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Regional Hydro-power Resources: Status of Development and Barriers

Sri Lanka

Nexant

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For

United States Agency for International Development

Under

South Asia Regional Initiative for Energy

Prepared by

Nexant SARI / Energy

List of Abbreviations

CEB	Ceylon Electricity Board
CEA	Central Environmental Authority
ESC	Energy Supply Committee
GOSL	Government of Sri Lanka
GTZ	Dutsche Gesellshaft Für Technische Zusammenarbeit
GWh	Gigawatt hours
JICA	Japan International Cooperation Agency
JABIC	Japanese Bank of International Corporation
kV	Kilo Volts
KWh	Kilowatt hour
LECO	Lanka Electricity Company
MCM	Million cubic meters
MU	Million units (equivalent to GWh)
MW	Megawatt
PROR	Peaking Run-of-River
ROR	Run-of-River
SARI/Energy	South Asia Regional Initiative / Energy
USAID	United States Agency for International Development

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Summary of the Document

- Hydro potential of Sri Lanka is depleting and further potential of approximately 900 MW can be devolved. Such locations are identified and published under the master Plan for Power System of Sri Lanka and listed under the Section 4 of this report.

- Hydro-power meets about **38%** of the energy needs of the country. Bio Mass **(50%)**, and Imported Petroleum Fuels **(12%)** meet the balance energy needs of the country. Hydro-power is the major source of electricity (**68%** of the present capacity, the rest is out of thermal generation).

- The GOSL is on a move to develop any resource of hydro-power with private party participation in the view of long term benefits.

- This report presents the hydro-power potential, potential of upgrading the existing plants, current utilization and future plan of hydro-power development in the country. The government policy on hydro-power and issues and barriers for the development of hydro-power in Sri Lanka is also discussed.

Principal Results

- Overall tariff structure of electricity plays a major role on economy of the country. It is important to build the confidence of the Investors of the industrial sector for a reasonable tariff and a continuous supply of the electricity. By this context generation planning of Sri Lanka is forced to look for the least cost options. However the above planning criterion shall be changed with a concept of power pool of the region.

- At the moment Sri Lanka's main concern is to meet the growing demand of the Industrial and the urban commercial Sector while rural electrification is developed in a long term plan.

- Although the private investors are encouraged to develop the hydro resources risks and procedural barriers are withholding them from investing. Such issues and barriers to be addressed soon.

- Further studies are needed to study the interconnections of power with the neighboring countries in the context of exchanging power with the region which would be developed simultaneously with present thermal options.

Next Steps

- Preparation of a Regional lest cost generation plan

- The above would lead to a need of regional transmission plan as well. On the view of above regional power pool concept to promote the interconnections that establish the regional power trading.

- Making the approved hydro-power project available commercially to investors to purchase the license off the rack and to commence work from the design and the construction. (This would eliminate the risk of the investor to invest on pre feasibility and approval procedure) A consulting organization may work this out and the cost incurred may be distributed to all the successful projects.

- Making interconnected facility of **system studies** between partner countries, and to make the data available at partner countries.

- Making a web site of information on technical and statistical data of the region for any study team or investor can obtain data.

Sri Lanka is an Island in Indian Ocean adjacent to southern tip of the India. It covers an approximate area of 65610 sq km and The Middle of the country is mountainous and has a considerably high rain fall and the costal area around the island is fairly flat. The highest elevation in the middle of the country approximately is 2000 m above MSL.

The climate varies slightly from up country and the costal areas. The minimum temperature of the up country is 12 ^{0} C whereas the minimum temperature in the costal area is 24 ^{0} C. Rainy seasons are predominantly on North East Monsoon South West Monsoon which falls on May to July and October to December. The areas those experience the rainfalls differ for each monsoon.

Sri Lanka has 4 Main Rivers, Mahaveli, Kelani, Kalu and Walawe, Out of Mahawali and Kelani, **95%** of the Potential has been already developed. One Resource on Kalu is under Construction which is under Section 7 mentioned as Kukule River Project. Total Installed Capacity of Mahaweli River is 582 MW and Total installed Capacity of Kelani River is 335 MW.

Sri Lanka has a total installed capacity of 1,780 MW with an average plant factor of **53%.** Out of the above, 1,137 MW is generated from hydro stations and the balance is basically from thermal stations. Up to year 1980, **98 %** of Sri Lankan Power requirements were fulfilled by the hydro Resources. To date the hydro to thermal installed capacities are **63%** and **37%.** On weather pattern Sri Lanka normally experience a dry year in every four to five years. The drop on the reservoir levels in dry years has a direct impact on the total generating capacity, and energy storage depends heavily on the rainfall as the hydro plants have the dominant contribution on energy as well as capacity. Due to this reason one of the planning criterion is to find a balance between the installed capacities of Hydro Plants and Thermal Plants for an optimum generating cost.

Major Resources identified from 20 MW to 150 MW are available in Sri Lanka up to a total of approximately 900 MW. Four projects are identified for future additions and one is under construction. Government of Sri Lanka (GOSL) is looking forward to encourage private party participation in development of hydro resources. However studies have not been performed to identify the resources to be developed and how the system is capable of accepting the power generated. It would be much easier if a regional generation plan is developed and interconnections are established.

GOSL is in a move to encourage investors to develop the hydro resources. However addition of plants to a system needs system studies and proper planning for utilization. These plants shall be possibly added with already committed thermal plants.

The Advisory Meeting on Hydro-power Development and Rehabilitation of the Hydro Plants in RARI countries, held in Sri Lanka has recommended a list of prioritized issues needed to be addressed in regional context. The needs were as listed below.

(i) Evaluation of unique economic and all other benefits of a hydro-power project from the regional perspective and develop a pricing mechanism of hydro-power
(ii) Develop a Regional Master Plan for exploitation of hydro-power resources and
(iii) To set up a Regional Least Cost Generation Expansion Plan,

For these purposes a comprehensive and authentic documentation of Regional Hydro-power Resources, the present status of its development, hydro-power development policies adopted and issues and barriers perceived by the partner countries in the development of hydro-power will be needed.

Accordingly the study is to identify the potential of Development, Upgrading of Hydro-power Projects in each country among the SARI partner countries. Also documentation for available resource data shall be developed.

Section 3 Objective of the Report

The objective of the report is to provide a Comprehensive and Authentic Reference Document, comprising of the hydro-power potentialities with the parameters of all the identified projects, the present status of the utilization of hydro-power resources, the future hydro-power development plan, policies currently followed for the hydro-power development and the problems and issues as perceived in the partner countries.

This study is based on data available from mainly Ceylon Electricity board and the data obtained from the institutions like Central Engineering Consultancy Bureau, Central Environmental Authority. Table 4-1 presents the details of the references and resource database reviewed and used in the present study.

4.1 Resource Database

Following Table 4-1 gives the resource database in which published documents in connection with all the identified hydro resources are listed. Copy of the long Term Generation Expansion Plan of 2002, which is the rolling plan and spans for 2002 to 2016 has been given as the item in which the additions of the thermal as well as the hydro, to the Sri Lankan power system are highlighted. Further the Feasibility Study Report of the Broadlands Power Resource is added which may be developed with private party investments.

All the other published data are supplementary to Volume A2 of the Master Plan for the Electricity Supply of Sri Lanka. Pre feasibility of every other hydro resource identified has been documented as a candidate, for addition to the system.

4.2 Candidate Projects

The feasibility reports of hydro projects studied under the Master Plan for the Electricity Supply of Sri Lanka is given as published documents among other few study reports available. Each of these is identified as Candidates for additions to the electricity system. Most of which are not yet developed. The Master Plan Study has been concluded in October 1988. The exact project data and the costs may be finalized after a feasibility study.

4.3 Study of Hydro Potential

A study titled “Hydro-power Optimization In Sri Lanka” is in progress by JICA with JABIC Funding. This study is expected to be concluded in early 2004.

Table 4-1 References and Resource Database

Serial No	Country Code & Report REF	Title	Author	Agency	Year	Status
1	5001	Long Term Generation Expansion Plan 2002-2016	Generation Planning Branch of CEB	CEB	2001 Dec	Published
2	5002	Main Report of the Generation Master Plan of Sri Lanka	Lahmeyer International	GTZ	1988 Feb	Published
3	5003	Executive Summery of the Generation master Plan of Sri Lanka	Lahmeyer International	GTZ	1988 Feb	Published
4	5004	Supplement to volume A-1: CHP BADU013 (P/C 28 MW)	Lahmeyer International	GTZ	1988 Feb	Published
5	5005	Supplement to volume A-1: CHP BADU029 (P/C 12.5 MW)	Lahmeyer International	GTZ	1988 Feb	Published
6	5006	Supplement to volume A-1: CHP BELI015 (P/C 17.1 MW)	Lahmeyer International	GTZ	1988 Feb	Published
7	5007	Supplement to volume A-1: CHP DIYA008 (P/C 2.6 MW)	Lahmeyer International	GTZ	1988 Feb	Published
8	5008	Supplement to volume A-1: CHP GING052	Lahmeyer International	GTZ	1988 Feb	Published
9	5009	Supplement to volume A-1: CHP KALU075 (P/C 36 MW)	Lahmeyer International	GTZ	1988 Feb	Published
10	5010	Supplement to volume A-1: CHP KELA071 (P/C 25.9 MW)	Lahmeyer International	GTZ	1988 Feb	Published
11	5011	Supplement to volume A-1: CHP KOTM025 (P/C 64.4 MW)	Lahmeyer International	GTZ	1988 Feb	Published

Continued -Table 4-1 References and Resource Database

Serial No	Country Code & Report REF	Title	Author	Agency	Year	Status
12	5012	Supplement to volume A-1: CHP KOTM033 (P/C 93.3 MW)	Lahmeyer International	GTZ	1988 Feb	Published
13	5013	Supplement to volume A-1: CHP MAGA029 (P/C 19.3 MW)	Lahmeyer International	GTZ	1988 Feb	Published
14	5014	Supplement to volume A-1: CHP MAHW263 (P/C 27.3 MW)	Lahmeyer International	GTZ	1988 Feb	Published
15	5015	Supplement to volume A-1: CHP MAHW287 (P/C 10.4 MW)	Lahmeyer International	GTZ	1988 Feb	Published
16	5016	Supplement to volume A-1: CHP MAHW288 (P/C 18.3 MW)	Lahmeyer International	GTZ	1988 Feb	Published
17	5017	Supplement to volume A-1: CHP NALA004 (P/C 4.7 MW)	Lahmeyer International	GTZ	1988 Feb	Published
18	5018	Supplement to volume A-1: CHP NALA005 (P/C 8.1 MW)	Lahmeyer International	GTZ	1988 Feb	Published
19	5019	Supplement to volume A-1: CHP SUDU017 (P/C 25.3 MW)	Lahmeyer International	GTZ	1988 Feb	Published
20	5020	Supplement to volume A-1: CHP SUDU009 (P/C 17.8 MW)	Lahmeyer International	GTZ	1988 Feb	Published
21	5021	Supplement to volume A-1: CHP UMAO008 (P/C 35MVA)	Lahmeyer International	GTZ	1988 Feb	Published

Continued-Table 4-1 References and Resource Database

Serial No	Country Code & Report REF	Title	Author	Agency	Year	Status
22	5024	Supplement to volume A-1: CHP UMAO042 (P/C 41.8 MW)	Lahmeyer International	GTZ	1988 Feb	Published
24	5025	Supplement to volume A-1: CHP MAGU043 (P/C 35.7 MW)	Lahmeyer International	GTZ	1988 Feb	Published
25	5026	Supplement to volume A-2: CHP BELI009 (P/C 10.2 MW)	Lahmeyer International	GTZ	1988 Dec	Published
26	5027	Supplement to volume A-2: CHP BELO014 (P/C 13.4 MW)	Lahmeyer International	GTZ	1988 Dec	Published
27	5028	Supplement to volume A-2: CHP KUMB103	Lahmeyer International	GTZ	1988 Oct	Published
28	5029	Supplement to volume A-2: CHP MAND001	Lahmeyer International	GTZ	1988 Oct	Published
29	5030	Supplement to volume A-2: CHP RAWE003 (P/C 5.4 MW)	Lahmeyer International	GTZ	1988 Oct	Published
30	5031	Supplement to volume A-2: CHP RAKW030	Lahmeyer International	GTZ	1988 Oct	Published
31	5032	Supplement to volume A-2: CHP RITI023	Lahmeyer International	GTZ	1988 Oct	Published
32	5033	Supplement to volume A-2: CHP WEWL003	Lahmeyer International	GTZ	1988 Oct	Published
33	5034	Supplement to volume A-2: CHP GING052 (P/C 38.1 MW)	Lahmeyer International	GTZ	1988 Oct	Published

Continued-Table 4-1 References and Resource Database

Serial No	Country Code & Report REF	Title	Author	Agency	Year	Status
34	5035	Supplement to volume A-2: CHP UMAO008 (P/C 35 MW)	Lahmeyer International	GTZ	1988 Oct	Published
35	5036	Supplement to volume A-2: CHP UMAO021 (P/C 31.5 MW)	Lahmeyer International	GTZ	1988 Oct	Published
36	5037	Supplement to volume A-2: CHP UMAO0042 (P/C 41.8 MW)	Lahmeyer International	GTZ	1988 Oct	Published
37	5038	Supplement to volume A-2: CHP UMAO063	Lahmeyer International	GTZ	1988 Oct	Published
38	5039	Supplement to volume A-2: CHP MAGU043 (P/C 35.7 MW)	Lahmeyer International	GTZ	1988 Oct	Published
39	5040	Supplement to volume A-2: CHP BELI009 (P/C 10.2 MW)	Lahmeyer International	GTZ	1988 Oct	Published
40	5041	Supplement to volume A-2: CHP BELI014 (P/C 13.4 MW)	Lahmeyer International	GTZ	1988 Oct	Published
41	5042	Supplement to volume A-2: CHP KUMB103	Lahmeyer International	GTZ	1988 Oct	Published
42	5043	Supplement to volume A-2: CHP MADU003	Lahmeyer International	GTZ	1988 Oct	Published
43	5044	Supplement to volume A-2: CHP KURD014	Lahmeyer International	GTZ	1988 Oct	Published
44	5045	Supplement to volume A-2: CHP KURO019	Lahmeyer International	GTZ	1988 Oct	Published

Continued-Table 4-1 References and Resource Database

Serial No	Country Code & Report REF	Title	Author	Agency	Year	Status
45	5046	Supplement to volume A-2: CHP MADU003	Lahmeyer International	GTZ	1988 Oct	Published
46	5047	Supplement to volume A-2: CHP MAND001	Lahmeyer International	GTZ	1988 Oct	Published
47	5048	Supplement to volume A-2: CHP RAWE030	Lahmeyer International	GTZ	1988 Oct	Published
49	5049	Supplement to volume A-2: CHP RITI 023	Lahmeyer International	GTZ	1988 Oct	Published
50	5050	Supplement to volume A-2: CHP WEWL003	Lahmeyer International	GTZ	1988 Oct	Published
51	5051	Supplement to volume A-2: CHP GING052 (P/C 38.1MW)	Lahmeyer International	GTZ	1988 Oct	Published
52	5052	A2 Candidate Power Projects Part II	Lahmeyer International	GTZ	1988 Oct	Published
53	5053	Broadlands Power Project, Feasibility Report Vol 1, Vol 2, Vol 3.	Lahmeyer International	GTZ	1988 Oct	Published
54	5054	Guide For Grid Interconnection of Embedded Generators. Volume 1 Volume 2	CEB	CEB	2000 Dec	Published

Sri Lanka has already harnessed more than **45 %** of its Hydro-power Potential. Most of these are multi task projects of controlling floods, supplying of irrigation water and generation of power. By the Master plan the Electricity Supply of Sri Lanka, as mentioned above in the Resource Data Base all the Techno-economically feasible hydro-power potential has been identified and the balance available, has been identified as approximately 1268 MW. Out of which estimated potential that can be developed is 1066 MW. The balance may not be able to develop due to environmental and economic barriers.

Table 5-1: Hydro-power Potential

	Particulars	in MW	%
1	Estimated Total Potential	2423	
2	Developed	1137	46
3	Techno Economically feasible for Development	1066	43
4	Under Construction	70	1.6
5	Committed for future Projects	150	6.1
6	Expected Total Development By 2012	1663	68

Note : Percentage calculations are based on total potential of hydro projects.

Sri Lanka has already developed approximately over **80%** the resources on Mahaweli River and the Kelani River. One of the resources of Walawe River has also been developed. All the existing Plants are listed in the Table 5-1 below and the capacities and the possible renovations are indicated in the table.

Table 6-1 Existing Projects

PROJECT NAME	OWNER	YEAR OF INSTALATION	OUTPUT		RESOVIOR		TYPE	POSSIBLE RENOVATION, MORDERNISATION AND UPGRADING
			MW	ANNUAL ENERGY MU	CAPACITY MCM	AREA KM^2	1-Run of River 2-ROR/Pondage 3-Peaking 4-Storage 5-Pump Storage	
Wimalasurendra	CEB	Jan-65	50 2x25	122.1	47.6		4	Modernization, and upgrading Required
Old Laxapana	CEB	Ph1 Dec 1950 and Ph2 Dec 1958	50 3x8.33 2x12.5	260.8	0.522		2	Modernized in 1996
New Laxapana	CEB	Unit 1 Feb 1974 unit 2 Mar 1974	100 2x50	465.8	1.037		2	Modernization, and upgrading Possible
Canyon	CEB	Unit 1 Mar,1983 Unit2 1988	60 2x30	137.3	123.3		4	Modernization, and upgrading Possible

PROJECT NAME	OWNER	YEAR OF INSTALATION	OUTPUT		RESOVIOR		TYPE	POSSIBLE RENOVATION, MORDERNISATION AND UPGRADING
			MW	ANNUAL ENERGY MU	CAPACITY MCM	AREA KM^2	1-Run of River 2-ROR/Pondage 3-Peaking 4-Storage 5-Pump Storage	
Polpitiya	CEB	Apr-69	75 2x37.5	396.8	0.172		2	Modernization Project in Progress
Ukuwela	CEB	Unit 1 Jul 1976 Unit 2 Aug 1976	38 2x19	164.4	4.3		4	Modernization, and upgrading Possible
Bowatenna	CEB	Jun-81	40 1x40	48.8	49.8		2	Modernization, and upgrading Possible
Kotmale	CEB	Unit 1 Apr 1985 Unit 2 & 3 Feb 1988	201 3x67	445.1	172		4	Modernization, and upgrading Possible in another 5 yeas
Victoria	CEB	Unit 1 Jan 1985 Unit 2 Oct 1984 Unit 3	210	663.7	722		4	Modernization, and upgrading Possible in another 5 yeas

PROJECT NAME	OWNER	YEAR OF INSTALATION	OUTPUT		RESOVIOR		TYPE	POSSIBLE RENOVATION, MORDERNISATION AND UPGRADING
			MW	ANNUAL ENERGY MU	CAPACITY MCM	AREA KM^2	1-Run of River 2-ROR/Pondage 3-Peaking 4-Storage 5-Pump Storage	
		Unit 3 Feb 1986	3x70					
Randenigala	CEB	Jul-86	122 2x61	326.4	861		4	Modernization, and upgrading Possible in another 5 yeas
Rantambe	CEB	Jan-90	49 2x24.5	189.1	22		2	Modernization, and upgrading Possible in another 5 yeas
Samanalawewa	CEB	Oct-92	120 2x60	277.3	278		4	
Nilambe	CEB	Jul-98	3.2 2x1.6	11.6			2	
Udawalawe	CEB	Apr-69	6 3x2	7.6			4	

PROJECT NAME	OWNER	YEAR OF INSTALATION	OUTPUT		RESOVIOR		TYPE	POSSIBLE RENOVATION, MORDERNISATION AND UPGRADING
			MW	ANNUAL ENERGY MU	CAPACITY MCM	AREA KM^2	1-Run of River 2-ROR/Pondage 3-Peaking 4-Storage 5-Pump Storage	
Inginiyagala	CEB	Jun-63	11 2x2.475 2x3.15	26.8			4	Modernization, and upgrading badly Needed

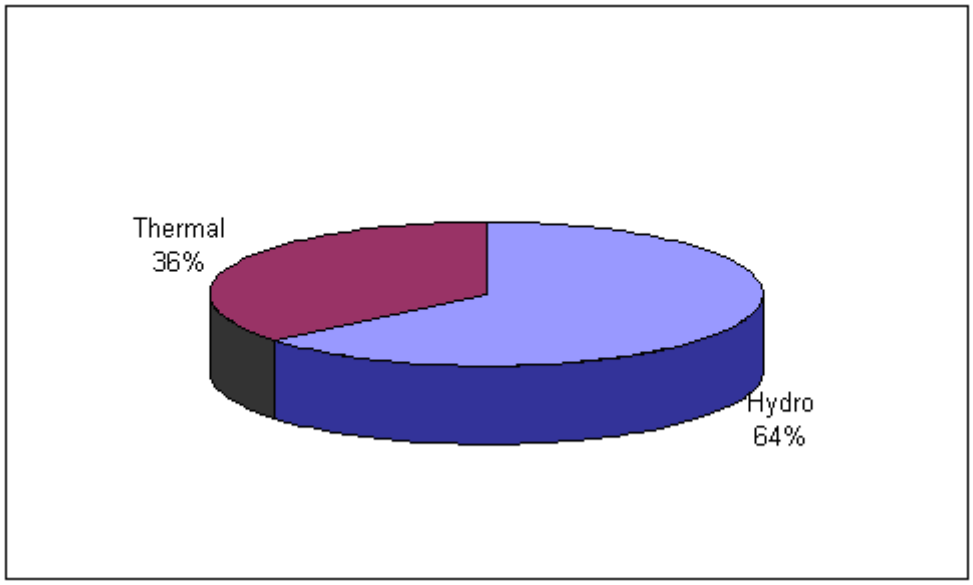


Figure 6-1 Power Matrix 2002

Table 6-2 : Transmission and Distribution Line Length

S. No.	Type	Length (km)
1	220 kV Double Circuit	453
1	132 kV Double Circuit	2429
2	132 kV Single Circuit	41
7	33 kV Single Circuit	45,536

7.1 Projects Under construction

Kukule Ganga (River) Project, 70 MW of capacity is the Only Project that is under Construction. This is to be Completed Early 2004. This is constructed Under JABIC Funding and owned by CEB.

7.2 Delayed Projects Due to Barriers

Upper Kotmale Project has been planned to be another addition simultaneously with the above Project however this project got delayed due to Protests of Environmentalists and CEB had to fight a Court Case filed by the Environmentalists. After winning the case the commencement of the project is still dragged on due to protests by the public of the area.

Table 7-1 New Projects Currently under Construction

Project Name	Owner	Expected Year of Commissioning	Output		Reservoir		Type	Comments
			Capacity MW	Annual Energy MU	Capacity MCM	Area km^2		
Kukule Ganga Project	CEB	2004	70 35x2	306	1.7		5-Storage	Project work implemented so far to the schedule

Note

MU=1,000,000 KWh
MCM=Million Cubic Meters

Column 8 :Type
1-Run of River
2-Run of River with Pondage
3-Peaking
4-Multipurpose
5-Storage
6-Pump Storage

The potential on upgrading of the existing projects are given in the Table 8-1 below. It has been a practice to get the same machine manufacturer to upgrade the existing projects. However the projects upgraded has been just the updating of controls protection and equipment than the upgrade of capacity etc. Therefore studies are needed to upgrade the following projects. Scope of the ongoing study by JABIC, Hydro-power Optimization In Sri Lanka, covers the studies of Upgrading of plants.

Table 8-1 Data on Possible type of Renovation Modification Upgrading and Life Extension.

Project Name	Owner	Existing Capacity MW	New Estimated Capacity MW	Annual Energy		Possible Type of Renovation, Modification, Upgrading and Life Extention		
				Existing MU	New Estimated MU	Civil	Mecahnical /Electrical	Comments
Wimalasurendra Power Station	CEB	50 2x25	-	122.1	-	Possible	Possible	Not Yet Studied.
New Laxapana	CEB	100 2x50		465.8		Possible	Possible	Not Yet Studied
Ukuwela	CEB	38 2x19		164.4		Not Possible	Possible	Not Yet Studied
Bowatenna	CEB	40 1x40		48.8		May Be Possible	Possible	Not Yet Studied.
Kotmale	CEB	201 3x67		445.1		Possible if the Upper Kotmale will not be Constructed	Possible	Studied

The only future commitment at the moment is the Upper Kotmale Project. It was very discouraging to face the protests of various parties and the barriers to develop this project. However it is identified that the environmental aspects are not so severe on the most of other projects listed under the section 4. The power matrix projected with planned thermal and hydro are projected to 2012 is given in the Figure 9-1

Table 9-1 New Projects Planned Upto 2012

Project Name	Level of Study	Owner	Expected Year of Commissioning	Out put		Reservoir Data		Type	Impacts	Benefits
				Capacity MW	Annua MU	Capacity	Area Km^2			
Upper Kotmale	Detailed Design	CEB	2004	150	320			5	Loosing of Most valuable tea estates and 4 water falls	Usage of untapped enewable energy

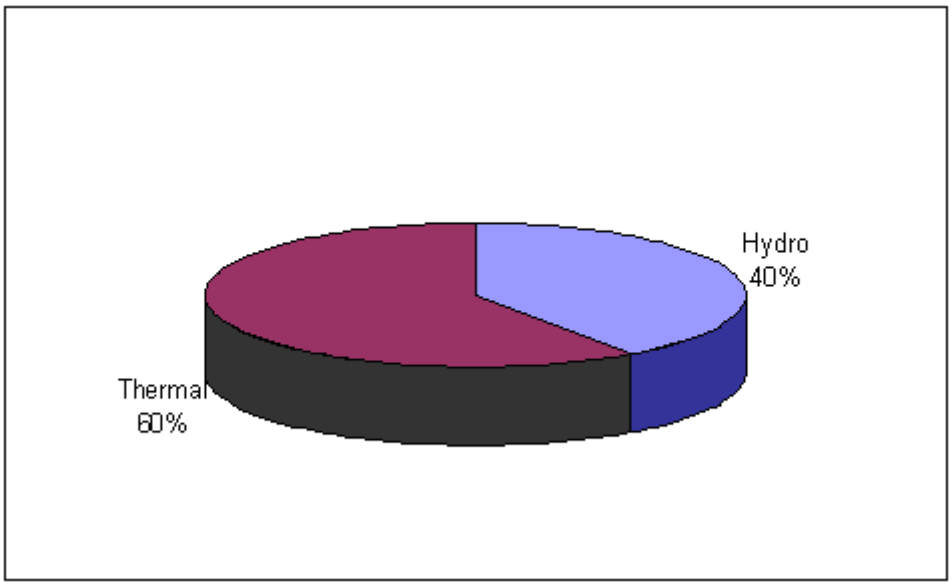


Figure 9-1 Power Matrix in 2012 – Projected

Water Resources are depleting in Sri Lanka and approximately **46 %** of resources has been developed up to date. However present government is interested in seeking possibilities of Privet investment to develop the Hydro-power Resources. The Electricity Act of Sri Lanka of 1959 with various amendments from time to time does not allow any private investor to handle Generation or Distribution of Power in Large or small scale. However it is considered that with the License obtained from the Ministry of Power and Energy this legislation is overruled. Further with the reforms planned to privatize the Electricity Authorities in Sri Lanka The Electricity ACT shall be amended or modified.

Two Main Authorities of Power Trade in Sri Lanka are Ceylon Electricity Board and Lanka Electricity (Pvt) Ltd. However CEB holds controlling shares of LECO.

Objectives

The objectives of the hydro-power policy are to achieve the following:

1. To utilize the existing water resources and to ensure that these are devolved and the returns are ensured so that the private investors are encouraged.

2. To ensure the maximum amount of renewable energy for to ensure the availability of power needed for economic activities.

Up to very recent past private investors were allowed to develop the plants only up to 10 MW. Now the limit is taken up to 50 MW and Energy Supply Committee of Sri Lanka has invited world wide "Expression of Interest" to develop the Hydro Plants. The Paper notice appeared on the Ceylon Observer (Weekend Paper) on 21st of July 2002 announcing the uplift of the limit of the plant that can be developed by the investors is given in the Appendix A.

The price paid for the Hydro plants were increased to Rs. 5.63 (US$ 0.058) in the wet season and Rs. 5.94 (US$ 0.061) in the Dry Season to encourage the private investors.

10.1 Highlights of the New Policy

New policy guidelines have not been drafted yet. However the policy covers the following topics/ provisions to develop hydro-power in the country to achieve the above stated objectives.

1. Environmental Provisions
2. Provision of Water Rights
3. Interactions with Provincial Development Plans
4. Right of Ways of Transmission / Distribution
5. Provision of Investment in Generation, Transmission and Distribution
6. Power Purchase Arrangements
7. Domestic Electricity Market Arrangements
8. Licensing Arrangements
9. Royalty Arrangements
10. Tax and Custom Facilities Arrangements (BOI Status)

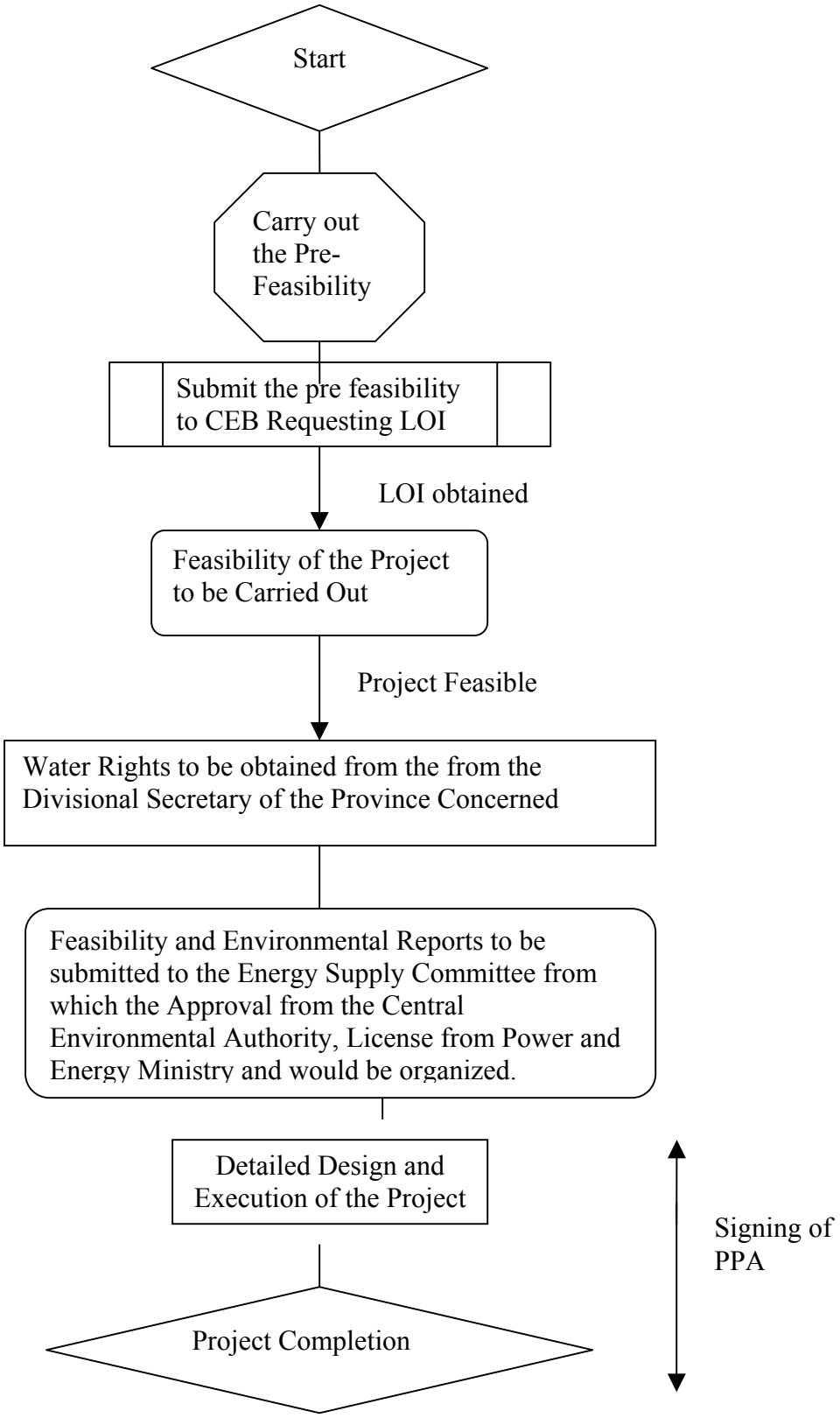
10.2 Institutional Setup

At the moment Energy Supply Committee is handling the private investors approvals etc. and a Chairman for Multidisciplinary Regulator will be set up to handle the investment approvals and the related activities.

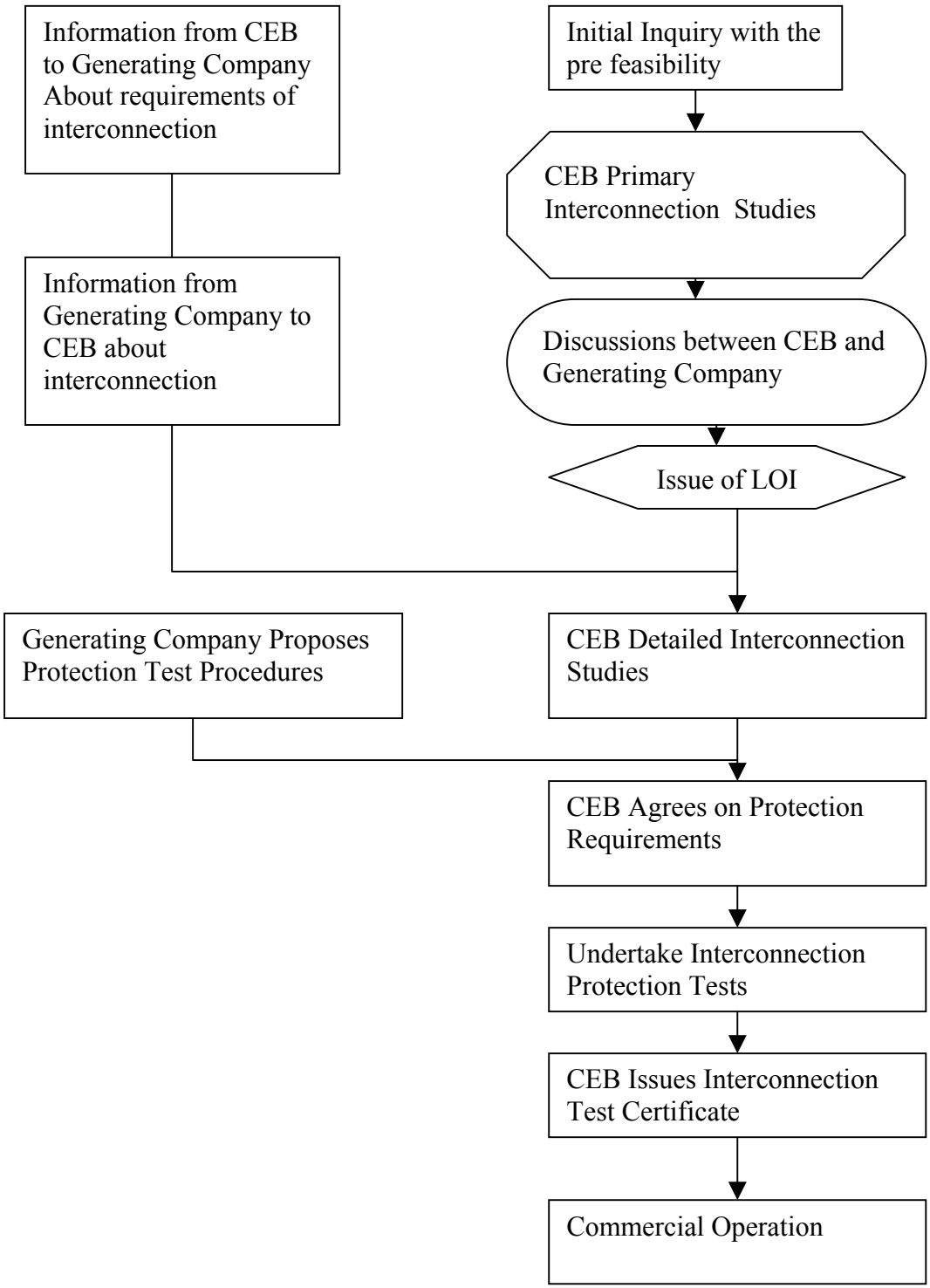
10.2.1 Operational – Level Institutions

Ceylon Electricity Board is an integrated public utility with the mandate for power generation, transmission and distribution. CEB owns the Generation plants and the Transmission Network. At least **95 %** of the Distribution network is also directly owned by CEB. A Grid Connection Code has been developed by CEB and the grid connection is closely supervised by CEB and the PPA is signed between CEB and the private developer.

Flow Chart 10-1, Developers Procedures for overall Approval



Flow Chart 10-2, Developers Procedures with CEB



Sri Lanka is interested in developing the possible hydro resources. Candidate Plants of the Master Plan are not very promising according to the price estimates and in comparison to the Thermal Generation.

Following Factors are dominant on planning criterion to find the least cost candidate for the system.

- The Reflected cost of the KWh
- Financing of the project
- Thermal and the Hydro Balance to face the dry years
- Diversification of Fuels and Resources.

According to the weather pattern of Sri Lanka every 4 to 5 years a dry year falls. The Hydro capacity energy wise and capacity wise has a direct influence with the reservoir levels and the balance between thermal and hydro to be hit to cater the demand in dry year at a least cost option.

If a regional connectivity is available and a regional generation plan is established this planning criterion shall be changed drastically according to a regional power exchange scenario. Further the financing barriers shall be diminished with the private investor participation.

Sri Lanka's Energy needs are met as shown in the Figure 11-1

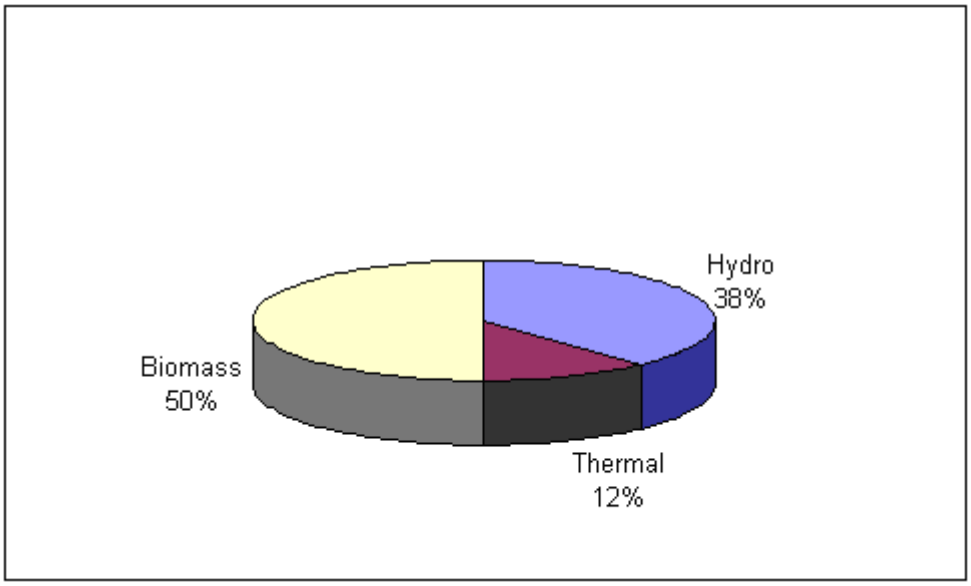


Figure 11-1 Gross Primary Energy Supply by Source

- **38%** of the total energy needs is met by hydro-power.
- **50%** of the total energy needs is met by Bio-mass.
- Approximately **45%** hydro-power potential is developed to date.
- **45%** of the population has access to electricity

- Industrial and domestic loads keeps on growing the energy consumption by sectors are given in Figure 11-2

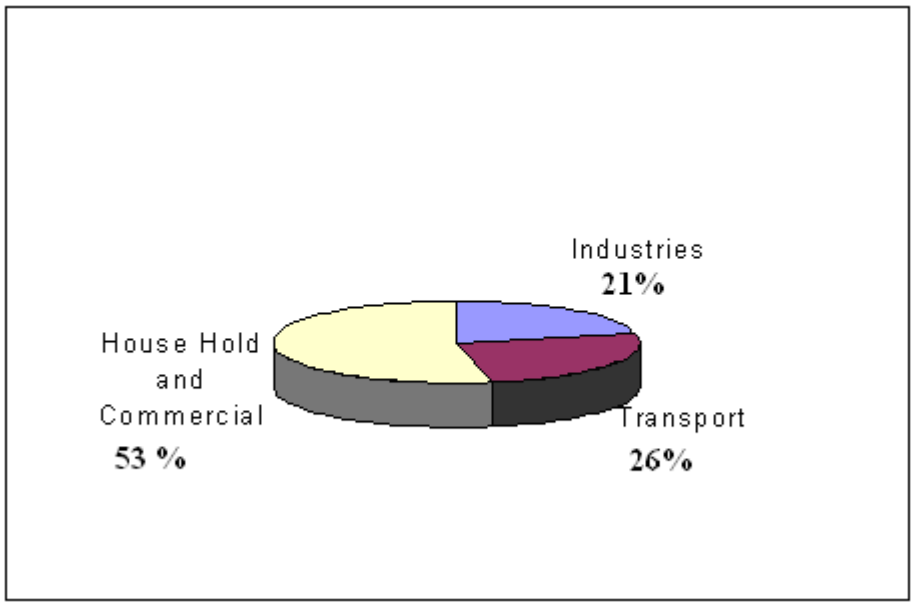


Figure 11-2 Gross Energy Consumption by Sector

11.1 Promotion of Power Exchange

Sri Lanka has its Transmission and Distribution Network spanning over the Island. The war torn sector in the north is getting rehabilitated at a rate and the demand in north is also rising. The demand growth according to the long-term generation expansion plan is around **10%** per year and the planned plants around 500 MW will be added to the system up to 2005. Further 400 MW will also be added to the system by 2010. If hydro potential will be added during this duration the system can accept the plants. Hence the thermal plants can be delayed. In the Scenario the excess power can be exchanged with the regional network if the interconnection is established. Further benefits like sharing of the Peak will be possible with south India with the interconnection.

11.1.1 Cost of Hydro-power Development

Projects over 10 MW, especially due to resettlement and other environmental barriers become non feasible due to the fixed rates for hydro development. Therefore it is advisable to negotiate on case by case for an agreement for a PPA.

11.2 Barriers

By discussing with the private Investors following issues were brought up on developing Hydro plants.

- High risks in terms of market risks, currency depreciation, production risks and foreign exchange risks

- Risk on delay or non payment, government is not in favor to offer a sovereign guarantee.

- Right of ways for the transmission lines leads into disputes.
- Weak legislative and regulatory policies and absence of laid out procedures.
- Stringent environmental criteria on development of hydro plants
- Feasibility study and the approval criteria costs very high while the risk of getting the project rejected is very high

- It is very important for Sri Lanka to adhere to the least cost generation plan as the investors in industrial Sector always tend to look for the best infrastructure at least cost. The BOI institutions play very important role on economy of Sri Lanka. Therefore it is very important to maintain a least possible tariff.

- Sri Lanka has its Transmission and Distribution network fairly developed and 45% of domestic users have the access for Electricity. In this context Sri Lanka has the potential for sales of electricity and even if the even if the balance hydro is developed.

- Private Investments are needed to go ahead with the simultaneous development of the balance resources.

- The new procedures of Sri Lanka on private party participation are encouraging. However the risks on investments are still high. Draw backs are mostly the investments needed before the approval is obtained, fixed price paid for that may not suit commercially for the plants over 10MW.

- The planning criterion of least cost generation shall be drastically changed if the Power Pool of the Region is established.

- The Environmental clearance procedures and the approval procedures to be clearly laid out to build the confidence of the investor.

- Preparation of a regional resource database for the mutual benefits of the region and a Regional Least Cost Generation Expansion Plan should be prepared to promote the "regional power pool" concept. Also the interconnection possibilities have to be reviewed on this context.

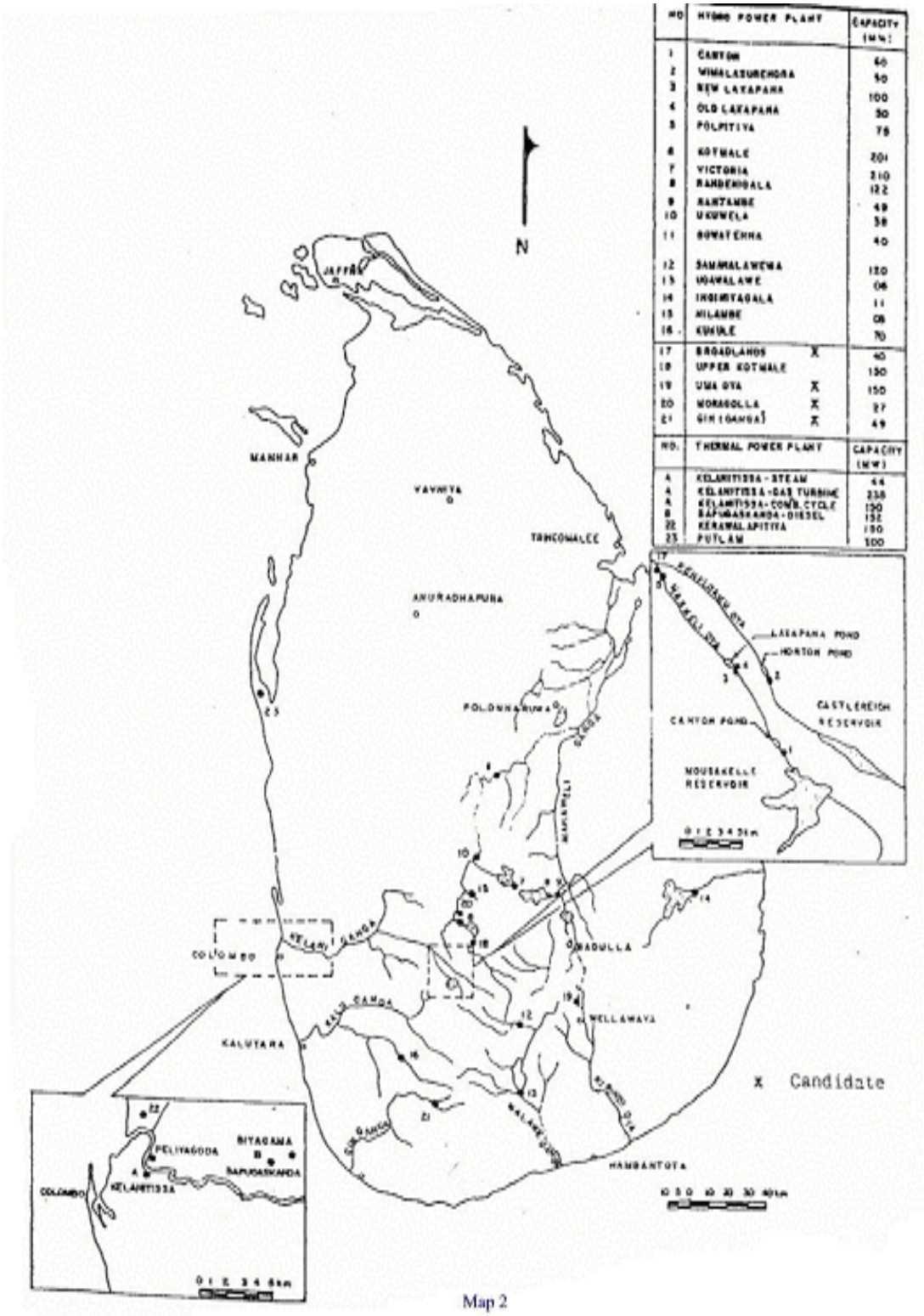
- The approval for the projects studied by an institution and readily available off the shelf for an investor to purchase the approval and to carry out the construction and the commercial operation. This will eliminate the risk of investments by a private party before the approval. A government policy on this may be required. As an example each resource may be developed by a private party on competitive bidding.

- Upgrading of facilities of system studies and connectivity on study offices may be needed in a case of the regional power pool concept.

Maps

Regional Map (With all SARI partner countries)

Map of Sri Lanka



NO	HYDRO POWER PLANT		CAPACITY (MW)
1	CANYON		60
2	WIMALASURENDRA		50
3	NEW LAXAPANA		100
4	OLD LAXAPANA		50
5	POLPITIYA		75
6	KOTMALE		201
7	VICTORIA		210
8	RANDENIGALA		122
9	RANTAMBE		49
10	UKUWELA		38
11	BOWATENNA		40
12	SAMANALAWEWA		120
13	UDAWALAWE		06
14	INGINIYAGALA		11
15	MILAMBE		08
16	KUKULE		70
17	BADALANDE	X	40
18	UPPER KOTMALE		150
19	UMA OYA	X	150
20	MORAGOLLA	X	27
21	GIN GANGA I	X	49

NO.	THERMAL POWER PLANT	CAPACITY (MW)
A	KELANITISSA - STEAM	64
A	KELANITISSA - GAS TURBINE	238
A	KELANITISSA - COMB. CYCLE	150
B	SAPUGASKANDA - DIESEL	102
22	KERAWALAPITIYA	150
23	PUTLAM	300

Map 2

Regional Hydropower Resources - Status of Development and Barriers (Sri Lanka)