

A Road Map for an Energy Independent Sri Lanka by 2030

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Abstract.

The independence of our energy sources is an urgent national imperative.

“Sri Lanka Energy Sector Development Plan for a Knowledge Based Economy 2015-2025” was published by the Ministry of Power and Renewable Energy a few years ago.

These are very laudable and for Sri Lanka imminently achievable goals, addressing the energy sector in a border perspective. Thus maximizing the contribution of indigenous resources, technology and skills is equally important as exemplified by the “Prosumer Concept”. Where the consumer also become a power producer (prosumer explanation)

Energy needs are not limited to electricity. However, growing evidence points to electricity being the major source of energy in the near future serving many sectors including transport, supported by advances in technologies and diminishing cost trends in the world. Sri Lanka has every opportunity to benefit from these trends.

Thus, a well thought out road map covering not only the technological aspects, but policy, public awareness, social issues and certainly the economic aspects is an urgent need. This paper provides some background and proposals for such a road map leading to the goal of Sri Lanka with 100% renewable energy for most sectors by the year 2030 or earlier.

Key Words :Energy Security, Indigenous Energy, Prosumer Concept.

1.0 Introduction and Historical Background

The need and urgency for achieving a status of energy independence for Sri Lanka have been discussed with increasing frequency in the recent years. This is driven by the two related and increasingly compelling trends seen, on one hand the end of the fossil fuel era and on the other, the bitter truth of the global warming and climate change which are now impossible to ignore. Of particular relevance to Sri Lanka is the 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 at 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.[1] It is no longer possible for tea, rubber and coconuts to generate adequate foreign exchange to import oil and coal. It is distressingly obvious that we are able to continue on this basis, only because of the remittances from expatriate workers, some of whom work under the most unsatisfactory conditions.

These issues have received the attention of successive governments limited to ambitious goals and targets spelled out in published policy statements. The publication “An Energy Empowered Nation, Ten Year Development Plan for a Knowledge Based Economy 2015-2025” [2] which was published a few years back by the Ministry of Power and Renewable Energy aims at a goal of 100% indigenous energy by the year 2030. This paper attempts to spell out a road map to achieve this goal, which by no means is impossible, by examining the present status, Sri Lanka’s indigenous energy potential, the barriers to overcome and most important the much needed strong policy initiatives.

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. The situation in the case of the electricity power is even more pathetic, as we have deteriorated from a high 95% hydro based generation to 27% now. The dependence on oil and coal has increased to over 70% by 2017[3]. This is not due to lack of any indigenous renewable sources in Sri Lanka but due to our ineptness in harnessing such resources and the lack of vision.

2.1 The Role of Electricity in National Energy Demand

Sri Lanka is well endowed with adequate indigenous energy resources and with the promise of natural gas from Mannar basin, it is well within our means to devise our own strategies and long-term plans to achieve the desired goals of long-term sustainability and security in energy supplies. It is also necessary to recognize some important issues which appear to be not receiving adequate attention both in the public discourse and in the information reaching the public from the relevant authorities. Thus attention needs to be paid to the issues.

2.2 Energy is not limited to electricity.

In fact, electricity occupies only a minor fraction in the national energy basket. Currently it is only about 11% of all forms of energy covering electricity for domestic, commercial, industrial use, thermal energy for industrial use, domestic and commercial use and fuel for transport including that of agricultural machinery. The energy balance below illustrates the relative importance:

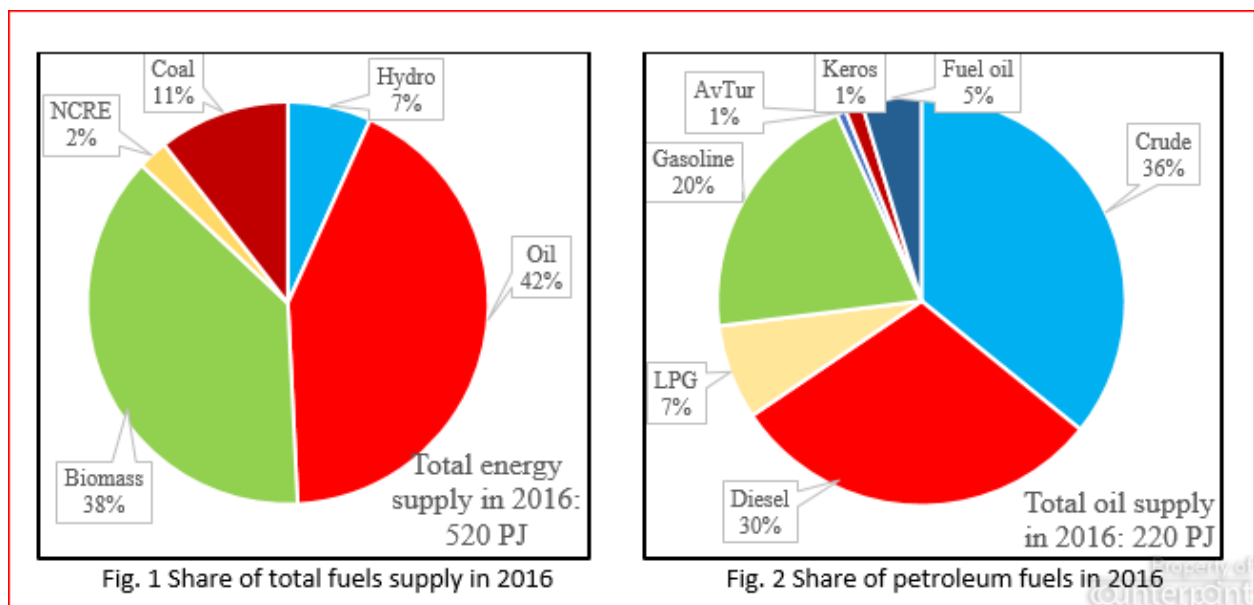


Figure 1: Supply of energy by different sources in year 2015 [11]

However, considering the flexibility of usage and the value of electricity as a highly adaptable form of energy, as well as the current state of technologies and economies, it holds the promise of making electricity the prime form of energy for most of energy needs, even in Sri Lanka. As such, the way forward could primarily address the means of maximizing the use of electricity for the national energy needs as well as the optimization of the indigenous resources for its generation.

2.3 The Major Problem of Energy for Transport

While the world over the transport sector has had to depend on the fossil fuels for its transportation needs, including Sri Lanka, we had in the past the good fortune and the good sense to optimize the use of the more efficient modes of public transport such as trains and buses. However, this picture has changed with the decline of public transport with exponential expansion of inefficient modes of transport such as cars, three wheelers and motor cycles.

2.4 Thermal Energy for Industries

The industrial sector has fared relatively better, as the contribution of biomass for thermal energy needs has remained high at 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. The domestic sector, too, has drifted towards the use of LPG as a source of energy for cooking, but the use of fuel wood remains at a significantly high level.

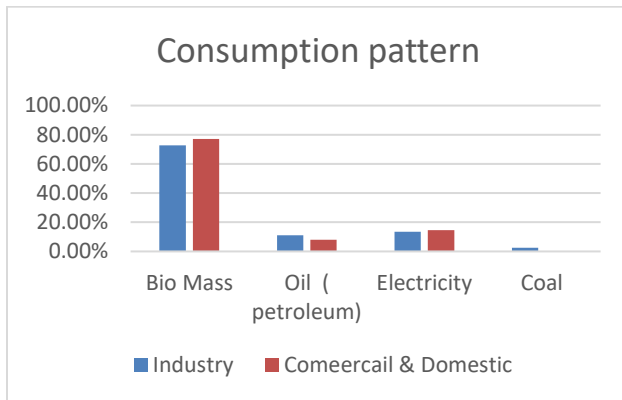


Figure 2 -Energy Consumption by Industries and Domestic and Commercial Sectors [3]

3.0 Present Status

The relative contributions of the different sources of energy to meet the national energy demand over the past decade are illustrated below. It is seen that on this macro scale there has been a retrogressive change by reducing the contribution from indigenous resources such as biomass and hydro power replaced by imported oil and coal.

3.1 Primary Energy Supply

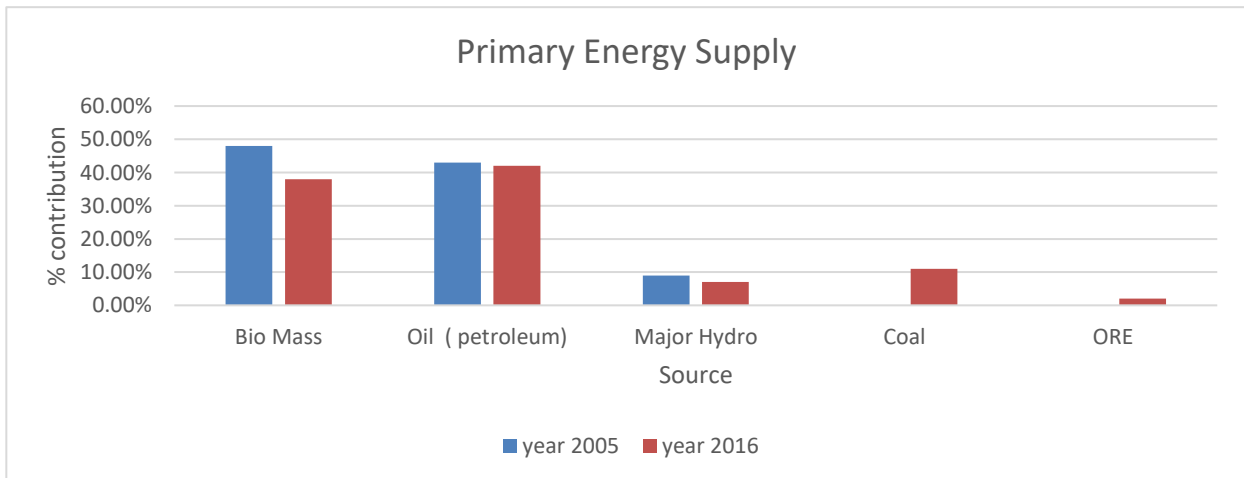


Figure 3 – The change in Primary Energy Supply 2005 to 2016 [3]

This deterioration of the security of energy supplies is more marked when considering the resources used for electrical generation as seen below:

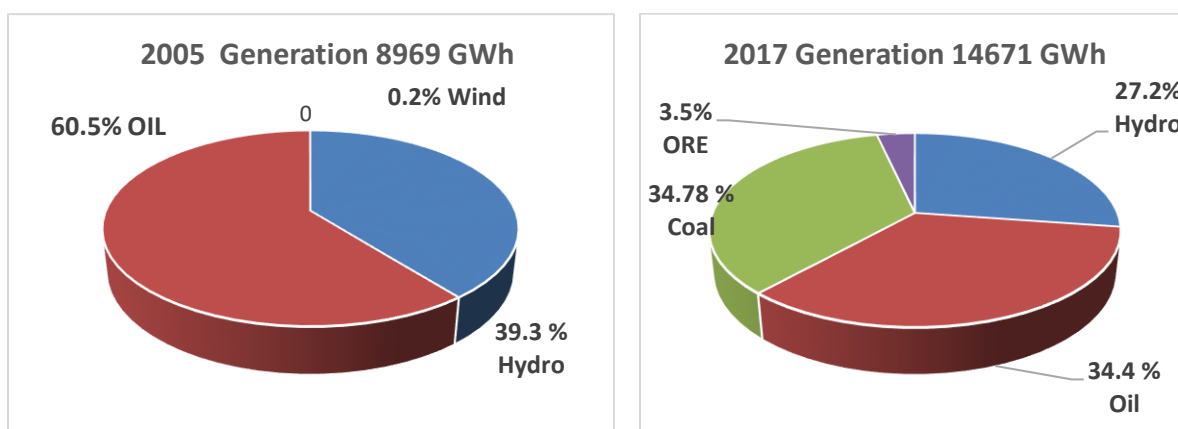


Figure 4 –Change in Sources of Electricity Supply 2005 to 2017[3]

The impact of the first coal power plant, installed under much controversy, on electricity generation has been significant. However, the frequent breakdowns of the 900 MW power plant and the environmental problems faced are yet to be resolved and have highlighted the need for more responsible evaluation of the feasibility of any coal power additions to the grid.

In this back ground, the role of Nonconventional Renewable Energy (NCRE or ORE) development by the private sector, mandated by the Sri Lanka Sustainable Energy Act of 2007, contributed significantly to bridge the mounting gap between electricity supply and demand. This contribution, up to the year 2015, has been steady and growing as shown below. However, this progress, too, has been stalled since the end of 2015 with no new NCRE project approvals from CEB. The ensuing gap is now being filled by more oil based emergency electricity generation.

Table 1 – The present status of NCRE Projects (31st Dec 2017)

Other Renewable Energy Technology		No of Projects	Capacity (MW)
1	Mini Hydro Power	182	354.044

2	Biomass - Agricultural & Industrial Waste	4	13.08
3	Biomass - Dendro Power	6	13.02
4	Solar Power- Parks	8	51.36
5	Wind Power	15	128.45
Total		213	560

Source : SLSEA

One other positive change, which is worth of noticing, is the development of roof top solar PV systems supported by the three systems of net metering under the Surya Bala Sangraamaya announced by the Ministry of Power and Renewable Energy in August 2016. This has added nearly 170 MW of generation capacity from over 17500 installations of varying capacities. A further addition of over 100 -200 MW annually from roof top solar PV is considered feasible.

5. The Way Forward for an Energy Secure Nation

The present status of the energy supply in Sri Lanka as well as the encouraging developments in the world, including technological advances as well as favorable downward trend of many renewable energy technologies, have pointed the way forward for a secure energy status.

Sri Lanka is dependent largely on the CEB for providing uninterrupted electricity to the country as they hold the monopoly for the electricity sales and owns of the national grid. As stated above, electricity could easily be a major contributor in the total primary energy supply. As such, the CEB should recognize this certainly and be the champions of this change by using their monopoly status. In this effort there is the need to take into account the impact on the national economy, environment, health and social aspects with a broader outlook, than the insular attitude presently exhibited. The danger exists of the relevance and the monopoly position of a centralized utility being overridden by other movements, which are now feasible with the technological advances as already demonstrated in countries like Australia, Germany Denmark, China and the USA.

These should lead to an energy sector no longer dependent on the use of any imported fossil fuels. Such planning must emerge from a visionary national policy on the energy sector which is a crying need. The initiative of the former Minister of Power and Energy for the development of a **Sri Lanka Energy Sector Development Plan for a Knowledge Based Economy 2015 to 2025** provides a harbinger of such a policy.

The projected goals are very laudable and highly achievable in Sri Lanka, given our past record of near 100% hydro power contribution and near 50% contribution by biomass to primary energy supply. Therefore, the goal of 100% renewable energy, by the year 2030 as envisaged, is not a daunting task as it would appear at first sight.

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 4,087 MW, consisting of 900 MW of coal power, 1,291 MW of oil burning thermal power, 1,391 MW of hydro power and 477 MW of non-conventional renewable energy sources such as wind, mini hydro, biomass and solar power plants”. [5]

Two other concepts are gaining recognition which will further enhance the movement towards an energy sector fueled by indigenous resources.

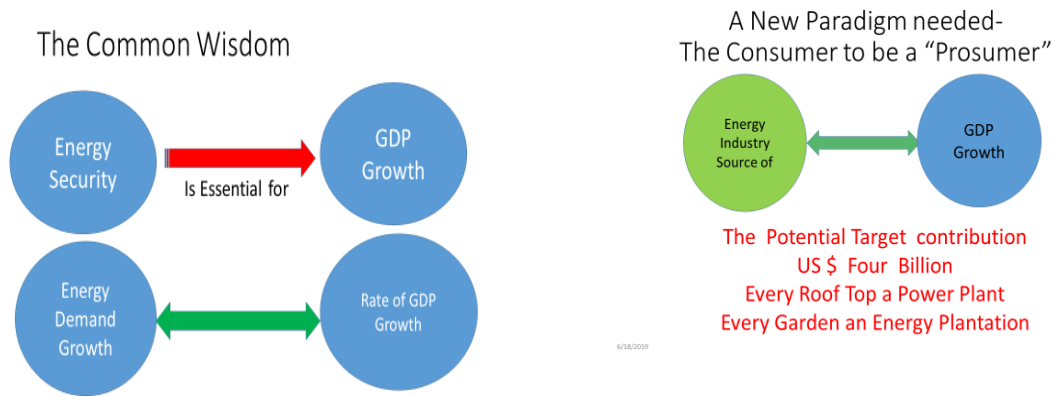


Figure 5: The Paradigm Shift on Energy Policy

With the declining rate of GDP growth seen in the recent years, further affected by the recent tragic events, the major sectors contributing to the economy have had a setback. As such, the above option of making energy supply and industry an indigenous endeavor is an attractive option which has the salutary impact of enhancing future energy security.

Closely coupled to this is the seriously deteriorated balance of payment situation. The ability of the export earnings, from the three traditional exports of tea rubber and coconut, to fund the import of the fossil fuels, was surpassed by the year 2008.

Both these problems are overcome if development of indigenous energy resources and technologies, for them, are integrated to the main stream energy economy. The technical and economic feasibility of this option has already been proven by the NCRE sector as well as the increasing contribution of biomass for industrial thermal energy needs. The rate at which this change can be accelerated is determined only by the adoption of correct national policies and strategies, which are sadly lacking due to the parochial and antiquated concepts which continue to be followed by the political authority as well as the engineering professionals vested with the important responsibility of ensuring long-term energy security.

6. The Road Map and the Conclusion

Due to the inevitable trend of electricity becoming the major contributor for the major energy supply, this paper has given greater emphasis to discuss this sector. Regarding the other major sector of industrial thermal energy, the trend has already changed and there are laudable programs to modernize and ensure sustainability of biomass as the source of thermal and electrical energy for this sector.

While many countries including India, UK and Denmark have already declared target dates for electrification of the transport sector, no such goals are set for Sri Lanka. But, this change is inevitable even if delayed by a lack of vision.

The practical potential of renewable energy available for us has been reported by a recent ADB study[10] Against this, the projected potential of indigenous sources of energy given as Biomass 2400 MW, Mini Hydro 873 MW, Wind 5653 MW and Solar 6000 MW, from just 1% of the scrub lands, must be revisited.

Table 2 – The Practical Potential of Renewable Energy for Electricity generation

Resource	Total Potential	Practical Potential	Predicted Demand by 2030 and (Current)	Remarks
Mini Hydro		873 MW	Electricity only 5893 MW (4087) 30644 GWh (14500)	Resource targeted for thermal energy as well
Bio Mass	2,596,000 ha of suitable lands for energy plantations	2400 MW		
Wind	24,000 MW	5650 MW		
Solar	Unlimited	6000 MW based on energy of 1885 kWh/m ² /year		Land requirement of only 1% of the scrub lands of extent 1.6 Million ha.

These resource predictions need to be considered in comparison with the current electricity generation of 14500 GWh from 4087 MW of power plants and the predicted growth up to 30500 GWh by 2030. The fossil fuel demand for transport is estimated to grow up to 565.7 PJ (21,880 kT/year) by 2040 from the current 128.1 PJ(4950.7kT/year) [12]

Contribution through Energy Conservation and Improved Efficiencies

The role to be played by Demand Side Management, not limited to electricity, is most important in energy conservation. The work done by the SLSEA has demonstrated the potential contribution of saving 1875 GWh in electricity by 2020 and reaching over 20% in some sectors. [6]

It was shown that thermal energy demand of the domestic and industrial sectors is, even now, served overwhelmingly by biomass. Thus, the financial considerations alone will drive them towards a 100% indigenous energy supply including a growing contribution from electricity, too, if the potential of self-generation using Solar PV is realized.

A major change required is the electrification of the transport sector, which will be the next challenge to be taken up.

It is often stated strongly, by reputable energy experts, that a grid supply cannot rely on 100 % renewable energy. Unfortunately, such statements are made only by considering the time-variable resources such as wind and solar energy. However, such narrow resource commitment is not necessary for Sri Lanka with its 1350 MW of major hydro power and the considerable contribution that can be made from Dendro power, both are firm and dispatchable (where the Utility can demand generation as and when required) energy resources. These provide a window of opportunity to make the proposed change to renewables. What is needed is not to make further investments on plants such as coal, which have proven to be not the best economic and environmental solution. Thus, the emerging deficits should be bridged using indigenous resources. Sri Lanka is indeed fortunate that all such resources are also renewable except, perhaps, the Mannar Gas resource which in any way is an indigenous resource.

It is important also to state that it is not necessary for all or any such renewable energy plants to be developed by the private sector. If the CEB could accept the reality of the writing on the wall they should be the champions of the change, taking up whatever is viable for them to implement on their own as is being done in the Mannar Island. Otherwise, they should have the perspicacity to leverage the interest and funds of the private sector while adhering to the principles stated above and in keeping with the principle of Least **Economic** Cost of Generation.

The CEB is quite right to state that there are many complexities and intricacies in integrating new (renewable?) power plans to the national grid, which is their own (experience?) expertise. Mere proposals, for development of different resources or technologies, are not adequate without taking into consideration such issues. However, it is also necessary for the CEB to realize that it is in their mandate to develop and

manage the grid to absorb such (what?) changes which are inevitable. However, the fact that intermittency of solar and wind power generation is no longer a problem as amply demonstrated, over a year ago in South Australia, with the installation of the Hornsdale Power Reserve of 100 MW battery [7] Other technologies, such as more sophisticated inverters, more accurate forecasting for both solar and wind and updated IEEE standards 1567 -2018 [8],[9] are already in service to overcome the perceived problems earlier with a larger percentage of integration of non-firm energy resources, in effect making them dispatchable. Thus, the immense bounty of these two resources, that Sri Lanka is endowed with, can now be harnessed toward ensuring future energy security as well as paving the way towards much enhanced role of electricity in the national economy.

It is the role and mandate of the engineers of all disciplines to contribute positively to adapt and adopt such changes in the interest of Sri Lanka.

7. The Renewable Energy Potential and Practical Projections

What we need are the correct policies and strategies to progressively move towards the desired goal. In this regard, the macro policy is clear with the following milestones some of which are stated in the development plan Energy Empowered Nation.[2]

In addition, the following goals are also important:

- Convert progressively the balance fossil fuel usage in industrial thermal energy to bio mass and/or electricity by the year 2025.
- Maximize roof top Solar PV generation, in the domestic sector as envisaged by Surya Bala Sangraamaya, with necessary incentives to entice the lower level consumers, too. This sector is the source of major drain on CEB revenue as the CEB loses over Rs 15 per unit supplied to this sector while the average cost of generation is over Rs 20 per unit.
- Facilitate the introduction of limited battery storage for all roof top solar PV installations to draw from during the peak hours, particularly for the domestic consumers who contribute the largest share of the night peak demand. This will eliminate the need for additional large scale power plants to a great extent to meet the increasing peak demand..

8. Policy Initiatives

None of the above targets can be met unless there are overarching national policies which are mandatory on all parties in the public- and the private-sector, as well as the general consumers. The updating of current policies or arriving at new policies is required as noted below:

- The National Energy Policy needs to be updated with the vision to achieve energy none dependence on foreign imports, to provide all forms of energy, not limited to electricity. This will require the entire subject of energy supply to be placed under one Ministry, including the petroleum sector which will continue its significant presence for several decades. The policy should clearly identify the time-targeted sector wise goals and the relevant parties mandated to achieve the goals. The following points are to be recognized in formulating the policy:
 - Adequate and wide consultation with stakeholder-including the public consumers
 - Holistic approach to meet all energy needs, not limited to electricity only
 - The major role to be played by electricity in the future energy scenario. This requires a firm and time-targeted policy for electrification of the transport sector
 - Recognize the wider role of energy industry by itself as a contributor to national economic growth
 - Need for none dependence on imported energy resources and its impact on balance of payments

- Spin-off benefits to other sectors of the economy from development of indigenous resources in energy supply and management
- Promoting the concept of “Prosumer” whereby, the consumers themselves become producers of electricity, via the Surya Bala Sangraamaya and introducing “wheeling” (whereby consumers are permitted to use the transmission system to harness electricity generated by them in locations remote to the point of consumption), to bring in the larger consumers in to the “Prosumer” sphere
- Promoting energy storage, at domestic consumer level, to reduce the night peak demand
- Grid-level storage to be introduced to facilitate larger level of integration of solar and wind power
- The clear role of the PUCSL as the regulator and ensuring its independence and recognition
- The long-term generation planning exercise to recognize the larger role to be played by electricity and the impacts on other sectors of the economy and thus be subject to scrutiny by a wider stakeholder consultation.

9. The Road Map

Since there is no dearth of the indigenous energy resources, the obvious way forward is a well formulated holistic energy policy and 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 (feasible?). Thus, the investments by the CEB should primarily be targeted towards developing and enhancing facilities to absorb power from decentralized small-scale power plants. The significant role that Demand Side Management could play to reduce the magnitude of the problem has to be recognized and pursued for its best effect. Thus, the burden of investments on further power generation can be transferred to the private sector, except where the CEB may find it more attractive to do so, without a burden on the public finances. This is due to the improved potential for distributed generation with smaller power plants, for which the level investment required is within the capacity of even local private sector investors.

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