THE BIOMASS ENERGY SECTOR IN SRI LANKA SUCESSES AND CONSTRAINTS

By Eng. Parakrama Jayasinghe BSc., FIE (SL) ,C Eng. MIMech E
(President – Bio Energy Association of Sri Lanka)

1.0 Introduction

The importance of bio mass as a resource for future energy generation , both thermal and electrical is well recognized world wide. However, in Sri Lanka lack of information and sometimes misinformation hinders the utilization of these renewable and indigenous resources, the development of which has a multitude of spin off benefits. The availability of a substantial quantities of variety of bio mass and the very real potential for developing these to be a very significant national resource is hardly known or noticed.

2.0 Energy Resources of Sri Lanka

The major forms of primary energy used in Sri Lanka during the year 2003 were biomass (48%), hydro electricity (9 %) and petroleum oil (43%). Figure 2.0 shows the composition of energy supply by source

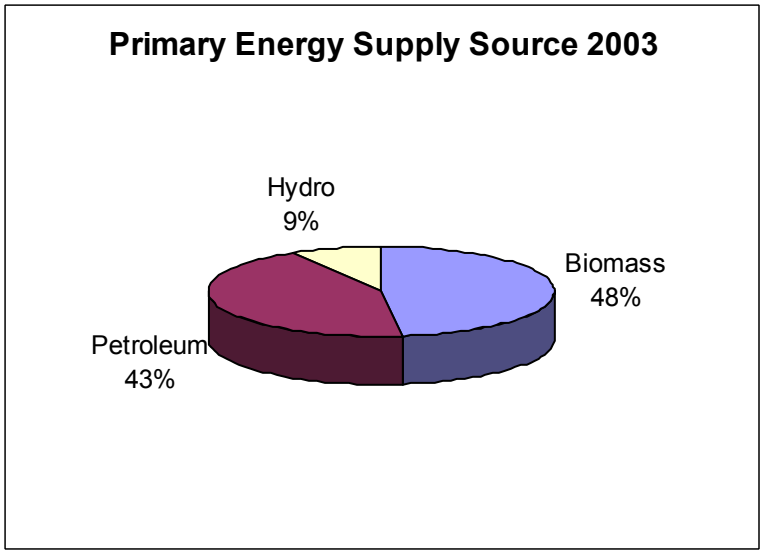


Figure 2.0 Energy Supply by Source – 2003(Energy Balance 2003 – Energy Conservation Fund)

Growth in the economy and in areas of social development both in the medium and long term has placed a high demand on energy with emphasis on electricity. It has been recognized by the World Bank that economic growth is directly linked to growth in the energy sector.

The Ceylon Electricity Board estimates growth in the consumption to be approximately 8%.annually in the next five to ten years requiring an additional 120-150 MW annually to meet this demand. While only 60% of households presently have access to electricity, this is expected to increase to 80% by 2010.

2.1 Use of Biomass Energy in Sri Lanka

Biomass accounts for nearly 15% of world energy supplies. In industrialised countries, biomass supplies about 3% of total primary energy, and is used for heating, electricity and to off set emissions from coal-fuelled facilities.

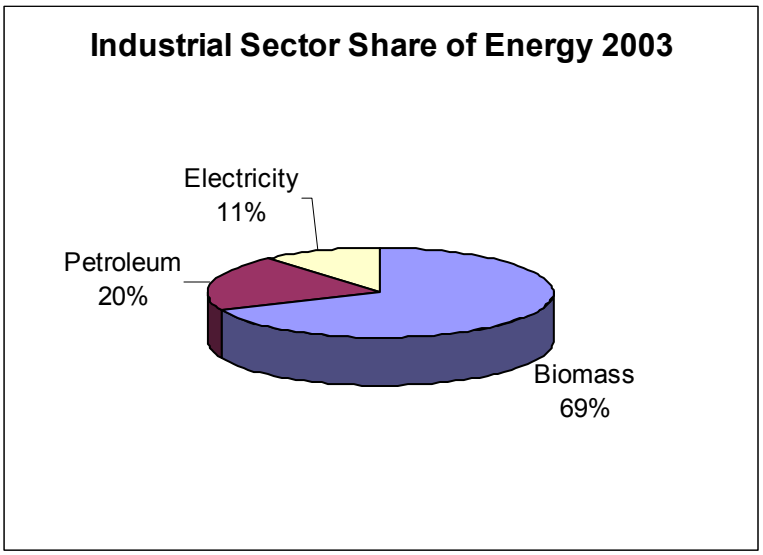
In developing countries, biomass fuel supplies approximately 35% of total primary energy, most of which is used traditionally for domestic cooking and space heating.

Traditional biomass accounts for nearly 52% of the primary energy supplied in Sri Lanka. Nearly 76% of our population still depend on fuel wood and other forms of biomass for their household cooking. However the introduction of LPG for the domestic cooking some decades ago has reduced such use in the urban house holds.

This trend will continue to the future until there is a substantial increase in the per capita income of the rural population and they have access to other forms of energy at affordable prices, which seems remote with the ever increasing cost of fossil fuels. . .

In addition the traditional small and medium industrial sector too has been sing bio mass particularly fuel wood for their thermal energy needs. The Brick and Tile sector in particular uses considerable amounts of fuel wood form different sources. Unfortunately jungle wood harvested in an unsustainable manner continues to be used heavily , although the renewable sources such as rubber wood from replanting activates also make a major contribution. Some measures to introduce rice husk as a heating medium for brick making has not made a significant impact yet..

The tea and rubber processing industries, with more than 1000 factories distributed in the wet zone of the country is a heavy user of fuel wood. Although some of the estates have grown wood lots to furnish their energy needs the major supplies comes form rubber plantations or from jungle clearing. In the past decades the difficulty of getting fuel wood form such sources has prompted the tea industry to rely on diesel and other heating oils to fire their dryers.



3.0 Recent Changes

There has been some significant events which ahs altered the above usage pattern or created an interest in alternative sources of energy, both in the house holds and in industry. Of these the gradual increase in the price of fossil fuels over the past decade with the most recent drastic escalation has enhanced such interest. The two charts below illustrate the rise in cost of furnace oil over the past decade and the relative cost of different fuels as at present.

Price for (Fuel Wood)
delivered
Rs. 2,000 / Tonne

31,000/= (2005)

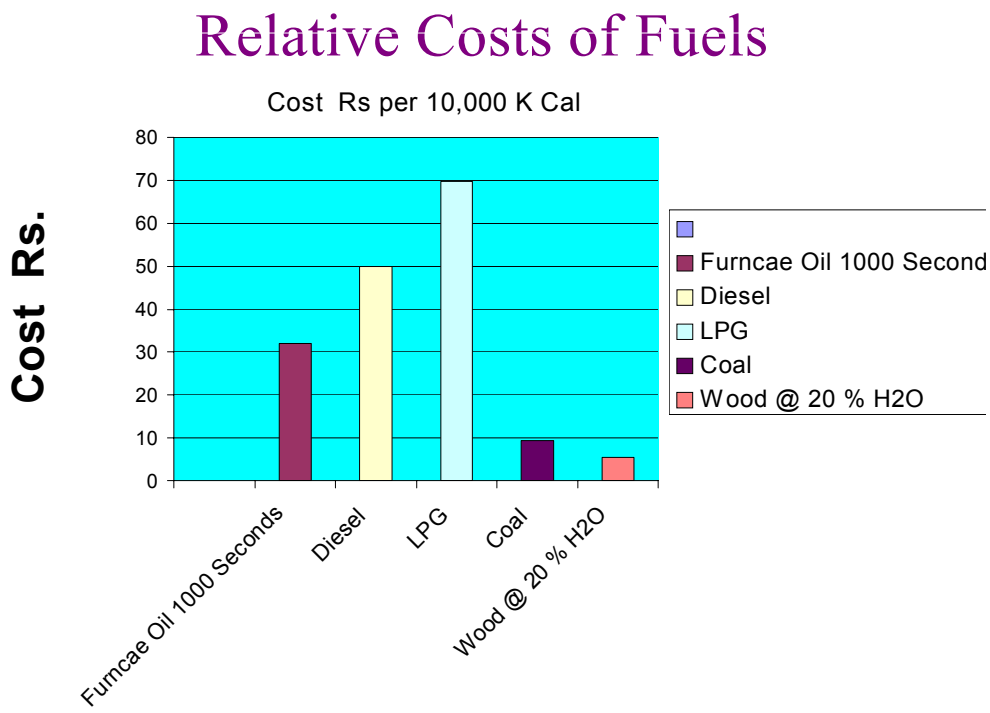
26,000/= (2003)

~~16,000/=~~ (2001 year)

~~10,000~~ / =

(1996)
At current ^price of Rs. ~~6,000~~ / = per Tonne for Oil

.



The other significant event is the introduction of manufacture of Medium Density Fibre Board In Sri Lanka. This industry which could absorb large quantities of wood, even the smaller branches created heavy competition for the available wood, rubber wood in particular. Thus even those industries which were using fuel wood are forced to look for alternatives as the means of reducing their consumption.

4.0 Promotional Activities on Sustainable Use of Fuel Wood for Energy and Fertility

Although the actual circumstances mentioned above made a heavy impact only in the recent years and months, the writing was on the wall as far as Sri Lanka is concerned for many years. Sri Lanka has no proven fossil fuel resources and the attempts to search for such resources have been disjointed. As such several concerned persons had sounded the alarms for more than two decades, of the need to look for an alternate indigenous source of energy , not only to replace the current use fossil fuels but also to provide for the expanding needs.

However, such warnings fell on deaf years, partly due to the country being nearly self sufficient for its electricity supplies through Hydro Resources at that time, and the import of fossil fuels to meet the demands of the time for thermal energy and transport not being considered too heavy a drain. However, the main reason is the lack of vision of the successive energy authorities and the failure of the national planning authorities to see the increasing drain of the foreign exchange .

Although bio mass constituted a major component of the country's total energy consumption, as shown above, it was never accepted as a viable alternative, for the replacement of the so called modern forms of energy. The fact that it has been in use in tea processing and other industries for decades has had no credence.

The fact that all four of sugar factories (two closed down) used sugar cane bagasse to generate electricity since the early part of the last century failed to convince those in authority that bio mass is a viable source for generation of electricity.

In addition to the attempts to create awareness in this sector, the actual R & D and promotional work done by the National Engineering Research and Development Center (NERDC) over several decades is noteworthy. A more detailed presentation of this work is expected to me made by them for this conference. In particular, successful work was done on wood gasification and use of such waste products as rice husk for bakeries and other thermal energy needs, the development of a stove for house hold cooking among others. The reasons for these technologies not being utilized in a more widespread manner can perhaps be traced back to the reasons mentioned above.

5.0 Winds of Change

The inexorable escalation of fossil fuel prices in the world oil markets, as well as the sudden realization for some, that Sri Lanka has nearly exhausted its hydro electric potential is prompting some attention to be given to the potential of bio mass as a viable source of energy. In this light the efforts of the Ministry of Science and technology is laudable.

The recently concluded project by the Alternate Energy Division of the Ministry of Science and Technology, also supported by the European Commission was instrumental in

- the bringing into the country two modern gassifiers, one for thermal energy and one for Power Generation from India, for demonstration of these technologies in the year 2003
- The visit to several facilities and installations in India where such technologies were in practical use by some interested technologists and administrators
- The trials carried out on Sustainably Grown Fuel wood species in different climatic and geographical locations in the country.

As a direct result of these initiatives several new gassifiers have already been manufactured and are in use in Sri Lanka and the first Dendro Power Plant of capacity 1.0 MW is already connected to the national grid.

As a parallel activity, the pioneering work done by the Coconut Research Institute of Sri Lanka , on the plantation and collection of valuable data on the yields, propagation methods and other benefits of the selected SRC species, such as Gliricidia Sepium has given a greater fillip to the expansion of the fuel wood resource.

As such the interest has been reawakened at an appropriate time.

It is appropriate to mention the potential for utilization of Biomass for Energy Generation in Sri Lanka before listing the successes achieved so far.

The Bio Energy Association of Sri Lanka has published the following statistics

6.0 The Biomass Availability in Sri Lanka

The biomass availability in MT per year is indicated below:

Type	MT / Year	%
Rice Husk available from commercial mills	179,149	6.2
Biomass from Coconut Plantations available for industrial use	1,062,385	37
Sugar Bagasse	283,604	8.3
Bio degradable garbage	786,840	27.4
Saw Dust	52,298	1.8
Off cuts from Timber Mills	47,938	1.7
Biomass from Home Gardens Such as Gliricidia	505,880	17.6
Total	2,873,880	100

These figures are as at 1997 and obtained from the Sri Lanka Energy Balance.
This is a very substantial quantity and it is expected that some of these quantities are currently being used in different sectors particularly as a source of thermal energy. However there is no formal assessment of the usage and valuation of this resource. On the other hand the usage of bio mass such as Saw Dust and Rice Husk is very minimal and most of these are currently posing an environmental problem. On the other hand there is a very great potential to develop purpose grown fuel wood plantations to enhance this resource and to formalize its use for main stream economic activities.

Recently, sustainably grown biomass using Short Rotation Coppicing (SRC) species such as Gliricidia Sepium has attracted interest, as a source of energy for generation of electricity, due to its potential as a low-cost, indigenous supply of energy and for potential environmental and developmental benefits. Biomass conversion is seen as one option for reducing CO_2 build up, in addition to the benefits to plantations which include reduced soil erosion, restoration of degraded land and amelioration of local impacts to the environment from fossil fired power generation e.g. SO_2 and NO_x. Perhaps even more important for Sri Lanka is the potential for poverty alleviation due to the substantial additional incomes that would flow in the rural economies.

6.1 Large Potential

Based on the yield data obtained from many independent studies the following data has been gathered.

1. A hectare of energy plantation with 5000 trees per Ha of Gliricidia, Accacia or Cassia in the dry zone of Sri Lanka would produce a minimum of 30 tonnes (dry) per hectare per year.

2. The total extent of degraded marginal land suitable for energy plantation in Sri Lanka is estimated at 1.6 million hectares.

3. The consumption of fuel wood for generation of electricity using currently available technologies, and equipment, while meeting all environmental and other conditions is about 1.2 –1.5 kg/kwh

4. Hence the national potential for Dendro power in Sri Lanka is estimated as in excess of 4000 MW annually generating over 24,000 GWh. This is nearly 4 times the total hydropower potential in this country. The Dendro potential in our country is adequate to meet our electrical energy demand for many decades.

7.0 Economics of Replacing Fossil Fuels with SGF

In order to achieve the fossil fuel replacement targets the following extents of SGF plantations will need to be established.

The cost of creating these, if the land is made available are also given in the table below.

Year	CEB Projection of Annual Energy GWH	Proposed Replacement %	GWH	Land Requirement Additional Ha	Incremental Cost of Establishment Rs Millions	F.E.Savings from fossil fuel imports Rs Millions
2005	6967	2 %	139.34	6500	65	**1,463**
2006	8342	10%	834.2	35540	356	**8,759**
2008	9892	20%	1978.4	50,550	506	**20,773**
2010	11505	50%	5752.5	176,630	1,767	**60,401**

Supplementary Details and Spin Off Benefits

In particular the spin off benefits listed below are note worthy. **If only 10% of the fossil fuel imports** are replaced by bio fuels, the benefits would result in

- **Employment potential** **50,000 farmers**
- **Contribution to Rural Economies -** **Rs 2000 Million/year**
- **Saving in Foreign Exchange** **US $ 72 Million/year**
- **Soil Enrichment** **22,000 tons of Urea/year**
- **Potential carbon Credits @ US$ 5.00 per ton** **US $ 5,000,000/year**
- **Enhancement of Green Cover** **75,000 Ha**
- **Livestock Development** **32 Million Litres of Milk/year**

The total potential of this resource is more than enough for total replacement of fossil fuels currently imported for the Electricity generation and thermal use in Industry which would enhance the above figures several fold.

8.0 Land Availability for Dendro Plantations

Land Type	Extent – Ha	%
Natural forest	1,678,000	26
Forest Plantations	81,000	1
Industrial Plantations	769,000	12
Paddy Lands	799,000	12
Sparsely used crop lands	1,263,000	20
Range scrub lands	502,000	8
Other	1,408,000	21
Total	6,500,000	100

What is evident from this information is that, the sparsely used crop lands and the range scrub lands amount to 28% of the total land extent and is more than the acreage under the industrial plantations and paddy lands in the country which amounts to 24%.

9.0 The Successes Achieved

The recent efforts to promote the use of bio mass by various concerned individuals and organizations, have started to show positive results and encouraging signs of increased awareness and interest among different sectors. The currently operating installations and facilities include:

A. Thermal Installations

	Installation	Institution	Capacity	Wood consumption
1	Wood Gassifier for Thermal Incinerator/waste heat boiler	Pellaco Ltd	600 KW_{th}	4.5 tons per day
2	Wood Gassifiers for Generation of Hot air for product drying	Ligoncel Limited	I nos 1000 kWt_h, 2 Nos 1,200 kW_{th}	20 tons per day
3	Wood gassifier for Galvanizing Plant	Lanka Transformers Limited	180 kW_{th}	1.5 tons per day
4	Conversion of boilers for use of SRC wood fuels	Dipped Products Limited	2000 kW_{th}	20 Tons per day
5	Wood Gassifier for firing rotary kiln	Haycarb Limited	1000 kW_{th}	10 Tons per day

B. Electrical Power Generation Installations

	Installation	Institution	Capacity	Wood consumption

1	Dendro Power Plant at Walapane	Lanka Transformers Limited	1.00 MW (Currently being expanded to 1.5 MW)	40 tons per day
2	Charcoal Manufacture and power generation Stage I with 1.0 MW being commissioned	Recogen Limited	6 MW	Using Coconut Shells
3	Combined Heat and Power form Kiln waste gases	Haycarb Limited	300 kW	Using waste gases
4	Village electrification using wood Gassification Moneragala serving 100 households	Energy Forum	35 kW	
5	Village Electrification using wood gasification Pokunutenna serving 50 households		5.0 kW	
6	Coconut Estate for Electricity and Irrigation Kakapalliya		3.5 kW	

C. Projects Under Design

Tokyo Cement Limited – Captive power Plant using Rice Husk combustion and Steam Turbine Technology 10.00 MW

Grid Connected Dendro Power plant using SRC wood and Rice Husk using Steam Turbine Technology LOI Issued 10.00 MW

Talawakele Tea Estates Limited – 300 kw captive power plant using wood gasification

Grid Connected Dendro Power Plants using SRC wood and Rice Husk --

13 Projects of capacity 1.0 MW to 10 MW 70 MW total
(awaiting clarification of tariff payable by CEB.)

D. State Policy and Awareness Issues

1. A presentation was made to Her Excellency The President and the cabinet of Ministers on the potential and the viability of Bio mass power generation in October 2004

2. As a direct result of this, an inter-ministerial committee was appointed to prepare recommendations for action. This report has now been handed over to the Hon Minister of Power and Energy and a specific cabinet Paper is expected to be submitted shortly for the implementation of the recommendations
3. The participation of several relevant ministries in this committee has created valuable awareness and appreciation of the bio mass resource and the need for its utilization as a an economic activity, amongst all relevant ministries
4. The Ministry of Plantation Industries has declared the Energy Plantations as the Fourth Plantation Crop of the country and has obtained cabinet approval for its promotion.
5. The Annual Budget for the year 2005 has addressed the need for review of the tariff paid for the power generated using renewable resources such as biomass.
6. Several consultancy projects some with funding by international donor agencies have been undertaken by different agencies to study and report on the viability of Biomass as an energy resource. The reports submitted to date have all recommended its immediate usage.

E. Public Awareness

1. An awareness campaign has been carried out with newspaper advertisements and preparation of a video presentation of the current activities with the assistance of the Norwegian Embassy. This has evoked much interest amongst different sectors of the public and industry.
2. Many plantation companies have embarked on creating their own energy plantations, with a view to harnessing this resource for their process energy needs. Some have also embarked on projects to procure the necessary technologies and equipment.
3. Regular inquiries are received on the aspects of plantations, market for the biomass for energy use and on technologies from members of the public and small and medium scale industries.

10.0 Constraints

With so much work done and the obvious advantages of adopting biomass for energy production, one would wonder why it has not become the main source of Sri Lanka's energy supply. Two primary reasons could be identified as the main constraints

- Conservatism for change by the authorities and
- Resistance by those with entrenched interests to maintain the status quo in spite of the disadvantages to the country.

These are obvious constraints for any change all over the world and have to be overcome by appropriate means. However, the less cumbersome constraints which can be overcome and being addressed currently are discussed in detail.

10.1 Thermal Energy Sector

The use of biomass for thermal energy is widespread in the traditional uses, such as in home cooking and the traditional small scale industries. However, the major constraints preventing the widespread adoption of biomass for energy, more efficiently and using modern technology, where it can replace the use of fossil fuels, can be identified as

- Lack of awareness of the advantages and the availability of the technologies
- The payback for the additional investments being considered too long until recently
- Fear of shortage of biomass supplies
- Lack of capital for the conversion
- Cost of energy not being a major component of the COP and thus not being considered a priority

As mentioned earlier this picture is changing rapidly with the recent increase in price of fossil fuels and the increased awareness.

10.2 Electrical Sector

It is necessary to consider this under two sub headings. Viz:.

1. Captive power generation perhaps wit cogeneration where applicable
2. Large scale generation for connection to the grid as independent power producers.

With respect to the small scale captive power generation sector, the main constraints are

- The present technologies being too expensive for small scale generation
- Lack of awareness of the availability of the technologies
- Conservatism due to inadequate information on successful operations locally and internationally
- Perceived uncertainly of supplies of biomass
- Cost of grid electricity being subsidized below cost of generation

The situation is quite different for the large scale power generation. The main constraint being, the spread of misinformation, on the viability of the use of biomass. The ,common objections brought forward which deter the prospective investors are,

a. Dendro Energy usage is new and unproven.

b. The fuel supply is uncertain and cannot be guaranteed.

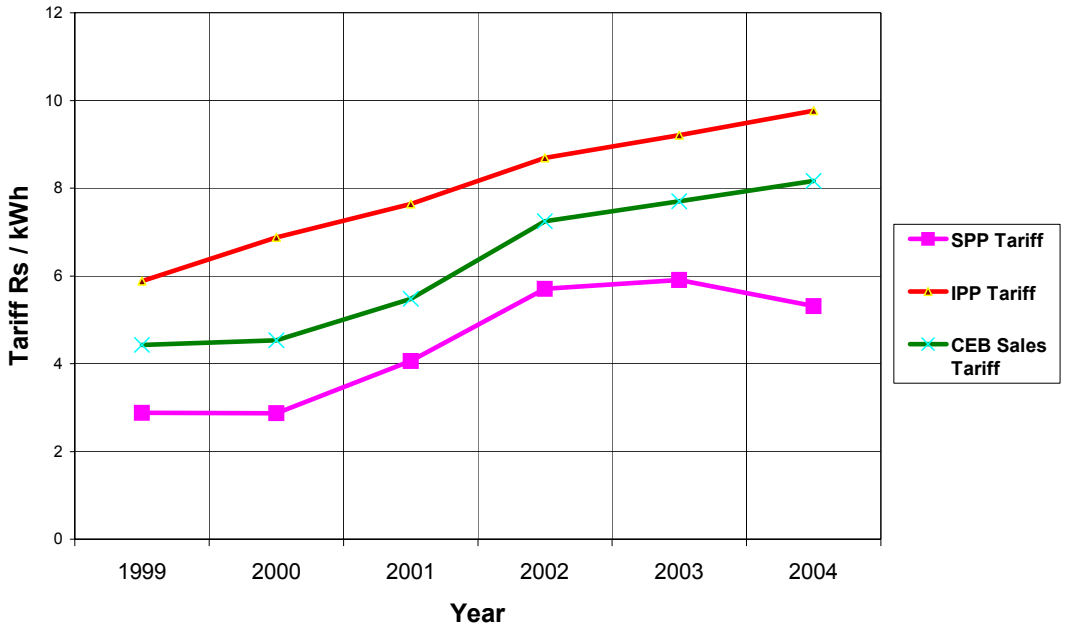
c. The grid can absorb only a limited amount of small power generators termed embedded generators.

d. There aren't adequate lands to justify the claim of the large potential.

All these claims are baseless and serve only to delay the adoption of the use of biomass, particularly SRC fuel wood as a major source of energy, to meet the future energy needs of the country. The single most important constraint is the lack of a firm government policy and an action plan to achieve same. For many years there has been policy statements made, extolling the importance and the need to promote the use of renewable energy. But these policies have not been translated into proper action plans and directives to the single state owned monopoly electrical utility. As such, unlike anywhere else in the world, in Sri Lanka, the tariff paid for electricity generated from renewable resources attract a lesser tariff than for the imported non renewable fossil fuels, all of which is imported in to Sri Lanka.

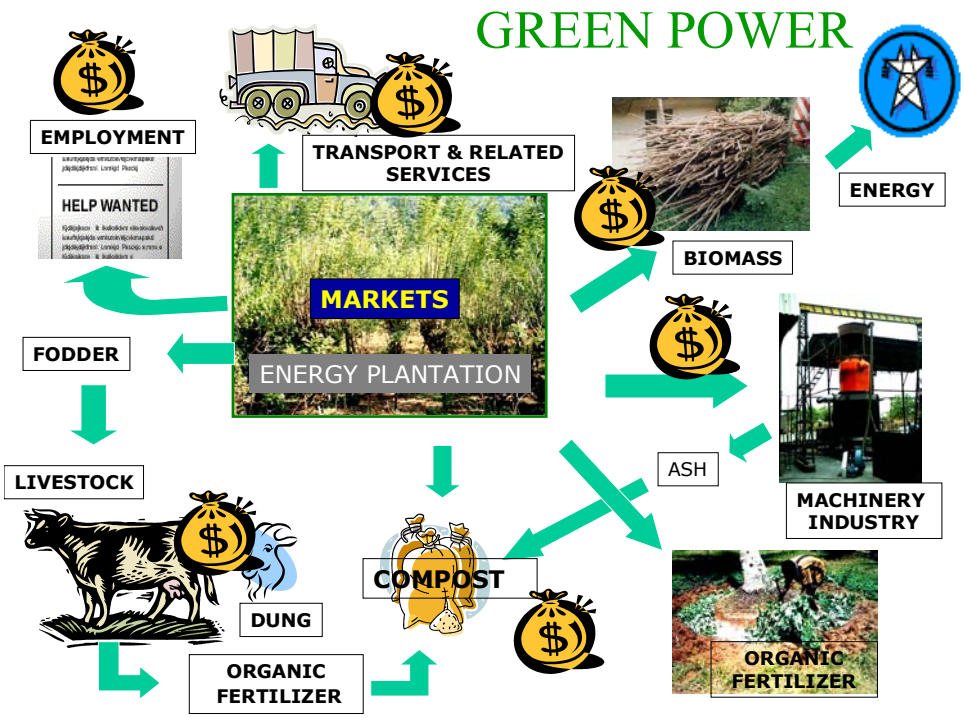
(Source : Statistical Digests – CEB)

SPP and IPP Tariff Comparison



The recent initiatives taken mentioned earlier may correct this situation. If so, the single most important barrier for widespread use of bio mass for large scale power generation would be removed, and Sri Lanka would gain in multiple fronts as shown in the charts below.

Multiple Avenues of Using Bio Mass from Energy Plantations


GREEN POWER
EMPLOYMENT
HELP WANTED
TRANSPORT & RELATED SERVICES
ENERGY
BIOMASS
MARKETS
ENERGY PLANTATION
FODDER
LIVESTOCK
ASH
MACHINERY INDUSTRY
COMPOST
DUNG
ORGANIC FERTILIZER
ORGANIC FERTILIZER