Feed-in-tariff in Sri Lanka

Contents

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1. Introduction

Sri Lanka is a lower middle income country with a population of about 20 million. Its per capita energy consumption is 0.4 toe and it is far below the lower middle income country average of 1.02 toe. (Table 1) In the 1990's the energy mix in Sri Lanka was dominated by hydro power (over 90%) and with the demand growth rate of 6% per annum, capacity additions were mainly done using oil-fired power plants, and as a result 60% of power was generated from oil in 2011.

Table 1: GDP per capita and energy use comparison

Key Indicators Among Comparator Countries, 2008								
	Country Classification (World Bank)	Energy use (kgoe per capita)	Energy use (kgoe/US$1,000 GDP PPP (2005 Constant Intern'l US$)	Human Development Index	Inequality Adjusted HDI	GDP per capita PPP (2005 Constant Intern'l US$)	Combustible Biomass Share of Total Energy (Percent)	2007 CO2 Emissions (MT/capita)
Bangladesh	Low Income	192	142	0.500	0.363	1,356	31	0.304
Nepal	Low Income	339	332	0.458	0.301	1,021	86	0.121
India	Lower Middle Income	545	196	0.547	0.392	2,781	26	1.432
Indonesia	Lower Middle Income	846	237	0.617	0.504	3,570	27	1.707
Pakistan	Lower Middle Income	495	214	0.504	0.346	2,317	35	0.950
Sri Lanka	Lower Middle Income	436	105	0.691	0.579	4,150	53	0.607
Vietnam	Lower Middle Income	698	267	0.584	0.510	2,611	42	1.321
China	Upper Middle Income	1,598	280	0.687	0.534	5,712	10	4.957
Malaysia	Upper Middle Income	2,645	205	0.761	n/a	12,930	4	7.183
Thailand	Upper Middle Income	1,570	213	0.682	0.537	7,378	19	4.090
Turkey	Upper Middle Income	1,389	112	0.699	0.542	12,406	5	4.121

Source: The World Bank, http://data.worldbank.org/products/data-books/little-data-book and UNDP http://hdr.undp.org/

The per capita carbon dioxide emissions in Sri Lanka at present is only 0.62 ton/y, which is far below the global average of 4.29 ton/y. This indicates that Sri Lanka has adequate carbon space for establishing fossil fuel power plants. Based on this fact, as the electricity demand in Sri Lanka is growing at a rate of about 7-8% per annum, the business as usual electricity generation expansion plan mainly concentrated on imported coal. At present coal is purchased on a three year contract from a private supplier selected from an open tendering process. The base price of coal is fixed and the escalation rate is tagged with coal and oil price indexes.

The Government of Sri Lanka however has recognized the importance of deviating from the fossil fuel dominant business usual generation expansion plan due to non-availability of coal reserves in Sri Lanka and due to its commitment to tackle climate change issue on moral grounds. Sri Lanka has expressed its intensions for bypassing carbon intensive pathways and achieving sustainable development with the international financial and technical support.

Sri Lanka introduced Feed-in-Tariff (FIT) in the early 1990's for creating an enabling environment to promote renewable energy technologies. Recognizing that it possessed few domestic alternatives, Sri Lanka decided that RE development would be essential to meet future demand growth.

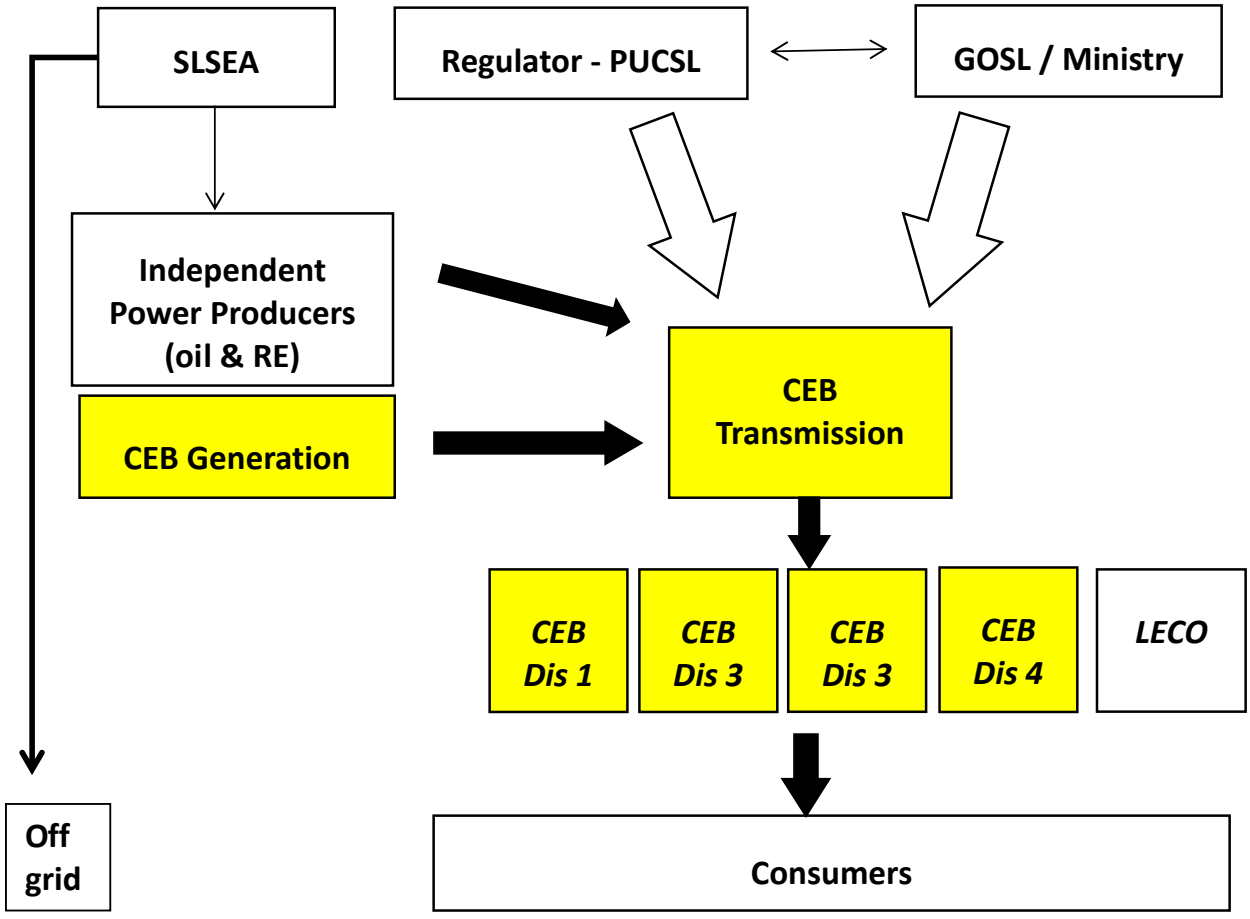
Although electricity demand in Sri Lanka is increasing a rate of 7% per annum, the sector has managed to maintain a renewable energy share of 40%, mainly due to Sri Lanka's exploitation of hydro power. In the coming years, Sri Lanka will have to exploit alternative sources of Renewable Energy (RE) if it is to maintain the same proportion until 2020.

2. The state of play of renewable energy policy and planning in Sri Lanka

Since 2009 the power sector in Sri Lanka is regulated by the Public Utilities Commission of Sri Lanka (PUCSL). This independent regulator works within the policy framework established by the Ministry of Power and Energy. The PUCSL has issued one transmission license to the transmission division of the state owned utility: the Ceylon Electricity Board (CEB). There are 5 distribution licenses issued by the PUCSL; four of them to 4 regions of the CEB and one to another state owned electricity distribution company named Lanka Electric Company (LECO).

Generation licenses in Sri Lanka are issued to CEB, its subsidiaries and to the private sector. Accordingly, CEB generation division has a generation license for 1203 MW of hydro power installed capacity and 809 MW of thermal power (coal &oil). The CEB subsidiaries have licenses for a total of 391.5 MW and the private power producers have 8 licenses for a total thermal power capacity of 465 MW. In addition, there are renewable energy licenses issued to 89 Independent Power Producers (IPP) for a total installed capacity of 211 MW. The Sri Lanka Sustainable Energy Authority (SLSEA) was established in 2007 to promote and facilitate renewable energy and energy efficiency technologies in Sri Lanka. (Chart 1)

Chart 1



In 2011, 40% of annual electricity generation (4000 GWh out of 10,000 GWh) in Sri Lanka was generated using renewable energy technologies (hydro power with plant capacities less than 200

MW). The electricity demand in Sri Lanka is increasing at a rate of 7% and the government target is to maintain a 40% share of renewable energy in Sri Lanka until 2020 by tapping other renewable energy resources such as biomass, wind, solar and ocean energy.[1] Further government has indicated to achieve carbon neutral growth in the power sector by 2020 and to follow a carbon emissions reduction pathway after 2030.[2]

The 2008 long term electricity generation expansion plan of Sri Lanka suggested establishing 4000 MW of coal power plants (85% of the capacity) by 2025. In 2010 the Minister of Power and Energy gave instructions to review the' National Energy Policy and Strategies of Sri Lanka' for creating an enabling policy environment and revising the 2008 long-term generation plan for achieving the newly introduced renewable energy targets. The Ministry of Power and Energy has appointed a multi-stakeholder committee to review the 'National Energy Policy and Strategies of Sri Lanka'. The review process is currently under way. The state owned utility, Ceylon Electricity Board (CEB), will be conducting the studies the long-term electricity generation expansion plan based on the directions of the government on internalizing the social and environmental concerns for rationalizing the incorporation of renewable energy technologies in the long term energy mix. The regulator, Public Utilities Commission of Sri Lanka (PUCSL), will make public the draft plans, and conduct public hearings for getting public comments. The PUCSL analyses the public comments and makes necessary revisions and finalize the plans.

With establishment of SLSEA in 2007 and empowering the PUCSL in 2009, the rules and regulations were changed drastically in favor of renewables. Transparent tariff setting vastly improved with the introduction of an open process which included public consultations for which the representatives of the private sector, the utility and the consumers participate.

The Government of Sri Lanka established a state owned renewable energy company in 2011 to get hands-on experience with renewable energy technologies, to understand the issues faced by the private sector while implementing the renewable energy projects, to add competitive pressures to the private sector players, and to benchmark the costs involved with RE technologies. The process began only in 2011 and it is too early access the impact of this initiative on the expansion of the renewable energy in Sri Lanka.

Feed-in-Tariffs (FITs)

The FIT introduced is for the power plants with capacities less than 10 MW and the potential sites are allocated based on first come first serve basis to the private sector firms. This tariff is not offered to power plants over 10 MW assuming that the unit cost of those is likely to be lower than the unit cost of power plants with a capacity less than 10 MW. Any investor keen on establishing a power plant in the range of 10 MW - 25 MW can submit a proposal and negotiate for a tariff less than the announced FIT. According to the Electricity Act of Sri Lanka, 100% privately owned facilities which have a capacity greater than 25 MW are not eligible for supplying power to the national grid. However a joint venture company with a certain percentage of state equity can apply for renewable energy power plants above 25 MW. The tariff for these power plants is negotiable.

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[1] "Mahinda Chinthanaya Vision for the Future" 2010 page 45: *'The contribution to electricity generation from non-conventional renewable energy sources in Sri Lanka will be raised to 10% of the total electricity production, by the year 2016.'* With 60% demand increase by 2016 the renewable energy target for 2016 is 38% (large hydro+ others).

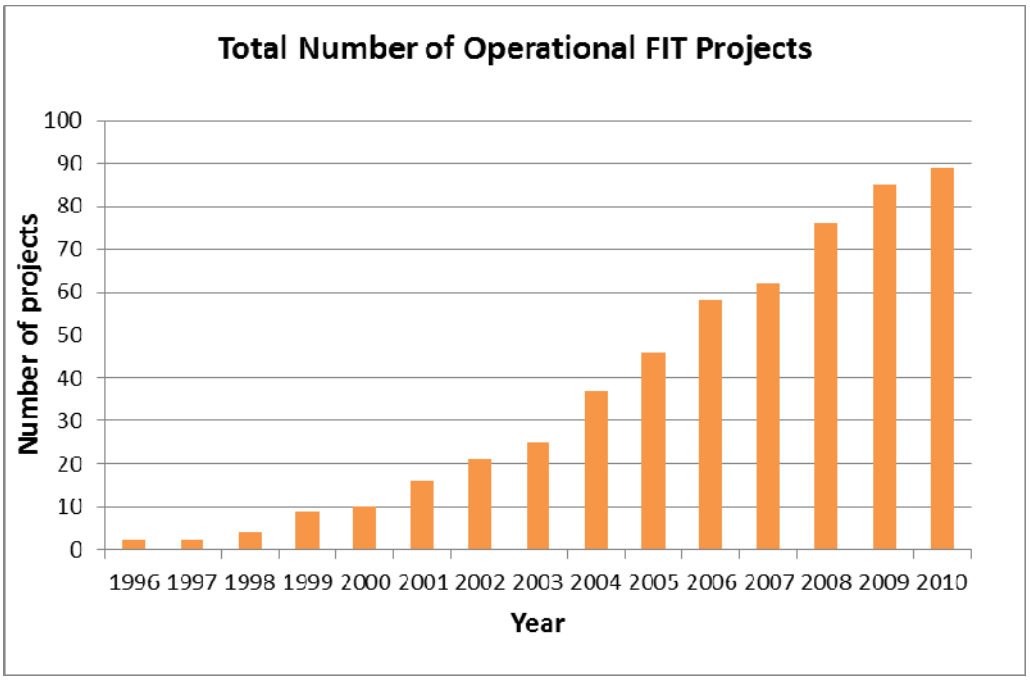
[2] Directions of the Minister given to Ministry of Power and Energy

Table 4: Project Caps and Conditions

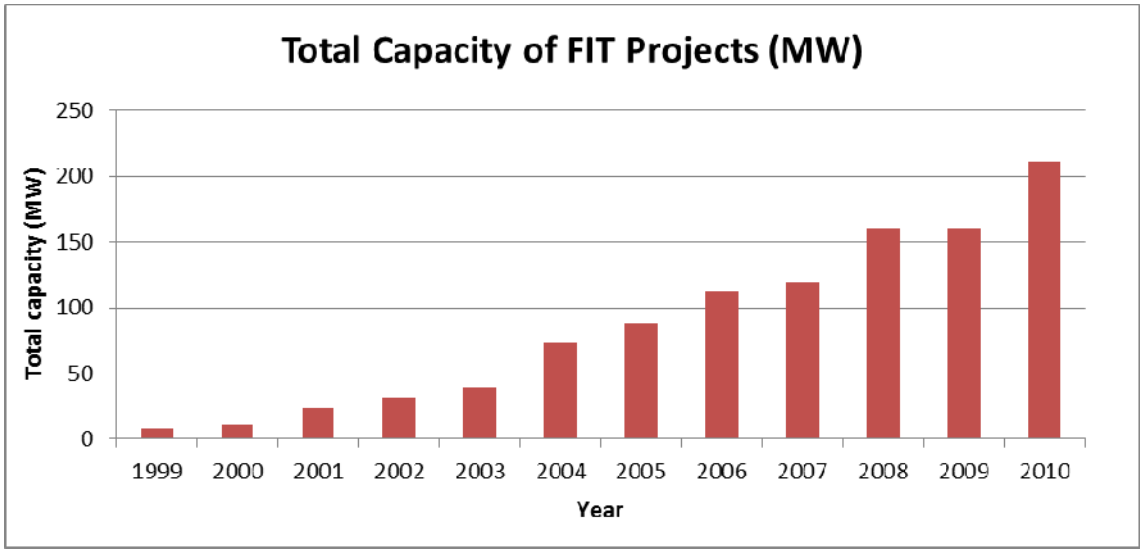
Capacity Range	Conditions applied for private sector
less than 10 MW	First come first serve basis; declared standardized tariff
Greater than 10 up to 25 MW	Tariff negotiable and expected to be less than the declared tariff
Greater than 25 MW	Need to have a state equity; tariff negotiable

Since the introduction the FIT in Sri Lanka there was a steady progress in the renewable energy sector.

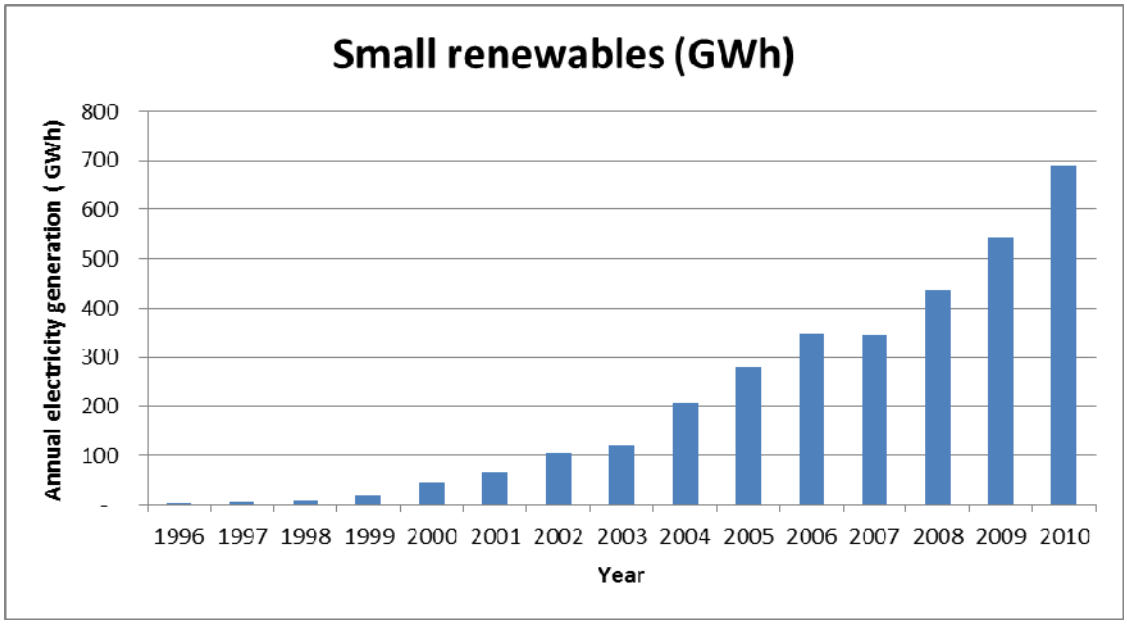
Graph 1: Total number of renewable energy projects (excluding large hydro) in Sri Lanka



Graph 2: Total capacity of renewable energy (excluding large hydro) projects in Sri Lanka



Graph 3: Annual electricity generation from renewable energy (excluding large hydro) projects in Sri Lanka



The government of Sri Lanka in early 1990 introduced the avoided cost principle for FIT and encouraged the private sector to establish renewable energy power plants with a capacity less than 10 MW. However there were no targets as such during that period. At the early stages the power purchase agreement (PPA) was signed for a 15 years period and later with the introduction of the cost based principle it was extended to 20 years.

The private sector had concerns on the way the avoided cost was calculated. Their main concerns were, not taking into account the subsidies given to the fossil fuel while calculating the avoided cost

and using a 3 year floating average for avoided cost estimates while the prices were increasing continuously. For these two reasons the announced avoided costs were less than the actual avoided cost.

Despite the concerns raised by some of the investors, the FIT was attractive enough to get participation of the private sector for establishing mini hydro power plants. As a result there were 62 power plants established by 2007 with a total installed capacity of 119 MW.

In 2007 the government established Sri Lanka Sustainable Energy Authority (SLSEA) to address the issues associated with renewable energy technologies (such as getting clearances from different government agencies). Recognizing that the avoided cost principle was not adequate to meet the cost of renewable energy technologies other than mini-hydro, SLSEA took the initiative for introducing a technology-specific-cost-based tariff for RE with capacity less than 10 MW. The FIT is applicable to the power plants having a capacity less than 10 MW. The Provisional Approval (PA) is issued to the applicants on a 'first come, first serve' basis by the SLSEA. Once the PA is issued, the project developer needs to get a Letter of Intent (LOI) from the CEB for purchasing power from the proposed plant, land clearances from relevant authorities, water use rights from the irrigation department and department of agrarian services, and environmental clearances from the Central Environmental Authority (CEA). After getting the necessary clearances, the developer will receive an Energy Permit (EP) from the SLSEA. Getting clearances from the relevant authorities was always a challenge to the project developers and it was expected that the SLSEA will play a role for accelerating the process. The SLSEA however has so far failed to adequately address this issue.

According to the SLSEA act the project developer need get the EP within a year of obtaining the PA. After issuing the Energy Permit the PUCSL will issue the generation license and the CEB signs the Power Purchase Agreement with the project developer. The FIT is standardized, non-negotiable, cost-based, sources and technology-specific. The power producer has the option of selecting either a three-tier tariff or a flat tariff. The EP and PPA are valid for a period of 20 years and extendable by mutual consent. The project developer starts the construction work after getting the PPA and it is expected that the investor will complete the construction work and commission the power plant within a 2-year period. If any project developer fails to commission the plant within the 2 year period then it is possible for the developer to apply for getting an extension. The SLSEA will give a reasonable extension period if the progress achieved by the developer is satisfactory. If not the SLSEA cancels the Energy Permit.

Accordingly, cost based technology specific FIT was introduced for mini-hydro, wind, biomass with energy plantations (Dendro Power), agricultural and industrial waste, Municipal solid waste to energy, waste energy recovery and wave energy technologies. The investor had the option of selecting the 3-tier tariff or the flat tariff for a 20 year period. Later, the wave energy tariff was removed as there were no investors keen on investing on wave power at the declared tariff. The mini hydro tariff was the lowest of all as the cost of mini-hydro was relatively low. Further it was less risky as the technology was familiar to Sri Lankan investors and financing institutions. At the initial stage these tariffs were establishing by reviewing the proposals submitted by potential investors. The tariffs were announced only for above mentioned technologies and the all the other renewable energy technologies were not considered for FIT, either because the government lack reliable data to fix the tariff or because the costs involved with those technologies were too high for introducing a reasonable tariff without burdening the consumers.

Some investors however expressed their willingness to invest and generate power from other renewable energy sources such as solar and geo thermal energy claiming that they can provide electricity at competitive prices. They claimed that they are in a position to do so as they have

certain comparative advantages such as access to lending with low interest rate, lower capital costs, more efficient technologies etc. In order to create an enabling environment for them to generate power and sell to the grid, the government announced a tariff cap in 2011. Accordingly any other renewable energy technology that does not have a declared tariff would be offered a flat tariff of SLRs. 20.70 per kWh, for 20 year period.

Three-tier Tariff

The Three-tier tariff consists of a 'fixed rate', an 'operations and maintenance' (O&M) rate and a 'fuel rate'. The 3 tier tariff was introduced to allow the investors to receive a fair return during the loan repayment period. To compensate for the higher tariffs in tier 1, developers are required to deliver an average amount of energy at least equal to that delivered in tier 1 during the tier 2. This obligation is stipulated in the agreement, with corresponding penalties for non-delivery in tier 2.

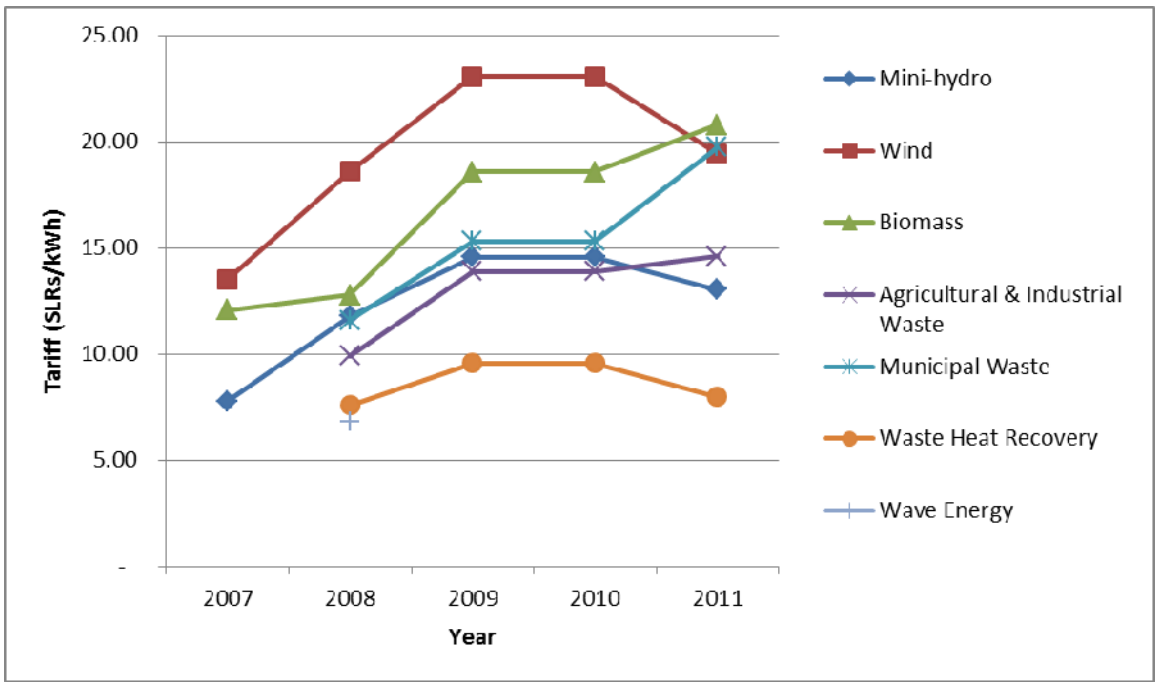
Table 2: 3-Tier tariff used in 2011 (LKR/kWh) for 20 year period

Technology / Source	Non-escalable			Escalable	Escalable	Escalable Year 16+	
	Year 1-8	Year 9-15	Year 16+	Base O&M (year 1-20)	Base Fuel (year 1-20)	Base Tariff to SPP	Royalty (% of total Tariff)
Mini-hydro	12.64	5.16	None	1.61	None	1.68	10%
Mini-hydro-local	12.92	5.28	None	1.65	None	1.68	10%
Wind	17.78	7.26	None	3.03	None	1.68	10%
Wind-local	18.28	7.47	None	3.11	None	1.68	10%
Biomass (1-15 ys)	7.58	3.10	None	1.29	9.10	1.68	None
Biomass 16yr onwards	7.58	3.10	None	1.61	9.10	1.68	None
Agro & Indus (1-15 ys)	7.58	3.10	None	1.29	4.55	1.68	None
Agro & Indus 16yr onwards	7.58	3.10	None	1.61	4.55	1.68	
Municipal Waste	15.16	6.19	None	4.51	1.75	1.68	None
Waste Heat	7.13	2.65	None	0.43	None	1.68	None
Escalation per year	None	None	None	7.64%	5.09%	5.09%	

Table 3: Flat tariff - All inclusive rate (for years 1-20) in USD Cents/kWh used since 2007

Year	**2007**	**2008**	**2009**	**2010**	**2011**
Mini-hydro	6.87	10.42	12.90	12.90	11.54
Mini-hydro - Local	-	-	-	-	11.79
Wind	11.96	16.47	20.42	20.42	17.19
Wind - Local	-	-	-	-	17.67
Biomass	10.67	11.30	16.42	16.42	18.32
Agricultural & Industrial Waste		8.76	12.28	12.28	12.86
Municipal Waste		10.26	13.55	13.55	19.49
Waste Heat Recovery		6.70	8.45	8.45	5.88
Wave Energy	-	6.04	-	-	
Any other renewable energy technology	-	-	-	-	18.32

The declared levelized tariff in the recent past



Other Incentives

When the new scheme was introduced the projects which were commissioned prior to 2007 were allowed to switch to cost based tariff or to continue with the avoided cost tariff. The projects which are still continuing with the avoided cost principle are offered a dry-season tariff and a wet-season tariff where the dry season tariff is higher than the wet season tariff. The Board of Investment (BOI) registered investors with a capital investment of over USD 3 million, get an Import Duty exemption and Corporate Tax holidays for a 5 year period.

FIT setting

Since the establishment of the Public Utilities Commission (PUCSL) in 2009, the process for tariff setting has become more transparent. Towards the end of a calendar year the utility (CEB) with the SLSEA inputs, compiles the FIT proposal for the coming year and submits it to the PUCSL. The PUCSL publishes the CEB proposal, conducts public hearings, get public comments, makes necessary changes, and announces the FIT at the beginning the coming year.

It is difficult to assess the added cost of electricity due to FIT rates as the fossil fuel is heavy subsidized. The government of Sri Lanka has so far not considered the option of reducing fossil fuel subsidies or a tax on fossil fuels as a financing mechanism. However the government has given instructions to internalize factors such as subsidies given to fossil fuel, the difference between local & foreign costs and environmental costs while formulating long term electricity generation expansion plan. The outcome of this planning study will be used for prioritizing the technologies.

From the utilities' perspective, the main concern on existing FIT is that certain projects are getting windfall profits. The utility lacks the reliable data to assess the true cost of power plants for tariff setting. Tariff setting for the "typical case" inaccurately reflects the true conditions at most sites.

The regulator sets tariff using a 1 MW plant as a benchmark. This practice ignores economies of scale, allowing higher capacity plants to receive higher profits. Differentiated tariffs require analysis on different project sizes, at the very least a few price benchmarks to allow for "linear interpolation" between the two points. Basing FITs on one "normal size" project is bound to be precisely wrong almost all of the time, which opens the door to gaming and to the "windfall profits" that the utilities are concerned about. Differentiated tariffs will encourage establishment of low-head mini hydro power plants and the power plants with a capacity less than 1 MW the costs of which is higher than the existing mini hydro plants. It is better to study the international experiences on these and adopt a suitable mechanism to tap these resources in the future.

From the project developer's perspective, there are several concerns: Developers argue that the plant factors used for the tariff calculations are too high. Some developers highlight the need of having a separate tariff for biomass power plants using both wood and waste as fuel. The availability of finance is also a critical constraint. Despite having the World Bank financing mechanism, the registered Participatory Credit Institutions (PCI) were reluctant to release funds for most of the technologies (other than mini hydro and wind) as it is the responsibility of the PCIs to evaluate the project proposals. They do not have the confidence over the financial viability and the sustainability of certain technologies. It is important that the "capacity building" should not only target technical staff on the ground and the regulators, but also the lending community. A key part of a successful FIT relies on an education of the lenders, to become more familiar with the technologies, and the terms.

Finally, the lack of a FIT for technologies such as solar PV is also an issue. No FIT has been declared for technologies such as solar PV due to their estimated high upfront costs. The government however has introduced a tariff cap of SLRs. 20.70 per unit (US cts. 18.5) for all the other renewable technologies expecting that the investors with comparative advantages may still be able to initiate certain projects.

Financing

The Government of Sri Lanka together with the World Bank introduced a lending scheme under its Energy Services Delivery Project (ESDP) and Renewable Energy for Rural Economic Development (RERED) from 1997 to 2010. Under these projects the World Bank provided a soft loan to the Government of Sri Lanka (GOSL). These projects were designed to lend funds through intermediaries (Participating Credit Institutions (PCIs)) to sub-borrowers undertaking renewable energy projects. Any private enterprise, non-governmental organization (NGO), co-operative or individual operating in Sri Lanka was considered as an eligible enterprise. Once the loan was approved, PCIs forward a completed loan Refinance Application (RA) form requesting commitment for a maximum of 80% of the approved loan amount. Release of grant funds by the Administrative Unit of the World Bank project was based on evidence of work done. The GOSL released these loans at Weighted Average Cost of Capital (WACC) through registered financial institutions to the project developers. The WACC was annually calculated by the Administrative Unit of the World Bank funded project. However this financing mechanism ended in 2011 and there is a need to establish a follow up financing mechanism as there are new ambitious targets given to the renewable energy sector.

Technical environment

The mini hydro sector has a history of over 18 years in Sri Lanka and it has become a mature industry. There is adequate human capacity and technical know-how to construct, operate and maintain the mini hydro power plants in Sri Lanka. After gaining experience one of the local mini hydro companies has entered the turbine manufacturing industry, and the government recently

introduced a higher FIT for mini hydro plants having local turbine for encouraging local value addition. Furthermore the mini hydro developers have expanded their market to some of the African countries. The wind energy sector is now following the path of the mini hydro sector, and started manufacturing wind turbines locally. Local jobs help build local capacity, which helps increase the benefits to Sri Lanka. The existence of local manufacturing also tends to give rise to a more stable policy environment, as it employment opportunities.

Sri Lanka has over 20 years of experience in off-grid solar PV sector and was able to establish over 100,000 Solar Home Systems (SHS) with a total capacity of about 3 MW. The mechanisms were well established for marketing SHS however it was not possible to utilize this strength for further expansion due absence of a Feed-in-Tariff for solar PV. Sri Lanka, despite having a significant potential for geothermal, wave, and OTEC technologies has failed to initiate a process for tapping these resources. It is important to recognize these opportunities take necessary measures for utilizing these technologies.

Current status

There are 98 renewable energy project with a total capacity of 234 MW commissioned in Sri Lanka since the introduction of FIT. In 2010 the electricity contribution from small renewables was 6.5%. With the projects in the pipeline it is possible to achieve the government declared non-conventional renewable energy target (renewable energy other than large hydro) of 10% by 2016. The already committed plants at present will be able to generate over 2000 GWh/y which will be over 13% by 2016. With the proposed wind and solar parks the annual electricity generation will be increased to 2430 GWh/y which will be about 16% by 2016.

Table 5: Current status of the non-conventional renewable energy sector

		Biomass		Mini Hydro		Solar		Wind		All	
		No.	MW	No.	MW	No.	MW	No.	MW	No.	MW
1	**Commissioned (generating)**	**3**	**13**	**87**	**189**	**4**	**1**	**4**	**31**	**98**	**234**
2	Under Construction	15	74	112	211			10	99	137	384
3	Valid Provisional Approval	7	81	37	41	1	10			46	142
	Committed (1+2+3)	**25**	**167**	**236**	**441**	**5**	**11**	**14**	**130**	**281**	**759**
	Wind Farm							1	100	1	100
	Solar Farm							1	100	1	100
	Estimated annual energy generation from committed power plants (GWh/y)		850		1350		15		225		2,440

The estimated potential in the Renewable Energy (RE) at present is as follows:

- Hydro Power Potential - 1960 MW @ 40% pf (1290 MW already tapped)
- Dendro Power Potential - 900 MW @ 70% pf; BEASL estimate - 3,000 MW
- Wind Power Potential - 3000 MW @ 30% pf; NREL estimate 20,000+24,000 MW
- Solar Power Potential - 4.5 to 6.0 kWh/m2/day @ 16% pf
- Wave Power Potential - 200 MW @ 65% pf; NARA estimate- 2000 MW
- OTEC Potential -Trincomalee Canyon is the one of the world best places
- Geothermal Potential - 30 MW; (Geological Survey and Mining Bureau (GSMB) estimate)

Non availability of proven fossil fuel reserves and the estimated RE potential lays the foundation for the promotion of the renewable energy in sector Sri Lanka.

Sri Lanka has a proven track record of about 20 years with FIT mechanisms. It accepts the role of private sector in establishing renewable energy power plants. International financing agencies have the confidence to financially support Sri Lanka as it has always serviced debt. The private sector, financing institutions and the utility is familiar with the established mechanisms.

The FIT related technologies in Sri Lanka are not yet recognized by the Long Term Electricity Generation Expansion Plan (LTEGEP) as the computer models used by planners are not sophisticated enough to use non-dispatchable technologies such as wind and solar as candidate options for generation planning. Further, unless the external social and environmental costs are not internalized the renewable energy will not be economically feasible. The planners have failed to internalize such technologies while conducting their studies. This has become a major obstacle for FIT for wider application as those technologies are considered as expensive options that burden the consumers.

The FIT in Sri Lanka is calculated taking into account the estimated cost of the project and a declared Return on Equity (ROE). As the full cost is paid it is not possible for the project developer to claim carbon credits for the project. The government on the other hand is not in a position to bear the additional costs and it is therefore passed either to the rate payer or to the tax payer at present. There is a concern among the consumers on this issue they may not favor establishing renewable energy using FIT. The government need introduce a carbon trading mechanism to cover additional costs involved with renewable energy to ensure successful implementation of FIT in Sri Lanka.

3. Needs and potential for increased international support

Most important barriers and gaps that need to be addressed to enable further scale-up of renewable energy are as follows:

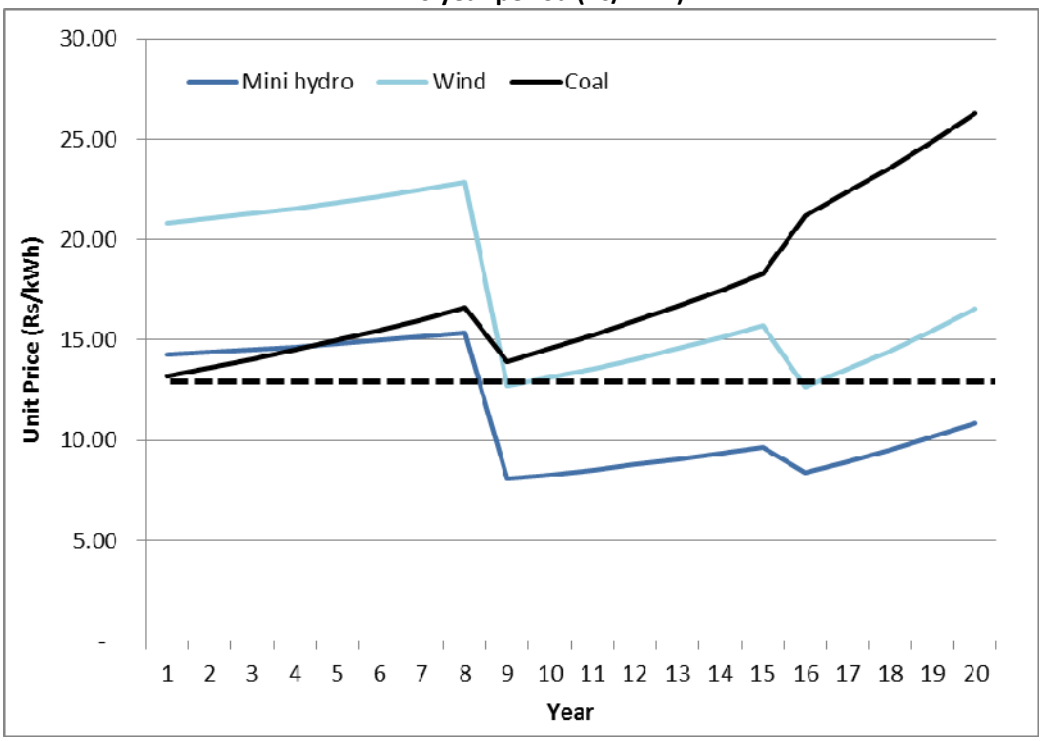
1. The World Bank funded financing mechanism made available lending at concessionary rates since 1997. However this project ended in 2011 and no more funding is available under this scheme for the banks to release to the project developers. The banks which were involved with this project are familiar with mini hydro and wind energy technologies and they may continue to provide lending for renewable energy technologies utilizing their own funds despite the termination of World Bank projects; however at a higher interest rate. This situation will discourage the investors unless the FIT is changed to adjust to the increased interest rates. However the regulator (PUCSL) may get reluctant to increase the FIT as it will be a burden to the consumers in the short term. In this context, after documenting the lessons learnt from the recently completed financing mechanism, it is important to introduce a new financing mechanism for the next phase with international concessionary financial support for achieving new renewable energy targets. This new mechanism should include public sector financing for FIT, private sector financing for capital, technical assistance for government agencies and capacity building for civil society organizations.

2. The most important factor that influences renewable energy technologies is the capital cost as these technologies are comparatively higher for RE plants than fossil fuel power plants. The tiered tariff in Sri Lanka is designed for the investor to get a return on equity even during the loan repayment period. Accordingly the rate of the first tier of the tiered FIT (formulated considering a short term commercial loan) is high and hence when compared with fossil fuel technologies tiered tariff become noncompetitive at the initial stages. Passing this initial stage higher cost to the tariff payers living in developing countries is not recommended and hence

international support is needed to overcome this barrier.

The tariff of renewable energy technologies which have no fuel cost (technologies other than biomass) is fixed for 20 year period. The fossil fuel prices may increase during this period due to scarcity of resources. Further the climate change issue will reach a climax during this decade and it is likely that taxes and other monetary tools may be imposed to discourage using fossil fuels. Therefore, the life time cost of renewable energy is likely to be more cost effective than fossil fuels. However the renewable energy technologies may not be able to compete with fossil fuels when the unit price of renewable energy in year 1 is compared with the unit price of a coal fired power plant at current prices. As a result of the introduction of the FIT, the consumers have to pay a higher tariff during the initial years when compared with the avoided cost of a unit of electricity (See Graph 4).

Graph 4: A comparison between renewable energy 3-tier tariff and estimated cost of coal for a 20 year period (Rs/kWh)



If the international agencies provide concessionary lending with a grace period to developing countries, then the consumer tariff can be lowered during the initial stage. If concessionary lending is provided, the FIT can be restructured to have a lower initial cost so that it can compete with fossil fuels. While this is one approach, it could be suggested that there is a need for broader subsidy reform, so that the existing subsidization of fossil fuels is removed or reduced. Subsidy reform can be one of the areas in which international support could be valuable. That is to chart out pathways for subsidy reform, concrete measures with clear timelines for ramping fossil subsidies down, and alternative sources of supply up. In conjunction with this kind of subsidy reform, funding can be re-allocated to RE, thereby reducing the price spread further, and potentially eliminating it altogether. If such schemes are in place then it may be possible to introduce FIT for other renewable energy technologies such as Solar PV. This will be a favorable situation for both the consumers and producers for using renewable energy.

3. Sri Lanka is an island nation having a very small grid. Because of this reason system stability related issues are a major constraint for expansion of non dispatchable renewable energy technologies such as wind and solar in Sri Lanka. With the introduction of the FIT, wind power got the momentum but the sector suddenly came to a standstill due to limitations in absorbing the wind power to the system in Sri Lanka.

   In Sri Lanka the peak demand at present is about 2000 MW and during the night from 10.00 pm to 4.30 am the demand drops to about 800 MW. While estimating the maximum possible wind power that can be evacuated to the Sri Lanka grid system, the grid stability and the balance between consumption and production should be considered. The CEB report 'Wind inter connection proposal", stated that the loss of more than 59 MW wind, gives unacceptable frequency drop at off peak load. In this analysis of wind power integration in the existing system, the expected wind power is 123 MW up to year 2020. One main reason for selecting this level is that the wind turbines are not visible for the control room or cannot be expected to be able to stay on the grid or support the grid during failures.

   Due to the reluctance of the CEB to accommodate wind, World Bank conducted a study and suggested that the system can integrate a maximum of 643 MW of wind by 2020. However the CEB has not so far agreed to the recommendations of the World Bank study. Similar system constraints will apply for Solar PV as well once a FIT is introduced for solar PV. As this argument is used by the CEB as an excuse to do little it is important to take necessary measures to resolve this issue. Many islands around the world are beginning to incorporate advanced storage solutions to address this, and allow the wind supply to be matched more closely to demand. For Sri Lanka, it would be valuable to have a more detailed discussion of how pumped storage, thermal storage, DSM strategies, etc. could complement the FIT policy to address these concerns.

   The two solutions currently discussed to overcome this limitation are the regional grid (Indo-Lanka power link) and the pumped storage power plants. When compared with Sri Lanka the neighboring India is having very large electricity grid however in the absence of a South Asia regional grid it is not possible to get the advantage of this factor to evacuate more renewable energy power to the Sri Lanka grid. The feasibility studies conducted on regional grid with the financial support of the ADB indicated that it is not an attractive option for the near future.

   The initial assessments conducted on pumped storage power plants revealed that there are about 8 sites with a total capacity of about 3500 MW. The cost of a pumped storage power plant will be about 1000 USD/kW as per the initial assessments conducted by the Ceylon Electricity Board. Further studies on pumped storage are needed to further explore the possibilities. If power storage become a viable option then the renewable energy targets formulated by the government to be achieved by 2020 will become feasible. International financing for pumped storage is crucial for Sri Lanka to overcome the current system limitation for wind and solar power.

   Introducing advanced technologies for predicting wind and solar fluctuations is another area which needs international support. If the fluctuations can be predicted in advance then it can reduce the system stability related issues arising from non dispatchable wind and solar energy technologies to a greater extent. The CEB does not have the capability to conduct a proper risk analysis at present to arrive at reasonable conclusions. Grid integration is partly about technology, but it’s also about skills, infrastructures, and technical knowledge required to deal with intermittent supply sources. There is both a “hard” (i.e. technology-based) dimension and a “soft” (i.e. human capital) based dimension. International support is needed for technical

assistance and financing these initiatives.

4. The FIT in Sri Lanka is applied only for few renewable energy technologies. There is no FIT in Sri Lanka for number of other renewable energy technologies including solar PV. The Government is reluctant to introduce a FIT for those technologies as the levelized tariffs are prohibitively due to high capital costs involved with such technologies are. If concessionary funding mechanisms are available for FIT then the tariff can be reduced significantly. This will considerably lift the short term burden on the consumers. This will make such technologies competitive as the fossil fuel prices will be drastically increasing in the near future. In other words the additional international financial support can be used to formulate technology specific FIT's for other technologies such as Solar PV, Concentrated Solar Thermal, Geothermal, Wave Power and Ocean Thermal Energy Conversion (OTEC).

   Further absence of a comprehensive database on renewable energy potential (biomass, geothermal, wave, OTEC, ocean current etc.) has become another constraint for attracting potential investors for the renewable energy technologies in Sri Lanka. International support for assessing the potential will be very important at this stage.

5. The biomass technologies can support the local communities in Sri Lanka to a greater extent than any other renewable energy technology as the rural farmers can engaged with establishing energy plantations and selling fuel wood to the biomass power plants. Here the Sri Lankan scientists have recommended establishing energy plantations and to establish a fuel wood supply chain. There are certain fast growing short rotational coppicing species recognized for this purpose. The out grower system is a well-established mechanism in Sri Lanka for commercial crops. Here the power plant owner establishes and maintains only about 20% of plantations and encourages the farmers living in the surrounding to establish plantations and supply wood to the power plant. This management system is well established in Sri Lanka for tea, rubber, coconut and sugarcane industries. These factories mainly get tea leaves, latex, coconut and sugarcane from out growers and this has become the most economical way of growing in Sri Lanka when compared with establishing and managing central plantations. This practice lifts the burden on the investor for getting land and managing human resources.

   Biomass based power generation is still not popular in Sri Lanka despite the enabling environment created, mainly because the investors have no confidence on the out growers for fuel wood supply. It takes at least two years to have mature wood after establishing the plantations and there is uncertainty about whether the farmers will grow the required amount of plants or not. The fuel wood price is also a concern of investors and traditional lenders. On the other hand farmers have no confidence over the energy companies to establish energy plantations in advance without having a power plant in the area to which to sell their wood. Detailed studies need to be conducted to understand the opportunity costs of the different farmer categories for organizing and establishing fuel wood supply chains. In this context financial support is needed to conduct a country wide study on the biomass availability which will help addressing the fuel wood supply chain issues prevailing in Sri Lanka.

   The government should take necessary steps to introduce biomass collection, storage and clearing houses country wide to build the confidence of the farmers to establish energy plantations. Additional international funding can be used to establish a country wide biomass collection and clearing mechanism which will establish a guaranteed price for fuel wood. The guaranteed price will remove the uncertainty associated with establishing energy plantations. On one hand it will give the farmers a guaranteed price for the wood they sell and on the other hand it will give the energy companies an assurance for uninterrupted fuel wood at a

guaranteed price. This will make sure that power plants can achieve the expected plant factors to make the industry financially viable.

Another important issue is lack of capacity of the energy sector professionals to work with the plantation sector practitioners for establishing the energy plantations and for organizing the fuel wood supply chain. A capacity building program needed to be designed to address this issue.

The barriers and gaps could be addressed by international support, including financial assistance (grants, concessional and long-term loans), technical assistance and capacity building. International support, and regional cooperation, in the forms of workshops, conferences, technical staff "exchange" programs, and so on is needed to overcome these technical barriers.

4. Summary and Conclusions

Sri Lanka is one of the pioneering countries in the developing world that introduced FIT for the promotion of renewable energy technologies. The FIT in Sri Lanka was in operation near 2 decade and it has demonstrated that the FIT can make a significant impact on the energy mix of a developing country.

Recognizing the importance of the concentrating on renewable energy technologies the government of Sri Lanka has announced ambitious targets for renewable energy which include 50:50 capacity additions for renewable energy: fossil fuel until 2020. Accordingly Sri Lanka will be maintaining the 40% renewable energy share until 2020 despite the demand is increasing at a rate of 6-7% per annum. Further the government is of the view that the country will be able to maintain carbon neutral growth after 2020 until 2030 and then gradually reduce the carbon emissions level with the development of energy efficient and renewable energy storage technologies worldwide.

It is important to recognize that the key constraint for the wider use of renewable energy technologies is the absence of adequate international financing mechanisms. At present the available clean energy international financing mechanisms are not optimally utilized for the promotion of renewable energy technologies. If such mechanisms are optimally utilized then the renewable energy technologies will reach grid parity and be able to compete with all the fossil fuels. With the presence of additional international financial mechanisms the FIT in Sri Lanka can be expanded to accommodate the other renewable technologies such as Solar PV. Further certain technical barriers for the promotion of renewable energy such as storage issue can be resolved. The bottle necks that hinder the progress of biomass technologies can also be removed by establishing fuel wood collection and clearing centers, using additional international financing.