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Himanshu A. Amarawickrama  
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## **ABSTRACT**

In 2002 the Government of Sri Lanka proposed power sector policy guidelines for the first time in its history in order to facilitate the restructuring of the sector. This paper attempts to critically examine and appraise the Government's proposals with suggestions for improvements. The methodology employed is to first examine the requirements of the Sri Lankan power sector by analysing the current problems that the power sector faces and to empirically estimate electricity demand to identify the future consumption and capacity expansion needs of the sector. Secondly, it is assessed to what extent the proposed reforms address the requirements of the sector identified above. Finally, alternative proposals are introduced in order to address the identified flaws in the current proposed reforms.

*JEL Classification:* Q48, Q41

*Key Words:* Developing Countries, Electricity Supply Industry, Power Policy, Sri Lanka

# Sri Lankan Electricity Supply Industry: A Critique of Proposed Reforms\*

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## 1 INTRODUCTION

Over the last couple of decades there has been a substantial focus on power sector reforms of developing countries. A substantial number of countries have initiated massive economic development programmes including reforms in the Electricity Supply Industry (ESI) in order to try and achieve higher economic growth. However, different countries have introduced reforms in their respective ESIs for a different blend of reasons, in different ways, at different times, using different restructuring models and at a different pace. Arguably this is because the power industry in each country is unique in composition, development and structure. Also, the general attitudes of society, political will and the leadership that ultimately decide on the reforms vary considerably. Like most developing countries, it is generally assumed that the growth of the Sri Lankan economy is inextricably linked with the growth in electricity consumption and hence the quality of life of its citizens<sup>1</sup>, as illustrated in *Figure 1*. Based on this the Government of Sri Lanka

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### \* Acknowledgement

The authors would like to thank Professor Priyantha DC Wijayatunga from University of Moratuwa, Dr. Thilak Siyambalapitiya from Resource Management Associates (Private) Limited and Mr. Jayasiri Karunanayake from LECO for their help towards this study, especially with the data on the Sri Lankan system. Of course any errors and omissions are due to the authors.

<sup>1</sup> Morimoto & Hope (2004) have shown that Sri Lanka could produce an extra output of USD 1120-1740 for every 1MWh increase in electricity supply. M Morimoto and C Hope, "The impact of electricity supply on economic growth in Sri Lanka", *Energy Economics*, Vol. 26, No. 1, 2004 Jan, pp 77-85.

(GOSL) proposed new power sector policy guidelines<sup>2</sup> and introduced the electricity reforms act<sup>3</sup> to restructure the ESI in late 2002.

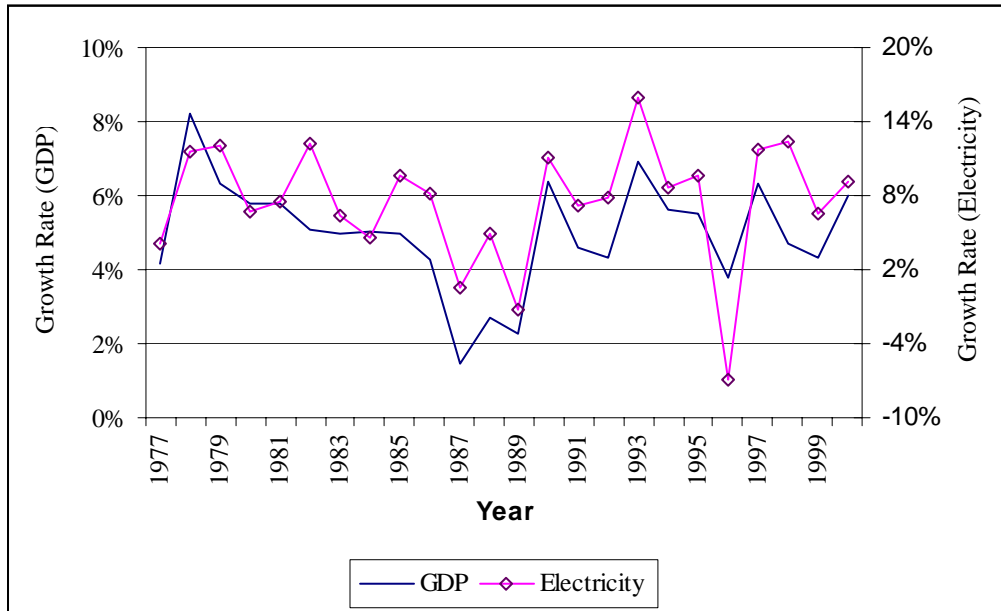


Figure 1 Variation of Economic Growth and Electricity Demand Growth<sup>4</sup>

Sri Lanka (often still referred to as Ceylon) is an island that covers around 65,000km<sup>2</sup> area with a population of around 19 million; out of which just over 60% of households were electrified in 2002. Sri Lanka is shaped like a giant teardrop falling from the southern tip of the vast Indian subcontinent, separated from India by the 50km wide Palk Strait. This isolates the Sri Lankan electrical power system from that of the Indian sub continent, hence at present there are no imports or exports of electricity.<sup>5</sup> The island is just 435km long and only 225km wide at its widest<sup>6</sup> and is administratively divided into 8 provinces as shown in Figure 2 and 24 districts.

<sup>2</sup> Proposed Power Sector Policy Guidelines, Ministry of Power and Energy, Sri Lanka, November 2002 (PPSPG, 2002).

<sup>3</sup> Electricity Reforms Act No. 28 of 2002 (Reforms Act, 2002).

<sup>4</sup> Athalage R A and Wijayathunga P D C, "Sri Lanka electricity industry: long term thermal generation fuel options" Centre for Energy studies, University of Moratuwa, 2002.

<sup>5</sup> Wijayathunga P D C and Wijeratne D G D C, "Sri Lanka energy supply status and cross boarder energy trade issues" Workshop on Regional Power Trade, SARI/Energy, USAID, Kathmandu, Nepal, 2001.

<sup>6</sup> Sri Lanka is about the same size as Ireland, West Virginia or Tasmania.



Figure 2: A map of Sri Lanka<sup>7</sup>

Sri Lanka has a very high literacy rate of more than 90% and its other social development indicators are remarkably higher than those of developing countries and the countries of the region. Sri Lanka's HDI (Human Development Index) rank was 81 in 2001, ahead of countries like South Africa and Turkey, whose per capita GDP is more than double of that of Sri Lanka.<sup>8</sup>

The country's per capita GDP (PPP) was around US\$ 3,500<sup>9</sup> in 2002 out of which the service sector contributed around 54%, the industrial sector around 26% and the agricultural sector around 20%. The predominant contribution of the service sector reflects

<sup>7</sup> University of Texas at Austin Library online. [http://www.lib.utexas.edu/maps/sri\\_lanka.html](http://www.lib.utexas.edu/maps/sri_lanka.html)

<sup>8</sup> *Human Development Report, 2001*, UNDP and World Development Indicators, 2003, World Bank.

an extensive government apparatus for social services but also includes the repatriated earnings of overseas workers, a large trading sector, and a rapidly expanding communication sector.

Sri Lanka's GDP grew at an average annual rate of 5.5% throughout the early 1990s until a drought and a deteriorating security situation lowered growth to 3.8% in 1996. The economy rebounded in 1997-2000 with average annual growth of 5.3%. But 2001 saw the first contraction in the country's history, due to a combination of power shortages, severe budgetary problems and the global slowdown. However, recovering from 2001, in 2002 the country recorded a growth rate of 3.7%.<sup>10</sup> But this is well below the average growth rate of lower middle-income countries for 2002 of around 5%.<sup>11</sup>

From the mid 1990s the economy has faced a series of challenges due to increased defence spending and a higher oil bill, resulting in a budget deficit of around 10% in 2001. Hence, Sri Lanka is highly dependent on foreign assistance with Japan being its largest donor. The GOSL is also pursuing development activities with the funding and technical assistance of the World Bank (WB) group and the Asian Development Bank (ADB).

As far as is known there has been very little academic analysis of the Sri Lankan electricity sector other than David et al. (2002)<sup>12</sup> and Siyambalapitiya (2002)<sup>13</sup>. David et al. refers to the pre-reform period in Sri Lanka (in addition to other Asian developing countries) identifying some of the key characteristics of the Sri Lankan ESI system: capacity shortfall, overstretched distribution networks in most cities and associated poor quality of supply and reliability problems and inadequate supply to rural areas. David et al. go on to

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<sup>9</sup> *World Development Indicators*, 2003, World Bank.

<sup>10</sup> *Central Bank of Sri Lanka Annual Report (CBSL AR)*, 2000, 2001 and 2002.

<sup>11</sup> *World Development Indicators*, 2003, World Bank.

<sup>12</sup> David A K, Leeprechanon N, Liu F and Moorthy S S, "Transition to an electricity market: A model for developing countries", *IEEE Transactions on Power Systems*, 2002, vol. 17, No. 3 pp 885-894.

<sup>13</sup> Siyambalapitiya T, "A review of the energy policy in Sri Lanka and its implementation", *Energy for Sustainable Development*, Vol. VI, No. 1 (2002), pp 5-13.



propose a framework as the best alternative under the above constraints, including the need for private participation, foreign investment, greater rural electrification, privatisation and a centrally planned, government owned National Transmission Authority (NTA).

Siyambalapitiya (2002) (published in the same year as, but before, the GOSL proposals for reforms) criticizes general energy policy in Sri Lanka since the publication of the energy policy document in 1997.<sup>14</sup> In particular he concludes that “energy policy for Sri Lanka, though accepted by the government, is largely forgotten by almost all decision makers” adding that the “policy has no action plans or monitoring system that are essential for its implementation” (p. 13). But this all changed to some extent with the GOSL’s proposals in late 2002, although as argued later, these proposals are not without problems.

Given the background above this paper proceeds as follows: The next section outlines and discusses the demand and supply fundamentals of the Sri Lankan electricity sector followed by section 3 that considers the proposed power sector reforms by the GOSL. Section 4 evaluates the Sri Lankan ESI and proposed reforms. Section 5 introduces suggestions for an alternative structure and policy (drawing on forecast simulations in the Appendix), followed by a summary and conclusion in Section 6.

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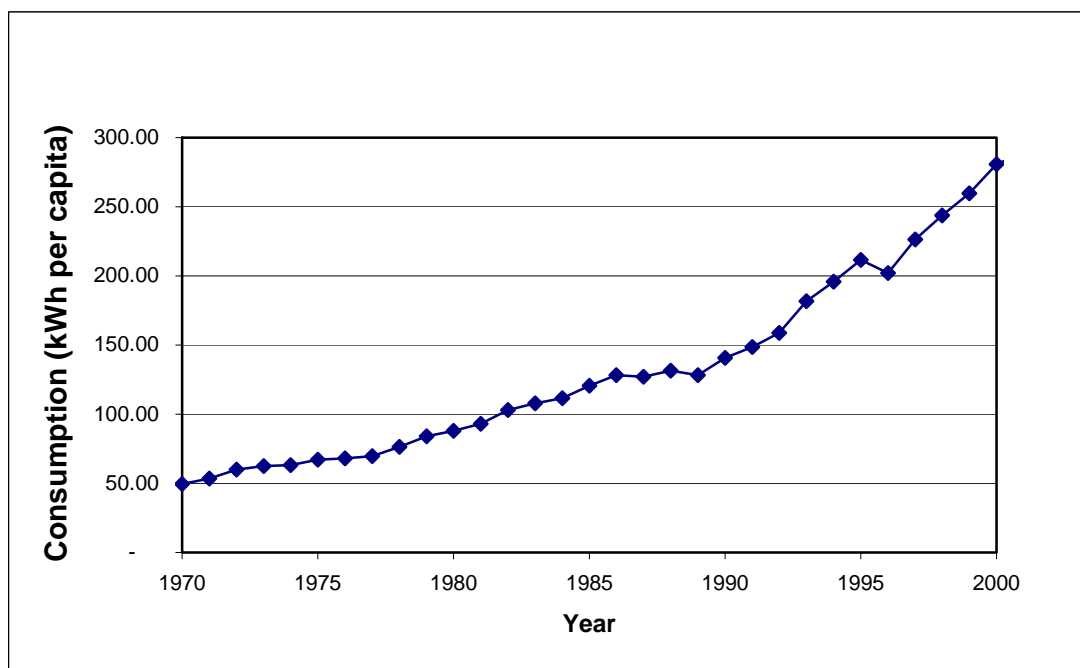
<sup>14</sup> *Report of the National Committee to Formulate the National Energy Policy of Sri Lanka, 1997*, Ministry of Irrigation and Power.

## 2 CURRENT STRUCTURE OF ESI IN SRI LANKA

### 2.1 The demand side

#### 2.1.1 Consumption

Consumption of electricity in Sri Lanka was around 290 kWh per capita per year in 2001<sup>15</sup> having grown rapidly over the last three decades, as illustrated in *Figure 3*. From 1986 to 2001 consumption increased on average by 6.0% per annum and peak demand increased on average by 6.5% per annum from 540 MW to 1445 MW.<sup>16</sup> Despite this strong growth, Sri Lanka's per capita electricity consumption was about 60% of that of its neighbours, India and Pakistan.<sup>17</sup>



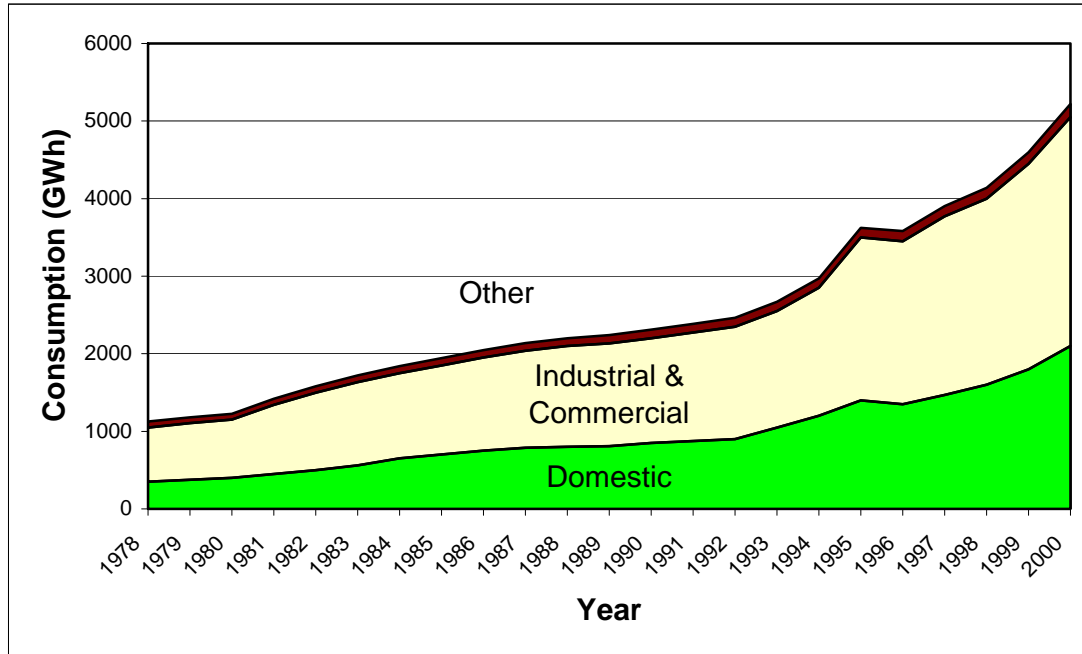
*Figure 3: Per capita electricity consumption in Sri Lanka*

<sup>15</sup> *Statistical Digest 2001*, Statistical Unit, Information Management Branch, CEB.

<sup>16</sup> *Long Term Generation Expansion Plan 2002-2016*, Generation Planning Branch, Ceylon Electricity Board, December 2001 (LTGEP, 2001).

<sup>17</sup> Athalage R A and Wijayathunga P D C, op. cit.

Electricity consumption by sector from 1978-2000 is given in *Figure 4*. This illustrates the growth both in the domestic and industrial & commercial sectors.



*Figure 4: Electricity consumption by sector from 1978-2000*<sup>18</sup>

### 2.1.2 Electrification

The proportion of grid-connected houses has been ever increasing from 7% in 1976 to 61% in 2002 (altogether around 3.1 million customers out of around 5 million households).<sup>19</sup>

The new connections to the system are on average around 230,000 consumers every year.<sup>20</sup>

*Figure 5* shows that in 2000 electrification varied from less than 20% households in some districts in the North to almost 92% in Colombo.<sup>21</sup> Household electrification was as high

as 85% in the urban areas while the rural areas recorded only 47% as average electrification in 2001.<sup>22</sup>

<sup>18</sup> LTGEP, 2001.

<sup>19</sup> *Sri Lanka rural electrification policy*, Ministry of Power and Energy, Sri Lanka, November 2002.

<sup>20</sup> LTGEP, 2001.

<sup>21</sup> PPSPG, 2002.

<sup>22</sup> Athalage R A and Wijayathunga P D C, op. cit.

## 2.2 Structure of the ESI

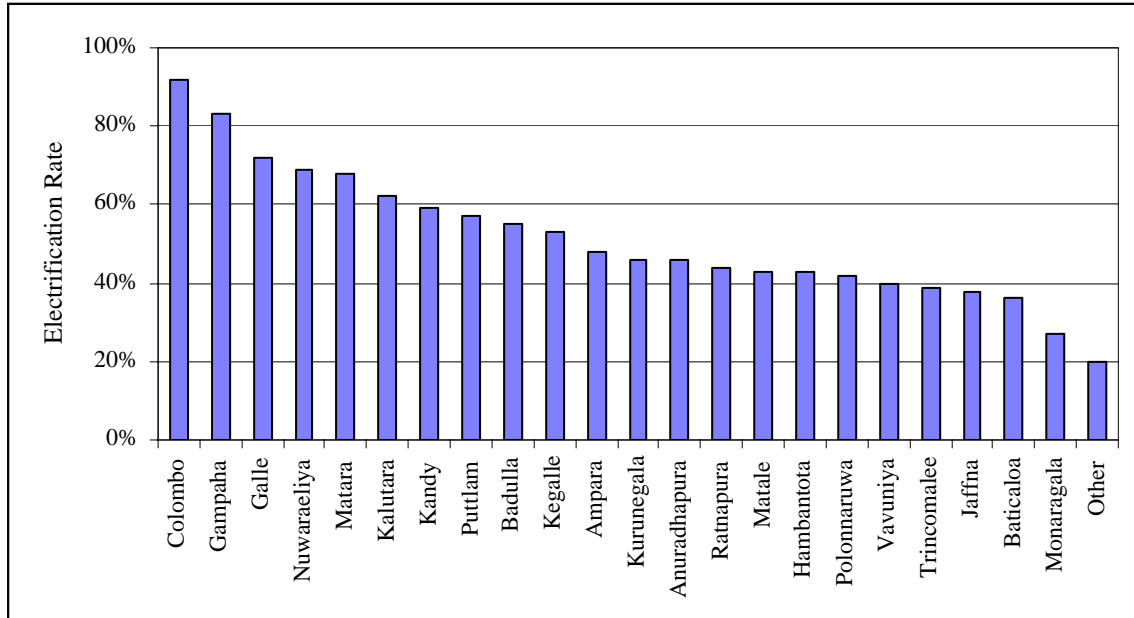


Figure 5: Electrification rates in different districts in 2000 <sup>23</sup>

The electric power sector in Sri Lanka is organised under the Ministry of Power and Energy (MOPE). The Ceylon Electricity Board (CEB) undertakes the generation and transmission of electric power in the whole country and distribution and supply of electric power in areas other than those areas served by the Lanka Electricity Company (Private) Limited (LECO), which is responsible for about 15% of total electricity distribution and supply of the country. <sup>24</sup> The current structure of the ESI is given in Figure 6. It can be seen that this is a typical version of model 1 according to Hunt & Shuttleworth's (1996)

<sup>23</sup> Athalage R A and Wijayathunga P D C, op. cit.

<sup>24</sup> LECO is a limited liability company, which started operations on 1st June 1984 and now operates in 32 Local Government areas in the Western and Southern coastal belt townships around Colombo. Its customer base has grown from about 12,000 to over 300,000 Customers and has a staff of 1,345 in 2001. LECO remains a profitable company with a private management but the majority of the shares are owned by CEB. More details can be found at [www.lanka.net/leco](http://www.lanka.net/leco)

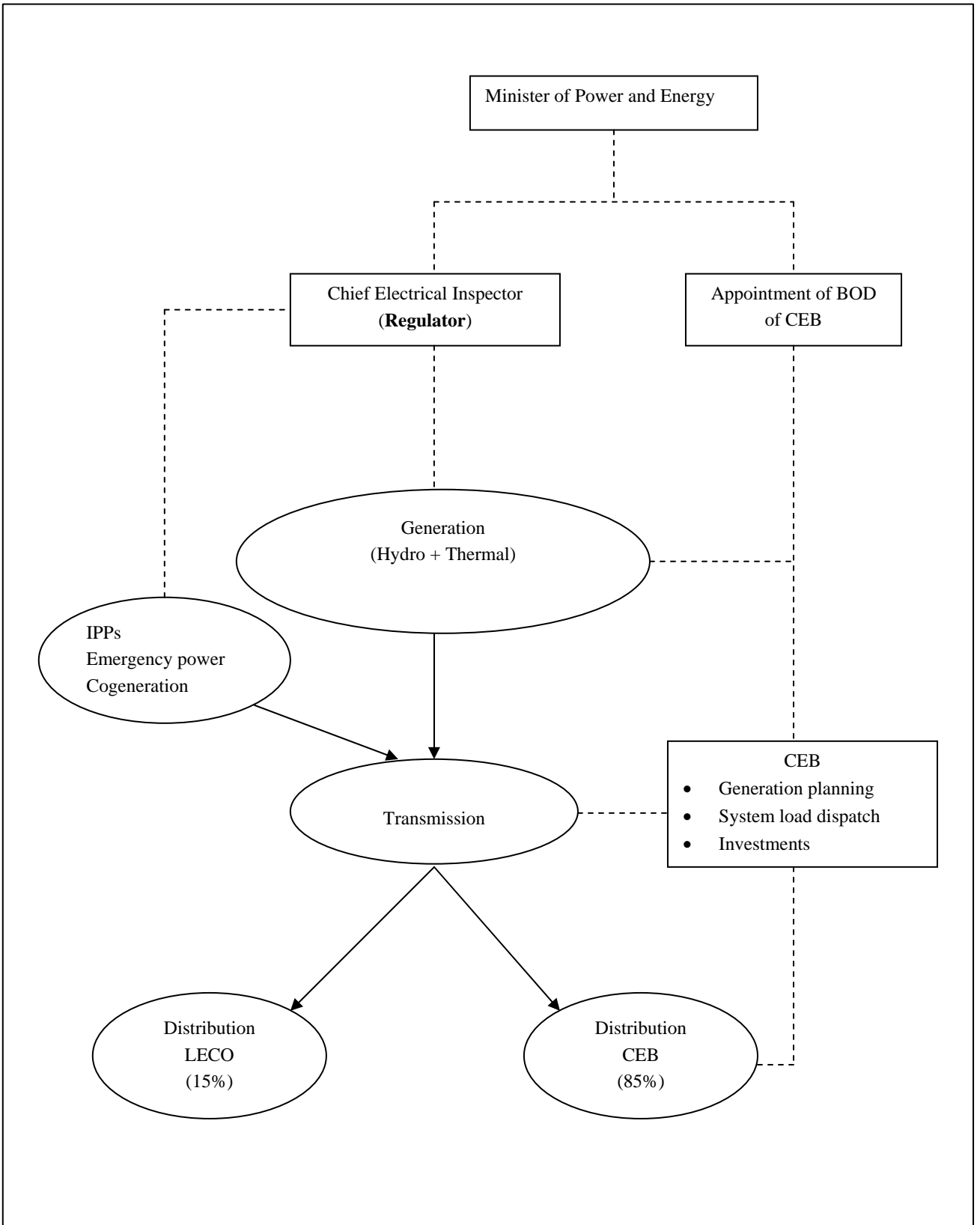


Figure 6: Current Structure of the ESI (The arrows show the power flow and the dotted lines show the control or regulatory activities)

classification.<sup>25</sup>

### 2.2.1 The CEB

The CEB was set up in 1969 as the national power utility. At the time of writing the CEB still operated as a monopoly and according to the last published accounts employed a staff of around 14.3 thousand and had a customer base of around 2.7 million.<sup>26</sup> Control of an organisation this big is often very difficult, with no clear incentives for management to perform better. The hiring and firing is difficult due to bureaucracy and powerful workers' unions.<sup>27</sup> Furthermore, given the monopsony position the CEB has strong bargaining power that arguably causes problems such as one-sided fuel contracts with the fuel supplier Ceylon Petroleum Corporation (CPC). In addition, given its strong position the CEB is arguably ignorant of the environment norms and standards. This all creates economic inefficiencies and environmental problems. The Board of Directors (BOD) of the CEB are currently direct appointees of the minister of power and energy; and the GOSL has the power to hire and fire the BOD directly and top management indirectly in the CEB. As the sole shareholder, the GOSL has a fundamental right to appoint the BOD, which has arguably resulted in too much political intervention in the sector and discontinuity in the planning at top level at regular intervals. Due to bureaucracy and high level of political

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25 Hunt and Shuttleworth (1996) identified four basic models for an ESI. Obviously, in practice structures may deviate in particular ways and circumstances, but ultimately most existing structures can be incorporated in these 4 models. They depend upon the varying degrees of monopoly, competition and choice for consumers. Model 1 is where a single monopoly company/utility handles generation, transmission and distribution which is known as "monopoly at all levels". Model 2 is where competition is introduced in generation, which is known as "single buyer model" or "purchasing agency". In addition to competition in generation in Model 3 there is open access to transmission wires so that distribution companies can buy directly from the generators. This is known as "wholesale competition"; thus competition is at distribution level. Model 4 is where competition is introduced to retail market. Hence the distribution is separated from the retail supply. This permits ultimate choice to all the customers to select their suppliers and is known as "retail competition". See Hunt S, Shuttleworth G, *Competition and choice in electricity*, 1996, Wiley, New York, USA. Bhattacharyya (1995) describes a fifth model, which is a publicly owned monopoly with an operation and management contract to a private party. To promote better management, the utility's operation and maintenance is contracted out to a private party (third party) but the ownership still remains with the state. Examples are the model existing in Ivory Cost. See Bhattacharyya S C, "Power sector privatisation in developing countries: Will it solve all problems?" *Energy Sources*, Vol. 17, 1995, pp 373-389.

<sup>26</sup> *Ceylon Electricity Board, Annual Report, 1999* (CEB AR, 1999).

<sup>27</sup> There are two strong workers unions in CEB. They are CEB Workers' Union and CEB Engineers' Union.

intervention there is a lack of accountability in the sector.<sup>28</sup> E.g. there is no single department or person in the CEB who is accountable for the delay in execution of the generation expansion plan.<sup>29</sup> However it could be argued that the CEB is one of the best-managed government owned entities in Sri Lanka<sup>30</sup> although it did have some financial losses due to the high oil bill and insufficient tariff to cover its costs in the early 2000s.<sup>31</sup> The CEB handles the system dispatch activities and its generation planning branch prepares the Long Term Generation Expansion Plan (LTGEP) and the transmission and the distribution planning divisions prepare their system expansion plans respectively to cater for the LTGEP commitments. Apart from these main functions, as a government owned utility the CEB is required to provide ancillary electricity services to government buildings, hospitals, security and street lighting on non commercial basis.

### **2.3 Sector regulation**

The legal regulatory framework of the sector is facilitated by the Electricity Act No. 19 of 1950 and as amended from time to time.<sup>32</sup> The act specifies that the generation and transmission of electric power is carried out as a public utility (CEB) and the distribution through a licensee under the licence provided by Chief Electrical Inspector (CEI). Any IPPs are required to get a generating licence from the CEI. The administrator of the act or the regulator is the Chief Electrical Inspector who is under the MOPE. But according to PPSPG 2002 this does not function adequately (p. 4).

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<sup>28</sup> David et al., op. cit.

<sup>29</sup> The generation planning branch is traditionally accountable only for academic activities like producing LTGEP every year, but not for execution of such plan.

<sup>30</sup> But still there are lot of inefficiencies in the system although consumers per employee rate is around 157 (CEB AR, 1999) which is in comparison with the internationally accepted standard 160 given in Wamukonya (2003), p. 1277 (Wamukonya N, "Power sector reform in developing countries; mismatched agendas", *Energy Policy*, Vol. 31, 2003, pp 1273-1289).

<sup>31</sup> CBSL AR, 2002.

<sup>32</sup> PPSPG, 2002, p. 4.

## 2.4 The supply side

### 2.4.1 Generation capacity

In 2000 total electricity generation was 6687MWh in order to meet a demand of 5258MWh and average system losses for this period were 21.4%.<sup>33</sup> The country's electricity generation capacity was around 2000 MW<sup>34</sup> in 2001.

### 2.4.2 Hydro power generation

The Sri Lankan system was predominantly a hydropower-based system, but since 1996 there has been a high contribution of thermal generation due to new IPP plants and emergency power. This can be seen in *Figure 7*, which shows the hydrothermal share variation over past years. In 2001 about 60% of installed generating capacity were hydro plants, however in the same year hydro only contributed to around 48% of the electricity actually generated.<sup>35</sup>

The total estimated hydro potential of Sri Lanka is around 2000MW out of which around 1350MW has already been developed. Further exploitation is becoming increasingly difficult due to impacts on the environment and human resettlement. Sri Lanka's hydro plants can be divided into two main complexes namely the Mahaweli system (660MW) and the Kelani System (335MW). Unlike the Kelani system, the Mahaweli system is operated as a multi purpose system and hence power generated from the associated power stations is governed by the down stream irrigation and flood control requirements.<sup>36</sup> *Table 1* gives the details of these plants.

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<sup>33</sup> LTEGP, 2001.

<sup>34</sup> Statistical Digest, 2001, CEB. At the time of writing it is around 2100MW as given by *Table 1* (excluding committed plants, but uncommissioned). But it should be noted that this is the machine nameplate capacity and it is unlikely to be available at any given point in time due to high hydro dependency.

<sup>35</sup> Statistical Digest, 2001.

<sup>36</sup> Ibid.



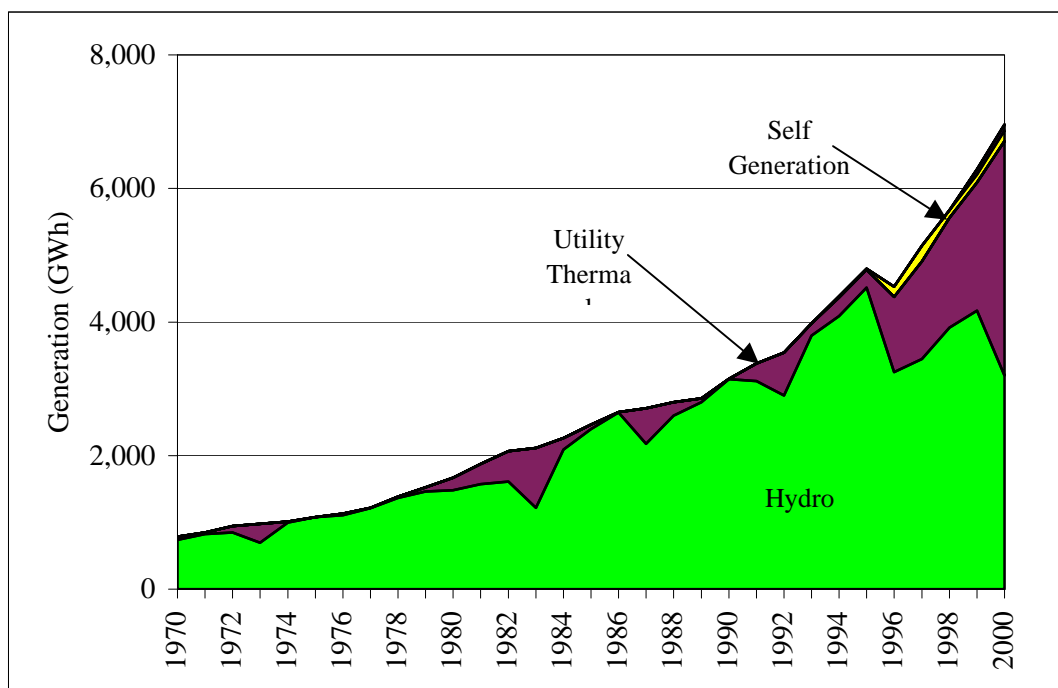


Figure 7: Hydro Thermal share in the recent past<sup>37</sup>

### 2.4.3 Thermal generation

Table 1 also shows that the CEB has about 563MW of thermal power generation capacity, mainly concentrated in two locations namely Sapugaskanda and Kelanitissa within the proximity of Colombo.

### 2.4.4 IPPs

In the mid 1990s the GOSL introduced a new policy package for the power sector aiming to sustain an adequate level of investment in the power sector, by attracting private sector investment. With these latest developments Sri Lanka in late 2003 had around 350MW of IPPs belonging to different developers (see Table 1).

<sup>37</sup> LTGEP, 2001.

Plant Name	Ownership	Year of Commissioning	Capacity (MW)	Annual Avg. Energy (GWh)
<b>Laxapana Complex</b>				
Canyon	CEB	1983,1988	2*30=60	163
Wimalasurendra	CEB	1965	2*25=50	114
Old Laxapana	CEB	1950,1958	3*8.33+2*12.5=50	279
New Laxapana	CEB	1974	2*50=100	467
Polpitiya	CEB	1969	2*37.5=75	409
<b>Laxapana total</b>			<b>335</b>	<b>1432</b>
<b>Mahaweli Complex</b>				
Victoria	CEB	1984,1985, 1986	3*70=210	769
Kotmale	CEB	1985, 1988, 1988	3*67=201	494
Randenigala	CEB	1986	2*61=122	392
Ukuwela	CEB	1976	2*19=38	172
Bowatenna	CEB	1981	1*40	54
Rantambe	CEB	1990	2*24.5=49	219
<b>Mahaweli Total</b>			<b>660</b>	<b>2100</b>
<b>Other Hydro</b>				
Samalawewa	CEB	1992	2*60=120	361
Inginiyagala	CEB	1963	2*2.5+2*3=11	NA
Udawalawe	CEB	1969	3*2=6	NA
Nilambe	CEB	1988	2*1.5=3	NA
Small Hydro Plants	Private		12.25	NA
Kukule (committed)**	CEB	2003	2*35=70	303
Upper Kothmale (committed)**	CEB	2008	2*75=150	530
<b>Hydro Total</b>			<b>1367</b>	
<b>Kelanitissa Complex</b>				
GT (Old)	CEB	1980,1981,1982	6*20=120	600
GT (New)	CEB	1997	1*115	813
Steam Plant	CEB	1962,1963	2*25=50	250
CCGT	CEB	2001,2002	1*165	1253
<b>Sapugaskanda Complex</b>				
Diesel (old)	CEB	1984	4*20=80	488
Diesel (new)	CEB	1997, 1999	8*10=80	444
Small thermal	CEB	1999	1*8	NA
<b>IPPs</b>				
Lakdhanavi	Private	1997	22.5	156
Asia Power	Private	1998	51	330
Colombo Power	Private	2000	64	420

Plant Name	Ownership	Year of Commissioning	Capacity (MW)	Annual Avg. Energy (GWh)
AES	Private	2003	163	1314
Ace Power	Private	2002	2*25=50	272
<b>Thermal total<sup>38</sup></b>			<b>969</b>	
<b>Grand Total</b>			<b>2336</b>	

\*\*Kukule and Upper Kotmale are not yet commissioned.

*Table 1: Details of existing and committed plants<sup>39</sup>*

#### **2.4.5 Under investment crisis in generation**

The very high rate of growth in demand for electricity combined with the variability of the supply of hydroelectricity means that at the time of writing there is an urgent requirement for greater, reliable and more diversified generation capacity in order to ensure security of supply, which was clearly reflected by the severe power cuts that occurred during the 1996 and 2001 drought periods. As a result, the GOSL and the CEB have looked at alternative ways of meeting the anticipated shortfall in electricity.

According to LTGEP the best solution for Sri Lanka's ever-increasing electricity demand and increasing fuel bill is to have a coal fired plant with imported high quality coal from Australia/Indonesia or South Africa. Although there are few ideal sites for this plant, finalising a site took almost 10 years and eventually the coastal site of Kalpitiya (see *Figure 2*) was identified as the location. However the political mandate was never given to this proposed 900 MW<sup>40</sup> coal fired power plant, even after the funding had been approved by the JBIC (Japanese Bank for International Corporation) as a soft loan to the GOSL. This is due to the political sensitivity of the area and the major environmental lobbies against coal. As the planned generation expansion did not kick off due to various political reasons

<sup>38</sup> In addition to these plants there are two main CEB hired power plants namely Aggreko 58MW and Lakdhanavi 21MW.

<sup>39</sup> LTGEP, 2001.

<sup>40</sup> Initially it is planned to build 300 MW and capacity additions of 300MW each at two stages.

the CEB had to go for hired power plants at greater unit costs of electricity. These plants cause more environmental deterioration due to lack of planning for mitigation.

#### **2.4.6 Transmission and distribution losses**

Transmission and distribution losses were around 21.4% in 2000 having increased every year from 1998<sup>41</sup> although the CEB had plans to reduce the losses by 14.6% in the 2009. Since the system Load Factor (LF)<sup>42</sup> is around 55%,<sup>43</sup> there is a very high peak demand than the system average load requirement. Therefore the country needs to pay high peaking power prices in the peak periods.

#### **2.5 Electricity tariff**

The CEB is expected to function as an independent autonomous body from the government and function on sound commercial principles, but is also required to have the tariff endorsed by the government. This often results in a conflict of interest given the desire of the GOSL to keep prices low in order to help attain its social objectives. Hence, there has been significant political influence in tariff setting over a number of years, with prices being less than the cost of supply. Consequently, this has produced two types of implicit subsidies; (a) subsidies between sectors (industrial and commercial consumers subsidise the domestic consumers) and (b) subsidies within the same sector (high demand domestic consumers subsidise low demand domestic consumers). LECO is also governed by the same tariff structure.<sup>44</sup> In 2001 the average real electricity tariff was about Rs. 6.69 at 1996 prices (equal to about 0.06 US dollars) per kWh, *Figure 8* illustrates the variation of

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<sup>41</sup> According to LTGEP 2001, this is attributable to the increase in un-metered connections during last few years, with nearly 230,000 new customers getting connected every year.

<sup>42</sup> LF is defined as  $LF = (\text{average load} / \text{peak load}) * 100$  and average load is calculated by  $\text{Avg. load} = (\text{generation (GWh)} / \text{number of hours per year (h)})$ .

<sup>43</sup> LTGEP, 2001.

<sup>44</sup> CEB's tariff to LECO is back calculated so that LECO runs as a profitable company. This can also be thought as another subsidy.

the real tariff from 1970 to 2001. It is interesting to note the price spikes, usually brought about by the ‘political’ tariff setting.

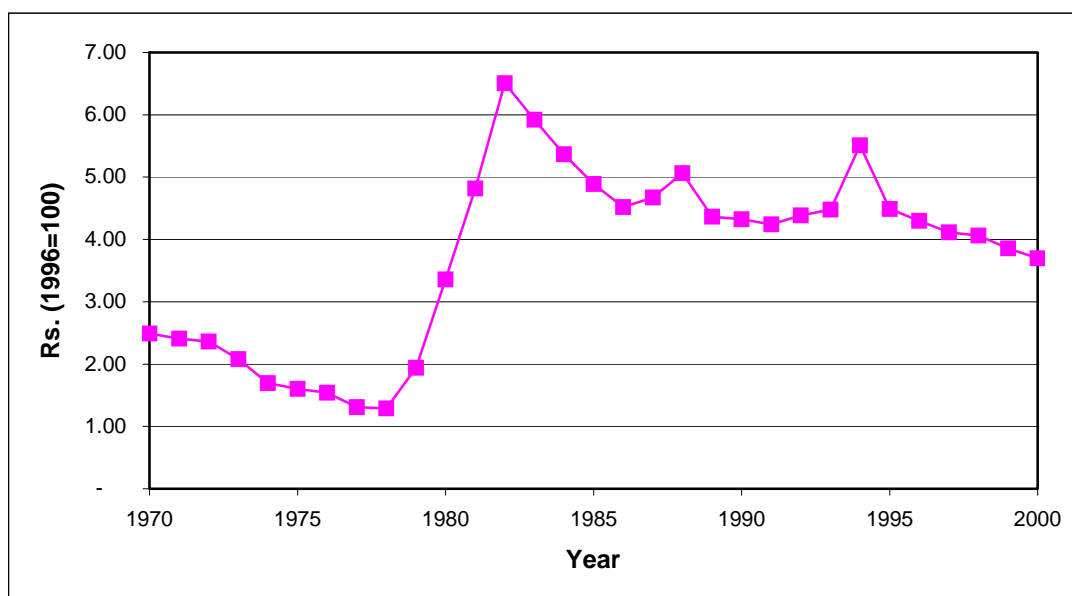


Figure 8: Average Real Electricity Tariff per kWh from 1970-2001

### 3 PROPOSED REFORMS BY THE GOSL

#### 3.1 Introduction

In November 2002 the Ministry of Power and Energy issued the Proposed Power Sector Policy Guidelines (PPSPG) with the basic objective:

“.....to meet the demand for electricity at all times at least economic, social and environmental cost and thereby promote economic development and social well-being”<sup>45</sup>

Furthermore, the guidelines highlight the vision of the power sector as:

- Creating an efficient and dynamic power sector to facilitate rapid economic growth.

<sup>45</sup> PPSPG, 2002, p. 1.

- Having at least 80% of the population accessible to electricity grid at affordable prices.
- Having a cost based tariff and a reliable supply to industrial sector to sustain their competitiveness in respective international markets.
- Having a power sector which will operate with sound commercial and business like principles with a non-monopolistic structure.
- Having a substantial private sector investment in the power sector.
- Having a reliable electricity transportation system with loss levels reduced to internationally acceptable levels.
- Having a transparent regulatory process to be established that will safeguard the interest of all the parties including customers, investors and environmentalists.<sup>46</sup>

Therefore creating competition, attracting private investment and improving efficiency are the major driving forces behind the reforms.

### **3.2 Restructuring**

It is proposed that the power sector reform process in Sri Lanka as announced by the Electricity Reforms Act of 2002 (Reforms Act) will start with the restructuring of the sector. It is not expressed anywhere in the documents that the restructured companies are to be privatised although the Act does provide provisions for future privatisation.<sup>47</sup> But the proposed policy guidelines express the concern of MOPE about increased private sector participation. However it is proposed that the restructuring ensures that the new companies will be more independent, efficient and operate in an economical manner, while ensuring security of supply.

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<sup>46</sup> PPSPG, 2002, p. 6.

<sup>47</sup> "...the Committee shall discharge its functions under subsection (4) in relation to a successor Company, only so long as the Government owns at least fifty per centum of shares of that successor company" - Section 50(5) (p. 48) of the Reforms Act (2002). This implies that the government has provided provision for future privatisation .

The GOSL plans to separate out its role as the owner, operator and regulator of the electric power sector, with each role clearly defined and separated.<sup>48</sup> The proposed new structure for the Sri Lankan ESI is illustrated in *Figure 9*. This shows that the proposal is for all the CEB's hydro and thermal power generation stations to be transferred to a new generation company, which will be in charge of all hydro and thermal stations. This company is referred to as Genco hereafter.

It is also proposed that all transmission activities of the CEB are transformed to another newly formed company. This company is referred to as Transco hereafter. It is implied from Section 42 of the Reform Act that bulk power trading, dispatch, transmission operations and investment decisions in future generation (long term generation planning) and tendering for such plants will be the responsibility of Transco. Therefore it is evident that any investment decision whether public or private should only be taken in accordance with this LTGEP, which is prepared by Transco.

Furthermore the proposal is for all distribution activities including LECO's area, to be divided in to 3<sup>49</sup> or more distribution companies by area and act as regulated local monopolies (these companies are referred to as Distcos hereafter<sup>50</sup>). Although it is now understood that there will be 5 distribution companies, as shown in *Figure 10*. In addition there is a provision in the proposals to form another company, known as the CEB residual company (shown as company 8 in *Figure 9*), to take care of other ancillary duties of CEB.<sup>51</sup>

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<sup>48</sup> PPSPG, 2002, p. 11.

<sup>49</sup> PPSPG, 2002, p. 11. But in the same document in p. 15 it says that a minimum 4 distribution companies will be set up.

<sup>50</sup> Genco, Transco and Distcos will be Public Companies under *Public Company Act No. 23 of 1987*.

<sup>51</sup> This company will act as an intermediate company and then will be dismantled once these functions can be taken care of by other means.

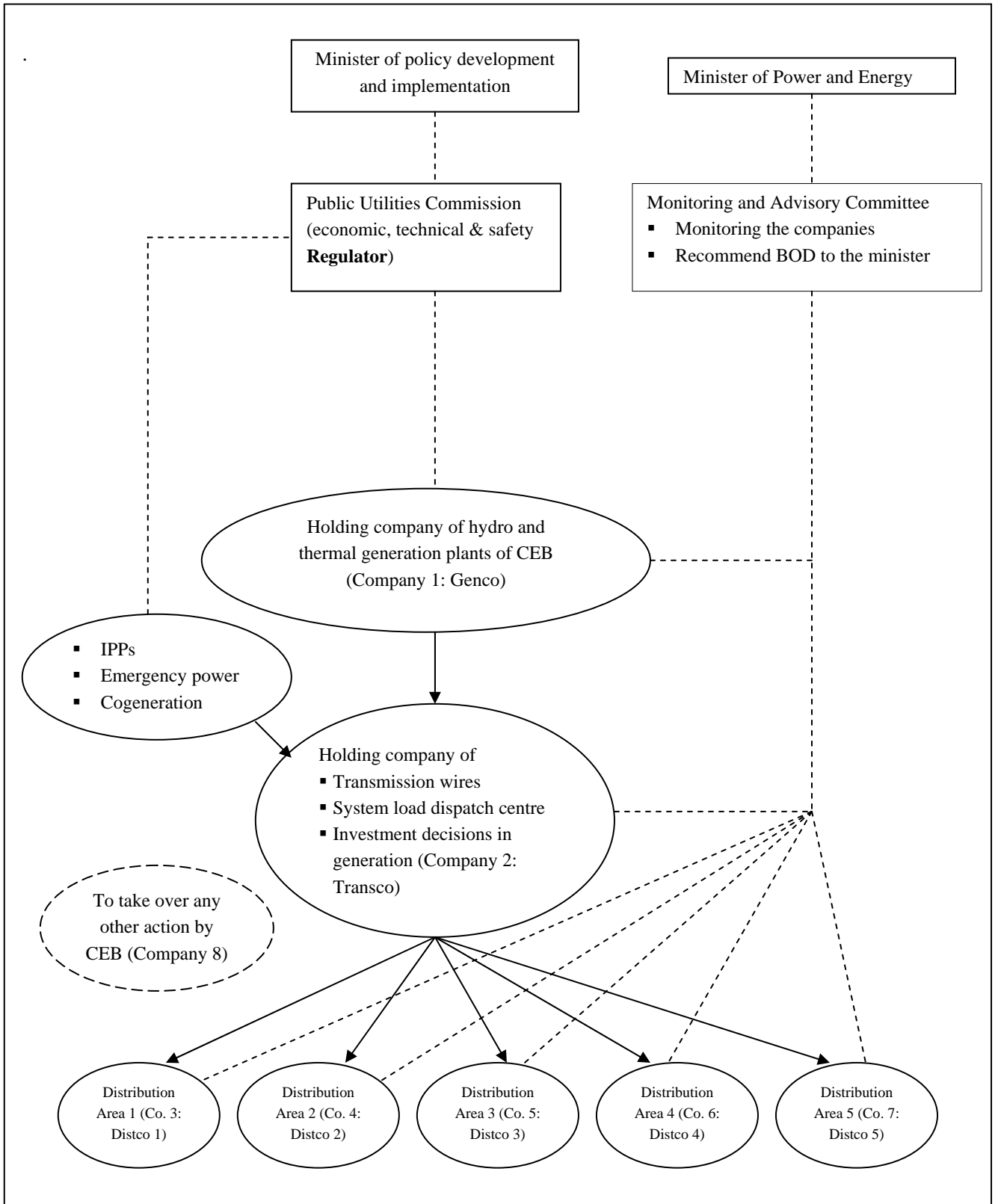


Figure 9: The GOSL's Proposed Structure of the ESI (The arrows show the power flow and the dotted lines show the control or regulatory activities)



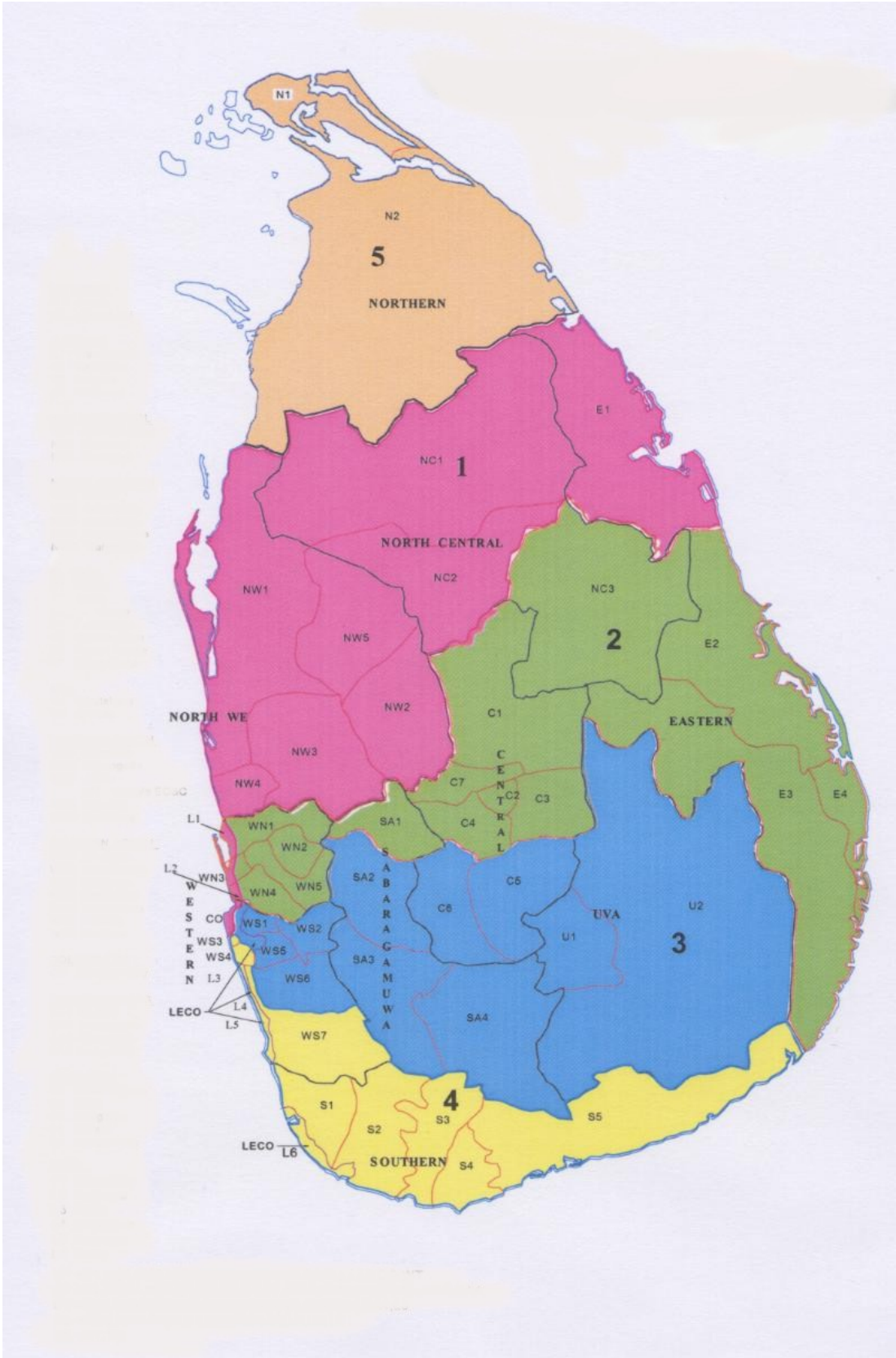


Figure 10: The GOSL's proposed Distco boundaries

According to the proposals, directors of any newly formed company will be appointed by the minister of power and energy under the recommendation of Monitoring and Advisory Committee (M&AC) which will be a monitoring body for financial and operational performances of the companies as far as government owns at least 50% of shares of them. Finally, it is proposed that the existing and new IPPs, emergency power generators (as far as there is a system shortage of power) and co generators will also supply power to Transco, apart from the main publicly owned generator. In summary the proposed structure for Sri Lanka would be similar to Model 2 of Hunt & Shuttleworth (1996) classification with vertical deintegration, but with limited provision for future competition in generation.

### **3.3 Regulation**

It is proposed that all companies in the power sector will be subject to economic, technical and safety regulation by the Public Utilities Commission (PUC), which is a body, constituted by the Public Utilities Commission of Sri Lanka Act No. 35 of 2002.<sup>52</sup>

The PUC will act as the regulator of the electricity sector in Sri Lanka particularly for the objectives given below:

- Protect consumer interest by promoting efficiency improvements.
- Regulate tariff and charges.
- Ensure all reasonable consumer demands are met.
- Ensure that all efficient licensees are able to finance their activities as demanded by their licence conditions.
- Promote efficient use of electricity.

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<sup>52</sup> See *Public Utilities Commission of Sri Lanka Act No. 35 of 2002*.

- Promote safety in electrical systems.
- Protect environmental norms from electrical activities.
- Promote Competition.
- Benchmark power sector companies with international standards.<sup>53</sup>

### **3.4 Tariff**

Both transmission and bulk supply tariffs as well as distribution and retail supply tariffs shall be applicable as given in licence conditions and according to the proposals, the tariff should be set by the Distcos and Transco and approved by the PUC and should adequately reflect costs. According to the Reforms Act the companies will be permitted to recover all reasonable costs (as authorised by the PUC) they incur when carrying out such services in an efficient manner. If the PUC sets tariffs which may require the company to subsidise any group of consumers the PUC will make sure that the GOSL compensates the licensee for such subsidies and the GOSL has an adequate provision for such subsidies. The tariff policy is based on the following principles.

- The tariff will be based on sound commercial principals, i.e. the customers have to pay the cost they make on the system.
- Assurance of price stability at reasonable levels.
- The tariff should generate sufficient revenues for the financial investments of the sector.
- Tariff structure should be simple and should facilitate metering and billing.
- Assurance of at least minimum level of services to low income domestic customers (but when it is economically feasible).<sup>54</sup>

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<sup>53</sup> Section 4 of the Reforms Act, 2002 and Section 14 of the PUC of Sri Lanka Act, 2002.

<sup>54</sup> PPSPG, 2002, p. 14.

### **3.5 Private sector participation**

The policy guideline specifically states that the private sector will play a key role in the power sector, but as explained below the private participation is not encourage in some areas of the ESI. The thermal additions will continue to seek private sector financing on a Build Own Operate (BOO) or a Build Own Transfer (BOT) basis. It is proposed that public finance, including concessionary loans, will only be utilised for the improvement of general infrastructure of the thermal power projects.

As part of the proposals Transco will produce the LTGEP as a least cost, reliable and environmentally acceptable generation expansion plan. The projects identified in such a plan will then be tendered out accordingly. In addition, there is a provision for private proposals (which are referred to as unsolicited proposals in the PPSPG) if such proposals are based on alternative sources of energy and new technology which are more cost effective than the other forms of energy.

Furthermore, there is provision for major hydropower generation (more than 50 MW) to be developed to its full potential and function under the newly formed Genco. It is proposed that Genco should remain under government control for the foreseeable future, although medium hydro (from 10MW to 50MW) projects will be open to the private sector on a 20 year BOT basis. However the policy guideline prefers the new medium hydro plants to be owned by the Genco.<sup>55</sup> Only mini and micro hydro projects will be 100% open to the private sector. The proposals encourage the private sector to develop all renewable energy<sup>56</sup> up to a ceiling of 10% of total Sri Lanka electricity demand. However there is no justification for this arbitrary ceiling.

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<sup>55</sup> The reason given is the importance in hydro electricity as the only indigenous source of energy and complications in having to agree on a minimum availability with an IPP. It is however noted that there are number of hydro IPPs throughout the world.

<sup>56</sup> Referred to as non-traditional energy in the PPSPG, 2002.

Having outlined the key proposals for reform, the following section analyses them in more detail.

#### **4 EVALUATION OF THE CURRENT SITUATION AND PROPOSED REFORMS**

It is shown in the Appendix that the Sri Lankan power sector requires rapid system expansion over the next couple of decades. *Figure 11* illustrates the forecasts up to 2020 based on the estimation given in the Appendix with three scenarios plus the CEB LTGEP (2001) projections. It can be seen that the base case scenario is very similar to that of the CEB projection, however, the high and low cases show that there is potential for a substantial difference depending on the outcome of Sri Lanka's economic growth over the next two decades.

This suggests that a capacity addition of around 125 – 250 MW is required every year from 2002 to 2020 (as shown in *Table A3* in the Appendix). Even if electricity demand is as given by the low case scenario then there would still need an additional capacity of 75 – 165 MW per year. This increase in capacity needs to be coupled with the necessary transmission and distribution network expansion. With this backdrop the problems with the current system are re-considered along with the proposed changes by the GOSL.

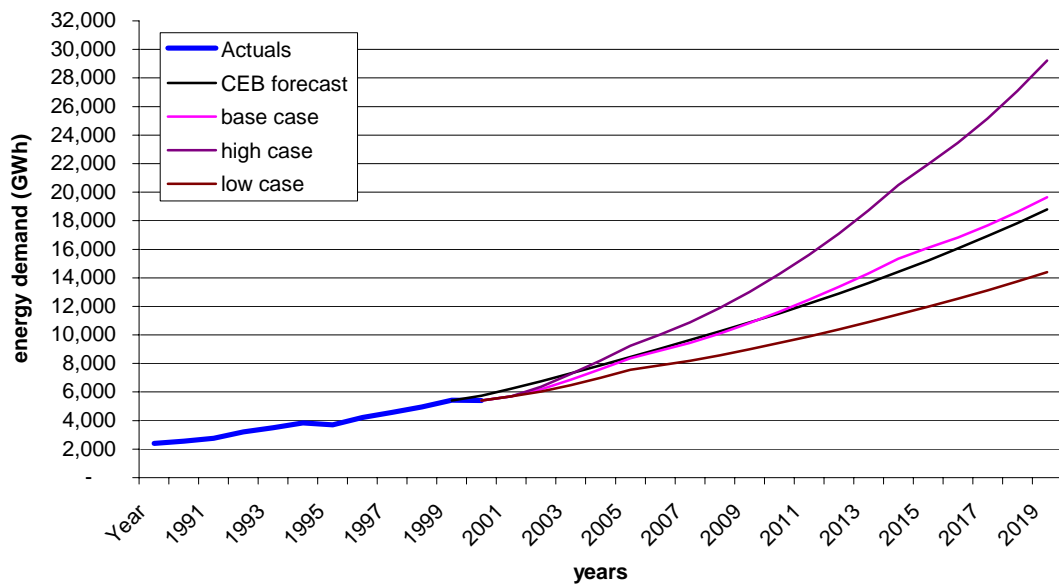


Figure 11: Comparison of forecasts

#### 4.1 Are there more problems with the current system than those identified by the GOSL?

Section 2 above highlighted the perceived problems by the GOSL with the current system of operating the ESI, but arguably the problems are more severe and go much deeper. In particular:

- The CEB is too large and not well managed. In 2002 the CEB employed over 14 thousand people with control and organisation becoming difficult.
- The CEB's deteriorating financial position and decreasing performance will continue unless significant action is taken soon.
- The lack of accountability within the CEB without proper regulation will lead to further problems unless action is taken soon.
- The Government still intervenes in the operation of the industry, with all the problems this entails as seen in many other countries over many years.

- There is significant under capacity in generation and investment in the network, as illustrated by the scenarios presented in the Appendix.
- The tariff remains subsidised and does not reflect the ‘economic’ cost of production.

## **4.2 Do the GOSL’s proposed reforms go far enough?**

Given the above, we are of the opinion that the GOSL’s proposed reforms do not go far enough.

### **4.2.1 Restructuring**

Although the proposed reforms, outlined in section 3, would result in the vertical separation of the CEB with a number of smaller companies replacing the existing ‘large’ monopoly, Genco and Transco which will be public companies, initially owned by the government with no immediate plan for privatisation (with the plan to keep Transco as a state owned company for the foreseeable future) will still hold significant influence in the ESI. It appears that the Genco will behave almost as a monopoly in the proposed structure due to its superior size. It holds about 75% of current generation capacity and all the hydro stations and old thermal stations where marginal cost (MC) of operation is lower. This may make Genco superior to other generators. Transco will be able to make powerful decisions like system control and deciding on the future generation options in addition to transmission activities. This may create a conflict of interest of Transco’s transmission business and LTGEP activities. Therefore although the vertical unbundling is consistent with electricity reforms in a number of countries and would appear a sensible development, the detail of the changes requires further examination.

With the five ex-officio members (apart from the three members appointed by the minister), the M&AC should be more independent<sup>57</sup> since it reduces the chances for

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<sup>57</sup> Because the five ex officio members are non political appointees.

political interference. Therefore proposed new arrangements for appointing the BOD of the new publicly owned companies (as explained above) will mean that the power of the minister will be curtailed to some extent but arguably the reforms do not go far enough.

It is widely accepted that restructuring of electricity sector should happen before privatization.<sup>58</sup> The proposed power sector changes in Sri Lanka do follow this sequence. Also it is acknowledged here that the importance of political leadership and government willingness are required if the goals set for the Sri Lankan ESI are to be achieved. Bacon (1995)<sup>59</sup> mentions that governments are the fundamental agents for reforms. However in the context of current restructuring of the ESI in Sri Lanka it is doubtful that such a political mandate is given apart from mere pressure from multilateral lenders.

The proposed Distcos will have access to a similar geographical portion of the load centre western province and the remote rural areas of the country in order to ensure that they all have the same cross section of consumers. But this could well create more complicated problems and an additional burden on the system, which is discussed, in more detail in Section 5.

#### **4.2.2 Regulation**

In developing countries like Sri Lanka the credibility and the independence of the regulator is very important as described in Bell (2000).<sup>60</sup> Arguably, the proposed regulator PUC should create such confidence in the way it is structured.

The regulator will be appointed by the minister of policy development and implementation<sup>61</sup> with the concurrence of the constitutional council.<sup>62</sup> Therefore arguably

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<sup>58</sup> Tenenbaum B, Lock R, and Baker J, "Electricity privatisation; structural, competitive, and regulatory options, *Energy Policy*, 1992, pp 1134-1160.

<sup>59</sup> Bacon, R W "Privatisation and reform in the global electricity supply industry", *Annual Review of Energy and the Environment*, 20, 1995, pp 119-143.

<sup>60</sup> Bell M, "Regulation in developing countries is different: avoiding negotiation, renegotiation and frustration" *Energy Policy*, 2003, pp 299-305.



the PUC is structured as a supreme and a credible committee appointed by a distinct authority, compared to the CEI who is under the same ministry. This will make the regulatory arm separate from the operations arm. But again, in our view the proposals do not go far enough. Although promoting competition is one of the statutory duties of the regulator it is however not clear how it is going to be implemented given the very powerful position of Genco and Transco.

### **4.2.3 Tariff/Prices**

The proposed policy does recognise the need for electricity tariffs to cover the operating costs and future investment in the sector. It is proposed that the all cross subsidies will be eliminated or separately supported by the government without burden to any other consumer or sector companies. This should ensure that the new companies are financially viable. However it is not yet clear how the prices/tariff for electricity are to be regulated and will be decided by the PUC, although it would appear that price cap regulation is to be favoured over ROR regulation.<sup>63</sup>

### **4.2.4 Privatisation**

It seems that the privatisation in the newly formed companies will not be encouraged immediately, although there is a vague provision in the act. Perhaps it would have been more prudent to keep relevant private participation options clearly identified because this will avoid necessary amendments to the Act at the time of private participation in the future. Nevertheless new thermal generation is open to the private sector, although there are limitations in private participation in hydro generation (except mini and micro hydro), transmission and distribution activities. The private sector is encouraged to invest in

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<sup>61</sup> Traditionally this post is held by the head of the state. Currently this role is assumed by the Prime Minister and hence arguably the credibility level is high.

<sup>62</sup> Constitutional Council is a committee appointed by the parliament of Sri Lanka.

<sup>63</sup> Rate of Return Regulation is proven to be a failure in the state of Orissa, India where a similar structure is implemented.

renewable energy technologies and in rural electrification however there is no clear plan as to how the incentives are to be provided to encourage private participation.

In summary; it is our view, that the proposed policy guidelines are not the best available remedy for the crisis situation of the Sri Lankan power sector. Arguably the GOSL proposals will not ensure that the goals of the sector (to meet the demand for electricity at all times at least economic, social and environmental cost to promote economic social development of the country) will be met.

## **5 ALTERNATIVE PROPOSALS**

### **5.1 An alternative structure**

It is our view that vertical separation of the sector as well as horizontal separation of generation and distribution to introduce as much competition as possible, (consistent with basic economic theory) is required to solve the concerns discussed in Section 4. To ensure competition in generation develops quickly it is vital that there are a number of relatively equal sized companies established. According to Green (1996)<sup>64</sup> it is important to avoid the mistake made in the UK where the development of competition in generation was hampered due to the inadequate split of the old CEB at privatisation.

Therefore our proposed 'alternative structure' for Sri Lanka is to break up the CEB generating stations into smaller economically viable business units as illustrated in *Figure 12*. The CEB's hydro plants should be separated to form three different companies. From a location perspective the division of Mahaweli and Kelani hydro systems to two generating companies is suitable. Also since they are independent cascading systems there can be no significant effect of one plant operation to the other. All other hydro systems namely Samanalawewa (120MW) plant and Kukule plant (70MW) together with other

small hydro plants should form another company. Proximity wise Kukule and Samanalawewa are not as close as desired and the other small plants are scattered all around. But arguably this alternative proposal would allow generation to be split into manageable smaller units.

Furthermore the thermal generation of CEB should, in our view, be divested in to different companies by location and technology. Sapugaskanda power station (144 MW), which includes CEB owned Diesel generators, should form a separate company. The Kelanitissa complex should be divided in to two companies. The old stations including GT(old), GT(new) and steam plants (which are scheduled to be retired) should form one company (with around 250 MW capacity) and the new 165MW CCGT should form a separate company.<sup>65</sup>

Therefore, as described above, the CEB owned power stations should be broken up in to 6 companies to enhance the development of competition. The transmission company should be a completely separate entity, which should be responsible for bulk power trading (to start with), transmission operations and economic dispatch. Unlike the GOSL proposals, it is our view that the LTGEP function should be removed from Transco. Instead this function should be undertaken by the regulator (PUC). This will address the conflict of interest discussed above and make sure this important aspect of ESI is under direct supervision of the regulator.

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<sup>64</sup> Green R, "Reforms of the electricity supply industry in UK", *The Journal of Energy Literature*, Vol. II (1), 1996, pp 3-24.

<sup>65</sup> There are two reasons to suggest that the CCGT as a separate company. Firstly it may create a good comparison with the similar private CCGT plant (AES Plant), with same technology specifications, at the same proximity. Secondly most of the new power plant additions in Sri Lanka will be CCGTs hence it can be arguably expected that creating competition among CCGTs will force them to make more onerous efficiency gains.

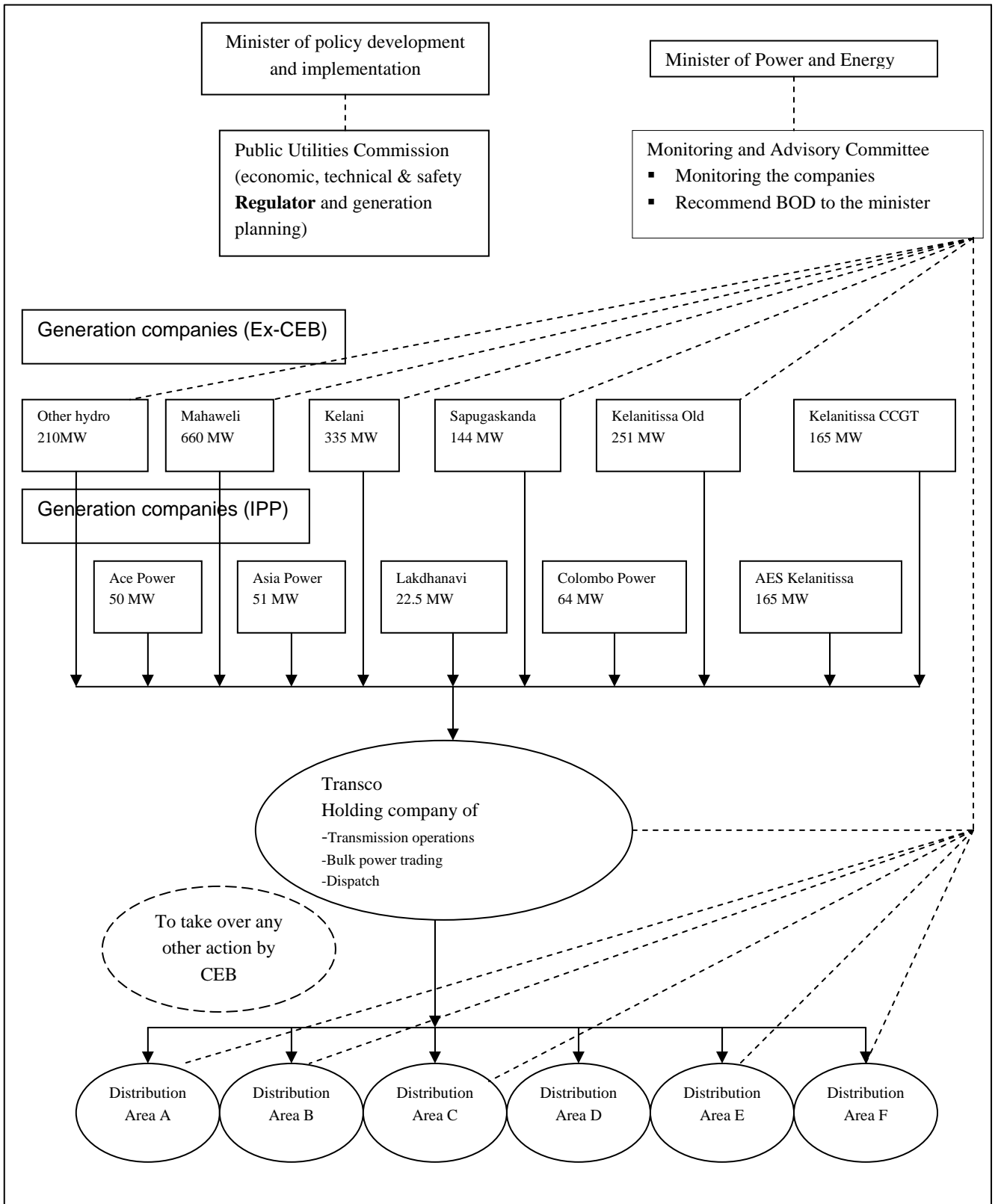


Figure 12: Proposed Alternative Structure for the ESI (The arrows show the power flow and the dotted lines show the control or regulatory activities<sup>66</sup>)

<sup>66</sup> The control of M&AC over the companies applicable only when the GOSL holds management control.

It can be argued that the proposed distribution company division has a number of flaws. Sri Lanka is administratively divided into 8 provinces and electricity is one of the services where concurrence of the Provincial Council is required. In the GOSL proposals every distribution company is spread across the country and they need to deal with number of local authorities and every local authority has to deal with number of distribution companies. This could well create administrative problems, unnecessary political stress and cumbersome administrative procedures resulting in additional cost burdens to the consumer. However it may not be appropriate to have every province declared as a separate distribution company since it may create unattractive companies and higher costs due to more information requirements. Also the current proposal of segregation of Distcos involves an excessive amount of accounting and physical asset separation. Therefore this separation can be done smoothly and less costly if the segregation is done by separating the companies by the divisions already identified by the CEB for its operational purposes.<sup>67</sup> Hence it is proposed here that the distribution companies should be divided as illustrated in *Table 2* and *Figure 13*.

*Table 2* illustrates that according to percentage revenue and sales this division is almost even, except for company F. North and Eastern Provinces should be separated due to the high political unrest in these areas due to terrorism. Also the new funding is expected to rehabilitate the systems and increase electrification after the ceasefire agreement between the terrorists and the GOSL. The funding and rehabilitation work should be easily handled by one company.

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<sup>67</sup> Sri Lankan distribution system is divided currently in to 11 areas for administration purposes namely; Colombo City, Western (South) Western (North), North Western, Central, North Central, Southern, Uva, Sabaragamuwa, Northern and Eastern.

Company	Area	No. of customers (%)	Sales in GWh (%)	Revenue (%)
A	Colombo City,	4.4	13.8	18.6
B	Western (North)	13.3	20.6	19.9
C	Western (South)	13.3	23.7	21.5
D	Central, North Central, North Western	33.6	21.1	20.8
E	Southern, Uva and Sabaragamuwa	28.2	16.6	15.4
F	North and Eastern	8.0	4.2	3.8

(All the divisions are as identified by CEB for operational purposes)

*Table 2: Details of alternative proposal for Distcos<sup>68</sup>*

In terms of the number of customers the distribution is biased towards the two geographically large companies (D and E) but these would have a wide dispersion of customers with a low per capita consumption (most of the rural electrification schemes are under these areas); in contrast to companies A, B and C that would enjoy a highly dense population with higher consumption rates. But by proper comparative regulation these company performances can be assessed giving due considerations to the adverse conditions of company D, E and F<sup>69</sup> and the dominant position of company A. In our opinion, the alternative distribution company proposal is the best way to address the above administrative constraints.

## 5.2 Privatisation

To attract private investment and to reduce inefficiency and the ever-increasing GOSL PSBR requirement (due to the power sector), we argue that the privatisation of the sector is desirable and inevitable; as quoted in Tanenbaum et al. (1992) “When the state owns, no

<sup>68</sup> The data were taken from Statistical Digest, 2001.

<sup>69</sup> Though company F is a special case as explained above.

body owns; and when nobody owns, nobody cares” (p.1).<sup>70</sup> There is a general acceptance that private ownership leads to cost reductions and efficiency gains.

However some of the companies may not be attractive enough for privatisation but management contracts may be introduced in the event if privatisation fails.<sup>71</sup> This might be expected in the old CEB plants and distribution companies D, E and F.

In Sri Lanka, power sector privatisation has inherent opposition from the CEB workers’ union as well as the engineers’ union, which are very powerful bodies within the current structure. But given our proposals it would result in at least 10 new companies, that should lead to less resistance from trade unions.

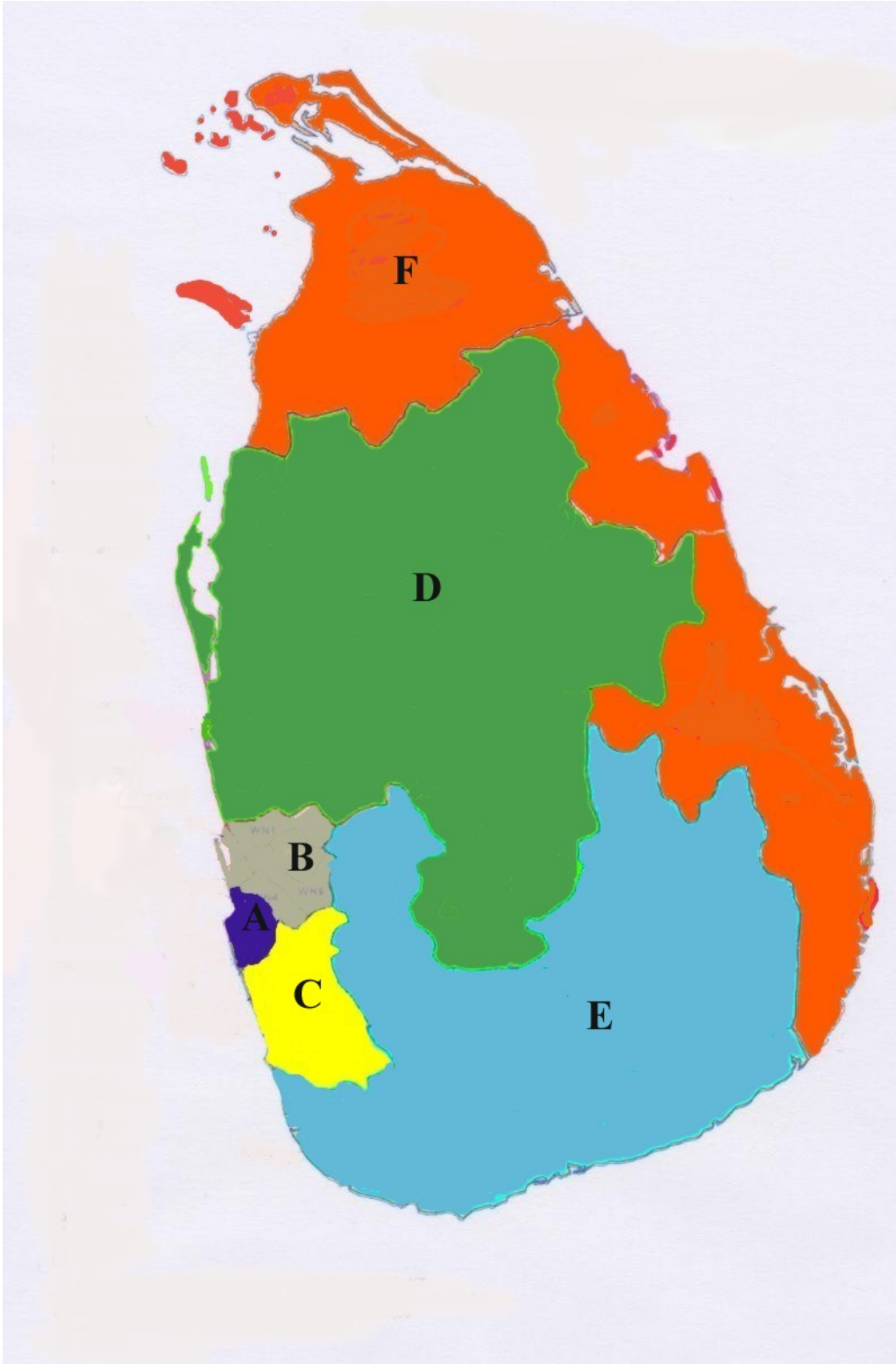
We argue that in a less advance power system like the Sri Lankan system it should not be desirable to privatise in the same way as elsewhere in the world in more advanced systems. Therefore we propose a phased partial privatisation with private management. It is understood that the market conditions has to be sufficiently attractive for private investment. Also due to the current economic storm going through the IPPs and other power sector investors<sup>72</sup>; in the near future it may be hard to attract foreign investment to a small ESI like the Sri Lankan system. In our view, local investment should be exploited as much as possible especially in the distribution sector where in general the network, although not perfect, is well established. Also listing of the companies in the Colombo Stock Exchange may help them raise money for necessary investment (however some of the companies may not be attractive enough).

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<sup>70</sup> Tenenbaum et al., op. cit. Tanenbaum et al. quotes this from Putnam, Hayes and Bartlett, *Report on Conference on Reconstruction/Privatisation*, Moscow, 4-5 Spetember 1991, pp. 3-5.

<sup>71</sup> Parts of the business like maintenance work, repair, operations and construction etc may be attractive for the private sector. Badelt and Yehia (2000) identified 4 ways to create private participation in ESI. They are management contracts, leasing, concession and divestiture. For details see Badelt G, Yahia M, “The way to restructure the Lebanese electric power sector: a challenge for the transitional management” *Energy Policy*, Vol. 28, 2000, pp 39-47.

<sup>72</sup> Especially after the Enron collapse in late 2001 and Alsthom bankruptcy in mid 2003.



*Figure 13: Alternative geographical division of the distribution companies*



The existing generation companies should be privatised partly with the management rights or operational contracts to the private investor. The other advantage is that when the government privatises parts of the business, and the privatisation has the desired effects, it may increase the share prices of the company. At this point any subsequent divestiture by the GOSL can make additional money.<sup>73</sup>

In the privatisation of the existing thermal generation; proper Fuel Supply Agreements (FSA) for supply of fuel has to be written in a bankable way. The risk allocation may be very complicated. A proper way of risk mitigation has to be addressed at least for the initial years of deregulation. Out of the five distribution companies the first three (A, B and C) will be very attractive to a private investor and also D and E may be for some extent to local private investors. But the company F may remain government owned for a foreseeable future. The distribution company privatisation also should be done in stages.

For transmission we do not agree with the view of David et al. (2002) or that of the GOSL, that the new Transco should remain in the public sector. Although there might be a case for the GOSL to continue to own the majority of shares in the short run, we see no reason why it should not be privatised during the medium to longer term when the new structure matures.

It is important to make sure that all the physical and accounting separations of assets are completed and all the audited accounts are approved for all the divested companies before privatisation. This can be a very lengthy process. But success of the privatisation depends to a large extent on the rigorous and accurate execution of this process.<sup>74</sup>

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<sup>73</sup> Green R, "Lessons from electricity privatisation in UK", *Pacific and Asian Journal of Energy*, Vol. 5(2), 1995, pp 235-247.

<sup>74</sup> At the time of privatisation in the State of Orissa, India, the asset finalisation and the accounting for segregated companies were done only provisionally and this caused litigation and unnecessary administration hurdles for the newly formed companies.

### 5.3 Regulation and competition

Section 5 of the Reforms Act gives power to the minister of power and energy to forward general policy guidelines in the power sector to the cabinet for approval. The PUC need to take such guidelines into consideration when discharging functions. Unfortunately such an arrangement is likely to interfere with the PUC's independence. In our view this section of the Act should not be required to be implemented unless absolutely necessary.

It is alternatively proposed that the best way to create more competition is in the generating sector. The generating companies will be encouraged to compete with each other; however due to under capacity in generation this may be seen only in the off peak and favourable hydro conditions. There is a reasonable apprehension that the bulk consumers will negotiate with the low cost hydro and old thermal generators for cheaper electricity contracts than the average cost of electricity production in the country. Hence the low demand domestic customers may have to pay for expensive power. On the other hand with the horizontal separation the take or pay obligations given to IPPs may need to be assigned to a credible source of electricity demand. Therefore in the first few years<sup>75</sup> the IPP obligations should in our opinion be passed on to Distco A to C<sup>76</sup> proportionately. However when the gap between supply and demand reduces full competition in generation should be created with minimum regulation.

We expect that the regulator would encourage efficiency gains in all the functions of the sector. Namely investment decisions, decisions on best choice of fuel, right location and right timing. Also efficiency in production and investment, electricity conservation and allocative efficiency (i.e. the products are allocated to the consumers who value them most

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<sup>75</sup> May be at least till the IPPs manage to clear there long term debts fully.

<sup>76</sup> Since Distcos A to C has the consumers with best paying capacity.

(Hunt and Shuttleworth, 1996)) to be encouraged. Also proper public awareness of the matters related to ESI has to be promoted by the regulator.

#### **5.4 Tariff/Prices**

In our view proper tariff structure which covers costs and investments as well as appropriate incentives for the cost savings has to be provided. It is apprehend that during the first few years the electricity prices for subsidised (currently) customers will rise due to the removal of subsidies. However due to the low price elasticity of demand for electricity in Sri Lanka (-0.3 %, as shown in Appendix) it is thought that this may not be an economic concern though may be an equity and social concern.

The LTGEP aspect should be handled by the regulator by promoting proper generation expansion by way of providing incentives to new addition of power plants at lower cost, and high operational efficiency. The regulator can select the fuel source since Sri Lanka imports all its primary fuels for electricity generation.

#### **5.5 Phasing of changes**

The above has set out a phased approach to the 'alternative' changes as follows:

##### **5.5.1 Period 1**

The generators should be asked to give their LRMC and SRMC for the consideration and the tariff should be set to match the MC. Hence tariff regulation can be linked to MC minus efficiency gains plus Consumer Price Index (CPI), with around 3 to 5 year revisions. The similar type companies (by technology) can be compared by yardstick competition to create artificial competition. The Transco will decide on the dispatch to arrive at a minimum average cost of electricity at the selling end.

Arguably in the same way RPI-X regulation linked to CPI is preferred in transmission and distribution. Empirical studies suggest that price cap regulation is superior to traditional

ROR regulation.<sup>77</sup> Proper incentives to more efficient dispatch will be given to Transco and Distcos. This gives first hand incentives for better performances.

Distcos can be compared with yardstick regulation with RPI-X regime as in the case of the RECs<sup>78</sup> in the England and Wales system. These should incentivise the Distcos with respect to loss reduction (billing), bill collection<sup>79</sup>, meter installation, technical reliability and reliability in billing, less voltage fluctuations and customer care. Parallel to the suggested price cap regulation it is vital that the quality of service in transmission and distribution be regularly monitored by the regulator.<sup>80</sup> Retail competition may not be encouraged in the near future due to high cost involved with it as suggested by Green (1995). He argues that at the starting of deregulation, competition should be introduced only in generation or in supply but not in both cases. Also Tanenbaum (1992) suggested that for the first few years of privatisation it is better to limit competition to only generation part of the business. In summary the structure proposed here is an advanced version of Model 2 as given by Hunt and Shuttleworth (1996).

### **5.5.2 Period 2**

As discussed above in Period 2, open access to transmission grid should begin to help create competition. So the bulk consumer should be given access to the grid up to a limit so that they can have bilateral contracts with the generators. That is, the bulk consumers will have choice in identifying and choosing their buyer. Thus slowly helping to establish competition in generation. Still the Transco and Distcos should be regulated using RPI-X

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<sup>77</sup> Dahl C and Mendonca A F, "The Brazilian electrical system reforms", *Energy Policy*, Vol. 27, 1999, pp 73-83.

<sup>78</sup> Regional Electricity Companies.

<sup>79</sup> There are two types of non-technical losses in distribution. One is the billing as a % of electricity consumption by the Distco (this has technical loss plus billing loss). Second is how much can be collected from the billed amount (this is known as collection loss).

<sup>80</sup> Tenenbaum et al., op. cit.

tariff regime coupled with yardstick competition. Thus the structure of ESI will be Model 3 according to Hunt and Shuttleworth (1996) classification.<sup>81</sup>

## **5.6 Concerns of the alternative proposal**

To help facilitate future competition in generation, take or pay guarantees for new investments should be stopped as soon as possible. But since the country do not even have a long term non recourse credit rating,<sup>82</sup> it is unlikely that international/national investors will be encouraged to build generating stations on their own without take or pay guarantee by the utility,<sup>83</sup> backed by the GOSL. This will be a challenge for competition in generation. However multilateral support and introduction of proper guarantee companies (at present the exposure of this type of arrangements in the world is limited) could be seen as an option for the GOSL.

Another concern is that the uncertainty associated with the impact of the possible deregulation and liberalisation of the petroleum sector in Sri Lanka. It is not clear what the impact will be on the ESI given the high percentage of thermal power generation expected in the future.

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<sup>81</sup> The ultimate aim is to reach Model 4 (Hunt and Shuttleworth, 1996) with choice of selecting supplier at all levels, by separating retail supply and distribution.

<sup>82</sup> Fitch Sovereign Ratings, April 2004, [www.fitchratings.com](http://www.fitchratings.com)

<sup>83</sup> It will be an assigned distco in the post reform structure.

## 6 SUMMARY AND CONCLUSION

It has been demonstrated that although the GOSL's proposed policy guidelines and reforms are going in the right direction, they could be further improved. *Table 3* below summarise the current ESI, proposed reforms by GOSL and the alternative proposals discussed here.

We have recommended that there should not be, in the long run, any hindrance to private participation in any part of the sector namely generation, transmission and distribution<sup>84</sup> although at the beginning transmission company should be encouraged to have private-public partnership. However it is stressed that we do not suggest outright privatisation of the sector (as in the case of England and Wales), but a no hindrance policy to the private investor. It is acknowledged that the pace of privatisation should be managed so that undesired effects like economic shocks can be avoided.

It has been argued that the proposed monopoly structure for generation, by creating one huge company should be re-considered, in the spirit of competition. In addition the introduction of choice into electricity supply to bulk consumers should be considered as early as possible with the reforms.

We have proposed that the government intervention, by way of its ownership in the businesses in the sector and by way of policy, should be reduced gradually so that the government intervention and regulatory intervention will be slowly replaced by market.

One may argue how far efficiency can be improved with a stock of employees who have been working in a typical monopolistic utility mind set for a large part of their career; we should not therefore expect improvements overnight.

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<sup>84</sup> Private participation will be encouraged in supply when separated from distribution later when the sector moves towards Model 4. However at this stage the ESI will assume to be matured and hence anyway attract private participation.

Finally we reiterate that in our view the GOSL needs to grasp the initiative of the reforms of the ESI and ensure that they are completed in an efficient and effective way. Otherwise the full benefits of the changes will not be enjoyed by the Sri Lankan citizens in the longer term.

<b>Identified concerns</b>	<b>Current structure</b>	<b>Proposed reforms by GOSL</b>	<b>Alternative/additional proposed reforms</b>
Deintegration of the monopoly	No	Yes, but limited	Yes
Improving competition	No	Not adequate (due to large GOSL companies)	Yes
Private investment and management	Yes (only limited to BOO/BOT projects)	Yes (subject to limitations)	Yes (unlimited encouragement)
Efficiency gains	Not adequate	Yes (through regulation)	Yes (through regulation and competition)
Timely implementation of system expansion	Not adequate	Not addressed	Addressed
Cost reflecting tariff structure	No	Yes	Yes
Improved rural electrification	No	Yes	Yes
Less political interference and independent regulator	No	Yes	Yes, but with added caution about minister's intervention
Loss reduction and reliability improvement	No	Not adequate (GOSL can direct policies)	Yes (GOSL should not give policy directions, unless absolutely necessary)
Type of regulation for natural monopolies	CEI (no effective regulation)	PUC (not yet finalised)	PUC (RPI-X with yardstick competition)
Public awareness and support	No	No	Yes
Hunt & Shuttleworth (1996) classification	Model 1	Model 2	Model 2 but reaching Model 3

*Table 3: Summary of the features in proposed and alternative reforms*



## Appendix : Data Sources, Estimation and Forecast Results

### *Electricity Demand Estimation*

In this Appendix an electricity demand function for Sri Lanka is estimated and used to forecast future electricity requirements for Sri Lanka. LTGEP (2001) provide forecasts for the domestic, industrial and commercial sectors, with the total obtained by aggregating the three sectors. Low, medium and high economic growth scenarios are predicted and the medium growth values are taken as the base case. However the methodology used is not clear. Therefore the forecasts obtained from the estimated equation are compared with the CEB projections from LTGEP (2001).

### *Methodology*

There are various ways to estimate electricity demand functions. Given data availability and that the forecast derived here is used as an indicative prediction, the commonly used two stage Engle-Granger Error Correction Model (ECM)<sup>85</sup> was used (see Hendry and Juselius, 2000<sup>86</sup> for a full explanation of the technique).

It was therefore assumed that there exists for Sri Lanka, a simple long-run equilibrium log-linear cointegrating relationship between electricity consumption per capita ( $E_t$ ), GDP per capita ( $Y_t$ ), the real Electricity Price per kWh ( $P_t$ ), and the Underlying Energy Demand Trend ( $T$ ) given by:

$$e_t = \beta_0 + \beta_1 y_t + \beta_2 p_t + \beta_3 t \quad (1)$$

where  $e_t$  = natural logarithm of per capita electricity demand in kWh;

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<sup>85</sup> Engle R F and Granger C W J “Co-integration and Error Correction: Representation, Estimation and Testing” *Econometrica*, March 1987, pp 251-76.

<sup>86</sup> Hendry D and Juselius K, “Explaining cointegration analysis: Part I, *Energy Journal*, Vol. 21, 2000, pp 1-42.

$y_t$  = natural logarithm of per capita GDP at 1996 constant (factor cost)

prices in Sri Lankan Rupees;

$p_t$  = natural logarithm of average unit (per kWh) price of electricity at

constant 1996 prices in Sri Lankan Rupees;

$t$  = 1970 – 2000.

The time series properties of the variables were initially tested to see if they were stationary using the Augmented Dickey Fuller (ADF) test. Equation (1) was then estimated by Ordinary Least Squares (OLS) and the residuals used, via the ADF statistic, to test for cointegration. In addition the Johansen multivariate method was used to check that the assumption of one cointegrating vector was acceptable (see Hendry and Juselius 2001<sup>87</sup>).

The residuals from the preferred cointegrating vector were then used as the error correction (EC) term in the following short-run dynamic equation:

$$\Delta e_t = \alpha_0 + \alpha_1 \Delta e_t + \alpha_2 \Delta e_{t-1} + \alpha_3 \Delta e_{t-2} + \alpha_4 \Delta y_t + \alpha_5 \Delta y_{t-1} + \alpha_6 \Delta y_{t-2} + \alpha_7 \Delta p_t + \alpha_8 \Delta p_{t-1} + \alpha_9 \Delta p_{t-2} + \alpha_{10} \text{rain}_t + \alpha_{11} \text{temp}_t + \alpha_{12} \text{EC}_{t-1} \quad (2)$$

where  $\Delta$  is the difference operator,

$\text{rain}_t$  = Annual rainfall at Nuwaraeliya<sup>88</sup> measured in metres,

$\text{temp}_t$  = Annual average temperature data in Colombo<sup>89</sup> in multiples of 10 degree Celsius

(Note the two additional variables, *rain* and *temp* were added here since they were found to be stationary in levels, see below.) The preferred equation was found by selecting a

<sup>87</sup> Hendry D and Juselius K, "Explaining cointegration analysis: Part II, *Energy Journal*, Vol. 22, 2001, pp 75-120.

<sup>88</sup> In this model the rain fall data was used as a proxy for reservoir water level in the hydro plants, therefore the monitoring station closest to the hydro plants were taken. Hence the data from the observation station at Nuwara-eliya is chosen.

<sup>89</sup> Since Colombo is the load centre of the country the temperature data for Colombo is chosen.

restricted model by testing down from the over-parameterised model of equation (2) that satisfied parameter restrictions without violating a range of diagnostic tests. In particular, the equation residuals were tested for the presence of non-normality, serial correlation and heteroscedasticity. The estimated preferred equation was used to generate the indicative forecast of Sri Lankan electricity demand until 2020 discussed in section 4 of the main text.

### ***Data***

Data used in the estimation consisted of annual data over the period 1970 – 2001 inclusive. The data for electricity consumption for Sri Lanka were taken from the MOPE data base<sup>90</sup> for 1970 – 2000 and from Statistical Digest, CEB for 2001. These were divided by estimates of the population taken from CBSL, AR 2002 to give per capita consumption,  $E_t$ . Data for GDP at 1996 prices were taken from the Special Statistical Appendix of the CBSL AR, 2002 and divided by population estimates to give the variable  $Y_t$ . Data for the average nominal electricity price per unit were taken from the MOPE data base for 1970 – 2000 and from the CBSL AR for 2001. These were deflated by the GDP deflator taken from Special Statistical Appendix to give  $P_t$ . Data for  $rain_t$  and  $temp_t$  were taken from the Meteorological Department of Sri Lanka.

### ***Results***

All estimations were undertaken using Eviews version 4.1. The calculated ADF statistics from testing the time series properties of the variables are given in *Table A1*. It can be seen that for  $e_t$ ,  $y_t$  and  $p_t$  the calculated ADF statistics are less than the 1% critical value of -

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<sup>90</sup> Data Base on Energy, CD from MOPE, Sri Lanka. This is similar to EIA data base of energy balances for non OECD countries.

4.29 (in absolute terms) whereas for  $rain_t$  and  $temp_t$  the calculated statistics are greater than the 1% critical value. Therefore, it is concluded that  $e_t$ ,  $y_t$  and  $p_t$  are non stationary and assumed to be stationary in first differences, whereas  $rain_t$  and  $temp_t$  are stationary.

Variable	ADF Test Statistic
$e_t$	-2.50
$p_t$	-2.54
$y_t$	-2.61
$rain_t$	-5.35
$temp_t$	-4.99

*Table A1 : Unit Root Test results*

A number of versions of equation (1) were estimated with and without the time trend and with and without the price variable. The preferred relationship being:

$$e_t = -6.972200 + 1.116503y_t - 0.003361p_t + 0.021003t \quad t = 1970 - 2001 \quad (3)$$

$$ADF = -4.45$$

Cointegration is accepted given the ADF statistic is greater in absolute terms than the 1% critical value of -3.67. Furthermore, it gives a long-run income elasticity of 1.1 and a long-run price elasticity of -0.003. The estimated income and price elasticities are consistent with similar studies for developing countries. Dahl (1994)<sup>91</sup> found that for the low energy

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<sup>91</sup> Dahl C, "A survey of energy demand elasticities for the developing world", *Journal of Energy and Development*, Vol. 18, No. 1, 1994, pp 1-47.

price countries (most of them are low-income countries and countries from the Gulf Cooperation Council) produce low price elasticity estimates, which is consistent with the results here.

Equation (3) also suggests that the Underlying Energy Demand Trend is increasing at about 2% per annum. Therefore, although this is not reflecting any improvements in technical progress or increases in energy efficiency it is not rejected given the arguments by Hunt, et al. (2003).<sup>92</sup> Instead, this is picking up other exogenous effects that are leading to an increase in electricity consumption – quite possibly one important factor being the increase electrification over the estimation period.

As a further test the Johansen procedure, is used to ensure there is one, and only one cointegrating vector. The results, given in *Table A2*, show that one cointegrating equation is clearly accepted at the 5% level of significance.

Unrestricted Cointegration Test	Results		
	No of CE*	Test statistic	5% critical value
Trace Statistic	0	45.73	42.44
	At most 1	13.91	25.32
	At most 2	3.80	12.25
Maximum Eigen Statistic	0	31.82	25.54
	At most 1	10.12	18.96
	At most 2	3.80	12.25

<sup>92</sup> Hunt L C, Judge G, Ninomiya Y, “Underlying trends and seasonality in UK energy demand: A sectoral analysis”, *Energy Economics*, Vol. 25, No. 1, January 2003, pp 93-118.

Table A2: Johansen Cointegration Tests \*(CE=Cointegrating Equation)

Given the acceptance of one CE, the following preferred short-run dynamic equation was obtained following the testing down of the general model given in equation (2) above:

$$\Delta e_t = 0.211879\Delta e_{t-1} + 1.488248\Delta y_t - 0.738465EC_{t-1} \quad t = 1970 - 2001 \quad (4)$$

[0.09]                      [0.00]                      [0.00]

Adj R<sup>2</sup> = 0.58; LMSC:F =0.75[0.48]; HET:F= 0.85[0.54]; Norm:χ<sup>2</sup> =2.79[0.25];  
 RESET:F= 0.50[0.49]; Chow BP<sub>1995</sub>: F=0.72[0.55]; Chow FT<sub>1995-2001</sub>: F=1.43[0.25]<sup>93</sup>

Equation 4 passes all diagnostic tests, all coefficients are statistically significant at the 10% level with the coefficient on the error correction significant and of the right sign and magnitude – suggesting that nearly ¾ of any disequilibrium is adjusted for each year. Note neither *rain* nor *temp* proved to be significant so they were eliminated.

### **Forecasting**

Using the estimated equation (4), with the long-run equation (3) embedded via the EC term, future energy demand was forecast until 2020. In order to drive the forecast, assumptions were required for real GDP, the real energy price and population growth. The projections for population were taken from the department of census and statistics of Sri Lanka, which gives values for every five years (2006, 2011, 2016 and 2021) so assuming that the growth is linear, projected population for the intervening years were interpolated. For GDP, three scenarios were conducted; the base case is taken from the GDP projections of the CBSL AR 2002, which gives projections up to 2006, after that it is assumed a 4.5% growth; the high growth scenario is 2% more than the base case and the low growth

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<sup>93</sup> The probabilities are given in square brackets.

scenario is 2% less than the base case<sup>94</sup>. For the electricity price predictions, the actual value is taken for 2002 from CBSL AR, 2002 and assumed that this will not change until a 30% real price increase expected in year 2005, since reforms are assumed to be implemented by this year.<sup>95</sup> Thereafter, the real electricity price is assumed to stay unchanged for 5 years and gradually decline by 2% per annum every year until 2020.

The base case forecasts are given in *Table A3*. The peak load is calculated by using a loss level of 18% and 15% (as shown in *Table A3*) and a system LF of 55% (average LF for 1986-2000 is around 55% as mentioned in *Section 2.4.6*).

Year	Electricity Demand		Gross Losses <sup>96</sup> (%)	Generation (GWh)	Load Factor (LF) (%)	Peak (MW)
	(GWh)	% Growth				
2002	5,700	5.3	18	6,951	55	1,443
2003	6,197	8.7	18	7,558	55	1,569
2004	6,862	10.7	18	8,368	55	1,737
2005	7,592	10.6	18	9,259	55	1,922
2006	8,367	10.2	18	10,204	55	2,118
2007	8,896	6.3	15	10,466	55	2,172
2008	9,448	6.2	15	11,115	55	2,307
2009	10,099	6.9	15	11,881	55	2,466
2010	10,830	7.2	15	12,741	55	2,644
2011	11,616	7.3	15	13,666	55	2,836
2012	12,458	7.2	15	14,656	55	3,042
2013	13,356	7.2	15	15,713	55	3,261
2014	14,315	7.2	15	16,842	55	3,496
2015	15,343	7.2	15	18,051	55	3,746
2016	16,095	4.9	15	18,935	55	3,930
2017	16,827	4.6	15	19,797	55	4,109

<sup>94</sup> The growth projections for other south Asian countries except Pakistan and India is given as 4.6% till 2012 (Source: WEFA/DRI - 2002).

<sup>95</sup> It is assumed that when the political prices are replaced with MC based prices initially there will be an average price rise of around 30%.

<sup>96</sup> Including self generation also as a loss.

2018	17,666	5.0	15	20,783	55	4,314
2019	18,618	5.4	15	21,904	55	4,546
2020	19,642	5.5	15	23,108	55	4,796

*Table A3: Electricity demand forecasts for Sri Lanka 2002-2020 base case*

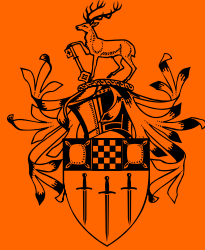
It can be seen from Table A3 that the base scenario produces a fairly high demand growth of around 10% in the initial years (2003-2006) due to the high GDP growth assumption (around 7.5% to 9.0%). Thereafter there is a relatively steady growth until 2015 of around 7% per annum, due to the steady GDP growth rate assumption of per annum. From 2016 – 2020 the projected electricity consumption growth is around 5% per annum given the lower GDP growth assumption of 3% per annum.



Note:

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