SRI LANKA

THE ENERGY AND POWER SECTOR

A PRELIMINARY REVIEW
AND
IDENTIFICATION STUDY

REPORT FROM MISSION TO SRI LANKA

CONDUCTED BY NVE ON BEHALF OF NORAD

Norway
February 2004

TABLE OF CONTENTS:

PREFACE

The electricity industry in Sri Lanka is undergoing fundamental changes. While change was certainly expected, this increased pace of change may be a surprise to many people.

The Sri Lankan electricity industry is facing significant changes as the Government discusses implementation of a new reform that will set out a new road-map for the electricity sector restructuring. The reform process envisages a liberalised power industry and the Government has invited the private sector to become involved in the electricity industry.

As a background for evaluation of further co-operation between Sri Lanka and Norway in the power sector, the team was asked to assess in general options and issues in the power sector reviewing current development and expansion plans. In responds to the request a project identification fact-finding mission has been conducted.

During the stay in Sri Lanka, the project team held discussions with the authorities in charge, made inspections of the sites in questions, and gathered available data and pertinent reports for review and study.

Itinerary of the mission is included in Appendix 1. Reports, documents and data which are referred to in this report are listed in Appendix 2. Photos from the mission will be included in Appendix 3.

The project team wishes to express their sincere thanks to the personnel of Ministry of Power & Energy, CEB, ADB, ESC, ECF and the Norwegian Embassy and others, for the kind co-operation and assistance extended to the team in conducting the fact finding mission.

Norway, February 2004

Knut Hofstad, NVE

Jan Pedersen, Agder Energi

EXECUTIVE SUMMARY

The Sri Lankan power sector is suffering at the moment. There have been serious shortages of electricity in the past 5-10 years, due to delays in completing investments in power stations and infrastructure to meet the growth in demand.

Emergency measures to increase the amount of power available, through the installation of auto-diesel plants, have reduced the shortage but have led to serious increases in electric prices to both industry and consumers.

The development strategies defined by the Ministry of Energy & Power for the power sector should be easy for the Norwegian Government to support. To comply with the principles given and to ensure that future financial support will benefit the development and increase the efficiency of the existing power sector system, we recommend concentrating future assistance to the following 4 niches where Norwegian competence and know-how can be fully utilised:

Part A: Institutional Reforms in the Power Sector
Part B: Rehabilitation and Repair of Deteriorating Hydro-Power Assets
Part C: Development of Renewable Resources
Part D: Institutional Cooperation between Government Bodies in the Power and Petroleum sector.

The situation in Sri Lanka calls for development of a "National Master Plan for the Power Sector" which will secure a sustainable development. An ADB assessment report of the Energy Sector is being prepared and it is expected that a preliminary version will be published in April 2004. The study is called "Energy Sector Master Plan." This plan should identify policies, strategies, plans and projects that should be given priority in the sector. We therefore recommend looking at the recommendation given in the Master Plan Study before the Technical Assistance Programme for Sri Lanka will be finally set.

The preparation of the Technical Assistance Programme should be divided into two phases. The principal reason for carrying out the work in two phases is to undertake a Sri Lankan/Norwegian Workshop between the two phases to allow an adequate Sri Lankan input into the Programme and to integrate findings from the Master Plan study mentioned above.

Part of the proposed co-operation strategy will probably coincide with other donors. ADB has already indicated that they will support the institutional reform process and the oil and gas exploration programme. The Norwegian Government should therefore as soon as possible investigate possibilities to direct ones efforts towards mutual project opportunities.

CHAPTER 1: BACKGROUND

1.1 General

The Norwegian Government is considering financial assistance to projects where Norwegian skills and experience can be of help to the future development of the power sector in Sri Lanka. In order to identify sustainable projects a team of Consultants was sent to Sri Lanka to review the situation in the power sector.

This report presents the results of a fact-finding mission to Sri Lanka to identify project within the power sector that would be of mutual interest to the Norwegian and the Sri Lankan Governments to implement. The energy sector is an important element in the country's development and is one out of three areas of co-operation that already has been given priority by the two Governments.

The documents from the seminar on "Investment Opportunities in Renewable Energy in Sri Lanka" have served as background papers for the work of the Mission. Special mention should be also made of the Ministry's papers on policy, legislation and restructuring of the power sector in the country. The Mission work has been carried out during the stay in Colombo where close contacts have been maintained with the various stakeholders in the power sector.

1.2 Terms of Reference

Based on a visit to Sri Lanka, including meeting with relevant personnel and institutions, the project team shall prepare a report where the following topics are dealt with:

- Status for the reform process within the Sri Lankan power sector and identification of possible Norwegian assistance to the different components of the further reform process.
- How an upgrading of the existent hydropower stations can increase the efficiency and the availability of electricity? What potential does such an upgrading constitute?
- What alternative sources of energy could be economic, technical and environmental sustainable, and what potential do the different solutions contain? The report should emphasis especially on wood fuel energy.
- In what fields could it be relevant to involve Norwegian industries and institutions?
- To identify the need for development of a Master Plan for introduction of alternative sources of energy in Sri Lanka.
- Identification of possible fields of co-operations with Asian Development Bank.

1.3 Study Approach

The Terms of Reference (TOR) for the mission was written such that the study to be made should serve as a useful input for the upcoming discussion of co-operation in the power sector that is going to take place at a political level.

The project team proposes to divide the programme work in two phases as follows:

Phase 1: A Preliminary Review and Project Identification Study
Phase 2: A Detailed Description of Terms of Reference for the Technical Assistance Programme consisting of the projects given priority by the Sri Lankan Government in accordance with the "Energy Sector Master Plan" under preparation by ADB.

An important component of the approach will be a Workshop to be carried out between Phase 1 and Phase 2. Based on the recommendation given, we recommend arranging a small action-oriented Workshop focusing on the reform process within the Sri Lankan power sector addressing various questions of interests for the different stakeholders in the sector. The purpose of the Workshop to be held in Colombo will be:

- to acquaint both sides with the issues raised in the Project Identification Study
- to discuss the issues raised in the report and to make a report of this discussions
- to give Sri Lankan participant a brief introductions to Norwegian experience and practice
- to adjust and develop a work programme for Phase 2 work

The workshop will give Norwegian experts an opportunity to analyse the situation of Sri Lanka in the light of their experience from Norway and other countries, together with their Sri Lankan counterparts. In this way it is hoped that the strategy developed by the study will be a joint Sri Lankan /Norwegian product which has benefited both from Norwegian experience and Sri Lankan reality.

Phase 2 of the work should be scheduled to fit into the preparation of the ADB financed National Master Plan Study.

CHAPTER 2: THE POWER SECTOR OF SRI LANKA

2.1 General

The peak demand in 2002 was 1421 MW and in 2003 1492 MW. The electricity requirements have been growing at an average rate of 6-7 % annually, and this trend is expected to continue in the foreseeable future. At this rate, the country needs about 150-200 MW of base load plants added to the system each year.

The increase in generating capacity has failed to keep pace with increase in demand for electricity. The repeated failure of monsoon rains led to reduced reliability of Sri Lanka's main power source - hydro. Planned power projects, both thermal (coal) and hydro (Upper Kotmale) have been subject to long delays due to legal battles, public protests and political discussions. Emergency measures to meet these shortages have reduced the extent of power cuts but at the cost of dramatically higher consumer prices. The resulting instability of the system, together with the expense of emergency power generation through short-term alternatives, has adversely affected domestic and industrial consumers.

Traditionally, power sectors were monopolies that were generally owned by the state. During the last decade this situation has changed significantly and the power sectors all over the world are being restructured and reformed in order to create competition, attract private investment and also to improve operational efficiency. Sri Lanka is no exception.

2.2 The Participants

The Sri Lankan power sector has been controlled by CEB since 1969, the only major change being the creation of the LECO in 1983 to distribute power to parts of Colombo and some coastal regions.

Until 1996, electricity demand was met by CEB (Ceylon Electricity Board) owned hydro and thermal generating plants. Since 1996, private sector has also participated in power generation. At present their contribution amount to 25 % of total existing capacity.

The Ministry of Power and Energy (MPE) is the main government agency responsible for development and implementation of policy in the electricity sector, including regulation of sector participants and activities. The MPE's institutional capacity is stretched to manage the many ongoing electricity sector initiatives and developments.

An institutional strengthening is therefore required, together with the establishment of the Public Utility Commission (PUC). The establishment of PUC is the responsibility of the Ministry of Economical Reforms, Science and Technology. The basic goal of the sector according to the new Reform Act is to meet the demand for electricity at all

times at least economic, social and environmental cost and thereby promote economic development and social well being.

At present Ceylon Electricity Board (CEB), as the national electricity supplier and as operator of the national transmission system plays a dominant role in the sector. Around 80 % of the Sri Lankan consumers are supplied by CEB. The remaining 20 % is supplied by Lanka Electricity Company (LECO).

The Energy Supply Committee (ESC) was established in March 2002 by an Act of Parliament with the objective of ensuring adequate supplies of electricity, petroleum and other energy requirements and also to regulate the activities of power and petroleum sector. The Committee has been involved in the following Projects:

- Power Sector Reforms
- Petroleum Sector Reforms
- Electricity Tariff Study
- Coal Power Development Project
- Transmission and Distribution Loss Reduction of CEB Networks
- Mini Hydro Development
- Generation, Transmission and Distribution of Electricity for Areas not covered by the National Grid
- Development of Sri Lanka Renewable Energy Framework
- National Energy Plan

The Committee was entrusted with a two year mandate that terminates in March 2004. It is expected that their work will be transferred to PUC.

The Energy Conservation Fund (ECF) is a statutory body within the Ministry of Power & Energy established under the Energy Conservation Fund Act of 1985. The broad objective of the Fund are promoting and initiating activities and projects related to improvement of energy demand management and conservation, energy policy research and the use of renewable resources of energy.

The activities carried out by the ECF during the year 2003 are described below.

1. Training and Awareness Programmes
2. National Energy Balance, Data Collection
3. Energy Audits
4. Wind Energy Development

2.3 Prices and Tariffs

The country continues to be heavily dependent on hydropower and emergency thermal power, which comes at a high price. Electricity prices in Sri Lanka are now among the highest in Asia. According to the latest information published by local authorities, the average cost of power per kWh in Sri Lanka is 7.5 US cents. This will have to be compared with 5.8 US cents in Malaysia, and 6.9 US cents in Bangladesh. Apart from the high cost, the Central Bank of Sri Lanka also has stated that "*the risk of the availability of an adequate and reliable power supply has become*

one of the major concerns that stands in the way of building investors confidence in Sri Lanka."

2.4 Quality of Supply

Sri Lanka's reliance on hydro-power creates difficulties during periods of drought, as it did during much of 2001 and the first half of 2002. Power outages are common and CEB would have to ration supplies during periods of drought.

Outages are likely to continue for the foreseeable future as supply will remain vulnerable to the vagaries of the weather. The companies requiring very reliable power supplies have therefore been forced to invest in standby generators which normally run on diesel.

As part of the new Electricity Reform Act approved in 2002, the ESC was established to explore solutions to avoid a repeat of the power shortage that crippled the country in 2002.

A positive development for the expansion of generating capacity was the finalisation of financing for two private (auto diesel) power plants, which will have a combined capacity of 200 MW. The two plants will operate on a BOO-basis and therefore the owners will be private power investors (IPPs). One of the plants is a 100 MW facility located in Embilipitiya in the South. The other is a 100 MW plant to be built in Puttalam in the east. The two plants are scheduled to be completed by 2005.

2.5 The Off-Grid Systems

One success story of the Sri Lankan power sector in recent years has been the use of small scale generation sources to bring power to communities that cannot economically be connected to the network. These systems not only bring major welfare benefits to the communities they serve. They are also environmentally sound and represent resources that the community can control.

Chapter 3: An International Review of Institutional Reform in the Electricity Sector

3.1 General

An electricity supply industry consists of four different elements. Firstly, there is the generation of electricity. Secondly, there is the transmission of power over high voltage networks that interconnect power stations and load centres. It is customary for the operators of the transmission system to co-ordinate supply and demand i. e. dispatch plant, and ensures that auxiliary services (e.g. spinning reserve) are available. However, it is possible for these functions to be separated from grid ownership. Thirdly, there is the distribution of power over low voltage distribution and reticulation networks, i.e. the connection of individual end- users to the electricity grid. Lastly, there is the retailing of power to end-users. This is a commercial function that involves energy trading as well as customer interaction.

Power sector reforms are being implemented in developing and industrialised countries alike. While the details of reforms are varied as the countries in which they are implemented, it is possible to identify four distinct, yet related, classes of reforms. These are changes to:

- The operation of the market, i.e. the introduction of competition.
- The structure of the industry, i. e. the extent of vertical and horizontal integration.
- Utility ownership and the role of the private sector; and
- The regulatory system.

Radical changes, such as those implemented in UK and Norway, attempt to effect simultaneous changes in all of these categories. Other countries have deliberately implemented a phase reform process, for example in Chile where a new regulatory and power pool system was put in place years before any privatisation occurred. In general when one looks at different countries the new system has continued to evolve as utilities adopt new strategies and regulators respond to perceive shortcomings in the system.

In many countries reforms have addressed very specific issues, such as the introduction of independent power producers (IPPs), or the improvement of utility performance (very similar to Sri Lanka), and have not attempted a complete overhaul of the power sector. Nevertheless, even in these countries, it is speculated that reforms will eventually lead to more fundamental and far reaching changes.

In order to understand the diversity found in the international experience, it is important to examine the rationale for reform, and to consider how this has varied across countries. Not only does such analysis provide insight into the countries' reform processes, but is essential in order to understand the implication which their experiences might hold for Sri Lanka.

3.2 Drivers for Change

There are a number of different drivers for change. Firstly, there is the belief that these changes can result in efficiency gains. Competitive markets and private ownership have the potential to deliver cost savings, and efficient markets and effective regulation can translate these into price reduction for end users.

Secondly, financing arrangement has also added new pressures on the industry. Fiscal constraints mean that governments are no longer prepared to carry the cost of loss-making utilities. They are also unable to finance the development of the power sector. Both constraints have encouraged a focus on private sector participation.

Thirdly, technological developments have also provided a stimulus to reform. Not only do more sophisticated systems of electronic metering and control enable more complex institutional arrangements to work, but the development of new technologies in particular combined–cycle thermal plants, appeal to private sector investors. Lastly, environmental pressures are also helping shape the nature of reforms. Special arrangements to encourage renewables and energy efficiency are being factored into reform plans.

3.3 Structural Changes

The introduction of competitive markets is being accompanied by changes to the organisational structure of the power sector. For wholesale competition to work, it is important that the generation sub-sector be broken into competing firms. A feature of many countries' power sectors is the development of independent power producers. These new companies are usually private owned.

The other type of structural reform is the vertical separation of generation, transmission and distribution. For wholesale competition to work, it is essential that there be non-discriminatory access to the transmission system. This is most easily done if transmission is independent. Similarly, distribution companies are separated from generation so that these companies cannot use their access to end- users in order to benefit their generators.

3.4 Private Sector Participation

The encouragement of independent power producers (IPPs) is a common form of private sector participation. These independent companies, often foreign firms, bid for the right to construct and operate new capacity. The willingness to invest is usually dependent on the signing of long-term power purchase agreements in order to provide the security required for such a large-scale investment. However, in countries where wholesale market exists, there is evidence that these markets can provide sufficient incentives to attract independents without the security of long term contracts.

Another form of private sector participation is the use of management contracts, where ownership of utility assets remains with the state, but management of the

assets is transferred to a private company. This is a model that is very suitable for distribution companies.

3.5 Regulation

It is increasingly recognised that the power sector requires effective and independent regulation. Power sector reforms introduce new regulatory responsibilities to be undertaken especially where private participants have market power. A common feature has been the establishment of new regulatory authorities with powers and independence defined by legislation.

In Sri Lanka electricity regulators are combined with gas regulatory authorities and other infrastructure regulatory authorities. This makes sense both as response to integration across power and gas markets, as well as the development and sharing of regulatory capacity.

One of the principal responsibilities of regulators is price control and oversight. In some cases, competition is seen as an alternative to price regulation. However, it is increasingly clear that even competitive markets require a high degree of oversight, especially while competition is still in its formative stage like in Sri Lanka.

In the past it has not been deemed necessary to regulate the prices of public utilities since these utilities are required to pursue the public interest. Even public utilities are now being subject to more formalised price control system. Price control mechanism include rate of return price caps, where price are set so that utilities earns a target return on assets. Different systems exist in different countries.

The principle of uniform pricing should be abandoned and a pricing system based on costs should be adopted. In case of several independent distribution utilities, the price may be different from one utility to another, but be the same to all customers of the same group for each particular distribution utility.

Other regulatory responsibilities include the establishment of monitoring of safety and performance standards, the issuing of licences and concessions, and regulation of third-party access. This last responsibility is first required when wholesale or retail competition necessitates non-discriminatory access to transmission and distribution grid.

3.6 Institutional Market Models

The power markets operating in different parts of the world can broadly be classified into four basic generic structures:

1. Monopoly model
2. Single Buyer model
3. Third party or open-access model
4. Power pool (wholesale or spot market) model

The monopoly model offers no scope for competition. Hence, the choice centres on the other three models. Each of these generic models may have variations within

itself in respect of the agency responsible for management of the market and its governance and regulations.

The reform Act introduces the Single Buyer model for Sri Lanka. In a Single-Buyer model, a single entity purchases power from all generators on a competitive basis and in turn sells it the supply entities. The model has the following advantages:

- It is simple and has low transaction costs.
- It facilitates design of equitable bulk supply tariff.

The disadvantages associated with this model are:

- Competition is limited.
- The buyer may not have the incentive to seek out the most economical source of supply.

3.7 Impacts of Reforms

The development of effective competition in a new market has not always proved easy, with the dominant market power of a few players being a persistent problem. Addressing these problems has tended to require regulatory intervention. While a high degree of new investments has been experienced in a number of countries this has largely been dependent on the establishment of long-term PPAs, which in themselves reduce the scope for true competition in power pools. It is also important to note that reforms have changed the direction of investment, generally towards less capital-intensive generation options, in particular gas-fired plant.

Stranded costs and benefits are important issues that arise from institutional reform. Stranded costs occur when expensive plant is unable to compete in new markets, but owners feel that investment was undertaken with regulatory approval. This could be the case for CEB in Sri Lanka. It could be difficult to transfer the debt from old utility to the new generation-company without compensating adequately. Mechanisms to address this have involved the accelerated depreciation of these plants through the application of a levy to electricity sales.

Stranded benefits arise when utilities under the new arrangements are unwilling to provide non-commercial services which used to be provided free of costs. Examples include investments in electrification (especially rural electrification), renewable sources and energy efficiency. Strategies to support such activities have included the imposition of responsibilities on participants (by the regulator), and dedicated levies to support these programmes.

3.8 Implications for Sri Lanka

It is highly unlikely that a wholesale market can be established in Sri Lanka due to the small size of the domestic power market. Future generation options within Sri Lanka suggest that the development of IPPs is likely, and this will change the structure of the generation component of the industry.

The restructuring of the distribution sector is of major concern for Sri Lanka. The creation of regional distributors with geographically defined service areas is one of the options used internationally. Such a development will challenge the implementation of rural electrification programmes. The funds have to be provided by the government and transfer of the responsibility for the rural electrification programmes to a separate new agency could be an option.

The extent and type of regulation required will depend on market structure, industry structure and the extent of private participation. Even with the status quo, Government has recognised the need to improve regulatory capacity to provide effective, yet arm's length, oversight of the industry. This includes the issuing of licences and control over prices at both the wholesale and retail market.

CHAPTER 4: RESTRUCTURING OF THE ENERGY SECTOR OF SRI LANKA

4.1 General

Historians may view the last 10 years as the decade of the greatest changes in power industry world wide since its beginning. The organisation of the power sector in many countries has traditionally been the result of a development started after the Second World War and based on a "social contract". To allow power utilities to fulfil their mission in a situation where high demand was combined with insufficient quality of services, various countries adopted a system of exclusive rights whereby power industries operated without commercial risks in a monopoly situation.

In exchange for this protection the power utilities committed themselves to making huge necessary investments and to fulfilling all the obligations of a public service that the political power imposed on them. Profit was not considered a primary objective. In these stable conditions, the power industry has developed in an optimal way.

Recent developments in the power industry are framed in the general tendency world wide of deregulation. The Government has therefore developed a new policy document on which the power sector is being restructured and reformed.

4.2 Government Energy Policy

The Government has been actively pursuing the primary objectives of accelerated economic growth and fair distribution of benefits of such growth.

In the context of the national policy framework, the new policy package for the power sector aims to lower prices to the consumer and ensure a high level of service and supply reliability and to sustain an adequate level of investments in the power sector at all times, by harnessing the private sector investment particularly into the power generation sector.

The basic goal of the sector according to the new Reform Act is to meet the demand for electricity at all times at least economic, social and environmental cost and thereby promote economic development and social well being.

The Ministry of Power & Energy has set the following vision for the sector:

"Sri Lanka will have an efficient and dynamic energy sector, which would facilitate economic development and adopt international best practice."

The vision will be supported by the following mission developed for MP&E::

"Mission of the Ministry of Power & Energy is to meet the demand for energy services with affordable, reliable, diverse, safe and environmentally acceptable choices for the people of Sri Lanka. Such services are to be provided in the most economically and

socially efficient manner, thereby promoting sustainable economic development and social well-being of the country."

4.3 The proposed Energy Act and Regulation

The objective of restructuring of the electricity sector was initially conceptualised by PriceWaterhouseCoopers (PWC) in a report released in 1996. The Electricity Reform Act was approved by the Parliament in August 2002.

Regulation of the sector operations is important in view of the inherent natural monopolistic nature of transmission and distribution and also because of the critical role electrical power plays in the economic activities. The Government has initiated a transparent regulatory framework under the provisions of the New Electricity Reform Act of 2002.

The Single Buyer Model is already established in several countries. The design of the model, however, varies from country to country. The primary objective of reforms of the power sector in developing countries is often ensuring that sufficient investment capital is made available to meet growing demand.

The Single Buyer Model proposed for Sri Lanka keeps the generation and distribution separate at a corporate level. This will result in a model where all generation in the future will be taken care of by IPPs. These IPPs are only economically feasible if they are given long-term Power Purchase Agreements (PPAs), which provide guaranteed income (very often in international currency). International experience shows that unless foreign IPPs represent only a minor element of the system, they represent a big risk to consumers, especially if the local currency declines in value or demand falls.

A particular problem that developing countries face is extension of the grid to unserved consumers (rural electrification). In Sri Lanka, only 60 % of the population are served by grid electricity, whereas it is estimated that about 80 % could reasonable be served by grid extension.

The Sri Lankan Government needs to think carefully to ensure that mechanisms are in place in the new structure for:

1. grid extension to be continued at an appropriate rate and without excessive cost to the public
2. sufficient capital to be made available for investments in new capacity to meet growing demand.

The legal status of small isolated systems needs to be clarified in Sri Lanka. The two nationally owned companies that distribute electricity in Sri Lanka, the CEB and LECO have exclusive rights to supply electricity in their franchise regions, so it would appear that the position of the existing schemes is unclear because they are not owned by CEB or LECO.

The Sri Lankan Government, however, has strongly supported these schemes, which are helping it to achieve its policy goals on electrification. The Government should

therefore see to that these off-grid systems should be exempted from the exclusive rights to supply energy.

The Public Utilities Commission (PUC) of Sri Lanka will accordingly act as the economic, technical, and safety regulator for the electricity industry in Sri Lanka.

4.4 The New Structure of the Power Sector

The power sector will be restructured to benefit the consumers. Private sector participation will be encouraged. The roles of the Government as owner, regulator and operator will be clearly defined and separated. Sector entities will be allowed to operate as independent autonomous bodies.

Wholesale power would be bought by a "Single Buyer" with no effective market and consumers would not be offered choice. There would be little scope of competition in the model. New generating capacity would be built by new investors, Independent Power Producer (IPPs). Distribution companies would not be allowed to generate electricity.

The Act envisages unbundling of the two utilities CEB and LECO which are the main players in the electricity supply of the country. Under the reform process the two utilities will be merged and unbundled into a generation company, a transmission company and 5 distribution companies.

It is estimated that for about 20 % of Sri Lanka households, it will not be economic to bring them grid supplied electricity. However, Sri Lanka is rich in renewable resources, such as small-scale hydro, solar, biomass and wind, which could be used to provide power to these isolated areas. These can be community-run systems that offer limited, but reliable supplies of electricity at prices not affected by world fuel market conditions. They generally use technology that can be produced and maintained locally.

A recent survey carried out by the Energy Conservation Fund operating under the Ministry of Power and Energy in Sri Lanka reveals that there are 161 micro hydro units in operation in good condition providing basic electricity requirements of approximately 4000 households. The total capacity is 1,622 kW.

CHAPTER 5: EXISTING POWER SYSTEM AND EXPANSION PLANS

5.1 Generation

The major forms of primary energy used in Sri Lanka during the year 2000 were biomass (52.9 %), hydro power (8.3 %) and petroleum oil (38.8 %). The import share was 41 %, mainly petroleum products.

The annual final energy consumption in Sri Lanka is 352 PJ (during the year 2000) of which 58.2 % is biomass, 36.5 % Petroleum and 5.3 % electricity. Per capita the consumption is 19 GJ compare to 203 GJ per capita in Norway.

The generation of electricity is 6.7 TWh (2000) of which 47.8 % is hydro electricity and 52.1 % comes from thermal energy. The electricity produced per capita is 370 kWh compared to 5 - 6 000 kWh per capita in a typical European country (Norway is quite untypical here)).

The contribution by hydropower to the electric generation has dwindled from 94 % in 1995 to less than 50 % in 2003. Since the remaining potential is estimated at only 200 MW the contribution by hydro power in the future is expected to drop further (to 26 % in 2015).

5.2 Transmission

Several programmes of development of the transmission grid and the grid substations have been planned and finalized. In this context funding has been obtained among others from Japan and ADB.

A cable connection to India has been considered, but so far no consensus has been achieved with India. There are apparently several political and technical problems related to this issue.

5.3 Distribution

The electricity distribution in Sri Lanka is carried out by CEB and LECO (Lanka Electricity Company Ltd.). In 2003 62 % of the people had obtained a grid connection to their homes. It is expected that by the end of the year further two hundred thousand new households would obtain connections. Further plans of rural electrifications exist.

The total distribution losses have been reduced to 13.6 % in the year 2000 [4]. Some uncertainty is related to the figure since several customers are without meter and their consumptions thereby are to be estimated. Some thefts of electricity are also reported. A brief examination of the low voltage grid revealed a bad physical condition with slanting poles and power lines hanging in a way that impossible could be in accordance with security regulations. Apparently there is a need to reconstruct a great deal of the low voltage grid.

5.4 Power Balance

The installed capacity in 2002 was 2231 MW shared on 1172 MW hydro and 1056 MW thermal.

The electricity produced is in large extent depending on annual precipitation. To improve the base load situation a coal power plant has been under consideration for many years, but so far no coal power plant has been commissioned due to resistance from local and environmental groups. As a consequence in 10 out of the last 20 year power cuts has been a matter of necessity [9].

To improve the situation and strengthen the power balance, several minor less efficient thermal power plants have been brought into operation. The thermal generating system is then characterized with its high share of using diesel fuel. 60 % of the fuel used for thermal generation is diesel. Using diesel fuel as part of the base load generating is very expensive, 3 - 8 RS/kWh (3.5 – 9 US cent/kWh) in fuel cost, and cause an unnecessary heavy economical burden to the country. This is obvious one of the main problems of the energy system in Sri Lanka. (In a combined cycle gas turbine the fuel cost is 2 US cent/kWh with a gas price at 14 US cent/Sm3).

5.5 Power Demand Forecasts

Due to the low consumption of electricity per capita in Sri Lanka there is a large potential for increased demand for electricity. During the last 10 years the average growth rate was about 6-7 % per annum. CEB has carried out an analysis of the future demand for the electricity and in accordance with the medium forecast the future growth rate continue to be about 7 % until 2022 which is comparable with the growth that took place in Norway during the 1950s, 1960s and 1970s. The estimated growth rate is thereby realistic if the growth is in parallel with a high economic growth. Fig. 1 shows the expected development of electricity production.

A lasting growth rate of 7 % is ambitious and implies a doubling of generating capacity every 10 years. That means additional capacity of at least 1500 MW/8 TWh within 2014.

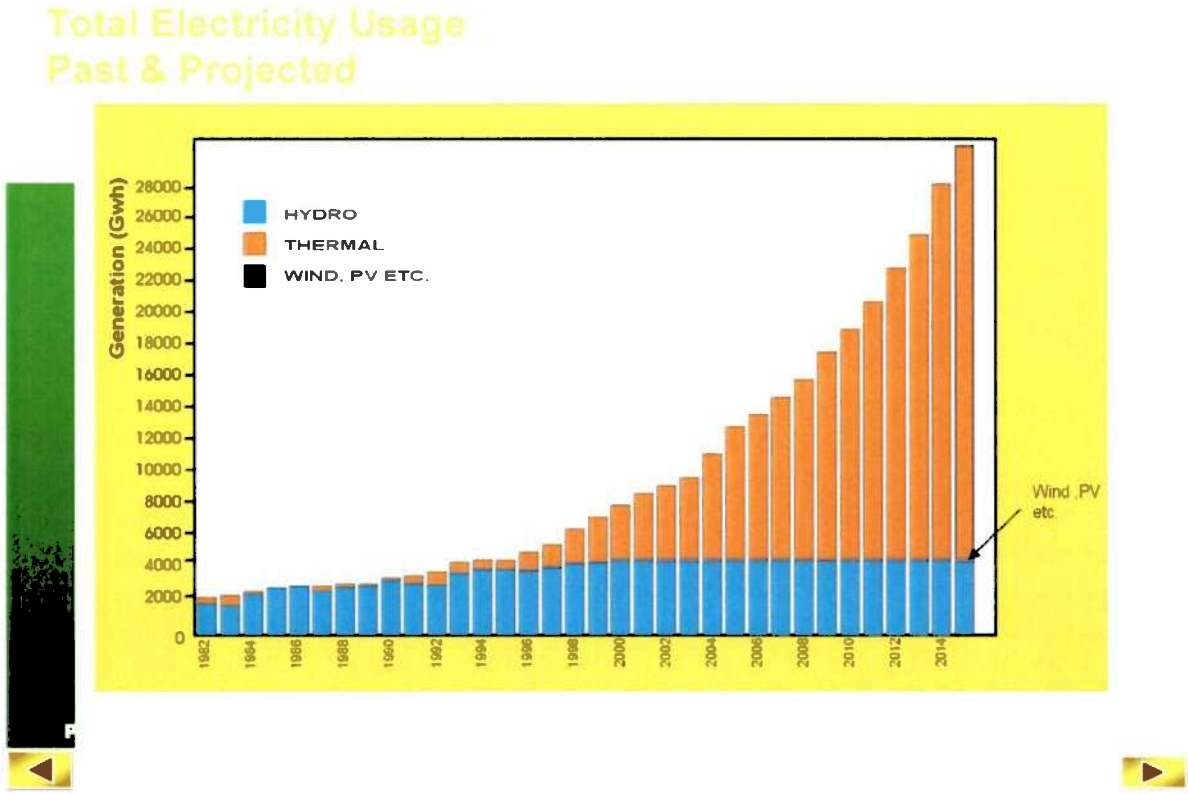


Figure 1. Total Electricity Usage. Past & Projected

5.6 Rural Electrification

The major electrification programmes undertaken by CEB (Ceylon Electricity Board) has resulted in the proportion of grid connected households in the country to increase from about 7 % in 1976 to around 62 % in 2003. However, most of the rural population still has no access to grid electricity. There are approximately 1.8 million households in the rural areas to be electrified as it stands today [2]. The Ministry of Power and Energy has considered the problem of rural electrification and concluded that due to technical and financial limitations only about 80 % of the households in the country can be finally connected to the main grid. The remaining 20 % of the country's households will then need to be electrified through off grid systems.

The Sri Lanka Government seeks to promote and support further rural electrification in order to expand access to 75 % of Sri Lanka's population by 2007 in the most economical efficient manner, including connection to the main grid and, where this is not feasible, off-grid services at the village or household scale. To achieve these objectives, the Government will establish the necessary legal, regulatory, financial, and institutional mechanisms. A rural electrification policy document has been made out [2].

5.7 Power Sector Master Plan

The Ministry of Power & Energy has requested ADB technical assistance to prepare an energy sector master plan. The proposed energy sector master plan will cover the power, petroleum, oil and gas exploration, liquid petroleum gas, and renewable resources.

Sri Lanka needs to develop for the energy sector a medium- to long term planning framework. Such a plan is needed for Sri Lanka to achieve an efficient and financially sustainable power sector through the introduction of market-based incentive structures. The energy sector master plan should be updated by PUC through an interactive approach with energy sector stakeholders.

The master plan study is to be completed in April 2004.

Chapter 6: RENEWABLE RESOURCES

6.1 General

Sri Lanka has no proven reserves of fossil energy like oil, natural gas or coal. Importing these products constitute a heavy economical burden to the country and weaken the balance of trade. However, the country is supplied with plenty of renewable resources which they in a much larger extent plan to harness.

6.2 Biomass

The major form of primary energy used in Sri Lanka is biomass. Estimates suggest that biomass use accounts for about 55 % of total energy consumption and 49 % come from wood fuels. Biomass fuels are consumed mostly by households, but also by industry. Most of the wood is used as firewood for cooking. The stove is often primitive, the efficiency is low and the pollution level is high causing an unhealthy environment in the kitchen where the stoves often are installed. Introducing improved wood stoves or gasifier stoves are proposed to better the situation.

Biomass is evidently the most promising of the renewable energy resources in the country. According to several independent studies an energy plantation would produce 15-20 tonnes (dry) wood per hectare per year (in more suitable places even more). The total extent of land suitable for energy plantation in Sri Lanka is estimated at 1.6 million hectares. Converted to energy this figure represents 370 PJ/year or 103 TWh_{heat}/year. If the biomass is used for electricity production the outcome would be 20-40 TWh_{el}, depending of the efficiency of the power station (20-40 %). This is nearly 4 times the total hydro power potential in the country.

To produce electricity from wood fuel, two optional technologies has been focused. In one option, wood fuel is combusted in a boiler to raise steam at high temperature and pressure (similar to traditional oil or coal fired systems). A second method of converting wood into electricity is through a gasification process. The gas is then used as fuel to drive an internal combustion engine. Two prototype plants are established to demonstrate the optional techniques.

Garbage is usually regarded as biomass. Schemes for regaining the energy of the large quantity of garbage have apparently not been brought into focus in Sri Lanka.

6.3 Wind

A complete wind/solar atlas have been made out with assistance from USAID. A thorough discussion of the future role of the wind power in Sri Lanka must be based on knowledge of the wind conditions in the country, but so far we have not received any copy of the present wind atlas. Generally there is an all around view that close to the equator usually the wind currents are not very strong.

A pilot wind power plant of capacity 3 MW has been in operation since 1999. So far the overall plant factor is 14.3 % (full load hours 1252). According to a feasibility study the annual plant factor for the plant is expected to be around 17 % (full load hours 1489) when the problems of initial phase are solved. This is still really bad and was explained by the fact that the power plant was not located to a place with the best wind conditions, due to environmental reasons. Available transmission capacity of the grid was also a limiting factor.

6.4 Solar

Electricity generated directly from solar energy is still too costly for grid connection. However, solar electricity is a viable option by itself, or as a component of hybrid systems for off-grid power systems in far remote areas (see paragraph 6.6).

6.5 Waves

The Open University of Sri Lanka has in cooperation with NARA examined the prospect of Ocean Waves as an electricity generation option for Sri Lanka. The south-eastern seas are identified as having ideal conditions for energy extraction from ocean waves. The working group involved is looking for international cooperation to develop a prototype station.

6.6 Off grid systems for isolated areas

The off-grid electricity supply options now available and widely practised in Sri Lanka are solar home systems and village hydro schemes, mainly in the southern areas of the country. A few households are also supplied with off-grid wind turbine systems. In addition to these technologies, biomass based electrification systems also have a significant potential as an off-grid option, particularly in the areas where either agricultural wastes are available or where dedicated energy plantations can be established [2].

1.8 million houses in Sri Lanka have no electricity. To address this problem the Government has launched a program termed "Renewable Energy for Rural Economic Development" (RERED) which provides financial assistance to consumers who wish to purchase solar home systems (SHS), thus help the population to overcome the problem of high capital cost. The advantage of such systems is that they require minimal servicing. In Sri Lanka the solar industry started as far back as 1986.To day more than 40 000 systems are installed in the country. In fact on a per capita basis, Sri Lanka is the global solar power leader, according to a recent World Bank mission [8].

CHAPTER 7: INVESTMENT OPTIONS IN THE POWER SECTOR

7.1 Sri Lankan Generation Option

7.1.1 Base Load

Hydro power is the main indigenous sources of power available in Sri Lanka for the generation of electricity. Its availability is dependent on rainfall patterns and has varied widely over the years. In 1990, 99.8 % of the countries requirement of electricity was generated from hydro and in 2002 the percentage of hydro generated was only 38.8 %. In 2003 the hydro contribution will increase to about 45 % of the total.

In order to meet the increase in the demand for electricity the CEB undertakes a regular planning cycle for optimizing the investments in the network, reducing the operating cost and minimizing the tariff. The CEB prepares annually, the generation forecast for coming 20 years, taking into consideration the envisaged development in the economy by the Government, the expansion of the distribution system by rural electrification programme. This process results in a least cost long term generation plan, a long term transmission development plan, and distribution plan which fit into a system as a whole. Out of this planning process, several projects to increase the generation capacity have been planned.

To day the base load supply of Sri Lanka is indeed very costly. New generation capacity should be considered, not only for meeting the increased demand in the future, but also for replacing the extensive use of diesel based power production which probably is the most expensive thermal power option.

In the short run all large scale thermal generation would continue to depend on import of fossil fuel. CEB has considered several options and a coal-steam power plant seems to be most attractive from an economical point of view. The Government has given due consideration for the establishment of 3x300 MW coal fired power plant on the eastern or southern coast of Sri Lanka. The plant needs to be in operation by 2008/2009 according to the current forecast of demand growth. Political discussion has postponed the implementation of the project. The Government of Sri Lanka has received a grant of US$ 560.000 from the Government of USA to fund the cost of services required for technical assistance in relation to the implementation of the first of the 300 MW units.

In this connection it should be noted that a steam power plant can be constructed as a multi fuelled plant enabling the plant to partly operate as a dendro thermal plant. Maintaining a regular supply of biomass to fuel a power plant implies complicated logistics and is assumed to be a major problem. In this case a thermal power plant would be less vulnerable for unreliable fuel supply if it can be combined with imported coal. This solution can be an attractive option to increase the use of indigenous source of energy and should be considered.

LNG as fuel for Combined Cycle plants has not been considered with reference to studies that have stated that LNG is not a feasible option due to the low potential demand and the resulting high cost. This conclusion is not in line with feasibility studies done by NVE concerning the possibilities of small scale LNG distribution along the Norwegian coast. An installation for storage and handling LNG should in our opinion be examined more carefully, taking into consideration that such installation could provide fuel for both new and existing plants and some industries as well.

7.1.2 Hydro developments

The development of Upper Kotmale hydro power plant of capacity 150 MW is underway. JBIC is expected to fund this project. The implementation is delayed due to political discussions.

7.1.3 Solar, wind and waves generation

A. Solar

Grid connected photovoltaic systems is not an economical option for many years. There is still a large potential for establishing off-grid solar home system in rural areas. It is assumed that a large majority of rural households are low-intensive consumers, using less than 50 kWh per month, mainly for lighting purposes. However, as the level of prosperity increases also in the rural areas, the future solar home system must be design to meet larger demand. In the future still 20 % of the households are expected to be not connected to the grid. This will probably only be acceptable if the solar home systems are improved to meet a more demanding people.

B. Waves

The technology for harnessing wave energy is so far not commercialized. However the research activities going on in Sri Lanka can be relevant for Norwegian research organisations, e.g. NTNU. Collaboration between organisations in Norway and Sri Lanka could be to the advantage of both (see paragraph 6.5).

C. Wind

Wind energy is free; however, to establish a wind power plant to harness the wind energy, high capital costs are required. Wind energy development has successfully been implemented in many European countries, but the driving forces in these countries have been to fulfil an obligation to reduce the consumption of fossil energy and in some cases the desire to develop a new industry based on wind energy technology.

In Sri Lanka the situation is different. From an economical point of view, wind energy can only compete with new thermal power capacity when the wind condition is exceptionally good, that is an average wind speed more than 8 m/s.
The progress of wind energy technology has been encouraging the last years and even more reasonable solutions are expected in the near future. Hence the wind energy is not a feasible option in the present situation, but could be an economical solution within some years. This is especially the case for the off shore wind development where the available technology is premature.

In some rural areas there is a possibility for small scale wind power either to compete with solar power or to operate together with solar power in hybrid systems.

7.1.4 Biomass energy generation

The prospects for dendro (wood) power are promising. The energy potential is large, foreign exchange will be saved from not importing fuel, and fuel wood farming can become an attractive employment opportunity to the rural population. Still there are several barriers for the commercialisation of biomass energy technologies. Lack of experience and uncertainty of the reliability of the generating unit, uncertainty of sustainable biomass supplies, negative impacts of converting land areas into plantations, time consuming process required for plantations, competition from fossil fuels, real or perceived risk of financing biomass projects are some of them. Unfair tariff paid by CEB is also a problem. The tariff as stipulated today does not give the right incentive to the producer. As a matter of fact the feed in tariff paid by CEB is a way of discriminating use of indigenous fuel for the benefit of using imported energy fuel. All these barriers must be addressed before an extensive use of dendro power become relevant. How far the dendro power can contribute to the power supply in the future is still an open question until more experience is achieved. The Ministry for Economic Reform, Science and Technology is working in collaboration with the Ministry of Power and Energy in the promotion of this technology and some prototype plants are under developing. Introducing dendro power should be widely supported, but as a matter of necessity the technical and regulatory barriers must find its solution. (Biomass can also be cost effective in co-firing with coal power plants, se paragraph 7.1.1)

Sri Lanka is a country with abundance of vegetative biomass (e.g. agricultural and forestry residues) and therefore has a big potential for generation of bioethanol. Domestic production of transport fuel will help create jobs, reduce dependence on foreign oil and improve the economy. The department of Chemical and Process Engineering, University of Moratuwa is planning to investigate the feasibility of producing bioethanol utilizing local bio waste material and to setup a mini demonstration plant with external financial assistance to educate and motivate the local entrepreneurs to invest on decentralized bioethanol plants. NORAD has been asked for financial support.

Another project proposal is based on utilizing the considerable amount of saw dust and timber off-cut remains which are currently dumped at various places and has become an environmental problem. SLEMA wishes to use the surplus biomass as fuel in a thermal power plant. SLEMA solicit support for financing a demonstration project.

Depositing the garbage (such as house refuse) into landfills induce environmental problems. Utilizing the garbage for energy production has been a supplementary energy resource in many countries in Europe. Modern combustion stoves are today environmentally friendly with low pollution rates. The synergy effects of combusting garbage in order to generate electricity should be evaluated and the energy potential should be surveyed.

7.1.5 Import of power from India

Import of power could also better the power balance in the country. A submarine cable to India should be considered more carefully for many reasons:

- The power balance of Sri Lanka is weak and the supply system is vulnerable to annual variations of precipitation and other limitations of the system. A submarine cable would relieve many of the problems connecting to a small and vulnerable system.
- A future electricity market limited to the domestic system is too small to operate appropriate.

Norway's wide experience in this field could be of great value.

7.2 Rehabilitation of Existing Hydro Power Plants

7.2.1 Hydro-power Developments

Laxapana Hydro Power Complex was the introduction of Hydro-Power to the CEB and it took place in the early 1950s. Since then, this power plant complex expanded into the present status of 5 cascaded power plants.

The Mahaweli River development started in early 1970s, and a cascade of power plants were built at various stages, and this complex of power plants is now known as Mahaweli Hydro-Power Complex.

4 larger Hydro-Power plants are also operating in separate catchments areas.

7.2.2 Hydro-power plants visited during mission.

To get an idea of the potential for up rating/refurbishment the project team visited the Laxpana Hydro-Power Complex in the Kelani River. The Laxapana Complex covers the following power stations:

Power Plant	**Commissioned**
Old Laxapana	1950 - 1958
Wimalasurendra	1964
Polpitiya	1968
New Laxapana	1974
Canyon	1983 - 1989

Only the three oldest plants were visited during our field trip.

The mission was asked to evaluate how an upgrading of existing hydropower plants could increase the efficiency and the availability of electricity. In this report we use the following definition:

Refurbishment:

- Reducing head loss by redesigning/rehabilitating the waterways system
- Increasing efficiency by the installation of remote control systems and more reliable electro/mechanical equipment.

Old Laxapana and Polpitiya underwent some rehabilitation work in 1994-95 and 2002 – 2003. Coyne et Bellier of Belgium has carried out a study to evaluate the status of turbines on the rehabilitation of Wimalasurendra and New Laxapana power plants. The report was prepared in 1999.

7.2.3 Findings

The project team met with chief of operation at the site and with hydropower engineers at the main office in Colombo. It was clear that even though there had been some rehabilitation work carried out covering the electrical equipment there was still a need for further rehabilitation.

The mechanical equipment was old and wearing of turbines and valves is an increasing problem. There were also more difficult challenges related to leakages and lack of function related to the waterways system. The tunnels had not been inspected and some of them were not operating properly. Several projects for improvements have been identified but not implemented due to lack of funds.

To improve the output from the power stations and to protect the values already invested in the schemes, a general survey of the whole complex should be carried out. It seems to the project team that existing studies carried out create a sub-optimal way of looking at the complex.

During our visit to the Laxapana Hydro-Power Complex the hydrometric network was discussed. The information received indicated the existence of a hydrometric network which is poorly and inadequately equipped.

8. PETROLEUM SECTOR

8.1 Oil and Gas Exploration

Oil import accounts for 10 % of total import cost of the country. A growing demand for petroleum products is expected. No domestic oil resources and total import dependent makes the country very vulnerable to price and supply fluctuations. Seismic surveys and satellite gravity surveys are indicating that some off-shore areas contain geological structures that can bear oil/gas reserves.

A ship borne seismic survey has been conducted with TGS-NOPEC Norwegian Geophysical Company. India has started producing oil in 2000 from an off-shore field close to the border between India and Sri Lanka. The prospect of finding oil/gas reserves is promising. So far no regulatory framework for oil exploration has been established.

CHAPTER 9: CONCLUSIONS AND RECOMMENDATIONS

9.1 Institutional Reforms in the Power Sector

The preparation of regulatory frameworks and the institutional restructuring processes to be implemented as a result from the new laws will create a new situation providing a foundation for increased efficiency. These changes are urgent and will very soon make demands on efficient management infrastructure rehabilitation programmes, and new projects to be implemented to improve the social conditions of the Sri Lankan population. The development of new legal and institutional system in the power sector, including the progress of the corresponding projects in the petroleum sector is crucial and should consequently carry the highest priority.

Some projects in the power sector are lacking strategy plans that make it difficult to identify activities and feasible schedules for new projects. Due to the complexity of some of the proposed projects and the limited management and implementation capacity in the related institutions, new projects have to be carefully planned and programmed beforehand.

Strategy plan preparations should carry a high priority as interest from financial institutions to participate in financing of new generating or infrastructure projects etc. very much will depend on the existence of established policies, priorities and work programmes.

With a progressive power industry and a number attractive trade incentive, there are ample scopes for investors and private players to become involved in the development of Sri Lanka's power sector. Counterparts are both IPPs and state owned utilities, which for decades have operated not as commercial entities, but as extensions of the state.

9.2 Investment in the Power Sector

The demand for new base load capacity can be met by construction of new hydro-power plants, refurbishing of old hydro-power plants or by construction of thermal plants based on diesel, gas or coal.

The Generation Expansion Plan 2003 – 2017 recommends the adoption of the least cost generation expansion sequence derived for the base demand forecast case and also emphasizes the need to implement the plan to avoid energy shortfalls.

The most important project in the sequence is the need to implement a 300 MW of coal-fired thermal power plant in 2008. Committed hydro-power plant is the 150 MW Upper Kotmale hydro-power plant scheduled for commissioning in 2009. Delaying the implementation of these two plants would be less economic to the nation.

On short-term, CEB is making arrangements for the construction of 300 MW Combined Cycle Power Plant at Kerawalapitiya with the participation of the private sector. Arrangements have also been made with the private sector to install 200 MW of diesel plants at Puttalam and Embilipitiya.

The methodology adopted in the studies optimally selects plant additions from given thermal as well as hydropower generation expansion candidates which will, together with existing and committed power plants meet the electricity demand with a given level of reliability. The mix of sources will be determined by the Parliament through regulations.

Based on experience from Norway, existing hydro-power plants designed in 1950-70 do not operate on maximum efficiency. This is according to various reasons related to the wearing of either electrical equipment, mechanical equipment or the civil work structures. The potential for new capacity from rehabilitation of Hydro-Power plants should therefore be investigated.

9.3 Technical Assistance Programme

9.3.1 General

Based on the findings of the mission, the project team recommends focusing the technical assistance activities on helping the Government and the players of the power sector to expand the power system to meet the growing demand for electricity in and economically viable and least-cost manner, maintaining the momentum of institutional reforms in the power sector. We recommend building the technical assistance programme on the following four components:

Part A: Institutional Reforms in the Power Sector
Part B: Rehabilitation and Repair of Deteriorating Hydro-Power Assets
Part C: Development of Renewable Resources
Part D: Institutional Cooperation between Government Bodies in the Power and Petroleum sector.

9.3.2 Institutional Reforms in the Power Sector

The main objective of the reforms is to separate the regulatory functions of the Government from the management and administrations of power utilities and to promote the development of commercially viable and autonomous companies.

The new electricity law introduces great changes in the energy sector in Sri Lanka. In order to comply with the principles laid down by the law it is necessary to reorganise the institutional structure operating in the power sector and to define the tasks of the actors, including the state's regulating functions. The process of transition will take resources and time and requires retraining of personnel involved.

To achieve these objectives we recommend financing consulting services to support the implementation of the following studies:

a) Capacity building in the new power utilities to improve management and performance in the areas of strategic thinking and commercial operations.
b) Supervision of the restructuring of CEB and LECO.
c) Supervision of the creation of new regional distribution companies.
d) Planning and execution of seminar, workshops and training programmes

9.3.3 Rehabilitation and Repair of Deteriorating Hydro-Power Assets

The field trip to the Laxapana Complex revealed that there is a need for refurbishment of existing schemes. A continuous hydrologic service from the catchments of the Hydro-Power Complex was also missing.

A General Rehabilitation Study should be carried out covering hydrological, electrical, mechanical and civil work.

Special focus should be put on achieving a proper operation of intakes, the tunnel systems, and the surge chambers. The mission has identified the following projects related to the Laxapana Hydro-Power Complex developments:

a) Rehabilitation of Hydropower Plants in the Laxapana Hydro Power Complex
b) Upgrading of Hydrometric Network and Database for the Laxapana Hydro Power Complex

9.3.3.1 Rehabilitation of Hydropower Plants in the Laxapana Hydro Power Complex

In the next phase of the project a team should be appointed to prepare a Terms of Reference for a Rehabilitation Study of the Laxapana Hydro-Power Complex including dams, tunnelling, surge chambers, penstocks, turbines and electrical equipment incl. transformers.

The main goal of the Rehabilitation Study should be to:

1. Identify the total potential of up rating/refurbishing work
2. Prepare cost estimates for the various options
3. Estimate remaining lifetime as a function of time.
4. Estimate yearly investment to protect investments from eroding.
5. Specify Feasibility Studies on the most appropriate projects. Point out the problems preventing implementation of the projects and indicate solutions to these problems.
6. Indicate what could be done to promote the implementation of the projects.
7. Capacity building in CEB for the improvement of their civil work maintenance practice.

Point 5 and 6 is highlighted due to the fact that refurbishing of hydro-power plants is usually not economically viable due to loss of income from reduced generation during construction period.

Refurbishing of large hydro-power plants requires special know-how. Special emphasizes should therefore be put on licence requirements, economic evaluation of alternatives, safety aspects, financing, construction while the old plant is operating, etc.

We would further recommend that the Public Utilities Committee try to stimulate the interest in up rating and refurbishing old plants by means of seminars and workshops and by providing information through appropriate media. In this context experience from similar project and work in other countries should be presented.

9.3.3.2 Upgrading of Hydrometric Network and Database for the Laxapana Hydro Power Complex

A reliable and continuous hydrologic service, operating a hydrometric network, is an obvious part of a national system for water resources assessment. The very minimum requirement would be stations capable of mapping precipitations, surface water run-off and groundwater levels.

Almost all hydro-power project designs depend on the answer to the question "How much water can be expected?" Peak rates of flow are basis of design project to control excess water, while volume of flow during longer periods of time is of interest in designing project for use of water. The answer to the question is found through the application of hydrometric network.

Adequate and reliable data on hydrology are fundamental for safe and economic design of installations related to water. The lack of a proper designed hydrometric network could soon be a bottleneck for future optimalization of hydro-power resources.

Based on the above findings the project team recommend carrying out a hydrological study of the Laxapana Hydro-Power Complex. The first phase of the projects could be "Preparation of a Network Programme for Rehabilitation of the Hydrometric Network in the Laxapana Hydro-Power Complex." More detailed description of the study should be carried out in the next phase of the study.

9.3.4 Development of Renewable Resources

The Government of Sri Lanka has supported measures for the development and utilization of new and renewable energy resources for electric power generation over many years. Mini hydro plants are now being developed and it is expected that their total contribution will be significant in the future. The use of dendro power with energy plantations is under experimentation. Measures have been made to promote photovoltaic systems for rural lighting. The development seems to be well under way and should be widely supported.

In connection with renewable resources several reports and minutes have been submitted to us. The reports describe plans and visions for the future role of renewable energy. However, based on the documents received, it seems to us that this issue needs further consideration and clarification. The plans are not in a

sufficient degree made specific, and the benefits of the proposed projects are not satisfactory proved. Alternative technologies and designs should have been evaluated more carefully to form an overall basis for finding the individual optimum solutions for the user. In order to qualify for financial support, more detailed and comprehensive pre investment studies, showing the economical profits of the optional renewable energy projects, will be necessary.

Among all the plans to promote the use of renewable energy resources, the possibility of regaining the energy of the garbage is apparently a neglected field. More attention should be paid to approach this problem area. As a first step a Terms of Reference for a feasibility study should be prepared. The main goal of the feasibility study should be to

1. Describe the present garbage treatment system
2. Identify the total energy potential of the garbage
3. Evaluate optional technologies for power production based on garbage. Prepare cost estimates for the various options.
4. Evaluate the synergy effects of regaining the energy of the garbage.

Dendro Energy Promotional Campaign

Bio Energy Association of Sri Lanka has launched a promotional campaign to promote use of dendro energy and in this connection applied for financial support. The campaign will be conducted in four stages:

- Preliminary excitement phase (to excite curiosity and anticipation)
- Pre launch phase (preparatory works for the main programme)
- Main launch event (among other things: press conference, distribution of information, web site)
- Post launch programme (follow up activities)

A promotional campaign is important when a large part of the population is to be involved. However, this kind of campaign is not by oneself sufficient to succeed in promoting use of bio energy. In addition it is crucial to ensure that the campaign is combined with practical opportunities for the population to take new feasible solutions into service.

9.3.5 Institutional Cooperation between Government Bodies in the Power and Petroleum sector.

Development of policies and strategies for governmental management of the power and petroleum sub-sectors will be the main activity. Legislation and institutional matters are aspects of these policies and strategies.

The projects in this field should based on experience from other countries including Norway discuss policy, legal framework, and institutional structure of the power and the petroleum sector and how to strengthen the capabilities of top management people from all stakeholders in the sector.

The cooperation will include governmental management with regards to:

a) The Power Sector:

- Development of regulations for the new Electricity Law, and implementation of the regulations.
- Reorganisation of the power sector including creation of a new regulatory agency.
- Establish the regulatory framework comprising of administrative regulations and technical regulations.
- Planning and execution of seminar, workshops and training programmes

b) The Petroleum Sector

- Creation of a new regulatory agency
- Establish the regulatory framework for:
  - Petroleum resource management
  - Environmental protection
  - Safety and emergency regulations
- Planning and execution of seminar, workshops and training programmes

9.3 Possible Fields of co-operation with the Asian Development Bank (ADB)

An ADB assessment report of the Energy Sector is being prepared and it is expected that a preliminary version will be published in April 2004. The study is called "Energy Sector Master Plan."

The objective of the master plan study is to analyse the sector's institutional structure, available resources and working conditions, in order to point out the factors that that restrain a quick and efficient development of the sector.

We understand that ADB plan to offer assistance to the transition process and that the bank plan to secure that measures, adjustments and action needed for an onward and sustainable development are well defined.

The ADB's activities should be coordinated with the Norwegian Government's activities in the sector.

9.4 Recommendations for the next phase

The Technical Assistance Cooperation Programme between Sri Lanka and Norway refers to the process of development of knowledge in the field of national administration and development of the energy sector, including policy and basic principles, legal framework, economics and efficiency measures and institutional structures from ministerial levels, trough regulatory functions and out to the commercial activities operating in the energy and power sector.

The Technical Assistance Programme should also be adapted to the policies and strategies introduced in the "National Master Plan for the Energy Sector" now under preparation of the ADB. The Master Plan should serve as useful input to the Technical Assistance Programme at the actual stage of development.

The Technical Assistance Programmes should further consist of studies and transfer of know-how in the form of preparation and arrangement of seminars, symposia and workshops for selected fields of co-operations. Workshops should be carried out on selected components of the Programme. Summarizing reports and conclusions from working group discussions should serve as backgrounds papers for the Phase 2 of the mission. The documents from the seminar on "Investment Opportunities in Renewable Energy in Sri Lanka" has served as background papers for this report and is a good example of how to convene a two ways learning process – to learn about conditions in Sri Lanka and about basic principles and solutions in Norway and other countries represented among the invited participants.

APPENDIX 1: Itinerary

Jan. 11 (Sun):	Departure from Norway
Jan. 12 (Mon):	Arrival Sri Lanka, Colombo. Meeting with the Ambassador and the Ministry of Power and Energy
Jan. 13 (Thu):	Meeting with Ceylon Electricity Board incl. visit to Kelanithissa Power Plant and Ceylon Petroleum Corporation.
Jan. 14 (Wen):	Meeting with Energy Supply Committee, Sri Lanka Energy Managers Association and Asia Development Bank Resident Mission
Jan. 15 (Thu):	Field visit. Visit to Sapugaskanda Hydro Power Plant, Dendro Thermal Plant - owned by Lanka Transformers and Industrial Service Bureau in Kurunegala incl. visit to their project site in Madampe. Stay over in Kandy
Jan. 16 (Fri):	Field visit. Visit to Laxapana Hydro Power Plant. Stay over in Kandy
Jan. 17 (Sat):	Meeting with Integrated Development Association in Kandy.
Jan. 18 (Sun):	Holiday
Jan. 19 (Mon):	Meeting with Energy Forum (Bio Energy Association) and Ministry of Economic Reform Science & Technology
Jan. 20 (Thu):	Meeting with Lanka Transformers incl. visit to Transformer factory at Angulana. Debriefing Session at the Embassy
Jan. 21 (Wed):	Return to Norway

APPENDIX 2: List of abbreviations

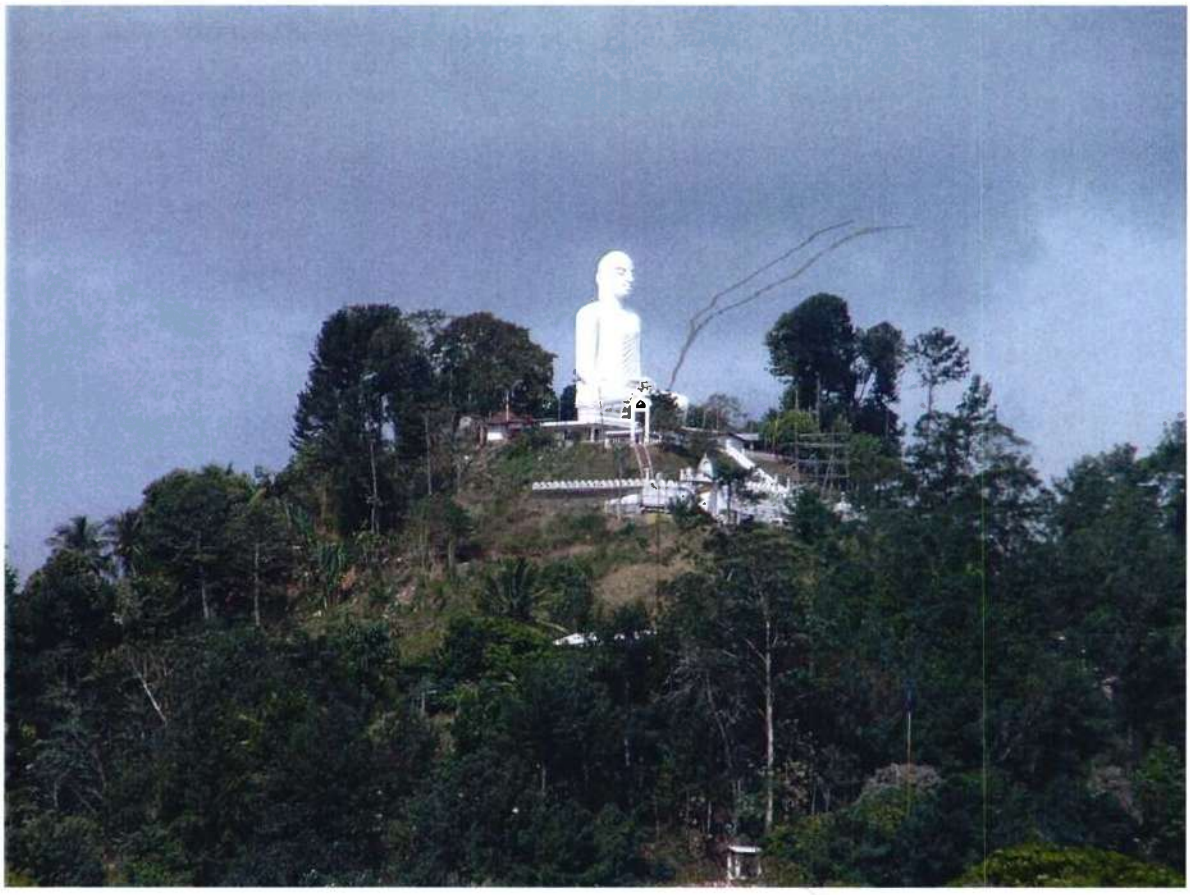
ADB	Asian Development Bank
CEB	Ceylon Electricity Board
ECF	Energy Conservation Fund
ESC	Energy Supply Committee
IPP	Independent Power Producers
LNG	Liquified Natural Gas
LOCO	Lanka Electricity Company
MPE	Ministry of Power and Energy
NARA	National Aquatic Resources and Development Agency
NTNU	Norwegian University of Science and Technology
OUSL	Open University of Sri Lanka
PUC	Public Utility Commission
RERED	Renewable Energy for Rural Economic Development
SHS	Solar Home System
SLEMA	Sri Lanka Energy Managers Association

APPENDIX 3: REFERENCES

[1] Sri Lanka Energy Balance 2000. Energy Conservation Fund
[2] Sri Lanka Rural Electrification Policy. Ministry of Power & Energy, Nov. 2002
[3] Energy Efficiency Conservation and Demand Side Management Strategies for the Electricity Sector of Sri Lanka. Ministry of Power & Energy, Nov. 2002
[4] Power & Energy for National Development. Ministry of Power & Energy, 2003.12.02
[5] Regaining Sri Lanka with Bio Energy. The Dendro Option. Bio Energy Association of Sri Lanka
[6] E-Scene. January 2004
[7] The Prospects for Discovery of Oil and Gas and Partnership Building Opportunities in Sri Lanka. A presentation by Titus Jayawardena.
[8] Daily News, 21 Jan. 2004
[9] Statistical Digest 2002. Ceylon Electricity Board
[10] The national importance of the NERD gasifier stove and the need for greater focus on the role of kitchen in national social development. R.M. Amerasekera, 13 May 2003
[11] Proposed Power Sector Policy Guidelines. Ministry of Power & Energy. Nov. 2002
[12] Long Term Generation Expansion Plan 2003 – 2017. Ceylon Electricity Board. June 2003
[13] Wave Energy Study – Sri Lanka Southern Coastline. Interim report. Arjuna De Zoysa OUSL), Kamal Tennakoon (NARA)
[14] Ocean Wave Energy – Feasibility and Prototype Station in Sri Lanka. Arjuna De Zoysa OUSL), Kamal Tennakoon (NARA)
[15] Technical Assistance to Sri Lanka for the Energy Sector Master Plan. R.Stroem, Asian Development Bank
[16] Prospects, Trade-offs and Challenges of Using Wood Biomass for Power Generation and Thermal Applications in Sri Lanka. R.M. Amerasekera, IDEA, Kandy
[17] Biomass Energy, Gender and Technology. R.M. Amerasekera, IDEA
[18] Investment Opportunities in Renewable Energy in Sri Lanka. Seminar Organised by Sri Lanka Energy Managers Association. SLEMA February 12, 2003
[19] Investment Opportunities in Renewable Energy in Sri Lanka. Proceedings of the Seminar Organised by Sri Lanka Energy Managers Association. SLEMA February 12, 2003
[20] Mitigation of Domestic Air Pollution. Project Concept Paper. IDEA
[21] Approach of the Energy Forum. Enhancing the Capability of the Energy Sector in Sri Lanka through Private-Public-Civil Society Alliances. Asoka Abeygunawardana
[22] Resource Potential of Sawdust and its Spatial Distribution in the Kandy District. R.M. Amerasekera, P. Jayaratna, July 2002
[23] Green Energy. Message from the President Ray Wijewardene. Bio-Energy Association of Sri Lanka. May 2003
[24] A direction for development. Ray Wijewardene
[25] Modern Biomass Energy for Sri Lanka. NN
[26] Sri Lanka Takes Two-Pronged Approach to Reforming Power Sector. Graham Dwyer
[27] Dendro Power Demonstration Facility. P.G. Joseph, AED
[28] Sri Lanka. Wood Energy Situation. NN
[29] Project: Demonstration mini bioethanol plant. University of Moratuwa
[30] Energy Conservation Fund. Expected assistance from the Norwegian Embassy
[31] Project Proposal: Local Wind Power Development. NERDC
[32] Project Proposal for a Saw Dust & Off Cuts Power Plants (SLEMA)

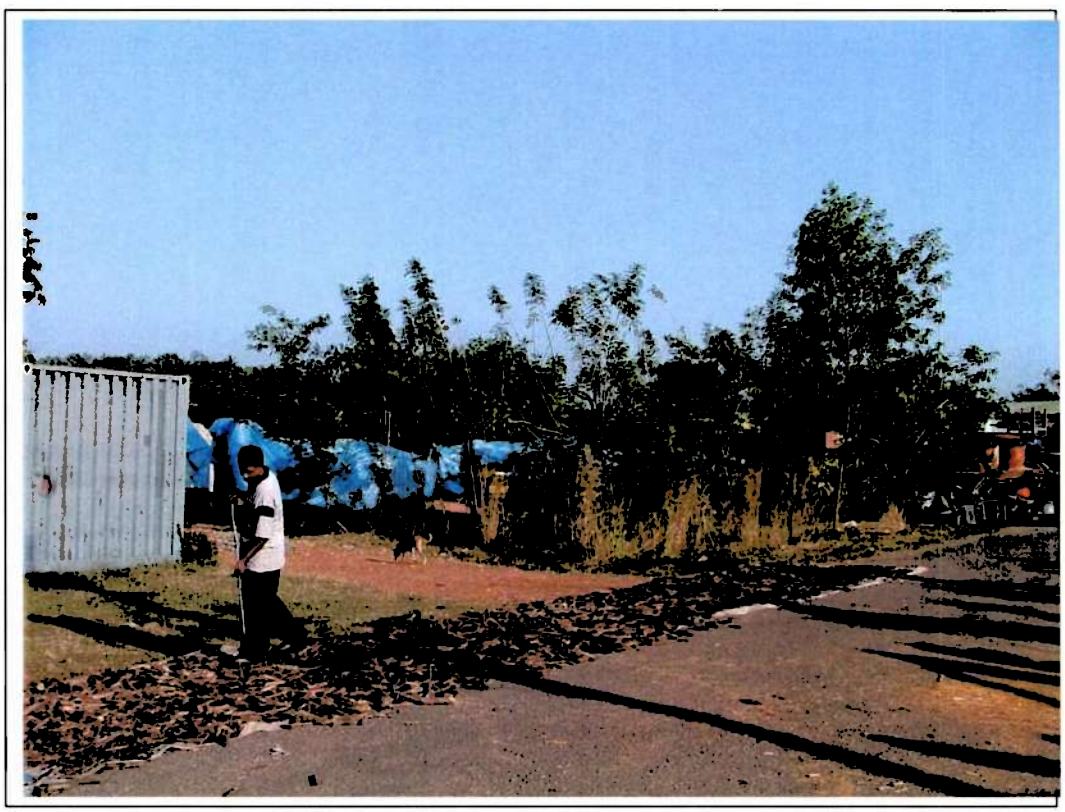
[33] Submission to The Norwegian Delegation on Power Sector. L.P. Jayasinghe President of the Bio Energy Association of Sri Lanka.

APENDIX 4 PHOTOS



....with respect...

From a Short Rotation Coppice (SRC) Plantation

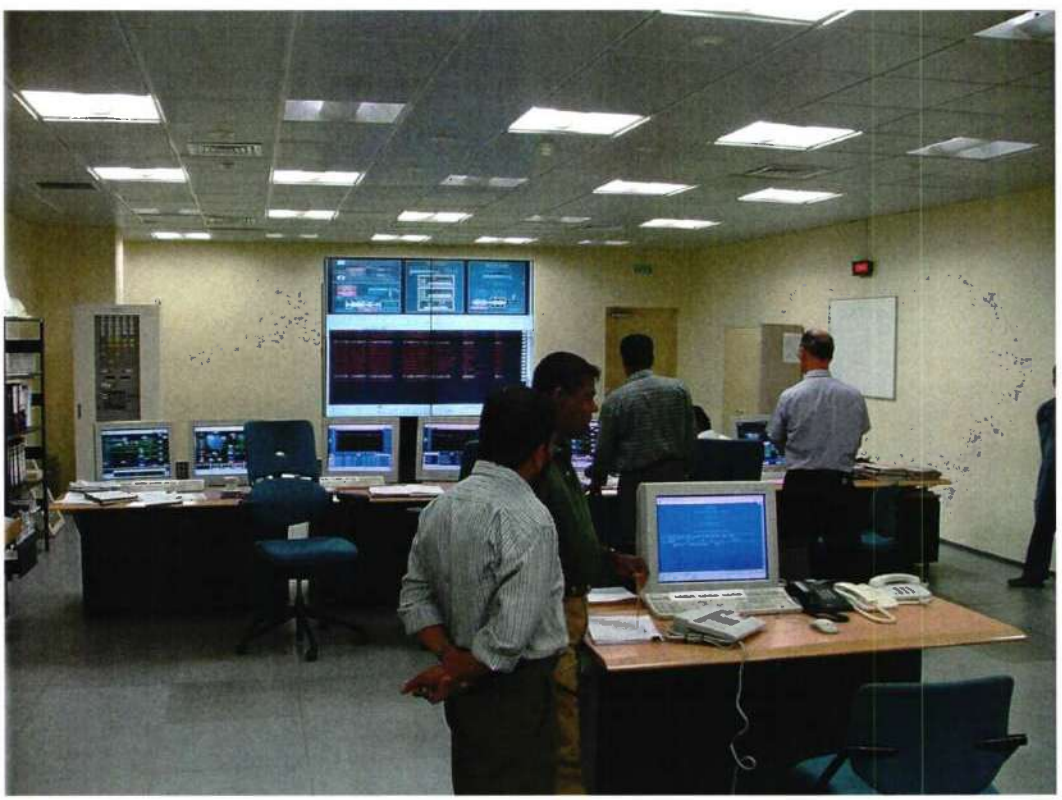


Branches of wood are lopped and spread on the ground to dry

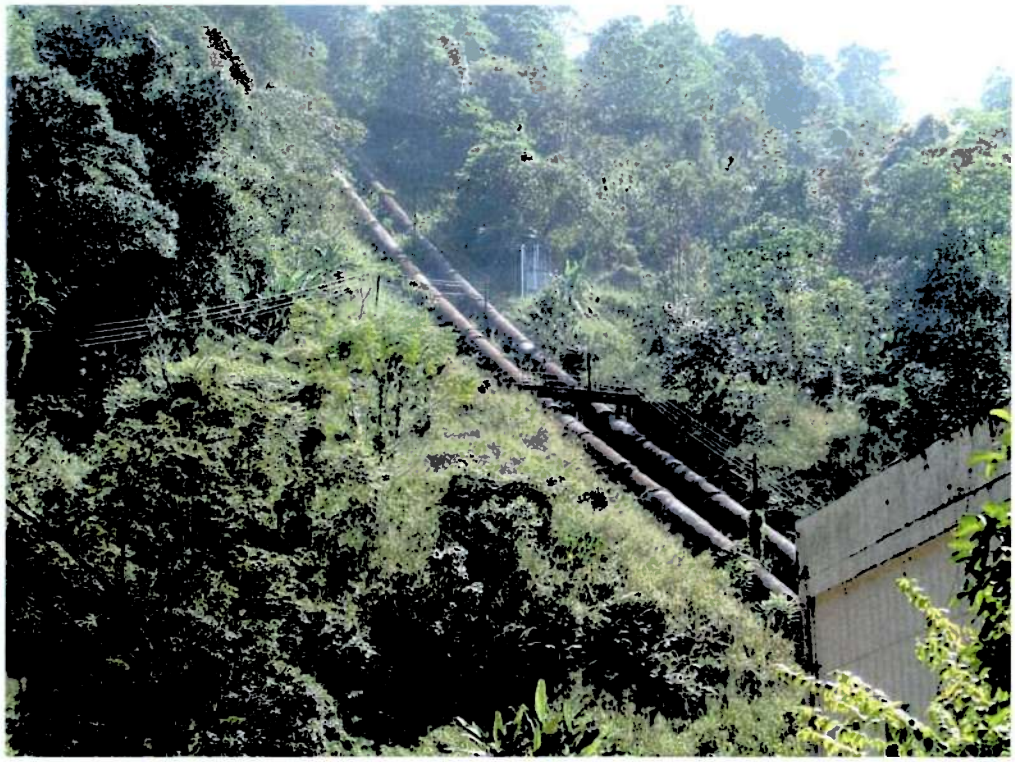
Wood Gasifier - Internal Combustion Engine Driven Generator (Sapugaskanda)

Dendro Thermal Power Plant under construction

Kelanitissa Power Station (Combined Cycle)

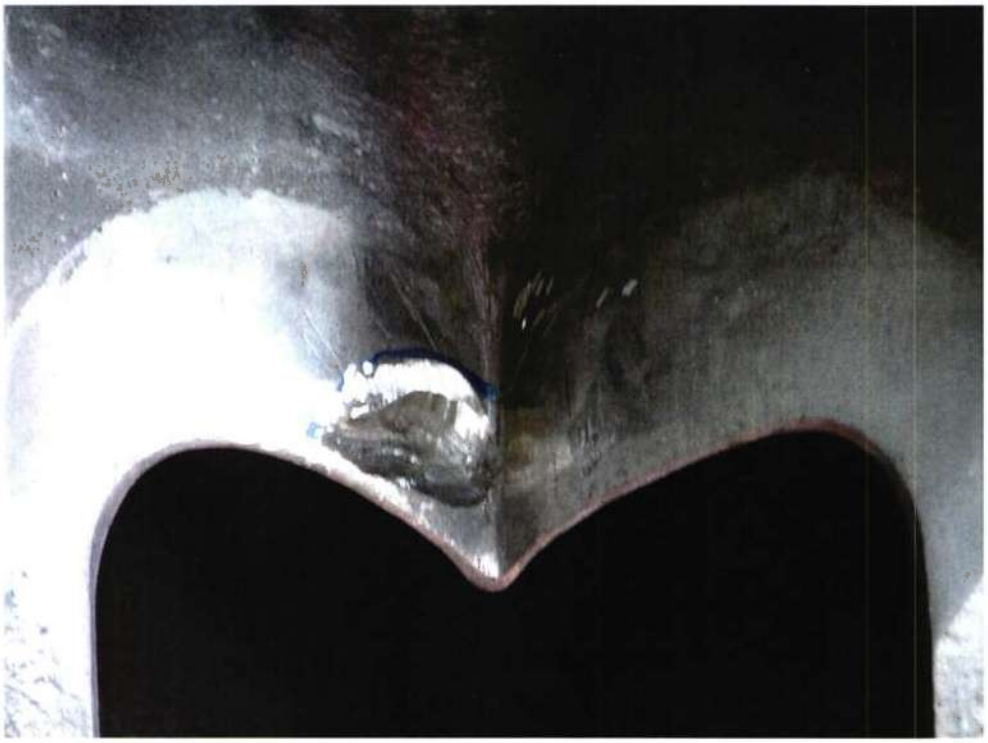


Kelanitissa Power Station (control room)



Sapugaskanda Hydro Power Plant

Laxapana Hydro Power Station



Cavitation (Pelton Turbine)

On the beach - at last....