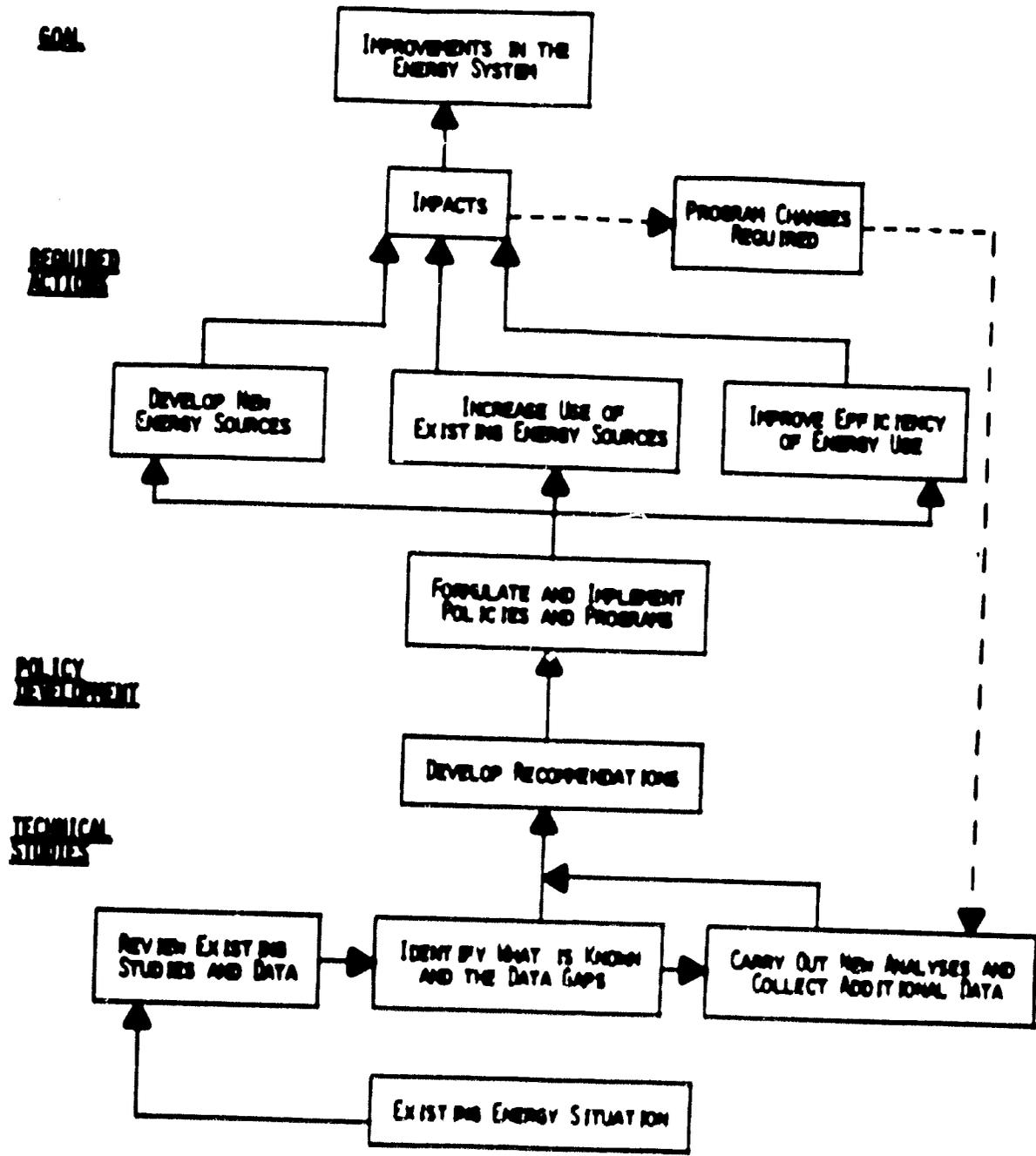
At the bottom line, the NEC is an advisory body without significant access to the top-decision-making levels of the GOL. Its principal recommendations have not been officially disavowed by the Head of state, but neither have they been acted on. In terms of Figure S, it can be said that energy planning (and for that matter planning in virtually every sector) is presently stalled at the stage of program/policy formulation and implementation.

Hard choices have been postponed in Liberia to the detriment of energy services and the economy as a whole. Calls for needed reforms have so far gone unheeded. At this point it remains unclear when actions will be taken and on what basis decisions will be made. When the stage is again set for decisions which at least consider technical efficiency arguments, the NEC's INEP should prove to be a valuable starting point in the energy sector.

The NEC has demonstrated convincingly that it is capable of making effective use of outside technical assistance to enhance the capabilities of its own staff, and that it can focus the

Figure S

Outline of Energy Policy Evaluation and Implementation Stages



work of outside experts on helping it develop practical solutions to important problems. Continuation of U.S.A.I.D.'s energy sector technical assistance is a recommendation of both the INEP and the World Bank's Liberian energy assessment. With regard to this recommendation, it is necessary to consider the basic question of the appropriate goals in Liberia of continued energy sector technical assistance. In certain respects, energy analysis has gone as far as it can reasonably go within the present planning context in that nation. Without firm decisions on recommended actions in different energy subsectors, further study is likely to result in little noticeable improvement in Liberia's energy situation.

Until the larger planning context improves, the major benefits of continued outside technical assistance in the energy sector are likely to be in the form of the further professional development of some GUL staff and in encouragement provided to those persons within the GUL who continue to lobby for more effective management of the energy sector.

CONCLUDING COMMENTS

If there are aspects of the U.S.A.I.D.-funded energy sector technical assistance in Liberia which might be beneficially replicated in other countries (and perhaps in other sectors in Liberia), probably none is more important than the close working relationships between the Liberian and U.S. project staffs. Project participants from both sides benefited significantly from the professional development opportunities

provided by this arrangement, and this in turn helped to make highly efficient use of the limited U.S.A.I.D. and Liberian resources available for the energy work.

F U L L R E P O R T

I INTRODUCTION

Report Perspective

The U. S. A. I. D.-funded energy sector technical assistance programs in Liberia have been characterized from their beginning in 1982 by a high level of interaction between the Liberian and American counterparts. All aspects of these technical assistance efforts were carried out in close cooperation and with substantial collaborative efforts on the part of Liberian counterparts from the member agencies of the NEC. While the specialized data collection and analysis activities involved varying degrees of counterpart participation, final energy policy recommendations put forward to the GQL were in all cases solely the work of the NEC, its Secretariat, or its member agencies.

In April 1985 the NEC sent its Integrated National Energy Program (INEP) to the GQL (Ref. 1). The INEP contains a comprehensive set of recommendations for Liberia's energy sector and is the culmination of work over the past three years on the part of NEC staff, its advisors and consultants, and outside agencies. For more detailed descriptions of the research methodology and findings than those provided here, the reader is referred to the INEP, to the specific source reports/memoranda listed as references to this report, and to the four semi-annual reports submitted by the Resident Energy Advisor to U. S. A. I. D. (Ref. 2).

The descriptions which follow focus on the process of the technical assistance activities and their impacts and summarize

the specific findings and recommendations. This particular report is directed to U.S.A.I.D. to provide documentation on the direction and consequences of its assistance program. In keeping with this aim, the stress here is on describing activities stemming directly or indirectly from this assistance. Periodic reports submitted by the Department of Energy (Ministry of Lands, Mines and Energy -- LM&E), by the Liberia Electricity Corporation (LEC), by the Liberia Petroleum Refinery (LPRC), and other member agencies of the NEC, provide a more complete description of the activities of individual GOL agencies in the energy sector.

Previous Work In The Liberian Energy Sector

The technical assistance activities described in this report represent a "second phase" of U.S.A.I.D.'s energy sector support to the GOL. The first phase occurred from April 1982 to March 1983 when the Energy Office of the Science and Technology Bureau (S&T) funded ORNL to assist the GOL in initiating a national energy assessment for Liberia. That project involved many of the same Liberian and American staff persons who were active in this second phase, and laid the groundwork for the close working relationships between the GOL personnel and their U.S.A.I.D.-funded counterparts in the energy sector.

A substantial Liberian energy sector data base was developed during this first phase (Ref. 3). A reasonably comprehensive and up-to-date description of the energy sector and its various subsectors is, clearly, a highly valuable and often necessary

condition for addressing energy policy issues. The availability of the comprehensive energy data base developed during the first phase allowed the participants in the second phase to concentrate on more detailed analyses focused on specific energy policy issues.

Activities From Nov. 1983 to Oct. 1985

Because of the close working relationships among the resident energy advisor, the short-term consultants, and the project's Liberian counterparts, the descriptions which follow are not divided by "actor", but rather are divided by major type of activity.

In this overview report project activities and impacts in six general categories are reviewed and summarized:

- A) Major data collection and technical analysis activities, including development of study proposals
- B) Major policy analyses and counterpart policy recommendations to the GOL
- C) Reviews of the energy policy development process in Liberia
- D) Principal liaison activities with other donor agencies
- E) Formal and informal professional development activities carried out for GOL counterparts
- F) Other, related activities.

The above categories differ somewhat from the classification in the scope of work for the Resident Energy Advisor (Ref. 4) and

for that of the ORNL short-term consultants (see Ref. 5), but the activities described here touch on all major aspects of the responsibilities covered in these scopes of work.

Section II of this report reviews the individual project activities and developments. Section III reviews developments with regards to the goal of institution building and considers future needs of the GOL in the area of energy sector technical assistance. Section IV presents closing comments on the energy assessment work in Liberia, particularly on the importance of developing effective counterpart working relationships.

II ACTIVITY DESCRIPTION/IMPACT REVIEW

This section reviews project activities from November 1983 to October 1985. Figure 1 (page 44) at the end of this section illustrates the timing of these activities.

(A) Data Collection and Technical Analysis

As noted above, an extensive and reasonably up-to-date Liberian energy data base existed at the start of this second phase of U.S.A.I.D.'s energy sector technical assistance. In addition, soon after the start of this second phase, the International Bank For Reconstruction and Development ('The World Bank'), undertook its own energy sector assessment for Liberia (Ref. 6). The Secretariat of the NEC served as the principal coordinating agency with World Bank's Energy Assessments Division staff and acted with the Ministry of Planning and Economic Affairs (MPEA) as a major liaison with the World Bank on energy matters.

The World Bank's Liberian energy assessment added considerable detail to the existing energy information in certain subsectors, particularly the financial and technical aspects of electricity and petroleum supply capability. The Secretariat of the NEC benefited considerably from access to both the first phase data and the information developed by the World Bank early in the NEC's second phase assessment program. In light of this situation, the 1983-85 data collection efforts on the part of the

NEC and its U. S. A. I. D.-funded counterparts were largely confined to specific technical analyses undertaken to provide an in-depth look at certain subjects not covered in detail during the 1982 NEC or the early 1984 World Bank assessments. The major broad-based data collection and analysis activity on the part of the NEC during its second phase work was development of a 1982 Energy Balance for Liberia.

Project energy data collection and technical analysis activities centered in the following general areas:

- 1) public sector building energy conservation opportunities
- 2) examination of the economics of industrial scale wood energy supply in Liberia
- 3) development of a 1982 National Energy Balance for Liberia
- 4) evaluation of the existing management information system for LEC and opportunities for up-grading this system
- 5) undertaking up-dates of the subsector descriptions for electricity and transport
- 6) starting of work on a 1984 National Energy Balance for Liberia.
- 7) other, short-term research activities

(A. 1 Public Sector Building Energy Conservation)

It is clear from even casual observation that the use of electricity in public sector offices in Liberia is highly inefficient. Open or broken windows in air-conditioned rooms are commonplace. LEC has made the compelling argument that unpaid

public sector electricity consumption adds greatly to LEC's already overstrained finances. In turn, it is clear that the GOL's mounting budgetary problems make it unlikely that government will substantially increase payments to LEC anytime soon. Under these circumstances, building electricity conservation for the public sector is an obvious imperative.

Energy conservation programs can and should be considered in terms of both immediate or short-term moves and in terms of investments and policies to reduce inefficiencies over the longer term. The NEC's policy recommendations for immediate and short-term actions are described in Section B.2 of this paper. Before addressing the question of longer-term improvements, the Secretariat of the NEC requested a consulting engineer from ORNL experienced in building energy audits. Gerald Pine, Ph.D., arrived in February 1984 and worked with R. E. Rhineland, a staff person from the Department of Energy (MLM&E), a member agency, and the Secretariat of the NEC.

Under Pine's direction, he and Rhineland conducted a detailed investigation of one middle-sized GOL office building and less detailed examinations of a sample of other GOL buildings of various sizes and ages. The principal conclusion of this work is that investments to make reasonably efficient use of air-conditioning in most existing GOL buildings would increase comfort levels, but not significantly reduce energy use. Since most air-conditioners are undersized for their cooling loads, they would continue to operate at capacity, even if these cooling loads are reduced through better seals and other measures. The

principal recommendation for the longer term, then, is that the GOL should set and enforce energy efficiency design standards for new office buildings (Ref. 7).

(A.2 Economics of Industrial-Scale Wood Energy Supply)

From the NEC assessment work in 1982, it was clear that Liberia's wood resource base has the potential for considerably greater levels of utilization, including industrial-scale energy supply (Ref. 3). From a resource standpoint, wood appears to a particularly attractive option for rural electric power supply. Miedi-Himie Neufville, Ph.D., Secretary of the NEC, and William F. Barron, Ph.D., EIA-funded Resident Energy Advisor, drew-up the terms of reference for short-term consultants from ORNL, including a resource economist and an engineer to work with NEC staff and Barron to carry out a detailed analysis of the economics of wood supply under Liberian conditions.

The purpose of this wood economics study was to develop a description of several existing and potential wood supply systems, the costs associated with each system component, and then to determine how the delivered cost of energy is likely to change in response to changes in the source of supply, transport distance, and scale of operation. The study design called for development of a detailed production function for wood growing, harvesting, and transport subsystems for wood from several sources: retired rubber trees, secondary forests, and wood plantations (with and without associated shifting agriculture),

to serve the fuel requirements for an electric power plant of 1.5 Megawatts (MW).

During 1984, Robert Perlack, Ph.D., a resource economist from ORNL made two trips to Liberia to collect field data on wood growing, harvesting, and transport costs. Garland Samuels, an engineer from ORNL, made one trip to Liberia during 1984 to assist in several research efforts, including collection of information on the actual operating experience in Liberia of wood-fired steam plants. Barron and Rhinelandt generally worked on a day-to-day basis with Perlack and Samuels during their visits.

The wood energy economic analysis indicates that wood (being only 10% to 20% of the cost of petroleum on an equal energy basis) from all four sources considered in the above seems likely to be highly competitive with petroleum fuels. Economies-of-scale are important (especially in wood transport), and significant advantages exist in utilizing standing biomass compared to establishment of energy plantations. However, even wood energy plantations appear likely to be highly competitive with petroleum fuels in Liberia (Ref. 8).

Working independently of the NEC wood studies, the World Bank evaluated prospects for a 15 MW wood-fired electric plant to serve the Monrovia grid. The World Bank study concluded that such a plant is viable, but given LEC's other requirements for capital, it should have a relatively low priority (Ref. 6).

In Liberia, the technical issues associated with the viability of wood-fired electric power plants and other industrial scale uses of wood appear to be reasonably well understood and the findings are highly encouraging. The real issues at this point are: (1) the feasibility of the institutional changes needed to make use of this resource for publically generated electricity supply, and (2) for private sector use, the question of when the overall Liberian economic context will again be sufficiently favorable for capital-intensive investments.

(A.3 Development of a 1982 National Energy Balance)

National energy balances show energy sources, energy forms, conversion processes (and associated losses), and use by specific types of consumers for a given year. Detailed national energy balances require considerable amounts of data and careful data review to identify missing information, and to avoid double counting or other methodological errors. Although they require substantial levels of effort, national energy balances are highly useful planning tools and, as such, generally have a high priority in broad-based energy assessments. A national energy balance for Liberia for the Year 1981 was developed as part of the 1982 NEC Liberian energy assessment work (see Ref. 3).

Given the rapidly changing economic situation in Liberia in the early 1980's and the likely consequences for energy use patterns, Noufville and Barron decided to develop a 1982 energy balance. Data collection efforts began in November 1983 and

continued through March 1984. During Samuels' visit in March 1984 he worked with Barron, Rhineland, and Melvin Smith (of the Department of Energy) to review the data and finalize the 1982 energy balance for Liberia. The specific format for the 1982 Liberia energy balance was developed by Samuels and Barron and involved certain changes in structure compared to that for the 1981 one for Liberia and other national energy balance formats in general use (Ref. 9).

The 1982 balance showed that approximately 13.2 million barrels of crude oil equivalent (1 BCOE = 5.8 million BTU or 6.12 gigajoules) were available in 1982, 67% in the form of wood, 4% in the form of hydroelectric power, and 29% in the form of petroleum. Residential use accounted for nearly all wood consumption (directly in the form of fuelwood or indirectly in the form of charcoal). Mining operations accounted for about 60% of total petroleum use (mostly for electricity generated for ore processing and for power to the mining communities). Transportation accounted for another 25% of petroleum consumption, with the remaining 15% of petroleum utilized for forestry, agriculture, and miscellaneous uses. Hydroelectric power represented only a small fraction of total energy supply, but accounted for over 70% of the power produced by LEC for the Monrovia grid (Ref. 9).

(A.4 LEC Management Information System Studies)

Between May and September 1984, Barron worked with two teams of LEC mid-level staff to investigate LEC's options for an

improved information system for management decision-making. One first team developed a detailed first-hand description of the existing data system for electrical generation and compared this to the type of data required to: (1) effectively evaluate alternative generation investment options, and (2) to ensure cost-effective operation of existing equipment.

The team concluded that nearly all the required data was already being collected, although much of it was not being used and some of it was not in a form which could be utilized. More importantly, available technical staff were not properly trained to determine optimal operational procedures or to project future investment requirements. The team recommended that two "investment analyst" positions be created employing existing staff with backgrounds in economics and engineering. A detailed scope of work for these two positions was outlined and submitted to LEC management in June 1984 (Ref. 10).

Following the submission of the above findings to LEC management, Barron worked with a second team of LEC mid-level staff (including several persons who participated on the first team). This second team drew up the detailed terms of reference for a "Senior Planning Advisor" to the LEC Corporate Planning and Development Department. This report was submitted to LEC management in September 1984. (Ref. 10).

LEC management had responded enthusiastically to the initial inquiries from the Secretariat of the NEC and its own mid-level staff concerning these two investigations. Considerable support

and cooperation was provided by LEC management and the teams had ready access to relevant personnel and technical data. However, as of October 1985, more than a year after report submission, no apparent action has been taken by LEC on either set of recommendations.

One useful outcome of these two investigations under the leadership of the Secretariat of the NEC is that several of the participating LEC staff persons became involved in other NEC activities (e.g., energy trainee participant selection, the energy program implementation workshop).

(A.5 Up-dates of the Transport and Electricity Subsector Descriptions)

Given the relatively high quality of the existing data base, Neufville and Barron made the decision to carry out up-dating of the existing subsector descriptions in a manner which placed considerable responsibility on mid-level GOL staff. These staff persons worked under the general, intermittent supervision of Neufville and Barron and in several cases under the direction of short-term consultants from OPNL. While the GOL staff involved in this effort had some previous training and experience, this approach resulted in a slower than anticipated up-dating of the subsector descriptions. This time cost was considered acceptable in light of the training benefits.

Working under the general supervision of Neufville and Barron, Rhineland and Smith worked to up-date the Transport and

Electricity subsector descriptions produced as part of the 1982 NEC assessment work. Data for these descriptions had previously ended with 1981 figures. Rhineland and Smith collected data for 1982, 1983, and available information for 1984. A draft updated transportation report was submitted in November 1984. Over the next several months this draft was revised and a final version was completed in March 1985 (Ref. 11).

Rhineland and Smith began working on the electricity subsector description update in February 1985 and an initial draft is expected in October 1985 (Ref. 12). The slow pace of these efforts is due to several factors. First, Rhineland and Smith still have had only limited experience with this type of work. Second, Neufville and Barron purposely provide only general guidelines to the authors with regards to approaches to overcome data collection problems or data validity issues so as to place greater responsibility on these staff persons and hence maximize the professional development value of their work experience. Another problem with relying on Department of Energy mid-level staff for this type of work is that available mid-level staff have other research and administrative duties which frequently preclude the continuation of work on the energy subsector updates for weeks at a time.

(A.6 Start of Work On A 1984 Energy Balance)

The World Bank developed a 1983 Liberian energy balance. Although this one was less detailed than those developed by the NEC, Neufville and Barron decided that it was most appropriate

for the NEC to utilize the Bank's 1983 balance and begin work on one for 1984. In June 1985 Neufville assigned Rhineland and Smith to begin collecting data for the 1984 energy balance. As with the subsector up-dates, Neufville and Barron acted in a supervisory capacity, with most of the data collection and preliminary data analysis efforts being carried out by the mid-level staff. However, because of the importance of consistent methodology and the complexity of the data interpretation, Neufville and Barron became involved earlier and more frequently in the work than in the case of the subsector description up-dates.

One major problem with the 1984 energy balance is that it is already clear that the data supplied by the Liberia Petroleum Refining company (LPRC) is less reliable than it has been in the past. For example, when reported "sales" exceeded "imports" for some products by more than 20% (far more than changes in inventory could reasonably account for), Department of Energy staff returned to LPRC to inquire about the discrepancies. They were told that imports for certain concession customers are sometimes "borrowed" by LPRC and then returned and that records sometimes failed to clearly indicate the cancelling transactions. Thus, double counting probably occurs in the figures supplied by LPRC, but the level cannot be accurately determined without access to original records (Ref. 13).

In late October 1985 Jacob Sandikie returned from an eighteen-month masters degree program under USAID funding. It

is expected that Sandikie will work with Rhineland and Smith starting about November on completing the 1984 energy balance.

(A.7 Other Research Activities)

7.a Solar hot water heating

Virtually all hot water heating in the Monrovia area is presently electric, and this use of power might be a good candidate for substitution by solar energy. The decision to switch heating systems would be a market one on the part of individual consumers and property owners. The questions at hand were whether large-scale conversion would have a sufficient impact on electricity demand to warrant further research into the economics of conversion, or to consider the potential value of publicity campaigns, and possibly the creation of incentives to encourage the use of solar hot water heating.

Based on an informal examination of a sample of Liberian and expatriate households (about 50), Barron developed preliminary estimates of the typical range of sizes and energy use patterns for hot water heaters in Monrovia. With this information a rough range of hot-water heater energy use by individual middle and upper income Liberian households and expatriate households was developed. Extrapolating from income and housing data and other classifications in the 1974 Liberian Housing and Population Census and additional information supplied by the National Housing Authority of Liberia, Barron developed preliminary estimates for a plausible range of total hot water heater energy

conservation in the Monrovia area for 1984.

The result of this analysis indicated that hot water heating probably represented between 3% and 8% of total and peak demand on LEC (Ref. 14). Based on this analysis and a later, separate brief review by the World Bank, both the NEC and the World Bank concluded that conversion of hot water heating to solar power in the Monrovia area should be left entirely to market factors and that no further research or publically financed incentives were warranted at this time to encourage conversion.

7.b Rubber tree resource base

Early in the project it was clear that a reasonable first approximation of the number, size and location of rubber farms in Liberia was needed to better understand the role this resource base might play in any industrial-scale use of wood. In December 1983 Barron obtained data from the Liberian Rubber Planters Association and developed preliminary estimates of the size and geographical distribution of smallerholder and middle-sized rubber farms to add to the already known information on the size and location of major plantations (Ref. 15).

In February 1984 this information was supplemented by additional data developed by the World Bank. On the basis of these studies, both the NEC and the World Bank concluded that active and abandoned rubber farms in Liberia offered a viable and substantial energy resource within reasonable transport distances of demand centers (Ref. 1, 6).

(B) Major Policy Analyses and Counterpart Policy
Recommendations To The Government of Liberia

As noted in the Introduction, Neufville and Barron decided at the start of this project that the principal focus of project activity should be on evaluations to develop the technical basis for specific recommendations to be put forward to the GOL by the NEC. In some cases this meant addressing issues on the NEC's own agenda and in other cases responding to policy initiatives put forward by other agencies inside and outside the NEC and the GOL.

This approach represented a shift away from the focus of the first phase (1982) technical assistance efforts. At the start of the 1982 energy technical assistance project relatively little reliable, recent information was available on energy supply or use patterns. Major research efforts therefore went into development of an adequate across-the-board energy information base. Only toward the end of that first phase project was the energy sector data base comprehensive enough to allow the NEC to effectively respond to policy issues. In December of 1982 the nature of Liberia's energy problems was sufficiently well understood for the NEC to develop an initial set of recommendations to the GOL (in this case on emergency energy conservation). This set of recommendations included the proposal to shut down the Liberian petroleum refinery (Ref. 16).

Although it was clear in November 1983 that the energy data base from the first phase needed up-dating and that certain gaps still remained, Neufville and Barron agreed that the first

priority for the use of available personnel was to be for research to develop the technical basis for evaluating specific, already-pending policy issues. General improvements in the data base would be the secondary priority.

The policy analyses and NEC recommendations to the GOL centered on four major areas:

- 1) appropriate public sector response to the mounting dry season electricity shortages which began in early 1983 and have continued each dry season since that time
- 2) technical review and development of NEC recommendations regarding major hydro-electric project proposals
- 3) further review of issues and positions associated with the viability of the Liberian Petroleum refinery
- 4) technical review and formulation of NEC responses to the World Bank's draft ('Green Cover') diagnostic report "Liberia: Issues and Options In The Energy Sector"
- 5) development of a comprehensive national energy planning document for NEC presentation to the GOL

(B.1 Development of Recommendations For Public Sector Responses To Electricity Shortages)

Since January 1983, LEC has been forced to undertake substantial load shedding whenever output at its 64 MW hydro-electric facility is unable to meet a major share of demand. Such periods generally last from January until early May. As noted in Section II A.1, the public sector is an obvious candidate for efficiency improvements in the area of electricity use.

A related issue was how public sector consumption might be dramatically curtailed during periods of emergency to help ease the burden on other sectors (i.e., industry, commercial, residential).

Behind these questions lay the presumption that public sector consumption could probably be considerably reduced without serious impairment to productivity and that the energy saved could be effectively utilized in other sectors. Another presumption is that within the public sector, mandatory conservation is enforceable and potentially more effective than campaigns aimed at voluntary reduction in private sector consumption.

Before the NEC made a specific proposal to government, it was necessary to determine as accurately as possible the contribution of the public sector to electricity demand on LEC's generators. This information was not readily available, since LEC records consumption by government-owned corporations as "Commercial" and that by ministries as "Government". Actually, the real question is public sector contribution to dry season demands on LEC's own generators. During the dry season LEC's grid is split and a portion of it is served by the Bong Mining Company (BMC). While reduced public sector consumption in the BMC-supplied area would have some benefit, this area generally does not suffer from load shedding while Bong is the supplier, and therefore, emergency conservation in that area is a less pressing concern.

Barron and Lucille Kawah (a staff person from LEC) examined LEC's detailed records on the specific consumption and location of various public sector buildings and estimated that the public sector (official "government" and government-owned corporations) accounted for approximately 20% of demands on LEC's dry season generation facilities (Ref. 17).

The Secretariat of the NEC concluded that 50% to 75% of this public sector demand on LEC might be eliminated during periods of emergency, and demonstrated that this could make a substantial contribution to providing additional power for other sectors. In February 1984 the Secretariat of the NEC issued a position paper calling for a GOL ban on the use of air-conditioning in public sector offices (except for certain vital functions) during periods of officially declared electricity emergency. To ease the burden on public sector employees, it was further recommended that government offices be open only from about 8 AM until 1 PM during the emergency period (Ref. 18).

Although this proposal was made in early 1984 and widely discussed within the GOL, no action was taken by government officials. Despite renewed calls by the NEC for this measure during the third annual load shedding season of 1985, no action has yet been taken. The recommendation that the public sector drastically reduce its electricity consumption during periods of load shedding is included in the NEC's Integrated National Energy Program For Liberia (INEP) (Ref. 1).

(B.2 Review and Comment On Major Hydroelectric
Development Proposals)

Between 1981 and 1985 three feasibility studies were carried out for major hydroelectric projects in Liberia. Two of these feasibility studies were conducted for LEC for the further development of the St. Paul River. The third feasibility study was carried out for the Mano River Union, of which Liberia is a member state, for the joint development of the boundary river between Liberia and Sierra Leone. All the studies were carried out by private engineering consulting firms and the conclusion of each was that the specific project under study was highly attractive and should be undertaken as soon as possible (Ref. 19).

During 1982 the NEC reviewed the C.T. Main proposal for the large-scale development of the St. Paul River put forward that year to LEC. The NEC review concluded that the C.T. Main analysis was seriously flawed and that the proposed project was dangerously oversized for Liberia's needs. In particular, the NEC felt that the electricity demand growth projections used by C.T. Main (5% to 11% annually for 25 years) were an unrealistic basis for project evaluation. Although LEC and the Office of the Head of State strongly supported the C.T. Main proposal and (actively sought funding from abroad), no donor or banking agency was willing to finance it and the proposal was quietly dropped in 1983.

Also during 1982 the NEC reviewed the Mano River Proposal and found it much less risky than the C.T. Main proposal (Ref. 3). The NEC recommended further evaluation of the Mano proposal.

In 1984 a "scaled-down" version of the C.T. Main proposal was studied and later advocated by Harza Engineering and Stanley Consultants Joint Venture. Neufville and Barron reviewed the Harza/Stanley report and found some of the same methodological problems involved in the C.T. Main analysis (e.g. , an unrealistic range set of electricity demand growth projections used in the sensitivity analysis). However, despite concern over the thoroughness of the study, Neufville and Barron felt that these problems did not seriously affect the Harza/Stanley recommendations for two of the three elements which the consultants found to be attractive, i.e., construction of a water storage reservoir for flow augmentation in the dry season and the addition of one 17 MW generating unit at the existing St. Paul River hydroelectric facility (Ref. 20). The Secretariat of the NEC advocated this much reduced proposal for further hydroelectric development of the St. Paul River and included this recommendation in its comprehensive planning document (Ref. 1). In light of its subsequent support for the major part of the Harza/stanley recommendations, the Secretariat of the NEC recommended shelving the Mono River proposal for at least the next five years.

(B.3 Further Debates On the Liberian Petroleum Refinery)

The NEC first recommended permanent closure of the small (12 - 15,000 barrels per day) Liberian petroleum refinery operated by LPRC in December of 1982. The refinery did close in December

1982 because of offshore liquidity problems, but kept all its staff, and continued planning for reopening. During early 1983 a series of technical studies, including ones by LPRC itself, ORNL, and A.D. Little (under U.S.A.I.D. funding) were carried out. Each of the studies listed above, with the exception of that by LPRC, concluded the refinery should be permanently closed (Ref. 21, 22).

In September 1983 LPRC brought in Stone and Webster Engineering Corp. to review possibilities for refinery expansion and reopening. The Stone and Webster review was issued to LPRC in late December 1983 . It concluded that a refinery in Liberia was potentially viable and that LPRC should seek funding for a major facility expansion (about \$ 80 million). LPRC circulated this report in its continuing efforts to secure GOL support for major capital investment in the refinery, and its near-term restarting of refining operations.

Neufville and Barron reviewed the Stone and Webster report and concluded that its recommendations rested on several highly questionable assumptions regarding the marketability of heavy petroleum products to neighboring West Africa states, future relative crude oil and product prices, and the ability of the GOL or LPRC to acquire (and finance) the necessary capital for expansion. In February 1984 Neufville issued a memorandum to member agencies of the NEC (including LPRC) pointing out the problems with the Stone and Webster review and reaffirming the Secretary's strong opposition to reopening the refinery (Ref. 23).

In February 1984 the World Bank carried out another independent analysis of refinery operations. The World Bank's report, like that of the NEC, ORNL, and A.D. Little studies before it, strongly urged the GOL to keep it closed and to substantially restructure its product importation operations (Ref. 6).

(B.4 Review And Comment On The World Bank's
Draft Version of "Liberia: Issues And Options
In The Energy Sector")

In November 1983 the World Bank began its own energy assessment for Liberia. The Secretariat of the NEC met with the World Bank Energy Assessments Division reconnaissance team and worked with them to identify crucial policy issues and data gaps. During the visit of the full World Bank energy assessment team in February 1984, the Secretariat of the NEC served as a major liaison point for the team, helping arrange appointments, providing logistical support, and raising and discussing research and policy issues.

The World Bank's energy assessment team utilized the energy data base developed in 1982 during the first phase of the NEC's energy assessment, and in late 1983 worked out an agreement with the NEC and ORNL to avoid duplication of effort. For example, the NEC's 1982 description of the household energy sector and the 1984 analysis of conservation opportunities in public sector buildings (see Section II A.1) were utilized directly in the World Bank's report. For its part the NEC extensively utilized the World Bank's analysis of several subsectors, particularly petroleum importation and LEC's Monrovia electric grid.

The draft ('Green Cover') version of the World Bank's Liberian energy sector assessment was received by the NEC in June 1984 and distributed to the NEC's member agencies. The Secretariat of the NEC coordinated the GOL's review and comment on the draft report. Detailed comments were provided by the Secretariat, by the MPEA and by LEC. Less detailed comments were received from LPRC and several other member agencies (e.g., the Ministry of Agriculture, the Forest Development Authority). The Secretariat of the NEC organized a meeting of member agencies and coordinated the formal GOL response to the draft report.

The Secretariat and most of the member agencies of the NEC agreed with the majority of the draft report's recommendations and findings, but identified several minor errors/inconsistencies, and disagreed on a few major points. In particular, the Secretariat disagreed with: (1) the Bank's low priority for water storage reservoir for LEC's hydroelectric system, (2) with the proposed structure of the GOL's energy planning agency, (3) the significance of rural electrification, and (4) the appropriate scale for wood-fired electric power generation in Liberia. The Secretariat gave hydro storage a higher priority than did the Bank; preferred the creation of an independent energy planning agency rather than the bank's proposed expansion of a planning unit within an existing ministry; placed a greater importance on rural electrification issues; and preferred that any initial test of wood-fired steam electric power be in the range of 1-3 MW, rather than the 10-15 MW suggested by the Bank (Ref. 24).

LPRC strongly disagreed with the Bank's conclusions on petroleum refining and importation in Liberia and initially ignored the Bank's draft report. Later LPRC sent brief comments rejecting the draft's conclusions directly to the World Bank. LEC disagreed with the draft report's call for an outside management team for LEC, but participated actively in the review process.

In November 1984 World Bank representatives returned to Liberia to review the GCL's comments on the draft report. As before, the Secretariat of the NEC acted as a principal liaison point and coordinator for discussions. In December 1984 the final ('Blue Cover') version of the World Bank's "Liberia: Issues and Options in the Energy Sector" was released (Ref. 6).

(B.5 Development of The Integrated National Energy Program For Liberia)

A major objective of the U. S. A. I. D.-funded technical assistance in the energy sector was the eventual development of a comprehensive energy planning document for Liberia. Formulation of a specific "national energy plan" began in November 1984. Neufville, with assistance from Barron, began constructing the draft plan on the basis of the 1982 NEC energy assessment, the results of analyses/policy reviews carried out by the NEC and its advisor/consultants during 1983 and 1984, and the recently completed World Bank Liberian energy assessment. In early January 1985 Thomas Wilbanks, Ph.D., from ORNL arrived in Liberia and worked with Neufville, several other GCL staff persons, and

Barron to further refine the format of the draft plan and presentation of its proposed contents.

In mid-January 1985 the Secretariat of the NEC released a draft version of the "1985 National Energy Plan For Liberia" to member agencies of the NEC and others for their review, comments and suggested revisions. Detailed comments were received from five of the nine member agencies of the NEC. The responding agencies endorsed the draft plan in general, although there were some differences with regard to several specific recommendations. The MPEA (the GOL's principal planning agency) strongly endorsed the document, noting that "... it outlines a set of realistic objectives... (and) its intended plan of action as they relate to energy use, energy supply and energy institutions are all appropriate." Comments on the draft plan were also received from U.A.I.D., and the World Bank.

On the basis of these inputs, the draft planning document was revised in substance in several areas, and a number of clarifications were made in the narrative. Several reviewers felt that a "plan" requires a specific timetable for implementation. Given the considerable uncertainty in Liberia's economic and political future, the Secretariat of the NEC concluded that it was inappropriate at this stage in Liberia's energy planning process to include such an implementation schedule. In consequence, the term "Program" was adopted in place of "Plan" in the document's title.

The revised document, now called the "Integrated National Energy Program For Liberia" (INEP) was reviewed by the member agencies of the NEC. A few agencies expressed differences of opinion regarding emphasis or priority the revised document gave to certain problems and recommendations, but no serious reservations were expressed by the five member agencies which chose to participate in the final review. In April an advance copy (photocopy) of the INEP was released by the NEC as its comprehensive set of recommendations to the GOL for actions in the energy sector. In June 1985 a final copy of the INEP was distributed (Ref. 1).

To encourage public discussion of the INEP, John Pfelemer, Deputy Director of the USAID Mission in Liberia suggested that the NEC consider holding an energy program implementation workshop, and the Mission offered to financially support the workshop. The Secretariat of the NEC agreed with this suggestion and in June 1985 Barron began working with USAID Mission staff to arrange for funding. In early July a Workshop Organizing Committee was formed and this group (consisting of Neufville, James Guseh of the Ministry of Justice, Mydea Karpah of LEC, Carole Scherrer-Palma the USAID Mission Energy Officer, and Barron) worked out the specific agenda, format for discussion, the list of invitees, and other matters.

The Energy Program Implementation Workshop was held from September 4 through 6, 1985 in the city of Buchanan, about 100 miles from Monrovia. Workshop participants included senior GOL staff, senior representatives of donor agencies and embassies, and

persons from Liberia's industrial and commercial sectors. The number of participants for the three meeting days varied between about 30 and 45.

Three sessions were held addressing the major points in the INEP with regard to energy use, energy supply, and energy institutions. Participation was active and a surprising degree of consensus eventually emerged on most points, though often only after considerable discussion. Attendees from all sectors expressed the opinion that the Workshop was a useful means of providing a public forum for discussion of Liberia's pressing energy problems and for stimulating discussions of the recommendations in the INEP. Neufville, Guseh and Kawah produced a report on the activities and conclusions reached during the Workshop sessions (Ref. 25).

C. Reports On The Process Of Liberian Energy Policy Development

It is useful to document, to the extent possible, the actual process of the evaluation of energy policy options, the inter-agency discussions and debates, and the process of the top-level decision-making. Such descriptions should be helpful in formulating approaches to subsequent energy planning and technical assistance efforts in Liberia and possibly in other developing countries as well.

In early 1985 Neufville, Barron, and Patricia Koshel (AID/Washington) completed a paper entitled "The Evolution of Energy Planning In Liberia", which was subsequently submitted for

Journal publication. The paper describes the creation and evolution of the NEC, its successes, failures, and possible future developments. The paper also described the role of outside technical assistance in helping the NEC to address energy policy issues (Ref. 26).

In June 1985 Barron and Neufville wrote two case studies describing in the first paper the history of the evaluation process for proposed major hydroelectric developments in Liberia (1981 - 1985), and in the second the policy issues and technical studies carried out in support of the debates regarding the viability of the Liberian petroleum refinery (1982 - 1985). These case studies outline the major developments, identify the principal actors and their policy positions, and describe the course of the public policy debates. In addition, both case studies summarize the major technical issues which entered into the policy discussions (Ref. 27).

The major conclusions of the hydroelectric case study are that in the early 1980's LEC and the GOL over-emphasized very large increases in hydroelectric power (involving outputs from several times to more than ten times established demand) and that by doing so they lost the opportunity to obtain early funding for more reasonably sized hydroelectric projects. By the time LEC and the GOL agreed on the need for projects involving only moderate increases in output, Liberia's economic and fiscal situation had declined to the point where it became very difficult to fund any capital-intensive project.

The major conclusion of the refinery case study is that the weight of several detailed investigations of the refinery's viability is clearly on the side of permanent closure and fundamental organizational restructuring. Such reforms would likely save the financially hard-pressed GOL substantial sums each year compared to present costs. However, the top levels of the GOL have thus far chosen not to move on the recommendations.

D. Major Liaison Activities With Donor Agencies

As outlined in the terms of reference for the Resident Energy Advisor to Liberia (Ref. 4), one important goal of the U.S.A.I.D. technical assistance effort was to improve the coordination of donor agency assistance to Liberia in the energy sector. Over the course of this project Neufville and Barron worked to make the Secretariat of the NEC into an effective coordinating agency for the activities of various donor agencies (e.g., the World Bank, the Delegation of the European Economic Communities --EEC, and U.S.A.I.D.) in the energy sector.

The principal liaison activities with donors other than USAID were with:

- 1) the World Bank
- 2) the Liberian Delegation of the EEC
- 3) the United Nations
- 4) and various embassies during the Energy Program Implementation Workshop

(D.1 World Bank Liaison Activities)

Contact between project staff and staff of the Energy Assessments Division of the World Bank began several weeks before the energy advisor arrived in Liberia. Barron and several project persons from ORNL met with World Bank staff in September and October 1983 to discuss the up-coming energy assessment work. During subsequent trips to Washington by Neufville and, separately, by Barron, meetings were held with World Bank staff to discuss the process of the energy assessment work.

It 's important to note that at all times the work of the World Bank on the one hand and that of the NEC (and its U.S.A.I.D-funded advisor and consultants) on the other remained independent undertakings. These meetings simply helped to ensure that duplication of research activities was avoided.

As noted in Section II B.3, the Secretariat of the NEC served as a principal liaison agency for the World Bank's work in the energy sector in Liberia from late 1983. Neufville and Barron worked closely with World Bank staff in Liberia during the course of the Bank's energy assessment and follow-on work (e.g., the energy sector management assistance proposals, Ref. 28, and the Power Efficiency Audit of LEC in June 1985).

(D.2 Liaison With The Liberian Delegation of the European Economic Community)

The Secretariat of the NEC interacted extensively with representatives of the EEC during the period of February to April

1984 to develop a proposal for EEC funding for a rural electric station study. Working in conjunction with the MPEA and EEC staff, Neufville and Barron helped to develop the terms of reference for a study of the potential for a small hydroelectric plant (1-5 MW) and of institutional reform for the power system for the city of Gbarnga, Bong County (Ref. 29).

This proposal was put forward to the EEC by the MPEA in April 1984 and forwarded to the EEC's Brussels office. The Brussels office decided to send a hydroelectric specialist to Liberia on a short-term assignment before considering the proposal further. This specialist was scheduled to arrive in the Spring of 1985 but his visit has since been delayed. EEC staff remain optimistic that the proposal will eventually be funded.

(D.3 Liaison With The United Nations)

Before coming to Liberia in November 1983, Barron met with staff of the United Nations Department of Technical Cooperation for Development (UN/DTCD) to follow-up on their just-completed review of Liberian energy planning (Ref. 30) and in particular on discussions they had with Neufville in Liberia on possible UN support for energy planning in Liberia.

In November 1983 Neufville and Barron worked with senior staff of the UN Development Program (UNDP) office in Monrovia to evaluate possibilities for UNDP support for energy planning in Liberia in 1986 and 1987, after the on-going U. S. A. I. D. -funded assistance program was scheduled for completion. During the next

several months the Secretariat of the NEC interacted extensively with both the local UNDP office and, by correspondence, with the UN/DTCO office in New York to develop a proposal for UN assistance to the NEC. A proposal was put forward, but by 1985 it was clear that budget cutbacks made funding unlikely.

(D.4 Liaison With Other Agencies)

One purpose of the Energy Program Implementation Workshop held in September 1985 was to involve representatives of donor agencies and embassies in discussions about the nature of Liberia's energy problems and the NEC's recommendations for addressing these problems. In preparation for the Workshop, Neufville and Barron visited the embassies of a number of existing and potential donor nations in Liberia. Meetings were held with the Ambassadors of West Germany, France, and The People's Republic of China, and with the Charge' d'Affaires of the Swedish Embassy, the Resident Representative of the UNDP, and with senior staff of the Japanese and Italian embassies.

These meetings resulted in attendance at the Workshop of senior representatives of the French, Chinese, Swedish, and Italian embassies, and the UNDP, as well as the American embassy and U.S.A.I.D. It is hoped that the Workshop served to stimulate interest on the part of these agencies in possibly funding programs to help Liberia address its pressing and growing energy problems.

E. Formal And Informal Professional Development Activities

Throughout the period of U. S. A. I. D.-funded energy sector technical assistance, the Secretariat of the NEC has been able to draw on its member agencies to provide mid and upper-mid level staff to work on the energy assessment activities. A major goal of the U. S. A. I. D.-funded technical assistance in the energy sector in Liberia is to strengthen the capability of the Liberian energy analysts, planners, and the GOL's planning institutions, such as the NEC.

Beginning with the 1982 technical assistance program and continuing through the 1983-85 program, nearly all data collection and analytic activities were carried out as joint undertakings of Liberian and American project staff. During the course of the research activities, efforts were consistently made to train the Liberian participants in the techniques and approaches to the work. In a few cases where the research was of a highly specialized and technical nature (e.g., econometric modelling), the work was carried out largely by American participants with secondary support from Liberians. However, in such cases efforts were made to provide for later training in the use of these techniques to Liberian participants. For example, two participants in the First Phase work traveled to the U. S. to receive short-term training in the use of several computer-based economic models of the Liberian economy.

To supplement the professional development benefits of the "hands-on" data collection and analysis experiences of Liberian

project participants, Barron developed the curriculum for a short course in project evaluation methodology (Ref. 31). This course emphasized introductory benefit/cost analysis and the significant role of judgements and assumptions in the formal evaluation process. Barron taught the six week (12 two hour sessions) at the Department of Energy in July and August 1984. The class was attended by fourteen persons: the MLM&E (3), the Ministry of Finance (2), the Ministry of Agriculture (2), LEC (3), LPRC (2), and the Forest Development Authority (2).

In early October 1985 a second short course on project evaluation methodology was held, taught by Barron and Carl Petrich from ORNL.

E. Other Related Activities

Activities related to USAID's energy sector technical assistance in Liberia not covered in other parts of this report include:

- 1) responses by the NEC, its advisor, and short-term consultants to information inquiries and requests for short-term assistance made by LEC, MPEA, the National Iron Ore Company (NIOC), and the USAID Mission
- 2) visits to Liberia by EIA/Abidjan and AID/Wash. consultants and staff
- 3) orientation and consultation trips made by the resident energy outside outside of Liberia

(F.1 Assistance Provided By The Secretariat
Of The NEC, Its Advisor, And Consultants To
LEC, MPEA, NIOC, U. S. A. I. D.)

As the NEC became more active and visible from 1982 through 1985, various agencies began looking to the Secretariat for assistance or advice on various energy matters. For the most part such requests involved only moderate amounts of effort on the part of Secretariat staff, the resident advisor, and short-term consultants. In a few cases, however, the efforts were more substantial.

On several occasions LEC senior staff asked Neufville and Barron to review project proposals submitted to LEC (see for example, Ref. 32). In addition, several mid-level LEC staff persons who participated in the short-course on project evaluation methodology (see Section II E) and others asked Barron for assistance when they were assigned responsibilities involving project design or evaluation. This assistance was either in the form of explanations about technical issues or of a review of an early draft version of their work.

On several occasions Neufville and Barron responded to information requests from the MPEA, particularly with regards to preparation of material for Liberia's positions on energy in meetings of the the Mano River Union (Liberia, Sierra Leone, and Guinea) and the Economic Community of West African States (ECOWAS).

Requests from National Iron Ore Company (NIOC) for assistance included more substantial time and effort. NIOC was

Interested in exploring possibilities for substituting wood for part of its petroleum-based electricity generation at its Mono River mine site which lies well outside the Monrovia electric grid. NIOC invited Neufville and Barron to the mine site in April 1984 to review their situation. Over the next several months Neufville and Barron worked on an intermittent basis with NIOC and consultants from Mat-Chem (Canada), the contract company managing NIOC for the GOL. Initial work was on a very preliminary evaluation of the economic and financial viability of wood-fired electricity at the mine and later on developing a study design for more detailed evaluation of the proposal. This work included a trip by Barron with senior Mat-Chem and GOL/NIOC staff to Kenema, Sierra Leone to visit a wood-fired 1.2 MW electric power plant (Ref. 33).

Unfortunately, over this period NIOC's financial situation steadily worsened (April 1984 - January 1985). In March 1985 NIOC ceased operations and the proposal was dropped. However, NIOC staff interest in wood-fired electric power plants continued and this led to further discussions with the Secretariat of the NEC and with the MPEA. These discussions led to a series of exploratory letters between the MPEA and the African Development Bank on possibilities for a wood-fired electric plant at the site despite mine closure (Ref. 34).

The Secretariat of the NEC served as a clearinghouse for the dissemination of information to GOL agencies on USAID's energy training programs. This role involved helping to ensure that

relevant agencies and departments within them received the information in a timely manner and helping to collect the completed application forms. In addition, the Secretariat informally reviewed the training programs and applications and passed on to U.S.A.I.D. its comments on the relevance of specific program offerings and the usefulness of specific programs to the professional development of individual applicants.

On their own initiative Barron and Samuels wrote a memorandum to the Monrovia USAID Mission and the US Embassy on U.S. Government Liberian operation energy conservation opportunities (Ref. 35). This memorandum was submitted in March 1983 but as of October 1985, no response has been received and no apparent action on it has been taken.

(F.2 Visits by EIA/Abidjan, USAID/Washington
Contractors and Staff)

A number of visits were made to Liberia on energy matters by contractors from the EIA Regional Office in Abidjan, Ivory Coast, and by Washington-based U.S.A.I.D. staff and contractors.

In January 1984 Ed Karch, Deputy Director for West Africa of the EIA Abidjan office, visited Liberia for several days and met with Barron, Neufville, and Perlack to discuss possible activities relating to wood and charcoal studies. This visit was followed-up in September 1984 by Asif Shaikh, Director of EIA for West Africa, who met with Barron, Neufville, Jim Pagano (then Mission Energy Officer), and Deputy Mission Director Pfelemeier

on several matters, including the appropriateness of a technical and insitutional evaluation of a wood-fired electric power plant for the city of Gbarnga, Bong County.

During these discussions it was decided that the Abidjan office of EIA could assist the on-going Liberian energy sector technical assistance program through support in the development of a study to evaluate charcoal export possibilities for Liberia, and by designing and holding in Monrovia a managment skills workshop for top LEC managers. (It was agreed in September 1984 to postpone both activities until about June 1985, because of up-coming NEC work on coordinating the GOL's response to the draft World Bank Liberian energy assessment report and the NEC's development of a national energy program for Liberia.) By mutual agreement of EIA Abidjan, EIA/Washington, the Liberia Mission, and the Secretariat of the NEC, the LEC managment workshop was eventually cancelled due to scheduling problems and difficulties identifying a trainer with the appropriate combination of skills.

In September 1985 Kjell Christopherson, Ph.D., the new EIA Director for West Africa, and Karch visited Liberia to follow-up on the charcoal export study. (In late September 1985, the USAID Liberia Mission formally extended its support for a charcoal export study stressing examination of international transport costs and importing country market conditions.) While in Liberia, Karch and Christopherson also attended the NEC's Energy Program Implementation Workshop.

Wes Fisher, Energy Advisor to the Africa Bureau of AID/Washington, visited Liberia in June 1984. Fisher, Barron, Neufville, and Pagano reviewed project activities and areas of possible additional assistance which the Bureau could provide to project participants in Liberia.

In late August 1984, Frank Denton, Ph.D., from AID/Washington visited Liberia to work with Barron, Neufville, and Pagano to help make a preliminary determination of the technical and institutional feasibility of a wood-fired electric power plant for the city of Gbarnga (Ref. 36). Asif Shaikh also participated in this work briefly during his stay which partly overlapped that of Denton. On the basis of Denton's work, Shaikh's comments, previous work by the Secretariat of the NEC and other agencies, Neufville, Barron, and Pagano visited Gbarnga to discuss matters of institutional reform with senior personnel of major electricity producers and consumers in the area (Ref. 37). The NEC included pertinent recommendations on an experiment in rural station institutional reform in its INEP (Ref. 1).

In November 1984 Shirely Burchfield, a consultant with Africa Bureau, visited Liberia as one stop on a several nation energy data collection and review program. Burchfield worked with Neufville, Barron, and staff from a number of the member agencies of the NEC (e.g., M.M.E, LEC, MPEA, LPRC) obtaining information on the nature of their energy data systems. A draft version of her report was reviewed by Barron and Neufville in May 1985 (Ref. 38).

(F.3 Orientation/Consultations Trips Made
By Energy Advisor Barron Outside Liberia)

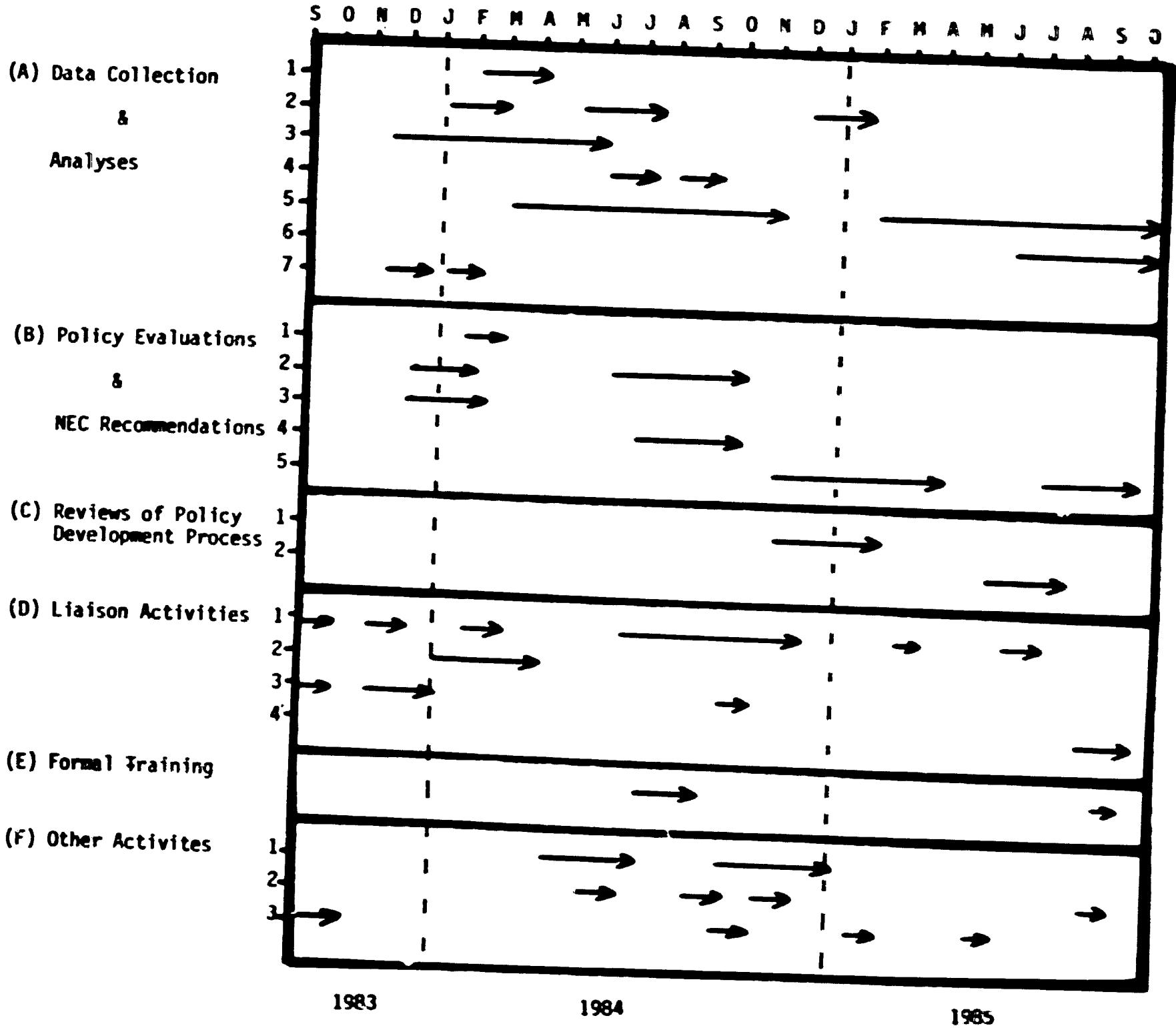
Prior to his arrival in Liberia on November 1, 1983, Barron attended a two-week orientation program in Washington. During this time he also met with staff of the Energy Assessments Division of the World Bank as they were preparing for their upcoming Liberian energy assessment and with staff of the UN/DTCT to discuss their recent trip and forthcoming report on energy planning in Liberia (Ref. 30).

In late September and early October 1984 the Monrovia USAID Mission funded a trip by Barron for consultation with short-term project staff at ORNL, and for meetings with AID/Washington staff (Africa Bureau, S&T Bureau), World Bank, and UN headquarters staff. This purpose of this trip was to help improve coordination of energy sector activities in Liberia by these various organizations.

During February 1985, while on R&R in Southeast Asia, Barron worked for several days for the Office of Energy of S&T in Kuala Lumpur to review a forthcoming energy planning manual being produced by the Asian and Pacific Development Center (Ref. 39).

With Mission approval but at his own expense Barron accompanied Neufville on a trip to Kenya in May 1985 and, with Neufville, held discussions on local energy matters with senior staff of the Kenyan Ministry of Energy and Regional Development and with Nairobi-based USAID energy staff and contractors.

Figure 1
Timetable for Project Activities



III INSTITUTION BUILDING

The National Energy Committee

Major aims of the U. S. A. I. D.-funded energy sector technical assistance are to strengthen the ability of the GOI to systematically evaluate the nation's energy options and, after decisions have been made, to effectively implement appropriate energy programs. "Institution building" involves development of pools of local technical expertise and creation of effective organizational structures, procedures, and responsibilities on the part of agencies designated to evaluate options, make decisions, and implement programs.

While the effectiveness of an institution will always depend in large measure on the abilities and dedication of its individual staff members, the goal of institution building is to strengthen those professional development opportunities, organizational relationships, and expectations of effectiveness which will provide continuity of performance through changes in personnel.

With regards to the goal of institution building, the primary concern of U. S. A. I. D.'s energy sector technical assistance in Liberia is to strengthen agencies which evaluate policy options in the energy sector. (Issues related to agencies for policy decisions and program implementation are considered later in this report.)

In the area of technical reviews and development of energy policy recommendations noteworthy achievements have been made. During both phases of the joint GOL/U. S. A. I. D. energy assessment work, between five and fifteen mid-level and upper mid-level Liberian public sector staff have been continually, deeply involved in project activities. Drawing from the member agencies of the NEC and occasionally from other GOL agencies, the Secretariat of the NEC has worked with the NEC's Technical Subcommittee (composed of upper-mid level staff) and directed the NEC's Energy Assessment Team (composed of mid level staff). The MLM&E, LEC, and the MPEA, have been particularly well represented in these efforts. The U. S. A. I. D.-funded technical assistance acted as a vital supplement to this locally based effort. The availability of substantial outside technical resources, opened-up possibilities for pursuing specific lines of analytic inquiry and served as a catalyst for the more active GOL investigation of its energy options.

Over the past several years the active GOL participants have gained considerably in their understanding of the nature of energy problems and opportunities facing Liberia. In several cases, participants have also gained a much better understanding of program evaluation methods. An interagency committee such as the NEC has significant drawbacks when it comes to sustaining research and analysis activities, but it also has the significant advantage of providing a potential pool of talented and interested host country project participants which is far larger than any single agency could offer.

The NEC is not yet in a position to meet all of its analytic responsibilities strictly from its own personnel. Yet, at a minimum, the experiences of GOL personnel in the two phases of the joint GOL/U.S.A. I.D. national energy assessment place the NEC in a stronger position to identify specific areas of needed outside expertise and to guide the consultants to ensure that their work answers the most relevant questions. (For further descriptions of the impacts and limitations of the professional development aspects of the energy assessment activities see Refs. 2, 3, 26).

There seems to be little question that the National Energy Committee and, in particular, its Secretariat, are much more active institutions in the latter part of 1985 than they were early in 1982. Unfortunately, at this stage continued effectiveness probably still depends on a few key individuals who provide the leadership and on a moderate number of interested and capable mid-level staff persons who carry out much of the data collection and some of the analytic work. Under favorable circumstances, a self-sustaining, effective organization for energy policy will likely emerge, though probably with an institutional structure somewhat different from that of the present NEC and its Secretariat (see Ref. 1, 26).

Under relatively adverse circumstances, resulting in the loss or reassignment of the particular persons most responsible for the NEC's successes to-date, the more tangible gains in organizational development would probably slip away. However,

even in that case, certain important intangible long-term benefits would still remain. These would be in the form of individual Liberians who are better trained and more experienced in energy analysis and policy evaluation, and in the form of documentation and experiences of GOL personnel in the NEC's work during this period.

To sum up, the first stages of "institution building" in Liberia's energy sector have been reasonably successful with regard to analysis and policy evaluation activities. However, it should be recognized that these institutional gains have not yet been secured through the firm establishment of a self-sustaining organization capable of effective operations if it suffered the loss of these persons presently responsible for its major achievements.

The Larger Planning Context

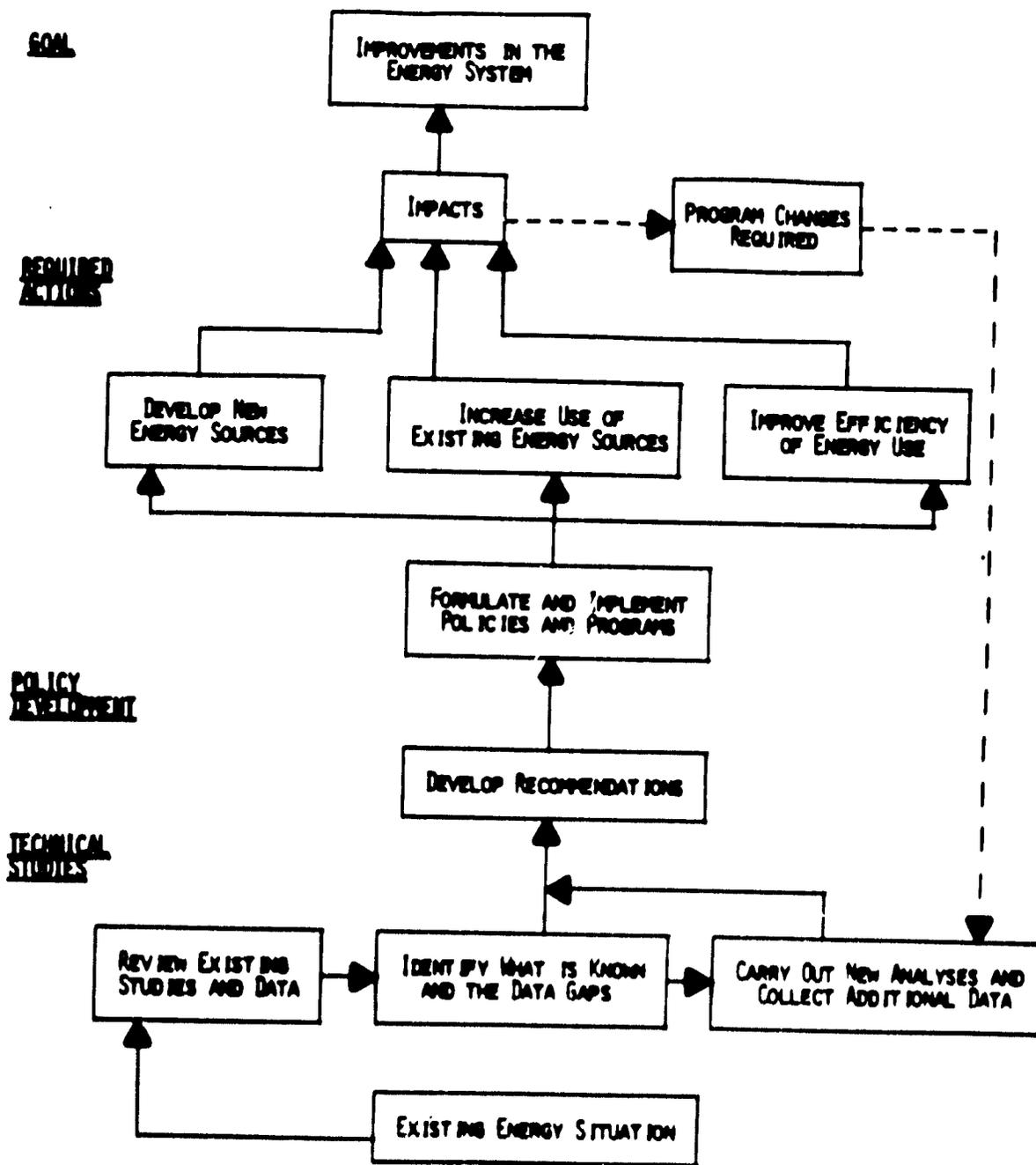
It is probably fair to say that in Liberia the energy situation is reasonably well understood, the nature of the particular problems has been adequately identified, and a realistic set of programs to address these problems have been proposed. The soundness of program recommendations cannot, of course, be finally judged until they have been adopted and implemented. However, it can be stated with some confidence that the NEC has made highly effective use of its own staff and the outside technical expertise (provided directly to the NEC by U.S.A.I.D. and indirectly by the World Bank through the results of its own assessment work) in evaluating the full range of options in

Liberia's energy sector. The NEC has carefully selected and molded these inputs in light of the Liberian economic, social, and political setting.

Through its Technical Subcommittee, its Energy Assessment Team, and ad hoc working groups (such as the GOL participants at the Workshop), the NEC has provided a mechanism for the "technocratic" levels of various public sector agencies to openly evaluate and discuss energy policy options. Through its published recommendations on energy policy, the NEC has occasionally stimulated considerable discussion throughout the GOL on important energy policy issues (e.g., issues associated with the evaluation of the proposals for large hydroelectric development).

However, as the discussions which occurred during the Energy Program Implementation Workshop (September 1985) occasionally pointed out, an analysis and evaluation agency, such as the NEC, can only carry matters so far. At the bottom line, the NEC is an advisory body without significant access to the top decision-making levels of the GOL. Its principal recommendations (e.g., permanent closure of the petroleum refinery, institutional reform within LEC and LPRC, mandatory public sector emergency electricity conservation) have not been officially disavowed by the top decision makers, but neither have they been acted on over the past three years. In terms of Figure 2 it can be said that energy planning is presently stalled at the "Policy Development" stage. Without clear decisions, program implementation cannot be effectively addressed.

Figure 2
 Outline of Energy Policy Evaluation
 and Implementation Stages



A planning context in which a series of well researched policy recommendations simply fail to elicit a direct response from those with the power to decide, cannot fail to have a demoralizing effect on technical staff. This was all too clear at times during the Workshop.

For balance it should be noted that Liberia is facing severe and growing economic and fiscal problems. It is also undergoing a political change from military to civilian rule. Any government at any time is generally reluctant to admit the need for fundamental reforms and painful adjustments. This is particularly true when economic decline is already imposing considerable hardship and when transitional governments are in power. Elections were held in Liberia in late October 1985, though these resulted in widespread charges of fraud against the incumbent regime. Dissatisfaction with the fairness of the election contributed at least indirectly to subsequent violence and political strife.

Many of the programs in the INEP call for basic institutional reform and acceptance of these recommendations on the part of the top decision making levels of the GOL would involve at least short-term hardship for some groups. Also, many of the programs in the INEP will require substantial outside funding. Presently, Liberia's debt management problems are so severe that potential lending agencies are holding back until signs of significant fiscal policy changes are evident. The INEP itself notes that any major capital investments in the energy sector

should be tied to specific institutional reforms for that energy subsector in order to avoid at least some of the waste which has occurred in the past (e.g., coupling the introduction of funds to up-grade the generating equipment at LEC to reforms in LEC's billing and revenue collection system, tying investments in petroleum product importation system to specified organizational and management reforms in LPRC).

Hard choices have been postponed in Liberia to the detriment of the energy services and the economy as a whole. The cost of imported energy supplies for the modern sector (electricity and petroleum fuels) represent a significant drag on the economy and supplies are becoming less reliable, producing secondary damage to the economy, as businesses face higher costs or curtailed activity. These problems make action and perhaps unpleasant additional near-term sacrifice a growing imperative. Yet, calls for basic reform of electric utility management and petroleum importation operations continue to go unheeded. When actions will be taken and how effective they will be remains highly uncertain at this point.

When the stage is finally set for action, the NEC's INEP should prove to be a most valuable starting point. In contrast to the highly interdependent program recommendations of some national energy plans which stem directly from specific sets of assumptions in detailed forecasting and simulation models, the programs in the INEP address fundamental issues and are applicable to a wide range of future conditions. Because these programs do address basic problems, the majority of the recommenda-

tions identified in the INEP should remain as valid five years from now as they are in 1985, even though specific economic and energy conditions are likely to have changed somewhat in that time (Ref. 1).

Areas Of Possible Future Technical Assistance

The NEC has demonstrated convincingly that it is capable of making effective use of outside technical assistance to enhance the capabilities of its own staff, and to focus the work of the outside experts on developing practical solutions to important technical problems. Continuation of U.S.A.I.D.'s energy sector technical assistance is a recommendation of both the INEP and the World Bank's Liberian energy assessment (Ref. 1, 6).

The NEC's (or for that matter any of its likely successor organization's) greatest needs for technical assistance in the next few years will continue to be for an economist/financial analyst experienced in technology assessment and for an engineer experienced in energy technologies. If possible, the economist should be available in residence or at least make scheduled periodic trips of several months each. If possible, one or more engineers (with different areas of expertise) should be on call for periodic visits to Liberia to work on specific investigations.

With the above noted, it is necessary to consider the more fundamental question of the appropriate goals in Liberia of continued energy sector technical assistance. In certain

respects energy analysis has gone as far as it reasonably can within the present planning context. Without firm decisions on what energy policy should be and serious implementation efforts, further study is likely to result in little noticeable improvement in the nation's energy situation.

Until the larger planning context improves, the major benefits of continued outside technical assistance are likely to be in the form of the further professional development of GOL staff, and in the encouragement given to those individuals within the GOL who have been lobbying strongly for more effective management of the energy sector. Outside technical assistance at this stage also is probably vital in helping the NEC (or its successor organization) to develop and maintain the information base it needs to keep raising policy issues and pressing for actions. Continued professional development could have valuable long-term impacts in helping Liberia to meet its energy challenges in the coming years and decades.

IV CONCLUDING COMMENTS

The U.S.A.I.D.-funded technical assistance over the past several years has made a major contribution to the preparatory and analytic stages of energy planning in Liberia. The high level of this contribution was made possible by the quality of the GOL counterpart participation. Separately, the quality of the Liberian and American team efforts were each necessary but not sufficient conditions for success. It was the close working relationships between the participants from each country that were essential for success.

If there are aspects of the U.S.A.I.D.-funded energy sector technical assistance in Liberia which might be beneficially replicated in other countries (and perhaps in other sectors in Liberia), probably none is more important than the nature of the close counterpart working relationships which have characterized the GOL/U.S.A.I.D. energy sector cooperation over the past several years. From the start of this work both the Liberian and American project staff devoted considerable time and effort to developing effective working arrangements. At times this attention to institution-building resulted in a slow-down in the data collection and analysis work, but in the end there was a higher level of skills transfer than would otherwise have been the case. The close working relationships were also instrumental in helping to ensure that the short-term outside assistance was well integrated into the longer term activities.

The important point is that all project staff, Liberian and American, were consistently working toward commonly accepted goals with an understanding of the potential contribution each person could make and a recognition that energy policy analysis requires an understanding of the social and political context as well as economic and engineering analyses. For additional information on the counterpart working arrangements see References 2, 3 and 26.

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