



Joint UNDP/World Bank Energy Sector Management Program

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January 1984

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

The Joint UNDP/World Bank Energy Sector Management Program is designed to provide a rapid and flexible response to governments who request assistance in implementing the policy, planning and institutional recommendations of the Energy Assessment Reports produced under another Joint UNDP/World Bank Program, or in carrying out prefeasibility studies for energy investments identified in these reports.

The Energy Sector Management Program can provide the following types of assistance for countries which have had assessments:

- o assistance to improve a government's ability to manage its energy sector, for example by defining staffing and work programs, evaluating management information needs, identifying sources of public and private finance, developing a medium-term investment plan;
- o prefeasibility work on priority investment plans, especially those which will improve the efficiency of energy use, bring about economic fuel substitution, or provide enough affordable energy to rural areas;
- o specific short-term assistance in institutional and manpower development, both at the sectoral and agency levels.

The Program aims to supplement, advance and strengthen the impact of bilateral or 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 jointly by the UNDP and the World Bank, important financial contributions to the Program have been made by the Governments of the United Kingdom, the Netherlands, Denmark, Finland, Norway, Sweden, Australia and New Zealand.

SRI LANKA

ENERGY ASSESSMENT STATUS REPORT

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ESTIMATED AVERAGE CURRENCY EQUIVALENTS

1US\$ =	Rs. 16.5	(1980)
	19.2	(1981)
	20.8	(1982)
	23.6	(1983)

ABBREVIATIONS AND ACRONYMS

CEB	-	Ceylon Electricity Board
CGWC	-	Colombo Gas and Water Company
CISIR	-	Ceylon Institute for Scientific and Industrial Research
CPC	-	Ceylon Petroleum Corporation
CTB	-	Ceylon Transport Board
CT	-	Energy Coordinating Team
DMAC	-	Energy Efficiency, Demand Management and Conservation Task Force
EPPAN	-	Energy Planning and Policy Analysis Task Force
GOSL	-	Government of Sri Lanka
JEDB	-	Janata Estates Development Board
MPE	-	Ministry of Power and Energy
NERD	-	National Engineering Research & Development Center
NERSE	-	New, Renewable and Rural Sources of Energy Task Force
NRESA	-	Natural Resources, Energy and Science Authority
SPC	-	State Plantations Corporation

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SRI LANKA

ENERGY ASSESSMENT STATUS REPORT 1/

I. BACKGROUND AND SUMMARY

1.1 Although Sri Lanka was able to cope relatively easily with the first round of oil price increases in 1973/74, its energy situation deteriorated dramatically by the end of the decade. The marked improvement in economic performance after 1978 brought with it a rapid increase in the demand for commercial energy. As the rate of growth of domestic energy production (hydropower) actually declined during this period, the economy's oil import requirements increased by about 60% between 1977 and 1981 and, because of the 1979 doubling of oil prices, the proportion of non-oil export earnings devoted to importing petroleum rose from 11% to 41% (Table 1). At the same time, despite the addition of expensive thermal generating capacity, the supply of electricity could not keep pace with rising demand and severe power shortages ensued in both 1980 and 1981, affecting both industrial production and the prospect of attracting additional private investment, which was an important feature of the Government's economic development strategy.

1.2 The net effect of these developments was that energy had become a major national concern by the time of the energy assessment mission to Sri Lanka in June 1981. 2/ Given the immediate energy problems facing the country, the mission's work focussed primarily on those options which could result in quick improvements in the country's energy situation. The most important of these options lay in improving the efficiency of energy use in the main consuming sectors such as industry and transport, an area which had received little attention until then. The mission's findings indicated that a concerted energy efficiency improvement program, focussing initially on the largest industrial and commercial energy users, could result in substantial oil savings (\$24 million per year by 1984/85) and improve the electricity supply/demand balance, at a relatively low investment cost. The main constraints that needed to be overcome were the absence of an effective institutional framework for carrying out this task and the need for technical support in conducting energy audits and the other preinvestment work required. The mission also recommended a number of changes to the structure and level of energy prices to complement this demand management effort.

1/ This report was prepared by a mission comprising Masood Ahmed and Huda Kraske, which visited Sri Lanka in December 1983. The report was discussed with Government of Sri Lanka (GOSL) officials in the field and the list of priority technical assistance projects, in Section V, is fully endorsed by GOSL.

2/ The final report of that mission, Sri Lanka: Issues and Options in the Energy Sector, was issued in May 1982 as part of the joint UNDP/World Bank Energy Sector Assessment Program.

1.3 On the supply side, the most important short term recommendation was to ensure the timely completion of the Victoria hydro project by mid-1984. Specific improvements in the supply of petroleum products were also recommended. For the longer term, there was a need to begin the preparatory work for introducing coal-fired power generation by 1990 and to expand the inadequate level of afforestation activities to ensure a sustainable supply of fuelwood, which remains the country's most important energy resource. In the area of renewable energy, the priority was to develop the institutional framework to coordinate, streamline, and better focus the then widely-spread program, which encompassed a variety of technologies and applications.

1.4 Finally, the report stressed the importance of strengthening the overall institutional framework for energy policy formulation and investment planning and implementation. Weaknesses in this regard had been a major cause of Sri Lanka's current energy problems and without major improvements, the institutional structure was likely to become a serious bottleneck in implementing the country's future energy development strategy.

1.5 The Government noted the main findings of the energy assessment report and subsequently acted on most of its recommendations. As discussed in detail in the following sections, the institutional structure for energy policy analysis and sector management has been greatly strengthened through the establishment of a number of issue-specific task forces in the Ministry of Power and Energy, under the overall direction of a Senior Energy Advisor to the Minister. ^{1/} In the area of demand management, both electricity and petroleum prices have been raised to reflect the cost of supply, and the relative price structure has been altered to remove a number of anomalies identified in the report.

II. MAIN SECTOR DEVELOPMENTS 1980 - 1983

2.1 The major developments in the energy sector can be summarized under the following headings:

1. Energy supply and demand
 - Petroleum
 - Electricity
 - Fuelwood and other renewables
2. Energy pricing policy
3. Institutional changes
4. Industrial conservation

^{1/} The fact that this energy portfolio is being held by the President himself, has further helped to facilitate action in this sector.

Energy Supply and Demand 1/

2.2 Primary commercial energy consumption increased from 1.684 million toe in 1980 to 2.075 million toe in 1982 (11% per year), compared to an 8.8% annual growth rate during 1977-1980. However, in 1983, preliminary estimates indicate that consumption declined by 8% to 1.918 million toe as a result of reduced hydroelectric generation (-25%) due to the severity and continuation of the drought, the mid 1983 disturbances in economic activity, and price increases in major oil products in July 1983 (Table 2).

Petroleum

2.3 The demand for petroleum products grew by 13% during 1980-82, compared to 9.5% during 1977-80. The net oil import bill also peaked in 1982 and consumed almost 50% of non-petroleum export earnings, compared to only 35% in 1980. During 1983, figures for the first three quarters suggest that consumption has fallen slightly and the cost of oil imports is expected to be about 12% lower than in the previous year, partly due to improved freight management and better prices (Table 1).

2.4 On the supply side, the detailed analysis recommended for both the single point mooring buoy and the hydrocracker projects has been carried out, with the former proceeding now to the implementation stage. The hydrocracker project has been shelved for the time being as it is not profitable. The recommendation to close down the LPG pipeline has been partly implemented, with the pipeline being reduced from 180 miles to 11 miles serving a few large users.

Electricity

2.5 Electricity generation (Table 3) increased by 11.3% annually during 1980-82, i.e. at roughly the same rate as during 1977-80, but declined to 2% during 1983. However, growth rates of hydro and thermal generation varied markedly. Hydro generation declined by about 7% per annum, from 1479 GWh in 1980 to 1206 GWh in 1983 due to drought conditions and constituted only 57% of total generation in contrast to 89% in 1980. On the other hand, thermal generation increased geometrically from 188 GWh in 1980 to 907 GWh in 1983 i.e. at almost 70% per annum. Electricity sales, estimated at about 80% of generation, increased from 1392 GWh in 1980 to about 1700 GWh in 1983 (1188.6 GWh by August 1983). Private generation has been encouraged from February 1983 and is estimated at about 6 GWh per month. Two hour power cuts are in force since November 1, 1983, but this is still an improvement over 1981 when eight hour cuts were not considered unusual.

1/ Estimates of 1983 electricity generation probably correspond to actual figures; however, estimates for petroleum imports and consumption, based on imports up to September, might deviate from actual figures for 1983 since petroleum is received in bulk shipments arriving at varying intervals.

2.6 The serious supply shortfalls of 1980 and 1981 have been considerably alleviated through the addition of 40MW of gas turbines in late 1981 and the 30MW extension of the Canyon hydro station in February 1983. However, demand is still in excess of supply and the situation may worsen again in the first half of 1984 because of the extremely poor rainfall level of 1983 which has led to an estimated 25% drop in hydro generation during this year and will have a continued impact until the next monsoon. Thus, the daily two hour power cuts in effect now will probably need to be extended in the coming months.

2.7 Of the power projects under construction, work on the Victoria project has proceeded satisfactorily and the project should be ready for commissioning in mid-1984. Initially, power from the project may need to be transmitted to the grid through a temporary 6 kilometer 132KV connection because the permanent 230KV line is unlikely to be ready in time. Also during 1984, 80MW of diesel plant will be added to the system in two phases - 40MW in April and 40MW in August. For the proposed coal-fired power station, a prefeasibility report has been prepared, and detailed feasibility work is scheduled to begin in 1984. This project should be ready for commissioning around 1990. A prefeasibility study for a power system efficiency improvement and distribution rehabilitation project has also been carried out (with UNDP/World Bank assistance) and the detailed design and preparation of the subsequent investment project is underway.

Fuelwood and Other Renewables

2.8 In the fuelwood area, an additional IDA-assisted project has come on stream with a large component of training and technical assistance, including the preparation of a Forestry Master Plan and Forestry Department strengthening. However, there is a need to ensure that the temporary supply of wood from the clearing of the Mahaweli area does not lead to a false sense of complacency regarding the seriousness of the underlying fuelwood supply problem. As to renewables, some progress has been made to strengthen the institutional implementation capability, and to reorient efforts to more immediately relevant projects, but this is still an area where substantial improvements need to be made.

Energy Pricing Policy

2.9 In the area of demand management, the main changes have been the rationalization of electricity tariffs in mid-1982 which brought their structure more in line with the costs of supply. The level of tariffs was raised further in mid 1983, through an increase in the fuel adjustment surcharge from 110% to 185% of basic tariffs. Moreover, capacity charges for electricity have been trebled with a dramatic effect in terms of consumer response through the installation of power factor correction equipment.

2.10 Petroleum prices were raised in July 1983 to reflect higher costs and the devaluation of the Rupee (Table 5). An important structural change was the virtual elimination of the general subsidy on kerosene. To protect the purchasing power of lower income households,

the value of kerosene stamps, provided to about half of the population, was also raised at the same time. This increase in the price of kerosene also permitted the CPC to increase industrial diesel prices which had not been increased for fear of substitution by cheap kerosene.

Institutional Developments

2.11 The major development in the institutional framework of the energy sector has been the setting up of the Energy Coordinating Team (ECT) in December 1982 in the Ministry of Power and Energy (MPE), under the supervision of a newly appointed Senior Energy Advisor to the Minister. The principal objective of the ECT is to coordinate work among the relevant ministries and prevent duplication of efforts. The ECT consists primarily of three coordinating task forces that cover the following areas:

- (i) Energy Planning and Policy Analysis (EPPAN), under which an integration of all energy sector activities is attempted. EPPAN is attempting to identify the overall objectives of national energy policy in order to define an energy strategy that meets these objectives within the established goals of maximizing Sri Lanka's development in the coming decades. The setting up of a comprehensive energy data base, including energy balances which feed into energy policy analysis and modelling, is already underway.
- (ii) Energy Efficiency, Demand Management and Conservation (EDMAC) includes a number of activities that are of short-term importance in the area of energy conservation, especially in industry, but also in commerce, households, transport and agriculture. EDMAC has also been instrumental in setting up a special cell in CEB to reduce system losses, and in reviewing electricity and petroleum pricing policies.
- (iii) New, Renewable and Rural Sources of Energy (NERSE) aims at coordinating activities in the renewable energy subsector, assessing the economic and technical feasibilities of some of these technologies as they apply to Sri Lanka and promoting and financing the commercialization of these technologies.

The three task forces meet on a regular basis (approximately once a month) and they include representatives of the major energy related ministries, departments and parastatal organizations. The task forces also have access to a small group of economists and technical staff who have been recruited for this purpose by the MPE.

Industrial Energy Conservation

2.12 In the industrial energy conservation area, a number of corporations have implemented the easier and low cost efficiency improvement recommendations made by the assessment mission. In parallel a major public awareness and training effort has been launched. The next step in this effort is a detailed training course in energy auditing for the plant managers of the 30 largest energy consuming corporations, planned for February-March 1984. If this momentum can be maintained, the necessary feasibility and preinvestment work for major industrial retrofitting and energy efficiency projects should be carried out during 1984 with the projects being implemented in the subsequent 2-3 years. In transport, smaller industries, and the household sector, progress has been slower but plans are underway to tackle these sectors in the coming 12-24 months.

Summary

2.13 The actions that the Government has taken have had some impact on alleviating the current energy problem but their main importance is in laying the basis for substantially larger improvements in the second half of the 1980s. In short, much of the groundwork for effective energy sector management has been done in the last two years and the country is ready to begin the operational and implementation phase of a number of programs which will improve the energy situation in the medium term. The task now is to ensure that this momentum can be maintained, particularly during a period when overall resource availability is seriously constrained. This in turn requires that both the government and external assistance agencies allocate available resources only to those projects which have high, relatively certain and, preferably, quick payoffs. Some of these activities are listed in part V of this report.

2.14 A few policy issues also remain to be resolved. These include:

- (i) Reviewing the efficiency of the existing institutional arrangements for the marketing and distribution of Liquefied Petroleum Gas (LPG) and, in particular, the respective roles of the CPC and the CGWC.
- (ii) Reviewing the arrangements for tax collection in the petroleum sector whereby CPC's retail sales price includes an element of government imposed taxes which are not accounted for separately in CPC accounts and are transferred to the exchequer in an ad-hoc manner.
- (iii) Examining the feasibility and benefits of introducing an automatic adjustment clause in retail petroleum prices to reflect movements in international prices or in the exchange rate.

III. STATUS OF ENERGY ASSESSMENT RECOMMENDATIONS

<u>Recommendation</u>	<u>Action Taken</u>
<u>Energy Planning and Institutions</u>	
(i) Longer-term energy strategy should be developed to ensure that energy requirements are met at least cost.	Overall energy planning and coordination has been strengthened with the setting up of the ECT (para. 2.10). The EPPAN task force is in the process of doing that, with the assistance of a newly established computerized data bank and models.
(ii) An energy advisory and audit service should be established to provide industry with technical information with regard to conservation.	The EDMAC task force is taking aggressive and commendable actions to implement a national conservation program, focussed initially on the industrial sector (para. 2.10).
(iii) Improve the degree of coordination between CGWC and CPC.	No action has been taken in this regard.
(iv) Strengthen the capabilities of the Forestry Department.	The 1982 Bank forestry project has a sizable institutional and training component. Moreover, the Forestry Master Plan currently under preparation will define further institutional requirements in this sector.

National Energy Conservation Program

- (i) Initiate a concerted national energy conservation program, focussing initially on the industrial and commercial sectors.

EDMAC has already initiated such a program with a series of seminars for senior managers of major energy using corporations, to be followed by actual training in energy audits early in 1984, then the undertaking of feasibility studies and actual implementation of conservation investments (para. 2.11). The total time required for the implementation of the energy efficiency improvement investments in the large industries is estimated to be about 2-3 years. During this period, a program to tackle the energy efficiency of smaller industries can also be developed. In this regard it is important to note that several of the industries visited by the assessment mission accepted the mission's recommendations passed on to them by the Government, and instituted conservation measures on their own.

- (ii) Develop a program to improve the efficiency of energy use in the transport sector, focussing initially on the larger users, such as the CTB and the railways.

A working group of EDMAC is now examining the short and long term measures that could be employed to improve the energy efficiency of the transport sector. However, work in this area has progressed slowly.

Pricing

- (i) Abolish the general subsidy on kerosene by raising the price to its economic cost of supply. To protect poorer domestic users of kerosene, raise the value of kerosene stamps accordingly.

In July 1983, kerosene prices were raised to the estimated border cost of supply. The value of kerosene stamps has also been raised to Rs. 21 per household per month, from Rs. 9.50 in 1981. As a result of this action, the Treasury will save an estimated \$2.7 million during 1984 (based on an estimated consumption of 161,000 tons of kerosene in 1983, retail prices of Rs. 5.20/liter prevailing in March 1983 compared to the current price of Rs. 6.58/liter).

- (ii) Widen the differential between light and heavy fuel oil to induce greater use of heavier products.

While the differential between different types of fuel oil has not changed much, the differential between heavy diesel oil and fuel oil has been sharply increased (from less than Rs. 1 per gallon in 1980 to Rs. 13 per gallon). This increase has been made possible partly by the increase in kerosene prices whose previously low levels were restricting the CPC's ability to alter fuel prices. CPC reports that the price changes have resulted in a shift to the use of heavier fuels.

Petroleum

- (i) Examine the viability of installing a Single Point Mooring Buoy (SPMB) system for unloading crude oil directly from large tankers, thereby lowering freight costs.
- (ii) Reexamine the viability of the proposed hydro-cracker project to modify the refinery's production pattern.
- (iii) Examine the viability of recovering additional LPG from the refinery fuel gas system for supply to the domestic market.

CPC has carried out a detailed feasibility study which confirms the profitability of this project. Implementation is planned for November 1985 to May 1986 and the expected cost of \$40 million will be financed from commercial sources and CPC's own funds.

CPC has reevaluated this project and found it to be unprofitable, particularly given the projected increase in CEB's demand for fuel oil in its diesel plants to be commissioned in 1984. The project therefore has been shelved for an indefinite period.

No detailed analysis has been made of this project but CPC feels that it would be more economical to import the additional LPG directly rather than invest in the facilities to recover it from the refinery.

- (iv) Close down the LPG/Air pipeline operated by the CGWC. The pipeline system has been reduced from 180 miles to 11 miles and now serves only a few major users whose needs cannot be met through bottled gas. Losses on the pipeline have fallen from 70% to 50% of (the reduced) throughput and, according to the CGWC, should fall further as a result of an ongoing pipeline rehabilitation program.
- (v) Do not embark on a proposed new gas pipeline project without a thorough re-examination of its technical and economic feasibility. Plans for such a project are in abeyance.
- (vi) Examine short-term options to improve the refinery's operation through changing feedstock mix, increasing bitumen production and aggressively marketing heavier fuel oil. During 1982, CPC altered the crude mix of the refinery to take advantage of relative price movements; it is monitoring relative crude prices to see if this action can be repeated. Regarding bitumen production, the refinery's output increased to 25,000 tons in 1982 but further increases are limited by the demand of the highways department. In the area of fuel oil production, a widening of the retail price differential between diesel and fuel oil has enabled CPC to market more of the heavier products.

Coal

- (i) Begin, urgently, the preparatory work required to ensure the commissioning of a coal-fired power station by 1989. A prefeasibility study was completed, with Australian assistance, in April 1983. The preparation of detailed designs and engineering specifications will be done during 1984 with ADB assistance. The plant is now expected to be commissioned around 1990. This is likely to be followed by additional coal-fired units in the 1990s.

- (ii) Study the potential for coal conversion in the industrial sector and develop an action program (encompassing institutional arrangements, infrastructure requirements, etc.) to meet this demand.

No systematic exploration of this potential has been undertaken so far, as the Government has accorded a higher priority, initially, to improving the efficiency of energy use in the industrial sector.

Electric Power

- (i) Set up a monitoring mechanism to ensure that the Victoria project can be commissioned on schedule in mid-1984.

The Mahaweli Authority established a progress monitoring unit for Victoria and Kotmale. Victoria is now reasonably certain to be commissioned by mid-1984. However, a problem has arisen regarding the completion of the 230KV transmission line to link Victoria to the grid. CEB is now working on setting up an interim 132KV connection to the project until the permanent line is completed.

- (ii) Develop a program to reduce losses in the power transmission and distribution system.

A joint UNDP/World Bank mission of February 1983 analyzed ways of improving the power loss situation and identified the further work necessary to implement a power distribution rehabilitation project. CEB is acting on these recommendations and expects to carry out the detailed preparation of such a project during 1984. A separate unit has been set up in CEB to monitor system losses and to initiate efficiency improvement activities. Losses also should be reduced through the installation of capacitors by industrial and commercial users in response to higher capacity charges and a concerted publicity campaign. The UNDP/Bank study also identified a highly profitable project to rehabilitate the Kelanitissa steam plant which is operating below design levels of efficiency and has been derated in capacity. CEB plans to carry out this rehabilitation

- work during 1985 when the availability of additional hydropower will enable the Kelanitissa plant to be removed from service.
- (iii) Develop a contingency program to minimize the disruptive effects of possible electricity shortages in 1984.
- Some preliminary criteria for allocating electricity during shortages have been developed. The Government also has decided to close down the Fertilizer Factory (a large and uneconomic energy user) during the current short supply period. Owners of captive generation plant are also being encouraged to run them continuously during periods of overall shortage; currently an estimated 6 GWh per month of private generation is being produced.
- (iv) Improve the demand forecasting capability in the power sector and link it more closely to the schedule of implementation for major energy using projects.
- CEB's load forecasting unit has been strengthened and there is also better coordination with the Ministry of Finance and Planning on the timing of major new projects.
- (v) Conduct a comprehensive survey of all potential hydropower sites.
- Such a study is planned for 1984 with German bilateral assistance.

Afforestation

- (i) Afforestation activities should be accelerated and expanded.
- Forestry activities (notably the USAID and ADB assisted projects and the various plantings under integrated rural development projects and by tea estates) have been reenforced by the Bank assisted Forestry I project (co-financed with FINNIDA). The project includes, inter alia, the preparation of a Forestry Master Plan which will define the requirements for strengthening the sector's implementation capacity. However, the current afforestation activity is still well below the level required to meet the country's long-term fuelwood requirements.

Nonconventional Renewable Energy

- (i) An effective institutional framework should be developed to guide and coordinate the efforts of the different agencies involved in the development of renewable sources, and to define a set of priorities among the various renewable energy applications.
- The NERSE task force, has assumed this role (para. 2.10). NERSE has developed a preliminary set of priorities based on economic and technical criteria among various renewable energy technologies. However, the dissemination and implementation of these priority options needs to be pursued more vigorously. This effort should be facilitated by the work of the National Consultative Committee on New and Renewable Energy Sources currently being formed as part of the UN follow-up to the Nairobi Conference Program of Action.
- (ii) A detailed survey should be carried out on the size of the market for solar water heating, including assessment of the viability of local production. Assessment of solar drying potential and delineation of a commercialization and diffusion strategy should be made.
- No action has been taken in this area.
- (iii) Assess the potential for reviving minihydro schemes on tea estates, and assess the potential of minihydro power in irrigation systems.
- The State Plantations Corporation (SPC) commissioned the Hydraulic Engineering Corporation of China to conduct feasibility studies for the rehabilitation and extension of ten minihydro sites on its estates. The reports were completed in May 1983, and the cost of such rehabilitation is estimated to be US\$1.0 million. Financing is already being provided under the Bank's Tea I Rehabilitation Project.

In addition, feasibility studies of 67 other sites on the SPC's estates are underway (financed by CIDA) and scheduled for completion by March 1984. Financing of the preparation of design drawings and specifications for the 67 schemes is still required prior to implementation. Development of minihydro rehabilitation schemes on the JEDB estates has not progressed as well. Of the estimated 36 sites on these estates, appraisal has been done for only five sites, and only one site will be financed under the Bank's Tea II project. In view of Sri Lanka's tight power situation, which will continue for some time, review, identification and (where economic) financing of these schemes should be continued as a matter of priority.

Household Energy Utilization

- (i) Efforts to accelerate improvements in design and widespread dissemination of woodstoves and charcoal stoves need to be strengthened.

The Renewables Energy Unit in CEB, along with CISIR, has developed a ceramic stove which is expected to reduce household fuelwood consumption by at least a third. Several hundred units have already been distributed and have met with social acceptance. Given their low cost (Rs. 20 or \$0.80), the stoves should also be affordable to the majority of the population. However, the Government is also prepared to subsidize them if necessary to ensure their rapid dissemination. An ambitious target for the dissemination of 10,000 stoves has been set for 1984. As to charcoal stoves, the Timber Corporation which has gone into charcoal production has developed a charcoal stove which is available on the market at a price of Rs. 20.

- (ii) Carry out a study to determine the role of alternative fuels in meeting household needs, principally fuelwood, kerosene, electricity, LPG and naphtha. NRESA has recently conducted a household fuel use survey, and is still in the process of tabulating its results. Preliminary findings show that in rural areas, fuelwood supplies only 53% of energy needs, while 29% is supplied by coconut and other crop wastes and 18% by rubber tree branches and wastes. The report's findings will be published in the next 3 - 4 months.
- (iii) Examine the possibility of using imported LPG to supply expanding cooking fuel market. No systematic examination has taken place. However, the increase of kerosene prices is likely to result in a higher demand for LPG in the household sector.

IV. ONGOING AND PLANNED TECHNICAL ASSISTANCE ACTIVITIES

UNDP/World Bank

4.1 After the energy assessment, a joint UNDP/World Bank mission carried out an efficiency audit of the electric power distribution system and of CEB's generating plant. The report of the mission, published under the Energy Sector Management Program in June 1983, identified a \$1.5 million rehabilitation project for the Kelanitissa steam plant. It also defined further work required to prepare a distribution and system rehabilitation project. This latter work is expected to be financed from funds available under the Bank's ongoing Power VII project. Technical assistance and staff training are also components of the ongoing Power VII and VIII projects. The rehabilitation work at the Kelanitissa plant is expected to be carried out in 1985 when the plant can be withdrawn from service.

4.2 The 1982 Bank assisted Forestry project (co-financed with FINNIDA) includes technical assistance funds to draw up a Forestry Master Plan, which is already underway. Total technical assistance (including the Master Plan, Forestry Training and Plantations) under the project is \$3.2 million, or one-fifth of the total cost of the project.

4.3 Feasibility studies for the rehabilitation of ten minihydro plants on SPC tea estates have been completed by Chinese consultants financed under the Bank's Tea I Rehabilitation Project. This project is also expected to provide financing for the actual rehabilitation, estimated at about \$1.0 million. Financing for reactivating one minihydro site on JEDB estates will be provided under the Bank's Second Tea Rehabilitation Project.

UNDP/FAO

4.4 The UNDP has also financed the first part of a forestry inventory survey begun by FAO in January, 1982. The ongoing survey is funded until the end of 1984 and will feed into the Master Plan mentioned under 4.2.

UNDP/UNIDO

4.5 UNIDO is likely to execute a \$375,000 technical assistance project financed under the UNDP Country IPF (1984-86) for industrial energy conservation. This project would be implemented by the Ministry of Power and Energy, and the Ministry of Industry and Scientific Affairs. It would include the provision of instrumentation, training, and consultant expertise to selected large industrial corporations. It would also help to strengthen the energy audit and advisory capability of the National Engineering, Research and Development Center.

UNEP

4.6 The United Nations Environmental Program (UNEP) is financing a \$100,000 extension of the rural energy center at Pattiyapola.

Asian Development Bank

4.7 ADB has provided about \$80,000 to help strengthen the national energy policy analysis and planning effort in the Ministry of Power and Energy. The package includes hardware and software, consultant input and training to establish a computerised energy data base, energy balance and financial analysis models. The ADB has also agreed to finance the detailed feasibility study and project preparation for the proposed coal-fired thermal power station. This work is expected to be carried out by mid-1985 at an estimated cost of \$3.6 million. Some technical assistance is also included under the ADB's ongoing forestry project.

USAID

4.8 USAID is financing the ongoing (second) phase of the Demand Management and Conservation Program (para 2.11) which comprises two seminars for senior plant engineers from thirty large corporations. The \$100 - 150,000 grant will also finance some instrumentation and the preparation of a detailed energy audit manual. USAID may also provide additional funds to carry out some of the detailed feasibility studies and project preparation work for the energy conservation projects identified through the audits in this phase. USAID is also providing some technical assistance in the fuelwood subsector through its ongoing Mahaweli and Watershed Fuelwood projects. This includes experimental village charcoal production, local and overseas training, research and extension and improvement in the China Bay technical training facilities.

Finland

4.9 Finnish bilateral assistance has been obtained to finance a \$60-70,000 study which will review and evaluate the country's peat resources and the potential for their economic development for electric power production or direct use. The work will be carried out in coordination with the CEB and the Geological Survey.

4.10 Co-financing arrangements have already been made between IDA, the GOSL and FINNIDA, under which FINNIDA has committed US\$2.44 million of grant aid to finance technical assistance for the Master Plan and plantation activities under the Forestry Project (para. 2.7).

Canada

4.11 A C\$250,000 technical assistance grant from CIDA is financing feasibility studies on reactivating 67 minihydro sites on SPC tea estates. Canadian bilateral assistance to the CPC is being considered for carrying out seismic work in offshore waters to the west of the island. About 1000 line kilometers of seismic surveys may be done early in 1984 under this grant of about C\$1.6 million. CIDA is also providing technical assistance in the forestry sector under the Lower Uva Regional Project.

Germany

4.12 German technical assistance in the amount of DM5 million is being provided to Sri Lanka's power sector to carry out a survey of all hydro sites on the island and a detailed study of 2-3 specific hydro sites. The grant will also assist in power system expansion planning and institution building.

Holland

4.13 Dutch bilateral assistance of about \$100,000 is being sought for developing and field-testing gasifier units. Dutch financing of about \$150,000 is also provided for the initial research and development phase of a wind energy testing and dissemination program. The project is being implemented by NERSE and the Water Resources Board and is primarily aimed at harnessing wind energy for water pumping. The Dutch are also collaborating with NORAD and SIDA to finance about 9,000 ha of fuelwood plantations between 1980 and 1984.

Sweden

4.14 Swedish bilateral assistance financed a study in 1983 which confirmed the potential for energy efficiency improvements in the industrial sector through a series of quick and preliminary audits of selected plants. Swedish assistance may also be provided for further work in the energy conservation area but the program has not been finalized. Also under discussion is a \$100,000 package of assistance to test and disseminate biomass gasifiers in collaboration with CISIR and Peradeniya University.

Australia

4.15 Australian bilateral funding was used to carry out a prefeasibility study of the proposed coal-fired power station. The final report was issued in April 1983 and, as indicated above, the subsequent feasibility and project preparation work identified by this report is to be carried out in 1984/85 with ADB assistance.

V. PRIORITY AREAS FOR FUTURE TECHNICAL ASSISTANCE

5.1 Despite the relatively large amount of ongoing and planned technical assistance, there are a few areas where the provision of further technical assistance is a high priority.

(a) Large Industries Conservation Program

The current USAID technical assistance program will fund an intensive energy audit training seminar in February 1984 for senior engineers of 30 or so large corporations. Thereafter, these engineers are expected to carry out preliminary audits of their own corporations and to identify energy efficiency improvement projects which require detailed feasibility studies. These feasibility studies will then be offered to various donor agencies for financing. This arrangement has an important advantage in that the individual plant engineers will be involved in the efficiency improvement program from the outset. However, this decentralized approach also makes it important to ensure that the various projects identified are evaluated in comparable and consistent ways and the terms of reference for the individual feasibility studies clearly spell out the criteria that should be used for the technical, economic and financial analysis of proposed projects. An overall work program and schedule for the feasibility studies also needs to be drawn up to obtain a clearer definition of the timing of subsequent investments. Both of these tasks will be handled by the staff of the Ministry of Power and Energy but they will need specialized short term consultant support of about 10-12 weeks. To maintain the momentum of the large industry conservation program, it is essential that this support be provided in March/April 1984 i.e., soon after the detailed audit training course is completed. The Government is now contacting various donor agencies to see if they could provide the \$40,000-50,000 required for this task. If this effort is not successful, the Government has requested ESMP funding for this high priority task. The mission supports this request.

Starting in mid-1984, a much larger volume of support will be required from various donors to carry out the detailed feasibility studies for the various industry specific efficiency improvement projects. The precise amounts required will be defined during the audit stage.

(b) Transport Sector Conservation Program

Although the Government's initial efforts have rightly focussed on large industrial users, there is considerable potential for improving the energy efficiency of the Ceylon Transport Board (buses), the railways, and private transport operators. A working group of EDMAC is currently preparing a preliminary analysis of the short and longer term measures that could be employed to improve the energy efficiency of the transport sector and strengthen the institutions involved. Once their report is completed in February 1984, external consultant support will be needed to help review the findings and to draw up a detailed implementation program. An initial input of 12-16 man weeks costing \$50,000-60,000 is estimated to be required.

(c) Rural Industry Efficiency Program

Rural industry (mainly tea drying, brick making and copra processing) accounts for a quarter of all fuelwood use and a considerable amount of oil consumption. Preliminary estimates suggest that up to a third of the energy used in these industries could be saved through improved processing techniques and operational practices. However, a more detailed analysis is required of their existing energy use patterns and of the various technologies for energy efficiency improvements. This exercise, for which detailed terms of reference are available, could be carried out in about 12 months at an estimated cost of \$150,000.

(d) Solar Water Heating - Market Survey and Preinvestment Study

Although recent increases in electricity tariffs have made the economics of solar water heating (primarily, for the commercial and hotel sector) even more profitable, progress in the wider application of this technology has been slow and sporadic. This is partly because of limited awareness and information on the cost and reliability of this technology on the part of consumers, and partly because potential suppliers do not have reliable information on the extent of the market for this product. The Government wants the private sector to take the lead in developing and disseminating this technology,

but it recognizes that it may have to play an initial role to bring about this potential quickly (e.g. through certifying various manufacturers' products or ensuring the availability of loan financing for the high, up-front cost involved). However, it is not clear what the precise role of the Government and the parastatal organizations (CEB, CISIR, etc.) ought to be. Nor is it clear just how important action in this regard is, given the uncertainty regarding the size of the market.

To resolve these issues, a comprehensive study is required which will establish the "economic" market for this technology, evaluate how this market could best be supplied (domestic production, imports, etc.), examine the constraints that appear to be holding back the realization of this potential and propose measures that would help to overcome these constraints. The study would also identify the respective roles that the public and private sectors could play in the implementation of a solar water heating development program. The study is expected to cost \$80,000-100,000 and would be completed in 8-12 months.

(e) Kelanitissa Power Plant Rehabilitation

The joint UNDP/World Bank Power Sector efficiency audit study of 1983, identified a detailed program for the rehabilitation of this plant. CEB proposes to carry out this work in 1985 when the plant can be spared from electricity production. To this end, CEB needs to engage consulting engineers now who would help draw up tender documents for the rehabilitation work, order the necessary equipment and then help in the supervision of the implementation of the project. This assistance package is expected to cost about \$250,000 and would be required over an 18-24 month period beginning in early 1984.

(f) Preparatory Work for Major Hydro Projects

In addition to the above projects which fall under the broad category of energy efficiency improvements and fuel substitution, preparatory work on power plants to come on stream in the 1990s should commence now. The ADB is already financing the preparation of detailed designs and engineering specifications on a coal-fired power station to come on stream around 1990. However, preparatory work ranging from pre-feasibility to feasibility, to engineering studies on the next hydro plants to be commissioned during the nineties ought to start now. These include development of the Upper Kotmale Basin, Broadlands and Samanalawewa. Financing should be made available to cover the next stage of the preparatory work, on a case by case basis. These activities should require a total of about \$5-10 million.

The three projects involved are:

- (i) The Upper Kotmale Basin: This covers development of the upper reaches of the basin, as construction of the main Kotmale project in the lower reaches is already underway within the context of the Mahaweli development. The Mahaweli Master Plan prepared by UNDP/FAO dealt with the Upper Kotmale Basin at a reconnaissance or pre-feasibility level of study. This study recommended six hydro stations (including the Kotmale project currently under construction). The other five developments in the Upper Basin will have a combined installed capacity of about 100-250 MW (500 GWh per year).
- (ii) Broadlands Hydro Project: Some investigations of this project have already been carried out by Hydro Technical Corporation of New York and E.C.I. of Denver in 1961. Calculations by CEB in 1981 showed that a 20 MW plant could be erected; however, cost and energy availability differ greatly depending on whether a dam or a weir is built. A dam would cost Rs. 1,245 million and produce 132 GWh per year, while the weir alternative would cost only Rs. 700 million and produce 86 GWh of energy.
- (iii) Samanalawewa Project: This project is located at the southern extremity of the central mountains. Investigations of the site began as early as 1960 by the Department of Irrigation, and in 1966 by the Engineering Consultants Inc., U.S.A. The Mahaweli Development Board, with assistance from Snowy Mountains Engineering Corporation (Australia), prepared a design in the early 1970s based on the 1966 study. The project is expected to have an installed capacity of at least 120 MW and produce 480 GWh per annum. In 1975, further investigations and designs were carried out by the USSR and the Central Engineering Consultancy Bureau of Sri Lanka, which led to discussions of implementation and financing. However, no agreement was reached on the specifications of the project, and the talks were suspended.

Statistical Annex

Table 1: The Import Bill
(US\$ million)

	1980	1981	1982	1983 <u>a/</u>
A. Petroleum Imports	493	515	574	462
B. Petroleum Re-exports <u>b/</u>	188	175	158	98
C. Net Petroleum Imports	305	340	416	364
D. Non Petroleum Exports	877	891	857	945
E. C as % of D.	35	38	49	39

a/ Preliminary, based on September 1983 actual figures. Actual figures might be different since bulk shipments are received at varying intervals.

b/ Includes petroleum re-exports, foreign bunkering and aviation.

Source: Central Bank of Ceylon and Dec. 1983 Economic Mission Estimates.

Table 2: Primary Commercial Energy Consumption
('000 toe)

	1980	1981	1982	1983 <u>a/</u>	Average Growth 1980-82	Annual Rate % 1980-83	1982-83
Petroleum Products <u>b/</u>	1,237	1,216	1,589	1,554	13	8	- 2
Hydroelectricity <u>c/</u>	447	474	486	364	4.3	- 6.6	- 25
Total	1,684	1,690	2,075	1,918	11.00	4.43	- 8

a/ Preliminary estimates.

b/ Net of exports & foreign bunkering and aviation.

c/ Converted at the rate of 12,000 Btu/kWh and 39.68 million Btu/toe.

Table 3: Growth of Electricity Generation 1980-83

	1980	1981	1982	1983 <u>1/</u>
A. <u>Generation (GWh)</u>				
Hydro	1479	1571	1608	1206
Thermal	<u>188</u>	<u>301</u>	<u>458</u>	<u>907</u> <u>2/</u>
Total	<u>1667</u>	<u>1872</u>	<u>2066</u>	<u>2113</u>
(Sales)	(1392)	(1502)	(1680)	(1700)
B. <u>Growth Rates (%)</u>				
	<u>1980-82</u>	<u>1980-83</u>	<u>1982-83</u>	
Hydro	4	-6.6	-25	
Thermal	56	69	98	
Total	11.3	8.2	2	

1/ Preliminary

2/ Gas turbines are operated on a full-time basis.

Source: CEB

Table 4: Domestic Consumption of Oil Imports
('000 tons)

	1980	1981	1982	1983 <u>a/</u>
Total Oil Imports	2,001	1,889	2,233	2,026
Less Petroleum Product Exports	- 314	- 328	- 288	- 172
Less Foreign Bunkering and Aviation	<u>- 450</u>	<u>- 345</u>	<u>- 356</u>	<u>- 300</u>
Domestic Oil Consumption	1,237	1,216	1,589	1,554

a/ The 1983 figures have been extrapolated from figures available in CPC up to September, 1983.

Source: CPC

Table 5: Price Trends of Major Petroleum Products 1980-1983
(Rs./Gallon)

Product	July 1980	July 1981	July 1982	July 1983
Petrol	40	45.5	45.5	61.40
Kerosene	15.18	17.68	17.68	29.97
Auto Diesel	21.0	27.0	27.0	36.98
Super Diesel	23.0	30.0	30.0	42.2
Heavy Diesel	20.8	25.8	25.8	35.61
Furnace Oil				
500	20.2	20.2	20.2	22.22
1000	19.5	19.5	19.5	22.0

Source: CEB