



Joint UNDP/World Bank Energy Sector Management Assistance Program

Activity Completion Report

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JANUARY 1985

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Report of the Joint UNDP/World Bank Energy Sector Management Assistance Program

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ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAM

The Joint UNDP/World Bank Energy Sector Management Assistance Program (ESMAP), started in April 1983, assists countries in implementing the main investment and policy recommendations of the Energy Sector Assessment Reports produced under another Joint UNDP/World Bank Program. ESMAP provides staff and consultant assistance in formulating and justifying priority pre-investment and investment projects and in providing management, institutional and policy support. The reports produced under this Program provide governments, donors and potential investors with the information needed to speed up project preparation and implementation. ESMAP activities can be classified broadly into three groups:

- Energy Assessment Status Reports: these evaluate achievements in the year following issuance of the original assessment report and point out where urgent action is still needed;
- Project Formulation and Justification: work designed to accelerate the preparation and implementation of investment projects; and
- Institutional and Policy Support: this work also frequently leads to the identification of technical assistance packages.

The Program aims to supplement, advance and strengthen the impact of bilateral and multilateral resources already available for technical assistance in the energy sector.

Funding of the Program

The Program is a major international effort and, while the core finance has been provided by the UNDP and the World Bank, important financial contributions to the Program have also been made by a number of bilateral agencies. Countries which have now made or pledged initial contributions to the programs through the UNDP Energy Account, or through other cost-sharing arrangements with UNDP, are the Netherlands, Sweden, Australia, Switzerland, Finland, United Kingdom, Denmark, Norway, and New Zealand.

Further Information

For further information on the Program or to obtain copies of completed ESMAP reports, which are listed at the end of this document, please contact:

Division for Global and
Interregional Projects
United Nations Development
Program
One United Nations Plaza
New York, N.Y. 10017

OR

Energy Assessments Division
Energy Department
World Bank
1818 H Street, N.W.
Washington, D.C. 20433

NEPAL

ENERGY ASSESSMENT STATUS REPORT

JANUARY 1985

ACRONYMS

ADB	Asian Development Bank
ADB/N	Agricultural Development Bank of Nepal
BYS	Balajo Yantra Shala (manufacturer of multipurpose power units)
CFDP	Community Forestry Development Project
CIDA	Canadian International Development Agency
ED	Electricity Department
ESMAP	Energy Sector Management Assistance Program
FAO	Food and Agriculture Organization
HMG	His Majesty's Government of Nepal
IDA	International Development Association
IFAD	International Fund for Agricultural Development
NEA	Nepal Electricity Authority
NEC	Nepal Electricity Corporation
NRECA	National Rural Electrification Cooperative Association (United States)
ODA	Overseas Development Agency (United Kingdom)
RCUP	Resource Conservation and Utilization Project
RECAST	Research Center for Applied Science and Technology
SATA	Swiss Agency for Technical Assistance
SFDP	Small Farm Development Program
SHDB	Small Hydro Development Board
SFP	Second Forestry Project
UNDP	United Nations Development Program
UNICEF	United Nations International Children's Educational Fund
USAID	United States Agency for International Development
WEC	Water and Energy Commission
WECS	Water and Energy Commission Secretariat
WERDP	Water and Energy Resources Development Project

ABBREVIATIONS

ha	hectare
ICS	improved cooking stove
km	kilometer
kW	kilowatt
kWh	kilowatt hour
MPPU	multipurpose power unit
MW	megawatt
NR	Nepalese rupee
toe	tonne of oil equivalent

CURRENCY EQUIVALENTS

1 US dollar = 15 Nepalese rupees

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2. Ongoing Forestry Projects
3. Potential Hydro Project Sites

I. SUMMARY AND RECOMMENDATIONS

1.1 The Kingdom of Nepal, with a population of 16 million (93% rural) is landlocked and has an economy based largely on traditional rainfed agriculture. The land area (147,181 square kilometers) has a difficult terrain which includes high mountains (44%) and a central region of mountains and terraced hills (41%) which support 60% of the population. The remaining 15% of the land area is an extension of the Indo-Gangetic Plain (Terai) which houses 40% of the population and is the breadbasket of the country. Over 90% of the population rely on agriculture and their chief sources of energy are fuelwood, crop/animal wastes, and small amounts of charcoal. Total energy consumption is estimated to be about 3.5 million tonnes of oil equivalent (toe). Fuelwood accounts for 92%, and other traditional energy sources for 2%. The traditional practice of cutting down trees without replanting them has denuded the country's large forest resource base. This has created a serious imbalance between the supply and demand for fuelwood. Commercial energy consumption, mostly imported petroleum products, is small (6% of total energy) but costly to the economy. The estimated oil import bill of NR 587 million in 1983/84 amounted to 12% of foreign exchange earnings from goods and services in that year.

1.2 This report is based on the findings of a mission under the Energy Sector Management Assistance Program (ESMAP) which visited Kathmandu during July, 1984 ^{1/} to (a) report on the status of the action program recommended by the joint UNDP/World Bank Energy Assessment Report, Nepal: Issues and Options in the Energy Sector (August 1983), including assistance from donors to implement the recommendations, and (b) assess the need for further technical assistance in the energy sector, especially assistance which could be financed under ESMAP. The mission was impressed by the effort that the Water and Energy Commission Secretariat (WECS) had made to implement the recommendations of the Energy Assessment, assisted by a resident team of consultants financed by the Canadian International Development Agency (CIDA). The recommendations covered three main areas: (a) the development of energy supplies and resources (mainly fuelwood and hydropower); (b) improvements in energy demand management and efficiency; and (c) the development of energy institutions. The major recommendations are summarized in Table 1 which references paragraphs in this report where the status of their implementation is discussed.

1.3 HMG has begun a program to improve knowledge of its two major energy resources -- fuelwood and hydropower -- and form late long-term plans for their development. At the same time, HMG is looking at the potential contribution of biogas as a substitute for fuelwood in meeting household energy demand. HMG also is involved in a petroleum exploration

^{1/} Messrs. Zia Mian and Matthew Mitchell.

promotion project with IDA assistance. Seismic survey work was completed in July 1984 with gratifying results, and HMG and IDA exchanged views on a model production contract in October 1984.

SUMMARY

MAJOR ENERGY ASSESSMENT RECOMMENDATIONS

	Status (paragraph reference)
ENERGY SUPPLIES AND RESOURCE DEVELOPMENT	
Fuelwood	
1. Accelerate afforestation efforts	2.5, 2.8
2. Simplify and accelerate transfer of public forests to panchayats	2.5, 2.8
3. Prepare a national forestry development plan	4.10, 4.11
4. Survey plots of land available for forestry	2.5, 2.8
Hydropower	
1. Prepare hydrological studies of major basins	2.11 - 2.13
2. Prepare feasibility studies of 4-5 hydro sites	2.11 - 2.14
3. Increase existing electricity trade with India and agree on a pricing formula	2.11, 2.13
4. Select consultants to review mini-hydro development needs	2.16, 2.17
5. Waive licensing requirements for private entrepreneurs to generate and sell electricity to the Hills	2.19, 2.20
6. Prepare a long-term power investment plan	4.8
7. Formulate a long-term strategy for replacing existing water wheels with multipurpose power units (MPPU) and cross-flow turbines	2.19, 2.20
Biogas	
1. Continue private sector development of family biogas units	2.22, 2.23
2. Systematically monitor the program of community biogas units	2.22, 2.23
ENERGY DEMAND MANAGEMENT	
1. Accelerate dissemination of improved cooking stoves, beginning with a pilot project to distribute 100,000 stoves in the Kathmandu Valley over four years	3.3 - 3.6
2. Reduce electric power system losses	3.8 - 3.10
3. Explore the benefits and costs of an energy efficiency program for the road transport sector	3.13 - 3.14 6.4, 6.5
4. Move towards the economic pricing of electricity and fuelwood	3.11, 4.11
ENERGY INSTITUTIONS	
1. Increase the effectiveness of WECS in energy planning	4.2, 4.3
2. Strengthen the Energy Planning Directorate of WECS with a forester and renewable energy economist	4.3
3. Proceed with plans to create a National Electricity Authority (NEA) and consider integration of the Small Hydel Development Board (SHDB) into NEA	4.5 - 4.7
4. Enlarge student enrollment at forestry institutes and send 40 forest officers abroad for training	4.10 - 4.11
5. Strengthen the Ministry of Forestry's planning and monitoring office	4.10 - 4.11

1.4 Afforestation efforts are progressing along the lines of the "moderate scenario" of the Energy Assessment. However, a much greater effort will be required to avert large fuelwood deficits over the long term. The greatest scope for afforestation appears to be through the improved management of existing forests supplemented by fuelwood plantations in the short-to-medium term, and the widespread distribution of seedlings among the population to meet long-term needs. The emphasis in hydropower development has been on large and medium sites for domestic use and exports. Surveys and prefeasibility work are planned or underway for the major hydro basins and HMG is seeking donor assistance for some of this work. There is also substantial scope for mini and micro-hydro development but HMG requires technical assistance to (a) reduce the high cost of mini-hydro projects managed by the government, and (b) prepare a strategy to promote expanded micro-hydro development by the private sector. HMG has requested ESMAP assistance to do the prefeasibility work in these areas. In addition to fuelwood and hydropower, there is some scope for the development of biogas resources, though on a much smaller scale. WECS has begun to evaluate the potential for an expanded biogas program and has prepared a draft study. ADB/N's loan program for family-sized units is progressing well and meeting some of the energy needs of those who have enough animals and income to operate them. The development of community-sized biogas units appears to have greater scope for expansion, due to its lower cost per family, but has been constrained by a number of design and operational problems.

1.5 Efforts to improve energy demand management and efficiency have focussed on: (a) reducing fuelwood consumption through the distribution of improved cookstoves; (b) reducing power losses in the distribution of electricity, and (c) managing energy demand in the transport sector through measures to lower petroleum consumption. Improved cookstoves are being distributed under the various ongoing forestry projects. Acceptance of these stoves differs according to region but overall utilization is reportedly higher than 50%. HMG believes that a large-scale demonstration program is needed immediately for the Kathmandu Valley and would like technical assistance to prepare a strategy for such a program; however, the mission recommends that before seeking such assistance, HMG review the ongoing and planned programs of the various forestry projects, as well as the development of an indigenous capability to implement and monitor a large program. In the power sector, a program with support from ADB and the World Bank is underway to reduce high losses in the electricity distribution system, mainly caused by improper metering and electricity theft. HMG also has made progress toward the economic pricing of electricity. The current tariff structure is under review and further adjustments to bring it in line with the long-run marginal cost of electricity supply should be made by the end of 1984. There also appears to be some scope for energy savings in the road transport sector, which accounts for nearly half of total petroleum product consumption. HMG would like technical assistance to evaluate the scope for short-run, quick-payback energy savings in this sector.

1.6 Regarding institutional developments, the Water and Energy Commission's coordinating role in energy planning seems to have improved (i.e., the formation of an Energy Task Force) though no specific institutional changes have taken place. Specialists in forestry and renewable energy will be joining WECS to strengthen its energy sector work outside of hydropower development. In the power sector, HMG plans to establish a new electricity authority, formulate a long-term hydropower development program and expand training facilities. In the forestry sector, a long-term investment plan will be prepared covering projects and manpower requirements. Training programs will be expanded and the planning, programming, and monitoring office within the Ministry of Forestry and Watershed Management will be strengthened.

1.7 In considering the above activities, this report makes the following recommendations for further energy sector work by HMG and/or international donor agencies:

- (a) review and update fuelwood supply and demand estimates by region, using the results of a recent land resources mapping survey, and formulate strategies for meeting urban and rural fuelwood needs in preparation for a long-term forest development plan; at the same time, there should be a greater effort to transfer the forest estate to the local governments (panchayats) for management and development (para. 2.8);
- (b) consider funding hydropower prefeasibility and feasibility evaluations identified by WECS subject to an analysis of the proposed work in the context of major projects already under study or preparation, i.e. whether or not these will be sufficient to satisfy domestic demand and provide ample margin for exports (para. 2.14);
- (c) provide the necessary technical support to develop a strategy for reducing the high cost of mini-hydro projects developed by the SHDB to date and promote the expansion of multipurpose power units by the private sector; HMG has requested assistance from ESMAP to fund the prefeasibility work (paras. 6.4-6.5);
- (d) evaluate the improved cookstove dissemination programs for the Kathmandu Valley included as components of various forestry projects and the indigenous production capability to implement a large program immediately (para. 3.4); and
- (e) evaluate the feasibility of immediate, quick-payback measures for reducing petroleum consumption in the road transport sector and prepare an action program; HMG has requested assistance from ESMAP for this evaluation (paras. 6.2-6.3).

II. ENERGY SUPPLIES AND RESOURCE DEVELOPMENT

Overview

2.1 The two principal known indigenous energy resources of Nepal are forests and extensive river systems. The present area of forest cover is estimated at 3.8 million hectares (ha.), of which 2.9 million ha. are in the Hills and 0.9 million ha. in the Terai. Population pressure and increasing demand for arable land and forest products have caused about a 40% reduction in forest cover over the past 15 years. The estimated theoretical hydro-electric potential in Nepal is 83,000 MW, of which about 27,000 MW have been investigated for development. Most hydro sites are of such a size that exports to the Indian power market would be required to economically justify their development. HMG has begun a large program with various donor agencies to tackle the development and rehabilitation of these two energy resources. In addition, HMG is investigating the potential for the substitution of biogas for cooking fuels as well as for running small-scale agro-processing machinery in the Terai. The development of biogas has been handled largely through loans from the Agricultural Development Bank of Nepal (ADB/N) with support from the Asian Development Bank (ADB), UNDP, and UNICEF.

Fuelwood

2.2 Background. The Energy Assessment raised serious concern over Nepal's dwindling forests with an illustration of the planting program that would be required to meet projected fuelwood demand through 2010. The forest area was estimated to be about 4.3 million ha. with a total growing stock of 186 million m³. Overexploitation of forest areas was found to be the equivalent of clear-felling 100,000 ha. annually. This compared to an afforestation program which has averaged only about 5,000 ha. per year.

2.3 Fuelwood demand was projected to reach about 13 million m³ (9.1 million tonnes) by the year 2000 and 16 million m³ (11.4 million tonnes) by 2010, compared to the present level of around 8 million m³ (5.8 million tonnes). Based on available forest resource data and discussions with forestry experts in Nepal, the Energy Assessment Report produced two scenarios for fuelwood supply in the medium-to-long term: (a) an "accelerated program" of annual planting reaching 50,000 ha. by 1990, and (b) "a moderate program" reaching 20,000 ha. per year in 1990 and 50,000 ha. per year by 2010; the latter scenario, however, would result in the

virtual disappearance of Nepal's forests by 2010, causing a large wood energy deficit. 2/

2.4 The targets of the above scenarios are based mainly on fast-growing, high-yielding fuelwood plantations producing about 10 m³ per ha. However, based on recent Bank/FAO reviews of the forestry sector, it now appears that, given the limited amount of land available for plantations, the greatest scope for increasing fuelwood supplies in the short and medium term will be through the improved management of existing forests; this would include forest protection combined with an aggressive program of forestry management techniques, such as coppicing, which can result in yields of 5-6 m³ per ha. compared to less than 1 m³ per ha. for degraded forests.

2.5 Recommendation. HMG should: (a) attempt to meet the production targets of the "accelerated" planting scenario to avert serious fuelwood shortages; (b) survey plots of land available for forestry; and (c) simplify and accelerate the transfer of public lands to the Panchayats (local governments) for development.

2.6 Response. According to recent Bank/FAO estimates, feasible annual afforestation targets by 1990 would be on the order of 15,000 ha. of forests brought under improved management and 5,000-10,000 ha. of fuelwood plantations. These figures are close to those given for the target afforestation area in the Energy Assessment's "moderate scenario". However, if this scenario were followed through for the subsequent two decades, there would be an enormous fuelwood deficit - 7.3 million tonnes. The gap would have to be filled by other fuels and would amount to the equivalent of 2.5 million toe, or about 20 times the current annual level of oil imports. But given that the basis for current Bank/FAO targets is mainly improved forest management and not only the high-yielding plantations of the "moderate scenario", the wood energy gap could be even greater.

2.7 The above fuelwood supply scenarios underscore the sense of urgency in exploring innovative ways to increase fuelwood supplies as rapidly as possible and plan for alternative energy sources to meet projected fuel shortages over the long term. The ongoing forestry program includes three groups of activities which are extremely important to meeting this goal: (a) 17 field projects (in 71 of Nepal's 75 districts) which are designed to meet fuelwood and fodder needs through community participation; (b) seven central support projects to improve the forestry sector's institutional capabilities; and (c) small-scale projects for afforestation, research, forest utilization and energy

2/ These two scenarios include natural forest protection and the distribution of improved cooking stoves that are 25% more efficient than open-fire cooking.

conservation. The afforestation target of the current (Sixth) development plan (1980/81 to 1985/86) is about 17,000 ha. per year, of which the Bank/FAO Community Forestry Project accounts for about 60% (see Annex 2). The Bank/FAO Second Forestry Project (1983/84 to 1988/89) includes 35,000 ha. of forests to be brought under improved management (averaging 7,000 ha. per year) and 26,250 ha. of fuelwood plantations (averaging 5,250 ha. per year) along with the distribution of 32 million seedlings.

2.8 HMG now is preparing the investment program for the Seventh Five Year Plan and is formulating a national forestry development plan with assistance from ADB and the World Bank. Clearly, meeting projected fuelwood demand will require a much larger afforestation effort than in the past but there are a number of constraints which require attention. First of all, the current forest resource data base is based on old (1964) and incomplete survey data, which is woefully inadequate for planning purposes. Also, estimates made to date have been at a global level and therefore are not very useful for designing action programs to meet fuelwood needs, as these vary considerably by region. Furthermore, one of the most important steps toward Nepal's forestry development -- the transfer of the forest estate to the panchayats for local protection and management -- has not moved very rapidly. All experts agree that involving the local population will be crucial to mobilizing a massive afforestation program. Considering all of the above constraints, the mission recommends that, in preparation for a national forestry development plan, HMG:

- (a) accelerate the transfer of the forest estate to local communities for development and provide the necessary technical support;
- (b) make use of the data recently obtained from the CIDA-financed land resources mapping survey to more accurately determine the forestry resource base and land use patterns at the regional level;
- (c) update fuelwood demand estimates based on regional survey data and the results of improved stove programs; and
- (d) formulate a two-part fuelwood supply strategy; i.e. for urban areas: centralized, large-scale block plantations under efficient management, harvesting and distribution organizations and for rural areas: a decentralized self-managed program for individual farms and local communities through the extension of community forestry.

Hydropower

Large and Medium Scale Hydro

2.9 Background. The theoretical potential for large and medium-scale hydropower development in various river systems of Nepal is estimated at 83,000 MW, distributed by basin and region as follows:

<u>Basin</u>	<u>Region</u>	<u>Estimated Theoretical Potential</u> (MW)
Sapt Kosi	Eastern Region	22,000
Sapt Gandaki	Central and Western	21,000
Karnali and Mahakali	Far Western	36,000
Others		4,000
Total		<u>83,000</u>

2.10 The current installed hydropower capacity is 126 MW. The next step in the development program, the 69 MW Marsyangdi Hydroelectric Project, is designed to meet domestic power demand through 1993. Most of the hydropower development to date has focussed on projects sized to meet domestic requirements, which have resulted in electricity costs in Nepal as high as US\$14-17 per kWh. Over the long term, however, the development of large projects, combined with power exports to India, could not only reduce the cost of electricity in Nepal but also help finance Nepal's overall development program through power exports. For example, the development of Chisapani in the Karnali Basin (US\$900 per kW, compared to current projects costing about US\$3,000 per kW installed) could reduce the cost of electricity and have irrigation and flood control benefits as well.

2.11 Recommendation. HMG should complete: (a) systematic hydropower studies of Nepal's major river basins; and (b) feasibility studies of four or five sites selected by WECS. There also should be an increase in the current level of power trade with India (5 MW) to permit optimum sizing of future power plants and reduce the need for thermal back-up during the next decade.

2.12 Response. In preparation for a 20-30 year development program, HMG has taken steps to assess the resource potential and identify feasible projects in three major basins (Kosi, Sapt Gandaki, and Karnali). A list of potential hydropower sites is attached as Annex 3. The WECS recently completed a preliminary Hydro Project Ranking Study which has selected 10 priority sites for feasibility work. WECS findings indicate that the most attractive projects are in the Gandaki Basin due to upper basin storage potential and proximity to the Kathmandu load center.

Also, this basin is the only one that has been studied in detail. The preliminary ranking may be modified to reflect findings from the ongoing Kosi Basin study and the planned feasibility work in the Karnali Basin.

2.13 The WECS has selected five sites from the Gandaki Basin and two sites from the Kosi Basin to be considered for feasibility studies. A study of the Kosi Basin began in April 1983 with technical assistance from the Japanese International Cooperation Agency. It will be completed by early 1985. So far, 54 sites have been identified in this basin (estimated capacity of 12,000 MW). Fourteen of these are considered high-priority sites. For the Karnali Basin, a joint committee of representatives from India and Nepal was formed in March 1984 to study the feasibility of the Chisapani Multipurpose Project, to be financed by an IDA technical assistance credit of US\$11 million. The committee will approve the scope of work and selection of consultants as well as work out the extent to which power trade with India will increase and how power will be priced.

2.14 In March 1984, WECS prepared terms of reference for prefeasibility studies of five sites in the Gandaki Basin. These include three storage projects (Kali Gandaki/2, Seti Gandaki/1 and Burhi Gandaki) and two run-of-river projects (Mugling and Upper Trisuli). The WECS proposes that the study of these five priority sites be done in two phases: (a) prefeasibility studies of all sites; and (b) follow-up feasibility studies of sites which merit further investigation. Preliminary analysis by the WECS indicates that at least two of the sites could be advanced to the feasibility stage. It is estimated that the cost of the prefeasibility work would be about US\$5 million and that the cost of the feasibility studies could range from US\$5 million to US\$13 million depending on the number of projects selected for the second phase. The mission agrees with the government that donors should give high priority to these evaluations. However, the extent of prefeasibility work required at this time should be subject to analysis by WECS of whether or not the projects already under preparation and study will satisfy domestic power demand in the foreseeable future while allowing ample margin for exports.

Mini-Hydro

2.15 Background. Due to Nepal's rugged terrain and the high costs of large civil works and long transmission lines to service many areas, HMG has turned to the development of small hydro stations for electricity supply to isolated towns and villages. So far nine mini-hydro stations with a total capacity of 2,179 kW have been commissioned, a further 18 stations with installed capacity of 4,250 kW are under construction and 10 sites with a potential of 4,476 kW are under investigation. Most of these stations are being constructed and operated by the Small Hydro Development Board (SHDB). The expansion of mini-hydro stations has been constrained by: (a) the lack of adequate hydrological data and analysis of potential sites; (b) the high cost of sites developed so far (averaging US\$5,000 per kW installed); and (c) institutional shortcomings, including a lack of clearly defined goals and inadequately trained technical staff.

2.16 Recommendation. HMG should review the current program, site selection, supervision of construction and training of staff for mini-hydro development.

2.17 Response. In January 1983, the SHDB made a request to the National Rural Electrification Cooperation Association (NRECA) of the United States for technical assistance in mini-hydro development covering: (a) project selection; (b) detailed design work and tender documentation; and (c) training. In July 1983, NRECA sent a two-man team to review the needs of SHDB and determine where NRECA should concentrate its assistance. As a result of that visit, a team of specialists in civil design, hydrology, end uses, and organization was sent to Nepal in February 1984 for more detailed investigations. Subsequently, the team produced a report which reviewed several assistance options. 3/ The recommended option focussed on developing suitable technical designs and approaches to project implementation, operation and management through one or more demonstration projects, which would provide a good opportunity for data gathering and analysis in the areas of small-basin hydrology, civil costs, the load at decentralized rural locations, etc. It would also provide immediate, on-the-job training for engineers. There has, however, been no follow-up to this proposal. The mission and HMG agreed that technical assistance to design and implement a suitable program should receive priority attention. HMG has requested assistance from ESMAP to do the prefeasibility work, which would involve specification of the terms of reference and preparation of the project for funding by donor agencies, including cost estimates and manpower requirements. The proposed ESMAP assistance is described briefly in paras. 6.4 - 6.5.

Micro-Hydro

2.18 Background. Micro-hydropower offers an attractive source of energy for agro-processing and other small-scale industries in the Hills. There are about 25,000 traditional water wheels which have been used for milling and grinding and only slight improvements are needed to use them for operating other simple machinery as multipurpose power units (MPPUs). Sites with somewhat greater water flow are suitable for installing cross-flow turbines which can operate agro-processing machinery during the daytime and produce power for lighting at night. Both types of machinery, the improved water wheel in the 1-5 kW range and the cross-flow turbine with a 10-20 kW of capacity, are built in Nepal and cost less than US\$1,000 per kW of installed capacity.

2.19 Recommendation. To encourage the expansion of these technologies, the Assessment recommended: (a) waiving the complicated licensing requirements for hydro generation and distribution of power up

3/ NRECA Small, Decentralized Hydropower Program, Nepal: Status of the National Small Hydropower Program and Recommendations for Assistance, March 1984.

to 100 kW by privately-owned facilities, and (b) formulating a systematic plan to exploit this potential, i.e., an expanded loan program through ADB/N.

2.20 Response. The mission found that since the Assessment, the licensing requirements for micro-hydropower installation (up to 100 kW) had been waived and that the loan program of the ADB/N was progressing very well. ADB/N, through a credit from the ADB, is providing loans for the construction of 1,160 water turbines to power agro-processing units and minor irrigation works. UNICEF and IFAD are providing assistance for the construction of 50 improved water mills. The Japanese Government is also providing assistance for micro-hydro development under an agricultural development project. The proposed ESMAP assistance to the SHDB would provide a component to define a plan of action for the expansion of MPPUs, including guidelines for their construction and the operational relationship between ADB/N and SHDB.

Biogas

2.21 Background. In the Terai region, there is significant potential to substitute biogas for fuelwood and kerosene as a cooking fuel; an additional benefit is the slurry produced as a by-product, which may be used as fertilizer. There are currently 1,600 biogas plants operating in Nepal, of which all but 24 are family-sized units installed under various programs of the Department of Agriculture, the ADB/N and the Biogas Company. 4/

2.22 Recommendation. The dissemination of family-size biogas units should continue under private sector initiative through the current loan programs and the emphasis of future government programs should be on more economic, community-size biogas units. In addition to household applications, these units may be used to run modified diesel engines for simple milling and grinding operations, thus offering an opportunity to raise the income and standard of living of the small farmer. Experience with community-size biogas plants in Nepal and elsewhere has been limited and there have been problems with design, dung collection, maintenance, gas distribution, and community cooperation. Consequently, there should be a two-year systematic monitoring of these plants to identify design and operation problems as well as appropriate solutions.

4/ The ADB/N program, supported by a US\$2.5 million loan from the Asian Development Bank for 2,000 biogas plants, makes loans to farmers at 11% interest, using their land as collateral. In addition, a joint UNDP/UNICEF program is providing a 50% subsidy for the construction of 24 community biogas plants as pilot projects in areas of ADB/N's Small Farm Development Project.

2.23 Response. The WECS has taken steps to further evaluate the potential for an expanded biogas program and has prepared a draft report on the subject. This report includes a brief survey of the five operating community biogas plants and indicates that plant owners tend to run the milling component of the plant as much as possible to generate income to pay off their loan from the ADB/N. In some cases, the ADB/N has provided additional loans for mill owners to buy rice paddy, process it and sell the rice. When the loan is paid off, they may continue the operation for rice milling rather than for household use. Thus, in some cases, as a vehicle for fuelwood saving, community biogas units may be less promising though they apparently reduce diesel oil used in milling operations by 50-60%. Based on these findings, WECS recommends the priority siting of units designed to substitute for fuelwood for cooking in fuel deficit areas. WECS should continue to monitor the progress of the various projects underway to determine their future direction.

III. ENERGY DEMAND MANAGEMENT AND EFFICIENCY

Overview

3.1 There appear to be three major areas for improving energy efficiency in Nepal: (a) reduction of fuelwood use through the dissemination of improved cookstoves; (b) reduction of losses in electricity distribution; and (c) reduction of petroleum consumption in the road transport sector.

Improved Cooking Stoves

3.2 Background. The increased afforestation effort has been coupled with the distribution of improved cooking stoves (ICS) to help keep fuelwood demand at manageable levels. A number of stoves developed by the Research Center for Applied Science and Technology (RECAST) have been tested with an efficiency of about twice that of traditional stoves.

3.3 Recommendation. There should be a massive dissemination program of ICS to nearly all households in the Kathmandu Valley (about 100,000) over a period of four years in order to provide a demonstration project of sufficient critical mass to stimulate a nationwide shift to ICS.

3.4 Response. HMG would like to embark on a large-scale dissemination program to demonstrate the viability of ICS for the Kathmandu Valley and wishes to seek technical assistance to prepare logistics and a strategy to launch such a program. The mission, however, after site visits and discussions with experts, found that the current gradual approach of disseminating ICS as part of afforestation projects may be more appropriate. The existing distribution mechanism has been in place for several years and seems to be working well but there are several constraints to rapid, large-scale distribution including: (a) the availability of trained potters; (b) slow production techniques; (c) acceptability levels of different designs; (d) use of traditional stoves for heating purposes as well as for cooking; and (e) the high cost of stoves, which is beyond the means of most of the population. Therefore, the mission recommends that before seeking such assistance, HMG should first evaluate the programs of current forestry projects for the Kathmandu Valley and the development of an indigenous capability to implement a large-scale program.

3.5 Currently there are three major ongoing forestry/conservation projects with components for the dissemination of 36,650 ICS: (a) the Community Forestry Development Project (CFDP) and the Second Forestry Project (SFP), supported by the World Bank; (b) the Resource Conservation

and Utilization Project (RCUP); (c) the Rapti Integrated Rural Development Project (I.R.D.) supported by USAID; and (d) the Small Farmer Development Program supported by the ADB/N. The largest project, CFDP, under the first phase of a twenty-year forestry development program, plans to distribute 15,000 ICS (1980-81 to 1985-86). To date, the project reportedly has distributed slightly less than half the target number of stoves. According to a recent progress report, more than half of those distributed were being used on a regular basis. It was also found that the areas near Kathmandu with the largest fuelwood deficit and the best extension service recorded the highest degree of ICS use. Under the SFP, the distribution of 20,000 ICS is planned between 1983/84 and 1988/89. All other ongoing projects are on a much smaller scale with a combined target distribution of 1,650 ICS between 1980/81 and 1985/86. So far about half of the target number of stoves have been distributed.

3.6 While these distribution programs are underway, RECAST is actively involved in improving stove designs and production techniques, as well as stove distribution. So far, 6,000 RECAST-model stoves have been installed which, based on testing, are about 25% efficient compared to a 12% efficiency for traditional stoves. RECAST is now focussing on additional efforts to improve the production system, which is not yet geared for massive dissemination. According to RECAST staff, a new firing process has been developed which could significantly reduce the production time. RECAST is also looking into ways of increasing the productivity of the potters. If the production process were accelerated, more potters trained, and the productivity of the potters increased, RECAST estimates that production as high as 30,000 to 40,000 ICS eventually could be feasible on an annual basis.

Power System Losses and Tariffs

3.7 Background. The losses in the electric power system are high, about 31.5% of total generation, of which 22.5% are in the distribution system, 5% in transmission and 4% in generation. In its second power loan to Nepal, the ADB provided technical assistance for a comprehensive study of the loss situation by a power distribution engineer from British Electricity International, U.K. According to the results of this study, most of the losses in the distribution system are in the Bagmati Zone and are mainly caused by improper metering and theft of electricity.

3.8 Recommendation. Reduce losses in the distribution of electric power and move towards the economic pricing of electricity.

3.9 Response. Based on the recommendations of the above-mentioned study on loss reduction, the NEC has recruited 46 staff and purchased two vehicles and 7,200 meters. The NEC's program calls for the metering of all unmetered consumers by January 1985, the checking and sealing of meters for large industrial/commercial and all domestic consumers by 1988 and the rectification and calibration of all meters by 1990.

3.10 Under the Credit for the Marsyangdi Hydropower Project (May 1, 1984) targets for loss reduction were agreed upon and specialists will be appointed to help prepare a detailed program of specific measures to reduce losses; this program should be submitted to IDA by July 1985. The NEC also plans to strengthen and upgrade its local distribution system. In the Kathmandu Valley, improvements to the distribution system have been made with a grant of 2.1 billion yen (US\$9 million) from the Japanese Government. The strengthening of distribution systems outside the Kathmandu Valley is being addressed by the ADB's Third Power Project. Furthermore, the CIDA-financed Water and Energy Resource Development Project (WERDP) will provide a distribution planning advisor.

3.11 HMG has also made some progress in moving towards the economic pricing of electricity. Current plans are to review the tariff structure and level, leading to recommended adjustments by year end 1984. Also, an agreement was reached under the above-mentioned Credit that tariffs would be maintained at a level to produce revenues to earn a rate of return (net plant in service) of less than 5% on average for FY85, 5.4% for FY86, and 6% thereafter.

Transport Sector

3.12 Background. A large share (about half) of total petroleum consumption (108,000 toe) is used in the road transport sector. Most of this is high-speed diesel oil used to transport goods along the major trade route with India between the Terai and Kathmandu. No studies on the operating efficiency of vehicles were available to the Energy Assessment mission but in Nepal, as in many other countries, there could be substantial economic benefits from measures to conserve fuel. The report roughly estimated savings of about 10% of petroleum consumption in the transport sector through such measures as better vehicle maintenance, driver education, etc.

3.13 Recommendation. Explore the benefits and costs of energy savings in the road transport sector.

3.14 Response. HMG, with assistance from the Bank and ADB, is involved in work on road maintenance, vehicle taxation, road user charges, fuel pricing, etc. and with assistance from UNCTAD/ESCAP is exploring the feasibility of expanding electrified ropeway transport systems. This work should help to improve the efficiency of transport operations over the long term. Furthermore, as many trucks and buses used in Nepal are produced in India, current plans to design and manufacture more fuel-efficient vehicles in that country should result in some "spillover" efficiency improvements for Nepal. What is now required is an action program of feasible, cost-effective measures to improve the efficiency of the current stock of vehicles in the road transport sector and complement long-term planning, pricing, and operational measures which are part of ongoing work by the World Bank and ADB. HMG has requested ESMAP assistance to prepare an agenda of such measures (paras. 6.2 - 6.3).

IV. INSTITUTIONAL DEVELOPMENT

Water and Energy Commission

4.1 Background. The Energy Assessment indicated that although all relevant ministries were represented in the Water and Energy Commission (WEC), there had not been sufficient communication and coordination among ministries, and the WEC met infrequently. Also, the overall energy planning role of WECS has been hindered due to the perception of the WEC as the planning and policy-making arm of the Ministry of Water Resources because of its preoccupation with hydro development.

4.2 Recommendation. There should be a strengthening of WEC in its overall energy planning function, including well-defined intervention points with respect to other energy agencies, and the inclusion of an economist for renewable energy work and a forester in the Energy Planning Directorate of WEC.

4.3 Response. In November 1983, WECS formed an Energy Task Force consisting of representatives from governmental and non-governmental organizations active in Nepal's energy sector. A report on their findings was published in January 1984. The Task Force also produced reports on the forestry and power subsectors. A list of these reports is attached as Annex 1. In addition, the WECS has started interagency quarterly meetings to review, monitor, and recommend areas for action to the Commission. As for the role of the WEC in energy policy-making, no specific institutional changes have taken place, but members appear to be taking an increasingly active role and its status has been enhanced. Also, the Energy Task Force, which includes members from most of the main energy agencies, 5/ appears to function well and provide a useful forum for policy discussion and formulation. The recommendation to include two additional specialists (one for renewable energy and another for forestry) has been followed up by WECS and arrangements have been made for these specialists to begin work soon under financing from CIDA's WERDP.

5/ Water and Energy Commission, Small Hydro Development Board, Department of Mines and Geology, Nepal Oil Corporation, Fuelwood Corporation, Agricultural Development Bank, Resource Conservation and Utilization Project, Community Forestry Development Project, Research Center for Applied Science and Technology, BYS (local manufacturer of multipurpose power units), and BYSS/L (local manufacturer of solar water heating equipment).

Electric Power Sector

4.4 Background. In the electric power sector, the Assessment supported the integration of the Nepal Electricity Corporation (NEC) and the Electricity Department (ED) into a single agency - the Nepal Electricity Authority (NEA) - as well as the expansion of training facilities at the Butwal Technical Institute.

4.5 Recommendation. Proceed with plans to create NEA and consider the strengthening of SHDB through integration with this new entity.

4.6 Response. During the negotiations of the IDA-assisted Marsyangdi Hydroelectric Power Project (Appraisal Report of May 1984), it was agreed that the NEC would absorb the operations of the NEC and ED, as well as the electricity development boards; however, those boards presently executing projects would continue to do so through completion, after which future work would be implemented by the NEA. A memorandum of understanding under the ADB-financed Fourth Power Project states that the NEC will consist of four functional units: (a) generation and electrification, transmission; (b) distribution and customer service; (c) rural electrification (including isolated mini-hydro projects); and (d) planning, evaluation, and finance. A consulting firm (Coopers and Lybrand), financed by ADB, has been assisting HMG in implementing the reorganization. The first stage (institutional and organizational review) has been completed. The second stage, which is now underway, is focussed on the internal organizational structure and the design of management and accounting systems. For both stages, 56 man-months have been allocated including a team of four experts (one institutional/management specialist, two accounting/financial experts and a valuation engineer). The third stage, which also has been contracted, will consist of 22 man-months of work to implement the new system and train staff. Subsequently, under the ADB-supported Fifth Power Project, a further 36 man-months of consulting services will be made available to assist the new utility at the senior staff level. The NEA is expected to begin operation on April 30, 1985.

4.7 Furthermore, the CIDA team advising the WECS has produced a study which details a program for strengthening the NEC's technical operations. This study, which looks at expansion of the power system over the next decade, points out serious manpower problems in the technician category. HMG, with technical assistance from IDA under the Marsyangdi Project, will establish a comprehensive practical training facility for continuous programs to upgrade the skills of the power system staff. The cost of establishing the facility and the operation over three years is estimated at US\$3.6 million, of which US\$2.7 million would be in foreign exchange and financed under the Project. It includes two foreign resident specialists, two vehicles, spare parts and training equipment.

4.8 Finally, HMG plans to formulate a long-term power development program for Nepal and preliminary studies, such as the recently completed hydropower ranking survey, are underway. IDA will review these studies and exchange views with HMG.

Forestry Sector

4.9 Background. The forestry sector lacks a long-term development program to serve as a framework for the preparation of investment projects and related institutional/manpower requirements. The implementation of the current program is hampered by a lack of trained forest officers and insufficient staffing of the planning, programming and monitoring office of the Ministry of Forestry and Watershed Management. An expanded afforestation program will make those needs even more acute.

4.10 Recommendation. Prepare a 20-25 year forestry development plan, strengthen the planning, programming and monitoring office at the Ministry of Forestry and Watershed Management, and train forest officers.

4.11 Response. HMG has taken several initiatives to respond to these recommendations. There are plans to prepare a National Forestry Development Plan with assistance from IDA under the Second Forestry Project. The plan will be based on an inventory of forestry reserves and projections of demand for forest products, including fuelwood. It will assist HMG integrate numerous ongoing, foreign-assisted forestry development projects into a comprehensive development program. The Plan's preparatory work will include a review of pricing policies for fuelwood and timber as well as the development of guidelines for introducing cheaper afforestation techniques. Also, it will include the possibility of leasing forests to the private sector for farming. According to agreements made during the project's negotiation, the consultants for the Plan's preparation will be appointed no later than June 1, 1985 and the Plan will be produced no later than December 1986. Secondly, on the training side, HMG with IDA assistance under the second Forestry Project, will provide: (a) teaching facilities in Hetauda, Kathmandu, and Pokhara; and (b) the training of 109 assistant rangers and 34 forest officers (including overseas study tours). HMG, also with funding from the Project, will strengthen the Ministry of Forestry's existing Monitoring and Evaluation Unit through the addition of an experienced forest officer/economist.

V. SUMMARY OF MAJOR ONGOING TECHNICAL ASSISTANCE

Overview

5.1 Most of the ongoing technical assistance for energy in Nepal is designed to: (a) increase fuelwood supply along with promoting improved efficiency of wood use in the household sectors; (b) accelerate hydro-power resource identification and development; and (c) improve power system operations through power loss reduction programs combined with training programs to improve the skills of the power system staff. The development of biogas and micro-hydropower for rural areas is being handled mostly by the private sector through loan programs supported by multilateral donor agencies. Assistance in overall energy planning is provided by a team of resident advisors funded by CIDA. This long-term assistance began in 1978 and is expected to continue through 1986. Based on a review of the ongoing programs and technical assistance needs, the mission and HMG have agreed on areas where further technical assistance is required (para. 6.1 - 6.5).

Fuelwood Supply and Conservation

5.2 Nepal is receiving a considerable amount of technical assistance (planning, training etc.) associated with projects to increase the supply of fuelwood and improve the efficiency of its use (para. 2.7). These projects are supported by a number of multilateral agencies (ADB, FAO, IDA, UNDP and UNICEF) and bilateral aid from Australia, Canada (CIDA), Federal Republic of Germany, Switzerland, United Kingdom (ODA), and the United States (USAID). Annex 2 gives a listing of the targets for these fuelwood planting and ICS distribution projects under the Sixth Five Year Plan.

Hydropower Development

5.3 HMG is receiving assistance for studies of the Kosi Basin from Japan and will receive assistance from IDA for feasibility work in the Karnali Basin (para. 2.13). The information obtained from these studies, in addition to studies already made of the Gandaki Basin, should help identify sites for prefeasibility and feasibility work and assist HMG in the establishment of a long-term power development program. HMG is now seeking US\$5 million to US\$13 million from donor agencies for the prefeasibility and feasibility studies in the Gandaki Basin (para. 2.14).

Power System Operations

5.4 ADB and IDA are providing technical assistance to reduce losses in the power distribution system (para. 3.10). A comprehensive study financed by ADB identified the sources of losses in the system and recommended a program of actions to reduce them. Under the IDA-assisted Marsyangdi Power Project, targets for loss reduction and tariff levels have been set and funds have been allocated for the necessary technical assistance and equipment. Furthermore, HMG is receiving assistance from ADB for the reorganization of the power sector (para. 4.6) and from IDA for the establishment of a comprehensive, practical training facility to implement programs for upgrading the skills of power system staff (para. 4.7).

VI. PRIORITIES FOR FURTHER TECHNICAL ASSISTANCE

Overview

6.1 The mission found that Nepal was receiving a considerable amount of technical assistance in the energy sector, particularly in the development of fuelwood and hydropower resources and in the improvement of energy-related institutions and training programs. However, HMG and the mission agreed on two priority areas where further technical assistance is required: (a) potential short-term energy savings in the road transport sector, and (b) small hydropower development. HMG has requested assistance from ESMAP for pre-investment evaluations in both of these areas. The background objective, scope and estimated costs are summarized briefly below.

Energy Savings in Road Transport

Background and Objective

6.2 The objective of the ESMAP assistance will be to complement the work by ADB and the Bank for improving efficiency over the long-term (para. 3.14) by exploring the feasibility short-term, quick-payback measures which could yield immediate energy savings. Experience in a number of other countries suggests that certain technical, administrative, fiscal, and public education measures could result in savings on the order of 5-10% of energy consumption in the transport sector. Based on the current consumption figures for diesel oil and gasoline and the CIF prices of these fuels, annual benefits could be on the order of US\$1-2 million.

Scope of Work and Costs

6.3 HMG has requested ESMAP assistance to develop a program for promoting the efficient use of petroleum fuels by trucks and buses, i.e., driver education campaigns, improved vehicle maintenance procedures, better availability of spare parts, etc. The technical assistance would consist of a transport energy economist who would draw up a list of immediate, practical actions found to be cost-effective and prepare terms of reference for any further pre-investment evaluation required. This assistance would complement the long-term focus of transport programs involving the Bank, ADB and UNCTAD/ESCAP (para. 3.14). The consultant would coordinate his work closely with these agencies. The work program would include one man-month of field work in Nepal and one man-month of report writing. The total cost of this assistance is estimated at US\$30,000.

Small-Hydro Development

Background and Objective

6.4 The Small Hydro Development Board (SHDB) is involved in the construction of numerous mini-hydro projects, some of which are receiving funds from the Asian Development Bank (ADB), the United Nations Capital Development Fund, OPEC Fund, Austria and the Swiss Association for Technical Assistance (SATA). Others are being developed by HMG independently. The main problems with small-hydro development have been the high cost of the sites developed so far (averaging US\$5,000 per kW) and the lack of a strategy for small-hydro development as well as technical expertise in SHDB to implement it. HMG has requested assistance from ESMAP to prepare an action program and detailed terms of reference for technical assistance and training to develop such a strategy and in-house expertise.

Scope of Work and Costs

6.5 The ESMAP-financed pre-investment evaluation would review the current program of the SHDB, including the options proposed by the U.S. National Rural Electrification Cooperation Association (NRECA) (see para. 2.17). The emphasis of the work will be to design a suitable technical assistance package for donor assistance to SHDB in the following areas:

- (a) guidance on small-basin stream gauging, hydrology, and project site selection, and
- (b) training needs and institutional development.

The ESMAP evaluation will also specify the form and duration of assistance i.e., a resident advisor, demonstration projects, etc. It will then prepare detailed terms of reference, cost estimates and manpower requirements for the actual project. This evaluation will require three man-months of consultant time, including a hydrologist, a hydropower engineer, and an economist. The cost of this assistance will be about US\$50,000.

LIST OF RECENT WECS PUBLICATIONS

Title	Date
1. Energy Sector Component of Nepal Aid Group Submission	September 1983
2. Power Sector Component of the Nepal Aid Group Submission	September 1983
3. Report of the Task Force on Energy	January 1984
4. Report on Activities of Energy Sector Organizations	February 1984
5. Issues Paper on Forestry	February 1984
6. Hydropower Site Ranking Study	March 1984
7. Terms of Reference for a Study of Priority Projects in the Gandaki Basin	March 1984
8. Biogas Resources of Nepal (draft)	May 1984

ONGOING FORESTRY PROJECTS ^{a/}

Projects	Targets for Sixth Plan 1980/81 - 1985/86 (hectares)						Improved Stoves
	Donor Agency	National Forest	Panchayat Forest	Panchayat Protected	Other	Total	
Community Forestry Development and Training	FAO/UNDP/ IBRD	-	11,750	39,100	811	51,661	15,000
Urban Fuelwood Planting	ADB	-	-	-	10,000	10,000	-
Department of Forestry	HMG	3,000	0	0	1,350	4,350	-
Sagarnatha Forestry	ADB	3,700	-	-	-	3,700	-
Resource Conservation	USAID	2,130	-	751	445	3,326	350
Nepal-Australia Forestry	Australia	1,000	1,600	450	180	3,230	-
Rapti I.R.D.	USAID	590	915	690	346	2,541	200
Dept. of Soil and Watershed Conservation	HMG	1,595	-	-	-	1,595	-
Rasuwa-Nuwakot I.R.D.	IBRD	1,000	-	-	-	1,000	-
Karnali-Bheri I.R.D.	CIDA	783	-	-	-	783	-
Kosi Hill	ODA	516	110	68	-	694	-
Tinaw Watershed	Germany/ Switzerland	55	75	12	-	142	-
Small Farm Family Program	UNICEF	-	-	-	-	-	1,100
Total		14,369	14,450	41,071	13,132	83,022	16,650

^{a/} In addition, the Second Forestry Project, financed with assistance from IDA, will add a further 26,250 hectares of wood plantations, 35,000 hectares of improved natural forests, and 20,000 ICS between 1983/84 and 1988/89.

Source: WECS.

POTENTIAL HYDRO PROJECT SITES

Site	Capacity MW	Type <u>a/</u>
<u>Gandaki Basin</u>		
Kali Gandaki 1	1,600	S
Burhi Gandaki	540	S
Kali Gandaki 2	410	S
Seti Gandaki 1	340	S
Andhi Khola	110	S
Upper Trisuli (Syabru-Betrawati)	280	R
Mugling (Trisuli)	100	R
<u>Kosi Basin</u>		
Dudh Kosi 1	70	R
Dudh Kosi 2	40	R
Dudh Kosi 3	80	R
Indrawati	130	S
Danda (Sun Kosi)	260	S
Arun	120	R
Tama Kosi 1 (Khimti-Tama Div)	50	R
Kurule (Sun Kosi)	1,100	S
<u>Karnali Basin</u>		
Jubitan	100	R
Bheri-Babai Diversion	150	R
Bheri Storage	850	S
Karnali Bend (R)	260	R
Karnali Bend (S)	1,240	S
Lakarpata (R) (Karnali-Bheri)	390	R
Lakarpata (S) (Karnali-Bheri)	2,280	S
Thuli Gad	40	S
Seti Karnali	60	R
<u>Other Basins</u>		
Rita (Mahakali)	130	R
West Rapti	180	S
Jimruk	15	R
Bagmati	160	S

S = Storage

R = Run-of-River

Source: WECS.

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAM

Activities Completed

	<u>Date Completed</u>	
<u>Energy Assessment Status Report</u>		
Papua New Guinea	July, 1983	
Mauritius	October, 1983	
Sri Lanka	January, 1984	
Malawi	January, 1984	
Burundi	February, 1984	
Bangladesh	April, 1984	
Kenya	May, 1984	
Rwanda	May, 1984	
Zimbabwe	August, 1984	
Uganda	August, 1984	
Indonesia	September, 1984	
Senegal	October, 1984	
Sudan	November, 1984	
<u>Project Formulation and Justification</u>		
Panama	Power Loss Reduction Study	June, 1983
Zimbabwe	Power Loss Reduction Study	June, 1983
Sri Lanka	Power Loss Reduction Study	July, 1983
Malawi	Technical Assistance to Improve the Efficiency of Fuelwood Use in Tobacco Industry	November, 1983
Kenya	Power Loss Reduction Study	March, 1984
Sudan	Power Loss Reduction Study	June, 1984
Seychelles	Power Loss Reduction Study	August, 1984
<u>Institutional and Policy Support</u>		
Sudan	Management Assistance to the Ministry of Energy & Mining	May, 1983
Burundi	Petroleum Supply Management Study	December, 1983
Papua New Guinea	Proposals for Strengthening the Department of Minerals and Energy	October, 1984
Papua New Guinea	Power Tariff Study	October, 1984
Costa Rica	Recommended Tech. Asst. Projects	November, 1984