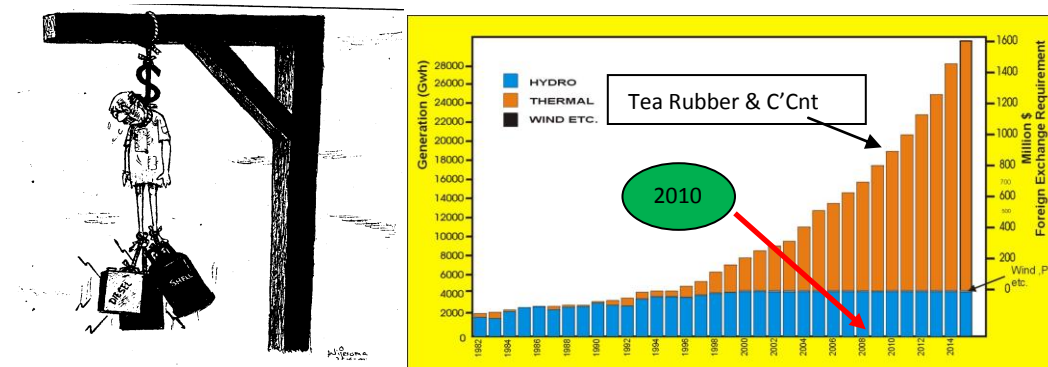


A Road Map for an Energy Independent Sri Lanka by 2030

1.0 Introduction and Historical Back Ground

The need and urgency for achieving a status of energy independence for Sri Lanka has been discussed with increasing frequency in the recent years. This is driven by the two related and increasingly compelling trends seen, one of the end of the fossil fuel era on one hand and the bitter truth of the global warming and climate change which is now impossible to ignore any more. Of particular relevance to Sri Lanka has been the more and more disturbing trend of the economic and fiscal impacts. The continuing and increasing dependence on imported sources of energy, has a knock on impact on all sectors of the economy with increasing negative influence on the balance of payments and parity rate. From a relatively comfortable status of the share of fossil fuel imports being 12 % of the total imports and being comfortably funded by the export revenue of the three traditional imports, prior to 2010, it is now stands at over 30% of the total import bill. It is no longer possible for Tea, Rubber and Coconuts to generate adequate foreign exchange to import the oil and coal. It is distressingly obvious that we are able to continue on this basis, only because of the remittances received from the expatriate workers, some of whom work under most unsatisfactory conditions. The country should not be in such a unsatisfactory status as the issue of future energy security, demanding a much greater attention than what it is receiving at present, driven by the euphoria of decidedly temporary dip in the world market price of oil, which has already bottomed out.

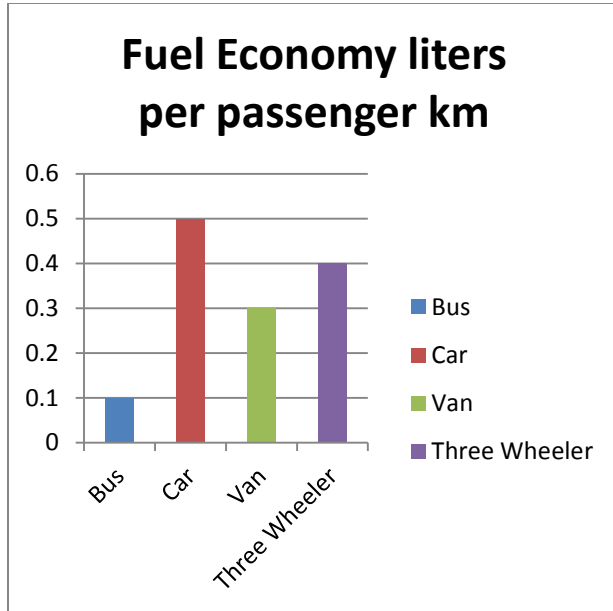
It is encouraging that these issues have received the attention of the successive governments with ambitious goals and targets spelled out in the published policy statements. The publication “ An Energy Empowered Nation” with the Ten Year Development Plan published recently aims at a goal of 100 % indigenous energy by year 2030. This paper attempts to spell out a road map to achieve the above goal, examining the present status, Sri Lanka’s indigenous energy potential and the barriers to overcome and most importantly the strong policy initiatives that are needed.



2. A period of darkness

Sri Lanka has had the unenviable reputation of a country with the maximum contribution of renewable energy sources for its electrical needs until about three decades ago. While the world over the transport sector has had to depend on the fossil fuels for its transportation needs, including Sri Lanka, we had the good fortune or I would like to consider it the good sense, to

optimize the use of the more efficient modes of transport such as trains and buses, at this time. I have the personal experience of going anywhere in the country using public transport at any time of the day or night. As the data below indicates the optimal use of the fuel is achieved using such modes of transport.



The fuel economy of a train is 20 times more efficient than that of a passenger car and will hardly be seen in the above chart !.

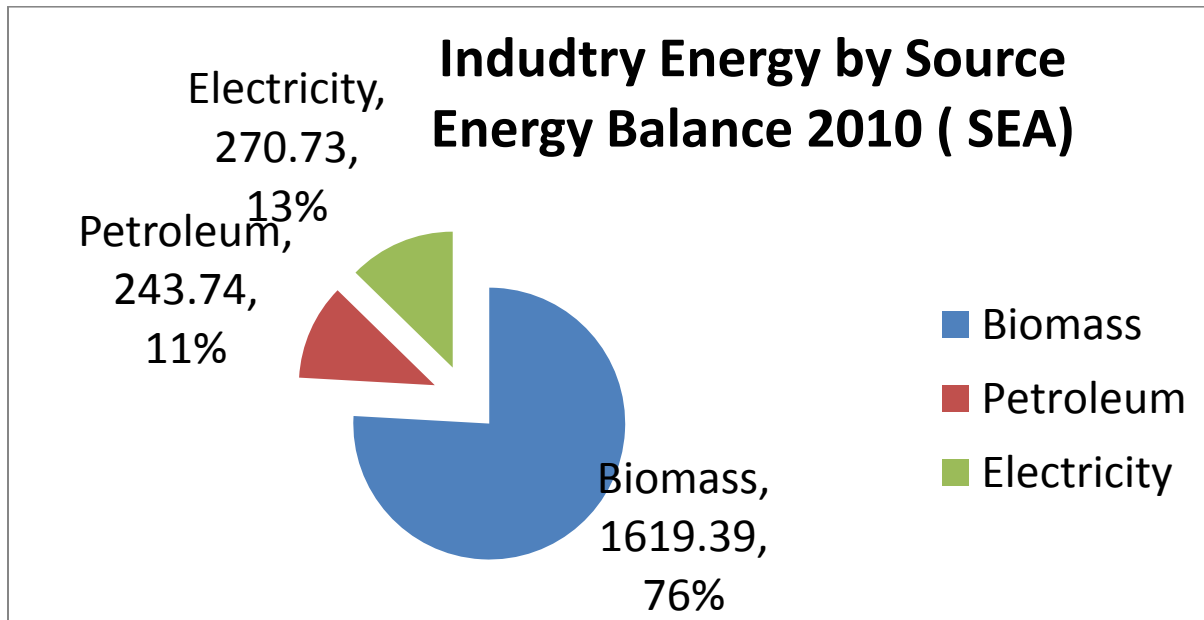
The situation in case of the electricity power is even more pathetic, as we have deteriorated from a high of 95% hydro based generation. The dependence on oil and coal has increased to over 49.7 % in 2014. This is not due to lack of any indigenous renewable sources in Sri Lanka but due to our ineptness in harnessing such resources and lack of vision.

Current & Future Status of Electricity Supply Sources

• Year	Hydro	Thermal
• 1995	94%	6 %
• 2005	47%	53 %
• 2015	26%	74%



The industrial sector has fared relatively better, in that the contribution of biomass for the thermal energy needs has remained at a high 70% in spite of the growth of demand. However, the sustainability of the fuel wood supplies is a matter of concern, that has to be addressed in the present strategies. The domestic sector too has drifted towards the use of LPG as the source of energy for cooking, but the use of fuel wood remains at a significant level.



As such the period from decade of 1990 has been one marked by poor planning, devoid of any strategic thinking and vision, making the present task of achieving 100% independence of energy that much more challenging.

3. Current and Future Demands of energy

The current total energy generation of the country stands at 487.169 PJ or 11635 ktoe (SEA Energy Balance 2014).

The Energy Demand by Sector over the years in PJ is shown below.

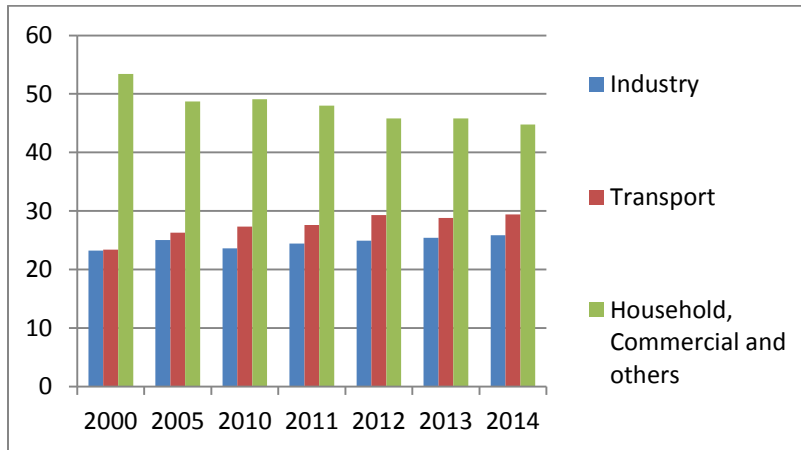
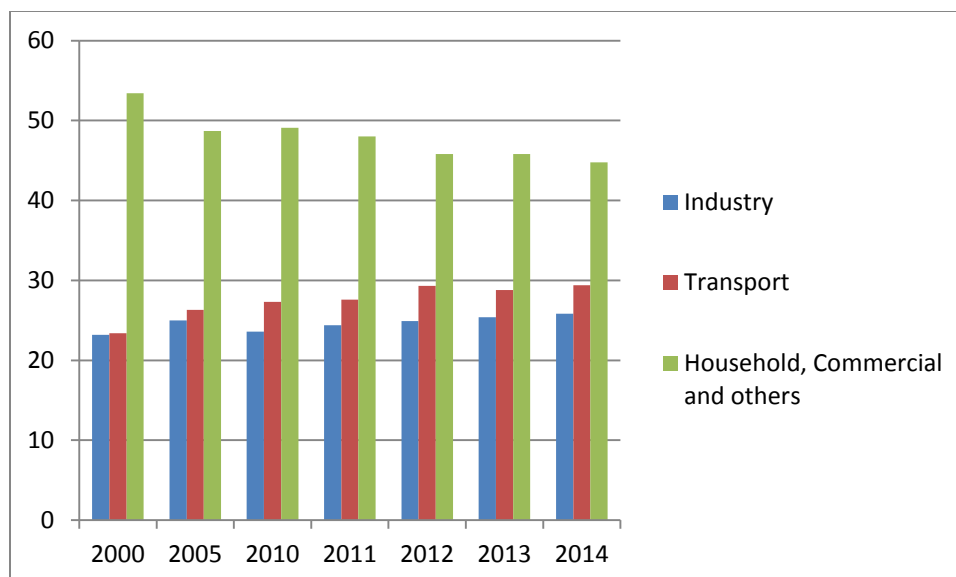


Figure 1 - Energy Demand by Sector in PJ

Table II

% of Demand	2000	2005	2010	2011	2012	2013	2014
Industry	23.2	25.0	23.6	24.4	24.9	25.4	25.85
Transport	23.4	26.3	27.3	27.6	29.3	28.8	29.38
Household, Commercial and others	53.4	48.7	49.1	48.0	45.8	45.8	44.76
Total Demand PJ	302.5	336.8	367.7	373.5	381.9	372.7	382.676

(Source: Sri Lanka Energy Balance 2014- Table 6.24)



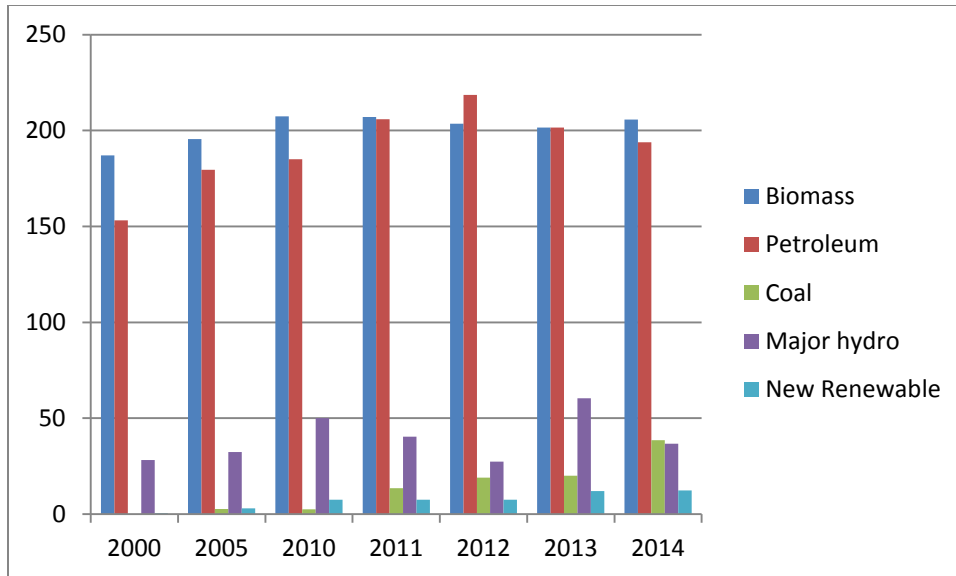
Distribution of Demand

While the total demand has increased steadily, the sector wise contribution has been similar over the years. While the efforts to increase the share of industries to the GDP growth are pursued, the intensity of energy per unit of GDP growth has been less than predicted. In the meanwhile the enhanced affluence of the people will certainly increase their share of demand. Thus while the total demand is increasing the split of the demand may not change drastically. The more important split however is the share of the sources tapped to provide the current and emerging demand patterns. The future pattern would be highly dependent on the national policies as the decisions and management of such supply strategies lies largely with the state.

Table III – Distribution of Share of Energy Resources

Energy Source	2000		2005		2010		2011		2012		2013		2014	
	PJ	%	PJ	%	PJ	%	PJ	%	PJ	%	PJ	%	PJ	%
Biomass	187.1	50.7	195.5	47.3	207.4	45.8	207.0	43.7	203.5	42.8	201.6	43.3	205.7	42.22
Petroleum	153.1	41.5	179.6	43.5	185.1	40.9	205.8	43.4	218.5	45.9	201.6	36.9	193.8	39.78
Coal			2.7	0.7	2.5	0.6	13.6	2.9	19.1	4.0	20.1	4.3	38.6	7.91
Major hydro	28.3	7.7	32.4	7.8	50.1	11.1	40.4	8.5	27.4	5.7	60.4	13.0	36.7	7.53
New Renewable	0.6	0.1	3.0	0.7	7.5	1.7	7.5	1.6	7.6	1.6	12.0	2.6	12.4	2.55
Total energy supply in PJ	369.0		413.1		452.7		474.2		476.1		465.9		487.2	

Source: Sri Lanka Energy Balance 2014-



Distribution of Energy resources

The situation in respect of transport however, could change due to a possible major changeover from oil to electricity as seen in the trends worldwide and even in Sri Lanka recently. (Hopefully sanity will prevail and the latest decision to increase the tax on EVs tenfold by the recent budget will be reversed as reportedly agreed by the Cabinet of Ministers). Such a trend could be orchestrated for the benefit of the country, by proper policy measures and other incentives as proposed in this paper.

The development plan also reports that “Sri Lanka has already achieved a grid connectivity of 98%, which is commendable by South Asian standards. Current total installed power generation capacity of the country is approximately 4,050 MW. The annual total electricity demand is about 10,500 GWh with a projected annual demand growth of around 4-6 % projected to reach 30,645 GWh and 5893 MW by 2030, according to the Long Term Generation Plan of the CEB. These projections have been contested based on the much lower rate of historical increase of demand than used in the above plan or in their previous LTGP scenarios.

Even though the increase in demand for energy runs parallel to the economic development, use of the demand growth patterns based on the historical trends is not advisable due to many reasons. One important reason for the enhanced rate of growth in the past decade has been our target for achieving the goal of electricity for all. As this target has now been nearly achieved, such rates of growth of demand for electricity are not likely in the future. In fact there has been a tapering off in the past few years with the growth registered as 0.8% in 2008, 0% in 2009, 1.37 % in 2013 and 3.5% in 2014. A further factor that is increasingly apparent, is the energy conservation measures adopted by the consumers, as well as the introduction of more energy efficient equipment, particularly for lighting and air conditioners as well as electric motors. Thus a 2-3% rate of growth is more likely.

The petroleum imports are reported to have a growth rate of 3% in the coming years. The strategy to restrict this may evolve as transferring the demand to electricity, particularly for transport. This may increase the demand for electrical energy, but would not have any impact on the total generation capacity as the demand for transport will occur in the day time for which there is more than enough generation capacity even now, to meet the possible increases for many years to come. In case of the demand for fossil fuels for thermal energy in industries, there is definitely a laudable trend towards greater use of biomass, and the demand is growing.

Considering the high flexibility of electricity, a reliable and affordable electricity generation could also be the means by which the targets for the other sectors could also be achieved.

4.0 The Renewable Energy Potential and Practical Projections

In case of Sri Lanka, all our indigenous sources also happen to be renewable. Thus a target of 100% independence for our energy supplies by 2030 would also be a target for achievement of 100% RE, a target strived for by many countries, due to the specter of climate change. Thus achieving this target will also earn us the kudos of being a good global citizen by reducing our carbon emissions substantially.

There have been many projections on our renewable energy potential, particularly for electricity, the highest form of energy, which can cater to all other demands of energy. Since some forms of energy, such as wind and solar are more suited for the power generation, these predicted targets are used for evaluation. Some note worthy predictions of such potential are listed below.

The studies conducted by The National Renewable Energy Laboratories (NREL) for Sri Lanka predicted a total potential of 20,000 MW of wind energy and 1885 kWh/m²/year of Solar Energy.

The Sustainable Energy Authority in its early assessments have estimated the potential of various indigenous sources of energy as

Table IV - Total RE Potential and Short Term Targets by 2020 (SEA)

Resource	Potential ktoe	Remarks	Target for 2015 MW	Target for 2020 MW
New Hydro	360	Additional capacity	350	600
Bio Mass	16,000	4000 MW equivalent	40	360
Wind	3440		230	1000
Solar	8,600,000		30	250
Total target			650	2210

A more recent assessment done as part of a study conducted with the financial assistance of the Asian Development Bank has announced the following Renewable Energy potential.

Table IV – Practical Potential

Resource	Total Potential	Practical Potential	Already Developed	Remarks
Mini Hydro		873 MW	253 MW	
Bio Mass	2,596,000 ha of suitable lands for energy plantations	2400 MW	11.5 MW	Resource targeted for thermal energy as well
Wind	24,000 MW	5650 MW	100 MW	
Solar	Unlimited	6000 MW based on energy of 1885 kWh/m ² /year	1.4 MW + 10 MW Rood Top Solar PV	Land requirement of only 1% of the scrub lands of extent 1.6 Million ha.

Source : Presentation by Mr Sumith Fernando- RMA Consultants

The above predictions are useful to provide the confidence that the target of 100% independence of energy by 2030 is a practical reality. This confidence is further reinforced by many recent developments in the world, both in the technologies and products as well as in commercial aspects, which has drastically driven down the cost of development of RE resources. It is also important to recognize the increasing consumer interest in the roof top solar installations driven by the Net Metering System introduced by the CEB recently. Some 10 MW of capacity in over 1000 installations has been commissioned. The demand is growing. The interest in developing the grid connected NCRE projects is seen in the 593 MW in approved projects covering the four different sources of RE.

There are also inquiries for the development of grid connected solar projects by many investors, even though the CEB is not entertaining any more project applications. The recent instruction by the Hon Minister of Power and Renewable Energy to the Sustainable Energy Authority to identify lands for the development of 500 MW of solar energy is most encouraging and signals a change of wind in implementing the policies published. These circumstances bring in a new dimension to the future energy development paradigm which needs to be recognized in the future planning.

5. The Wish List and Political Will

The projections and the targets envisaged by the government at present, with the overall objective of gaining full energy independence by the year 2030 is well documented.

“An Energy Empowered Nation” This is the title of the recently published “Sri Lanka Energy Sector Development Plan for a Knowledge Based Economy 2015-2025” by the Ministry of Power and Renewable Energy.

The fact that these targets have the full support of the government is apparent by the very firm assurances in the manifesto of the present President as well as in the policy statements of the previous administration.

As such while there is no lack of vision and political will to achieve this important goal, it will be necessary to ensure that such ambitions are reflected in the plans and activities of all the relevant state agencies, which are directly or indirectly involved. Thus the need of the moment is not to be looking at new sources of energy, but to facilitate and accelerate the development of already identified indigenous sources.

6. The World Scene and The Way Forward

In order to provide a further confidence for the achievement of the seemingly challenging task of energy independence by 2030, a look at the current trends and achievements in the rest of the world is useful. Some of these countries who have opted to follow a path to 100% RE are not so well endowed with RE resources as Sri Lanka is able to boast of.

Thus our modest target is highly achievable considering that even now we have over 50% in installed generation capacity and based on good weather, can generate over 50% of the electrical energy. What are required are the correct policies and strategies to progressively move towards

the desired goal. In this regard the macro policy is clear with the following mile stone targets as stated in the development plan.



- 60% generation using RE by 2020
- 100% generation using RE by 2030
- Reduction of system losses from 11% to 8% by 2020
- Limit the demand growth to 2% by 2020
- Reduce carbon emissions by 5% by 2015
- Reduce fossil fuel usage for transport by 5% by 2020

Since these targets are mainly related to electricity, it is also important to establish targets for other sectors as well. In particular

- To eliminate the use of fossil fuel for thermal energy in industries by fuels switching to Biomass by 2025.
- To achieve a general target of fossil fuel usage for passenger transport of 0.01 l/Passenger km by 2020, by improved public transport and use of energy efficient vehicles.
- To target 100% reduction of use of fossil fuels by conversion to electric vehicles and use of bio fuels for transport by 2030
- To promote the use of domestically generated bio gas for cooking in households

It is necessary to recognize the dangers of continued use of fossil fuels particularly coal, for reasons in addition to economics and energy security issues. These are not normally brought out to the forefront, in an attempt to push through pre conceived notions that the use of coal is the only and cheapest way for ensuring adequate supply of electricity.

To highlight this issue some numbers relating to a 500 MW coal power plant are noted below.

- *10,000 tons of sulfur dioxide.* Sulfur dioxide (SO_x) is the main cause of acid rain, which damages forests, lakes and buildings.
- *10,200 tons of nitrogen oxide.* Nitrogen oxide (NO_x) is a cause of acid rain.
- *500 tons of small particles* causing lung damage
- *220 tons of hydrocarbons.*
- *720 tons of carbon monoxide.* Carbon monoxide (CO)
- *125,000 tons of ash and 193,000 tons of sludge from the smokestack scrubber.* This ash and sludge consists of coal ash, limestone, and many pollutants, such as toxic metals like lead and mercury.
- *225 pounds of arsenic, 114 pounds of lead, 4 pounds of cadmium, and many other toxic heavy metals.*
- *Trace elements of uranium.* All but 16 of the 92 naturally occurring elements have been detected in coal, mostly as trace elements below 0.1 percent (1,000 parts per million, or ppm). A [study](#) by DOE's Oak Ridge National Lab found that radioactive emissions from coal combustion are greater than those from nuclear power production.

None of these emissions are regulated by the EIA studies conducted in Sri Lanka and no information is available publicly on the current situation.

7. Gaps in Policies and Regulations

Therefore, if the proposed targets are to be achieved, it is necessary to identify and eliminate the barriers existing due to several reasons.

- Lack of a national acceptance of the proposed policies – A national energy policy was published in 2006 and was ratified by the Parliament. But this was totally ignored by even the officials of the Ministry of Power and Energy which authored the Policy Document at that time. None of the other state agencies seem to be even aware of the existence of the policy, let alone abiding by it.
- The National Energy Policy was required to be reviewed in three years. The attempt to do so has fizzled out.
- There is a general policy (not known if this is documented) that all renewable power generation projects are to be developed by the private sector and each project is subject to a ceiling of 10 MW capacity. All major Hydro and other larger projects are to be developed by the CEB. The rationale of the original decision has not been explained and

no attempt has been made to review this policy with the changing circumstances. (This would have surfaced if the National Energy Policy was reviewed) . However the recent decision by the CEB to develop 100 MW of wind power in Mananr is a total departure from this policy stance.

- The Sustainable Energy Authority established as the apex body for the NCRE sector has concentrated on the aspects of approvals and policing, and not devoted adequate attention to the development of the resources and facilitation of the projects, presently developed by the private sector alone. Accordingly they have not implemented even the provisions in the SEA act which were designed specifically to provide such facilitation.
- There is unwarranted and illegal interference by local administration and politicians , which are not resolved by the SEA, even though the Act provides for such intervention.
- The onus of achieving the targets of NCRE penetration rests only with the private sector developers. None of the state agencies, the SEA, CEB or the Ministry are not called upon, to accept the responsibility of achieving the targets set by the State.
- The feed in tariff determination is not transparent and is skewed due to unfair comparisons with cost of coal power generation, without an independent agency performing the determination, based on the impact on the national economy and on a level playing field, without the subsidies and other incentives enjoyed by the state sector and not enjoyed by the private sector, being removed for the purpose of comparison.
- The Long Term Generation Plan of the CEB is at last being subject to rigorous public review and has been criticized as not accurate. This planning process should be viewed as a national effort with the need for wider stake holder participation prior to the planning stage.

8. The Road Map

Since there is no dearth of the indigenous energy resources, the obvious way forward is an aggressive action plan, which must be binding on all Sri Lankans, particularly the Ministries and state institutions, working towards a common goal. It is now apparent that any more centralized large power generation plants are no longer required. Thus the investments by the CEB should primarily be targeted towards developing and enhancing the facility to absorb power from decentralized small scale power generation. Thus the burden of investments on further power generation capacity can be transferred to the private sector, except in instances where the CEB may find it more attractive to do so without a burden on the public finances. For this purpose the Road Map proposed consists of the following actions.

1. Generate a National Energy Policy Document encompassing the objectives and targets of the document “ An Energy Empowered Nation” compliance to which should be mandatory by all parties including the private sector and citizens. This plan must include all sectors of energy not limited to electricity.
2. Mandate the SEA and/or CEB to achieve the set targets. They may develop strategies to use public funds or encourage private investments to achieve this goal in an optimal manner in line with the stated goals. There need be no restriction that the renewable energy development be limited to the private sector, nor the adhoc capacity limit of 10 MW for NCRE

3. The feed in tariff calculation must be done by the PUCSL acting independently with the national interests as the focus, and consideration of the economic costs, rather than the commercial interests of the CEB alone, with due recognition of the cost of the externalities and not be limited to the traditional costing methodologies,
4. Implement the proposal to allow time of day metering to the domestic sector to encourage the limited storage option for roof top solar installations, in order to reduce or limit the growth of the peak load demand, thus obviating the need for the Sampur Coal power Plant or any other fossil fuel based power plants in the future. This would also encourage the use of EVs and help the CEB fill the early morning valley in the daily demand curve.
5. Electrify the railways in stages commencing from the Weyangoda- Kalutara sector
6. Empower the SEA to act as the “One Stop Shop” it was envisaged to be, to facilitate the approval process for the private developers. Obtaining the clearances for the projects from other state agencies should be the responsibility of the SEA, since all such agencies are represented in the Project Approving Committee of the SEA.
7. Ensure that the approvals once issued by the SEA with the concurrence of the other relevant agencies are honored by the provincial administration and political authorities. Resolving any issues thereby should be the responsibility of the SEA.
8. The responsibility of facilitating the power evacuation from distributed power generation systems should be with the CEB. A close coordination between CEB and SEA is required so that the CEB can be proactive in this regard and thus encourage location of power plants in optimal locations.
9. The provisions in the SEA Act to promote RE development, such as the cess on the fossil fuel imports, the establishment of the RE development Fund to be implemented immediately.
10. Set baseline energy intensity for different sectors of consumers, based on best practices to limit the growth in demand, and provide facilitation and incentives to achieve same
11. Set a date by which the use of Incandescent Bulbs for lighting is heavily discouraged by suitable fiscal measures.
12. Set targets for fully eliminating the use of fossil fuels for thermal energy needs of industries by switching over to biomass.
13. Use the “Divi Neguma” program to expand the supply base for SRC fuel wood in homesteads, thereby ensuring the supply of fuel wood for industrial thermal needs and for power generation in stages
14. Encourage the forest department to utilize the large extents of scrub lands for fuel wood plantations in a manner not detrimental to the eco systems.
15. Encourage the tea and coconut plantations to generate their own fuel wood needs from within the plantations and create a surplus over and above their internal needs.
16. Set additional targets and milestones for reduction of use of fossil fuels for transport in addition to the 5% reduction by 2025 already proposed. This change over is happening at much greater pace and more challenging targets are achievable.
17. Immediately set up charging stations at all major towns for EVs, with regulation of charging costs.
18. Encourage all corporate offices both public and private, to provide solar PV based charging stations in their car parks and thus encourage the use of EVs by their staff.

While there could be many more initiatives possible, the above would constitute a good starting point and yield immediate dividends, towards “ An Energy Empowered Nation”

Eng. Parakrama Jayasinghe

parajaysinghe@gmail.com

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