

Viability of Coal and Oil-fired Power Plants in Sri Lanka

Abstract

Scientists predict that the peak oil and natural gas consumption will occur by the years from 2010 to 2012. Similarly world carbon dioxide (CO₂) emissions and coal consumption peaks will be reached by 2015 if the humankind is to stabilise the global average temperature increase to 2 °C above pre-industrial level. Due to these challenges faced by the modern world, it is unlikely that there is a future for fossil fuels. Yet, the Ceylon Electricity Board (CEB) states that the cheapest electricity is from coal. However, if one discards the wrong assumptions of the CEB and does a proper assessment of costs, then the price of a unit of coal-powered electricity will far exceed the cost of renewable energy in Sri Lanka.

Thus, the effort to construct 3,300 MW coal-fired power plants and 935 MW oil-fired power plants in Sri Lanka is simply an investment for outdated technologies. There is a future only for energy conservation and renewable energy sources.

Thus, it is absolutely essential that funds earmarked for fossil fuel-based techniques should be channelled towards energy conservation and tapping renewable energy sources.

The need

As the core source of energy to light up a home for a few hours at night and operate a television, electrical energy is a primary need of modern man. However, since electricity is also used to operate luxury equipment, it is also a luxury requirement.

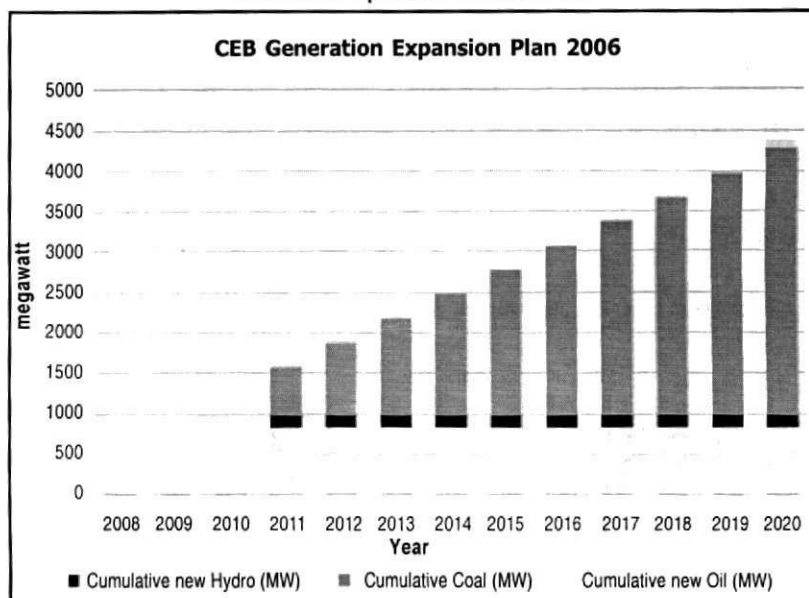
Twelve years ago, almost all of the electricity requirements of Sri Lanka were met by hydro-power plants. By 2008, the required capacity had increased to 2,000 MW, while the total number of required electrical units had increased to 10,000 GWh. Despite the fact that the petroleum crisis was looming, Sri Lanka opted to generate electricity by burning fossil fuels. As a result, 60%

of the electricity requirements are obtained currently by petroleum and only 40% through hydro-power. It is clear that this terrible situation is the direct result of the lack of foresight on the part of then governments.

Electricity Generation Plan of the CEB

According to an assessment of the CEB, the demand for electricity will increase by 7-10% per annum over the next twenty years (CEB, 2006). Accordingly, demand shall double every ten years. It is interpreted as the responsibility of the government to be able to meet this demand at affordable prices. In order to address this issue, the CEB prepared a plan and according to the plan, by the year 2020, Sri Lanka would have to newly construct the Upper Kotmale hydro-power plant (150 MW), oil-fired power plants (935 MW) and coal-fired power plants (3,300 MW) (Graph 1). Additionally, since the first coal-fired power plant will be commissioned only in 2012, the government is taking steps to build oil-fired power plants to meet the interim demand.

Graph 1
Generation Expansion Plan of the CEB



Source: CEB Long-term generation expansion plan, 2006.

This plan of the CEB was originally proposed about twenty years ago at the end of the Mahaweli project. Despite the massive and telling changes that have occurred globally, the CEB has obviously not changed its plans to reflect these realities.

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Worldwide, investments on renewable energy have increased three fold during the last 6 years. However, Sri Lanka is moving in the reverse direction to that of the rest of the world.

The CEB formulated its plan stating that it was the least-cost option for the country. According to them, the most economical and profitable means of satisfying the base load demand over the next 20 years is through power generated from coal. Additionally, in their estimate, oil-fired power is the only option for providing electricity at peak hours (CEB, 2006). The CEB and some experts in the energy sector have over the last 20 years constantly stated this mantra. As a result of this barrage, the people of Sri Lanka and the governments have accepted this view without question. This trend is still continuing with the

present government also espousing these plans as being both viable and practicable and accordingly, the coal-fired power plants proposed by the CEB are currently being built by the government. The Upper Kotmale and Uma-Oya hydro-electrical projects are being implemented due to special decisions of the current government and not because they are cheaper alternatives as per the plans of the CEB.

The statements of the CEB on the cheapest base and peak electricity generation sources were based on computer modelling and simulations (CEB, 2006). Using that very same framework, a study was commissioned by the Energy Forum of Sri Lanka with European Commission grants and this study revealed that the generation plan of the CEB was incorrect.

For their generation planning computer models, CEB has considered only coal, oil and hydro as power sources. No other energy sources were even considered as candidate options for optimisation using computer models (CEB, 2006). However, both the people of Sri Lanka and the government believe that the CEB has considered every possible energy source in determining the best sources to be coal and oil, and it is clear that the CEB has misled both the government and the citizens of Sri Lanka.

Assessment of Alternative Energy Sources for Electricity Generation

In order to determine appropriate alternative energy sources for producing electricity, the cost of producing electricity should be known for each such source. This is not an easy task. The reason for this is that the capital investment and the changing cost of fuel for the lifetime of the plant should both be assessed. Since the average lifetime of a plant is greater than 30 years, the flux of the price of fuel over a long period of time needs to be assessed, and in doing so, many factors need to be taken into consideration. A further point is that there is a general idea that the cost of generating electricity from each and every source is continuously increasing. This may be true of fossil fuel-based technologies but with renewable energy sources, it is false since the capital investment for such energy sources has dropped steeply over the last 30 years as shown in Graph 2. This is in direct contravention to the popular myth that renewable energy is expensive. It is clear that the cost of electricity generated through coal and oil increases steeply while that of renewable sources decreases equally steeply.

Given the new conditions, comparison of technologies for different energy sources should be done with great care. Experts with vested interests in promoting fossil fuel-based technologies cite only the high prices quoted by some of the private sector firms for establishing renewable energy power plants. Further, they are attempting to curb the voices of those who propose alternatives. We have to consider number of factors while comparing the unit costs of different technologies.

The results of summary (a possible scenario) of a study done by Energy Forum are shown in Table 1.

The government constructs coal-fired power stations on obtaining concessionary loans. The private sector constructs renewable energy power plants on obtaining commercial loans. As two different interest rates apply, costing is not based on a level playing field. For a proper analysis, this weakness should be eliminated. The first row of Table 1 indicates the cost of production if the government builds plants for both renewable and fossil fuel sources.

The second row of Table 1 indicates the cost of production if the private sector builds plants for both renewable and fossil fuel sources. The second row renewable energy figures are based on the

Table 1
Cost for various power plants in SLRs/kWh (a possible scenario)

Description	Oil	Solar PV	Coal	Large Hydro	Wind	Dendro	Mini Hydro	Wave
Capital investment- Concessionary loans (@ ROE 04%, IR 02%)	0.51	23.64	1.74	5.69	5.06	1.96	3.41	1.93
Capital investment- Commercial Loans (@ ROE 22%, IR 17%)	1.56	72.74	5.34	17.50	15.57	6.04	10.48	5.94
O&M costs	0.27	9.39	0.92	2.26	2.01	1.04	1.35	0.77
O&M costs Escalation (@ 6.52%)	0.11	3.75	0.37	0.90	0.80	0.42	0.54	0.31
Fuel cost at current prices	27.72	-	5.25	-	-	5.74	-	-
Gross unit cost for Commercial loans- 20 years flat tariff (SLRs/kWh)	29.65	85.88	11.87	20.66	18.39	13.23	12.38	7.01
Fuel price increase	62.34	-	8.45	-	-	6.74	-	-
Ex. rate increase (@ 2 Rs/US\$)	18.61	-	2.79	-	-	-	-	-
Import tax on fuel (@ 28.5%)	30.97	-	4.70	-	-	-	-	-
Additional T&D cost	1.07	1.07	2.67	2.67	2.67	1.07	2.67	2.67
Carbon Benefit 1 (@ 15 US\$/t)	-	1.23	-	1.23	1.23	1.23	1.23	1.23
Additional Carbon Benefit (@ 60 US\$/t)	-	3.69	-	3.69	3.69	3.69	3.69	3.69
Net unit cost for commercial loans- 20 years flat tariff (SLRs/kWh)	142.64	82.03	30.47	18.41	16.14	16.12	10.13	4.76

O&M- Operation and Maintenance
T&D- Transmission and Distribution
ROE - Return On Equity
IR - Interest Rate

Source: *A world without oil or coal* - Asoka Abeygunawardana (2008).

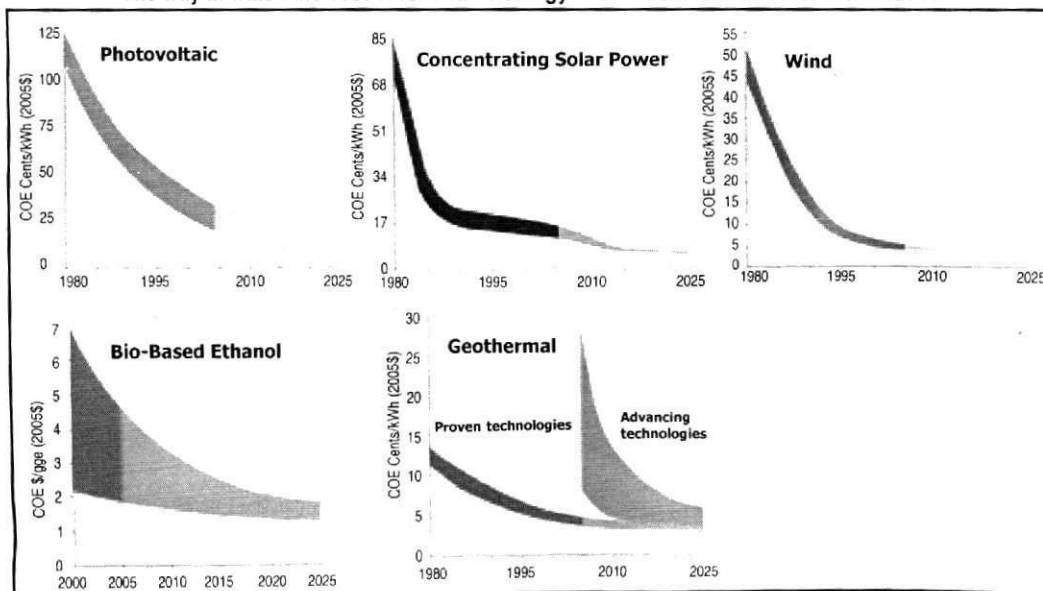
government published tariff for the private sector. Thus, the result if all power plants are constructed by the private sector is

clear from this row. Comparing these two rows, it is clear that the method of comparing the costs of energy sources by mixing two different loan mechanisms is incorrect. In order to get a correct picture, one must assume that all power stations are built either by the government or the private sector.

The 3rd and 4th rows of Table 1 indicate the maintenance costs. Since the CEB assumes that the cost of coal and oil will remain unchanged, the 5th row shows the fuel costs with respect to current prices.

Graph 2

The way in which the cost of renewable energy has decreased over the last 3 decades

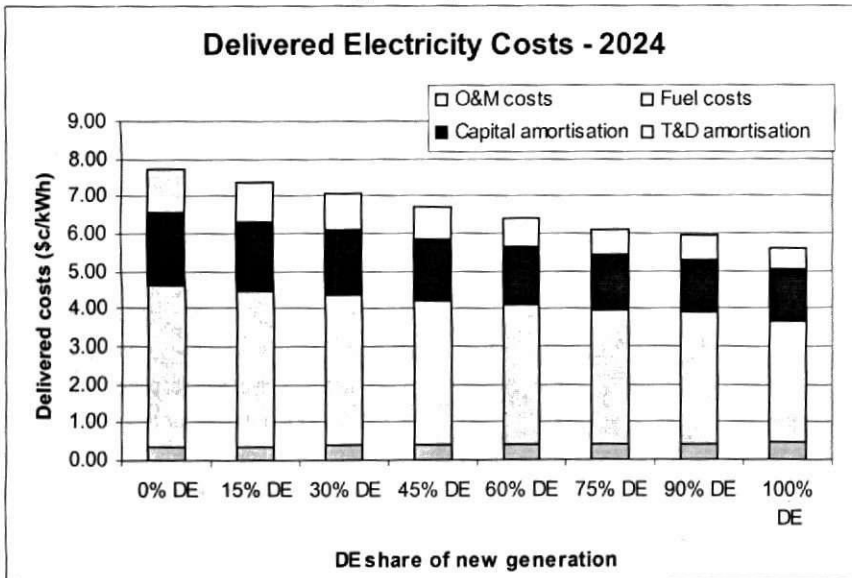


Source: National Renewable Energy Laboratory (NREL), 2005.

However this is an incorrect assumption. The price of coal has increased threefold globally over the last three years. This study takes into consideration the rise in fuel costs, and it has been assumed here that the cost of coal for coal-fired power plants will increase by 0.0225 US\$/kg/year and cost of wood for dendro-power plants will increase by 0.50 SLRs/kg/year. Further, it was assumed that the cost of diesel for oil-fired power plants will increase by SLRs. 20 /l/year, and this was factored into formulating the figures in row 6. All these assumptions may or may not become true.

centralised generation schemes, new transmission and distribution networks need to be established to deliver power to consumer. Additionally, since there is a loss in transmission, stations with a greater capacity will need to be built to compensate for this loss. These issues were analysed by the Energy Forum study conducted in 2006 and the results are shown in Graph 3. Capital investment is required for all of these as well. Accordingly, the additional transmission costs are shown in row 10 of Table 1.

Graph 3
How decentralized energy is cheaper than centralized electricity



DE - Decentralized Energy
T&D - Transmission and Distribution

Source: Incorporating social and environmental concerns in long term electricity generation expansion planning in Sri Lanka - Energy Forum 2006.

However, it is necessary to try different scenarios to get a better picture without assuming that there will be no fuel price fluctuations during the next 30 years.

The CEB has decided that the foreign exchange rate will also remain constant. Again, this is incorrect. The assumed change (2 SLRs/US\$/year) is indicated in row 7 of Table 1. Further, the CEB does not see a difference between using resources within the country and using imported fuel. However, Sri Lanka loses foreign exchange when it purchases fuels from abroad. The 8th row which considers import tax reflects this. Thus, by analysing the figures in rows 5 through 8, one can determine the cost of using each of the energy sources. Accordingly, the final fuel cost is set out in row 9.

Coal-fired power plants are usually built as large stations capable of generating 600-900 MW. However, the consumer of this generated electricity resides far away from the point of generation. With

Coal usage will have to be reduced in order to counter the effects of global warming. The situation that would arise due to this cannot be clearly determined right now. However, from March 2008 onwards, with the establishment of carbon trade, additional income may be generated by opting for renewable energy sources and rejecting coal-fired power plants. The income from carbon trade at the prevailing prices is shown in row 11 of Table 1. It should be noted that the value of carbon increases yearly. Accordingly, the increase in income in future years is shown in row 12.

Analysis of the figures in Table 1 shows that if CEB assumptions are applied, then the cost of coal-fired power plants is lower than that of other sources. However, their assumptions have not been factored in national requirements. When other factors such as the increase in foreign exchange rates, increase in fuel costs, differences in interest rates for concessionary and commercial loans, loss of foreign exchange for purchasing coal, capital investment for transmission systems for centralised generation plants and income from carbon trading are taken

into account, it is clearly seen that the most costly sources are coal and oil. The implication is simple: There is an urgent requirement for an alternative generation plan.

A power station is built for use over 40-50 years. Thus, future outcomes during that period need to be assessed before a plan is made. There is no future for coal-fired power stations due to the environmental costs incurred. Additionally, since Sri Lanka has no coal deposits, power generation from coal makes a financial loss. Thus, it is important that outdated technologies are rejected and new thinking is engaged to find solutions to the problems where high priority is given to energy conservation and renewable energy sources and the authorities stop giving these options step-motherly treatment.

The CEB's generation plan is to cater to the increasing demand forecasted. It has been formulated based on the hypothesis of low speed growth, medium speed growth and high speed growth (CEB, 2006). In the past, this type of rapid growth of demand was an indicator of prosperity. Scientists now believe that this unchecked growth will ultimately end in a massive disaster (Daly, 2005). Thus, the world is focusing on cyclic process and not infinite growth. That demand should be allowed to increase infinitely is an outdated concept. Hence in the current context, a country cannot think along the lines of the CEB in its neutrality to demand. Managing the rising demand for electricity takes precedence amongst all proposed solutions to the existing problem. Thus, instead of constant and increasing growth, stability should be established when the demand curve reaches a certain level.

Conclusion

The ultimate solution to the current and future energy crisis in the world in general and Sri Lanka in particular is energy conservation and renewable energy. Fossil fuel prices increase with the demand whereas the renewable energy prices decrease with the demand. Hence it is essential that funds earmarked for fossil fuel-based techniques should be channelled towards energy conservation and tapping renewable energy sources. A comprehensive study on power generation options and demand side management should be conducted by the Ministry of Power and Energy as the first step for initiating such a process in Sri Lanka.

References

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