Ministry of Power and Energy
Ceylon Electricity Board
Democratic Socialist Republic of Sri Lanka

Feasibility Study
for
Expansion of Victoria Hydropower Station
in
Sri Lanka

Final Report
(Main Report)

June 2009

Japan International Cooperation Agency

Electric Power Development Co., Ltd.
Nippon Koei Co., Ltd.

PREFACE

In response to a request from the Government of Sri Lanka, the Government of Japan decided to conduct the Feasibility Study for Expansion of Victoria Hydropower Station, and the study was implemented by the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Yoshimasa Ishii of Electric Power Development Co., Ltd. (J-Power), and consisted of J-Power and Nippon Koei Co., Ltd. to Sri Lanka four times from January 2008 to June 2009.

The study team held discussions with the officials concerned of the Government of Sri Lanka and Ceylon Electricity Board, and conducted related field surveys and examinations. After returning to Japan, the study team compiled the final results in this report.

I hope this report will contribute to stabilization of power supply in Sri Lanka and to enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Sri Lanka for their close cooperation throughout the study.

June 2009

Seiichi Nagatsuka
Vice President
Japan International Cooperation Agency

June 2009

LETTER OF TRANSMITTAL

Mr. Seiichi Nagatsuka
Vice President
Japan International Cooperation Agency
Tokyo, Japan

We are pleased to submit to you the report on the Feasibility Study for Expansion of Victoria Hydropower Station in Sri Lanka. This study has been conducted by Electric Power Development Co., Ltd. in association with Nippon Koei Co., Ltd. under a contract to JICA in a period from January 2008 to June 2009.

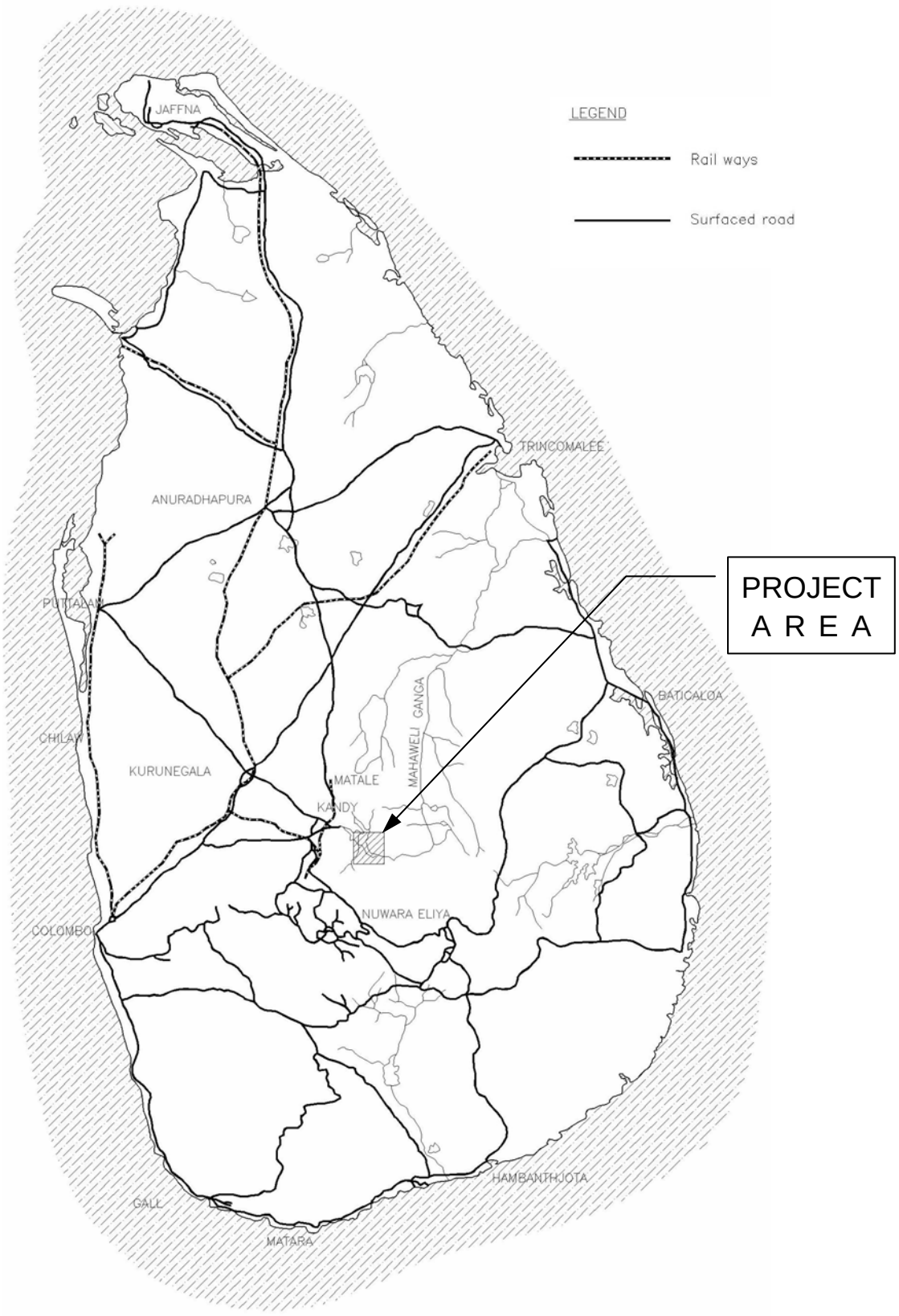
This report presents an expansion plan with an installed capacity of 228MW of the existing Victoria Hydropower Station (installed capacity of 210 MW). Completion of the project can cope with peak power demand in the country and contribute to stabilization of power supply.

We dearly wish that our proposed project will contribute to the utilization of domestic energy resources and to the improvement of Sri Lankan people's living and economic activities.

We would like to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of Economy, Trade and Industry of the Government of Japan. We are also most grateful for the cooperation and assistance from the officials and personnel concerned in Ceylon Electricity Board and the ministries concerned of the Government of Sri Lanka.

Very truly yours,

Yoshimasa Ishii
Team Leader,
Feasibility Study for Expansion of Victoria Hydropower Station
in Sri Lanka



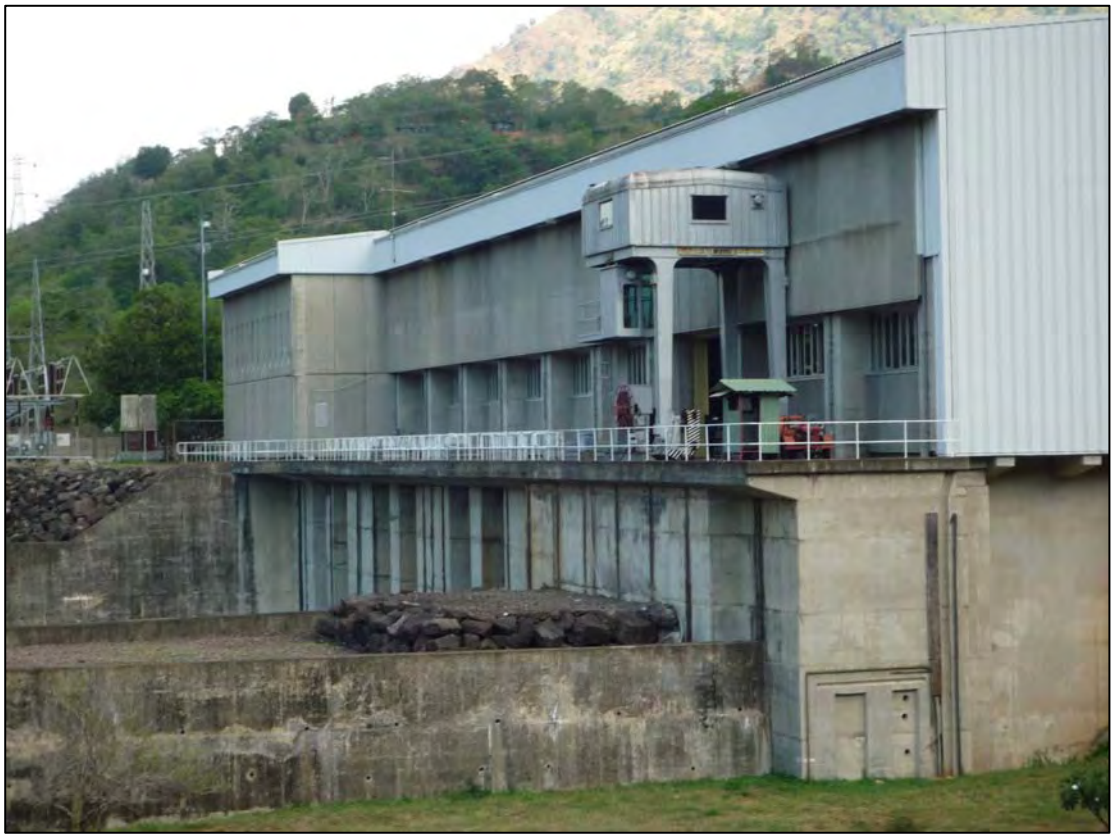
Location Map

Existing Victoria Dam

Existing Powerhouse & Switchyard

Existing Intake for Expansion

Existing Surge Tank



Existing Powerhouse

Existing Powerhouse Units

Expansion Area adjacent to Existing Powerhouse

Work Shop Held on February 11, 2009

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ABBREVIATIONS

Organizations

ADB	Asian Development Bank
BOI	Board of Investment
CBSL	Central Bank of Sri Lanka
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
CIDA	Canadian International Development Agency
DAC	Development Assistance Committee
DCS	Department of Census and Statistics
DWLC	Department of Wildlife Conservation
EC	European Community
ERD	External Resources Department
FAO	Food and Agriculture Organization
GN Division	Grama Niladari Division
IDA	International Development Association
IFC	International Finance Corporation
IMF	International Monetary Fund
IPP	Independent Power Producer
JEC	Japan Electrotechnical Committee
JICA	Japan International Cooperation Agency
LECO	Lanka Electricity Company
MASL	Mahaweli Authority of Sri Lanka
MOENR	Ministry of Environment and Natural Resources
MOFP	Ministry of Finance and Planning
MPE	Ministry of Power and Energy
MSO	Mahaweli Security Organization
NGO	Non-Governmental Organization
PAA	Project Approval Agency
PP	Project Proponent
PUC	Public Utilities Commission
SPP	Small Power Producer
RDA	Road Development Authority
TEC	Technical Evaluation Committee
UNDP	United Nations Development Programme
WB	World Bank

General and technical terms

AFC	Automatic Frequency Control
B/C	Benefit-Cost Ratio
BOD	Biological Oxygen Demand
CDM	Clean Development Mechanism
COD	Chemical Oxygen Demand
CPI	Consumer Price Index
DB	Design-Build (Scheme)
D/D	Detailed Design
DP	Dynamic Program
DSCR	Debt Service Coverage Ratio
DSWRPP	Dam Safety and Water Resources Planning Project
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EL.	Elevation
EPC	Engineering-Procurement and Construction (Scheme)
F/S	Feasibility Study
FSL	Full Supply Level
GDE	Gross Domestic Expenditure
FY	Fiscal Year
GDP	Gross Domestic Product
GNP	Gross National Product
GVA	Gross Value Added
IDC	Interest during Construction
IEE	Initial Environmental Evaluation
JIS	Japanese Industrial Standards
LLCR	Loan Life Coverage Ratio
LOLP	Loss of Load Probability
MOL	Minimum Operation Level
NEA	National Environmental Act
NPV	Net Present Value
O & M	Operation and Maintenance
ODA	Official Development Assistance
OOF	Other Official Funds
PI	Project Information
PIA	Project Impact Area

S/W	Scope of Work
TDS	Total Dissolved Solid
TOR	Terms of Reference
TSS	Total Suspended Solid
VAT	Value Added Tax
VRRS	Victoria Randenigala Rantambe Sanctuary
WASP	Wien Automatic System Planning
WPI	Whole Price Index

Units

A	Ampere
ha	Hectare
Hz	Hertz (Cycles per second)
MCM	Million Cubic Meter
Mvar	Megavar
m^3/s	Cubic meter per second
NTU	Newton Turbidity Unit
pfu	Plaque-Forming Unit
ppm	Parts per million
V	Volt
kV	Kilovolt = 10^3 V
VA	Volt Ampere
kVA	Kilovolt Ampere = 10^3 VA
MVA	Megavolt Ampere = 10^6 VA
W	Watt
kW	Kilowatt = 10^3 W
MW	Megawatt = 10^6 W
Wh	Watt Hour
kWh	Kilowatt Hour = 10^3 Wh
MWh	Megawatt Hour = 10^6 Wh
GWh	Gigawatt Hour = 10^9 Wh
Rs	Sri Lankan Rupees
US$	US Dollar
Mill. US$	Million US Dollar
USc	US Cent
°C	Celsius degrees

CONCLUSIONS AND RECOMMENDATIONS

Conclusions and Recommendations

This feasibility study (the Study) was implemented with respect to the Expansion of Victoria Hydropower Station (the Project) from January 2008, and the Project was judged feasible from technological, economical, financial and environmental perspectives as a result of the study. The details of the conclusions are discussed below.

Conclusions

(1) Background of the Study

Of around 2,000 MW which is estimated as hydropower potential in the country, 1,300 MW have been developed as of the end of 2006. However, development of hydropower is indispensable from the viewpoint of energy security of the country, which has limited domestic energy resources. In such background “the Study of Hydropower Optimization in Sri Lanka” (March 2004) was carried out under technical assistance of JICA to sort out the existing hydropower potential and to intend to optimize use of hydropower resources.

In this study, i) because it was expected that thermal power generation would necessarily take a major role in the long term, it was considered that the role of the hydropower in the country should be altered from power sources for base demand to those for peak demand, and ii) altering of the operation of existing reservoirs and power stations and expanding existing facilities were examined. The pre-feasibility study for expansion of the Victoria Hydropower Station was conducted as one of expansion projects, and possibility of the Expansion Project was confirmed.

(2) Power Demand and Power Expansion Plan

According to the demand forecast conducted with econometric model in December 2007 by CEB, required annual energy and peak demand is to grow with an average rate of around 8% per annum, respectively. Study Team confirmed that the abovementioned forecast was reasonable. CEB tentatively revised the above demand forecast by using time-trend method, because the country has been affected by the world-wide economic crisis since September 2008. Average annual growth rates of both generation and maximum power demand are smaller than those in the previous forecast, but still forecast over 6% continuously.

In the generation expansion plan for the period from 2008 up to 2022 prepared by CEB based on the revised demand forecast, power source for the peak demand is only Upper Kotmale hydropower project which is under construction.

Some of the countermeasures for the above issues, to secure the power sources for increasing peak demand, from the viewpoint of power expansion plan, are i) shifting the role of the

existing hydropower plants from the base load and/or middle load to the peak load operation, and ii) expansion of existing hydropower plants. Those measures expect effective use of domestic renewable power sources.

Expansion of existing hydropower plants has some difficulties too, such as lowering of reservoir water level during the construction (suspension of generation during the construction) and economic validity, etc. On the other hand, the Project has advantages because the intake facilities for expansion have already constructed, and it is not necessary to lower reservoir water level during expansion works.

The maximum peak demand in 2008 was 1,922 MW. According to the daily load curve on the day recording the maximum demand, it is understood that about 570 MW of power sources for the peak demand was necessary. The maximum power demand in 2016 is forecast as 3,222 MW by CEB. The required power sources for the peak demand are estimated at about 960 MW, under the condition that a similar daily load curve in 2016 is similar to that in 2008. Hence new peak power sources of 390 MW will be required to arranged. However, the power source for peak duration listed in the CEB's generation expansion plan is only Upper Kotmale (150 MW). If the Project with 228 MW is considered in the plan, the Project and Upper Kotmale will almost cover the peak requirement. The Project, therefore, will contribute to coping with increase of peak power demand.

(3) Meteorology and Hydrology

The Project site is located on the middle stream of the Mahaweli river of which the basin is the largest in the country. The Mahaweli river is originating in the southwest part of the Central Highlands, flowing through the northeast part of Sri Lanka island, and effluent to the Trincomalee bay.

According to the measurement records, the average annual rainfall at the Victoria dam is 1,375 mm. The project area receives more rainfall in the northeast monsoon period, from December to February, than that in the southwest monsoon period.

The Polgolla diversion weir is located 20 km upstream of the Victoria dam. The part of flow of the Mahaweli river is diverted to the Sudu river at the weir for irrigation purpose. Release records at the Polagolla weir from 1985 to 2006 provided by MASL is used for estimate on inflow into the Victoria reservoir in the Study. Average inflow into the reservoir is estimated at 1,532 MCM/year (48.6 m^3/s).

DSWRPP assisted by the World Bank and commenced in 2008 involves optimization of water resources of the Mahaweli river including assessment of the operation policy for the diversion at the Polgolla weir. The results might give affects on the Project.

(4) Environmental and Social Considerations

The terms of reference (TOR) for the environmental impact assessment (EIA) for the Project was issued by MASL appointed as Project Approval Agency for the Project. Hence, EIA in the Study covers both the TOR issued by MASL and JICA Guidelines for Environmental and Social Considerations.

EIA in the Study consists of i) assessment on environmental and social considerations for the three alternative options examined in the comparative study, and ii) assessment on environmental and social considerations for the optimal option selected in the comparative study. Comparison of the three alternative options from the viewpoint of environmental and social considerations was mainly conducted based on the existing data and information. The basic option mentioned in (5) is judged to be most favorable from the viewpoint of environmental and social considerations.

Hearings from habitants in the project area were conducted to ask them about their anticipated concerns on the construction works of the selected optimal option. Based on the hearing results, anticipated environmental impact items were revised.

Impact assessments were conducted based on survey results. The most anticipated social impact is drawdown of the wells near the tunnel alignment during the construction. While, the most anticipated biological issue is impact on wild elephants living in the downstream area of the powerhouse.

Regarding anticipated impacts, mitigation measures are proposed, and a monitoring plan is prepared.

Because the project area is located in the Victoria Randenigla Ramtanbe Sanctuary, temporary facilities areas and spoil bank areas are selected in consideration of results of field survey on flora and fauna so that field survey results are incorporated into layout design.

(5) Optimal Expansion Plan

The study on the optimal expansion scheme consists of i) selection of the optimal option among the CEB's three alternative options, and ii) optimization of the selected option.

The peak duration for the Hydropower Station after expansion is determined as 3 hours based on review of recorded daily and annual load curves, because it is confirmed for the Study that the Victoria Hydropower Station would be used for power source for peak demand.

The three alternative options are as follows;

1) Basic Option

The basic option is to place an additional powerhouse nearby the existing hydropower facilities.

2) Downstream Option

The downstream option is to place the surface type powerhouse 2 km downstream from the existing powerhouse. Placing the powerhouse in the downstream expects to gain an additional hydraulic head for hydropower generation.

3) Pumped Storage Option

The pumped storage option is the pumped storage power plan, using total head of 190 m between the Victoria and the Randenigala reservoirs.

The maximum discharge of the expansion power plant is estimated at 140 m^3/s which is the same as that of the existing power plant. In the case of the maximum discharge of 140 m^3/s for expansion, the upper limit of output of the expansion is to be 210 MW. Hence, 2-unit option (140 MW) and 3-unit option (210 MW) with the unit capacity of 70 MW for each alternative option are compared.

Consequently, the 3-unit option (210 MW) of the basic option is selected as optimal one from the economical viewpoint. Examinations from geological aspect and environmental aspect, and WASP analysis conclude that the basic option is optimal of the three alternative options.

Following the above, the optimizations of 210 MW class regarding i) unit capacity and the number of units, ii) normal intake water level, and iii) priority of operation for existing and expansion plants are carried out. As the results, the following is selected:

- Number of unit ..... 2 units
- Normal intake water level ..... EL. 430 m
- Operation rule of existing and additional units ..... Same operation for existing and expansion plants.

(6) Outlines of Proposed Expansion Plan

Based on the result in **(5)** above, the Project is to connect the existing intake for the expansion and a new powerhouse to be located next to the existing powerhouse with a waterway parallel to the existing waterway.

Water for generation of 140 m^3/s is to be taken at the existing intake for the expansion and led through the headrace tunnel and penstock to the surface type powerhouse. The installed capacity is 228 MW with 2 units, and 716 GWh of annual energy are obtained with the existing and expansion power facilities (210 MW and 228 MW). Power generated is evacuated to the CEB grid through the existing transmission lines.

(7) Basic Design

The design in the Study is carried out at more detailed level than conducted in a feasibility study on a hydropower project, in accordance with S/W (Scope of Work) for the Study. In the basic design, salient features of civil structures and electromechanical equipment for the optimal development scheme selected in (5) are examined, and drawings are prepared.

Following that, the construction planning, estimate of the project cost, and preparation of implementation schedule are conducted.

Open-air works and underground works of the Project are to be carried out near the existing Victoria dam, intake facilities, waterway and powerhouse. Hence, vibrations caused by blasting should be controlled to prevent them from being damaged due to the blasting. The maximum allowable blasting vibration is determined as 2 cm/s, in consideration of a value by elastic theory, allowable limits specified in a manual for tunnel works in Japan, values applied to railway and road tunnels in Japan, value applied to hydropower expansion projects in Japan, etc. The blasting vibration limit is incorporated into examinations on tunnel alignment and into construction planning.

The main structures consist of the headrace tunnel, surge tank, penstock and powerhouse. The existing intake for the expansion is to be connected to powerhouse through the headrace tunnel with around 5,000 m in length and 6.6 m in inner diameter, surge tank, and 1-line tunnel and 2-line open-air penstock with 6.6 m to 2.85 m in inner diameter. The powerhouse with 37 m in width, 44 m in height and 69 m in length is to be constructed next to the existing powerhouse. After generation, water used for generation is to be discharged to the Mahaweli river through the outlet.

(8) Construction Cost and Construction Schedule

The total project funding required is approximately US$222 million, as of October 2008, including the direct cost consisting of costs for preparatory works, civil works, hydromechanical equipment, and electromechanical equipment, and indirect cost such as environmental expenditures, construction administrative cost and engineering fee, and contingencies for variable quantities.

The construction period from the start of the preparatory works to the start of operation is estimated at 52 months (4 years and 4 months). The Project is scheduled to be commissioned at the end of 2016.

The DB (Design-Build) schemes in which the construction work including the detailed design is ordered in a lump sum, as recently introduced for thermal power projects, could be applicable because the Project has less unforeseeable physical risks involved in hydropower project than a hydropower project generally has. Hence, the DB and the conventional scheme (i.e. Contractor is determined by the bid after consultants execute the detailed design) are compared, and as a result the conventional scheme is recommended.

(9) Economic and Financial Evaluation

In the Study, economic evaluation is performed in consideration of the benefit as the saved cost of alternative thermal power project. The Economic Internal Rates of Return (EIRR) was estimated at 19.8% which exceeded the opportunity cost of capital of 10%. Thus the Project

was evaluated to be economically feasible. As the results of the sensitivity analysis, EIRR would 10%, even if the average fuel costs in the period from January up to October 2008 decrease by 72%, and it is also confirmed to be feasible.

Financial benefit of the Project is the revenue to be earned by the electricity sale. Financial Internal Rates of Return (FIRR) on the total investment is estimated at 9.6%. It is found out that the Project is to be financially feasible, when a concessional loan is provided.

Recommendations

The Victoria Hydropower Expansion Project has an advantage of not having the need to lower reservoir water level during a construction period for expansion, because the intake facilities for the expansion were already constructed during the construction of the existing power generation facilities. In addition, construction cost per kW of the Project is less than 50% of those of other candidate hydropower projects, and development of the Project expects effective use of domestic renewable power sources. The Project, therefore, should be promoted as a candidate for the next hydropower project.

The Project is feasible from technical, economic/financial and environmental perspectives and can be developed as a power generation project which will also contribute to coping with increasing peak demand. The operation can begin around at the end of 2016, given the time required for tasks to take place subsequent to this Feasibility Study, including funding arrangement, geological investigations, detailed design and construction works. The following will have to be conducted before implementing the Project:

(1) As mentioned in **Chapter 10** of this report, it is possible that loans to both the detailed design and the construction works will be provided at the same time, because the Project has i) less unforeseeable physical conditions such as geology, in comparison with usual hydropower projects, ii) less restriction for reservoir operation during expansion works and iii) no resettlement. Formulation of the Project such as listing it in the CEB's generation expansion plan after the completion of the Study and then financial arrangements are required.

(2) It is necessary to confirm the following issues before implementation of the Project as described in **12.1 of Chapter 12** in this report;

1) Because the existing Victoria Hydropower Station is being used for both peak and base power sources, i) base demand in the commissioning year of the Project will be satisfied with new power sources, based on the CEB's latest power demand forecast and power expansion plan, and ii) candidate power stations for system frequency adjustment are nominated.

2) The diversion policy at the Polgolla weir and irrigation demand in the downstream area is to be almost concluded in the Dam Safety and Water Resources Planning Project.

(3) In the detailed design, the results of additional investigations as shown in **12.3** of **Chapter 12** in this final report should be sufficiently incorporated and at the same time documents for bidding and contracting of construction works with a higher accuracy of construction cost estimates should be prepared.

(4) Bidding for construction works, and the selection of contractors will have to be performed before the construction of the Project. In addition, preparatory works such as the improvement of the existing roads will have to be completed before the construction launch of the Project.

(5) It is indispensable that conditions of the existing structures, houses, etc. to be affected by blasting during the construction, should be investigated and recorded immediately before the commencement of the construction works. A monitoring plan on blasting should be prepared during the detailed design stage.

Salient Features of Victoria Hydropower Expansion Project

Item		Dimension
Reservoir (Existing)	Name of River	Mahaweli river
	Full Supply Level	438.0 m
	Minimum Operation Level	370.0 m
	Available Depth	68.0 m
	Gross Storage Capacity	722×10^6 m^3
	Effective Storage Capacity	688×10^6 m^3
	Design Flood	9,510 m^3/s
Dam (Existing)	Type	Concrete Arch Dam
	Height of Dam	122 m
	Length of Dam Crest	520 m
	Volume of Dam	480×10^3 m^3
Intake for Expansion (Existing)	Number	1
	Type	Inclined Intake
Headrace Tunnel	Number	One (1)
	Inner Diameter	6.6 m
	Total Length	5,003 m
Surge Tank	Type	Restricted Orifice Type
	Diameter	20.0 m (Upper Section) 6.6 m (Lower Section)
	Height	117.0 m (Upper Section) 32.9 m (Lower Section)
Penstock	Type	Tunnel & Open-air
	Number	Tunnel: One (1) Open-air: Two (2)
	Inner Diameter	Tunnel: 6.6 m to 5.6 m Open-air: 3.95 m to 2.85 m
	Length: Tunnel	575 m
	Length Open-air	175 m for Unit 4 160 m for Unit 5
	Total Length	750 m for Unit 4 735 m for Unit 5
Powerhouse	Type	Surface type
	Size	37m wide × 44m high × 69m long
Development Plan	Normal Intake Water level	430.0 m
	Normal Tail Water Level	231.2 m
	Gross Head	199.0 m
	Effective Head	183.3 m
	Maximum Discharge	140 m^3/s
	Number of Unit	Two (2)
	Install Capacity	228 MW (only expansion)
	Peak Duration Time	3 hours
	95% Dependable Capacity	393 MW (with existing)
	Annual Generation Energy	716 GWh (with existing)
	(Firm Energy*)	468 GWh (with existing)
	(Secondary Energy**)	248 GWh (with existing)

Item		Dimension
Turbine	Type	Vertical Shaft, Francis Turbine
	Number	Two (2)
	Rated Output	122 MW per unit
	Revolving Speed	300 r/min
Generator	Type	Three-phases, Synchronous Generator
	Number	Two (2)
	Rated Output	140 MVA per unit
	Frequency	50 Hz
	Voltage	16.5 kV
	Power Factor	0.85 lag
Main Transformer	Type	Outdoor Special Three-phase Type or Outdoor Single Phase Type
	Number	Two (2)
	Capacity	145 MVA per unit
	Voltage	Primary 16.5 kV
		Secondary 220 kV
	Cooling	Natural Convection Oil Forced Air Type
Switchyard	Type	Conventional Type
	Bus System	Double Bus
	Number of Lines Connected	Three (3) cct Transmission Lines
	Voltage	220 kV
Construction Period Including Preparatory Works		52 months (4 years and 4 months)
Project Cost		US$222 million

*Note: * "Firm energy" means the total of power generated during 3-hour peak duration.*
*** "Secondary energy" means the total of power generated in duration except 3-hour peak time.*

CHAPTER 1

INTRODUCTION

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Chapter 1 Introduction

The Feasibility Study (hereinafter referred to as "the Study") for Expansion of Victoria Hydropower Station (hereinafter referred to as "the Expansion Project") is to be carried out under the Scope of Work (S/W) concluded on November 19, 2007 and Minutes of Meeting dated August 16, 2007 between Japan International Cooperation Agency (JICA), and Ministry of Power and Energy (MPE) and Ceylon Electricity Board (CEB) in Sri Lanka which play role as counterpart of the Study

1.1 Background of the Study

The annual maximum demand in Sri Lanka has grown at the rate of 6.9% in average from 1996 to 2006, and CEB forecasts that its growth rate will keep at around 6.4% in the next decade. Development of peak power resources in the country is one of the most important issues in the power sector.

Of around 2,000 MW which is estimated as hydropower potential in the country, 1,300 MW have been developed as of the end of 2006, and the number of remaining project sites that have potential from the viewpoints of economic efficiency and the natural/social environment is limited. However, development of hydropower is indispensable from the viewpoint of energy security of the country, which has limited domestic energy resources. In such background "the Study of Hydropower Optimization in Sri Lanka" (March 2004) was carried out under technical assistance of JICA to sort out the existing hydropower potential and to intend to optimize use of hydropower resources.

In this study, i) because it was expected that thermal power generation would necessarily take a major role in the long term, it was considered that the role of the hydropower in the country should be altered from power sources for base demand to that for peak demand, and ii) altering of the operation of existing reservoirs and power stations and expanding existing facilities were examined. The pre-feasibility study for expansion of the Victoria Hydropower Station was conducted as one of the expansion projects, and possibility of the Expansion Project was confirmed.

The Expansion Project has an advantage of not having the need to lower reservoir water level during a construction period for expansion in comparison with other expansion projects of hydropower stations, because the intake facilities for the Expansion Project were already constructed during the construction of the existing power generation facilities.

In these circumstances, the Government of Sri Lanka requested the Government of Japan to conduct a feasibility study for the Expansion Project. In response to the request, JICA, the executing organization of technical assistance of the Government of Japan, conducted a project formation study in August 2007. S/W was concluded between MPE/CEB and JICA on November 19, 2007. Based on S/W, the Study has been commenced by JICA Study Team in January 2008.

1.2 Purpose of the Study

The Study aims at formulating the optimum plan and assessing its technical, economic and financial, and environmental viabilities of the Expansion Project located in Central Province, at carrying out the technology transfer to Sri Lankan counterpart personnel in the course of the Study and at recommending further process of the project implementation.

1.3 Schedule of the Study

The Study was commenced in January 2008 and completed in June 2009 when the final report on the Study was submitted.

Figure 1.3-1 and **Table 1.3-1** show the study schedule.

Table 1.3-1 Work Schedule

FY	FY 2007			FY 2008												FY 2009		
Month	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Total Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
EIA/IEE Procedure by Sri Lanka Side																		
(1) Scoping committee (SC) (April 29, 2008)				▼														
(2) Site visit by SC (May 22, 2008)					▼													
(3) Final TOR for EIA/IEE (2.5 months after site visit)							▼											
JICA Study																		
［FY 2007］																		
(1) Preparatory Work in Japan																		
1) Examination of Basic Methodology	□																	
2) Preparation of Inception Report	□																	
3) Preparation of Questionnaire	□																	
(2) 1st Work in Sri Lanka																		
1) Explanation/Discussion of Inception Report		▲	▲															
2) Data Collection & Site Reconnaissance		■																
3) Power Sector Survey		■																
4) 1st Workshop		■																
5) Confirmation of Scope of Survey under Subletting																		
① Topographic Survey		■																
6) Comparative Study on Alternative Options		■																
［FY 2008］																		
(3) 1st Work in Japan																		
1) Preparation of Comparative Study on Alternative Options					□													
(4) 2nd Work in Sri Lanka																		
1) Comparative Study on Alternative Options																		
① Preliminary Study by JICA Team					■													
② Provision of Input Data for WASP-IV Simulation to CEB						■												
③ Examination of JICA Study Team's Results						■												
2) Optimization of Expansion Plan							■	□										
3) EIA Study																		
① Confirmation of Scope of Survey under Subletting							■											
② Preparation of Bidding Documents							■											
③ Bidding & Contracting for Subletting							■											
④ EIA Study under Subletting								■	■	■	■	■	■	■				
4) Topographic Survey																		
① Determination of Survey Area							■											
② Preparation of Bidding Documents							■											
③ Bidding & Contracting for Subletting							■											
④ Study under Subletting								■	■		■							
(5) 2nd Work in Japan																		
1) Preparation of Interim Report								□										
(6) 3rd Work in Sri Lanka																		
1) Explanation/Discussion of Interim Report								▲	▲									
2) Basic Design																		
① Civil Structures									■	■								
② Electromechanical Equipment									■	■								
③ Preparation of Implementation Schedule												■						
3) Environment & Social Considerations																		
① Impact Assessment/Mitigation Measures												■	■					
② Preparation of Groundwater Monitoring Plan													■					
(7) 3rd Work in Japan																		
1) Economic Analysis and Financial Evaluation												□	□					
2) Examination of Feasibility of Expansion Project													□					
3) Recommendations for Implementation													□					
4) Preparation of Draft Final Report														□				
(8) 4th Work in Sri Lanka																		
1) Explanation/Discussion of Draft Final Report														▲	▲			
2) 2nd Workshop															■			
［FY 2009］																		
(9) 4th Work in Japan																		
1) Preparation & Submission of Final Report																	□	

Legend :

Work in Sri Lanka ■ Work in Japan □ Explanation of Report ▲▲ Tasks by Sri Lanka ▼

No. of Month		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Fiscal Year		FY 2007			FY 2008												FY 2009			
Calendar Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
JICA Study Team	in Japan	Preparatory Work in Japan 1) Examination of Basic Methodology 2) Preparation of Inception Report 3) Preparation of Questionnaire			1st Work in Japan 1) Preparation of Preliminary Study on Alternative Options				2nd Work in Japan 1) Preparation of Interim Report				3rd Work in Japan 1) Economic Analysis & Financial Evaluation 2) Examination of Feasibility of Expansion Project 3) Recommendations for Implementation 4) Preparation of Draft Final Report				4th Work in Japan 1) Preparation of Final Report		
	in Sri Lanka	1st Work in Sri Lanka 1) Explanation/Discussion of Inception Report 2) Data Collection & Site Reconnaissance 3) Power Sector Survey 4) 1st Workshop 5) Confirmation of Scope of Survey under Subletting ① Topographic Survey 6) Comparative Study on Alternative Options			2nd Work in Sri Lanka 1) Comparative Study on Alternative Options ① Preliminary Study by JICA Team ② Provision of Input Data for WASP-IV Simulation to CEB ③ Examination of JICA Team's Study Results 2) Optimization of Expansion Plan 3) EIA Study ① Confirmation of Scope of Study under Subletting ② Preparation of Bidding Documents ③Bidding & Contracting for Subletting ④ Supervision of Work under Subletting 4) Topographic Survey ① Determination of Area for Mapping ② Preparation of Bidding Documents ③ Bidding & Contracting for Subletting ④ Supervision of Work under Subletting				3rd Work in Sri Lanka 1) Explanation/Discussion of Interim Report 2) Basic Design ① Design & Cost Estimation of Civil Works ② Design & Cost Estimation of EM Equipment ③ Preparation of Implementation Schedule 3) Environment and Social Considerations ① Impact Assessment/Mitigation Measures ② Preparation of Groundwater Monitoring Plan			4th Work in Sri Lanka 1) Explanation/Discussion of Draft Final Report 2) 2nd Workshop			
										EIA Study & Topographic Survey（Subletting）										
Report		Ic/R							It/R					Df/R					F/R	
Workshop			1st												2nd					

Assignment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	FY 2007			FY 2008												FY 2009		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
Team Leader/Construction Planning/Power Planning																		
Hydropower Planning Engineer																		
Civil Design Engineer 1 （Powerhouse）																		
Civil Design Engineer 2 （Waterway）																		
Geologist																		
Power System Engineer																		
Electromechanical Engineer																		
Power Planning Engineer (WASP)																		
Economist																		
Environmental Expert																		
Coordinator																		

Figure 1.3-1 Flow Chart of Feasibility Study for Expansion of Victoria Hydropower Station

1.4 Scope of the Study

In this section, the Study items are described as follows

1.4.1 Preparatory Work in Japan

(1) Collection and review of existing data, reports, and relevant information on the Project
(2) Preparation of inception report
(3) Preparation of questionnaire

1.4.2 1st Work in Sri Lanka

(1) Explanation/discussion of inception report
(2) Data collection and site reconnaissance
(3) Power sector survey
(4) 1st workshop
(5) Determination of scope of surveys under subletting (Topographic survey)
(6) Comparative study on alternative options

1.4.3 1st Work in Japan

(1) Preparation of comparative study on alternative options

1.4.4 2nd Work in Sri Lanka

(1) Comparative study on alternative options
(2) Optimization of expansion plan
(3) Survey on environmental and social consideration
  1) Confirmation of scope of survey under subletting
  2) Bidding & contracting for subletting
  3) Supervision of survey under subletting
(4) Topographic survey
  1) Confirmation of scope of survey under subletting
  2) Bidding & contracting for subletting
  3) Supervision of survey under subletting

1.4.5 2nd Work in Japan

(1) Preparation of interim report

1.4.6 3rd Work in Sri Lanka

(1) Explanation/discussion of interim report
(2) Basic design

1.4.7 3rd Work in Japan

(1) Economic analysis and financial evaluation
(2) Examination of feasibility of the Expansion Project
(3) Preparation of recommendations for implementation of the Expansion Project
(4) Preparation of draft final report

1.4.8 4th Work in Sri Lanka

(1) Explanation/discussion of draft final report
(2) 2nd workshop

1.4.9 4th Work in Japan

(1) Preparation and submission of final report

1.5 Surveys under Subletting

Outlines of surveys under subletting are described below:

1.5.1 Survey on Environmental and Social Considerations

The terms of reference (TOR) for the EIA study conducted under subletting were prepared based on those for EIA report issued by MASL, PAA of the expansion project. The outlines of TOR for subletting are described below:

It is noted as follows;

- Environmental evaluation of alternative options is to be described in (1) below, and surveys/examinations for the selected alternative option are to be indicated in items thereafter.
- Study Team provided to the local consultant data or examination results regarding evaluation of alternative options from the technical and economic aspects, project components of the selected alternative option, geology, hydrology, construction planning, affects on the existing structures due to blasting during construction, cost-benefit analysis of the Project, etc, which are covered in the Study. The local consultant is to describe those in the EIA report.

(1) Evaluation of Alternatives
  - To grasp the current environment in the project area through data/information and field surveys
  - To evaluate impacts due to the project
  - To roughly estimate costs for mitigation measures and monitoring plan, for economic evaluation by Study Team

(2) Survey on Current Environment in Project Area

1) Physical environment
  - Survey on characteristics of soils

- River water quality analysis
- Measurement of groundwater level and its water quality analysis
- Land use survey
- Measurement of air quality
- Measurement of noise

2) Biological environment
- Survey on fauna and flora in the project area
- Grasping present ecological status
- Survey on fauna and flora along the tunnel route
- Grasping the number of trees to be cut

3) Social environment
- Population survey
- Survey on social economic status
- Survey on river water users
- Survey on infrastructures and culturally/historically protected reserves
- Survey on socially/culturally sensitive areas

(3) Impact Assessment

1) Water resources and water quality
- Quality of surface water and groundwater
- Change in groundwater level

2) Ecology

3) Agricultural field

4) Air quality

5) Noise

(4) Mitigation Measures

1) Environmental monitoring program

2) Soil conservation management program

3) Debris, wastes, tunnel muck disposal facilities

4) Public health measures

5) Disaster management plan

6) Plan on restoration of land in the construction area

(5) Cost-Benefit Analysis

1) Cost estimate of mitigation measures and monitoring program

2) Descriptions of cost-benefit analysis for the project based on the study result to be provided by Study Team

(6) Preparation of Environmental Monitoring Program

(7) Preparation of EIA Report

1) Preparation of draft EIA report in English

2) Translation of EIA report into Sinhalese and Dravidian

1.5.2 Topographic Survey

The following surveys were carried out in the Study:

- 1/1,000 topographic mapping in the powerhouse area
- River cross section and longitudinal section survey from the outlet site 1.4 km in length downstream

1.6 Record on Dispatch of Study Team and Submission of Report

JICA commenced the Study in January 2008, based on S/W, and dispatched the Study Team to Sri Lanka as described below:

- 1st Work in Sri Lanka January 30, 2008 to February 29, 2008
- 2nd Work in Sri Lanka May 14, 2008 to July 30, 2008
- 3rd Work in Sri Lanka September 7, 2008 to November 26, 2008
  December 23, 2008 to January 17, 2009
- 4th Work in Sri Lanka January 28, 2009 to February 26, 2009

The Study Team submitted the following report on the Study to JICA/CEB:

- Inception Report January 2008
- Interim Report September 2008
- Draft Final Report January 2009
- Final Report June 2009

1.7 CEB and Study Team

1.7.1 CEB

The CEB counterpart is listed in **Table 1.7.1-1**:

Table 1.7.1-1 List of CEB Counterpart

No.	Name	Title	Responsibility
1	Ms. A. D. Tillekeratne	Deputy General Manager (Transmission & Generation Planning)	Team Leader
2	Mr. Samitha Midigaspe	Chief Engineer, Generation Planning & Design Branch	Focal Points
3	Ms. Thushara De Silva	Electrical Engineer, Generation Planning & Design Branch	Data & Power Planning
4	Mr. G. K. C. Opathella	Electrical Engineer, Generation Planning & Design Branch	General
5	Mr. A. A. Jayawardane	Electrical Engineer, Generation Planning & Design Branch	General
6	Mr. N. Anuradha Mudannayake	Electrical Engineer, Generation Planning & Design Branch	General Coordination & Power Planning
7	Mr. M. P. L. Rohitha Gunawardane	Environmental Officer, Transmission Design & Environment Branch	Environment
8	Dr. L. B. K. Laksiri	Civil Engineer, Project Director of Broadlands Hydropower Project	Civil, Hydrology, & Geology
9	Ms. Tharanga Wickramarathna	Electrical Engineer, Transmission Planning Branch	Power System
10	Mr. D. H. S. K. Thimothies	Chief Engineer (System Control Branch), System Control (Dispatch Centre)	Data & Power System
11	Mr. G. J. Aluthge	Project Manager of Moragolla Hydropower Project	System Operation & Electromechanical
12	Mr. T. M. S. K. Tillekeratne	Chief Engineer, Victoria Hydropower Station	Electromechanical Equipment
13	Mr. U. R. S. S. Senadhiratne	Electrical Engineer, Victoria Hydropower Station	Coordination in Victoria Hydropower Station
14	Mr. K. D. Mullarachechi	Operation Engineer, Victoria Hydropower Station	Coordination in Victoria Hydropower Station
15	Mr. B. M. I. Bandaranayake	Mechanical Engineer, Victoria Hydropower Station	Coordination in Victoria Hydropower Station
16	Mr. S. C. Nissanka	Civil Engineer, Victoria Hydropower Station	Coordination in Victoria Hydropower Station

1.7.2 JICA Study Team

The JICA Study Team members are listed in **Table 1.7.2-1**:

Table 1.7.2-1 List of Study Team Members

	Name	Assignment	Firm	Remarks
1	Yoshimasa Ishii	Team Leader / Power Planning / Construction Planning	Electric Power Development Co., Ltd. (J-Power)	
2	Sohei Uematsu	Hydropower Planning	Nippon Koei Co., Ltd	
3	Nobuaki Kawata	Civil Engineer 1 (Powerhouse)	J-Power	Up to August 2008
4	Tetsuaki Mouri	Civil Engineer 1 (Powerhouse)	J-Power	From August 2008
5	Shozo Kawasaki	Civil Engineer 2 (Waterway)	J-Power	
6	Tadashi Amano	Geology	J-Power	
7	Takatsugu Okabe	System Planning	J-Power	
8	Kozo Utsumi	Electromechanical Equipment	J-Power	
9	Hitoshi Azuma	Power Planning (WASP)	J-Power	
10	Tetsuya Hirahara	Economic and Financial Analysis	J-Power	
11	Akiko Urago	Environmental and Social Considerations	Nippon Koei Co., Ltd	
12	Tusyoshi Nakahara	Coordination	J-Power	Up to August 2008
13	Yasuaki Taguchi	Coordination	J-Power	Aug. to Dec.2008
14	Niro Okamoto	Coordination	J-Power	From Jan. 2009

CHAPTER 2

GENERAL INFORMATION OF SRI LANKA

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Chapter 2 General Information of Sri Lanka

2.1 Geography

The Democratic Socialist Republic of Sri Lanka (hereinafter referred to as "Sri Lanka") is an island country in the Indian Ocean, located to the south of the Indian subcontinent. The main island lies between 5°55´ and 9°55´ north latitude and between 79°42´ and 81°52´ east longitude, and stretches for about 240 km in the east-west direction and 435 km in the north-south direction. The area of the country is 67,095 km^2 including the internal waters of 1,170 km^2.

The administrative capital was relocated from Colombo to Sri Jayewardenepura in 1984, on the outskirts of Colombo. However, in practice, capital city functions remain in Colombo.

The topographic features of Sri Lanka are categorized in three zones on the basis of elevation: a central mountainous area called as the Central Highlands, the plains, and the coastal belt.

The Central Highlands area is in the south-central part of Sri Lanka. The core of this area is a high ridge, running north-south for approximately 65 km in length. This area includes some of Sri Lanka's highest mountains. Mt. Pidurutalagala is the highest at 2,524 m. At the plateau's southern end, mountain ranges stretch 50 km to the west toward Adams Peak (2,243 m) and 50 km to the east toward Mt. Namunukula(2,036 m). Flanking the high central ridges are two plateaus. On the west is the Hatton Plateau, a deeply dissected series of ridges sloping downward the north. On the east, the Uva Basin consists of rolling hills traversed by some deep valleys and gorges. To the north, separated from the main body of mountains and plateaus by broad valleys, lies the Knuckles Massif, with steep escarpments, deep gorges, and peaks rising to more than 1,800 m. South of Adams Peak lies the parallel ridges of the Rakwana Hills, with several peaks over 1,400 m.

Most of the island's surface consists of plains between 30 and 200 m above sea-level. In the southwest, ridges and valleys rise gradually to merge with the Central Highlands, giving a dissected appearance to the plain. Extensive erosion in this area has worn down the ridges and deposited rich soil for agriculture downstream. In the southeast, a red, lateritic soil covers relatively level ground that is studded with bare, monolithic hills. The transition from the plain to the Central Highlands is abrupt in the southeast, and the mountains appear to rise like a wall. In the east and the north, the plain is flat, dissected by long, narrow ridges of granite running from the Central Highlands.

A coastal belt about 30 m above sea-level surrounds the island. Much of the coast consists of sandy beaches indented by coastal lagoons. In the Jaffna Peninsula, limestone beds are exposed to the sea as low-lying cliffs in a few places. In the northeast and the southwest, where the coast cuts across the stratification of the crystalline rocks, rocky cliffs, bays, and offshore islands can be found: these conditions have created natural harbors at Trincomalee on the northeast coast and Galle on the southwest coast.

The rivers of Sri Lanka radiate from the Central Highlands to the sea. There are 16 principal rivers longer than 100 km in length, with 12 of them carrying about 75 percent of the mean river discharge in the entire country. The longest river is the Mahaweli Ganga (335 km), and the Aruvi Aru (164 km) follows. In the Central Highlands, river courses are frequently broken by discontinuities in the terrain, and where they encounter escarpments, numerous waterfalls and rapids have eroded a passage. Once they reach the plain, the rivers slow down and the waters meander across flood plains and deltas. The upper reaches of the river are wild and usually unnavigable, and the lower reaches are prone to seasonal flooding.

2.2 Climate

The climate of Sri Lanka is categorized as tropical as a whole. The annual average temperature in Colombo is about 27°C. At higher elevations, however, it is quite cool, and the annual average temperature goes down to about 15°C in Nuwara Eliya at about 1,800 m above sea-level.

The rainfall pattern is influenced by the monsoon winds of the Indian Ocean and Bay of Bengal and is marked by four seasons. The first season is from mid-May to October, when winds originate in the southwest, bringing moisture from the Indian Ocean. When these winds encounter the slopes of the Central Highlands, they unload heavy rains on the mountain slopes and the southwestern area of the island. However the leeward slopes in the east and northeast receive little rain. The second season occurs in October and November, the inter-monsoon season. During this season, periodic squalls occur and sometimes tropical cyclones bring overcast skies and rains to the southwest, northeast and eastern parts of the island. During the third season, December to March, monsoon winds come from the northeast, bringing moisture from the Bay of Bengal, unloading heavy rains on the northeastern slopes of the mountains. Another inter-monsoon period occurs from March to mid-May.

Monthly mean temperatures and monthly total precipitation in Colombo and Nuwara Eliya are shown in **Table 2.2-1** and **Table 2.2-2**, respectively.

Table 2.2-1 Monthly Mean Temperature

(°C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Colombo	26.4	26.7	27.6	28.0	28.0	27.6	27.3	27.3	27.4	26.8	26.4	26.3
Nuwara Eliya	14.2	14.3	15.1	16.2	16.9	16.0	15.5	15.7	15.7	15.8	15.5	14.7

Source: Hydropower Optimization Study, JICA

Table 2.2-2 Monthly Total Precipitation

(mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Colombo	79.7	81.8	113.7	255.8	368.7	199.5	147.0	90.1	233.7	372.2	319.0	175.1
Nuwara Eliya	116.1	89.6	68.9	168.9	184.7	215.0	185.0	160.1	177.1	245.0	221.9	212.9

Source: Hydropower Optimization Study, JICA

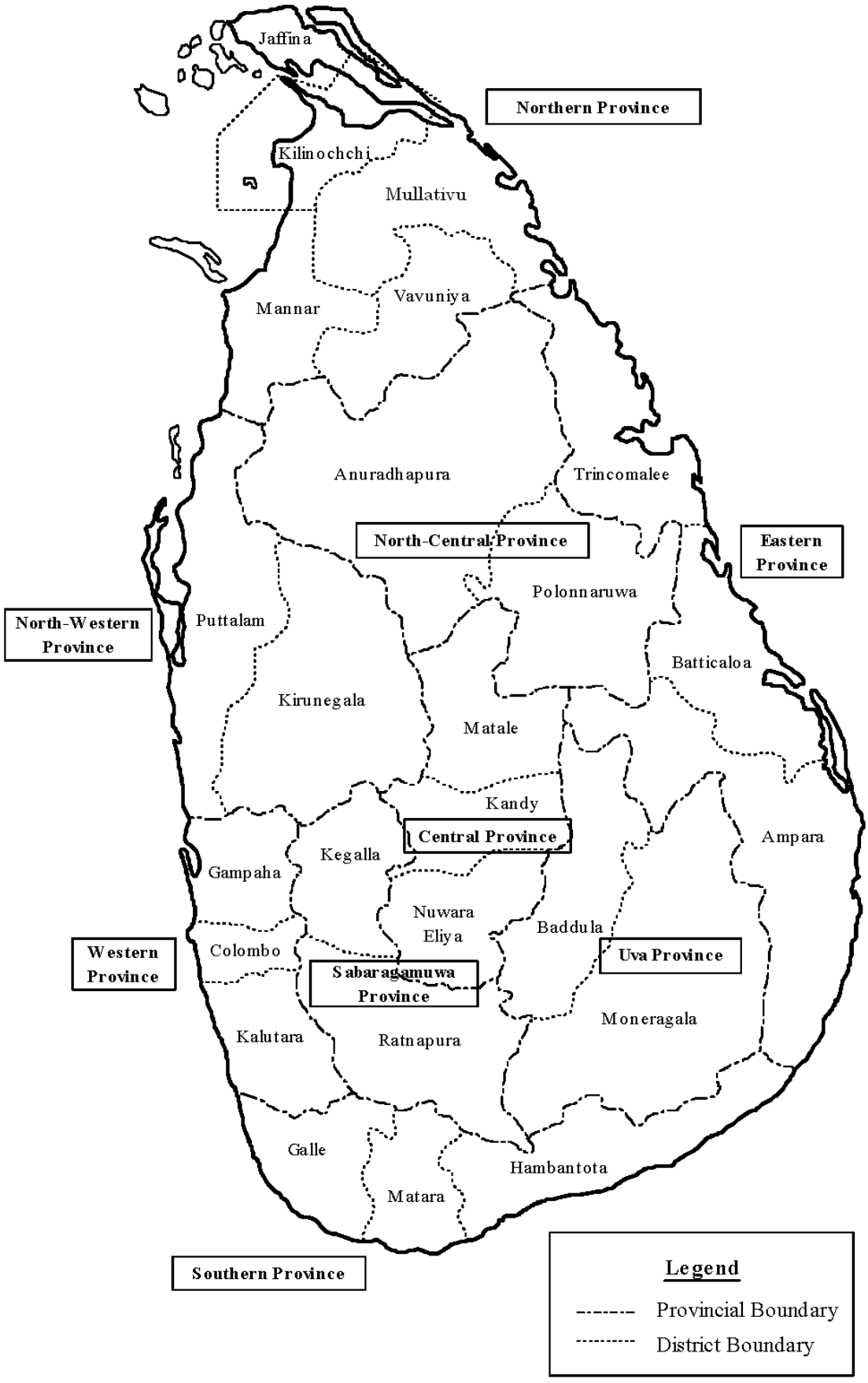
2.3 Government

The president, who is elected directly for a six-year term, serves as the head of state. In Sri Lanka, the president also serves as the head of government and appoints cabinet ministers in consultation with the prime minister. As of March 2008, there were 58 ministries of cabinet rank; the CEB belongs to the Ministry of Power and Energy.

The legislative branch of the government is unicameral, and the Parliament consists of 225 seats. The members of Parliament are elected by popular vote on the basis of a modified proportional representation system and serve six-year terms.

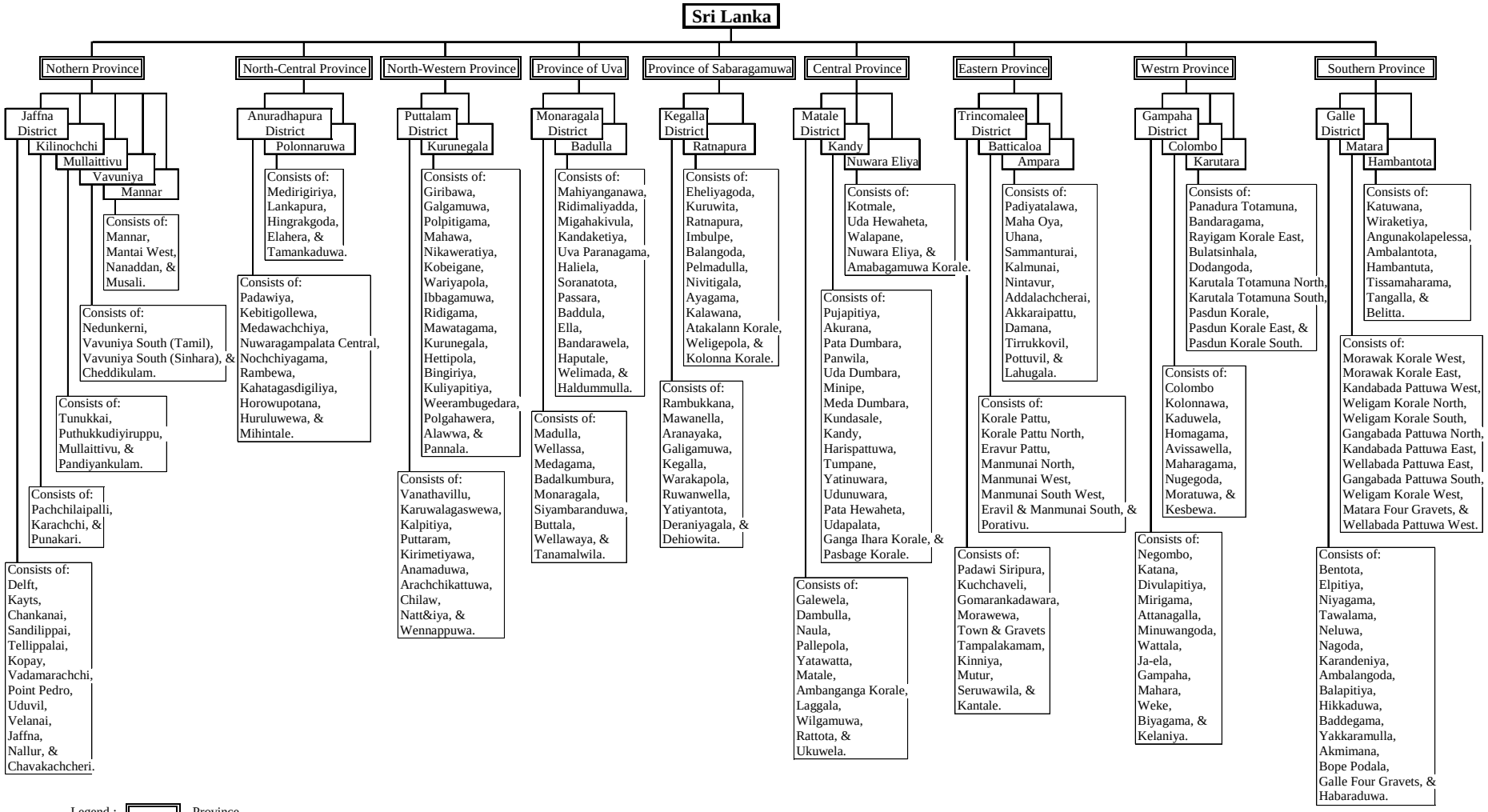
The administrative divisions of the country consist of 9 provinces, and 25 districts under these provinces. The smallest administrative unit is the Assistant Government Agent of Divisions (AGA Division), and there are 247 AGA Divisions in the country. The Victoria Hydropower Station is located in Nuwara Eliya District in Central Province.

Figure 2.3-1 and **Figure 2.3-2** show the administrative boundaries and the administrative structure of the country, respectively.



Source: Hydropower Optimization Study, JICA

Figure 2.3-1 Administrative Boundary



Source : CEB

Figure 2.3-2 Administrative Structure of Sri Lanka

2.4 Population

2.4.1 Census Population

The country has conducted 13 times of Population Censuses since 1871 up to 2001. The latest demographic survey was done by the Department of Census and Statistics (DCS) under the Ministry of Finance and Planning in July 2001, but its aggregation does not include population of North and East Provinces.

Table 2.4.1-1 shows the census population in 1981 and 2001. According to the table, the population of 14.85 million in 1981 increased to 18.80 million in 2001, the average annual growth rate was calculated at 1.19% for 20 years between the two censuses.

Population density was around 333 persons per km^2 in 2001 as shown in **Table 2.4.1-1**.

Table 2.4.1-1 Census Population and Administrative Area in Sri Lanka

Province/District	Area (km^2)			Population		Population Density in 2001 (Persons/ km^2)	Average Annual Growth Rate (%)
	Land	Inland Waters	Total Area	1981 Census (1000)	2001 Census (1000)		1981 - 2001
Western Province	3,593	91	3,684	3,920	5,381	1,461	1.60
Colombo	676	23	699	1,699	2,251	3,220	1.42
Gampaha	1,341	46	1,387	1,391	2,064	1,488	1.99
Kalutara	1,576	22	1,598	830	1,066	667	1.26
Central Province	5,575	99	5,674	2,009	2,424	427	0.94
Kandy	1,917	23	1,940	1,048	1,279	659	1.00
Matale	1,952	41	1,993	357	441	221	1.06
Nuwara Eliya	1,706	35	1,741	604	704	404	0.77
Southern Province	5,383	161	5,544	1,883	2,277	411	0.96
Galle	1,617	35	1,652	815	990	599	0.98
Matara	1,270	13	1,283	644	761	593	0.84
Hambantota	2,496	113	2,609	424	526	202	1.08
Northern Province	8,290	594	8,884	1,109			
Jaffna	929	96	1,025	831			
Kilinochchi	1,205	74	1,279	-			
Mannar	1,880	116	1,996	106	*1		
Vavuniya	1,861	106	1,967	95	1,868	129	0.49
Mullaitivu	2,415	202	2,617	77			
Eastern Province	9,361	635	9,996	975			
Batticaloa	2,610	244	2,854	330			
Trincomalee	2,529	198	2,727	256			
Amparai	4,222	193	4,415	389	593	134	2.13
North-Western Province	7,506	382	7,888	1,704	2,170	275	1.22
Kurunegala	4,624	192	4,816	1,212	1,460	303	0.94
Puttalam	2,882	190	3,072	493	710	231	1.85
North-Central Province	9,741	731	10,472	850	1,105	106	1.32
Anuradhapura	6,664	515	7,179	588	746	104	1.20
Polonnaruwa	3,077	216	3,293	262	359	109	1.60
Uva Province	8,335	165	8,500	915	1,177	138	1.27
Baddula	2,827	34	2,861	641	780	273	0.99
Moneragala	5,508	131	5,639	274	397	70	1.88
Sabaragamuwa Province	4,921	47	4,968	1,482	1,802	363	0.98
Ratnapura	3,236	39	3,275	797	1,016	310	1.22
Kegalla	1,685	8	1,693	685	786	464	0.69
Total in Sri Lanka	62,705	2,905	65,610	14,847	18,797	333	1.19

Source : Final Result of 2001 Census, Department of Census and Statistics, MFP
Note: *1 The populations in Northern and Eastern Provinces were not included.

2.4.2 Labor Force

A labor force was amounted as 7.5 million persons as of 2007, of which around 94% was actually employed. Thus, an unemployed rate was 6.0% in the same year as shown in **Table 2.4.2-1**. Since the unemployment rate was 10.5% in 1997, the rate in labor market has been improved by around 4.5% for eleven years.

The labor market can be disaggregated into three sectors of agriculture sector, industry sector and service sector. The service sector absorbed 42% of the overall employed workforce in 2007, the largest share in the three economic sectors. The agriculture sector absorbed 31% of the total people employed. Following them, the industries sector had 27%, as shown in the table. The agriculture sector share has gradually decreased from 36% in 1997, and the labor force in the agriculture sector seems to move to the other two sectors.

Minimum wages in 2007 were reported as Rs.171 per day for estate workers and Rs.13,670 per month for unskilled male workers in government employment, as shown in **Table 2.4.2-2**. Since their wages in 1999 were Rs.96 per day and Rs.3,400 per month respectively, their growth indices were 1.80 and 4.02 times for these seven years. The increase of consumer price index (CPI) in whole Sri Lanka was 2.03 times for the same period, so wage growth rates were almost equivalent to or higher than the CPI.

Table 2.4.2-1 Labour Force in Sri Lanka

Item	1997 *1	1998 *1	1999 *1	2000 *1	2001 *1	2002 *1	2003 *2	2004 *3	2005 *4	2006 *1	2007 *1
Estimated Mid-year Population (1000) *a											
Population in Sri Lanka	18,568	18,774	19,043	19,359	18,732	19,007	19,252	19,462	19,668	19,886	20,010
Annual Growth Rate (%)	1.3%	1.1%	1.4%	1.7%	-3.2%	1.5%	1.3%	1.1%	1.1%	1.1%	0.6%
Labour Force Participation of Household Population (1000)											
Household Population (10-years & Over)	12,871	12,882	13,169	13,565	13,870	14,201	15,651	16,593	16,871	14,834	15,048
Labour Force	6,266	6,661	6,673	6,827	6,773	7,145	7,654	8,061	8,141	7,599	7,489
Labour Force Participation Rate(%)	48.7	51.7	50.7	50.3	48.8	50.3	48.9	48.6	48.3	51.2	49.8
Actual Labour Force Situation											
Employed Force	5,608	6,049	6,083	6,310	6,236	6,519	7,013	7,394	7,518	7,105	7,042
Employment Rate(%)	89.5	90.8	91.1	92.4	92.1	91.2	91.6	91.7	92.3	93.5	94.0
Unemployed Force	658	611	591	517	537	626	641	667	623	493	447
Unemployment Rate(%)	10.5	9.2	8.9	7.6	7.9	8.8	8.4	8.3	7.7	6.5	6.0
Currently Employed Persons by Major Industrial Groups (%)											
Agriculture	36.2	39.3	36.3	36.0	32.6	34.5	34.0	33.5	30.7	32.2	31.3
Industries	24.2	21.9	21.9	23.6	23.9	22.4	23.0	24.1	25.6	26.6	26.6
Services	39.6	38.8	41.8	40.3	43.5	43.1	43.0	42.4	43.7	41.2	42.1

Source Mid-year Population Estimate, Department of Census and Statistics
Sri Lanka Labour Force Survey, Department of Census and Statistics
Note for Population:
*a; Population in 2001 was obtained from census of population and housing 2001, those in the other years were provisional.
Note for Labour Force;
*1: Excluding Eastern and Northern Provinces
*2: Including Eastern Province but excluding Northern Province
*3: Excluding Mulathivu and Kilinochchi Districts
*4: Including all districts

Table 2.4.2-2 Minimum Wages: 1997-2007

Item	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Average Wage Rate*1 (Rs./day)											
Agriculture *2	82.00	88.80	94.81	96.14	100.96	107.69	114.60	119.53	127.52	147.94	170.53
Manufacturing	77.74	82.08	89.47	93.42	105.06	111.04	114.52	123.72	126.31	128.51	173.15
Construction	86.00	91.42	99.00	99.00	155.00	155.00	155.00	155.00	178.50	178.50	200.50
Average Earnings*1 (Rs./day)											
Agriculture *2	87.40	100.72	96.89	104.12	112.11	128.72	138.43	152.94	178.47	206.33	198.01 *4
Manufacturing	166.30	174.17	199.20	221.11	230.66	273.10	306.28	310.84	336.49	356.11	411.60 *4
Construction	209.50	247.55	241.11	285.99	263.12	259.63	276.42	335.70	416.75	424.55	408.37 *4
Index Numbers of Minimum Wages (Base: 1978=100)											
Agriculture	971.8	1,097.7	1,115.9	1,142.7	1,176.4	1,269.6	1,382.3	1,397.7	1,527.4	1,567.1	1,821.40
Industry & Construction	710.7	807.7	829.2	857.2	919.7	986.5	1,009.4	1,044.1	1,078.4	1,090.6	1,522.40
Services	487.2	506.3	559.7	559.7	657.6	678.0	678.0	751.0	779.7	779.7	1,057.10
All Combined	849.1	953.3	977.6	1,000.4	1,049.2	1,126.5	1,205.3	1,233.1	1,329.7	1,358.2	1,648.80
Tea & Rubber Estate Workers											
Minimum Daily Rate of Wages (Rs./day)	82.41	85.47	94.65	94.65	97.51	99.56	112.24	116.46	116.46	132.83	154.51
Minimum Wage Rate Index Number (Base 1978=100)	957.15	992.65	1,099.30	1,099.30	1,132.57	1,156.33	1,303.54	1,352.61	1,352.61	1,542.74	1,794.57
Index Number of Real Wages (Base 1978=100)	104.46	98.96	104.70	98.69	88.99	82.99	87.70	84.97	76.01	76.65	75.30
Unskilled Male Workers in Government Employment *3											
Minimum Monthly Rate of Wages (Rs./month)	3,400.00	3,400.00	3,400.00	3,750.00	4,700.00	5,600.00	5,600.00	7,058.33	9,350.09	11,727.50	13,667.60
Minimum Wage Rate Index Number (Base 1978=100)	1,226.55	1,226.50	1,226.55	1,352.81	1,695.53	2,020.20	2,020.20	2,546.30	3,373.02	4,230.70	4,930.56
Index Number of Real Wages (Base 1978=100)	133.99	122.32	116.85	121.17	133.09	144.99	136.32	159.55	189.56	209.61	207.94

Source : Statistical Abstract 2007, December 2007, Department of Census and Statistics, Ministry of Finance and Planning Department of Labour
Note: *1 Wage Rates and Earnings are for the unskilled and skilled workers, respectively.
*2 There is no official minimum wage for agriculture sector, these rates are averages of plantation sector, i.e., Tea, Rubber, Coconut, Cocoa, Caromen and Pepper Growing Trades.
*3 As there is no salary inequality among workers in government employment according to their gender, all unskilled workers have been considered alike.
*4 Provisional

2.4.3 Ethnic Group and Religion

Sri Lanka is essentially composed of three main ethnic groups, i.e., the Sinhalese, Tamil and Muslim. They make up more than 99% of the countries population, as shown in **Table 2.4.3-1**. These groups are corresponding to religious and linguistic distinctions. The Sinhalese account for three-fourths of the people. They constitute the majority in the southern, western, central and north central parts of the country. On the particular rural areas of the Wet Zone lowlands, they account for more than 95% of those regional populations. The Tamil accounts for 17%, comprising two groups of Sri Lankan Tamils and Indian Tamils. They are in the Jaffna Peninsula, Central Hill country, Colombo and the northern lowlands. The Muslims account for about 8%, mainly reside in the eastern lowlands.

As shown in **Table 2.4.3-2**, Buddhist shares 77% of the population, 8% Hindus and 8% Muslims follow, and Roman Catholic 6%.

Table 2.4.3-1 Population by Ethnicity in 2001 Census Year

(Unit: 1000)

Province/District	Sinhalese	Sri Lankan Tamil	Indian Tamil	Sri Lankan Moor	Burgher	Malay	Others	Total
Western Province	4,531	326	62	375	28	37	25	5,384
Colombo	1,724	248	25	203	16	22	14	2,252
Gampaha	1,878	65	8	79	11	14	10	2,065
Kalutara	929	13	29	93	1	1	1	1,067
Central Province	1,584	122	483	223	3	5	4	2,424
Kandy	948	52	104	168	2	3	2	1,279
Matale	354	24	23	38	0	1	1	441
Nuwara Eliya	282	46	356	17	1	1	1	704
Southern Province	2,163	18	26	63	0	7	0	2,277
Galle	935	11	9	35	0	0	0	990
Matara	717	5	17	22	0	0	0	761
Hambantota	511	2	0	6	0	7	0	526
Northern Province								
Jaffna								
Kilinochchi *1								
Mannar	49	976	3	13	0	0	0	1,041
Vavuniya								
Mullaitivu								
Eastern Province	323	634	2	455	4	1	0	1,419
Batticaloa *1	6	362	1	114	3	0	0	486
Trincomalee *1	80	163	0	96	0	1	0	340
Amparai	237	109	1	245	1	0	0	593
North-Western Province	1,864	66	5	228	1	3	2	2,169
Kurunegala	1,341	18	3	95	0	2	1	1,460
Puttalam	523	48	2	133	1	1	1	709
North-Central Province	1,001	12	0	89	0	0	2	1,104
Anuradhapura	676	5	0	62	0	0	2	745
Polonnaruwa	325	7	0	27	0	0	0	359
Uva Province	940	36	151	47	1	2	1	1,178
Baddula	564	30	144	39	1	2	1	781
Moneragala	376	6	7	8	0	0	0	397
Sabaragamuwa Province	1,557	44	127	71	0	0	2	1,801
Ratnapura	882	29	83	21	0	0	1	1,016
Kegalla	675	15	44	50	0	0	1	785
Total in Sri Lanka	14,012	2,234	859	1,564	37	55	36	18,797
% Distribution	75%	12%	5%	8%	0%	0%	0%	100%

Source : Final Result of 2001 Census, Department of Census and Statistics, MFP
Note: *1 The populations in Northern and Eastern Provinces were not included.

Table 2.4.3-2 Population by Religion in 2001 Census Year

(Unit: 1000)

District	Buddhist	Hindus	Islam	Roman Catholic	Other Christian	Others	Total
Colombo	1,578	195	242	182	51	3	2,251
Gampaha	1,480	42	93	418	28	1	2,062
Kalutara	884	35	106	36	5	0	1,066
Kandy	937	134	174	23	10	0	1,278
Matale	349	42	40	8	2	0	441
Nuwara Eliya	279	359	19	35	11	1	704
Galle	932	15	35	5	3	0	990
Matara	716	17	22	3	2	0	760
Hambantota	510	1	13	1	1	0	526
Amparai	236	100	245	8	4	0	593
Kurunegala	1,301	13	98	41	7	1	1,461
Puttalam	308	29	135	230	7	1	710
Anuradhapura	671	3	63	6	2	0	745
Polonnaruwa	320	7	27	4	1	0	359
Baddula	562	158	41	13	5	0	779
Moneragala	375	12	8	2	1	0	398
Ratnapura	880	97	22	12	5	0	1,016
Kegalla	668	52	52	9	5	0	786
Total in 18 Districts	12,986	1,311	1,435	1,036	150	7	16,929
% Distribution	77%	8%	8%	6%	1%	0%	100%

Source : Final Result of 2001 Census, Department of Census and Statistics, MFP

2.5 Macro-economy

The macro-economic status of Sri Lanka is described in the following subsections. Major macro-economic indexes are shown in **Table 2.5-1**.

Table 2.5-1 Major Macroeconomic Indexes in Sri Lanka

No.	Description	Unit	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008 *1
1	Population at mid year	1000	18,774	19,043	19,359	18,732	19,007	19,252	19,462	19,668	19,886	20,010	20,217
2	Unemployment rate	%	9.2	8.9	7.6	7.9	8.8	8.4	8.3	7.7	6.5	5.5	5.2
3	GDP at Current Factor Cost Price	Billion Rp.	912.8	994.7	1125.3	1245.6	1403.3	1562.7	1800.7	2098.0	2484.2	n.a	n.a
4	Growth rate of GDP at Current Factor Cost Price	%	4.7	4.3	6.0	-1.5	4.0	6.0	5.4	6.0	7.4	n.a	n.a
5	Per Capita GDP at Current Market Pric	US$	879	863	899	841	870	981	1,062	1,241	1,421	1,634	2,014
6	CPI Growth Rate Sri Lanka Consumers' Price Index	%	n.a.	n.a.	1.5	12.0	10.2	2.6	7.9	10.6	9.6	20.4	n.a.
7	Average Excange Rate (US$ 1 =) *1	Rp.	64.59	70.39	75.78	89.36	95.66	96.52	101.19	100.50	103.95	110.62	108.33
8	Trade Balance	Billion Rp.	-1,091	-1,369	-1,798	-1,157	-1,407	-1,539	-2,243	-2,516	-3,370	-3,656	-5,871
9	Exports	Billion Rp.	4,798	4,610	5,522	4,817	4,699	5,133	5,757	6,347	6,883	7,640	8,137
10	Imports	Billion Rp.	5,889	5,979	7,320	5,974	6,106	6,672	8,000	8,863	10,253	11,296	14,008
11	Current Account Balance (% of GNP)	%	-1.4	-3.6	-6.4	-1.4	-1.4	-0.4	-3.1	-2.7	-5.3	-4.3	-9.3
12	Investment (% of GDP)	%	25.1	27.3	28	22	21.3	22	25.3	26.8	28.0	28.0	27.5
	Private	%	24.8	24.8	24.8	19.2	18.7	19.2	22.5	22.4	23.9	22.6	20.6
	Government	%	3	3.5	3.3	2.8	2.6	2.8	2.7	4.4	4.1	5.4	6.9
13	National Savings (% of GDP)	%	23.4	23.5	21.5	20.3	19.5	21.5	22	23.8	22.3	23.3	18.2
14	Revenue of Government Financial Operation (% of GDP)	%	17.2	17.7	16.8	16.7	16.5	15.2	14.9	15.5	16.3	15.8	14.9
15	Expenditure of Government Financial Operation (% of GDP)	%	26.3	25.2	26.7	27.5	25.4	22.9	22.8	23.8	24.3	23.5	22.6
16	Overall Budget Deficit of Government Financial Operation (% of GDP)	%	-9.2	-7.5	-9.9	-10.8	-8.9	-7.7	-7.9	-8.4	-8.0	-7.7	-7.7
17	Government Debt (% of GDP)	%	90.8	95.1	96.9	103.3	105.6	102.3	102.3	90.6	87.8	85.0	81.1
18	Total External Debt and Liabilities (% of GDP)	%	55.5	57.8	54.5	53.2	56.3	56.9	54.9	46.5	42.4	43.2	37.1
19	Debt service ratio	%	13.3	15.2	14.7	13.2	13.2	11.6	11.6	7.9	12.7	13.1	15.0

Source: Statistical Abstract, Department of Census and Statistics
Annual Report, Central Bank of Sri Lanka
Note: *1: Period Average

2.5.1 National Accounts

The gross domestic product (GDP) at current factor cost prices in Sri Lanka was Rs.2,484 billion in 2006, as shown in **Table 2.5.1-1**. Among major economic sectors, "trade, restaurant & hotels" sector recorded the largest gross value added (GVA) of Rs.496 billion, the highest contribution to the national economy, accounting for 20% of GDP as shown in **Table 2.5.1-2**. This sector's percentage contribution to GDP has decreased for the recent 10 years.

An economic sector of "agriculture, forestry & fishery" accounted for Rs.409 billion or 16.5% of GDP, the second position in GDP contribution. As shown in the table, the sector has decreased its GDP contribution.

Following them, "transport and communication" sector occupied the third position, accounting for Rs.361 billion or 14.5% of GDP. The manufacturing sector had the third position in GDP contribution up to 2005 but has gone down to the forth position in 2006 due to increase of GVA of "transport and communication".

Per capita GDP (at Market Price) was Rs.218,200 as shown in **Table 2.5.1-3**, equivalent to around US$2,014 in 2008. It has grown steadily after 2003 in US Dollar basis as shown in the table, although it dropped down to a minus rate because of a negative growth in 1999 and in 2001.

Table 2.5.1-4 shows GDP at 1996 constant factor cost prices, which figures out the real growth of the national economy (see **Table 2.5.1-5**). In 2001, the national economy recorded the worst performance for recent ten years, with real negative GDP growth of -1.5%, due to decreases in agricultural products caused by drought and decreases in demand of export goods. However, GDP has grown at a stable annual growth rate of 5.8% on average for the recent five years. Although the tsunami gave damages estimated as around US$1 billion to the country, affects on the damages to the national economy were compensated with investments for intensifying reconstruction activities, and much less concerns of affects on the damage to the national economy than expected have been revealed.

The three major sectors mentioned above have grown at 5.6%, 2.1% and 11.3% per annum on average for recent five years. Thus, the "agriculture, forestry and fishery" sector has grown at the lowest rate among the sectors. From the viewpoint of growth, the remarkable sector was "transport and communication". Although "electricity, gas and water supply" sector had rapid changes its annual growth rate, the growth rate of the sector recorded 12.0% on average for the same period.

Table 2.5.1-6 shows gross domestic expenditure (GDE) at current market prices from 1996 to 2006. In 2006, consumption accounted for Rs.2,213 billion or 73% of the total GDE, as shown in **Table 2.5.1-7**. Then, gross domestic fixed capital formation was Rs.803 billion, accounting for 27%. Of this total, that of public sector was Rs.108 billion or only 4% of the total GDE. This share gradually decreased year by year up to 2002, but has increased since 2003, as shown in the table. On the other hand, that of private sector has increased from 19% in 1996 to 23% in 2006, although it decreased temporarily.

Table 2.5.1-1 Gross Domestic Product at Current Factor Cost Prices: 1996-2006

(Unit: Rs. Billion)

Sector	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006 *1
Agriculture, Forestry & Fishery	156.1	175.8	192.7	205.6	223.9	249.8	287.8	297.3	320.5	362.8	409.0
Agriculture	122.6	139.0	153.3	163.5	177.4	199.6	232.9	238.2	257.7	306.4	329.9
Tea	10.3	12.7	14.4	12.3	15.6	15.9	17.3	16.9	20.8	21.6	22.8
Rubber	4.0	3.1	2.5	2.3	2.5	2.5	3.2	4.9	6.3	8.0	11.6
Coconut	12.8	15.0	15.6	17.7	13.2	13.3	20.2	19.3	19.4	23.9	22.6
Paddy	19.9	24.5	26.8	30.2	32.1	34.7	41.8	41.0	45.1	53.3	49.4
Others	75.5	83.8	94.0	101.1	114.0	133.2	150.3	156.2	166.1	199.6	223.6
Forestry	14.8	15.4	15.7	16.3	17.1	19.1	20.6	24.7	29.0	34.8	41.0
Fishery	18.8	21.4	23.7	25.8	29.4	31.1	34.4	34.4	33.8	21.6	38.0
Mining & Quarrying	13.9	16.6	17.4	18.3	21.5	24.0	25.8	27.5	36.0	45.0	53.9
Manufacturing	112.7	131.9	151.0	163.1	189.3	198.7	222.0	243.6	275.8	310.4	345.9
Export Processing (Tea, Rubber & Coconut)	16.2	19.5	23.2	24.8	28.2	28.6	35.0	35.9	42.1	47.3	52.7
Factory Industry	87.8	102.3	116.6	125.9	147.3	155.5	170.5	189.8	214.5	239.6	264.9
Small Industry	8.8	10.1	11.3	12.4	13.8	14.7	16.4	17.9	19.3	23.6	28.3
Construction	48.2	56.4	69.3	75.5	82.7	95.1	100.6	113.3	142.4	176.9	225.9
Electricity, Gas & Water	9.2	11.3	13.7	14.4	13.4	16.1	20.3	28.4	27.7	36.6	46.7
Trade, Restaurants & Hotels	159.8	182.5	202.2	218.3	261.2	269.9	295.5	323.3	380.9	424.7	496.4
Transport & Communication	74.5	87.2	102.6	115.0	133.0	152.0	175.7	216.1	260.3	305.5	361.4
Banking, Insurance & Real Estate	68.3	80.7	92.9	106.8	114.4	138.1	158.1	192.7	217.6	254.5	313.9
Public Administration	53.2	61.3	71.0	77.7	85.7	101.9	117.5	120.6	139.6	181.5	231.1
GDP	**695.9**	**803.7**	**912.8**	**994.7**	**1,125.3**	**1,245.6**	**1,403.3**	**1,562.7**	**1,800.7**	**2,098.0**	**2,484.2**
Net Factor Income from Abroad	-11.3	-9.4	-11.6	-17.8	-23.1	-23.8	-24.2	-16.5	-20.7	-30.0	-40.8
GNP	**684.7**	**794.3**	**901.3**	**976.9**	**1,102.2**	**1,221.8**	**1,379.1**	**1,546.2**	**1,780.1**	**2,068.0**	**2,443.4**

Source: Economic and Social Statistics of Sri Lanka, Central Bank of Sri Lanka
Note: *1 Provisional estimates

Table 2.5.1-2 Share of Gross Value Added to GDP: 1996-2006

(Unit: %)

Sector	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006*1
Agriculture, Forestry & Fishery	22.4	21.9	21.1	20.7	19.9	20.1	20.5	19.0	17.8	17.3	16.5
Mining & Quarrying	2.0	2.1	1.9	1.8	1.9	1.9	1.8	1.8	2.0	2.1	2.2
Manufacturing	16.2	16.4	16.5	16.4	16.8	16.0	15.8	15.6	15.3	14.8	13.9
Construction	6.9	7.0	7.6	7.6	7.3	7.6	7.2	7.2	7.9	8.4	9.1
Electricity, Gas & Water	1.3	1.4	1.5	1.5	1.2	1.3	1.4	1.8	1.5	1.7	1.9
Trade, Restaurants & Hotels	23.0	22.7	22.2	21.9	23.2	21.7	21.1	20.7	21.2	20.2	20.0
Transport & Communication	10.7	10.8	11.2	11.6	11.8	12.2	12.5	13.8	14.5	14.6	14.5
Banking, Insurance & Real Estat	9.8	10.0	10.2	10.7	10.2	11.1	11.3	12.3	12.1	12.1	12.6
Public Administration	7.6	7.6	7.8	7.8	7.6	8.2	8.4	7.7	7.8	8.7	9.3
GDP	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Study Team's calculation by using Economic and Social Statistics of Sri Lanka, Central Bank of Sri Lanka
Note: *1 Provisional estimates

Table 2.5.1-3 Per Capita GDP at Current Market Price: 1998-2008

Item	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008 *1
In Local Monetary Unit (Rs.)	56,760	60,740	68,102	75,133	83,226	94,664	107,432	124,709	147,775	178,830	218,161
In US Dollars Equivalent (US$)	879	863	899	841	870	981	1,062	1,241	1,421	1,634	2,014

Source: Economic and Social Statistics of Sri Lanka, Central Bank of Sri Lanka
Annual Report 2008, Central Bank of Sri Lanka
Note: *1 Provisional estimates

Table 2.5.1-4 Gross Domestic Product at 1996 Constant Factor Cost Prices: 1996-2006

(Unit: Rs. Billion)

Sector	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006 *1
Agriculture, Forestry & Fishery	156.11	160.75	164.80	172.24	175.32	169.38	173.60	176.45	175.85	179.28	187.73
Agriculture	122.59	126.11	128.34	133.95	136.21	130.41	132.88	137.15	135.97	148.71	149.51
Tea	10.33	11.07	11.20	11.34	12.23	11.80	12.40	12.13	12.32	12.62	12.38
Rubber	4.01	3.80	3.45	3.49	3.15	3.10	3.26	3.26	3.37	3.74	3.89
Coconut	12.84	13.26	12.83	14.00	15.12	13.07	11.29	12.20	12.21	11.95	12.86
Paddy	19.89	22.12	26.17	27.89	27.81	26.22	27.53	29.63	25.15	31.28	31.93
Others	75.52	75.86	74.70	77.24	77.91	76.21	78.40	79.92	82.92	89.13	88.45
Forestry	14.75	14.94	15.12	15.32	15.56	16.34	16.66	16.89	17.11	17.40	18.25
Fishery	18.76	19.70	21.35	22.97	23.54	22.63	24.06	22.41	22.78	13.17	19.97
Mining & Quarrying	13.93	14.46	13.68	14.24	14.92	15.02	14.86	15.70	16.95	19.33	20.89
Manufacturing	112.72	122.93	130.70	136.50	149.12	142.91	145.86	151.95	159.72	169.34	178.36
Export Processing (Tea, Rubber & Coconut)	16.20	16.77	16.58	17.21	17.93	16.74	16.58	16.56	16.77	17.22	17.41
Factory Industry	87.77	96.80	104.15	108.84	120.16	115.53	118.41	123.86	131.42	139.44	147.60
Small Industry	8.75	9.36	9.98	10.46	11.03	10.65	10.87	11.54	11.54	12.67	13.34
Construction	48.23	50.84	54.46	57.08	59.82	61.29	60.80	64.12	68.33	74.41	80.37
Electricity, Gas & Water	9.17	9.92	10.92	11.96	12.50	12.13	12.04	14.65	14.29	17.78	21.37
Trade, Restaurants & Hotels	159.75	170.15	177.61	179.94	195.23	181.73	191.51	206.51	219.04	225.10	238.32
Transport & Communication	74.50	81.07	87.27	94.30	101.67	105.50	113.52	125.54	142.73	159.48	180.31
Banking, Insurance & Real Estate	68.32	73.95	77.94	81.26	85.77	91.46	99.82	108.59	114.66	122.13	133.96
Ownership of Dwelling	53.20	55.69	57.41	60.83	62.70	64.38	65.21	66.56	69.15	72.90	74.92
GDP	**695.94**	**739.76**	**774.80**	**808.34**	**857.04**	**843.80**	**877.23**	**930.06**	**980.72**	**1,039.76**	**1,116.22**
Net Factor Income from Abroad	-11.26	-8.82	-9.89	-14.00	-16.84	-14.74	-13.97	-9.47	-11.30	-16.53	-21.67
GNP	**684.68**	**730.95**	**764.91**	**794.34**	**840.20**	**829.06**	**863.26**	**920.59**	**969.42**	**1,023.24**	**1,094.55**

Source: Economic and Social Statistics of Sri Lanka, Central Bank of Sri Lanka

Note: *1 Estimated on the basis of GDP at 1982 constant prices.
*2 Provisional estimate

Table 2.5.1-5 Real Growth Rates of GDP and GVA: 1996-2006

(Unit: %)

Sector	1997/96	1998/97	1999/98	2000/99	2001/00	2002/01	2003/02	2004/03	2005/04	2006/05
Agriculture, Forestry & Fishery	3.0	2.5	4.5	1.8	-3.4	2.5	1.6	-0.3	1.9	4.7
Mining & Quarrying	3.8	-5.4	4.1	4.8	0.7	-1.1	5.7	7.9	14.1	8.0
Manufacturing	9.1	6.3	4.4	9.2	-4.2	2.1	4.2	5.1	6.0	5.3
Construction	5.4	7.1	4.8	4.8	2.5	-0.8	5.5	6.6	8.9	8.0
Electricity, Gas & Water	8.1	10.1	9.5	4.5	-2.9	-0.7	21.6	-2.5	24.5	20.2
Trade, Restaurants & Hotels	6.5	4.4	1.3	8.5	-6.9	5.4	7.8	6.1	2.8	5.9
Transport & Communication	8.8	7.6	8.1	7.8	3.8	7.6	10.6	13.7	11.7	13.1
Banking, Insurance & Real Estate	8.2	5.4	4.3	5.5	6.6	9.1	8.8	5.6	6.5	9.7
Ownership of Dwelling	4.7	3.1	6.0	3.1	2.7	1.3	2.1	3.9	5.4	2.8
GDP	6.3	4.7	4.3	6.0	-1.5	4.0	6.0	5.4	6.0	7.4

Study Team's calculation by using Economic and Social Statistics of Sri Lanka, Central Bank of Sri Lanka

Table 2.5.1-6 Gross Domestic Expenditure at Current Market Prices: 1996-2006

(Unit: Rs. Billion)

Item	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006 *1
1. Consumption	650.4	736.0	823.3	890.2	1,038.4	1,185.5	1,358.6	1,486.3	1,686.5	1,906.3	2,213.0
(1) Private Consumption	569.4	643.8	723.5	790.4	906.2	1,041.0	1,214.1	1,341.9	1,542.1	1,761.9	2,068.5
(2) Public Consumption	81.0	92.2	99.7	99.9	132.2	144.4	144.4	144.4	144.4	144.4	144.4
(a) Central Government	79.4	90.3	97.8	98.2	130.8	143.7	138.9	138.7	164.5	194.9	253.2
(b) Local Governments	1.6	1.9	2.0	1.6	1.4	0.7	0.4	0.6	0.4	0.2	0.2
2. Gross Domestic Fixed Capital Formation	183.5	216.9	255.7	301.7	352.6	309.6	330.5	386.6	506.7	627.2	803.0
(1) Private Sector & Public Corporation	160.2	187.0	221.8	266.5	311.5	267.3	298.7	345.9	461.5	528.0	695.3
(2) Government & Public Enterprises	23.3	29.9	34.0	35.2	41.1	42.3	31.8	40.7	45.2	99.2	107.7
3. Changes in Stocks	2.8	0.2	0.2	0.1	0.0	0.0	4.3	2.1	0.3	0.3	0.4
(1) Private Sector & Public Corporation	2.6	0.2	0.1	0.1	0.0	0.0	4.2	2.1	0.2	0.2	0.3
(2) Government & Public Enterprises	0.2	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
4. Gross Domestic Expenditure (GDE)	836.7	953.1	1,079.1	1,192.1	1,391.0	1,495.2	1,693.4	1,875.1	2,193.5	2,533.9	3,016.3

Source: Economic and Social Statistics of Sri Lanka, Central Bank of Sri Lanka
Note: *1 Provisional

Table 2.5.1-7 Percentage Distribution of Gross Domestic Expenditure: 1996-2006

(Unit: %)

Item	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006 *1
1. Consumption	77.7	77.2	76.3	74.7	74.6	79.3	80.2	79.3	76.9	75.2	73.4
(1) Private Consumption	68.1	67.5	67.0	66.3	65.1	69.6	71.7	71.6	70.3	69.5	68.6
(2) Public Consumption	9.7	9.7	9.2	8.4	9.5	9.7	8.5	7.7	6.6	5.7	4.8
2. Gross Domestic Fixed Capital Formation	21.9	22.8	23.7	25.3	25.3	20.7	19.5	20.6	23.1	24.8	26.6
(1) Private Sector & Public Corporation	19.1	19.6	20.5	22.4	22.4	17.9	17.6	18.4	21.0	20.8	23.1
(2) Government & Public Enterprises	2.8	3.1	3.1	3.0	3.0	2.8	1.9	2.2	2.1	3.9	3.6
3. Changes in Stocks	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0
4. GDE	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Study Team's calculation by using Economic and Social Statistics of Sri Lanka, Central Bank of Sri Lanka
Note: *1 Provisional estimates

2.5.2 External Trade and Balance of Payment

Sri Lanka has traditionally run a deficit in current account until 2008, as shown in **Table 2.5.2-1**. The merchandise trade recorded to keep the balance in deficit for long time. The trade balance in deficit has increased rapidly since 2006, because of increase in import goods caused by reconstruction activities against the tsunami damages and good economic performance in the country, and price raise of imported goods including crude oil. On the other hand, services balance and transfers including workers' remittance have kept a level of surplus as shown in the table. In spite of the surplus, the current account balance has recorded deficit consecutively.

Capital account has exhibited a surplus. Long-term financial accounts have kept a surplus, although the balance fluctuated year by year as shown in the table. Short-run financial accounts have extremely been unstable in a balance. However, the over-all balance has frequently resulted in keeping a moderate balance, i.e., making up the deficit of current account and debt repayment by means of inflows of long-term loans.

It is worthy to note that the amount of the direct investment has drastically increased since 2006.

Sri Lanka's external trade has kept the balance in deficit as discussed above. Its trade structure has kept a traditional pattern as (i) exporting commodities such as tea, rubber, coconuts, etc., and light industrial products like textiles, garments, petroleum products, etc., and (ii) importing consumer goods like rice, wheat, sugar, etc., intermediate goods like petroleum, fertilizer, etc., and investment goods like machinery, transport equipment, etc. .It is said that this external trade is a typical external trade structure of developing countries. Therefore, the external environment in international markets for commodities and industrial products is a potent influence not only to Sri Lanka's external trade but also to the national economy.

Table 2.5.2-2 shows share rates of external trade by trading commodities. According to these data, industrial commodities including textile & garments, petroleum products and others are the highest for export showing constantly 70% or more in rate to the total export amount since 1998. The second one is the agricultural commodities including tea, rubber, and coconut with around 20% on average for the same period.

On the other hand, intermediate goods including petroleum, fertilizer, textiles & clothing, etc. are the highest for import with constantly 50% or more in rate to the total import amount. The second ones are investment goods including machinery, transport equipment, building materials and others with around 22% of rate on average to the total import amount.

Table 2.5.2-1 Balance of Payments: 1998- 2008

(Unit: US$ Million)

Item	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008 *1
Current Account	-226	-561	-1,066	-214	-236	-71	-648	-648	-1,496	-1,401	-3,775
Goods, Services and Income (net)	-1,126	-1,474	-2,064	-1,220	-1,364	-1,312	-2,028	-2,477	-3,501	-3,712	-6,441
Trade Balance	-1,091	-1,369	-1,798	-1,157	-1,407	-1,539	-2,243	-2,516	-3,370	-3,656	-5,871
Export	4,798	4,610	5,522	4,817	4,699	5,133	5,757	6,347	6,883	7,640	8,137
Import	5,889	5,979	7,320	5,974	6,106	6,672	8,000	8,863	10,253	11,296	14,008
Services (net)	145	149	38	204	295	399	419	338	257	302	402
Income (net)	-180	-254	-304	-267	-252	-172	-204	-299	-388	-358	-972
Transfers (net)	900	913	998	1,006	1,128	1,241	1,380	1,829	2,005	2,311	2,666
Private Transfers (net)	848	887	974	984	1,097	1,205	1,350	1,736	1,904	2,214	2,565
Official (net)	52	26	24	22	31	36	30	93	101	97	101
Capital & Financial Account (net)	414	372	442	562	443	721	631	1,224	1,808	2,097	1,774
Capital Account (net)	80	80	50	198	65	74	64	250	291	269	291
Financial Account (net)	334	292	392	-1	378	647	567	974	1,517	1,828	1,483
Long-term (net):	398	435	304	164	326	722	680	798	907	1,251	1,017
Direct Investment (net)	193	177	175	172	185	201	227	234	451	548	691
Other Private (net)	2	196	82	-257	-21	-33	14	11	-35	31	74
Government, Long-term (net)	203	62	47	249	162	554	439	553	491	672	252
Short-term (net):	-64	-143	88	-165	52	-75	-113	176	610	577	466
Commercial Bank Assets (net)	-48	-120	33	-112	-41	-96	-152	100	4	-281	210
Other (Net)	-16	-23	55	-53	93	21	39	76	606	858	256
Errors & Omissions	-151	-73	101	-127	131	-148	-189	-72	-106	-165	777
Overall Balance	37	-262	-523	221	338	502	-206	504	206	531	-1,224

Source : Economic and Social Statistics of Sri Lanka, Central Bank of Sri Lanka
Annual Report 2008, Central Bank of Sri Lanka
Note: :1 Provisional

Table 2.5.2-2 Foreign Trade: 1998-2008

(Unit: Rs. million)

Item	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008 *1
Export											
Agricultural Export	70,225	66,750	76,270	83,253	89,682	93,069	107,951	116,045	134,481	166,945	200,739
(Share to Total Exports)	(22.65%)	(20.54%)	(18.17%)	(19.36%)	(19.96%)	(18.80%)	(18.52%)	(18.25%)	(18.81%)	(19.74%)	(22.78%)
Tea	50,280	43,728	53,133	61,602	63,105	65,936	74,897	81,482	91,667	113,565	137,600
Rubber	2,808	2,305	2,179	2,129	2,552	3,717	5,155	4,724	9,674	12,089	13,538
Coconut Products	6,110	9,119	9,174	7,348	8,009	8,926	11,453	11,400	12,898	15,636	18,532
Minor Agricultural Products	11,027	11,598	11,784	12,174	16,016	14,490	16,446	18,439	20,242	25,655	31,069
Industrial Exports	233,508	250,575	325,931	331,687	347,657	383,833	457,175	497,695	560,628	660,389	667,350
(Share to Total Exports)	(75.30%)	(77.10%)	(77.63%)	(77.14%)	(77.36%)	(77.55%)	(78.44%)	(78.26%)	(78.43%)	(78.09%)	(75.72%)
Textiles & Garments	159,302	171,067	226,929	227,360	232,027	248,574	285,172	291,087	320,829	369,463	376,025
Petroleum Products	4,662	5,210	7,414	6,053	7,003	6,300	10,133	13,169	19,451	18,693	27,542
Rubber-based Products	11,528	11,350	14,924	15,417	17,441	22,298	28,727	39,693	43,360	53,318	n.a
Diamonds	7,838	11,343	13,578	14,837	18,335	20,874	24,950	26,594	32,440	38,588	45,354
Others	50,178	51,605	63,086	68,020	72,851	85,787	108,193	127,152	144,548	180,327	n.a
Gems	3,577	4,326	7,091	7,276	8,173	7,601	10,939	12,088	12,385	11,665	10,919
Others	2,802	3,363	10,560	7,767	3,883	10,456	6,738	10,134	7,343	6,684	2,313
Total Exports	310,112	325,014	419,852	429,983	449,395	494,959	582,803	635,962	714,837	845,683	881,321
Import											
Consumer Goods	80,956	87,505	105,403	110,059	126,180	142,911	164,609	165,221	206,140	221,371	n.a
(Share to Total Exports)	(21.30%)	(20.74%)	(19.02%)	(20.65%)	(21.59%)	(22.20%)	(20.29%)	(18.54%)	(19.33%)	(17.69%)	n.a
Wheat	8,133	7,792	9,625	9,783	12,427	13,255	18,536	14,200	20,679	25,891	n.a
Rice	2,621	3,290	288	969	1,732	819	6,186	1,554	576	4,261	n.a
Sugar	8,384	7,448	10,777	10,289	12,634	11,196	11,240	13,303	23,256	17,055	n.a
Other Food	27,405	28,032	31,894	37,425	39,746	42,443	43,021	46,553	55,022	70,537	n.a
Durables	34,413	40,943	52,819	51,593	59,641	75,198	85,626	89,611	106,607	103,627	n.a
Intermediate Goods	192,494	215,658	287,196	296,522	334,357	367,676	471,152	534,804	620,131	721,473	n.a
(Share to Total Exports)	(50.64%)	(51.12%)	(51.81%)	(55.64%)	(57.20%)	(57.11%)	(58.09%)	(60.00%)	(58.14%)	(57.67%)	n.a
Petroleum	22,275	35,344	68,381	65,190	75,627	80,807	122,732	166,562	215,168	276,775	n.a
Textiles	90,099	93,105	111,386	117,993	126,438	132,415	153,476	153,957	160,987	180,689	n.a
Fertiliser	3,989	4,690	6,059	6,047	7,259	8,457	10,902	13,552	17,036	21,422	n.a
Others	76,131	82,519	101,370	107,292	125,033	145,997	184,042	200,733	226,940	242,587	n.a
Investment Goods	95,322	110,599	130,889	96,185	112,046	127,363	169,096	188,081	233,637	275,765	n.a
(Share to Total Exports)	(25.08%)	(26.22%)	(23.61%)	(18.05%)	(19.17%)	(19.78%)	(20.85%)	(21.10%)	(21.90%)	(22.04%)	n.a
Machinery	50,592	47,736	59,538	54,287	61,296	67,330	86,709	86,567	110,853	138,033	n.a
Transport Equipment	17,098	37,191	39,489	11,469	14,449	19,869	26,008	32,743	37,928	40,292	n.a
Building Materials	19,590	18,296	23,087	22,145	26,013	31,677	40,709	50,967	56,822	86,414	n.a
Others	8,042	7,376	8,775	8,284	10,288	8,487	15,670	17,804	28,034	11,026	n.a
Others	11,367	8,126	30,802	30,198	11,907	5,799	6,280	3,272	6,781	32,526	n.a
Total Imports	380,139	421,888	554,290	532,964	584,490	643,749	811,137	891,378	1,066,689	1,251,135	1,516,681
Balance	-70,027	-96,874	-134,438	-102,981	-135,095	-148,790	-228,334	-255,416	-351,852	-405,452	-635,360

Source : Economic and Social Statistics of Sri Lanka, Central Bank of Sri Lanka
Annual Report 2008, Central Bank of Sri Lanka
Note: :1 Provisional

2.5.3 Government Finance

In Sri Lanka, a fiscal year starts from January 1 and ends on December 31 in the same year, i.e., the same as calendar year. In 2007 and 2008, the Government finances of Sri Lanka amounted to Rs.565.1 billion and Rs.655.3 billion in revenue and Rs.841.6 billion and Rs.996.1 billion in expenditure, as shown in **Table 2.5.3-1**. Thus, the balance of these fiscal operations was resulted in deficit as 277.6 billion in 2007 and 340.9 billion in 2008. These deficits were financed by borrowings, as enumerated in the table. The deficit in 2008 corresponded to 7.7% of GDP in the same year.

Taxes on goods and services share at around 90% to the total revenue in both 2007 and 2008. Current expenditures occupied a share of 74% in 2007 and 75% in 2008.

The Government debt outstanding accounted to Rs.3,578 billion at the end of 2008, corresponding to 81% of GDP.

Table 2.5.3-1 Fiscal Operation of Government: 1998-2008

(Unit: Rs. Billion)

Item	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008 *1
Revenue	**175.0**	**195.9**	**211.3**	**234.3**	**261.9**	**276.5**	**311.5**	**379.7**	**477.3**	**565.1**	**655.3**
1. Tax Revenue	147.4	166.0	182.4	205.8	221.8	231.6	281.6	336.8	428.4	508.9	585.6
(1) Direct Taxws	20.4	28.2	27.5	34.6	37.4	39.4	41.4	52.5	80.5	107.2	n.a
(2) Indirect Taxes	126.9	137.8	154.9	171.2	184.4	192.3	240.2	284.3	347.9	401.8	n.a
2. Non-tax Revenue	27.7	29.9	28.9	28.5	40.1	44.9	29.9	42.9	49.0	56.1	69.6
Expenditure & Net Lending	**268.2**	**279.2**	**335.8**	**386.5**	**403.0**	**417.7**	**476.9**	**584.7**	**713.1**	**841.6**	**996.1**
1. Current Expenditure	199.6	207.3	254.3	303.4	330.8	334.7	389.7	443.3	547.5	622.8	743.7
(1) General Services	66.2	63.2	82.6	82.1	81.0	86.4	95.4	105.6	133.1	162	n.a
(2) Social Services	63.6	66.3	77.2	88.0	106.1	104.8	138.8	188.7	204.6	226	n.a
(3) Economic Services	10.5	10.1	12.1	15.8	17.2	14.4	22.1	28.7	50.6	50	n.a
(4) Others including interest payment	59.3	67.7	82.4	117.4	126.6	129.1	133.3	120.3	159.1	185	n.a
2. Capital Expenditure	68.5	71.9	81.5	83.2	72.1	83.0	87.2	141.4	165.7	218.8	252.4
(1) General Services	6.2	6.3	7.2	6.6	4.7	5.2	7.2	9.9	21.4	32.1	n.a
(2) Social Services	15.5	17.5	16.5	14.6	15.7	19.2	29.0	36.0	48.4	55.0	n.a
(3) Economic Services	44.7	44.9	54.7	54.9	51.7	58.7	61.3	77.5	106.8	130.8	n.a
(4) Others and Net Lending	2.1	3.1	3.3	7.1	0.1	-0.2	-10.2	18.0	-10.8	0.9	n.a
Budget Deficit before Grants	**-93.1**	**-83.3**	**-124.5**	**-152.2**	**-141.1**	**-141.2**	**-165.4**	**-205.0**	**-235.8**	**-276.6**	**-340.9**
Financing of Budget Deficit	93.1	83.3	124.5	152.2	141.1	140.5	165.4	205.0	235.8	276.6	340.9
Foreign Financing	10.2	1.5	0.9	14.5	2.0	43.1	37.1	47.8	41.9	100.9	-5
Grants	7.2	6.8	5.1	5.5	7.1	7.6	8.7	32.6	30.1	30.5	31
Domestic Financing	71.4	74.9	118.5	123.6	126.4	79.7	117.2	123.6	163.8	145.1	314
Privatization Proceeds	4.4	0.1	0.4	8.6	5.7	10.2	2.4	1.0	0.0	0.0	0.0
Government Debt Outstanding	924.7	1,051.3	1,218.7	1,452.7	1,670.3	1,863.9	2,139.5	2,222.3	2,607.7	3,041.7	3,578.1
Domestic	463.4	543.5	676.7	816.0	948.4	1,020.0	1,143.4	1,265.7	1,479.2	1,715.2	2,129.3
Foreign	461.3	507.9	542.0	636.7	722.0	843.9	996.1	956.6	1,128.5	1,326.5	1,448.7
As percentage of GDP											
Revenue	17.2	17.7	16.8	16.7	16.5	15.2	14.9	15.5	16.3	15.8	14.9
Expenditure	26.3	25.2	26.7	27.5	25.4	22.9	22.8	23.8	24.3	23.5	22.6
Overall Budget Deficit (before Grants)	-9.2	-7.5	-9.9	-10.8	-8.9	-7.7	-7.9	-8.4	-8.0	-7.7	-7.7
Government Debt Outstanding	90.8	95.1	96.9	103.3	105.6	102.3	102.3	90.6	87.8	85.0	81.1

Source: Economic and Social Statistics of Sri Lanka, Central Bank of Sri Lanka
Annual Report 2008, Central Bank of Sri Lanka
Note: *1 Provisional

2.5.4 External Debt and Outstanding

(1) Foreign Assistance

Net receipts of official development assistance (ODA) from member nations of DAC, multilateral agencies, and others aggregated to US$4.1 billion in total for the seven years from 2000 through 2006, as shown in **Table 2.5.4-1**. The receipts fluctuated through the period. The receipts in 2006 accounted to US$800 million. During the above period, Japan was the top donor of ODA to Sri Lanka.

An annual net receipt of ODA accounted for approximately 2.8% of GDP in 2006. The average annual net receipt for the seven years in the above period corresponded to 2.8% of GDP and to around 18% of an annual expenditure of the central government, respectively.

(2) External Debt and Outstanding

In 2006, the total external debt outstanding was US$11.4 billion as shown in **Table 2.5.4-2**, accounting for 42% of GDP. The outstanding has exceeded US$10 billion since 2004. The total debt-service in 2006 was US$960 million, comprising US$700 million of principal repayment and US$260 million of interest payment.

The debt-service ratio (DSR), a kind of country risk assessment factors, has been from 7.9% in 2005 to 14.7% in 2000. Thus, DSR has kept a sound position in terms of external debt problem, because those were always lower than the level of 20%, the critical level of DSR.

Table 2.5.4-1 Total ODA Net: 2000-2006

(Unit: US$ Million)

Item	2000	2001	2002	2003	2004	2005	2006	Total	
DAC Countries	240.2	279.9	188.5	271.0	337.2	857.3	485.3	2,659.4	
Japan	163.7	184.7	118.9	172.3	179.5	312.9	202.7	1,334.7	
USA	-3.9	-9.7	-11.0	-8.6	-3.4	59.1	29.2	51.7	
Germany	21.2	31.1	7.8	16.3	28.6	75.2	63.9	244.1	
UK	9.9	15.0	7.7	9.3	16.8	13.7	6.9	79.3	
Australia	6.7	4.0	4.3	6.3	18.9	43.3	23.0	106.5	
Netherlands	6.9	15.6	18.6	21.5	13.9	56.2	15.0	147.7	
France	0.2	0.8	-2.5	-1.3	4.7	40.7	-0.7	41.9	
Belgium	0.1	0.0	0.0	0.1	0.1	5.4	0.8	6.5	
Norway	14.6	15.2	21.5	28.6	30.3	66.0	37.3	213.5	
Sweden	16.7	18.3	15.0	13.5	23.0	51.7	20.6	158.8	
Others	4.1	4.9	8.2	13.0	24.8	133.1	86.6	55.0	
Multilateral	25.2	20.2	135.2	388.5	162.0	284.7	272.8	1,288.6	
ADB	56.0	70.3	88.5	149.7	101.7	125.1	103.1	694.4	
IDA	28.3	11.9	59.0	168.3	31.7	114.3	113.3	526.8	
EC	6.0	7.1	12.6	15.2	14.9	16.1	24.5	96.4	
UNDP	5.0	3.2	1.7	3.2	2.5	2.6	3.1	21.3	
IFC	-	-	-	-	-	-	-	0.0	
IMF	-85.6	-90.8	-50.8	22.4	-8.3	-	-	-213.1	
Others	15.5	18.5	24.2	29.7	19.5	26.6	28.8	107.4	
Other Donor Countries	10.5	12.7	20.0	17.5	20.8	50.0	37.8	169.3	
Total	275.9	312.8	343.7	677.0	520.0	1,192.0	795.9	4,117.3	
% of GDP *2	1.6	2.0	2.1	3.6	2.5	4.9	2.8	2.8	*1
% of Govt's Revenue *2	9.9	11.9	12.6	23.6	16.9	31.5	17.3	17.7	*1

Source: Geographical Distribution of Financial Flows to Aid Recipients, Disbursements Commitments Country Indicators, OECD Development Assistance Committee

Note: *1 Average from 2000 to 2006

* 2 Study Team calculation using data of DEC and CBSL

Table 2.5.4-2 External Debt: 2000-2006

(Unit: US$ Million)

Item	2000	2001	2002	2003	2004	2005	2006
Total Debt Stocks	9,158	8,730	9,740	10,441	11,085	11,271	11,445
1. Long Term Debt	8,312	7,889	8,729	9,427	10,143	9,898	10,346
2. Use of IMF Credit	161	214	310	393	294	381	244
3. Short Term Debt	685	627	701	621	648	992	855
Debt Outstanding of Long Term Deb	8,312	7,888	8,729	9,427	10,143	9,898	10,346
1. Public and Publicly Guaranteed	7,944	7,499	8,400	9,159	9,847	9,655	10,140
a. Official Creditors	6,934	6,623	7,502	8,547	9,205	8,980	9,497
- Multilateral	3,412	3,239	3,754	4,281	4,656	4,554	4,914
- Bilateral	3,522	3,384	3,748	4,266	4,549	4,426	4,583
b. Private Creditors	1,010	876	898	612	642	675	644
- Bonds	65	65	65	65	65	65	65
- Commercial Banks	371	301	348	316	341	400	362
- Others	574	510	485	231	236	210	217
2. Private Non-guaranteed	368	389	329	268	296	243	206
Total Debt Service	790	753	721	606	771	449	958
1. Principal Repayment	541	521	501	419	553	302	698
a. Long Term Debt	455	450	450	388	441	264	544
b. IMF Repurchases	86	71	51	31	112	38	154
2. Interest Payments	249	232	220	187	218	147	260
a. Long Term Debt	214	209	205	175	191	99	201
b. IMF Charges	1	3	5	5	8	11	13
c. Short Term Debt	34	20	10	7	19	37	46
Ratios (%) *1							
1. Total Debt Stocks/GDP	54.5	53.2	56.3	56.9	54.9	46.5	42.4
2. Debt Service Ratio *2	14.7	13.2	13.2	11.6	11.6	7.9	12.7

Source: Global Development Finance, Country Tables, World Bank

Note: Long term debt is defined as having original maturity of more than one year.

*1 Source: Annual Report, Central Bank of Sri Lanka

*2 Debt service as a percentage of earnings from exports of goods and service

2.5.5 Price Index and Exchange Rates

(1) Price Index

Table 2.5.5-1 shows the consumer price index from the year 1999 to 2007. The consumer price index (CPI) in Sri Lanka increased to 249.5 (base: 1995 to 1997 = 100) in 2007. Then, the CPI increased twice during the above period. Thus, an annual inflation rate was calculated at 9.2% on average. During the same period, the maximum inflation rate was 20.4% in 2007 and the minimum one was 1.5% in 2000.

(2) Exchange Rates

Table 2.5.5-2 shows the average foreign exchange rate of Rupees per US$, Japanese Yen and Euro from 1996 to 2008. The value of Rupee dropped down from Rs.55.27 per US$ in 1996 to Rs.180.33 in 2008.

Table 2.5.5-1 Consumers' Price Index: Whole Sri Lanka 1999-2007

Year Month	Consumer Price Index (CPI) : 1995-1997 = 100 *1 All	Food, Bevarage, & Tobacco	Clothing & Footwear	Housing, Water, Power, & Fuel	Miscel-laneous	Annual Increase Rate of CPI (%)
1999	123.2	125.1	114.4	112.5	120.1	
2000	125.1	124.2	115.6	122.8	124.1	1.5
2001	140.1	139.2	119.9	136.9	147.9	12.0
2002	154.4	153.3	131.4	147.5	169.3	10.2
2003	158.4	154.8	141.9	156.9	182.9	2.6
2004	170.9	168.1	149.3	166.0	191.2	7.9
2005	189.1	185.0	154.4	190.3	208.1	10.6
2006	207.2	197.6	164.3	230.7	224.8	9.6
2007	249.5	242.8	175.8	273.3	247.1	20.4

Source: Economic and Social Statistics of Sri Lanka, Central Bank of Sri Lanka
**1: Annual figures are averages of monthly figures.*

Table 2.5.5-2 Average Exchange Rates[*1]: 1996-2008

(Unit: Rupees)

Year	US Dollar	Japanese Yen	Euro
1996	55.27	0.51	-
1997	58.99	0.49	-
1998	64.59	0.50	-
1999	70.39	0.62	75.07
2000	75.78	0.70	68.94
2001	89.36	0.74	79.99
2002	95.66	0.77	90.43
2003	96.52	0.83	109.16
2004	101.19	0.94	125.79
2005	100.50	0.91	125.10
2006	103.95	0.89	130.63
2007	110.62	0.94	151.63
2008 *2	108.33	1.05	159.32

Source: Economic and Social Statistics of Sri Lanka, CBSL
*Note: *1: Period Average*
**2: Provisional*

2.5.6 Transportation and Telecommunications

In Sri Lanka, there are 11,900 km of public road in total in 2007, as shown in **Table 2.5.6-1**. An annual expanding rate of road network was very small. On the other hand, the registered motor vehicles are increased with a rate of 10.6 % per annum for the recent six years from 2002. There are around 3,126,000 of motor vehicles as of 2007, and among these motor cycles, around 50% are motor cycles.

For the railway network in Sri Lanka, after the total length increased from 1,449 km in 2002 in broad gauge lines consisting of single lines and double lines, its length has not increased.

Sri Lanka has three major sea ports as the Colombo Port, the Trincomalee Port and the Galle Port. In 2007, the number of freight vessels and passenger vessels arrived in the Colombo Port are 4,326 vessels and 33 vessels respectively. In the same year, the number of freight vessels arrived in the Trincomalee Port and the Galle Port are 297 vessels and 87 vessels respectively.

Sri Lanka has one international airport named the Bandaranaike International Airport located in the northward of about 32 km far from Colombo city. Through this airport, around 4,843,000 passengers have come to and departed from Sri Lanka in 2007. Handling volumes of goods are 154,500 tons in total in the same year.

The number of facilities for postage services is 641 in post offices, 3,412 in sub-post office and 684 in post office agencies in 2007. Regarding communications services, 2.74 million telephones for fixed access services were installed in the forms of wired and wireless telephones, then, telephone sets were owned by 14 units per 100 persons in 2007. In addition, cellular phones have become in widespread use in recent years.

Table 2.5.6-1 Transportation and Telecommunication: 2002-2007

Item	2002	2003	2004	2005	2006	2,007
Road Sector						
Length of Public Road in Total (km)*1	11,650	11,650	11,660	11,683	11,774	11,903
Number of Motor Vehicles Registered (1000)	1,892	2,074	2,298	2,527	2,828	3,126
Cars	253	275	294	311	339	361
Three Wheelers	133	169	213	254	319	362
Motor cycles	923	1,010	1,135	1,266	1,422	1,605
Public Vehicles	68	70	72	74	77	80
Goods Vehicles	186	197	208	222	242	260
Agricultural Tractors	177	188	201	218	239	262
Others	152	165	176	183	190	196
Railway						
Broad Gauge (km)	1,449	1,449	1,449	1,449	1,449	1,449
Single Line	1,390	1,390	1,390	1,449	1,449	1,449
Double Line	117	131	131	131	131	131
Narrow Gauge (Single Line Only) (km)	59	59	59	-	-	-
Total	1,449	1,449	1,449	1,449	1,449	1,449
Sea Port and Sea Transport						
Colombo Port						
Number of Ships Arrived	3,787	3,838	3,688	3,929	4,228	4,326
Total Gross Registered Tonnage (1000)	81.0	86.2	84.7	87.5	100.2	116.6
Total Net Registered Tonneage (1000)	39.3	41.8	40.9	41.8	48.5	57.6
Number of Sailing Craft Arrived	175	173	185	184	72	33
Total Gross Registered Tonnage (1000)	47	44	49	49	19	9
Total Net Registered Tonneage (1000)	38	36	40	-	-	-
Trincomalee Port						
Number of Ships Arrived	199	121	107	96	141	297
Total Gross Registered Tonnage (1000)	1,550	1,486	1,552	1,766	1,775	1,569
Total Net Registered Tonneage (1000)	921	875	869	1,014	987	881
Galle Port						
Number of Ships Arrived	76	73	88	114	100	87
Total Gross Registered Tonnage (1000)	411	393	460	551	607	484
Total Net Registered Tonneage (1000)	203	189	224	260	298	238
Air Transport						
Number of Passenger by Air Craft (1000 Persons)						
To Sri Lanka			2,063.1	2,105.7	2,275.5	2,398.7
From Sri Lanka			2,015.3	2,133.4	2,310.3	2,444.3
Freight & Excess Baggage by Air Craft (1000 tons)						
To Sri Lanka			50.4	57.5	57.9	57.1
From Sri Lanka			83.2	84.8	96.2	97.4
Postal Facilities						
Main post offices (Public)	614	622	630	633	636	641
Sub post offices (Public)	3,452	3,482	3,411	3,408	3,407	3,412
Private post offices	570	580	611	663	684	684
Telecommunications						
Fixed access services						
Wireline in services (1000)	769	818	860	919	910	932
Wireless access (1000)	114	116	131	325	974	1,810
Telephones per 100 Persons	5	5	5	6	10	14
Other services						
Cellular Phones	932	1,393	2,211	3,362	5,412	7,983
Public Pay Phones	7	6	6	6	8	9
Internet & E-mail Subscribers (1000)	70	86	93	115	130	202

Source: Statistical Abstract, Department of Census and Statistics
Note: *1 Category A to B

CHAPTER 3

POWER SECTOR SURVEY

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3.1 Organization

Power supply in Sri Lanka started from operation of small power plants installed in the Colombo city in 1880s under the reign of the United Kingdom. Since then the power system in Sri Lanka has been consolidated and expanded by the construction of new power plants, transmission lines and substations. The major historical matters in the power sector are as follows:

1948 : Independence of Ceylon as a self governing domain from the United Kingdom.

1951 : Legislation of the law: “Electricity Act”.

1969 : Proclamation of “Ceylon Electricity Board Act”.
Establishment of CEB (Ceylon Electricity Board) under jurisdiction of MPE (Ministry of Power and Energy).

1983 : Establishment of LECO (Lanka Electricity Company) taking over distribution activities from local governments.

1996 : Establishment of PC (Power Committee)

Oct. 2002 : Proclamation of “Electricity Reform Act” and “Public Utilities Commission of Sri Lanka Act”.

Apr. 2003 : Financial assistance through loans to support electricity sector reform by JBIC, ADB, WB

Jul. 2003 : Establishment of PUC (Public Utilities Commission).

Oct. 2003 : Postponement of implementing the Electricity Sector Reform.

Jul. 2005 : Announcement of new electricity sector reform program approved by the Cabinet.

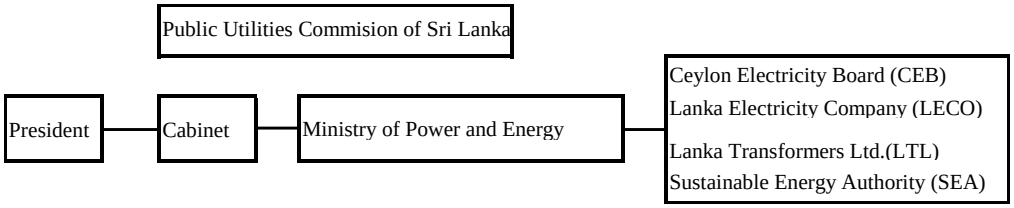
Dec. 2005 : Expiry of JBIC’s Power Sector Restructuring Project Loan.

Nov. 2006 : Suspension of unbundling of CEB by Cabinet. (abandoning organization reform)
Giving to PUC the authority for revision and permission on electricity tariff.

Almost all the power utilities in the country including generation, transmission and distribution are conducted by CEB established on 1969. Small Power Producers (SPPs) which operate hydropower stations with installed capacity less than 10 MW and Independent Power Producers (IPPs) operate thermal power plants participate in the generation activities, in addition to CEB.

Distribution is managed regionally by the two organizations which are composed of CEB and LECO established in 1983. CEB belong to the Ministry of Power and Energy which manages national power and energy policies..

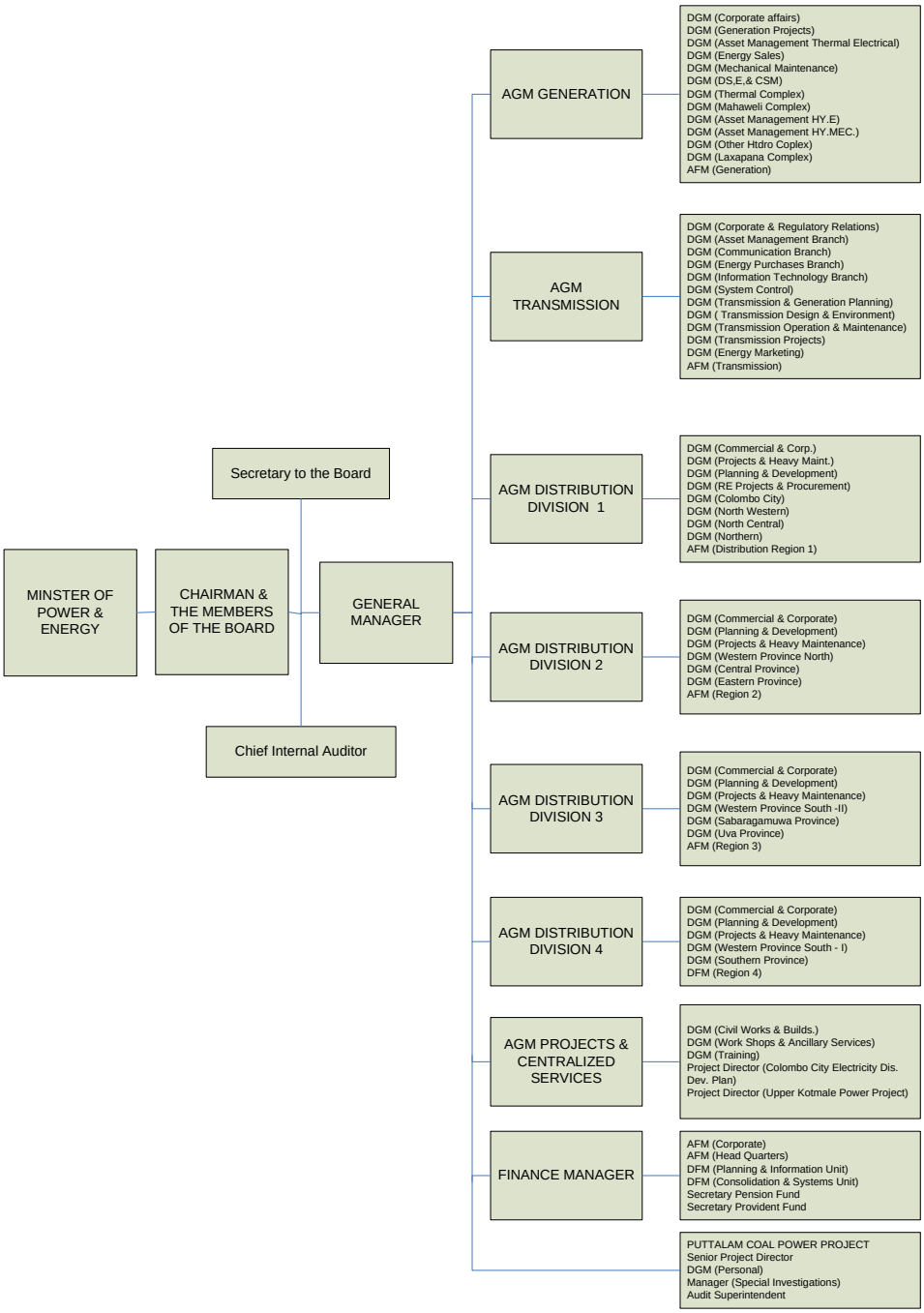
Figure 3.1-1 shows Organizations of Energy Sector in Sri Lanka.



Source: CEB

Figure 3.1-1 Organization of Energy Sector in Sri Lanka

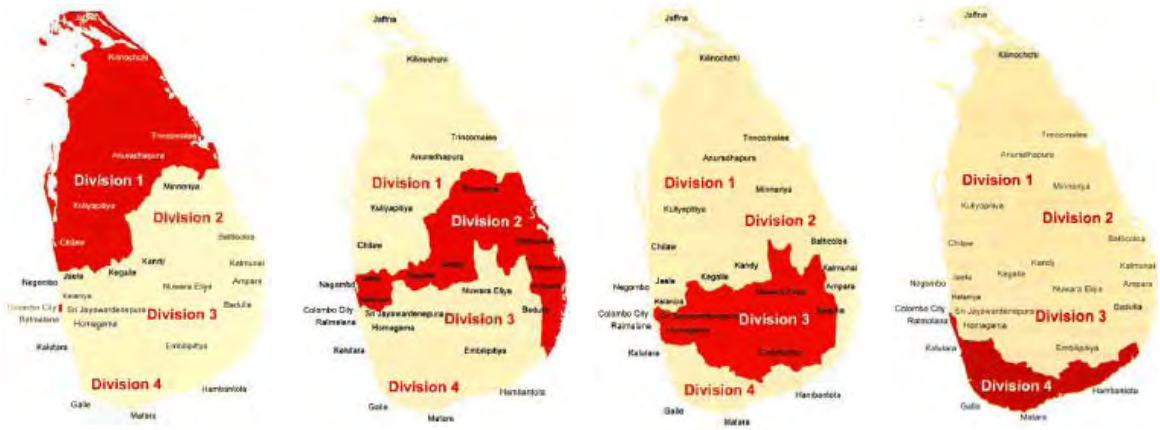
Figure 3.1-2 shows the organization of CEB. The existing Victoria Hydropower Station belongs to the Mahaweli Complex, Generation in the figure.



Source: CEB

Figure 3.1-2 Organization Chart of Ceylon Electricity Board

The area for power supply in Sri Lanka is divided into the four regional areas as shown in **Figure 3.1-3.**



Division 1 **Division 2** **Division 3** **Division 4**

Source: CEB

Figure 3.1-3 Areas for Electric Power Supply

(1) Division 1

Division 1 is composed of North Western Province, North Central Province, Northern Province and Colombo city. Minnerya which was previously in Division 2 was transferred into Division 1 in August 2005. Power to the Jaffna Peninsular is supplied by the independent grid.

(2) Division 2

Division 2 consists of Eastern Province, Central Province and Western Province North which is composed of Gampaha, Negombo, Kelaniya, Veyangoda and Ja-Era.

Central Province is composed of Kandy, Peradeniya, Kundasale, Katugastota, Matale and Kegalle. Eastern Province is composed of Trincomalee, Kalmunai, Ampara and Batticoloa.

(3) Division 3

Division 3 is composed of Western Province South2, Sabaragamuwa Province, and Uva Province.

(4) Division 4

Division 4 is composed of Western Province South1, and Southern Province.

3.2 Existing Power Plant

As of July 2008, the total installed capacity in Sri Lanka is 2,445 MW as shown in **Table 3.2-1**. It is composed of 1,756 MW owned by CEB, 659 MW by private sector (IPPs and SPPs), and 30 MW by a short-term contractor from the viewpoint of ownership. From the aspect of power sources, it consists of hydropower with 1,314 MW (53.7%), thermal power with 1,098 MW, and wind power with 3 MW.

Table 3.2-1 Existing Generation Plants in Sri Lanka

(MW)

CEB' Power Plant	**1,756**	
Hydro	1,205	13 plants (Include Small Hydro 20 MW)
Thermal	548	3 plants
Wind	3	Hambantota Pilot Plant
Private Power Plant	**659**	
Small Power Producers	109	60 plants (Less than 10 MW plants)
Thermal IPPs	550	8 plants (10, 15, 20 years Contract)
CEB Short Term Contract	**30**	Jaffuna 2 plants
Total	**2,445**	(Hydro: 1,314 MW, Thermal: 1,098 MW)

Source: CEB Long Term Generation Expansion Plant 2007-2021

Although all the power plants were owned by CEB until 1996, private sector was allowed to participate in power generation activities after 1996. CEB shares 72% of in the total installed capacity as of July 2008.

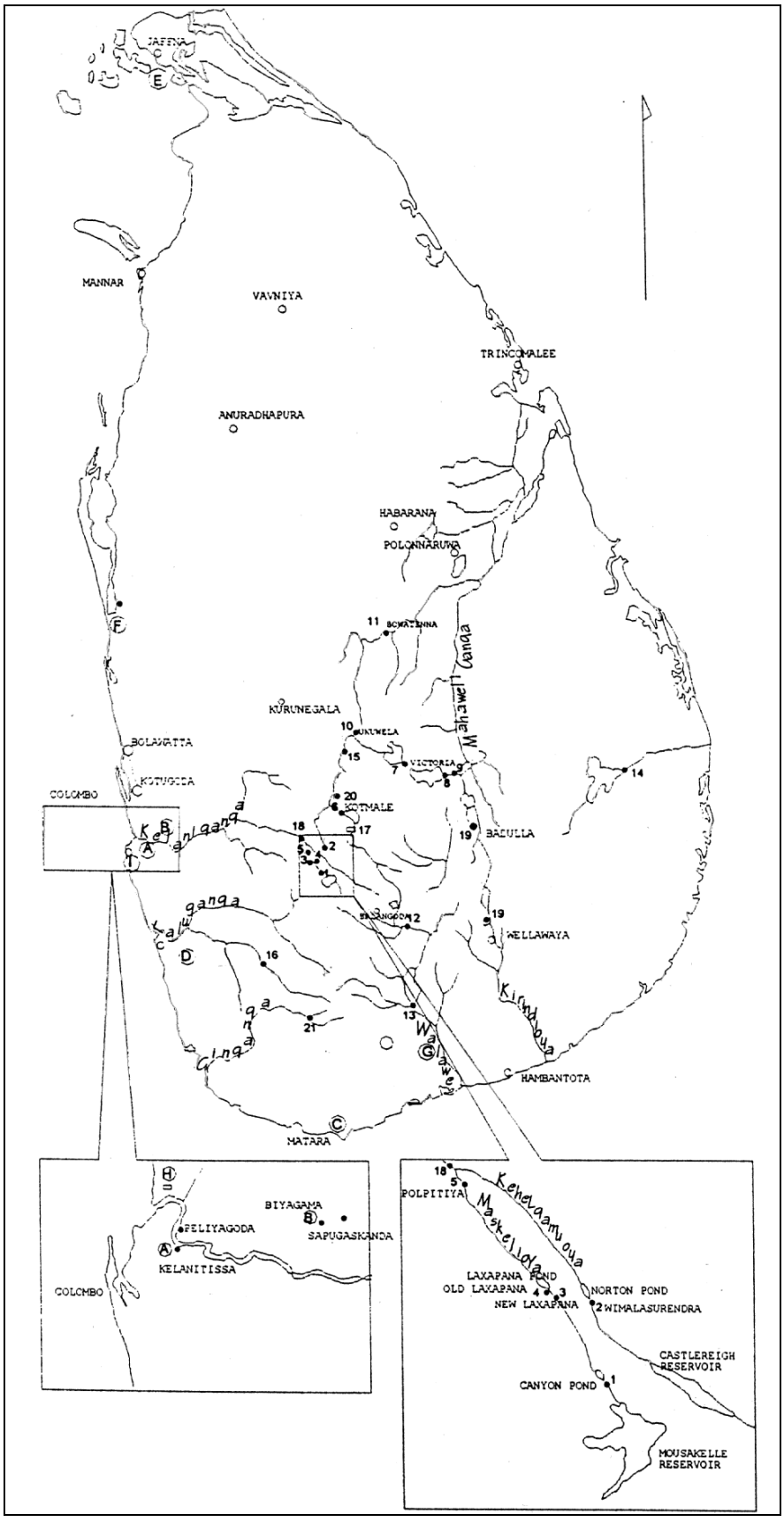
Table 3.2-2 shows each existing power plant owned by CEB and private sector in the country.

Table 3.2-2 Existing Power Plants in Sri Lanka

No.	Project Name	Installed Capacity (MW)	Commissioning
CEB's Power Plants			
	Hydropower Plants		
	Laxapana Complex		
1	Canyon	2x30	Unit 1:1983.3
			Unit 2:1989.5
2	Wimalasurendra	2x25	1965.1
3	New Laxapana	2x50	Unit 1:1974.2
			Unit 2:1974.3
4	Old Laxapna	3x8.33, 2x12.5	1950.12, 1958.12
5	Polpitiya	2x37.5	1969.4
	Mahaweli Complex		
6	Kotmale	3x67	Unit 1:1985.4
			Unit 2&3:1988.2
7	Victoria	3x70	Unit 1:1985.1
			Unit 2:1984.10
			Unit 3:1986.2
8	Randenigala	2x61	1986.7
9	Rantambe	2x24.5	1990.1
15	Nilambe	3.2	
10	Ukuwela	2x19	Unit 1:1976.7
			Unit 2:1976.8
11	Bowatenna	1x40	1981.6
	Other Hydro		
12	Samanalawewa	2x60	1992.1
13	Udawalawe	6	-
14	Inginiyagala	11	-
16	Kukule	2x35	2003.7
	Wind power	3	-
	Committed and Candidate Plant		
17	Upper Kotmale	2x75	Committed Plant
18	Broadlands	35	Candidate Plant
19	Uma Oya	150	Candidate Plant
20	Moragolla	27	Candidate Plant
21	Ginganga	49	Candidate Plant
	Thermal Power Plants		
A	Kelanitissa Power Station		
	Gas Turbine (old)	5x20	1981.12, 1982.3,4
	Gas Turbine (New)	115	1997.8
B	Sapugaskanda Power	160	
E	Chunnakam	8	1999.3
IPP Thermal Power Plants			
	Lakdanavi	22.5	1997.11
	Asia Power Ltd.	51	1998.6
C	Ace Power Matara	24.8	2002.3
D	Ace Power Horana	24.8	2002.12
F	Heladanavi	100	2004.10
G	Ace Power Embilipitiya	100	2005.3
H	Combined Cycle (AES)	165	2002.8
I	Colombo Power Pvt. Ltd.	64	2000.6

Source: CEB – Long Term Generation Expansion Plan 2007-2021

Figure 3.2-1 shows location s of each power plant with the identified number in **Table 3.2-2.**



Source: CEB – Long Term Generation Expansion Plan 2007-2021

Figure 3.2-1 Location Map of Existing Power Plants

Hydropower is a major renewable energy, although wind power (3 MW) is owned by CEB.

The total installed capacity owned by private sector with 659 MW consists of small hydropower plants of 109 MW (60 power plants with less than 10 MW in installed capacity) owned by SPPs and thermal power plants with 550 MW (8 power plants contracted for 10, 15, or 20 years) owned by IPPs.

Details of IPPs' thermal power plants are shown in **Table 3.2-3**.

Table 3.2-3 IPP Thermal Power Plants

Power Plant	Output (MW)	Term of Contract (Year)
AES Keranitessa Combind Cycle Power Plant	163	20
Colombo Power (Barge)	60	15
ACE power		
Matara	20	10
Horana	20	10
Embili pitiya	100	10
ASIA Power	49	20
Lakdahanavi	22.5	15
Heladanavi	100	10

Source: CEB Long Term Generation Expansion Plant 2007-2021

3.3 Existing Transmission Line and Substations

The transmission line voltages of 220 kV and 132 kV are adopted in Sri Lanka.

Existing 220 kV high voltage transmission system passes from Mahaweli complex including Kotmale, Victoria, Randenigala Rantambe hydropower stations to the main load center via Kotugoda, Pannipitiya and Biyagama substations. The other 220 kV transmission line from the Kotmale power station to the Anuradhapura substation started operation in January 2000.

220/132/33 kV and 220/132 kV high voltage transformers are installed in Rantambe, Biyagama, Kotugada, New Anuradhapura, Pannipitiya and Kelanitissa substations.

Regarding 132 kV transmission line system, it is used for intermediate connections among other hydropower stations, thermal power stations and substations.

As intermediate connections, there are 37 substations with 132/33 kV and four 132/11 kV indoor Gas Insulated Switchgears (GIS) installed at Fort, Kollupitiya, Maradana and Havelock substations.

132 kV underground cables are used for transmission to Colombo city connected at 2 connection points with conventional transmission line. The transmission lines are connected to Kelanitissa, Fort, Kollupitiya, Kolonnawa, Maradana, Havelock Town and Dehiwala substations.

Existing typical bus component of 132/33 kV substations are mainly of the Single Bus type, while double Bus type is adopted for the 220/132 kV substations.

The above CEB's power system is controlled at the System Control Center located in Dematagoda.

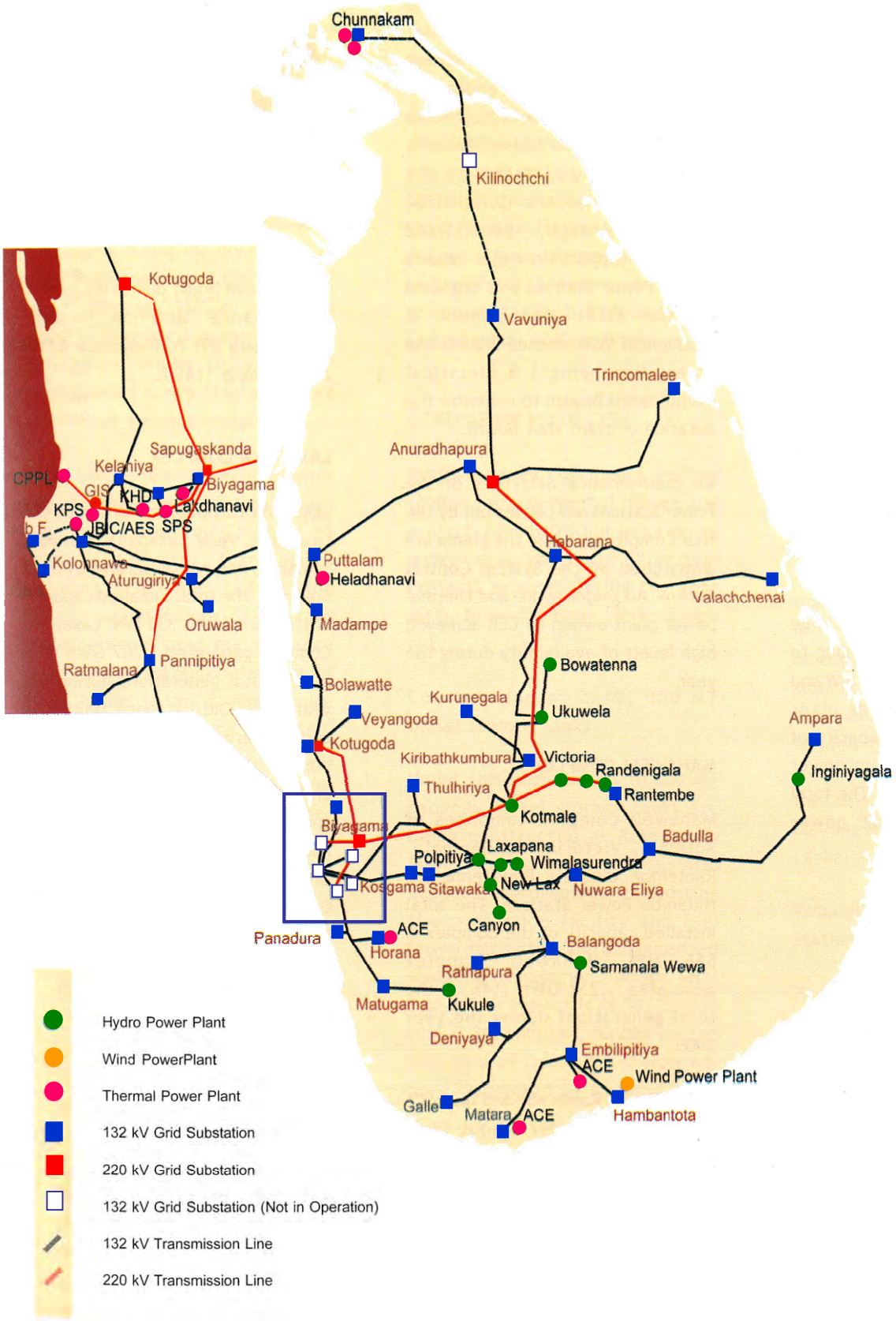
Capacity of the existing substations and length of transmission lines by each voltage class are shown in **Table 3.3-1.**

Table 3.3-1 Existing Substation and Transmission Line

Description		Present (year 2006)
1. Grid substation		
a. 132/33 kV	No. / Capacity [MVA]	37 / 2,570.5
b. 220/132/33 kV	No. / Capacity [MVA]	3 / 1,300/300
c. 132/11 kV	No. / Capacity [MVA]	4 / 306
2. Other major substation		
a. 220/132/33 kV	No. / Capacity [MVA]	2 / 800/200
b. 220/132 kV	No. / Capacity [MVA]	1 / 105
3. Transmission lines (Route length)		
a. 220 kV, 2 cct.	km	148.2
b. 220 kV, 1 cct.	km	182.5
c. 132 kV, 4 cct	km	3.6
d. 132 kV, 2 cct	km	1,356.1
e. 132 kV, 1 cct	km	315
f. 132 kV under ground cable	km	41.4
4. Reactive power sources		
a. Capacitors	Mvar	320
b. SVC	Mvar	20

Source: CEB Long Term Transmission Development Plan 2006-2015

The route map of 220 kV and 132 kV transmission lines is shown in **Figure 3.3-1.**



Source: CEB Annual Report and Accounts 2005

Figure 3.3-1 Transmission Line Route Map

3.4 Actual Results of Power Supply and Demand

3.4.1 Power Demand

(1) Generation and Peak Load

The annual peak load (MW) and generation (GWh) during the past ten years in the CEB grid are shown in **Table 3.4.1-1** and **Figure 3.4.1-1.**

Table 3.4.1-1 Generation and Peak Load

	Generation		Peak Load (MW)	
	Actual (GWh)	Rate of Inc. (%)	Actual (MW)	Rate of Inc. (%)
1996	4,527		968	
1997	5,146	12.0	1,037	6.7
1998	5,683	9.4	1,137	8.8
1999	6,173	7.9	1,291	11.9
2000	6,841	9.8	1,404	8.0
2001	6,520	-4.9	1,445	2.8
2002	6,946	6.1	1,422	-1.6
2003	7,612	8.7	1,516	6.2
2004	8,159	6.7	1,563	3.0
2005	8,769	7.0	1,748	10.6
2006	9,389	6.6	1,893	7.7
Ave.		7.6		6.9

Source: CEB National Demand Forecast 2006-2021

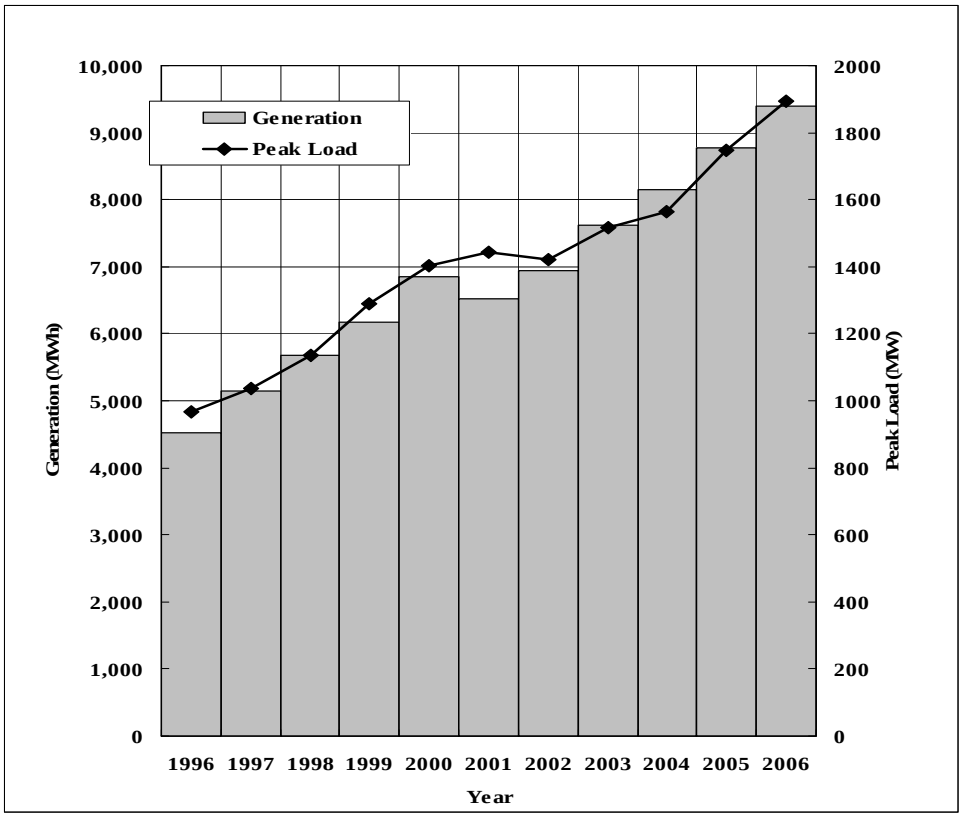


Figure 3.4.1-1 Generation and Peak Load

Under stable growth of social economic situation in the country from 1996 to 2006, the annual average growth rate of annual peak load and annual generation showed 7.6% and 6.9% each.

(2) Energy Demand (GWh) by Category

The energy demand of CEB is categorized to six in the same way as tariff category, as follows:

Category: 1. Domestic, 2. Religious, 3. General, 4. Industrial, 5. Bulk Supply to LECO, 6. Street Lighting.

Records of the number of consumers, sales revenue and energy demand in the past ten (10) years are show in **Table 3.4.1-2.**

Table 3.4.1-2 Number of Consumers, Sales Revenue and Energy Demand

Item	Unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Number of Consumers												
Domestic	-	471,599	503,330	548,110	593,468	643,314	713,307	848,540	930,554	1,010,719	1,113,740	1,229,750
Non-commercial	-	6,548	6,338	7,192	7,654	7,815	7,643	8,629	9,722	9,865	9,950	10,010
Commercial	-	2,162	2,441	2,637	2,948	3,096	3,386	3,898	5,317	5,454	6,000	6,170
Industrial	-	12,329	12,928	14,062	14,996	16,179	17,701	18,789	19,833	21,374	22,500	23,020
Water Supply & Irrigation		889	903	981	1,091	1,199	1,319	1,604	2,026	2,909	3,770	6,830
Street Light	-	456	482	683	842	932	1,012	1,048	1,229	1,437	1,500	1,550
Temporay Supply	-	187	155	175	207	144	141	172	138	150	155	
Transport	-	8	8	12	21	47	37	49	48	48	50	50
Temple	-	782	867	992	1,131	1,248	1,441	1,800	1,738	1,959	2,150	
Community Sale	-							1	1	15	35	58
Internal Total	-	494,960	527,452	574,844	622,358	673,974	745,987	884,530	970,606	1,053,930	1,159,850	1,277,438
Bulk Supply (India)	-	5	5	5	5	5	5	5	5	5	5	5
Grand Total	-	494,965	527,457	574,849	622,363	673,979	745,992	884,535	970,611	1,053,935	1,159,855	1,277,443

Item	Unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Sales Revenue												
Domestic	MRs	1,379.46	1,769.84	1,895.85	2,056.05	2,622.03	3,161.38	3,641.43	4,249.81	4,578.99	4,987.04	5,363.46
Non-commercial	MRs	307.25	386.36	405.14	419.58	527.40	835.78	722.12	783.99	816.01	862.37	929.48
Commercial	MRs	349.63	446.96	477.04	515.72	661.58	555.62	818.75	894.91	986.07	1,012.66	1,138.21
Industrial	MRs	1,406.73	1,801.58	1,973.37	2,093.88	2,599.34	3,086.10	3,608.13	4,039.65	4,380.22	4,799.74	5,061.11
Water Supply & Irrigation	MRs	68.40	95.70	100.28	78.14	95.65	120.90	138.68	148.53	154.80	211.57	196.63
Street Light	MRs	53.04	80.11	101.98	111.37	149.95	176.05	200.74	246.79	329.52	314.11	373.06
Temporay Supply	MRs	11.84	7.99	7.17	7.06	13.39	6.77	3.63	4.74	3.46	5.06	9.86
Transport	MRs	4.20	6.09	6.51	9.46	18.31	27.73	27.90	29.29	28.94	30.72	30.50
Temple	MRs	4.56	6.21	6.71	7.42	9.70	11.45	12.16	14.24	20.80	29.17	25.04
Community Sale	MRs								16.59	20.09	24.04	28.47
Internal Sales	MRs	3,585.10	4,600.84	4,974.05	5,298.67	6,697.35	7,981.78	9,173.53	10,428.53	11,318.92	12,276.48	13,155.82
Bulk Supply (India)	MRs	206.72	249.29	199.92	198.15	327.80	396.06	514.12	808.96	673.69	609.51	565.60
Total Sales	MRs	3,791.82	4,850.13	5,173.96	5,496.82	7,025.16	8,377.83	9,687.65	11,237.49	11,992.61	12,885.99	13,721.42

Item	Unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Energy Demand (GWh)												
Domestic	GWh	328.730	355.118	378.778	410.566	467.049	518.360	557.940	617.110	676.365	730.829	810.190
Non-commercial	GWh	53.464	57.991	60.227	62.931	63.592	73.157	78.220	80.736	83.012	91.342	101.030
Commercial	GWh	62.916	67.606	71.471	77.343	81.822	94.166	90.426	92.741	108.122	107.435	123.450
Industrial	GWh	358.672	376.742	413.738	440.996	508.357	520.634	596.677	629.505	689.799	763.771	803.350
Water Supply & Irrigation	GWh	25.091	27.978	29.045	22.831	15.742	28.600	29.283	29.983	31.671	36.115	42.730
Street Light	GWh	16.720	20.929	26.585	29.405	31.741	36.981	39.517	45.803	55.196	57.844	64.880
Temporay Supply	GWh	1.154	0.844	0.711	0.766	0.927	0.826	0.282	0.348	0.251	0.394	0.730
Transport	GWh	1.432	1.483	1.663	2.598	2.678	5.892	5.635	5.530	5.471	5.715	5.980
Temple	GWh	1.503	1.691	1.801	1.982	2.366	2.511	2.476	2.811	4.111	4.204	4.910
Community Sale	GWh							5.717	4.740	5.581	8.172	8.020
Internal Total	GWh	849.682	910.382	984.019	1,049.418	1,174.274	1,281.127	1,406.173	1,509.307	1,659.579	1,805.821	1,965.270
Bulk Supply (India)	GWh	87.014	100.218	67.410	64.158	95.000	126.000	133.857	192.249	141.235	112.529	101.000
Grand Total	GWh	936.696	1,010.600	1,051.429	1,113.576	1,269.274	1,407.127	1,540.030	1,701.556	1,800.814	1,918.350	2,066.270

Source: CEB Statistical Digest

The shares of the energy demand by each category to the total demand are shown in **Table 3.4.1-3**.

The major categories in the energy demand in the country are “Domestic” and “Industrial” sectors as shown in **Table 3.4.1-3** and **Figure 3.4.1-2**. The total demand of Domestic and Industrial sectors in 2006 is sharing 66% of the total energy demand.

The share of Industrial energy demand to the total demand has maintained constantly during the past 10 years, while Domestic energy demand grew with 4.3% per annum and has become the same share as that for Industrial in 2006.

The energy demand of Street Lighting in 2006 increased twice as much as that in 1996, however it shares only 5% of Domestic energy demand in 1996 and 3.8% in 2006.

Table 3.4.1-3 Energy Demand by Category

Energy Demand (GWh)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Domestic	1,026	1,191	1,353	1,526	1,700	1,767	1,790	1,995	2,166	2,403	2,579
Rate of increase (%)		16.1	13.6	12.8	11.4	3.9	1.3	11.5	8.6	10.9	7.3
Ratio to total (%)	28.6	29.5	29.9	31.7	32.3	33.7	32.5	32.1	32.5	33.1	32.9
Religious	20	22	25	29	31	31	31	35	38	41	43
Rate of increase (%)		0.1	0.1	0.2	0.1	0.0	0.0	0.1	0.1	0.1	0.0
Ratio to total (%)	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5
General Total	592	689	758	829	895	859	921	1,042	1,132	1,254	1,395
Rate of increase (%)		16.4	10.0	9.4	8.0	-4.0	7.2	13.1	8.6	10.8	11.2
Ratio to total (%)	16.5	17.1	16.8	17.2	17.0	16.4	16.7	16.8	17.0	17.3	17.8
Industrial Total	1,361	1,430	1,614	1,613	1,755	1,719	1,866	2,159	2,266	2,446	2,605
Rate of increase (%)		5.1	12.9	-0.1	8.8	-2.1	8.6	15.7	5.0	7.9	6.5
Ratio to total (%)	37.9	35.4	35.7	33.5	33.4	32.8	33.9	34.8	34.0	33.7	33.3
Bulk Supply to LECO	542	657	722	762	825	802	811	894	981	1,027	1,111
Rate of increase (%)		21.2	9.9	5.5	8.3	-2.8	1.1	10.2	9.7	4.7	8.2
Ratio to total (%)	15.1	16.3	16.0	15.8	15.7	15.3	14.7	14.4	14.7	14.2	14.2
Street Lighting	47	50	49	50	52	60	83	83	83	83	98
Rate of increase (%)		6.4	-2.0	2.0	4.0	15.4	38.3	0.0	0.0	0.0	18.1
Ratio to total (%)	1.3	1.2	1.1	1.0	1.0	1.1	1.5	1.3	1.2	1.1	1.3
TOTAL	3,588	4,039	4,521	4,809	5,258	5,236	5,502	6,209	6,667	7,255	7,832

Source: CEB Statistical Digest

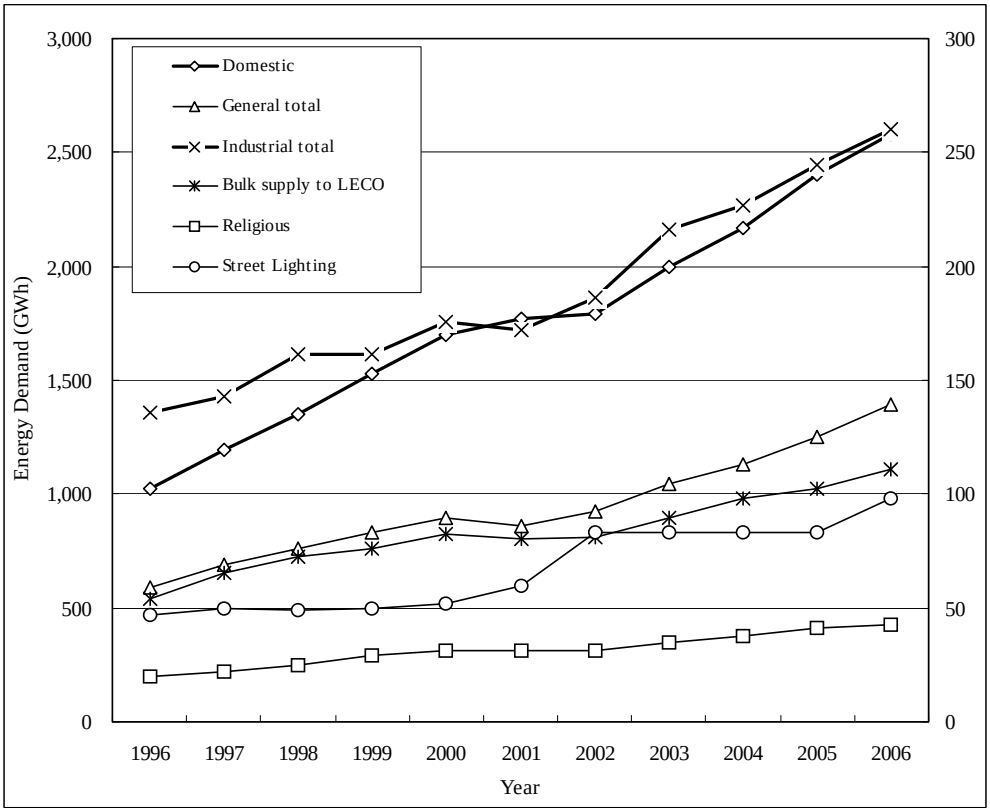
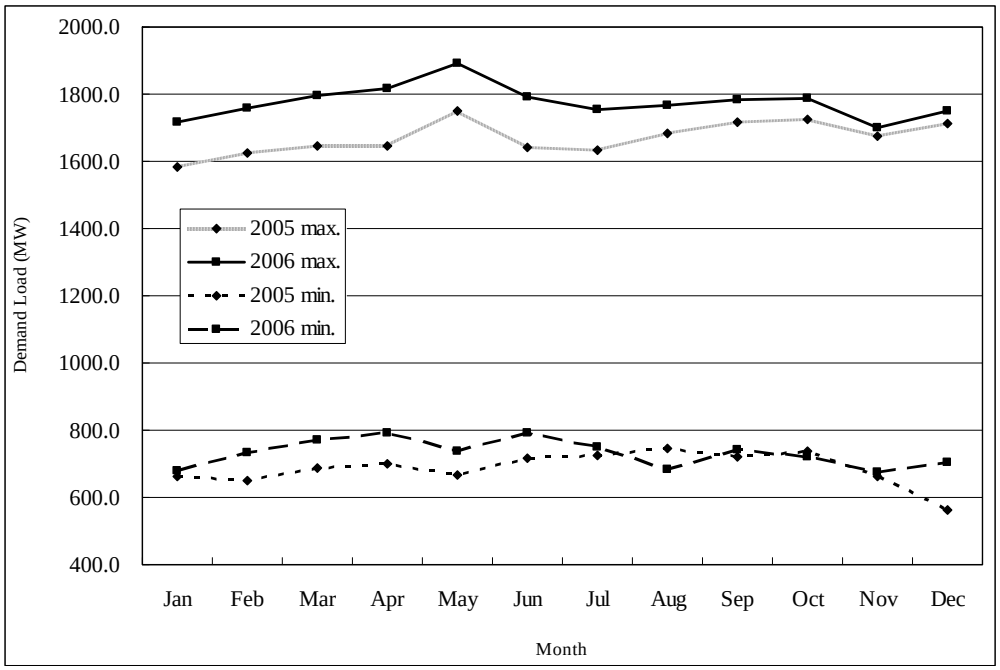


Figure 3.4.1-2 Energy Demand by Category

(3) Monthly Maximum and Minimum Load

The monthly maximum and minimum loads in 2005 and 2006 are shown in **Figure 3.4.1-3**. The annual peak demand is recorded in April to May or in November to December in Sri Lanka.

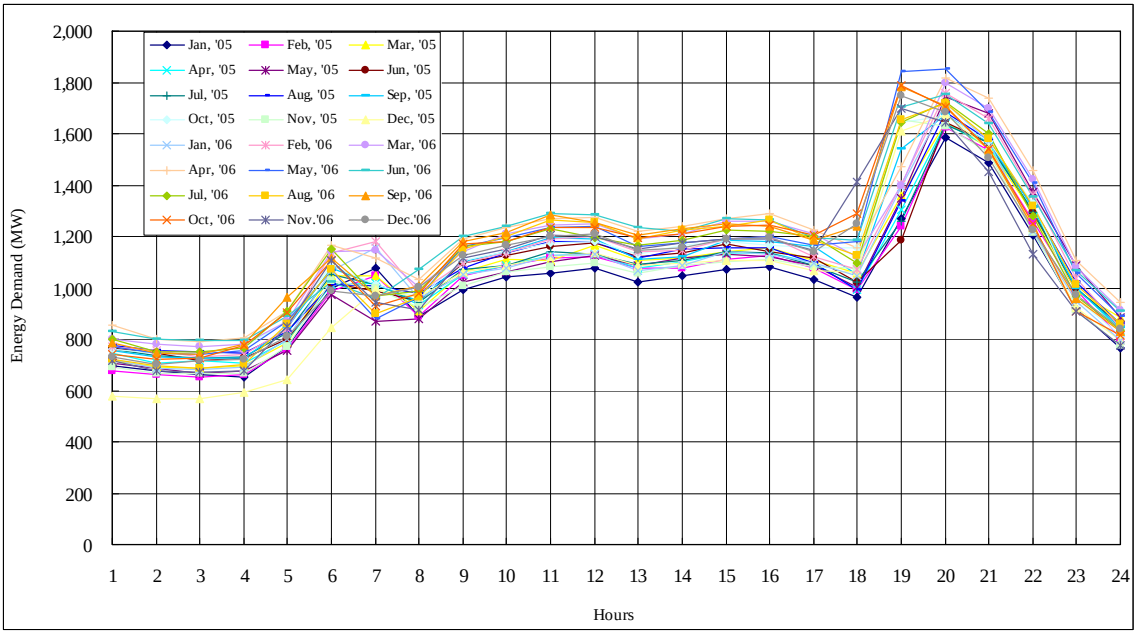


Source: CEB

Figure 3.4.1-3 Monthly Maximum & Minimum Load

(4) Daily Load

Daily load curves on the days when the monthly maximum was recorded in 2005 and in 2006 are shown in **Figure 3.4.1-4.** The daily peak load in the country is recorded in the evening. For the reason it shows the typical domestic power demand pattern due to lighting.



Source: CEB

Figure 3.4.1-4 Daily Load Curve Recorded in Terms of Monthly Maximum (2005/01 – 2006/12)

(5) Daily Load Curve by Power Source

Daily Load Curve by each power source in August 30, 2006 is shown in **Figure 3.4.1-5.**

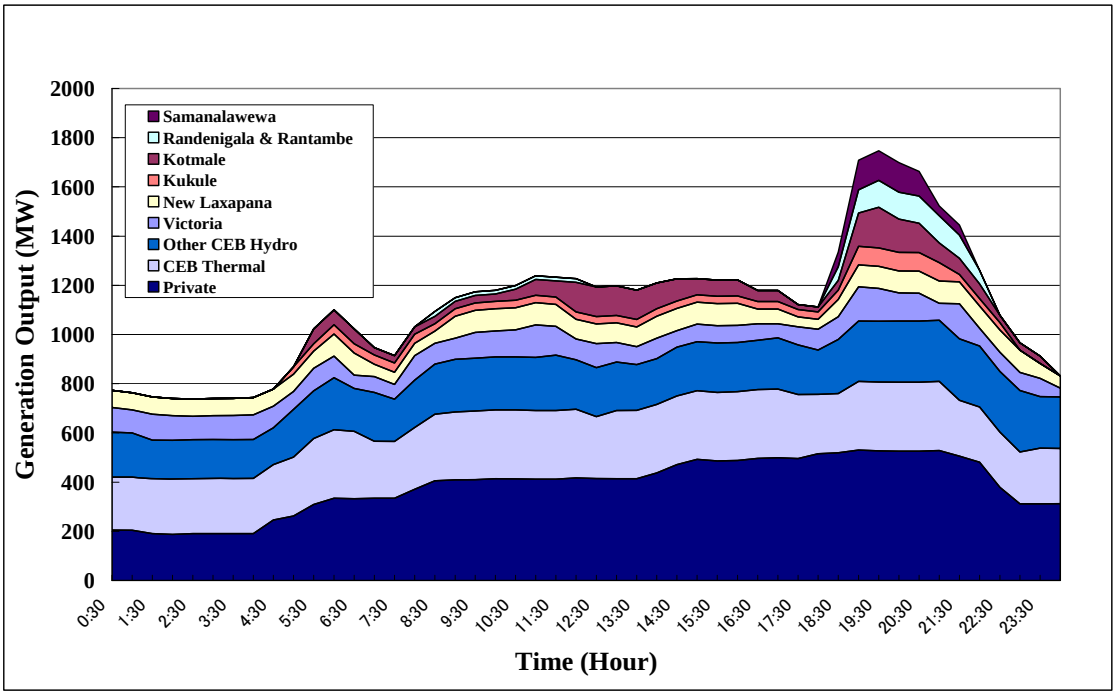


Figure 3.4.1-5 Daily Load Curve on 30 August 2006

Power sources for the base, middle and peak load are considered as follows:

1) For Base Load

   Power sources for the base load are mainly composed of IPPs' and CEB's thermal power plants.

2) For Middle Load

   Middle load is supplied by CEB's Hydropower plants except those for the peak load.

3) For Peak Load

   Peak load is mainly coped with by the Randenigara, Rantambe and Samanalawewa Hydropower plants. They are applied for compensation of short term load fluctuation and important power plant for stable operation of the power system.

(6) Annual Power Generation

The annual power generation by power source and by owner in the country is shown in **Table 3.4.1-4** and is increasing steadily recording 6,520 GWh in 2001, 8,769 GWh in 2005 and 9,389 GWh in 2006.

Table 3.4.1-4 Annual Electricity Production

Unit: GWh

Item/Year	2001	2005	2006
Hydro	**3,109.8**	**3,453**	**4,636**
CEB	3,045	3,173	4,290
SPPs	64.8	280	346
Thermal	**3,407**	**5,314**	**4,751**
CEB	1,896	2,162	1,669
IPPs & other	1,511	3,152	3,082
Wind	**3.5**	**2**	**2**
Total	**6,520.3**	**8,769**	**9,389**

Source: CEB Statistical Digest

(7) Maximum Power Demand

The maximum power demand in the country as of the end of 2008 is 1,922 MW recorded on May 21, 2008.

From 1997 to 2006, the annual maximum power demand (MW) is increasing at 6.9% per annum steadily.

Table 3.4.1-5 Maximum Power Demand

Year	Maximum Power Demand (MW)	Growth Rate (%)
1997	1,037	
1998	1,137	9.6
1999	1,291	13.5
2000	1,404	8.8
2001	1,445	2.9
2002	1,422	-1.6
2003	1,516	6.6
2004	1,563	3.1
2005	1,748	11.8
2006	1,893	8.3
Average		6.9

Source: Long Term Generation Expansion Plan 2007-2021

3.4.2 Power Supply

(1) Generation by River Basin

Table 3.4.2-1 and **Figure 3.4.2-1** shows CEB's power generation by power sources in 2006. The Mahaweli Complex to which the Victoria Hydropower Station belongs shares 22.6% of all power generation in 2006. This shows the complex plays an important role of power supply in power sources of the country.

Table 3.4.2-1 Generation Data

Power Source	Power Plant	2006 Total (MWh)	Share (%)
Hydro	Laxapana Complex	1,498,664	16.0
	Mahaweli Complex	2,122,907	22.6
	Samanalawewa	294,148	3.1
	Kukule	320,835	3.4
	Small Hydro	52,980	0.6
	Total Hydro	4,289,534	45.7
Thermal	Sapugaskanda Station A	347,660	3.7
	Sapugaskanda Station B	514,346	5.5
	KPS small GT	5,806	0.1
	KPS GT7	66,578	0.7
	KPS CCY DF	392,625	4.2
	KPS CCY Nap	340,622	3.6
	Small Diesel plants	0	0.0
	Chunakam p.s	1,280	0.0
	Total Thermal	1,668,917	17.8
Wind	Wind Hambantota	2,310	0.0
	Total CEB Generation	5,960,761	63.5
	Private Power Total	3,427,960	36.5
	Gross Generation	9,388,721	100.0

Source: CEB SYSTEM CONTROL & OPERATIONS Monthly Review Report (2006)

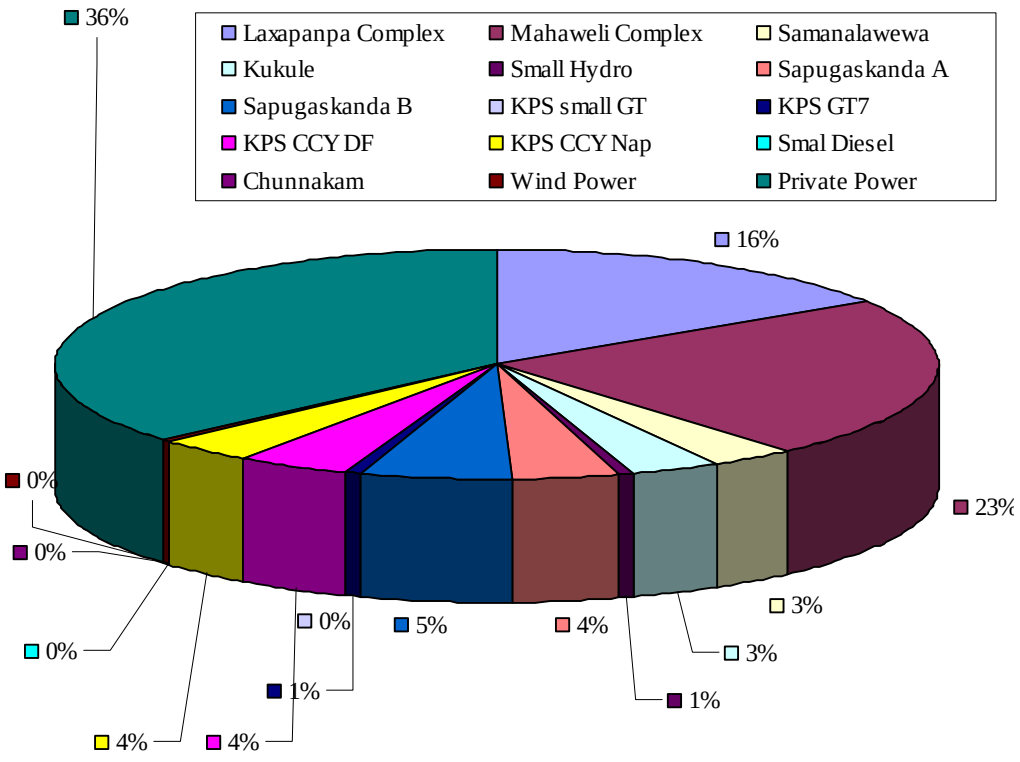


Figure 3.4.2-1 Generation Ratio in 2006

(2) Load Factor by Different Power Sources

Table 3.4.2-2 shows the yearly load factors in 2006 and monthly in May 2006, based on average power generation during corresponding periods.

Load factor of all generation including that by thermal power plants is 57%, while the load factor of the Mahaweli complex is 41.7% for the year of 2006 and 30.6% for May 2006.

It means that the power plants of the Mahaweli complex, as a whole, are used for peak operation rather than other power sources.

Table 3.4.2-2 Load Factor in 2006

Power Source	Power Plant	2006 Total (MWh)	2006/05 (MWh)	Annual Average Power Outputs (MW) (a)	2006/5 Monthly Average Power Outputs (MW) (b)	Maximum Demand (MW) May.15 19:30	Load Factor (%) for (a)	Load Factor (%) for (b)
Hydro	Laxapana Complex	1,498,664	111,339	171	150	187.6	91.2	79.8
	Mahaweli Complex	2,122,907	131,979	242	177	580.5	41.7	30.6
	Samanalawewa	294,148	23,535	34	32	128.0	26.2	24.7
	Kukule	320,835	24,589	37	33	75.0	48.8	44.1
	Small Hydro	52,980	7,667	6	10	11.9	50.8	86.6
	Total Hydro	4,289,534	299,109	490	402	983	49.8	40.9
Thermal	Sapugaskanda Station A	347,660	32,668	40	44	52	77.1	85.3
	Sapugaskanda Station B	514,346	47,569	59	64	63	93.9	102.3
	KPS small GT	5,806	316	1	0	0		
	KPS GT7	66,578	1,787	8	2	115	6.6	2.1
	KPS CCY DF	392,625	60,352	45	81	161	27.8	50.4
	KPS CCY Nap	340,622	29,191	39	39	0		
	Small Diesel plants	0	0	0	0	0		
	Chunakam p.s	1,280	69	0	0	0		
	Total Thermal	1,668,917	171,952	191	231	390	48.9	59.3
	Wind Hambantota	2,310	242	0	0	0		
	Total CEB Generation	5,960,761	471,303	680	633	1,373	49.6	46.1
	Private Power Total	3,427,960	342,484	391	460	520	75.3	88.6
	Gross Generation	9,388,721	813,787	1,072	1,094	1,893	56.6	57.8

Source: CEB SYSTEM CONTROL & OPERATIONS Monthly Review Report (2006)

3.5 Electricity Tariff

The electricity tariff system of CEB consists of two parts, demand plus fixed charge and energy (unit) charge. For a long time, the tariff had six categories: Domestic, Religious, General, Industrial, Bulk Supply to LECO and Street Lighting. However, another new category, Hotel, was added in a tariff revision in 2006. A time-of-day tariff is applicable to industrial and hotel sector use. The total energy sold under such tariff system, however, is limited to 4% of the total energy sold in 2007.

Formerly there was a cross subsidy from industrial and general use consumers to the domestic and religious consumers. However, the cross subsidy was gradually abolished with the tariff revision in 2006. Another tariff revision made in 2007 also supported this new policy. As a result, as compared with the average tariff in 2002, that for 2007 was increased by 41% for industrial use, and 20% for general use, while the rate was as high as 74% for domestic and 85% for religious use. At the same time consideration was made to maintain lower tariff for less income households with monthly energy consumption less than 30 kWh: only fixed charge was increased while unit rate for energy charge remained unchanged.

Tariff revision in recent years was made as follows: 2002 (April and August); 2006 (February and September); 2007 (February) and 2008 (March). As there was no revision for four years since 2002, the substantial increase in tariff was obliged consecutively in 2006 and 2007. Fuel Adjustment Cost (FAC) of 20% has been billed to the consumers since September 2006, except for domestic and religious consumers below 90 kWh/month.

Due to the fact that CEB relies on the thermal power generation which requires costly fuels, current tariff level does not cover the required cost. On the other hand, the tariff level lies in the higher in Southwest Asian countries, therefore, it would be difficult to implement further tariff increase.

Table 3.5-1 represents the comparison of electricity prices in selected Southwest Asian countries. **Table 3.5-2** shows the general average unit tariff of CEB for the past six years. **Table 3.5-3** shows current Electricity Tariff of CEB.

Table 3.5-1 Comparison of Regional Electricity Prices

(unit: in equivalent of LKR/kWh)

Consumer	Class	Electricity use (kWh/month)	Maximum demand (MW)	Bangladesh	India 1 (Tamilnadu)	India 2 (Kerala)	India 3 (Maharashtra)	Nepal	Pakistan	Sri Lanka
Household	Small	30	-	6.02	3.05	3.10	**8.08**	7.30	2.38	5.00
	Medium	90	-	5.22	5.06	4.37	6.29	**9.40**	4.51	6.50
	Large	300	-	5.69	8.04	8.27	9.34	10.76	5.63	**23.70**
Commercial	Small	1,000	-	9.58	**15.58**	14.12	14.83	12.96	9.02	10.74
	Medium	58,000	180	9.68	15.99	16.50	11.28	11.84	9.23	**20.32**
	Large	600,000	1,500	9.65	15.50	10.98	10.38	11.37	8.95	**19.37**
Industrial	Small	5,000	-	7.63	8.09	9.10	11.08	10.16	9.57	**13.05**
	Medium	65,000	180	7.07	11.67	11.72	10.60	9.20	8.41	**12.45**
	Large	270,000	600	7.02	11.23	11.32	10.15	8.91	7.20	**11.86**
	Vy Large	1,050,000	2,250	6.60	11.17	10.25	10.09	7.12	6.85	**11.80**

Source: "Electricity Tariff and its Long Term Impact on Business and Economy", a presentation paper by Udayasri Kariyawasam, Chairman, CEB (May 2008)

Table 3.5-2 General Average Unit Tariff of CEB

Year	Energy Sales (GWh)	Sales income (Million Rs.)	Unit rate (Rs./kWh)	Annual Increase
2002	5,500	40,544	7.37	
2003	6,209	47,719	7.69	4%
2004	6,667	51,119	7.67	0%
2005	7,255	55,978	7.72	0%
2006	7,832	69,941	8.93	16%
2007	8,276	87,400	10.56	18%

Source: Statistical Digest 2002-2007, CEB

Table 3.5-3 Tariff of CEB

(effective from March 15, 2008)

Tariff category		Unit charge (Rs/kWh)	Fixed charge (Rs/month)	Demand charge (Rs/kVA)
Domestic Purpose				
For those who consume -				
Upto 30 units per month		3.00	60.00	
in excess of 30 and up to 60 units per month		4.00	90.00	
in excess of 60 and up to 90 units per month		5.50	90.00	
in excess of 90 and up to 120 units per month		10.00	90.00	
in excess of 120 and up to 180 units per month		11.00	90.00	
in excess of 180 and up to 240 units per month		15.00	90.00	
in excess of 240 and up to 360 units per month		18.00	90.00	
in excess of 360 and up to 600 units per month		21.00	90.00	
above 600 units		25.00	3000.00	
Religious Purpose				
For those who consume -				
Upto 30 units per month		2.50	60.00	
In excess of 30 and up to 60 units per month		3.00	90.00	
In excess of 60 and up to 90 units per month		4.50	90.00	
In excess of 90 and up to 120 units per month		9.00	90.00	
In excess of 120 and up to 180 units per month		10.00	90.00	
In excess of 180 and up to 240 units per month		14.00	90.00	
In excess of 240 and up to 360 units per month		15.00	90.00	
In excess of 360 and up to 600 units per month		20.00	90.00	
above 600 units		22.00	3000.00	
LECO				
L-1		12.00		675.00
L-2		8.50		650.00
General Purpose				
GP1		15.00	240.00	
GP2		13.80	3000.00	750.00
GP3		13.60	3000.00	675.00
Industrial Purpose				
I-1		10.00	240.00	
I-2		8.10	3000.00	675.00
I-3		8.00	3000.00	650.00
I-2 (TD)	peak	22.00	3000.00	650.00
	off peak	7.50		
I-3 (TD)	peak	20.00	3000.00	650.00
	off peak	7.10		
Hotel Purpose				
H-1 (GP)		15.00	240.00	
H-2 (GP)		13.80	3000.00	750.00
H-2 (I)		8.10	3000.00	675.00
H-3 (I)		8.00	3000.00	650.00
H-2 (I-TD)	peak	22.00	3000.00	650.00
	off peak	7.50		
H-3 (I-TD)	peak	20.00	3000.00	650.00
	off peak	7.10		
Standby Tariff				
I-2 (ST)		8.10	3000.00	675.00
I-3 (ST)		8.00	3000.00	650.00
Street Lights		19.00		
3 part Time of Day Tariff				
Industrial/ Hotel Purpose				
I-2 (TD3)	peak (18:30 hrs - 22.30 hrs)	23.00	3000.00	650.00
	day (04.30 hrs -18.30 hrs)	7.30		
	off peak (rest of the time)	5.30		
I-3 (TD3)	peak (18.30 hrs- 22.30 hrs)	21.00	3000.00	650.00
	day (04.30 hrs -18.30 hrs)	6.90		
	off peak (rest of the time)	5.00		

Source: CEB

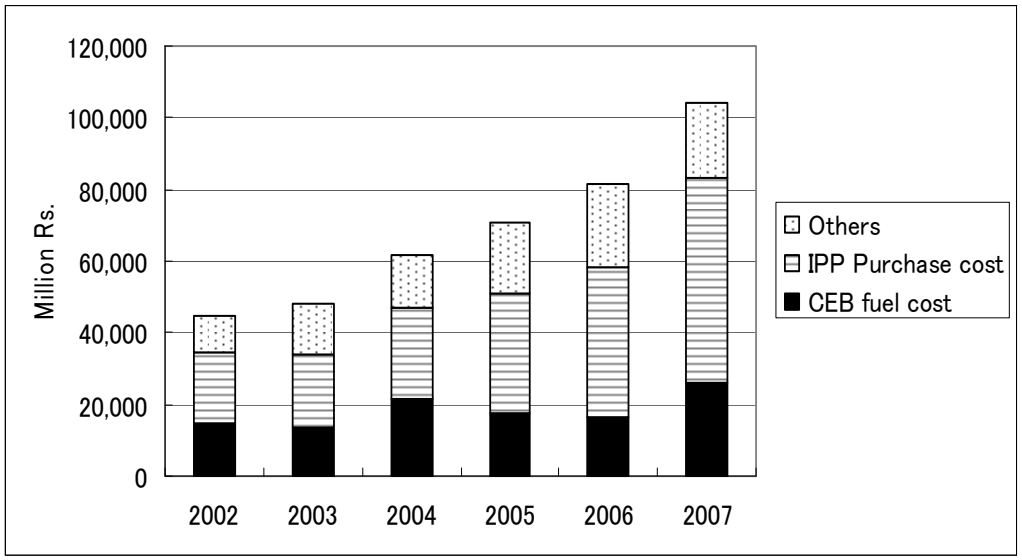
Note: Fuel Adjustment Charge 30% on all unit charges except DP & RP consumers consuming less than 90 units per month

3.6 Financial Situation of CEB

Electricity sales by CEB have been steadily growing for the past five years. The main reason is the annual increase of electricity sales by 8%. In addition, electricity tariff revision in 2002 and 2006 contributed largely in increase in income. Even with these recent tariff revisions, however, it does not reach to a level to recover the required cost.

On the other hand, the direct cost increases much more than the increase in electricity sales revenue. There are two major reasons for this cost increase: one is the increase of cost, especially fuel cost hike, in thermal power plants owned and operated by CEB since 1997; the other is the increase in power purchase cost from IPPs.

Cost structure of CEB is shown below:



Note: Figure for Others in 2007 is tentative.
Source: Data from CEB Annual Report and Statistical Digest 2002-2007

Figure 3.6-1 Breakdown of Direct Cost

Comparison of the cost in 2002 and 2007 reveals that electricity generation by thermal power plants by CEB increased by 120% and it occupies some 40% of total electricity generation. And that the fuel cost was increased by 170% due to rise in the fuel price.

As to the cost of power purchasing from IPPs, due to the fact that most of the plants are thermal, the situation is much the same with the case of CEB's thermal power generation. Purchase of electricity from IPPs in terms of kWh in 2007 increased by 170% as compared to 2002, while the purchase cost increased by as high as 290%. As a result, the average cost of power purchasing becomes Rs.14.79 in 2007, which is some 40% higher than the average unit sales price of CEB (Rs.10.56). This reverse balance has become a great problem to CEB.

Due mainly to the abovementioned situation, CEB has been producing no profit since 2000, and the amount of deficit has been increasing annually. Financial statements of CEB during the past five years are shown in **Table 3.6-1**.

Table 3.6-1 Financial Statements of CEB

(unit: Million Rs.)

1. Profit and Loss Statement	2006	2005	2004	2003	2002
Turnover	69,941	55,978	51,119	47,719	40,544
Cost of Sales (less)	81,733	71,026	61,564	48,363	44,801
Gross Profit	**-11,792**	**-15,048**	**-10,445**	**-644**	**-4,257**
Administrative Expenses (less)	2,383	2,518	634	2,347	454
Operating profit	**-14,175**	**-17,566**	**-11,079**	**-2,991**	**-4,711**
Other Operating Income	9,572	16,348	2,017	5,440	3,837
Finance Cost	-1,521	-5,634	-6,645	-6,199	-6,552
Profit before Tax	**-6,124**	**-6,852**	**-15,707**	**-3,750**	**-7,426**
Tax Payment	0	0	0	0	0
Profit after Tax	**-6,124**	**-6,852**	**-15,707**	**-3,750**	**-7,426**

2. Balance Sheet	2006	2005	2004	2003	2002
Non-Current Assets	**322,968**	**284,742**	**263,140**	**238,487**	**227,878**
- Property, Plant & Equipment	281,844	281,844	260,455	235,935	225,214
- Investment in Subsidiaries	725	725	725	725	725
- Investment of Insurance Reserve	2,173	2,173	1,960	1,827	1,939
Current Assets	**32,067**	**20,195**	**19,838**	**18,547**	**18,948**
- Inventories	9,439	7,832	5,342	6,307	5,814
- Trade and Other Receivables	21,362	10,936	13,595	11,194	12,021
- Cash and Bank Balances	1,266	1,427	901	1,046	1,114
Total Assets	**355,036**	**304,938**	**282,978**	**257,034**	**246,826**
Capital and Reserves	**245,520**	**178,234**	**161,167**	**152,370**	**149,874**
- Contributed Capital	55,264	20,200	17,536	16,176	15,839
- Reserves	243,820	204,970	183,327	159,966	153,757
- Retained Loss	-53,563	-46,937	-39,695	-23,772	-19,722
Non-Current Liabilities	**70,885**	**80,369**	**78,493**	**70,057**	**65,282**
- Interest bearing Loans & Borrowings	38,653	51,860	52,515	46,171	43,813
- Consumer Deposits	5,038	4,183	3,767	3,410	3,076
- Provisions and Other Deferred Liabilities	2,105	1,705	1,466	1,648	1,156
- Deferred Income	25,088	22,620	20,745	18,828	17,238
Current Liabilities	**38,630**	**46,335**	**43,318**	**34,607**	**31,670**
- Trade and Other Payables	30,961	26,280	16,295	12,995	12,120
- Interest bearing Loans & Borrowings	7,669	20,055	27,023	21,612	19,550
Total Equity and Liabilities	**355,035**	**304,938**	**282,978**	**257,034**	**246,826**

Source: CEB Annual Report, 2002-2006

3.7 Review of Structure of Power Sector

(1) Structure of Power Sector

CEB and LECO operate as electric utility in Sri Lanka.

CEB was established as a public power corporation by an act in 1969. CEB belongs to the Ministry of Power and Energy, and is in charge of generation, transmission and distribution. As of 2007,

CEB has approximately 3,867,000 customers and occupies 86% of electricity sales and 89% of whole customers. Based on the Power Sector Policy Directions in 1997, private investment in power sector was introduced and CEB began to purchase electricity generated by IPP companies. Nowadays 39.5% of the required energy comes from the power plants operated by IPPs.

LECO is a power distribution company established by the law in 1983. Major shareholders are CEB and Ministry of Finance. LECO receives bulk supply from CEB and supplying to the western coastal region between Negombo and Galle, covering approximately 400,000 consumers.

Public Utilities Commission (PUC) was established by law in 2002 as a regulator. It was inaugurated in 2003 to cover the energy (electric power and petroleum) and water sectors. PUC is to implement regulations on these sectors only after enactment of the relevant laws. The Sri Lanka Electricity Bill was passed in Parliament in March 2009.

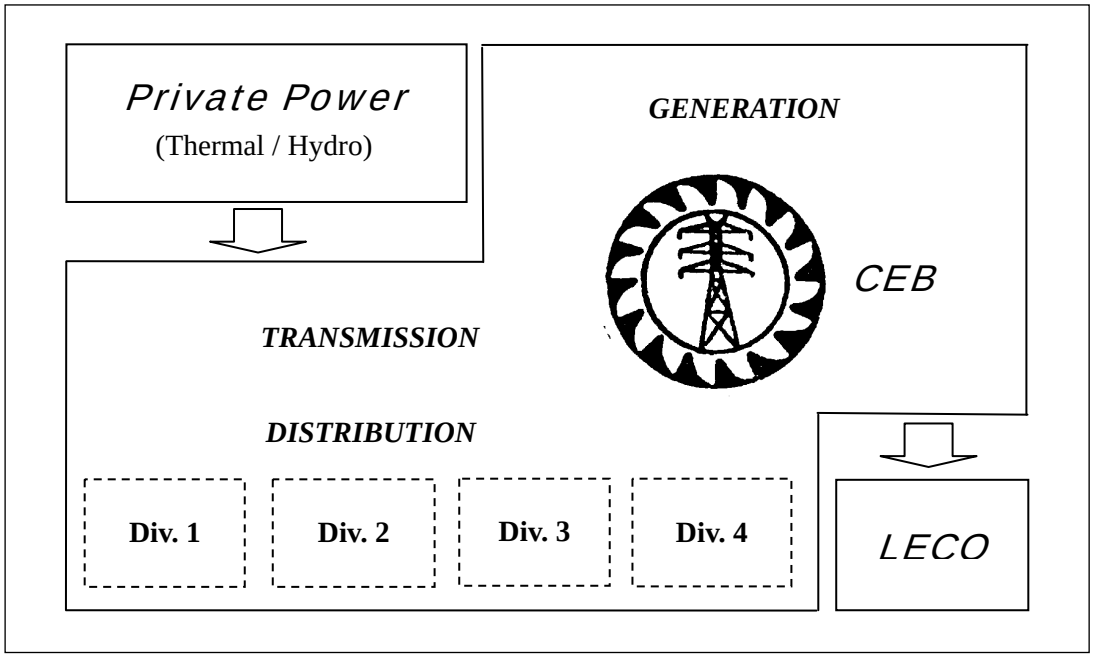


Figure 3.7-1 Electric Power Industry in Sri Lanka

(2) Current Situation of Power Sector Reform

CEB was established as a government corporation in 1969. The Government of Sri Lanka, in 1997, decided to restructure the power sector drastically in order to overcome accumulated inefficiencies in the CEB. The principal features of the power sector reform are as follows:

- The CEB/LECO will be separated into generation, transmission, and distribution functions, with transactions based on a single buyer model, and
- An independent regulator will be established to regulate the power sector.

It is expected that this reform process will improve the operating efficiencies of each entity, and secure financial soundness. As a consequence, the reliable and high-quality supply of electricity will be available to consumers at affordable prices.

Two bills were passed in Parliament for power sector reform. One is the Electricity Reform Act, No. 28 of 2002, and the other is the Public Utilities Commission of Sri Lanka Act, No. 35 of 2002. These acts contemplate to separate functionally CEB and LECO into generation, transmission and distribution companies, and restructure the sector based on the single-buyer model; and to establish an independent organization to regulate the power sector.

On the other hand, much more time than expected was consumed to incorporate opinions from the trade unions of CEB/LECO for amendment of such reform, arrangement of employee problem, and solution of technical problem, which were all necessary to have an agreement with the parties concerned. Although there were some pending issues with trade unions, the Reorganization Scheme which stipulates the unbundling matters was published in the Government Gazette in January 2004, and the contents were approved in the cabinet meeting in March 2004. The Minister of Power and Energy instructed to establish the Steering Committee to forward the Power Sector Reform. However, later a clear policy decision was taken not to unbundle CEB for the time being, after cabinet decision to implement tentatively the Strategic Business Unit (SBU) system by establishing plural divisions which function autonomously within CEB without changing the structure of CEB.

After a great patience and thorough discussions, the Sri Lanka Electricity Bill was passed in March 2009, replacing the Electricity Reform Act No.28. This bill does not touch on the controversial unbundling of CEB any more, but to forward steadily the regulatory reform of the power sector agreeable among the parties concerned. Thus the main point is to vest the PUC authority in licensing to the public utilities and approval of electricity tariff revision, among others.

On the other hand, structure of CEB without unbundling should have Functional Business Units (FBU) in generation, transmission and distribution, and works to set the Key Performance Indicators have been underway.

(3) Problems in Power Sector in Sri Lanka

Lots of problems had been pointed out for Power Sector in Sri Lanka. Power Sector has a lot to be solved and so many endeavors have been undertaken for a better solution. It is still on the way.

The following include the major problems in Power Sector:

- Current electricity tariff lies in the higher level in the region.
- CEB owns and operates thermal power plants with the higher fuel costs.
- CEB purchases energy from IPP with higher cost than its average electricity rates.
- CEB formulates Long Term Generation Expansion Plan annually but the plan has not been implemented due to circumstances.

CHAPTER 4

POWER DEVELOPMENT PLAN

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4.1 Load Demand Forecast

CEB revises annually the national load demand forecast, using a econometric model. In **Section 4.1.1**, CEB's demand forecast for the period from 2007 upto 2027 issued in December 2007 is described. For the purpose of the review of CEB's demand forecast, Study Team carried out a load demand forecast as mentioned in **4.1.2**. Both demand forecast results are compared. in **4.1.3**.

CEB revised the above national load demand forecast by using a time trend method, because the country has been affected by the world-wide economic crisis since September 2008. The revised demand forecast is mentioned in **4.1.4**.

4.1.1 Load Demand Forecast by CEB

In this section, conditions for the forecast, a demand model, and the results of the load demand forecast study by CEB are described:

(1) Demand Model

In the demand model applied by CEB to the demand forecast, the consumers are classified into three categories, and the parameters for each category as shown below:

1) Domestic: Past Demand, GDP per capita, Population, Average Electricity Tariff, Domestic Consumer Account.
2) Industrial and General Purpose: Past Demand, GDP, Population, Average Electricity Tariff, Industrial Consumer Account.
3) Others (Religious Purpose and Street Lighting): Past Demand

Regarding population, the forecast by DCS (Department of Census and Statistics) is used for the demand forecast.

GDP forecast from 2007 up to 2011 by the Central Bank of Sri Lanka and that after 2011 by CEB based on trend up to 2011 are used.

The average electricity tariffs in future for the domestic category is estimated by using CCPI (Colombo Consumer Price Index) and that for the industrial and general purpose is done by WPI (Wholesale Price Index), respectively.

The forecast demand models are as follows:

1) Domestic Sector

$$Ddom(t)i = b1 + b2GDPPCi + b3Ddom(t–1)i + ei$$

Where,

Ddom(t) : Energy Demand in domestic consumer category in the year of t.

GDPPCi : Gross Domestic Product per Capita.
Ddom(t-1) : Energy Demand in domestic consumer category in the year of (t-1).
b1, b2, b3 : Constant

2) Industrial & General Purpose

Di&gp(t)i = b1 + b2GDPi + ei

Where,

Di&gp(t)i : Energy Demand for electricity in Industrial and Gen. Purpose consumer categories in the year of t.
GDP : Gross Domestic Product
b1, b2 : Constant

3) Other Sector

ln(St) = B + ln(1+g)t

Where,

St : Electricity Sales in Religious Purpose and Street Lighting
g : Average annual growth rate of electricity
B : Constant

(2) Demand Forecast Scenarios

CEB forecast demand in the five load forecast scenarios, which was to be used for inputs to Long Term Generation Expansion Plan, as sensitivity studies. They are as follows;

1) Scenario 1 : Low Load Forecast: Considering low population growth and low GDP growth.
2) Scenario 2 : Base Load Forecast: Considering base population growth and base GDP growth
3) Scenario 3 : High Load Forecast: Considering high population growth and high GDP growth
4) Scenario 4 : Forecast with Constant Energy Losses: Considering base load growth with constant energy loss 16.6% on Scenario 2.
5) Scenario 5 : Forecast with DSM (Demand Side Management): Considering saving the Energy and Peak Demand by DSM measures on Scenario 2.

The results of each demand forecast scenario are as follows:

1) Scenario 1

Under the conditions of the low population growth rate with annual average 0.16%, and the low GDP growth rate with annual average 6.1%, energy demand is estimated to increase from 8,141 GWh in 2007 up to 34,057 GWh in 2027 with an annual average growth rate of 7.42%.

The maximum power demand is estimated to increase from 1,958 MW in 2007 up to 7,579 MW in 2027 with the annual average growth rate of 7.00%.

Load factor is estimated at 59.7% in 2027, which is higher by 2.8% than that in 2007.

2) Scenario 2

Under the conditions of the population growth rate of 0.59% per annum and the GDP growth rate 6.7% per annum, energy demand is estimated to grow from 8,258 GWh in 2007 to 40,615 GWh in 2027 with the annual average growth rate of 8.29%.

The maximum power demand is estimated to grow from 1,986 MW in 2007 to 9,038 MW in 2027 with the annual average growth rate of 7.9%.

The load factor is estimated at 59.7% in 2027, which is the same as that in Scenario 1.

3) Scenario 3

Under the conditions of the population growth rate with 0.85% per annum and the GDP growth rate with 7.5% per annum, energy demand is estimated to increase from 8,391 GWh in 2007 up to 48,198 GWh in 2027 with the annual average growth rate of 9.13%.

The maximum power demand is estimated to grow from 2,018 MW in 2007 up to 10,726 MW in 2027 with the annual average growth rate of 8.71%.

The load factor is estimated at 59.7% in 2027 which is the same as that in Scenario 1.

4) Scenario 4

Under the conditions of the same population growth rate and GDP growth rate for Scenario 2 and the constant energy losses of 16.6% through the forecast period up to 2027, energy demand is estimated to increase from 8,258 GWh in 2007 up to 40,615 GWh in 2027 with the annual average growth rate of 8.29%.

The maximum power demand is estimated to increase from 1,986 MW in 2007 up to 9,316 MW in 2027 with the annual average growth rate of 8.03%.

Load factor is estimated at 59.7% in 2027 which is the same as in that Scenario 1.

5) Scenario 5

Under the conditions of the same population growth rate and GDP growth rate in Scenario 2, low demand, low generation due to DSM (Demand Side Management), and the low system loss of 14.0% after 2015, demand generation is estimated to grow from 8,258 GWh in 2007 up to 40,615 GWh in 2027 with the annual average growth rate of 8.29%.

The maximum power demand is estimated to increase from 1,951 MW in 2007 up to 8,565 MW in 2027 with the annual average growth rate of 7.7%.

Load factor is estimated at 61.2% in 2027 increasing by 3.7% from that in 2007.

The results of the demand forecasts for 5 scenarios are shown in **Table 4.1.1-1**, **Table 4.1.1-2**, **Table 4.1.1-3**, **Table 4.1.1-4** and **Table 4.1.1-5**.

Table 4.1.1-1 Base Demand Load Forecast -2007

Year	Energy (GWh)	Growth (%)	Peak Load (MW)	Growth (%)
2007	8,258.00		1,986.00	
2008	8,644.0	4.7	2,064.0	3.9
2009	9,533.0	10.3	2,259.0	9.4
2010	10,393.0	9.0	2,447.0	8.3
2011	11,373.0	9.4	2,655.0	8.5
2012	12,429.0	9.3	2,880.0	8.5
2013	13,560.0	9.1	3,237.0	12.4
2014	14,767.0	8.9	3,385.0	4.6
2015	16,051.0	8.7	3,674.0	8.5
2016	17,416.0	8.5	3,977.0	8.2
2017	18,868.0	8.3	4,298.0	8.1
2018	20,423.0	8.2	4,642.0	8.0
2019	22,088.0	8.2	5,008.0	7.9
2020	23,871.0	8.1	5,400.0	7.8
2021	25,784.0	8.0	5,819.0	7.8
2022	27,840.0	8.0	6,268.0	7.7
2023	30,047.0	7.9	6,749.0	7.7
2024	32,415.0	7.9	7,264.0	7.6
2025	34,955.0	7.8	7,815.0	7.6
2026	37,683.0	7.8	8,405.0	7.5
2027	40,615.0	7.8	9,038.0	7.5
Average Growth Rate		8.30		7.88

Source: National Demand Forecast 2007-2027, Dec. 2007, CEB

Table 4.1.1-2 Low Demand Load Forecast -2007

Year	Energy (GWh)	Growth (%)	Peak Load (MW)	Growth (%)
2007	8,141.00		1,958.00	
2008	8,624.0	5.9	2,060.0	5.2
2009	9,353.0	8.5	2,216.0	7.6
2010	10,139.0	8.4	2,387.0	7.7
2011	11,016.0	8.6	2,571.0	7.7
2012	11,942.0	8.4	2,767.0	7.6
2013	12,918.0	8.2	2,988.0	8.0
2014	13,943.0	7.9	3,196.0	7.0
2015	15,020.0	7.7	3,438.0	7.6
2016	16,150.0	7.5	3,688.0	7.3
2017	17,336.0	7.3	3,949.0	7.1
2018	18,592.0	7.2	4,225.0	7.0
2019	19,922.0	7.2	4,517.0	6.9
2020	21,332.0	7.1	4,825.0	6.8
2021	22,831.0	7.0	5,152.0	6.8
2022	24,426.0	7.0	5,499.0	6.7
2023	26,122.0	6.9	5,867.0	6.7
2024	27,925.0	6.9	6,258.0	6.7
2025	29,841.0	6.9	6,671.0	6.6
2026	31,881.0	6.8	7,111.0	6.6
2027	34,057.0	6.8	7,579.0	6.6
Average Growth Rate		7.42		7.00

Source: National Demand Forecast 2007-2027, Dec. 2007, CEB

Table 4.1.1-3 High Demand Load Forecast -2007

Year	Energy (GWh)	Growth (%)	Peak Load (MW)	Growth (%)
2007	8,391.00		2,018.00	
2008	8,976.0	7.0	2,144.0	6.2
2009	9,856.0	9.8	2,335.0	8.9
2010	10,794.0	9.5	2,541.0	8.8
2011	11,887.0	10.1	2,775.0	9.2
2012	13,085.0	10.1	3,032.0	9.3
2013	14,389.0	10.0	3,328.0	9.8
2014	15,799.0	9.8	3,621.0	8.8
2015	17,317.0	9.6	3,964.0	9.5
2016	18,949.0	9.4	4,327.0	9.2
2017	20,700.0	9.2	4,716.0	9.0
2018	22,590.0	9.1	5,134.0	8.9
2019	24,632.0	9.0	5,585.0	8.8
2020	26,836.0	8.9	6,070.0	8.7
2021	29,219.0	8.9	6,594.0	8.6
2022	31,797.0	8.8	7,159.0	8.6
2023	34,586.0	8.8	7,768.0	8.5
2024	37,600.0	8.7	8,426.0	8.5
2025	40,858.0	8.7	9,135.0	8.4
2026	44,383.0	8.6	9,900.0	8.4
2027	48,198.0	8.6	10,726.0	8.3
Average Growth Rate		9.14		8.71

Source: National Demand Forecast 2007-2027, Dec. 2007, CEB

Table 4.1.1-4 Demand Load Forecast with Constant Energy Losses-2007

Year	Energy (GWh)	Growth (%)	Peak Load (MW)	Growth (%)
2007	8,258.00		1,986.00	
2008	8,644.0	4.7	2,074.0	4.4
2009	9,533.0	10.3	2,282.0	10.0
2010	10,393.0	9.0	2,482.0	8.8
2011	11,373.0	9.4	2,709.0	9.1
2012	12,429.0	9.3	2,953.0	9.0
2013	13,560.0	9.1	3,215.0	8.9
2014	14,767.0	8.9	3,492.0	8.6
2015	16,051.0	8.7	3,787.0	8.4
2016	17,416.0	8.5	4,099.0	8.2
2017	18,868.0	8.3	4,430.0	8.1
2018	20,423.0	8.2	4,784.0	8.0
2019	22,088.0	8.2	5,162.0	7.9
2020	23,871.0	8.1	5,566.0	7.8
2021	25,784.0	8.0	5,997.0	7.7
2022	27,840.0	8.0	6,460.0	7.7
2023	30,047.0	7.9	6,956.0	7.7
2024	32,415.0	7.9	7,487.0	7.6
2025	34,955.0	7.8	8,055.0	7.6
2026	37,683.0	7.8	8,663.0	7.5
2027	40,615.0	7.8	9,316.0	7.5
Average Growth Rate		8.30		8.04

Source: National Demand Forecast 2007-2027, Dec. 2007, CEB

Table 4.1.1-5 Demand Load Forecast with DSM-2007

Year	Energy (GWh)	Growth (%)	Peak Load (MW)	Growth (%)
2007	8,258.00		1,951.00	
2008	8,644.0	4.7	2,008.0	2.9
2009	9,533.0	10.3	2,181.0	8.6
2010	10,393.0	9.0	2,345.0	7.5
2011	11,373.0	9.4	2,529.0	7.8
2012	12,429.0	9.3	2,731.0	8.0
2013	13,560.0	9.1	2,964.0	8.5
2014	14,767.0	8.9	3,190.0	7.6
2015	16,051.0	8.7	3,456.0	8.3
2016	17,416.0	8.5	3,737.0	8.1
2017	18,868.0	8.3	4,036.0	8.0
2018	20,423.0	8.2	4,357.0	8.0
2019	22,088.0	8.2	4,702.0	7.9
2020	23,871.0	8.1	5,072.0	7.9
2021	25,784.0	8.0	5,469.0	7.8
2022	27,840.0	8.0	5,897.0	7.8
2023	30,047.0	7.9	6,357.0	7.8
2024	32,415.0	7.9	6,851.0	7.8
2025	34,955.0	7.8	7,382.0	7.8
2026	37,683.0	7.8	7,952.0	7.7
2027	40,615.0	7.8	8,565.0	7.7
Average Growth Rate		8.30		7.68

Source: National Demand Forecast 2007-2027, Dec. 2007, CEB

4.1.2 Load Demand Forecast by Study Team

There are two major concepts involved when forecasting national load demand. One is a macro approach covering the nationwide area by using an explanatory parameter such as GDP, selling price, the number of consumers or another index. The other is a micro concept, in which an attempt is made to forecast load demand by stacking the demands of each category as CEB applies in **4.1.1** above.

In the Study, the former “macro approach” concept was used with the intention to confirm the load demand forecast conducted by CEB. In order to decide the explanatory parameter to be used for the demand forecast study, GDP, Consumer Price Index (CPI), Wholesale Price Index (WPI), and the population are chosen for examination of the correlation between energy demand and each individual parameter.

(1) Consumer and Wholesale Price Indices

Correlation of past 10 years’ energy demand and price indices (CCPI and WPI) was confirmed.

Energy demand = $-0.0007 \times Nc^2 + 5.4608 \times Nc - 1069.8$

Correlation factor $R^2 = 0.9572$

Nc: Colombo Consumer Price Index (CCPI)

Energy demand = -3E-05 × Nw^2 + 1.5804 × Nw + 1214.9

Correlation factor R^2 = 0.9704

Nw: Wholesale Price Index (WPI)

Table 4.1.2-1 shows energy demands and price Indices during the past 10 years, and **Figure 4.1.2-1** shows correlations between energy demand and price indices.

Table 4.1.2-1 Demand and Price Index

Year	*Demand (sales) (GWh)	CCPI	WPI
1997	4,274.0	2,089.1	1,224.3
1998	4,635.0	2,284.9	1,298.7
1999	4,917.0	2,392.1	1,295.3
2000	5,425.0	2,539.8	1,317.2
2001	5,341.0	2,899.4	1,471.2
2002	5,643.0	3,176.4	1,629.0
2003	6,209.0	3,377.0	1,679.1
2004	6,781.0	3,632.8	1,889.0
2005	7,255.0	4,055.5	2,105.9
2006	7,831.0	4,610.8	2,351.6
Average Rate	6.96	9.19	7.52
Elasticity		0.76	0.93

**Including Power Cuts*
Source: National Demand forecast 2007-2027

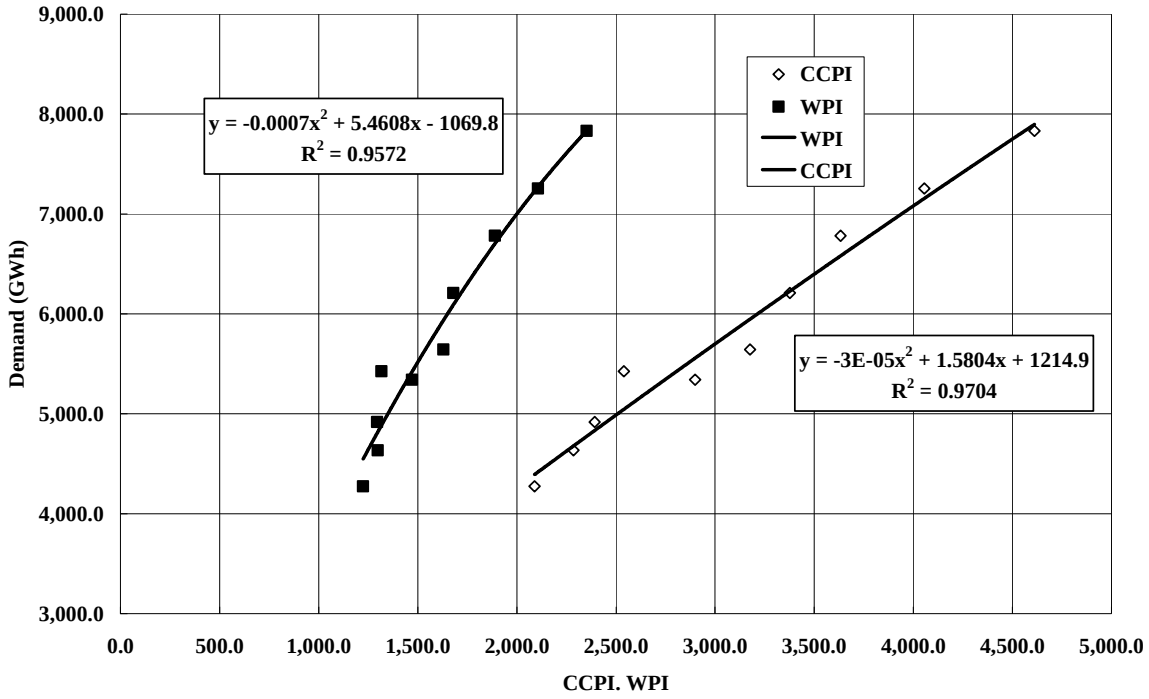

Figure 4.1.2-1 Demand and Price Indices

Correlations between energy demand and each index were around 96% and 97%. Price index is not always assured to reflect energy demand fluctuations under the unstable worldwide economic situation, so the CPI and WPI should not be applied to long term forecast over 10 years in the country.

(2) Population

In the same way as the price indices above, the correlation between energy demand and population was examined.

Energy demand = $585.43 \times N^2 - 20001 \times N + 173802$
Correlation Factor $R^2 = 0.912$
N: Population

Table 4.1.2-2 and **Figure 4.1.2-2** show the data and correlation between energy demand and population growth.

Table 4.1.2-2 Demand and Population

Year	Demand (GWh)	Population (Mill.)
1997	4,274	18.66
1998	4,635	18.91
1999	4,917	19.20
2000	5,425	19.05
2001	5,341	18.87
2002	5,643	19.13
2003	6,209	19.36
2004	6,781	19.62
2005	7,255	19.87
2006	7,831	19.89
Average Rate	6.96	0.71
Elasticity		9.78

Source: CEB National Demand Forecast 2007-2027

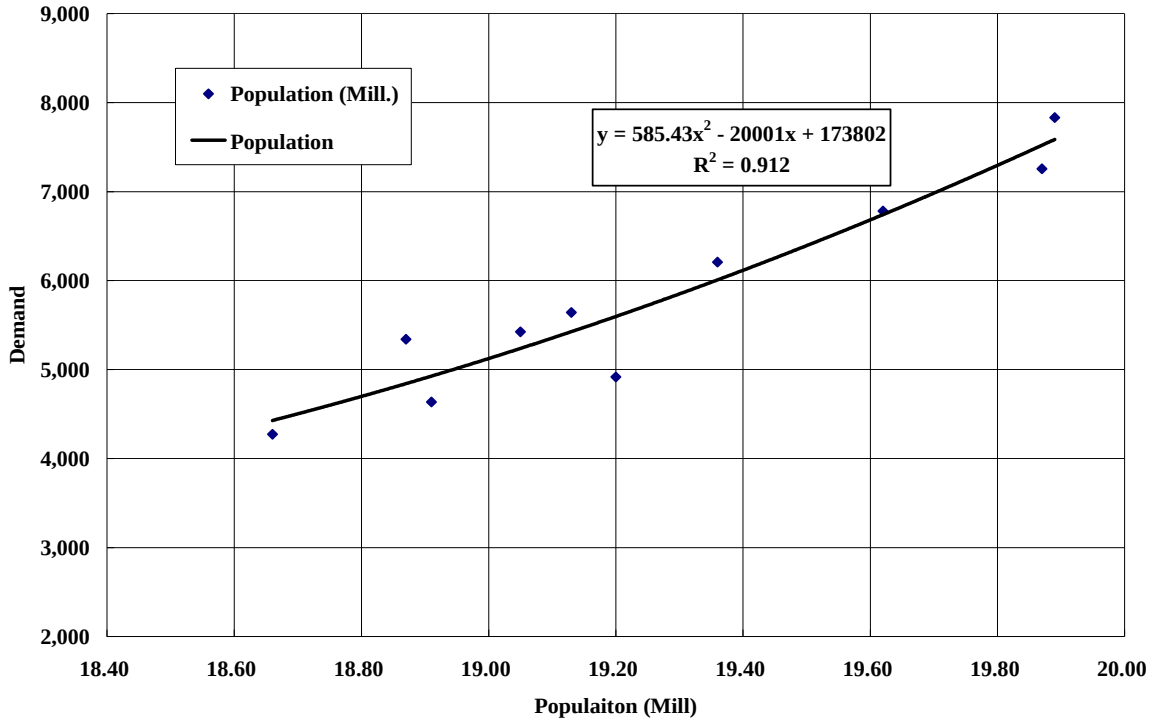

Figure 4.1.2-2 Demand and Population

Energy demand has increased 10 times of the growth rate of population. The correlation factor between energy demand and population was around 91% and is not so high in comparison with that of GDP mentioned in the next sub-section. It is not adopted as explanatory parameter for the demand forecast.

(3) GDP

The correlation between energy demand and GDP was examined for the past 10 years (1997-2006).

The correlation formula is shown as follows:

Energy demand = $-6E-10 \times N^2 + 0.0111 \times N - 3670.1$ (GWh)
Correlation factor $R^2 = 0.9985$
N: GDP

It was confirmed that GDP had high correlation with the energy demand in the past in a form of parabola. **Table 4.1.2-3**, **Figure 4.1.2-3** and **Figure 4.1.2-4** show the correlation between energy demand and GDP.

As a result of the above, GDP had the best correlation with energy demand, and Study Team decided to adopt GDP as the explanatory parameter for demand forecast. It is noted that the elasticity of energy demand from 1996 to 2006 was around 1.5 as shown in **Table 4.1.2-3**.

Table 4.1.2-3 Energy Demand and GDP

Year	Demand (GWh)	GDP (Mill.Rs)
1997	4,274	739,763
1998	4,635	774,796
1999	4,917	808,340
2000	5,425	857,035
2001	5,341	843,794
2002	5,643	877,248
2003	6,209	930,057
2004	6,781	980,720
2005	7,255	1,039,763
2006	7,831	1,116,215
Avarage	6.96	4.68
Elasticity		1.49

Source: CEB National Demand Forecast 2007-2027

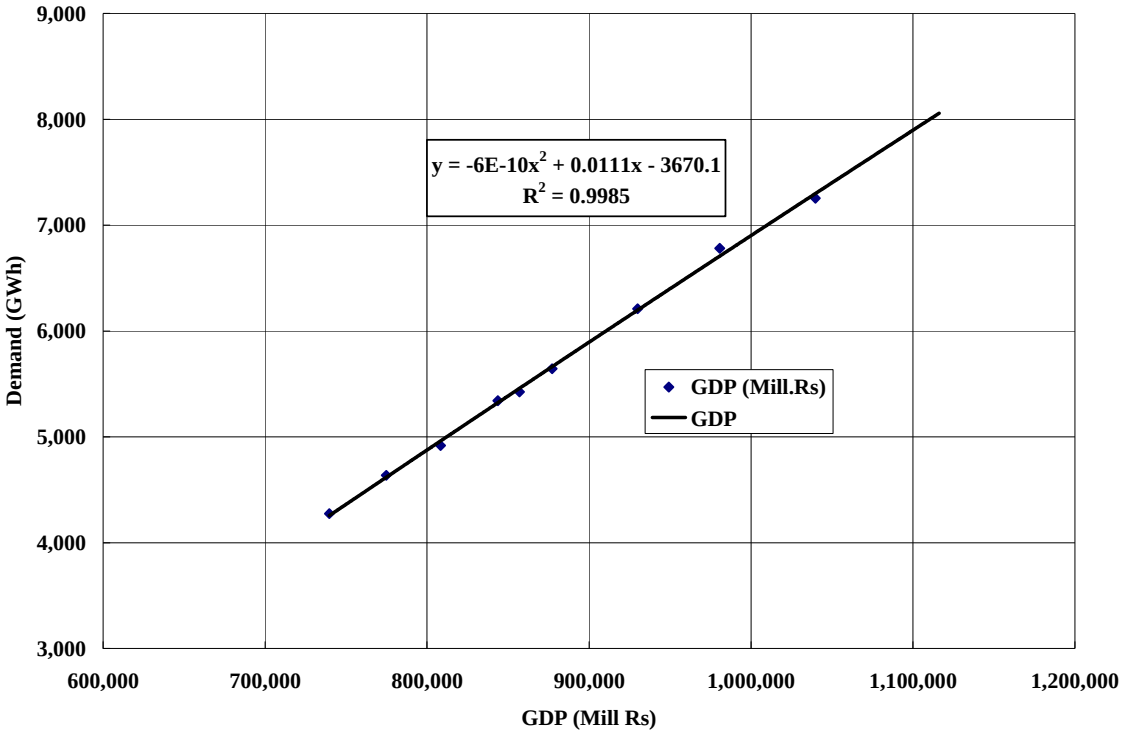

Figure 4.1.2-3 Energy Demand and GDP

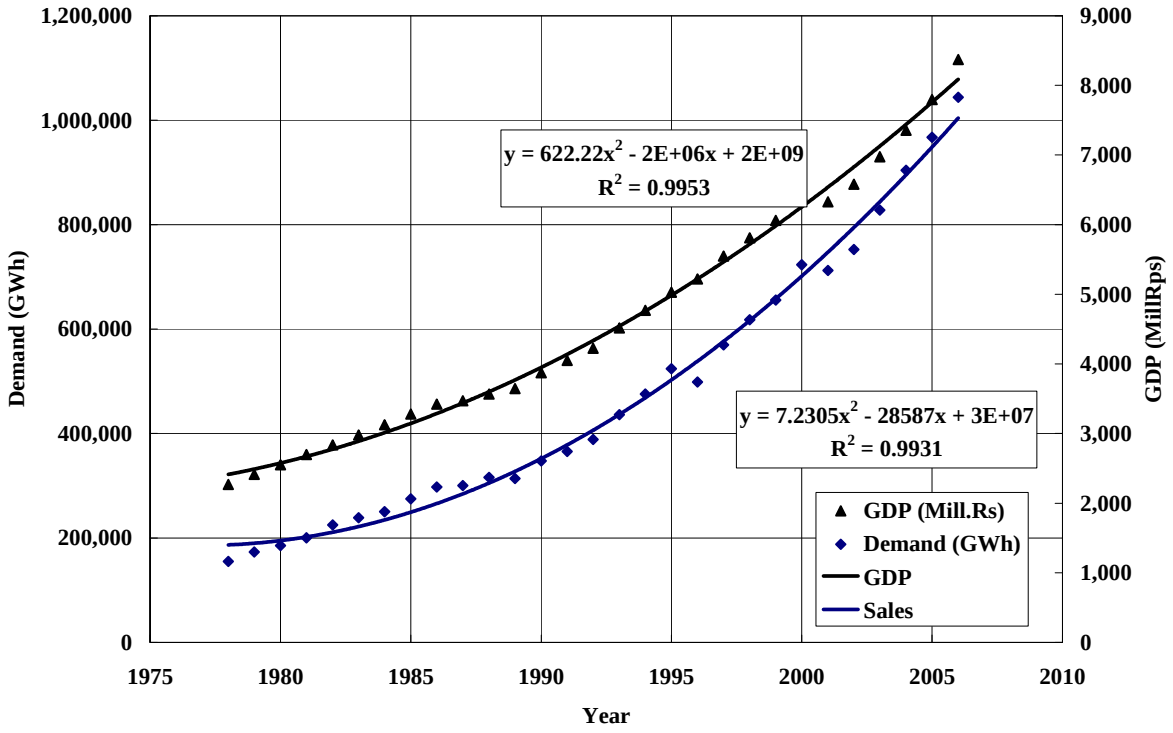

Figure 4.1.2-4 Energy Demand and GDP (results)

4.1.3 Load Demand Forecast by CEB and Study Team

(1) Energy Demand

Energy demand from 2007 to 2020 is estimated by Study Team by using GDP as explanatory parameter.

Table 4.1.3-1 and **Figure 4.1.3-1** show comparison of demand forecasts both by CEB and by Study Team at the consumers' end.

Table 4.1.3-1 Comparison of Demand between CEB and Study Team

Year	CEB Forecast (Base) (GWh)	JICA Forecast Demand (GWh)
2007	8,258	8,563
2008	8,644	9,094
2009	9,533	10,001
2010	10,393	10,979
2011	11,373	12,045
2012	12,429	13,164
2013	13,560	14,337
2014	14,767	15,563
2015	16,051	16,841
2016	17,416	18,170
2017	18,868	19,547
2018	20,423	20,970
2019	22,088	22,436
2020	23,871	23,941
Avarage (%)	8.51	8.23

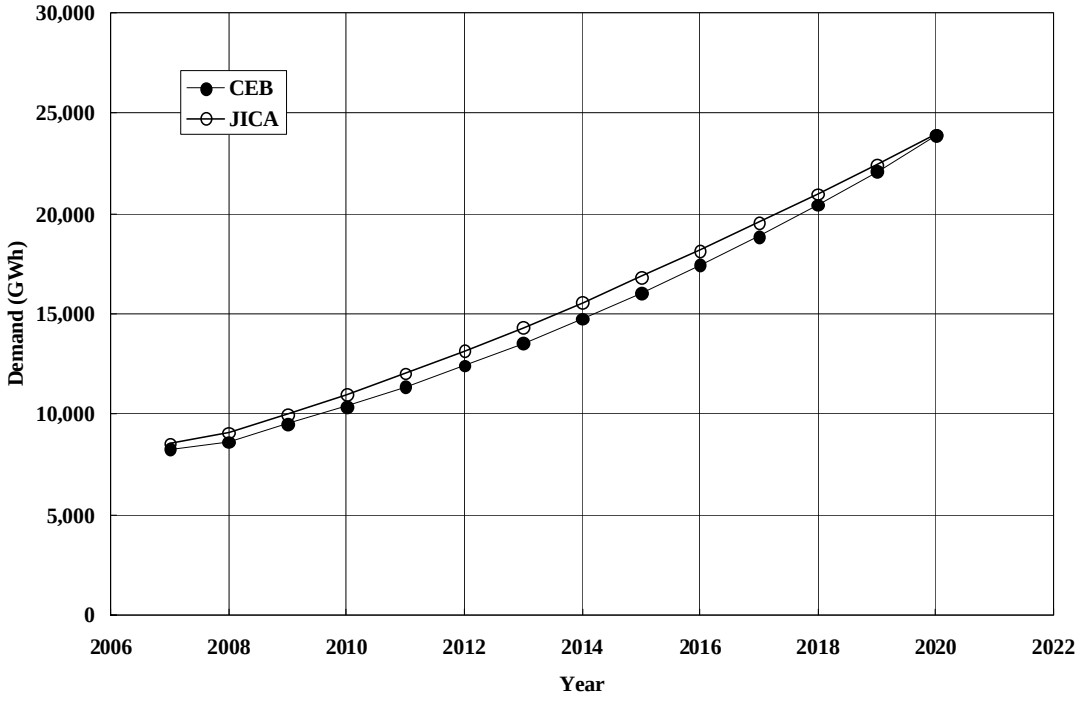

Figure 4.1.3-1 Comparison Demand between Study Team and CEB

According to the forecast of Study Team, average growth rate of energy demand is estimated as 8.23% per annum, while the annual average growth rate of the CEB base case (Scenario 1) is 8.51%.

(2) Loss Rate

The loss rate of the power system in the country is 18.2% on average for the past 20 years, although it was over 20% in 1999 and 2000. It, however, was improved as 16.6% in 2006 and as 15.7% in 2007. The loss rate is categorized due to generation, transmission and distribution. The loss rate due to distribution is shared with LECO (Lanka Electricity Company Ltd.) and CEB, and the loss rate by LECO is estimated as about 6%.

CEB is targeting the loss rate by 0.5% reduction year by year during 2005 to 2009, and after 2015 the overall loss rate will be capped at 14%.

The target of the loss rate by CEB is shown in **Table 4.1.3-2** and was used for calculation of energy demand every year at the generation end.

Table 4.1.3-2 Loss Rate

Year	Gx	Tx	Dx	Loss Rate (%)
2007	1.0	2.4	13.2	16.6
2008	1.0	2.4	12.8	16.2
2009	1.0	2.4	12.3	15.7
2010	1.0	2.4	11.9	15.3
2011	1.0	2.4	11.4	14.8
2012	1.0	2.4	11.0	14.4
2013	1.0	2.4	10.8	14.2
2014	1.0	2.4	10.4	13.8
2015	1.0	2.4	10.6	14.0
2016	1.0	2.7	10.3	14.0
2017	1.0	2.7	10.3	14.0
2018	1.0	2.7	10.3	14.0
2019	1.0	2.7	10.3	14.0
2020	1.0	2.7	10.3	14.0

Note: Gx: Generation Loss, Tx: Transmission Loss, Dx: Distribution Loss
Source: National Demand Forecast 2007-2027, Dec. 2007, CEB

(3) Generation and Peak Load

Table 4.1.3-3 shows the results of the forecast of the generation (GWh) based on the correlation between GDP and energy demand during the past 10 years, and the loss rate in **Table 4.1.3-2.** The period of forecast is up to 2020 including 2016 in which Victoria expansion project will be completed as mentioned in Chapter **10**. The generation up to 2020 by Study Team is forecast with a growth rate of 8.03% on average.

Table 4.1.3-3 Generation

Year	Demand	Gross Loss	Generation	Generation
	Forecast Basic By JICA (GWh)	Forecast By CEB (%)	Forecast Basic By JICA (GWh)	Forecast Basic By CEB (GWh)
2006	7,831	17.1	9,446	9,426
2007	8,563	16.6	10,267	9,898
2008	9,094	16.2	10,852	10,314
2009	10,001	15.7	11,864	11,313
2010	10,979	15.4	12,978	12,283
2011	12,045	14.9	14,154	13,360
2012	13,164	14.5	15,396	14,529
2013	14,337	14.5	16,768	15,861
2014	15,563	13.9	18,075	17,156
2015	16,841	14.0	19,583	18,668
2016	18,170	14.0	21,128	20,255
2017	19,547	14.0	22,729	21,944
2018	20,970	14.0	24,384	23,753
2019	22,436	14.0	26,088	25,689
2020	23,941	14.0	27,838	27,763
Avarage	8.31		8.03	8.02

The peak load (annual maximum demand) is anticipated to increase with growth of energy demand at both consumers' and generation ends under economic expansion in Sri Lanka. However, the load factor will be improved, because the efforts of reduction of loss rate makes the growth rate of the peak load of 7.79% in spite of that of the annual energy demand with 8.31%, as shown in **Table 4.1.3-4**. Improvement of the load factor seems to be one of the CEB's important politics. The load factor during a period of 2006 to 2020 is estimated by using a formula based on trending of actual results from 1986 to 2005.

Figure 4.1.3-2 shows the comparison of the peak load forecast by both Study Team and CEB for the period of 2006~2020.

Consequently the forecast by Study Team has almost the same result as that by CEB. The deference in energy demand up to 2020 between Study Team and CEB is only around 5%. Therefore, the energy demand forecast by CEB is confirmed to be reasonable.

Table 4.1.3-4 Load Factor and Peak Load Forecast

Year	Load Factor By JICA	Load Factor By CEB	Peak Load By JICA	Peak Load By CEB base
	Forecast (%)	Forecast (%)	Forecast (MW)	Forecast (MW)
2006	56.8	56.8	1,898	1,894
2007	57.0	56.9	2,080	1,986
2008	57.1	57.0	2,170	2,064
2009	57.2	57.2	2,368	2,259
2010	57.3	57.3	2,584	2,447
2011	57.5	57.4	2,812	2,655
2012	57.6	57.6	3,052	2,880
2013	57.7	57.7	3,317	3,237
2014	57.8	57.9	3,568	3,385
2015	58.0	58.0	3,857	3,674
2016	58.1	58.1	4,153	3,977
2017	58.2	58.3	4,458	4,298
2018	58.3	58.4	4,772	4,642
2019	58.5	58.6	5,095	5,008
2020	58.6	58.7	5,425	5,400
Avarage(%)			7.79	7.77

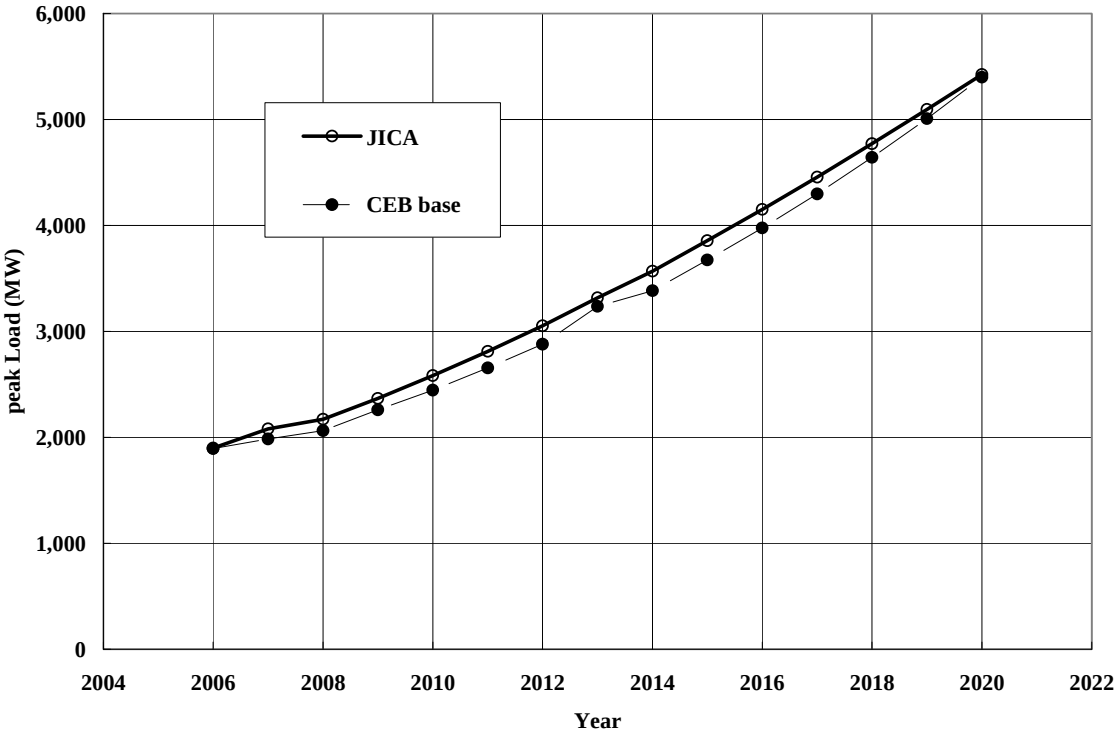

Figure 4.1.3-2 Peak Load Forecast

4.1.4 Revise of Load Demand Forecast by CEB

Since September 2008, Sri Lanka has been also affected by the world-wide economic crisis. Hence revision of the power demand forecast becomes necessary. By using a time trend method, generation (GWh) and maximum power demand (MW) up to 2028 were revised by CEB as shown in **Table 4.1.4-1**

Average annual growth rates of both generation and maximum power demand are smaller than those in the previous forecast mentioned in **4.1.1**, but still forecasted over 6% continuously. In the Study, this revised demand forecast reflecting the latest economic situation is used.

Table 4.1.4-1 New Demand, Load Factor and Peak Load Forecast (draft)

Year	Demand (GWh)	Loss (%)	Generation (GWh)	LF (%)	Peak (MW)
2008	8,527	15.7	9,863	57.0	1,974 *
2009	8,923	15.5	10,307	57.2	2,058
2010	9,523	15.3	11,250	57.3	2,241
2011	10,165	15.0	11,959	57.4	2,376
2012	10,849	14.8	12,730	57.6	2,524
2013	11,579	14.6	13,559	57.7	2,681
2014	12,359	14.7	14,496	57.9	2,860
2015	13,191	14.4	15,401	58.0	3,031
2016	14,079	14.2	16,412	58.1	3,222
2017	15,026	14.0	17,476	58.3	3,423
2018	16,038	14.0	18,652	58.4	3,645
2019	17,118	14.0	19,908	58.6	3,881
2020	18,270	14.0	21,248	58.7	4,133
2021	19,500	14.0	22,679	58.8	4,401
2022	20,812	14.0	24,206	59.0	4,686
2023	22,214	14.0	25,835	59.1	4,989
2024	23,709	14.0	27,574	59.2	5,313
2025	25,305	14.0	29,430	59.4	5,657
2026	27,009	14.0	31,412	59.5	6,024
2027	28,827	14.0	33,526	59.7	6,415
2028	30,767	14.0	35,783	59.7	6,847
Average	6.63		6.66		6.42

Note: estimated value*

Source: CEB

4.2 Development Plan

4.2.1 Generation Expansion Plan by CEB

To meet the requirements of an increase in peak load and required energy, as per the load forecast, CEB annually prepares a long term power expansion plan. The latest generation expansion plan for

the period from 2008 to 2022 has been established by CEB in February 2009, based on the demand forecast mentioned in **4.1.4**. The generation expansion plan is shown in **Table 4.2.1-1**.

The projects listed in the plan up to 2012 have been committed or are under construction.

Table 4.2.1-1 Generation Expansion Plan (draft)

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS
2008	-	-	-
2009	-	***2x 90 MW GT part Kerawalapitiya CCY***	-
2010	-	***2x 135 MW Kerawalapitiya CCY***	***2x 90 MW GT part Kerawalapitiya CCY***
2011		***1x285 MW Puttalam Coal (Stage 1)***	5x17MW Gas Turbine, Kelanitissa
2012	***150 MW Upper Kotmale***		20 MW ACE Power Matara
2013	-	3x 300 MW Coal Plant	22.5 MW Lakdanavi
			4x18 MW Sapugaskanda Diesel
			20 MW ACE Power Horana
2014	-	1x 300 MW Coal Plant	-
2015	-	1x 300 MW Coal Plant	60 MW Colombo Power
			100 MW Heladanavi Diesel, Puttalam
			100 MW ACE Power Diesel, Embilipitiya
2016	-		-
2017	-	1x 300 MW Coal Plant	-
2018	-	1x 300 MW Coal Plant	115 MW Gas Turbine, Kelanitissa
			49 MW Asia Power
2019	-		-
2020	-	1x 300 MW Coal Plant	-
2021	-	1x 300 MW Coal Plant	-
2022	-	1x 300 MW Coal Plant	-

Source: CEB

Table 4.2.1-2 and **Figure 4.2.1-1** show demand and supply balance based on demand forecast mentioned in **4.1** and power generation expansion plan by CEB.

If the projects listed above are developed and commissioned on schedule, the margin will be secured as 15% to 30%. It should be noted that the listed projects after 2013 have not been committed.

Power sources such as hydropower which will cope with the peak demand will be newly developed with the Upper Kotmale hydropower station having installed capacity of 150 MW by 2012.

Table 4.2.1-2 Power Development Plan

Unit: MW

Year	Existing	On going	Plan	Retirement	Total	Peak Load by CEB (base)	Margin Capacity	Margin (%)
2,008	2,434	-	-		2,434	1,974	460	18.9
2,009	2,434	180	-		2,614	2,058	556	21.3
2,010	2,434	450	-	-180	2,704	2,241	463	17.1
2,011	2,434	735	-	-265	2,904	2,376	528	18.2
2,012	2,434	885	-	-285	3,034	2,524	510	16.8
2,013	2,434	885	900	-400	3,820	2,681	1,139	29.8
2,014	2,434	885	1,200	-400	4,120	2,860	1,260	30.6
2,015	2,434	885	1,500	-660	4,159	3,031	1,128	27.1
2,016	2,434	885	1,500	-660	4,159	3,222	937	22.5
2,017	2,434	885	1,800	-660	4,459	3,423	1,036	23.2
2,018	2,434	885	2,100	-824	4,595	3,645	950	20.7
2,019	2,434	885	2,100	-824	4,595	3,881	714	15.5
2,020	2,434	885	2,400	-824	4,895	4,133	762	15.6
2,021	2,434	885	2,700	-824	5,195	4,401	794	15.3
2,022	2,434	885	3,000	-824	5,495	4,686	809	14.7

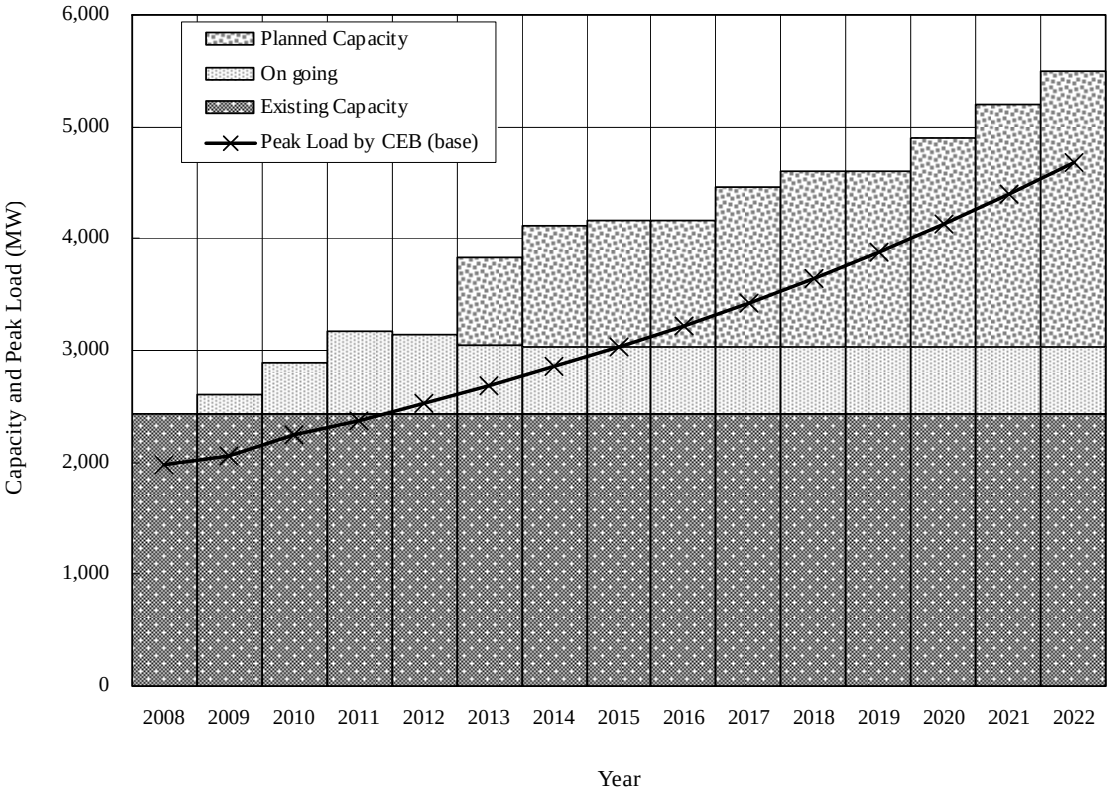

Figure 4.2.1-1 Generation Capacity and Peak Load

4.2.2 Justification Observed Based on the Power Development Plan

CEB prepared the power development plan for the period of 2008 up to 2022 as described in **Table 4.2.1-1** in **4.2.1**.

Although all power plants listed until 2012 have been committed or under construction, the power plants to be commissioned after 2013 have not been committed. It is concerned that following factors should be noted for development plan after 2013.

a. There will be no new power plant for peak load operation after 2013.
b. The new thermal power plant for peak load operation is facing difficulties because of the worldwide fossil fuel price increase or unstable fuel prices.

The countermeasures for the above issues, to secure the power sources for increasing peak demand, from the viewpoint of power expansion plan, are i) development of new hydropower projects, ii) shifting the role of the existing hydropower plants from the base and/or middle load to the peak load operation, and iii) expansion of existing hydropower plants. Those measures expect effective use of domestic renewable power sources.

Up to July 2008, 73% of hydropower potential in the country have already been developed or under construction. Hence, the number of possible development of new hydropower plants is limited and there might be no large size development project. Expansion of existing hydropower plants has some difficulties too, such as lowering of reservoir water level during the construction (suspension of generation during the construction) and economic validity, etc.

On the other hand, the project has advantages, because the intake facilities for expansion have been already constructed and it is not necessary to lower reservoir water level during expansion works. In addition, the construction cost per kW of the expansion project is estimated at around US$1,000[1]. This cost is much lower than that of other candidate hydropower projects[2] ranging from US$2,700 to 3,200.

The maximum peak demand recorded in 2008 was 1,922 MW. According to the daily load curve on the day recording the maximum peak demand, it is understood that about 570 MW of power sources for the peak demand was necessary. In 2016 when the Project is scheduled to be commissioned, the maximum power demand is forecast as 3,222 MW by CEB. The required power sources for the peak demand are estimated at about 960 MW, under the condition that a similar daily load curve in 2016 is similar to that in 2008. Hence new power sources of 390 MW (960MW-570MW) will be required to be arranged up to 2016. However, the new power source for peak demand listed in the CEB's generation expansion plan is only Upper Kotmale (150 MW). If the Project with 228 MW is considered in the plan, the Project and Upper Kotmale will cover around 100% of the peak requirement. Therefore the Project will contribute to coping with increase of peak power demand.

The Project, therefore, has the high priority of development to meet the increasing peak demand and to effectively use the domestic renewable energy in the country.

[1] The construction cost per kW is calculated dividing the project cost estimated in 10.3.3 by the installed capacity calculated in 9.6.1.
[2] Source: Long Term generation Expansion Plan 2007-2021, April 2007, CEB

[Reference]

Because large-scale thermal power plants to be commissioned after 2013 have not been committed; the commissioning year could be delayed for some reasons. In such a case, Victoria Hydropower Station could not be shifted from base/middle power sources to those for peak demand.

Therefore, capacity of new thermal power plants required to meet base power demand in 2016 when the Victoria expansion plant is scheduled to be completed is estimated as follows:

(1) Required Capacity Based on Annual Maximum Power Demand

The annual maximum power demand in 2016 when Victoria expansion power plant is to be commissioned is forecast as 3,222 MW mentioned in **4.1.4**. The maximum power demand in the past is 1,922 MW recorded on May 21, 2008.

Based on the actual daily load curve recorded on the above day in 2008, the daily power demand curve with the annual maximum demand in 2016 is forecast to estimate new thermal power plant capacity required for the demand. In this estimate, retirement of the existing thermal power plants is not considered.

Kerawalapitiya combined cycle plant (135 MW × 2 units), Puttalam coal thermal plant Stage 1 (285 MW) and Upper Kotmale hydropower plant (150 MW) will have already been commissioned in 2016, but the total capacity of the existing and these additional plants are not enough to cope with the demand.

In addition to above power plants, starting operation of a new thermal power plant with 300 MW class as base demand power source and the Victoria extension power plant for peak demand power source will fulfill the demand in 2016.

Table 4.2.2-1 Maximum Power Demand and Margin in 2016

(MW)

Max. Demand	**3,222**
Existing Total Power Supply	2,392
Kerawalapitiya (270MW)	259
Puttalam Coali (285MW)	262
Upper Kotmale	149
Total	**3,062**
Reserve (%)	**-5**
Victoria Ex	227
New Coal Power Plant (300MW)	276
Grand Total	**3,565**
Reserve (%)	**11**

Note: Supply capacity of thermal and hydropower plants excludes station service use.

Figure 4.2.2-1 shows the assumed daily load curve by power sources in 2016 and power sources with the new thermal power plant (300 MW × 1 unit).

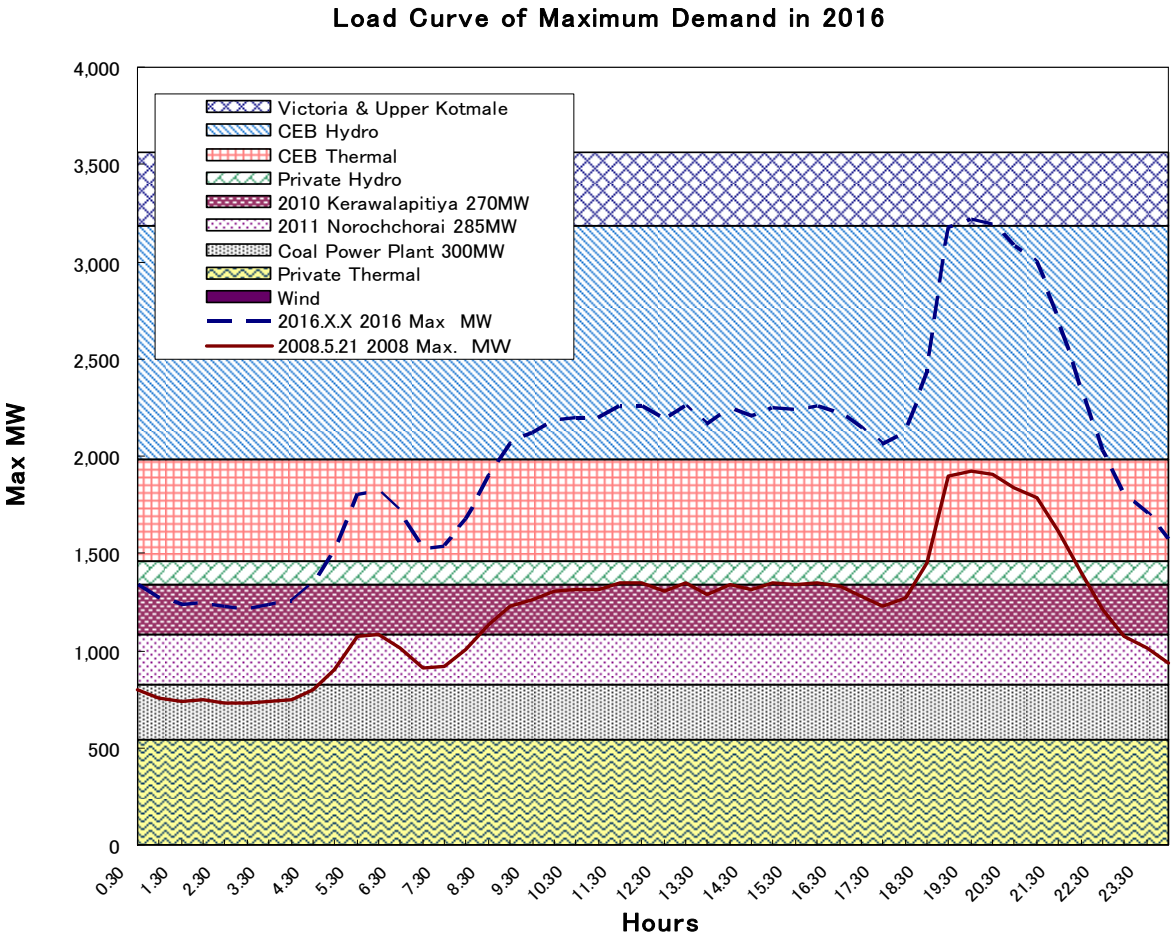

Figure 4.2.2-1 Daily Load Curve in 2016

(2) Required Capacity Based on Annual Generation

Based on the annual duration curve in 2007, the annual duration curve in 2016 is estimated, and annual energy of each power source is applied to the curve, to calculate required generation (GWh) and capacity (MW) of new base thermal power plants.

In addition to the condition that the Project is to be commissioned in 2016, the following are assumed:

1) Plant factor and station service ratio for a new coal-fired thermal power plant are assumed as 80% and 8%, respectively
2) Annual generation (GWh) of existing power plants is to be the same as that in 2007
3) Existing thermal power plants are not operated in addition to annual generation in 2007 for saving fuel cost and for keeping efficiency. Therefore annual generation of existing thermal power plants in 2016 remains unchanged at the level of 2007.
4) Retirement of the existing thermal power plants is not considered.

It is assumed the Kerawalapitiya combined cycle plant (135 MW × 2) and Puttalam coal fired thermal plant Stage 1 (285 MW) will have already been commissioned. Even in consideration of operation of Upper Kotmale (150 MW) hydropower station and Victoria expansion plant (228 MW) in addition to the two thermal power plants, the required total generation is not enough for energy demand in 2016 and has shortage of 2,150 GWh. The additional required capacity of a thermal power plant (X) is estimated at 330 MW, as follows:

X (MW) × 8760 hr/year × 0.8 × (1 - 0.08) = 2,150 GWh

X (MW) = 2,150 GWh / (8760 h × 0.8 × 0.92) = 333 MW

Hence, 1 unit of an additional new thermal power plant with installed capacity of 300 MW is required to meet the energy demand in 2016.

Figure 4.2.2-2 shows the estimated annual load duration curve and annual generation of each power sources.

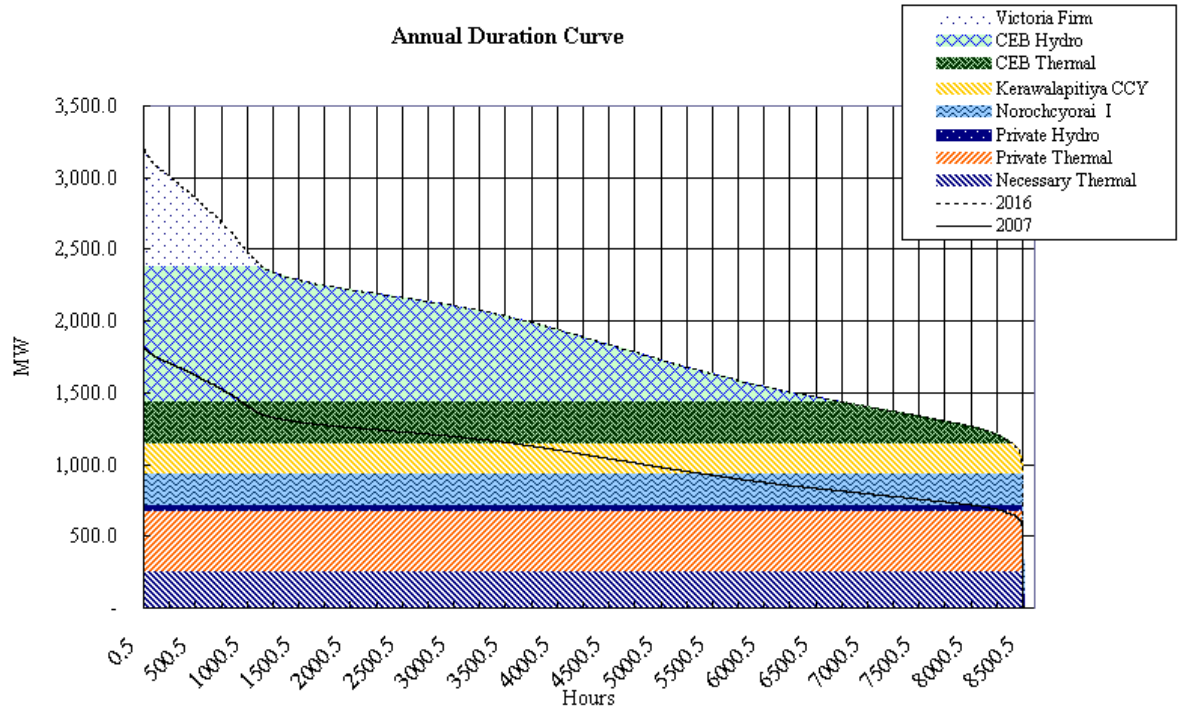

Figure 4.2.2-2 Annual Duration Curve in 2106

Based on the results mentioned in **(1)** and in **(2)** above, it is concluded that base demand in 2016 will be satisfied when a thermal power plant with capacity of 300 MW is commissioned in addition to the Kerawalapitiya combined cycle plant (270 MW) and Puttalam coal-fired thermal plant Stage 1 (285 MW), under condition that retirement of the existing thermal power plants is not considered.

It is necessary, before commencement of Project implementation, to check the demand and supply plan on base power in the commissioning year of the Project and to use the Victoria Power Station for peak power sources.