Development of Grid-Connected Biomass Energy Projects in Sri Lanka
Issues and Options

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ADB-financed project "TA 7011 SRI Building the Capacity of SEA"
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Abbreviations and Acronyms

ADB	Asian Development Bank
AEP	Annual Expenditure Program (SEF)
AWDR	Average Weighted Deposit Rate
BoI	Board of Investment of Sri Lanka
CDM	Clean Development Mechanism
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
CER	Certified Emissions Rights
DFCC	Development Finance Corporation of Ceylon
DNA	Designated National Agency
ECF	Energy Conservation Fund
GEF	Global Environment Facility
IPP	Independent Power Producer
MASL	Mahaweli Authority of Sri Lanka
MENR	Ministry of Environment and Natural Resources
MPE	Ministry of Power and Energy
MPEMD	Ministry of Public Estate Management and Development
NEPS	National Energy Policy and Strategies
PoA	Programme of Activities
PPP	Public Private Partnership
PUCSL	Public Utilities Commission of Sri Lanka
RERED	Renewable energy for Rural Economic Development
SEA	Sustainable Energy Authority
SEF	Sri Lanka Sustainable Energy Fund
SEGF	Sustainable Energy Guarantee Fund
SEMA	Strategic Enterprise Management Agency (SEMA)
SLCF	Sri Lanka Carbon Fund
SPP	Small Power Producer (up to 10 MW)
SPPA	Standard Power Purchase Agreement
WB	World Bank
WEC	World Energy Council

Map: Sri Lanka Power Sector

Source: ADB: Sri Lanka Country Assistance Program Evaluation: Power Sector, August 2007

Introduction: Purpose of this Paper

By December 2009, Sustainable Energy Authority (SEA) had received 55 project applications for biomass based power projects with a projected capacity of 329 MW. Classified by sources of biomass supply, the projects can be divided into three categories, listed by order of complexity:

- The 2 *sugar cane projects* with a capacity of 52 MW and implemented by sugar cane producers that use their own supplies of bagasse as fuel to generate power
- The 25 *solid waste projects* with a capacity of 188 MW, where power plant developers depend on contracts with municipalities to gain access to the resource
- The 27 *dendro, paddy husk, coconut shell and agricultural waste projects* with a capacity of 89 MW, where the power plant developer depends on contracts with a number of outside private suppliers to get access to the biomass resource.

The last category of projects is believed to have the largest resource potential: it is estimated that more than 1000 MW of dendro power plants can be established in Sri Lanka; the exact number depends also on the competing demand for biomass from industries switching from oil to biomass as their fuel source for the production of thermal energy.

The challenge for developers of dendro-power projects is daunting: they must organise commercial fuel wood chains from the scratch in parallel with the construction of the dendro-power plant.

The *Report of the Inter-Ministerial Working Committee on Dendro Thermal Technology* dated June 14, 2005 recommended the implementation of a 5-year Action plan to realize 100 MW capacity though a three-phased effort (10+40+50 MW), which comprised:

1. two parallel programs of (a) launching the dendro thermal technology, (b) building confidence in project developers and planting communities to invest;
2. institutional framework with the mandate and responsibility + attractive finance,
3. investment

Early 2009 progress is modest. As seen above, project developers have submitted a number of applications for preliminary project permits to SEA. But a concerted action program has not been launched and SEA is concerned that the implementation of biomass energy projects for industrial process heat and for grid connected power generation may continue to be low. SEA intends, therefore, to use funds under the ADB-financed project "TA 7011 SRI Building the Capacity of SEA" (managed by Sofreco) to fund TA to address legal, organisational, logistical, regulatory, technical and financial obstacles that prevent biomass-based power generation projects to move forward. The TA will also advise on the feasibility of developing a "Programme of Activities" scheme ("programmatic CDM" /"policy CDM") for renewable energy based power plants that are paid a feed-in-tariff for their sales to the grid.

The present paper serves as background for the approval by ADB of the request for TA and for the consultant TOR. The paper in no way pretends to provide a complete picture of the situation for biomass energy projects in Sri Lanka; it is a first step which follow-up TA can build and expand on.

Executive Summary of Recommendations

Situation

Despite the existence of a good biomass potential, a conducive feed-in-tariff, creative entrepreneurs, well thought-out concepts for the organisation of fuelwoood and a well-managed Biomass Energy Association as lobbyist, investments in dendro-power plants are not moving forward. There are several reasons for this, the most important being (i) slow procedures for land assignment, (ii) low equity of project developers, (iii) financial sector uncertainty about the risks of dendro-thermal technology and sustainability of fuelwood supply.

Motivation for a 10+ dendropower plants investment program

The ice can be broken through the implementation of a *Presidential Priority investment program* comprising at least ten dendro-power projects. Such a "big push" program will achieve several results simultaneously, giving it character of "action research": (i) it will force the development of regulatory standard procedures and institutional innovations, (ii) spread knowledge about dendro-power projects in the finance community, in public authorities and in the consultant community, (iii) give quality information about the costs of fuelwood supply and dendro-power technology, (iv) because of its scale trigger larger foreign equity investor interest, (v) permit the development of a "Program of Activities (PoA) by the Carbon Fund, (vi) due to Presidential prestige "force" national finance institutions to engage in financing and approval authorities to accelerate the processing of required permits.

A *RE-specific transmission development plan by CEB* would be prepared and implemented in parallel.

By demonstrating the viability of dendro-power in Sri Lanka, rationalizing the approval processes[1] and having several professional investors active on the ground in Sri Lanka the implementation of the program ought to guarantee a high level of follow-up investment. This, in turn, may make national manufacturing of components for dendro-power plants commercially feasible.

Consultant team to prepare investment program

It is recommended that *a team of one foreign dendro-power expert and three national consultants - experts in fuelwood supply, dendro-power technology, CDM - be hired to prepare the dendro-power priority investment program*. The consultants are to deliver the following outputs:

I. Analysis of issues and formulation of policy recommendations comprising:

1. Review of issues in fuelwood supply:

- Analyse the trade-offs between expanded fuelwood production and other forms of agricultural production. Establish the most likely opportunity costs for fuelwood production for the three

[1] one targeted institutional outcome are dendro-power plant manuals that are tailor-made for the specific needs of the specific approval authority and which streamline the review and approval process through standardised procedures (e.g. a guidebook for environmental approval procedure).

typical cases of (i) small farm-plots, (ii) intercropping at plantations and (iii) dedicated fuelwood plantations. Establish guidelines for identifying both clear-cut cases, where decision Government taking on an application for land is an administrative formality, as well as cases where political preferences have to decide.

- Would Government institutions owning land be willing to go into joint ventures with biomass developers to supply fuelwood? If yes, would this reduce the political hurdle for investor access to Government owned land?

- Is there a need for grant support to the development of biomass supply either specifically for the 10+ dendropower plant investment program or also for future investments in dendro-power? If yes, where is the money for that to come from and who would manage it?

- Analyse the pros and cons of revising the formula for the fuel-component in the feed-in-tariff and make a concrete proposal.

- Analyse the need to create a specialised fuelwood plantation authority, and if confirmed, analyse the pros and cons of creating the authority as an extension of the Tea Smallholders Authority.

- In the short term, cooperation between SEA, The Carbon Fund, CEB and the Presidential Secretariat is essential for getting the investment program off the ground. For the longer term, something along the institutional reforms proposed by the Inter-Ministerial Working Committee on Dendro Thermal Technology may be the ideal solution. Show how the proposed institutional set-ups can be tested at pilot scale through the 10+ dendro-power plant program.

2. Choice of dendro-power technology

- Analyse the economics of alternative power technology options in Sri Lanka as a function of biomass supply prices and international coal prices (economic and financial analysis of costs and benefits). In particular, analyse the pros and cons of using Indian steam turbine technology versus fuel-cell technology. Assess the maturity of fuel-cell power, and adjust project economics for differences in technology risks. Establish at what level of fuelwood prices, fuelcell technology becomes the lowest life-cycle cost option.

- Comment on the prospects in Sri Lanka for developing commercially competitive manufacturing of components for dendro-power plants and whether specific incentives are required to trigger such investments.

- Is there a need for grant support to pre-investments - to the preparation of pre-feasibility and feasibility studies - for the 10+ dendro-power plant investment program?

3. Attracting foreign investors:

- What framework conditions do foreign equity investors look for as a condition for market entry?

- Is the CDM-project opportunity essential for attracting foreign investor interest?

- The preparation of high quality (pre)feasibility studies by national project developers being a pre-requisite for this, is the introduction of financial support to the preparation of feasibility studies is justified, or are market forces sufficiently strong to generate sufficient activity?

- Are foreign investors interested in engaging in joint ventures or other forms of Public Private Partnerships (PPPs) with state plantation companies for the production of biomass?

- Recommend an approach (strategy and instruments) for attracting foreign investors to dendro-power and how to get in contact with them. How do you market project opportunities? Advise on channels for getting in contact with qualified foreign investors and ways to get them interested.

4. Securing low cost debt-finance.

- Is the introduction of a dendro-power bond issue – based on the securitisation of a bundle of individual bank loans – technically and commercially feasible? If yes, does it expand the supply of finance for RE in Sri Lanka?

- Is there a need for a guarantee facility for loans to fuelwood supply projects? If yes, who is to administer it and where is the money to come from?

- Is there need for introducing a specific micro-finance programm for fuelwood? If yes, how is it going to be organized and where is the money to come from?

- The year 2005-report by the Inter-Ministerial Working Committee on Dendro Thermal Technology recommended the establishment of a Development Fund to mobilize farmers into dendro farming initiatives financed by (i) existing government budget funds, (ii) funds from poverty alleviation and development programs and (iii) "green fund" for R&D, O&M costs in villages at initial stages, pilot projects. Is this modality feasible? If yes, who will manage the Development Fund?

- The foreign consultant / transaction advisor for dendro-power projects is to give bankers a presentation to on the risks of dendro-power projects and risk mitigating instruments. The presentation should provide bankers with a check list for project evaluation.

5. CDM

- With reference to the work by UNEP-Risoe on a Program of Activities (PoA) for municipal waste to energy, analyse the pros and cons of a PoA for dendro-power. Outline the scope and structure of a PoA for dendro-power. Analyse the pros and cons of having a single PoA for municipal waste and fuelwood. If the conclusion is positive, develop the documents for the PoA with the help of an international consultant specialised in PoAs.

- Dendro-power projects in Sri Lanka generate CO_2-reductions through (i) fuel switching in power generation and (ii) from expanded biomass production on marginal lands. Develop a (baseline) methodology for quantifying the CO_2-reduction benefits of reforestation on degraded lands in Sri Lanka which is acceptable to UNFCCC.

- Develop a (baseline) methodology for quantifying the additional CO_2-reduction benefits from the dendro-power plants as such.

- Develop principles for the sharing of CER-revenue between owners of the dendro-power plants and fuelwood suppliers.

- Advise on needs to provide capacity building assistance to the strengthening of CDM-expertise in the country

II. Preparation of a detailed 10+ dendro-power plants investment program

Based on the analysis of the items mentioned above, prepare a short document describing the proposed 10+ investment program, which can be used to seek approval as Presidential priority investment program.

III. Preparation of standard documents

- Standard application document to authority with the developer's plan for use of land

- Sample land-use contracts

- Preparation of sample woodfuel supply contracts for the most typical cases

IV. Information note for foreign investors

- Change the present "Development of Grid Connected Biomass" report into an information note for foreign investors on resource, legal, incentive and regulatory conditions for dendro-power in Sri Lanka

1 Status of Biomass Energy Projects for Industry and Power

1.1 Biomass power projects in operation

Around 50% of Sri Lanka's energy needs are met by biomass.[2] Rural households are the main biomass energy users. Some industries use biomass to cover their needs for thermal and electrical energy. The most widespread type of biomass used for process energy is biomass waste. Examples are[3]:

- The Pelawatte and Sevenegala sugar industries use *bagasse* for heat and power (no other industry at present uses biomass energy for CHP). No sugar plant is connected to the grid; but a 40 MW grid supply project is in the planning stages and the Palawat plantation supplies electricity to the dwellings of its workers. .
- An activated carbon manufacturing factory generates producer gas by burning *coconut shells* in a gasifier (charcoal generated in the process is the raw material inputs to the factory) and feeds the gas to a steam boiler as fuel
- Puttalam Cement factory uses *paddy husk* to meet some of its heat energy needs

The first attempt at setting up a *dendro-power plant* failed: Ceylon Tobacco Company's 1 MW dendro power plant at Walapane, which became operational in 2004 and consumed 40 MT of purchased Gliricidia wood per day, no longer operates. Four major reasons are given for this. (i) Inappropriate choice of project site. The location was decided because CTC had a warehouse which was no longer used. The plant thus got located in hill country where road infrastructure is poor and often blocked by landslides and were drying of green tree is difficult at certain times of the year. (ii) The connection line to the grid went through forested land; because of falling trees the grid was often out of service. (iii) The power tariff would - even under more ideal conditions - have been insufficient to cover the cost of generation: biomass power at that time had no preferential tariff, it got the same tariff as hydro-power. (iv) The supply chain for wood was weak. The supply chain had too many middlemen between delivery at the plant gate and the farmers growing the trees: the brokers were monopolizing; the growers got hardly anything.

Sine then, the following major developments took place:

- The Energy Conservation Fund (predecessor of the Sustainable Energy Authority) tested in 2006 a *"green premium" pilot mechanism* designed for two dentro-thermal projects, a 1 MW plant by the CEB subsidiary Lanka Transformers Ltd and one by Recogen Ltd on a 0.5 Rupee/KWh basis.
- Late 2008, two grid connected biomass power plants started operation: Tokio Cement's 10 MW plant which fires wood pellets and paddy rice husk and a 1 MW power plant using coconut shells, which will be expanded.

Off-grid, a few, domestically produced, small wood-gasifiers in the 5 kW to 7.5 kW range are operating.

[2] The industry sector contributed 27 percent to GDP in 2005, the services sector 59 percent and agriculture 14 percent.
[3] From Report of the Inter-Ministerial Working Committee on Dendro Thermal Technology , June 14, 2005

The weak development of grid-connected biomass power plants stands in contrast to the situation of small hydro, where a combination of acceptable tariffs and bank finance led to the commissioning of 70 units and 132 MW between 1998 and mid-2008.

1.2 Applications for permits to biomass power projects

By December 2009, SEA had received 1,066 project applications totalling 2,556 MW. 55 were for *biomass based power projects* with a projected capacity of 329 MW; 909 with a combined capacity of 1750 MW were *small hydro-* and 62 with a total capacity of 439 MW were *wind farm* projects.

	Nos.	Capacity, MW
Energy Permit obtained		
Coconut shell (1 MW already commissioned)	1	8
Paddy Husk	1	10
Provisional Approval obtained (excl. energy permit)		
Dendro	12	42.8
Paddy husk	1	2
Sugar cane	1	9.8
solid waste	22	165
Projects related to other departments for clearance		
Dendro (to UDA)	1	5
Projects under processing		
Agriculture waste	1	2
Dendro	10	11.8
Paddy husk	1	7.5
Sugar cane	1	42.2
Solid waste	3	23
Total	**55**	**329.1**

Depending on the type of biomass fuel, biomass power projects face huge differences in project organisation, implementation and project risks. It makes sense to distinguish between three categories of projects, listed below according to their level of project risk, starting with the lowest:

- The *2 sugar cane projects with a capacity of 52 MW*, that are implemented by sugar cane producers using their own supplies of bagasse to generate power
- The *25 solid waste projects with a capacity of 188 MW*, where power plant developers depend on contracts with municipalities to gain access to the resource
- The 27 *dendro, paddy husk, coconut shell and agricultural waste projects* with a capacity of 89 MW, where power plant developers depend on contracts with a number of outside private suppliers to get access to the biomass resource.

One will notice the small size of the average dendro-power project. Dendro power plants have substantial economies of scale – the cost of investment per MW is significantly lower for a 10 MW plant than for a 1 MW plant. Yet, many argue that 1-3 MW dendro-power plants are preferable because they are easier to finance and have lower fuel supply risk. Sri Lanka has a resource

potential for several hundred megawatt (see section 2.2), but the resources are spread and the location of the power plants must reflect that. The plants seek supply from outgrowers located within a radius of 20-40 km; a distance within 20 km is strongly preferred.

The *bagasse projects* will probably go ahead even if SEA's role remains to be limited to the "passive" processing of the provisional approvals and of the energy permits. Since no *solid (municipal) waste projects* have been implemented yet, there is a potential role for the contracting by SEA of TA assistance to developers and to local administrations with regard to technology and contract issues. The Sri Lanka Carbon Fund (SLCF) has contracted foreign expertise (UNEP/Risoe) to assist the development of a Programme of Activities (PoA) for municipal waste management projects. The *dendro-biomass waste project* category, therefore, has the highest need for specific support measures.

The following chapters provide details on the situation and the challenges which dendro-thermal projects face.

2 Biomass Supply

The dominant crops in agriculture are paddy, tea, rubber, and coconut. Whereas the amount of land devoted to tea, coconut, and rubber remained stable in the years after independence; the Accelerated Mahaweli Program irrigation project, begun in the 1980s, opened a large amount of new land for paddy cultivation in the dry zone of the Eastern part of Sri Lanka.[4]

2.1 Land Ownership Regime in Sri Lanka

Rural lands in Sri Lanka are subject to a complex system of public-private ownership. The 2005 report of the "Inter-Ministerial Working Committee on Dendro Thermal Technology" classified the country's land tenure as follows:

- State lands including forest reservations and other *lands that are not utilized for any specific productive purpose*
- Large-scale mono-cultured plantations dedicated for tea, rubber and coconuts owned by *state agencies* together with lands that are released to *private sector companies on long-term lease basis*
- Large. medium and small scale mono-cultured *plantations owned by private* companies and individuals
- *Chena lands* and *irrigable high land crop lands* particularly in dry zone areas

The heavy state ownership is the result of colonial legal heritage and post-colonial land reforms, as well as import substitution policies from 1948 to 1970, which due to a weak national private sector, led the Government to engage in commercial production.[5] The Land Reform Law of 1972 imposed a ceiling of twenty hectares (50 acres) per family on privately owned land and sought to distribute lands in excess of the ceiling for the benefit of landless peasants.[6]

[4] By the early twentieth century, there was no longer much land suitable for the expansion of cultivation in the wet zone, and in the 1930s the focus of agricultural development shifted from the wet zone to the dry zone and from plantation crops to rice.

[5] Under legislation passed in 1840, the title of most *forestland* was vested in the government. In order to stimulate the production of export crops, the colonial administration sold large tracts to persons who wished to develop plantations.

[6] The Land Development Ordinance of 1935 forbade the transfer of crown lands for purposes of cultivation except to enlarge the landholdings of near-landless or landless peasants. The Land Reform Law of 1972 applied only to holdings of individuals. It left untouched the plantations owned by joint-stock companies, many of them British. In 1975 the Land Reform (Amendment) Law brought these estates under state control. Over 169,000 hectares comprising 395 estates were taken over under this legislation. As a result, about two-thirds of land cultivated with *tea* was placed in the state sector; the respective proportions for *rubber* and *coconut* were 32 and 10 percent. Very little of the land acquired by the government was transferred to i*ndividuals*. Most was turned over to various *government agencies* - the state-owned plantations were managed by the Janatha Estates Development Board and the Sri Lanka State Plantation Corporation - or to *cooperative organizations*, such as the Up-Country Co-operative Estates Development Board.

2.2 Resources for dendro power plants

Among 16 identifed fuelwood plants, there is general agreement in Sri Lanka that Gliricidia is the fuelwood plant of choice.[7] Three reasons are given for this (i) the natural prevalence of the plant in rural Sri Lanka; (ii) the value of its leaves as natural fertilizer or as feed for animals, (iii) the ability of its tree roots to fix nitrogen in the soil. The proposed technology for harvesting uses systematic pruning of branches. According to the Biomass Energy Association, one tree can yield 6 kg of wood per year on a sustainable basis. 4700 trees can be planted per hectare. These assumptions leads to an annual production per hectare of 28 tons of harvestable fuelwood.

The energy content of Gliricidia at 25% moisture is 4000 kcal/kg (16 GJ/kg); about the same as rice paddy husk and municipal waste. Gliricidia delivered from farmers has up to 50% moisture content, which reduces the energy content of green wood to 2700 kcal/kg.

Based on a conversion efficiency of 20% (combustion) in dendro-power plants, 1.6 metric ton of Gliricidia must be harvested per MWh. A 1 MW biomass power plant operating at an 80% capacity factor will consume 31 MT of green wood per day or 11,000 tons per year, that are dried down to 25% moisture before use. This is equal to the annual sustainable yield of:

- 400 hectares (=1000 acres) if Glaricidia comes from mono-crop plantation or
- 510 hectares if provided through outgrowing by small scale farmers who plant 3700 trees per hectare (=1500 trees per acre).

Thus, the land requirement for 1000 MW of dendro-power plants amounts to 400,000 hectares dedicated plantation land or to 520,000 hectares of outgrowers' land.

The potential demand for fuelwood from well-located rural industries seeking to substitute 0.4 million tons of annual oil consumption for thermal energy needs increases total land demand by an additional 25%.[8]

The Biomass Energy Association estimates that the exploitation of presently unused or underexploited land for fuelwood production could supply 4000 MW of dendro-power plants. Or, if

[7] The Ministry of Science and Technology (MOST) in collaboration with the Forest Department, Coconut Research Institute (CRI) and the Land Use Policy Planning Division carried out field studies from 1999 to 2004 to determine the optimum parameters for Sustainable Short Rotation Coppicing Energy Plantations. Twelve trial plots were established in degraded marginal lands in different agro-climatic locations in the country with different species of wood. Branches of these trees were harvested at varying time intervals. These trials concluded the following optimum parameters: (i) Best species of tree for dry zone degraded marginal lands: Gliricidia sepium. (ii) Best spacing between trees: 1 meter x 1 meter. (iii) Best time interval for harvesting coppice branches: 6 to 8 months. The trials also revealed the following: First harvest of branches could be carried out 15 months after planting. Annual yield of woody biomass per hectare (average): 30 tonnes at the rate of 20% moisture. Total extent of availability of degraded marginal land suitable for energy plantations in Sri Lanka: 1.7 million hectares (excluding industrial plantation lands, pasture lands and reserves). Source: Asangi Jayasinghe. dendro: The Nation - Biomass - The long term solution for energy needs in Sri Lanka. The Nation, 10 Feb 2008

[8] The Biomass Energy Association advocates in " A Proposal for Immediate Reduction of Use of Imported Fossil Fuels in Industry" drafted by its President Dr. Parakrama Jayasinghe the substitution of 425,000 tons of oil in industry by fuelwood. As based on practice, 1 ton of oil can be replaced by 4 tons of fuelwood, satisfying this policy calls for an annual production of 1,7 million tons of fuelwood, requiring from 62,000 to 124,000 of hectares to be planted.

50% of the degraded marginal lands were converted into energy plantations 2000 MW of electricity with an annual output of 14,000 GWh could be generated.

2.3 Potential sources of supply

The following table is based on estimates by the Biomass Energy Association.

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

Source: David Ceretti: ART GOLD Sri Lanka Research on Renewable Energy in Sri Lanka,

2.3.1 Biomass waste

Use of biomass waste as part of the fuel mix in dendro-power plants reduces the sector's demand for land. The most attractive sources are *coconut shells* and *paddy rice husks*.

Rice mill owners can supply paddy husk during their high season, then they stop. Even during the high season, supply is not regular: mill owners choose to mill the rice when the market price is favorable. Thus, although rice millers are willing to transport their waste to the site of dendro power plants to get rid of an environmental problem, rice paddy husk can be a supplementary source of supply only.

Sri Lanka has *60 coconut mills*. Most coconut lands are less than 5 acres; total land use amounts to 720,000 acres (290,000 hectares). An average mill produces 60,000 nuts per day, works up to 180 days per year and needs 12,000 acres of planted coconuts for supply. The waste *coconut shells* from an average plant have enough calorific value to cover the energy needs of a 12 MW power plant. Since the energy needs of coconut mills are lower, they have surplus coconut shells to sell. Some are sold to thermal applications in industries, including in cement factories, others can be sold to dendro-power plants.

Although coconut shells from coconut estates can be only a marginal source of supply for future biomass plants, they increase the plant's security of fuel supply and are cheap.

2.3.2 Fuel wood outgrowers

The Biomass Energy Association expects most fuelwood supply for dendro power plants and for oil substitution in industries to be provided by outgrowers. Several factors justify this assumption. (i) Two thirds of all tree production in the country comes from smallholders. (ii) Most small farmers already grow Gliricidia on their land for fencing. (iii) Although many farmers have received no more than 2-3 acres of land, it is common to see at least 1 acre to be unused; when they have 7 acres, 3 may lay fallow. (iv) The organisation of outgrowing to serve a central source of supply is well-established in Sri Lanka. The 1000 tea factories get their leaves from local producers located within a radius of about 10-15 kms from the factory; 70% of black tea is grown by small producers having 1-3 acres. As there is good competition between tea factories for supply, each tea factory attempts to build local loyalty. The supply situation for coconut mills is similar.

Successful organisation of out-grower supply for dendro-power must overcome a dual risk hurdle:

- The power plant developer must be sure of supply every day during 365 days – meaning also during the harvesting and planting seasons.
- The small, poor farmers need to be convinced that an investment in the planting of Gliricidia in year 1 – before construction of the power plant has started - will have an assured demand three years later; that is, that the investment in the power plant will take place.

Biomass power projects in advanced stages of preparation have developed promising concepts for organising supply from small out-growers. They differ with regard to aggregation and with regard to the initiator. Two models will be presented here, one organised from the fuelwood supply side – the other from the fuelwood demand side.

The Cooperative Fuelwood Supplier Model

The *Human and Community Development Youth Organization*, a NGO, tackles the issue from the supply side. Its objective is to raise the annual revenues of low-income rural families. Getting farmers to invest in the production of fuelwood from Gliricidia is a mean. The NGO treats fuelwood supply as a side activity for involved farmers, promoting the technique of alley cropping (growing cash crops with the trees) to farmers. The organisation of supply proceeds as follows:

- To facilitate coordination amongst involved district-level development agencies and create an enabling environment for the activities, the NGO, in collaboration with local administrations, sets up *Public -Private Partnership Committees (PPPC)* with representation from public and private sectors.[9] The *Divisional Secretary* gives the NGO its list of farmers.

- The NGO conducts a social mobilization program to convince farmers in forming at divisional level a community company /cooperative to supply fuelwood to a nearby dendro-power plant. The cooperative, helped by the NGO, establishes fuelwood collection centers, organises the fuel wood transportation to the power plant and performs quality assurance.

[9] At the **community level** the PPPC provides support for improving the governance system and social empowerment process at the village level through the development of self-governing community institutions. At the **divisional level** the PPPC provides support for the strengthening of development programming and management capabilities of the Divisional Development Committees (DDCs). At the **district level** the PPPC supports the National Planning Commission and the Ministry of Science and Information to formulate policies that reflect and support local level development initiatives.

The cooperative will deal directly with the power company on the basis of a forward sale agreement; the price is to be revised every two years to reflect market prices at the time. An outgrowers' cooperative will typically have 300 members. To be a member – to get and maintain a member certificate - a farmer must have a minimum of 2000 trees in his home garden.

- The NGO gives TA assistance to the PPPC and to farmers and intends to initiate a micro-finance program[10] to assist also in livestock development and milk production, bee-keeping, the cultivation of fruits[11], vegetables and flowers as well as the organization of fertilizer production using gliricidia leaves.[12]

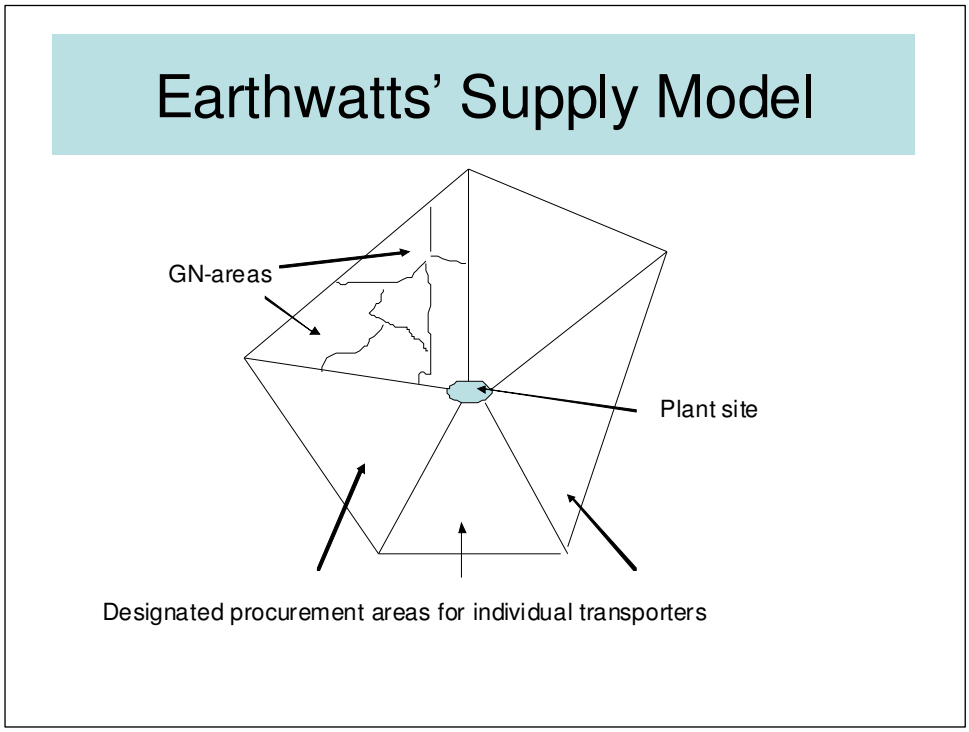
In parallel to its fuelwood supply side efforts, and using WEC-India as communication channel, the NGO seeks to find foreign investors willing to invest in 1-3 MW biomass fired power plants to off-take the fuelwood.[13] Potential interest has been expressed by developers from Korea, Malaysia and UK. The ability to access carbon credits is a major attraction for the foreign investors. Although each plant is to be owned by an individual investor, the NGO seeks to bundle 10 projects into one CDM-project; WEC is hiring consultants to prepare the necessary documents for it. However, the potential developers and the NGO are still far from reaching agreement on the sharing of future CDM-revenue. The power plant investors want 100%; the NGO wants 25% of net revenue to go to the farmers, with the remaining 75% being divided 20%/80% between the NGO as project promoter and the investors in the power plants.

Late 2008, the NGO works with 20,000 farmers from 7 districts to develop fuelwood supply for 16.5 MW of power generating capacity. So far, the NGO has managed to bring 2500 acres of Gliricidia plants under cultivation on previously uncultivated land[14] in 41 GN divisions[15] in the Thirppene Divisional Secretariat area[16], by mobilising 2500 families. The plans are to grow coconut and cinnamon alongside the growing of Gliricidia plant. A private developer is to invest in a 1.5MW thermal power plant to be established in Kattamutitchan to off-take the supply.

[10] For this the NGO needs assistance. Not having funds itself; it would have to get a MFI involved.
[11] For the marketing of products, the NGO relies on three options, depending on the market, the NGO uses different channels: (i) **Direct sales**. It has a network in Colombo and other areas to get the best price have 10 Distributing Center formed by the Government (take contact with these); (ii) **Milk processing plants + fruit processing plants** fruit in pulp form (e.g. 100 kilos of papaya, turn it into pulp, wood apple, mango) and packaging to reduce problems of seasonality; (iii) **Drinks**.
[12] The NGO is founding nurseries in collaboration with the Bioenergy Council of the International Union of Conservation (IUCN).
[13] The NGO went to India in 2008 to present its business model to potential developers at a WEC-India event.
[14] According to base line data, out of 78000 acres in the project area, 14258 acres are not cultivated or not utilized. In the North-Central dry zone every farmer has been given 2-3 acreas by the Government.
[15] An administrative unit, similar to a postal district unit, which allows the precise identification of the area.
[16] 70% of the families in the project are sumurdhi recipients and bellow the poverty level.

The "multiple transporter- wholesaler monopoly" model for fuel-wood supply

The project developer Earthwatts Lanka ltd specialises in electricity generation based on biomass and landfill resources. Its 6 MW (initial) to 10 MW (final) dendro power project in the Polonaruwa district is early 2009 at an advanced stage of preparation.[17] Earthwatts outgrowers' concept can be dubbed the "multiple transporter-monopoly" model. Earthwatts defines its area of supply as the 60-70 rural GNs located within a 30 kms radius from its power plant.[18] Farmers in the area have on average 7 acres of land of which 3 are fallow. Farmers are advised to set up semi-dedicated plantations on these, planting 1500 trees per acre. The supply area is divided into 15 to 20 procurement areas composed of neighbouring GNs, see the chart. Earthwatts signs a three year contract with individual lorry owners to act as "intermediary / aggregator / transporter" to supply fuelwood to the plant from out-growers in a defined procurement area. The contract gives the truck owner a maximum number of trips per year, which allows a local to get a bank loan towards the purchase of a used truck for the purpose. The power company acts as paymaster; the transporter deals with the farmers in his supply area to secure daily supply. There is no competition between transporters for supply from farmers: each transporter can procure fuelwood only from his assigned procurement area. The aim of the procurement monopoly is to promote sustainable supply. Earthwatts trains a team of about 160 harvesters – roughly ten per transporter – to do the harvesting and to advise farmers in their procurement area on sustainable harvesting. Earthwatts concentrates on Gliricidia's fuelwood. The Maheveli Authority is interested in buying the harvested leaves for fertilizer production; the alternative to assist farmers in using the leaves as fodder for domestic animals, is not contemplated by the Authority.



[17] The project is located in the Thermal Highlands in rain-fed areas that can have only short-term crops, maximum three months. There are, therefore, a long periods, where the farming population "is idle".

[18] The supply area is heavily forested. An ADB-supported survey made in 2006 showed that some 32,000 Maheweli settlers live in the area; almost 90% have grown Gliricidia for fences and for trees.

To convince farmers to engage in Gliricidia based fuelwood supply is an uphill task.[19] The promotion / awareness campaign, started by Earthwatts in 2006, comprises the following:

- To reduce the investment risk for farmers, Earthwatts pays farmers 3 Rupees for every Gliricidia tree they plant in supply areas approved by Earthwatts: 1 Rp when it is planted, 1 Rp if it is still standing after one year and 1 Rp if it is still standing after three years. From then on, harvesting of branches can begin.[20]

- Earthwatt put up a sign on the 49 acres of land, which it had leased long-term from the Maravehli Authority, indicating that a power plant is to be set up there. Due to delays in environmental approvals there has been no progress in construction since 2007, but Eartwatts keeps farmers informed about what is happening.

- Earthwatt has a three-step expansion plan for its annual purchases of fuelwood. For security of supply reasons, the initial capacity of the dendro-power plant is 5.5 MW; later 4.5 MW are to be added. The first goal, therefore, is to have 60% of needed supply ready when the plant starts operation. Step 1 begins already before the operation of the plant: to show its sincerity and get the supply chain working, Earthwatts has begun to buy fuelwood from the farmers which it on-sells to industries who replace oil consumption with fuelwood.

Earthwatt intends to plant 1000 acres itselve; are in contact with Maravehli Authority for that.

Earthwatts expects to employ 200 people in the project: 40 in the power plant and 160 wood harvesters.

The price structure for *green wood* in Earthwatts' supply model comprises:

- The purchase price for greenwood at the farmer's land. In the initial awareness campaigns in 2006, Earthwatts informed farmers that the buying *price for green wood* would be 1500 Rps per ton. The indicative price was raised end 2008 to 2500 Rps. In its financial modelling Earthwatts calculates with a price of 2700 Rps, increasing 5% per year.[21]

- Earthwatts' August 2008 estimate of *transport prices* was. 50-60 Rps per metric ton per km.

- The salaries for the 160 *harvesters*.

2.3.3 Intercropping at plantations

Sri Lanka has 400,000 ha of coconut estate. According to the Biomass Association, 40% of this land is suitable for inter-cropping with Gliricidia with two rows of coconut alternating with two rows of Gliricidia. But because most estates are located in the Northwestern and Western

[19] Farmers were very disillusioned. 15 years before farmers had been convinced by an outside company to grow asparagus, this, just as cashew cultivation promoted by Government a few years later had failed completely.
[20] This is well-established practice in tea, rubber and coconut tree planting, except that it is the Government which provides the subsidy in those cases.
[21] At April-2009 price levels, this yields a fuelwood price of US$11/Gcal versus an HFO price of US$27/Gcal.

Provinces, where also most of the industries that could switch from oil to biomass are located, the Biomass Association sees industry as the main off-taker for this potential supply.

The author of this study has not obtained information on the price structure and costs of production for inter-cropping.

2.3.4 Dedicated fuelwood plantations

Gliricidia was declared as the fourth national plantation crop in July 2005 by a cabinet decision.[22]

Much *state owned land* is either abandoned or sub-utilized; this offers opportunities for setting up fuelwood plantations. The Biomass Association estimates that 1.7 million has of scrub land is available; enough to supply 4000 MW dendro-power if converted to fuelwood plantation land. In addition, land can be purchased from *private coconut, tea and rubber plantations* that are in bad financial shape due to lack of investments and willing to give up operations.[23]

Yet, to acquire access to these marginal lands is an uphill task for two reasons.

1. Although many Government owned plantations have much unused or under-utilized land, giving out Government land to the private sector on long-term lease contracts is always controversial. There are many potentially interest parties; in the moment there is a plan for the use of a specific piece of land, there will be people who protest.

2. The ownership-authority over land is in the hands of different Government organisations; the National Livestock Board, for example, has 40,000 acres of land. A private investors needs to sign contracts with several different agencies in order to acquire the critical minimum amount of land needed for commercial operation.

The price structure for fuelwood plantations comprises the following elements:

Cost of investment:
- *Cost of project preparation* (land identification, legal registration, etc)
- *Cost of land*. The purchase price for land is 50,000 to 100,000 Rps per acre. Lease Government land costs around 3500 Rps per acre per year, which, assuming a yield of 14 to 18 tons per acre; leads to a cost of 190 to 250 Rps/ton green fuelwood
- *Cost of land clearing* plus *planting 2500 trees per acre* is estimated by developers at 40,000 Rps per acre. The amortisation of the 40,000 Rps depends on the chosen length of repayment period (10 year assumed) and on the rate of interest (10% assumed). Assuming a yield of 14 to 18 tons per acre; this cost amounts to 365 - 465 Rps per ton greenwood.

Cost of operation:
- *Annual cost of hired labor for operation and harvesting*. (no estimates received)
- Annual cost of *management* (no estimates received)

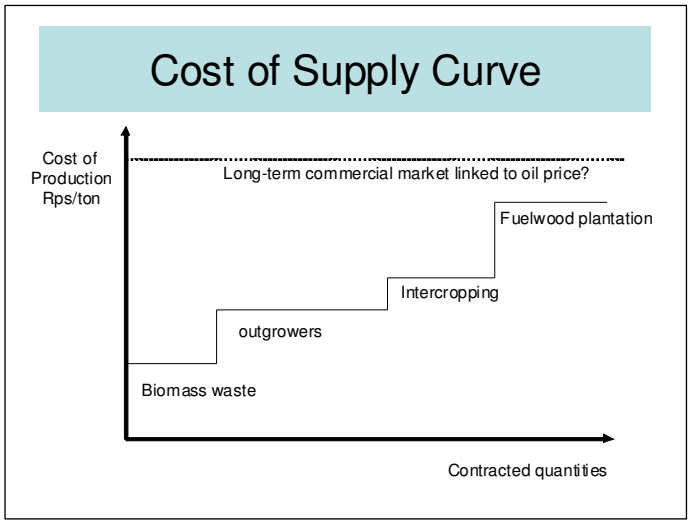
[22] The author of this study was unable to obtain information about the practical-legal implications of the decision.
[23] Tea plantations were handed over to private developers for 99 years' lease. Many state owners neglected their plantations because of the economic conditions; the world market price for tea had come down.

- Cost of *drying* (no estimates received, but the "main price component is the 25 percent loss of weight")
- *Transport* (=Earthwatt outgrower model estimate of 50-60 Rps per metric ton per km?)

One will notice that the cost of investment in 1000 acres of fuelwood plantation land (=land requirement for 1 MW biomass power plant capacity), not counting pre-investments in project preparation, amounts to 40 million Rps (=US$0.4 million) when the land is leased, or to 70 million RPS (=US$0.7 million) when the land is purchased (assumption 30,000 Rps = NPV of 3,500 Rps payment during 20 years and discount factor of 10%). Assuming that the cost of investment per MW in the power plant is around US$2 million, the cost of investment in 100 percent self-supply including costs of pre-investment would increase the total investment by around 40 percent.

2.3.5 Risk minimization strategy of dendro-power plants and cost of supply curve

Due to the incompleteness of the above information on costs of production, no precise estimates can be given of the relative costs of supply by source. For the initial years one can assume that the cost of supply curve will by be influenced look by the costs of production for the individual sources of supply (see the chart): biomass waste being the lowest cost source of supply (can be acquired in the short term for the cost of transport), dedicated fuelwood plantations needing the highest price to be commercially viable. In the long term, as the commercial fuelwood market develops and matures, one may (as indicated in the chart) expect prices to be dictated mainly by demand and thus, by the price of oil (or more precisely: HFO and diesel as alternative fuels) and not by individual costs of production. Price differences for contracted quantities can be expected to hold in the short to medium term only. In the long run, market integration is inevitable.[24]



Choice of plant location is maybe the most significant decision affecting the security of fuel supply; projects have failed because they were not placed in areas with abundant supply potential.[25]

Specific strategies for reducing fuel supply risks include (i) *opting for power plants in the 1-3 MW range*, which do not offer the economies of scale in investment and in plant operation of 10 MW power plants[26], but face less challenging fuel supply logistics and (ii) contracting supplies from multiple *sources of supply*:

[24] Experience during the last six years has shown a remarkable parallel evolution in the international prices for oil, gas, coal and internationally traded fuelwood pellets.
[25] Others because the intended project location was too far from the nearest grid.
[26] The upper limit for eligibility for feed-in-tariffs.

- Since the total supply of biomass waste for power plants is limited; their share in the supply of a future power plant is likely to be less than 20 percent.
- A third of supply may come from fuelwood plantations – some developer-owned, some estate-owned
- The remaining 50 percent or more of contracted supply would come from outgrowers.

2.4 Developers of Biomass Supply Projects

Developers actively engaged in expanding the supply of fuelwood for power plants include:

- *Power plant developers* who invest in small fuelwood plantations for own consumption and simultaneously encourage local farmers to grow Gliricidia trees on some of their land.

- *NGOs* who encourage local farmers to grow of Gliricidia trees for fuelwood as a supplement to agricultural production and simultaneously try to lift their agricultural production and incomes in general.

- *Commercial fuelwood suppliers* who invest in fuelwood plantations for sales of fuelwood to third parties.

Hempel Holdings Ltd. Is an example of the latter. These companies target both biomass power projects as well as industrial firms switching from oil to biomass for thermal energy generation. The industrial fuel substitution market, in fact, is seen as the easier and more promising market at least in the short term.

The task of developing biomass supply of sufficient scale is a challenge for all three developer categories.

- For *power plant developers*, the fuelwood supply activity increases the a priori risk of the project (before any money is spent on project development) as well as the length of time for project development from start of pre-feasibility study to commissioning.

- *NOGs* face the dual financing challenge of (i) financing their own costs of operation and (ii) securing micro-finance for their target group of farmers.

- *Commercial fuelwood companies* need to raise significant amounts of equity capital and debt finance. To develop 40,000 acres of fuelwood plantations (enough to cover the demand of a 40 MW power plant) calls for an investment of US$32 million (if the land is purchased). For this, the company needs to secure US$10 million in equity and US$22 million in debt finance.

2.5 Issues in Biomass Supply to address in a Support Programme

Fuelwood production is not the only commercial activity which can be developed on under-exploited lands: horticulture, agriculture and production of non-edible oilseed crops for environmentally friendly production of bio-diesel/bio-fuels are other options.[27] Decision taking Government agencies need to know the economic consequences for the local and national economy of choosing one option rather than the other. A study analysing *the trade-offs between expanded fuelwood production and other forms of agricultural production* can establish *the most likely opportunity costs for fuelwood production for the three typical cases of (i) small farm-plots, (ii) intercropping at plantations and (iii) dedicated fuelwood plantations.* The results can help local and national Government to base decision taking on land allocation and land uses on best available evidence.[28] The study can establish guidelines for identifying clear-cut cases, where decision taking is an administrative formality, as well as cases where political preferences have to decide.

One way to reduce the political hurdle for investor access to Government owned land is for *Government institutions to go into joint ventures with biomass developers to supply fuelwood.* SEA can encourage and facilitate such public private partnerships (PPPs). One may claim that lease of government owned land to a biomass supplier is a "soft joint venture" and that little is gained by going further into a legal joint venture with more active Government participation. A study could identify joint venture options and assess the pros and cons of these.

[27] The institutional and regulatory framework for the allocation of land to fuelwood plantations is discussed in chapter 3.

[28] This avoids repeating worldwide experiences during the last five years with unsustainable biofuel production methods and accelerates the administrative process.

3 Investors in Dendro-Power Plants

3.1 National investors

There is no shortage of entrepreneurial, creative and technically competent project developers in Sri Lanka looking for opportunities in the area of biomass-fired power. What they lack is capital; in addition, most lack access to local in-depth know-how in dendro-power technology.[29]

A few developers are well-capitalised. Examples are Pelwatte Sugar, which in 2006 applied to the Ceylon Electricity Board to build a 25MegaWatt power plant fired by sugar cane waste and Tokio Cement, the owner of a 10 MW plant, which burns coconut shells as the main fuel.

Project developers in general do not have sufficient equity capital to go beyond the pre-investment phase on their own. Nor do they have sufficient collateral to access debt finance in a country where the banking community is unwilling to engage in non-recourse project finance. Once a project has reached its final approval stage, developers sell the project to a well-capitalised (foreign) investor or take one onboard as a joint venture partner to co-finance the equity for the project and facilitate access to the required level of debt finance for the project. The focus on small 1-3 MW power plants is more than a risk strategy aimed at reducing the biomass supply risk: it also reflects the weak financial strength of biomass operators.

Presently, few professional project developers specialise in commercialising biomass-fired electricity generation projects in Sri Lanka. EarthWatts Lanka Limited (EEL), established by the Sri Lanka based Star Trading Company, is one of them. It has made skilful use of short term partnerships with foreign specialists to acquire key know-how; e.g. in the preparation of "gold standard" CDM projects.

The NGO "Human and Community Development Youth Organization" is more atypical, being a "pure amateur" in biomass power technology. The NGO refrains from investing in biomass-fired power plants. It concentrates on developing the biomass supply side whilst simultaneously marketing associated power plant investment opportunities to foreign investors. The NGO uses WEC-India as "broker" for connecting it with potentially interested investors.

State Plantations could be potential investors. The Ministry of Public Estate Management and Development (MPEMD) and the Strategic Enterprise Management Agency (SEMA)[30] have developed the "Plantation Asset Management Business model" for the sustainable commercial development of State plantations. It identifies a set of high return business resources for

[29] Some, at least of the early pioneers, also lacked proper understanding of project logistics and project economic concepts.

[30] SEMA is a special organisation established by a statutory declaration of the president. Twenty state enterprises of with special significance to the national economy were brought under its direct supervision in 2006 including State banks, Ceylon Electricity Board, Ceylon Petroleum Corporation, Sri Lanka Ports Authority, Sri Lanka Transport Board, Airports and Aviation Services Ltd, Sri Lanka Railway and JEDB, SLSPC, CPL, EPL, KPL, of the plantation sector. Those organisations were grouped in five main sections, namely as financial services cluster, the utilities cluster, the transport and logistics cluster, the plantation asset management cluster and the labour relations and special projects unit.

development as alternative or supplement to the traditional plantation management business model. Development of mini-hydro sites on plantation land and of dendro-power plants are among the favored new business activities.

3.2 Foreign investors

The Ministry of Finance advised SEA of its strong interest in the promotion of foreign investments in biomass-fired power plants.

One can distinguish three categories of foreign investors.

1. *Foreign investors specialised in biomass energy and based outside Sri Lanka.* Some have come on their own and spent time and money on the preparation of pre-feasibility and feasibility studies for specific projects. Not knowing the complexity of land ownership and user rights beforehand, they have seen their efforts blocked by problems related to the security of biomass supply.

2. The Tokio Cement biomass power plant is an *investment by a foreign investor who has an ongoing operation in Sri Lanka* in another business and who adds biomass power as a new item to the firm's investment portfolio.

3. *Investors looking worldwide for opportunities to invest in small-to-medium scale power plants using renewable energy and who, require to be presented with fully developed feasibility studies*. These investors have good technical know-how themselves or work together with technical specialists. The key questions they expect to be answered by the feasibility studies concern the biomass supply situation for the plant and the regulatory framework for the operation of biomass power plants on the power market. These investors are the logical cooperation partners for financially weak project developers based in Sri Lanka. Aligning the two can also make the financing of 10 MW-category power plants more feasible.

3.3 Power generation technology

For the moment, *Indian steam turbine technology* is the technology preferred by biomass power developers in Sri Lanka: it is proven technology and has lower costs of investment than alternative technologies. The downside is a low conversion efficiency of around 20 percent.

Fuelcell technology is the most advanced, unproven and expensive technology in terms of investment and non-fuel operating costs: the cost of investment for a 10 MW fuelcell power plant using biomass is estimated at US$23 million of which US$3 million are for civil works. But based on 70 percent gasification efficiency and 80 percent fuelcell efficiency, fuelcell power plants can achieve a 56% overall conversion efficiency. For Government energy policy, fuelcell technology has the advantage of doubling the share of RE-power in annual generation for an available amount of annual biomass supply. In addition to increased national security of supply, there are local

environmental advantages such as no need for cooling water and global environmental benefits in the form of higher CO_2-reductions.

Seen from this perspective, the most interesting "national project developer - foreign investor alliance" is the one between Earthwatts and the Singaporean fuelcell technology company AGNI Inc. AGNI is eager to demonstrate the economic-technical feasibility of its fuelcell power plant technology in a full scale refrence plant (gas from gasification is refined to extract hydrogen). AGNI is willing to co-finance 60% of the cost of investment through own equity, looking for the remaining 40% debt finance to come from local finance, most likely from the Bank of Ceylon.

3.4 Dendro-power issues to address in a Support Programme

To accelerate decision taking by investors, issue papers from consultants can clarify:

(i) The economics of alternative power technologies.

(ii) Principles for dividing CER revenues between owners of the dendro-power plants and fuelwood suppliers

(iii) Strategies and instruments for attracting foreign investors.

The essential question to answer in the first issue paper is to what extent choice of Indian steam turbine technology is the optimal economic choice for Sri Lanka or just a reflection of the weak financial strength and risk aversion of project developers? The study is to make an economic and financial analysis of the costs and benefits of the most relevant dendro-power technologies as a function of biomass supply prices and international coal prices. Inter alia, it will assess the maturity of fuel-cell power technology, and adjust project economics for differences in technology risks.

The second paper has to identify a fair principle for the sharing of project CERs between the biomass demand side (dendro-power plants) and the supply side (farmers). Dendro-power projects in Sri Lanka generate CO_2-reductions through (i) fuel switching in power generation and (ii) from expanded biomass production on marginal lands. The natural tendency for investors in a dendro-power plant is to seek property rights over all CERs generated by the project. Developers of biomass supply, in particular NGOs who have developed a project from the scratch and are fighting for the economic interests of their farmers, want to have rights to at least a share of the CERs generated by a project. To guide and facilitate negotiations on this, the study must develop a (baseline) methodology for quantifying the CO_2-reduction benefits of reforestation on degraded lands in Sri Lanka which is acceptable to UNFCCC. As a minimum, the project CERs for these would have to accrue to the biomass supply side. The (baseline) calculations of CO_2-reductions from replacing fossil fuels in national power supply have to be done as well.

The policy goal of attracting foreign investors requires proper marketing of project opportunities. The preparation by national project developers of high quality (pre)feasibility studies is a pre-requisite for this. The study is to answer, inter alia, whether the introduction of financial support to the preparation of feasibility studies is justified, or whether market forces will be sufficiently strong to generate sufficient activity once the implementation of an initial number of dendro-power plants projects has proven the validity of the concept in Sri Lanka? Another subject to answer is how

essential the CDM-project opportunity is for foreign investors? Due to their financial strengths, they can, by holding their project CERs until certification before selling them, get higher prices than national investors sell most of their project CERs on future contracts as a means to satisfy bank requirements for revenue certainty. If the Governments wants to attract foreign investment into dendro-power, it needs to clarify the CDM-opportunities and conditions as early as possible.

A third issue to look into is the interest of foreign investors to engage in joint ventures or other forms of Public Private Partnerships (PPPs) with state plantation companies for the production of biomass?

4 Regulatory Regime for Biomass Power Projects

4.1 A fragmented Structure

Sri Lanka has one of the most fragmented politico-administrative decision taking structures in the world. The Cabinet, for example, is composed of 50 ministers. Dendro-power projects face a daunting approval structure comprising. The most important are listed in their natural sequence:

- *Preliminary RE project permit* from SEA
- LOI showing CEB *agreement to connect* the plant to its transmission line
- *Land rights* through purchase or lease from the pertinent authority, e.g. Mahaweli Authority of Sri Lanka (MASL)
- *Land use rights from the* District Land Officer who utilizes GIS and data at the Land Use Planning Division of the Ministry of Agriculture, Land, Livestock and Irrigation
- *Environmental clearance* in the form of an Environment Protection License (EPL) from Central Environmental Authority (CEA)
- *Site clearance,* (permission to construct the project in accordance with the guidelines fixed in the EPL) from the pertinent authority, e.g. MASL
- Approval for location and construction of the *access road to the plant* by the transport authority
- *Project approval* by the Divisional Secretariat and by the Provincial Authority Pradeshiya Sabha (PS) where the plant is located
- *RE project permit* from SEA
- *PPA* with CEB
- *Generation license* from Public Utilities Commission of Sri Lanka (PUCSL)

In principle, a fragmented structure need not represent a blocking stone; Sri Lankans are capable organisers. Sri Lanka has developed appropriate institutional responses to handle coordination needs that are associated with a fragmented structure in other sectors and will develop smooth procedures for dendro-power projects also.

The key institutional response to the situation for RE power projects is the creation of SEA by Act in 2007 as coordination and facilitation body, a sort of one-stop-shop for project developers. Within the SEA structure, the coordination function objective is reflected in the composition of the Board of Management and the Projects Approving Committee: “all” stakeholders and approving bodies are represented on both.

Yet, so far, the structure has not functioned as intended for conjunctural as well as structural reasons.

First, up to the spring of 2009, a shortage of personnel and a huge number of applications for preliminary project permits prevented SEA from performing its support function for developers. Developers could not turn to SEA for help in dealing with regulatory authorities that were slow in responding, reversed earlier decisions, or took inflexible positions. A developer must expect that it takes two years after the signing of a LOI with CEB to get all approvals. The speculative surge in

project applications also prevented the Executive Approval Committee for project applications to be an instrument for reports by involved stakeholders on the status of the processing of authorisations for projects that had received a (preliminary) permit from SEA: the monthly meetings had to focus on applications for permits.

Secondly, whereas SEA can help in coordinating *central level* regulatory responses, SEA has little, if any, leverage when it comes to *local level* approvals of land leases, land purchases and land clearances. Obtaining these approvals can be something of a nightmare according to project developers.

4.2 Approval regime

4.2.1 Importance of "standardisation"

The *approval regime at power sector level* – SEA's project permits and RE resource rights, CEB's LoIs for connections and PPAs – works well: procedures are standard, approvals are bureaucratic-objective and fast: to get an LoI from CEB takes two weeks time.[31]

The opposite is the case for *approvals of local level issues* - land decisions, EIAs, clearance of land – where decision taking tends to become highly politicised and many organisations at community level are involved, e.g. local temple, trade unions. An investor who misses out on an organisation risks problems. The low level of "standardisation" leads to slow decision taking - an EIA for a dendro-power project takes more than 1½ years from start to approval – and to frequent back-stepping by authorities on earlier decisions. In short, project developers have no clear road map to follow; an investor has to define the road map himself, this requires experience and intimate knowledge of local customs.

4.2.2 Land approval

Land is required for the power plant site and for establishing fuelwood plantations.

The time required to obtain a long-term lease for a plant site from a state owned entity such as Mahaweli Authority of Sri Lanka (MASL), National Livestock Development Board (NLDB), or Janatha Estate Development Board (JEDB) takes a year: the land needs to be surveyed, valued and the deal needs to be approved.

A number of recommendations to accelerate the development of fuelwood supply have been proposed.

The Biomass Energy Association recommends that the *Forest Department make a clear declaration of strict forest areas* so abandoned chena lands and scrub lands can be released for energy plantations.

[31] Minor mistakes do occur. There are cases where SEA does not issue a preliminary Project Approval due to reservations by Committee, e.g. by forestry representative, yet CEB issues LoI.

The "Report of the Inter-Ministerial Working Committee on Dendro Thermal Technology of June 14, 2005, recommended the implementation of a new structure comprising (i) institutional reforms, (ii) data collection on land use and (ii) adoption of a land use policy:

1. National level coordinating body for land allocation (inter agency executive panel): Working Group on Expeditious Land Allocation (WGELA) appointed by the Minister of Agriculture, Land, and Livestock & Irrigation :
   - Composed of expertise from ministry, LUPP, provincial & central land commissioners and divisional secretaries
   - Power to solicit approvals and authorizations from land owning agencies and provisional level land authorities:
   - Meeting once per month
   - Headed by land commissioner
   - Uses the district land officers as the primary network to access district level data on land

   Other institutional:
   - Establishment of *Fuel wood Plantation Authority* under Ministry of Plantation Industries
   - Establish a regulatory mechanism to balance pricing, contractual and other trade issues

2. Adoption of uniform land policy

3. Physical survey of land; investigation by District Land Officers + utilize GIS and data at Land Use Planning Division of the Ministry of Agriculture, Land, Livestock and Irrigation:
   - Land availability and viability of economic exploitation through energy plantation
   - Availability of required infrastructure such as grid and road access
   - Be used to derive a 10 year development plan for fuelwood plantations

All three proposals are still relevant, yet little progress has been made toward their realization: (i) SEA has been established and (ii) fuelwood has received official status as fourth national plantation crop.[32]

4.2.3 Allocation of RE-Resources and CEB's LoI

By Act, the Government of SL has ownership of RE-resources. The Minister responsible for Energy can declare a geographic area to be an "Energy Development Area" within which the right to use a RE resource is subject to a concession regime. This regime can assure that RE-developments are aligned with CEB's transmission investments and be used to promote investments in larger scale windfarms.

SEA has by the Act of its creation in 2007 been given the authority to allocate the RE resources to developers through permits.[33] It starts with a *preliminary permit* for project investigation, basically

[32] The plantation plant status must have some positive implications for regulatory approvals. The author of this study has, however, not been able to get information about what the implications are beyond easier approvals of subsidies.

giving the developer the monopoly right to the resource at the site during the one-year duration of the permit[34], and ending with the full *project permit* once project feasibility is demonstrated. SEA's role as allocator of RE-resources is to ensure that a resource is properly assessed and optimally utilized. For dendro-power projects, the rule for preliminary permits and LoIs by CEB seems to be that the nearest project has to be at least 5 kms away from a site covered by another permit/LoI. The permit procedure enables SEA to monitor progress: when an applicant gets a preliminary approval and does not move the project forward, SEA can ask why - if he is not getting his approvals from other authorities?

Unfortunately the time-limited "monopoly-right" for investigation of a site has been misused by developers who seek permits for several sites with the purpose either of (temporarily) blocking others from getting access and/or to sell the preliminary permit to another developer. In this way, a secondary market for approvals has developed, at least for hydropower sites.

A cabinet decision early 2006 raised the limit for CEB's obligation to buy power from dendro-power plants to 50 MW from the previous limit of 10 Megawatts. But whereas plants up to 10 MW are eligible for the standardised feed-in-tariffs, plants larger than 10 MW negotiate individual tariffs with CEB.

Developers want to be connected to a transmission line rather than a distribution line; when the latter is down, the plant loses money. Acceptance by CEB to sign a LoI (for connecting a project to the transmission grid and purchase power) for a project depends on CEB's estimate of the grid's absorption capacity. CEB knows the limits for each sub-station and the requirements for the upgrading of neighbouring substations if more generation capacity is connected to the grid. The CEB representative on the Committee informs how much capacity is used up, how much capacity is committed.

In some hilly areas lack of grid capacity is upholding mini-hydro projects.[35] The situation, of course, frustrates developers who criticise that CEB has failed to come up with a master plan approach, on which CEB's investment program for the grid is to be based and that neither *grid substations' capacity* nor *percent loading condition* are transparently known by stakeholders outside CEB.

4.2.4 EIAs, site clearances and access roads

For approvals not directly related to energy sector issues, developers face the triple problem of politics, of interlocked authorisations and absence of standard procedures.

The interlocking of authorisations refers, for example, to a situation, where (i) Mahaveli makes a site clearance approval conditional on compliance with (ii) stipulations in a future Environment Protection License issued by CEA (e.g. do not cut down existing trees on the plant site without permission) and where (iii) CEB will not sign a PPA without an issued EPL. Faced with this, the

[33] The Sri Lanka Sustainable Energy Authority Act, No. 35 of 2007 indicates that a permit for an on-grid renewable energy project is valid for a period of twenty years, extendable for a further twenty years

[34] If there are justified reasons for slow progress in project preparation, SEA and CEB can grant an extension of permits and LoIs

[35] ADB has proposed to finance nine grid substations to overcome the problem of lack of grid capacity.

developer will not begin construction, even though an EPL is required for the operation of a dendro-power plant only, not for its construction on the site. Due to this it is almost impossible to proceed stepwise with an investment while waiting for authorizations to fall in place one by one.

Since dendro-power plants are new, the authorities have few references and standard procedures to rely on. Therefore, it is not unusual for developers to encounter back-and-forth decision taking.

The land allocation, land clearance, EIA/EPL and road approval process processes become politicised almost inevitably as third parties with interests in the land will use public hearing processes as a means to block the approval. Solutions for that can be found:

- SEA could act with more persuasive authority in cutting through political obstacles to decision taking at local level if it could speak to decision makers on behalf of the *Presidential Secretariat* through a project mandate. The Secretariat is in a unique position to promote the implementation of new policies and initiatives.
- The Carbon Fund can be a valuable alliance partner for SEA when it comes to assist developers in getting decisions on EIAs and EPLs. Being part of CEA, the Fund is better placed than SEA to manage the art of persuasion and just as eager as SEA to get projects with CDM-potential implemented.

4.2.5 Fees charged to project developers

The processing fees are reasonable:

- CEB charged 100,000 Rps for an LoI earlier; SEA proposes the fee to be split 50%/50% for the LoI and the preliminary permit.
- For the PPA, the processing fee of CEB was 100,000 Rps; also here SEA proposes the fee to be split between the PPA and the RE project permit.
- Projects larger than 10 MW, which sign non-standardised PPAs with CEB pay a royalty of 10 cents per kWh charged at the end of the year during project period. Projects up to 10 MW thatr are paid the feed-in-tariff pay royalty after 15 years.

4.3 Tariff approval

The feed-in tariffs (see section 5.3) are adjusted once per year. Tariffs for PPAs to be signed during the year are adjusted for developments in the cost of investment and of capital. "Ongoing PPAs" have variable components that are adjusted according to the formula defined in the PPA.

The *Public Utility Commission (PUC)* will, once it becomes fully operational through adjustment in the Electricity Act, be responsible for approving the technical adjustments in the feed-in-tariffs paid to RE-power plants and the calculation of the avoided cost tariff, which is paid by SEA to CEB. Until that happens, it is the *Tariff Committee* under the Ministry which reviews the structure once per year in the third quarter and calls up public views on the tariff calculation. Final responsibility rests with the Minister. Only one person from SEA sits on the Committee.

In the set-up, *SEA* has the technical responsibility for making the annual calculations for the feed-in-tariffs, defend these in public hearings with project developers (three sessions are planned), and submit the proposal to the Tariff Committee. For the calculations, SEA must maintain a data base on project costs, including project development costs (for which insufficient information exists at the moment), international price developments for plant equipment and biofuel prices.

4.4 Regulatory issues to address in a support programme

The implementation of an initial muli-projects investment program will have action research character through its learning-by-doing process:

- The implementation of a number of dendro-power projects is the most effective way to identify obstacles in the approval process and develop solutions to these through regulatory reforms.
- Standardisation of administrative processes is helped by experience.

The approval by the Presidential Secretariat of a *priority investment program for the implementation of at least 10 dendro-power projects* can (i) become a path-breaker for the institutional development required for large-scale investments in dendro-power and (ii) provide investors with certainty for the viability of the concepts for fuelwood supply and with information about local costs.

A *RE-specific transmission development plan by CEB* would be prepared and implemented in parallel.

One targeted institutional outcome are dendro-power plant *manuals that are tailor-made for the specific needs of the specific approval authority* and which streamline the review and approval process through standardised procedures. As example: a guidebook for the environmental approval procedure.

In the short term, *cooperation between SEA, The Carbon Fund, CEB and the Presidential Secretariat* is essential for getting the investment program off the ground. For the longer term, something along the institutional reforms proposed by the Inter-Ministerial Working Committee on Dendro Thermal Technology (section 4.2.2) may be the ideal solution. The proposed institutional set-ups can be tested at pilot scale through the priority program; based on the experience, the secondary legislation for its establishment can be drafted.

The implementation of the program will also *shed light on the key success factors for the foreign investor strategy* of the Ministry of Finance. For example, to what extent the objective calls for a clarification of CDM-rules and for financial support to the promotion of partnerships between foreign investors and national project developers.

5 Incentive Regime

5.1 Support to pre-investments

The above term refers to grant co-financing of *project investigation* (pre-feasibility and feasibility studies) and *project preparation* costs (creation of legal entity, search for equity and debt finance, establishment of biomass supply chain).

So far, SEA has not introduced cost-sharing facilities for pre-investments. The key source for this would be SEA's Sustainable Energy Fund. But although tested in a prototype way, the Sustainable Energy Fund remains to be established. Its objective is to finance subsidies to projects (renewable, energy efficiency, fuel switching), mass media awareness campaigns and incentives for the development of rural energy services in all areas of the country.

5.2 Investment support

5.2.1 Support to investments in biomass supply

Sri Lanka has a long history of government support programs to agriculture. Government support for farmers takes several forms, including the provision of credit for producers, subsidized fertilizer, the setting of minimum prices for agricultural produce, planting of trees, the building of irrigation works.

Following up on a recommendation by the Inter-Ministerial Working Committee on Dendro Thermal Technology in 2005, Gliricidia was given status as national plantation crop in 2006. This, in principle, opens up the possibility for providing incentives to fuelwood plantations similar to the ones listed above. Yet, so far the only incentive scheme already in place is *a subsidy by the Coconut Cultivation Board for planting of Gliricidia trees to as an under-crop in coconut plantations*. Presumably, the reason for that is that another recommendation by the Working Committee - to establish a *Fuel wood Plantation Authority* under Ministry of Plantation Industries - has so far not been reacted on.[36] Therefore, the only support avenue is to go through existing authorities.

5.2.2 Support to investments in dendro-power plants

Industrial promotion has also a long history in Sri Lanka. Examples are the 600 garments factory program launched by the Government 15 years ago: factories located in remote areas could get the land from the Government and finance from the state banks, and the current Gamata Karmanthayak 300 Industries Program under the Ministry of Industry.

[36] Tea smallholders have government programs administered by the Tea Smallholding Authority to give them finance to grow tea.

A negative development occurred in 2006, when the state budget declared the electricity industry as VAT exempt. Due to this, the facility previously available to the industry of being able to claim the VAT paid for imports and for local works during construction as deduction from VAT-payments to the state on electricity revenue, is no longer available. Basically, this increased the capital cost of a plant by 15 percent.

All SPPs enjoy a five-year tax holiday under Board of Investment of Sri Lanka (BoI) concessions. Better conditions can be obtained when a SPP-project is included in Gamata Karmanthayak, the President's 300 factories Programme, managed by the BoI.[37] In addition to normal BoI benefits, a BoI approved company is protected by "all kinds of treaties", enjoys a 10 years tax holiday and can get lower cost credits from banks as these get tax income tax exemption on profits from these projects.[38]

5.3 Feed-in-tariff

5.3.1 Design

SEA has implemented a remarkable well-designed regime of *technology-specific* feed-in-tariffs[39] for RE-based power plants of less than 10 MW that are operated as non-dispatchable power.[40] The tariff-design puts emphasis (i) on subsidy cost-effectiveness (minimizing "subsidy rents" - economic premiums higher than necessary to provide reasonable rate of returns on investments) and (ii) on compatibility between the financing terms for SPP-projects and their operating revenue.

The tariffs that have a duration of 20 years.[41] The PPA-tariff is a flat kWh-rate, calculated once per year as the sum of three individual components: capital cost, O&M cost, bio-fuel cost with the latter two being inflation-adjusted. Developers are offered the choice between a kWh-tariff which changes in three steps over time or a single rate for the 20 years, which, in principle, is equal to the levelized rate of the former. The three-tier tariff starts with a high tariff during years 1-6 corresponding to the typical project loan amortisation period in Sri Lanka, a lower tariff during years 7-15, and a low tariff from years 16-20.

The *payment mechanism for the feed-in-tariffs* is constructed in the way that CEB pays the full tariff to RE-generators, SEA's Sustainable Energy Fund pays CEB the difference between its avoided

[37] Earthwatts' Ellewewa Biomass Electricity Generation Project got BoI approved project status in 2007.
[38] This makes such loans cheaper for SPPs than loans under the World Bank-financed REDREEE scheme.
[39] For wind, hydro, ocean energy, and biomass divided into three categories: dendrothermal, municipal waste, agro-residues.
[40] Previous Standardized Power Purchase Agreements (SPPA) were based on CEB's avoided costs of supply. In 2006 dendro power plants were paid Rs6 per kWh by CEB. The Sri Lanka Energy Conservation Fund gave a supplementary payment of between Rs2.50 to Rs3.20 per kWh depending on the time of the year, linked to the avoided cost rate given to mini-hydro power plants.
[41] Larger dendro-power plants can get a power purchase agreement similar to diesel plants, which has a capacity charge based on a contracted energy volume and a variable charge, based on usage.

costs and the costs of its payments to RE-generators.[42] The financial incidence of the extra-cost of RE-power does thus not fall on consumers as electricity consumers but as oil consumers – an oil fee being one of the intended sources of finance for the fund. For projects commissioned in 2008, the technology-specific tariffs per kWh levelized over the 20 years' lifetime are shown in the table.

PPA-tariffs levelized over project lifetime

	US cent/KWh
Hydro	8,2
Wind	13,6
Municipal wastes	9,1
Dendro-power	10,8
Agroindustrial residues	8,1

20 years, discount rate 12%. Source: Matly (2008)

5.3.2 Cost assumptions

A detailed cost structure is used to calculate the feed-in-tariffs. This makes the price fixing process transparent and facilitates during hearings the stakeholder discussions on the validity of the assumptions made by consultants contracted by SEA to fix the feed-in-tariff.

The cost-of-capital is calculated based on the following assumptions:

- A debt-equity ratio of 60%-40%.
- For equity a pre-tax 22 percent rate of return is targeted in the cost-of-production calculation a every year for a period of 15 years. The equity rate is used for all RE-technologies; thus, there is no adjustment for differences in risks in the formula's cost of capital calculations. Arguably, except for seasonal and annual variations in output, uncertainties and risks are higher in dendro-power projects than in hydropower projects.
- The cost of debt finance was in 2008 17 percent based on the average of the Average Weighted Deposit Rate (AWDR) for 6 months and the Average Weighted Fixed Deposit Rate (AWFDR) plus a 5.5% premium. Debts are repayable in equal installments over six years.
- The discount rate used to levelise tier 1 tariffs as well as to calculate the 20-year levelised tariffs is the Weighted Average Cost of Capital based on the 60/40% debt/equity ratio.

The assumptions for the cost of investment and annual non-fuel O&M costs are shown in the table below – the figures for 2009 are proposed by the Biomass Association. For comparative purposes the cost assumptions for wind and hydro are shown as well.

[42] In a prototype form, the SEF was tested in March 2006 and subsidized two dentrothermal project SPPA (Lanka Transformers Ltd and Recogen Ltd) on a 0.5 Rupee/KWh basis, which represented a total subsidy about Rs 8 millions (about US$ 80,000) in 2006. Officially established by the 2007 SEA Act, the SEF is supposed to fund subsidies to renewable energy conversion plants, fuel switching including industrial thermal applications, use of energy efficient appliances and technologies, development of rural energy services, as well as awareness programs through mass media. Its resources would come mainly from a levy on import of fossil fuel products, share of CDM revenues and SEA service fees. One of the main short term objective of the SEF is to finance the new SPPA scheme for grid-connected renewable energy producers, filling the gap between cost-related tariffs of new schemes and CEB avoided costs.

	Hydro	Wind	Biomass	
	2008	2009	2008	2009
Capital Cost LKRM/MW	166	200	182 +VAT	200 + VAT
Annual O&M Cost as a % of Capital Cost	3% - for 20 years	3% - for 20 years	4% - for first 15 years 5% - balance 5 years	4% - for first 10 years 5% - next 5 years 6% for the balance 5 years
Return on Equity %	22	22	22	25

The cost of investment figure in 2008 fixed in Rps is equal to about US$1700 per kW before payment of VAT. The assumed plant factor for the calculation of annual GWh is 80%.

The *fuel cost component* in the price structure gives biomass power plants using fuelwood a higher tariff than biomass plants using agricultural residues: in 2008 the fuel component in the total feed-in-tariff amounts to around 5 US cents/KWh for fuelwood and 2.5 US cents/KWh for agricultural residues.

In the *Third Tier,* the socalled *base rate* (payment in addition to O&M and fuel) paid from year 16 onwards is 1.30 LKR/kWh in the year 2008 feed-in-tariff schedule.

The feed-in-tariff formula in the PPA has automatic *cost of inflation adjustments* for the base rate, O&M and fuel. The annual escalation rate for annual O&M is the average of the rates of change of Sri Lanka Consumer Price Index and the LKR/USD rates of change, for the five preceding years. For the base rate and for fuel, the adjustment rate is two thirds of that.

5.3.3 Evaluation of the feed-in-tariff: price signals and market compatibility

Technology-specific feed-in-tariffs serve the dual purpose of maximising the penetration of RE in national power supply (by allowing a plurality of resources of different costs to be developed) and of minimising the subsidy-cost of the scheme.[43]

In Sri Lanka, the subsidy cost for biomass power projects is minimized further by paying *bio-source specific* tariffs: the highest tariff is paid for dendro-power plants using grown fuelwood; lower tariffs are paid for plants using agro-residues (biomass waste such as bagasse, saw-dust, paddy husk, coconut shells) and municipal waste.

Also the *inflation-escalator in a signed PPA is item-specific*: the cost-of-capital is non-escalable (assumed to reflect fixed amortisation of the loan), non-fuel O&M and fuels have different adjustment rates.

The high subsidy-cost effectiveness of the scheme increases the likelihood that a large penetration of RE in power supply is considered affordable by the public and by policy makers. The detailed cost structure makes the annual price setting very transparent. This facilitates discussions on the justification of the tariff levels, making them defendable for policy makers.

[43] Subsidy defined as the difference between CEB's avoided costs of generation and the PPA-tariff.

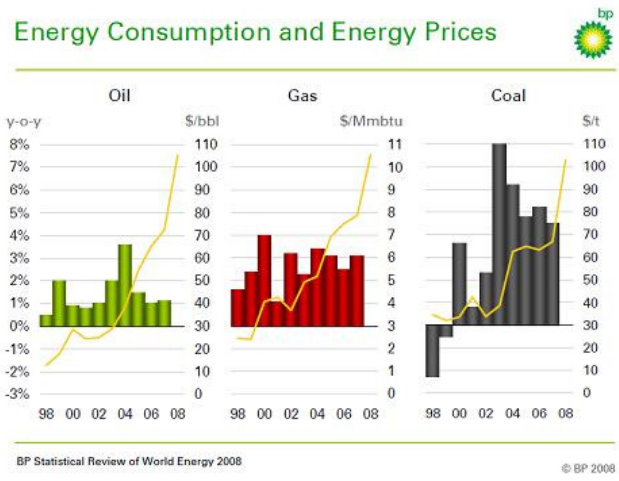
Yet, there are two other considerations to take into account when evaluating the design: (i) Does the kWh-charge give the right price signals to investors and to CEB? (ii) Is the fine-tuning of support compatible with market forces?

The kWh-rate is a pure energy rate, which is not time-of-day specific. Since the units are non-dispatchable, the high kWh-price has no influence on CEB's scheduling of generation according to merit order. The price signal to CEB given by the absence of a separate MW-charge is that these non-dispatchable plants have zero capacity value. CEB, in fact, does not take non-dispatchable plants into account in its generation expansion plans at present. As long as the share of RE-plants is low, this is the right decision. But once RE capacity increases, CEB will have to take the capacity value of RE power plants into account. That evolution is so obvious that no specific price signal need be given to CEB. However, in addition, the avoided-cost-calculations must at that time be adjusted for differences in the capacity value of RE-power plants. Since dendro-power plants provide firm capacity year-round – their capacity factor is estimated at 80 percent – their value is the highest.

For RE-investors, the most important issue is *whether the offered rate makes dendro-power commercially viable* and, thus, bankable. That seems to be the case. But it is an open question to what extent foreign investors would look for additional CER-revenue as a condition for market entry.

For the Government policy objective of reaching the maximum economically justified RE-penetration rate it is also important *that tariffs give investors the right price signals for their choice of technology*. The cost of investment and cost of fuel calculations in the price structure for the feed-in-tariff are based on conventional Indian dendro-power technology, not on fuel-cell technology. For the latter, the costs of investment is underestimated, the cost of fuel per kWh is overestimated. If, for the sake of argument, one assumes that lifecycle cost of production is the same for the two technologies, and investor take a six year loan in both cases, then the cash-flow during the first years is too low for fuel-cell technology.

The feed-in-tariff is structured in a market-friendly way except for the fuel component. Three assumptions are doubtful. (i) The *assumption that fuelwood prices will develop at two thirds the rate of non-fuel O&M* is untenable. The fuelwood resource will be under dual pressure: from the rising demand from dendro-power stations and fuel switching industries and from competing demand for land from food and bio-fuel production. (ii) The *assumption that the*



prices for sources of biomass will remain unconnected is against the logic of the energy market.[44] The totally parallel evolution of international prices for oil, gas and coal from 1998 to 2009 illustrates the point. (iii) The interconnectedness of fuels on the market and the volatility of international fuel prices makes the *assumption of an automatic adjustment formula for a 20 years' period* untenable.[45] It is recommended that the formula in the next revision is based on an annual assessment of market prices for fuelwood and the distinction between fuelwood and biomass residues be dropped.[46] There is no tea clearing auction system for fuelwood supply to give a benchmark price; but SEA can make market surveys of traded prices.

The positive aspect about the fuelwood component is that the infrequent adjustment (once per year) dampens the volatility in fuelwood prices as well as the growth in the average price during the year. SEA and CEB also reduce the price pressure on fuelwood by not allowing a new plant in an existing catchment area. The formula, proposed by the Biomass Energy Association to link the fuelwood price adjustment to the evolution in the price of fueloil, would undermine the positive contribution of renewable energy to price stability.

5.4 Connection charges

The developer pays for the MV-line which connects the plant with the nearest sub-station of CEB. After construction, ownership of the line is handed over to CEB, which takes over O&M costs. The output from the plant for which CEB pays is measured just outside the plant.

5.5 CDM

5.5.1 Organisation for CDM

The *Ministry of Environment & Natural Resources* (MENR) is Designated National Authority (DNA) in Sri Lanka. It founded the *Sri Lanka Carbon Fund* (SLCF) as private company with an

[44] The Biomass Association pointed out in a letter to SEA in late 2008:" Even in Sri Lanka the cost of coconut shell is already substantially higher than that of fuel wood. Not long ago, coconut fibre dust was considered as a material with negative cost. Once a use was found this item became very valuable raw material." … "Significant quantities of Gliricidia wood and coconut shells are being used in the industrial sector to replace furnace oil, diesel and LPG. Suppliers of wood to these industries are offering very high prices to purchase fuel wood from growers. Prices offered to growers vary form Rs 2.00 per Kg to Rs 4.50 per Kg irrespective of moisture content. Some buyers are paying even prices as high as Rs 7.00 The cost of coconut shells have increased to more than Rs 7.50." … "The present prices are 4.5 to 8 Rps delivered to factory. Based on existing wood, not new plantations. .. Only about 100-200 tons being traded daily."

[45] The above letter argues for non-discrimination: "The tariff structure for the fossil fuel based IPPs are protected from this uncertainly by the fuel cost being a pass through cost fully absorbed by the CEB. There is no reason why the renewable energy developers should be called upon to absorb the full risk of the fuel price escalation."

[46] The above letter also underlines the security of supply impact: "The guarantee of the availability and reliability of the fuel supply, which is the main concern expressed by the lending institutions, will be an issue for these plants. By removing the tariff differentiation between sustainably grown fuel wood and the so called agricultural waste, the developers will have greater flexibility of fuel supply and will therefore be better equipped to alley the concerns of the lending institutions. Also this resource which by and large remains underutilized can be used effectively."

initial, Government provided capital of 100 million Rps; the intention is to have 49% ownership by the private sector. The SLCF has registered national consultants for developing CDM-projects.

5.5.2 Dilemma for individual CDM-projects

For private developers, the present situation for CDM-projects poses something of a dilemma.

The feed-in-tariff is supposed to provide *investors in biomass power plants* with a normal rate of return. If that is the case, the project does not qualify as a stand-alone CDM-project. Yet, it may be argued that foreign investors can be attracted to invest in Sri Lanka only if they are given access to additional CER-revenue.

Commercial investors in *sustainable fuelwood supply* have a good case for seeking CDM-status for their projects: the risks are high, because the demand side has to be developed by others in parallel; whereas potential returns are low, if fuelwood prices develop as foreseen in the tariff-schedule. Yet, being eligible for claiming CO_2-reductions for the "reforestation" benefits only, the CER-revenue may be too small to justify the transaction costs of the CDM-project cycle.

Developers of fuelwood supply who collaborate with investors in specific future dendro-power plant projects want to be assured that they get a share of CER-revenues if the plant achieves status as a CDM-project. A CER-revenue sharing formula proposed by one NGO is: 25% to farmers, 15% to project developer/promoter, 60% to investor in the dendro-power plant.

5.5.3 Programme of Activities / Programmatic CDM / Policy CDM /

The ADB/SEA report "*Financing Sustainable Energy in Sri Lanka"* from November 2008, prepared under the "Building the Capacity of SEA" project by the Sofreco-consultant Michel Matly recommends the implementation of a Programme of Activities (PoA) / Programmatic CDM / Policy CDM for grid connected renewable energy in Sri Lanka.[47] The report suggests the following procedure:

- SEA build up a comprehensive policy-CDM project profile and propose it as soon as possible to the Sri Lanka Carbon Fund, following the procedure.
- Project promoters abandon their CDM-project rights to SEA when they access full-level feed-in tariffs; a lower level feed-in-tariff is awarded to developers who prefer to seek individual CDM-project status
- As soon as a plant is commissioned under the new scheme, SEA is eligible to claim for the CER corresponding to the related emission mitigation.

[47] The report ,describes PoA as follows. "In the policy-CDM approach, activities are implemented by public authorities through a "deliberate government policy", in the case of Sri Lanka its tariff subsidy. In CDM terms, the policy becomes a project. Emissions reduction credits are generated for the impact of the policy ex-post (new projects in operation). The certified emission reductions then flow directly to the hosting government, which decides to allocate the CER to private actors that were impacted by the policy." In March 2009, 8 PoAs are worldwide at the validation stage; none has been registered yet.

- SEA possibly also get CER from already commissioned plants (no-regret scheme) which have not previously addressed the carbon market.
- The CER-revenue is shared between investors, SEA, CEB and SLCF according to a pre-defined formula
- The developer should be required to emit its choice when getting SEA permit, and sign a "CESA", carbon emission selling agreement, in which its sells to SEA the CER corresponding to its future activity over the period of the SPPA (20 years), against the benefit of the full tariff.[48]
- The developer provides the necessary information for SEA to assess its future leakage emissions, transportation of fuel for biomass projects for instance."

The SLCF is developing a PoA for biomass power plants using municipal waste (including a waste management program) and has contracted UNEP-Risø to do the feasibility study for this. A UNEP-Risoe consultant was to visit Sri Lanka in March/April 2009. Although the situation for dendro-power plants is different, one would expect that much of the results and insights from the municipal waste PoA feasibility study are transferable to a PoA for dendro-power. In fact, it may be advisable to have one single PoA for the two. In any case, SLCF would expect contracted foreign experts to train national experts and work with them until validation.

The PoA approach reduces the transaction costs of the CDM project cycle: for registration, validation and for selling CERs. Having a portfolio of projects reduces the delivery risk and thus leads to higher prices for carbon credits sold on forward contracts. To maximise prices of credits sold forward on an off-take basis, the structure might include design features such as tranching of future carbon stream or revenues and/or streams of future cash receivables to match the risk appetite of future buyers/investors.

The PoA has to be compatible with the foreign investor strategy called for by the Ministry of Finance. National and foreign investors may distrust a revenue sharing structure were all CER-revenue first enters into the hands of Government (which also makes all the commercial deals) before being distributed to stakeholders according to a pre-agreed formula. It may therefore be necessary to make use of a Special Purpose Vehicle control the flows of carbon credits and cash, which is owned jointly 50%/50% by the public partners SEA and SLCF and the private project owners and biomass supply developers.

5.6 Incentive issue to address in a support programme

The review of the incentive regime for biomass leads to the recommendation that the following aspects be investigated by the consultant team for the preparation of a dendro-power investment program:

- It is proposed that the *need for a support scheme for pre-investments* is analysed by the consultant team. For the moment, no support is given neither to the preparation of feasibility studies nor to the development of biomass supply schemes. The argument for cost-sharing

[48] The CESA is a mere formality/declaration: according to the UNFCCC rules, the Government entity organising the PoA has full ownership rights to all CERs originating from the individual projects.

grant support towards the preparation of feasibility studies could be to accelerate the implementation of new dendro-power projects and facilitate foreign entry. The counter-argument is that market forces should be strong enough to create sufficient investments in preparatory studies once the first 10 dendro-power plants are under implementation. For the 10 plant scheme, however, a strong case can be made for partial grant-finance of feasibility studies: the need for success.

- A critical review of the *pros and cons of revising the formula for the fuel-component* in the feed-in-tariff leading to a concrete proposal.

- With reference to the work by UNEP-Risoe on a PoA for municipal waste to energy, analyse the pros and cons of a PoA for dendro-power, *outline the scope and structure of a PoA* dendr-power, including the option for a single PoA combining the two and develop principles for the sharing of CER-revenue. If the conclusion is positive, develop the documents for the PoA with the help of an international consultant specialised in PoAs.

6 Finance

6.1 Investment finance

According to experts from the finance sector in Sri Lanka, there are enough savings in Sri Lanka to finance even ambitious internal investment programs. Sufficient liquidity exists as witnessed in the market's reaction to initial public offerings (IPOs).

6.1.1 Sources of equity

The project developers in dendro-power and fuelwood supply are entrepreneurial and creative, but overall, weak in equity. They seek alliances with financially stronger equity partners, such as foreign investors in SPPs and technology suppliers. This approach is fully in line with the foreign investment objective of the Ministry of Finance.

What is worth looking into is to what extent project CERs are essential to attract foreign investment. The foreign investors, who are potentially interested in financing small scale projects of up to 10 MW, may specialise in CDM-project opportunities.

The investments in dendro-power plants can be considered relatively safe.

- The investments in the pilot program of 10+ dendro-power plants because it will enjoy strong political and technical support.
- Follow-up investments will have low risks because they can build on lessons learned and a supportive regulatory and institutional framework will have been put in place by the.

Due to low risks and long-term lifetime of the projects, a realistic option to exploit is whether insurance companies and pension funds in Sri Lanka may be interested in providing equity capital.

6.1.2 Sources of debt finance

The financial sector in Sri Lanka is relatively sophisticated and has, thanks to the World Bank financed RERED project, experience with project finance for SPPs (mini-hydro plants). RERED has given substantial capacity building to local banks, inter alia in risk analysis of renewable energy projects. But except for mini-hydro, bankers have not absorbed the details of different technologies and perform proper risk analysis for these.

A central institution is the *National Development Bank*, which is changing from development bank to commercial bank. It still borrows from the *National Savings Bank*, but is increasing its own

deposits. The NSB has high public confidence, re-lends to banks and to housing loans. Six commercial banks are "participating finance intermediaries" in the RERED project.[49]

Risk management at banks is said to extremely tight, inter alia, due to heavy levels of taxation on banks in the order of 60%: in addition to the 35% profit tax, banks have to pay taxes on employee salaries.

As the individual banks are small, no single bank will give 600-800 million Rps (~US$6-8 m) in loans to a dendro-power project. Syndication is required for that.

Banks were reluctant to take any interest in dendro-power projects: the required loans were high and banks claimed not to know the technology. Developers of fuelwood supply projects were confronted with sceptical bankers who had doubts about the resource base and the supply concepts.. To open the doors for developers of dendro-power projects, the Biomass Energy Association paid for a visit of bankers to India to see dendro-power plants on site. That helped to change the perception.[50]

Banks are willing to finance up to 60% of project costs. Loan maturity is up to 7 years. Investors can take loans from banks in Sri Lanka in either national currency (Rps) or in US-dollar. End-2008. loans in US$ had an interest rate of 8-10%.; loans in Rps of 20-22%.[51]

Corporate entities can access loans from Indian banks that are acquainted with dendro-power and hydro-power projects; e.g. ICI. Realistic interest rates are LIBOR plus 2 or plus 3.

6.1.3 Instruments to encourage bank lending

Despite the efforts of the Biomass Energy Association, the banking sector may, at present still be too cautious to engage in larger scale lending to dendro-power.

The Government of Sri Lanka has used the instrument of *directed lending* in other sectors. But since the default rates on directed loans given by state banks have been high (" people think they do not have to pay and get away with it"), this instrument is not feasible except maybe for the proposed pilot investment program of 10+ dendro-power plants. However, the authority of the Presidential Office, if it officially supports the program, ought to be sufficient to persuade the banks to engage.

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[49] This allows developers to shop around for the best deal. The RERED project is funded with the support of the World Bank and the Global Environment Facility (GEF). The scheme is administrated by the Development Finance Corporation of Ceylon (DFCC bank) and support channelled through an extended network of participating credit institutions and energy service providers. The RERED project addresses primarily the credit sector, by providing long term finances (IDA loan, no interest, 20 years to maturity and a 10-year grace period) and persuading banks and other financial institution to fund sustainable energy projects. Loans to energy providers are built on a mix of IDA resources and participating finance institutions own funding, with interest rates indexed on the Average Weighted Deposit Rate

[50] Mini-hydropower plants, being well-established technology face "no" problems with finance. The project iself plus corporate guarantees from the investing company are considered sufficient collateral. The financing of windfarm is more difficult. According to a project developer: the windfarm will be the first project of its kind, banks, therefore, have no track record, no expertise; therefore unable to make a judgement and prefer therefore, not to make a judgement."

[51] Rate of inflation in mid-2008 was 30%, end-2008: 18%.

The other directed lending instrument, to give banks in general a mandate to use part of their portfolio on RE-projects, can be used as an instrument of last resort.

Securitisation has received a bad name since the onslaught of the financial crisis in 2008. Yet the bundling of a loan-portfolio by a consortium of banks into a bond package may be a way to channel finance from pension funds and insurance companies into the RE-sector. The high transparency of the composition of loan assets behind the bonds minimizes the "securitisation risk" (reduced due diligence on the part of the originating lender).

The Government can introduce a 50% *guarantee on high risk loans* – as it does on agricultural loans. Fuelwood supply projects ought to qualify for such loans.

SEA's *Sustainable Energy Guarantee Fund* (SEGF) provides guarantees for (small) loans contracted by energy developers (ESCOs), mainly in the case of energy conservation. Its main resources are an initial capital grant (50 million rupees, i.e around MUS$ 0,5), an annual premium of not less than 0.5% of the guarantee offered to investors, as well as interest, service charges and penalties recovered from investors.[52] It is not advisable to expand the facility to cover (larger) loans to SPP-projects. That would require too much capital and new skills for the staff. It is better that the SEGF specialises in finance for energy savings.

6.2 Micro-Finance

The full economic benefits of Gliricidia based fuelwood supply are realised when fuelwood supply projects are organised as multi-purpose projects: making use of the trees for nitrogen fixation, of the branches for fuelwood and of the leaves for animal fodder and fertilizer. The inclusion of a *microfinance environmental lending program* for individual farmers, within the recommended pilot investment program for dendro-power, increases the likelihood of multi-benefits. The micro-lending activity must be accompanied by advisory assistance provided by agricultural extension services or by specialised NGOs.

[52] The concept was tested by SEA's predecessor, the ECF, which developed in 2004 a prototype "Sustainable Guarantee Facility". This provided one guarantee in 2006 to the Hatton National Bank, for a guarantee of Rs 7.5 million, around US$ 75 000.

6.3 Finance issues to address in a Support Program

The feasibility study for SEA's dendro-power development program must find answers to the following questions:

Promotion of finance in dendro-power plants

- What framework conditions do foreign equity investors look for as a condition for market entry?

- Is the introduction of a dendro-power bond issue – based on the securitisation of a bundle of individual bank loans – technically and commercially feasible? If yes, does it expand the supply of finance for RE in Sri Lanka?

- The foreign consultant / transaction advisor for dendro-power projects is to give a presentation to bankers on the risks of dendro-power projects and risk mitigating instruments. The presentation should provide bankers with a check list.

Promotion of finance in fuelwood supply

- Is there a need for a guarantee facility for loans to fuelwood supply projects? If yes, who is to administer it and where is the money to come from?

- Is there need for introducing a specific micro-finance programme for fuelwood? If yes, how is it going to be organized and where is the money to come from?

- The year 2005-report by the Inter-Ministerial Working Committee on Dendro Thermal Technology recommended the establishment of a Development Fund to mobilize farmers into dendro farming initiatives financed by (i) existing government budget funds, (ii) funds from poverty alleviation and development programs and (iii) "green fund" for R&D, O&M costs in villages at initial stages, pilot projects. Is this modality feasible? If yes, who will manage the Development Fund?

7 Support Structure

7.1 Public Institutional Support Structure

7.1.1 Institutional support to development of biomass supply

Sri Lanka has several agricultural extensions services that can assist capacity building in fuelwood supply. A non-exhaustive list of logical cooperation partners includes the Coconut Cultivation Board, Mahaweli Development Board, and the Department of Animal Production and Health.

The 2005 biomass report recommended additional support. In terms of new institutions, the report recommended the establishment of a Fuelwood Plantation Authority under Ministry of Plantation Industries.[53] The authority was supposed to implement a two-phased agricultural extension program for fuelwood farming model. An R&D-Phase 1 for the introduction of fuelwood farming technologies and modes of operating energy plantations together with other agricultural activities. A Phase 2 for the development of required entrepreneurial skills to manage fuelwood plantations.

Probably phase I is no longer relevant since a number of promising concepts have been developed by private actors. Also, the idea of setting up a separate authority for fuelwood may not be the best approach. One could consider the advantages of the synergy effects of expanding the authority (and the name) of the Tea Smallholders Authority to include fuelwood supply. Analogies between the tea industry and dendro-power are strong. Tea gives employment to about one million people. Tea factories have a processing center which enables farmers around the factory to produce the raw material. Sri Lanka's 1000 tea factories get their leaves from a radius of about 10-15 kms. 70% of black tea is grown by small producers having 1-3 acres. The Tea Smallholders Authority administers a program giving financial support to smallholders for the growing of tea. When a smallholder initially clears the land, he is given a payment, when he plants a tree another payment.

The experience of NGO-projects to develop fuelwood supply for dendro-power plants revealed a need for capacity building assistance at two local Government levels:

- At divisional level: support to the strengthening of development programming and management capabilities of the Divisional Development Committees (DDCs).
- At the District level: support to formulate policies that reflect and support local level development initiatives (supporting the capacity building efforts made by the National Planning Commission and the Ministry of Science and Information).

[53] It's the conventional institutional approach in Sri Lanka to create specialised institutions for specific sub-sectors.

7.1.2 Institutional support to developers of dendro-power plants

SEA is the key institution to provide support to developers of dendro-power plants. This support is limited to facilitate the processing of authorisations and approvals during the project preparation process. SEA interacts with the other involved public institutions through the project approval committee. So far, SEA has not been able to give follow-up assistance to developers during the six months of their preliminary permit.

7.2 Technical Supply Chain

7.2.1 Standardisation

Whereas codes of practice have been formulated for biogas and for mini-hydro plants, a similar initiative has yet to be taken for biomass energy.

7.2.2 Accredited consultants

SEA promotes the creation of pools of accredited consultants for the preparation of (pre)feasibility studies. In the procedure, a pre-feasibility submitted to SEA in connection with an application for a permit is to be prepared by an accredited consultant. Quality control is an advantage for SEA as poor studies give extra work for staff; project developers benefit from it equally. Any consultant is free to apply for accreditation any time. But because the standard fee for pre-feasibility studies is too small, only two people applied – in mini-hydro – and none for dendro-power.

Some consulting expertise in dendro-power is available in Sri Lanka. But this is an area where some capacity building is called for.

7.2.3 Transaction advisors

Developers need transaction advisors in two areas: (i) identification and negotiation with foreign equity investors; (ii) CDM project development and CER-sales. A further area is the fuelwood supply agreement. SEA can reduce the need for consulting/legal assistance for the structuring of fuelwood agreements by having sample documents developed for typical cases.

Identification and negotiation with foreign partners for equity investments

Apparently, there are no consulting firms in Sri Lanka who specialise as match-makers for developers of SPP-projects.

One biomass developer used the *PPP Coordinator at the World Energy Council (WEC) India* to get in contact with potential private investors.

The same developer also sent an application to the *Development Marketplace grant program administered by the World Bank*, under the heading "climate risk management with multiple benefits".

CDM project development and CER-sales

The SL Carbon Fund has good staff and believes that Sri Lanka has well-qualified consultants for developing the documentation for *project CDM*. Yet, the experience of national consultants so far has been limited mainly to the development of CDM-documentation for mini-hydro. One dendro-power developer, who opted for the development of a gold standard CDM-project, contracted Australian expertise for this purpose.

The SL Carbon Fund contracted Risoe-UNEP as consultant for the development of a *PoA* for municipal waste management. If a decision is taken to develop a PoA for dendro-power also, it would be logical to use the same consultant for the development of that PoA, working closely with local consultants for transfer of know-how.

Developers use foreign experts to develop the *carbon trading strategy* for a project. The costs for this are relatively high. A Malaysian carbon trading company, for example, asks on a success basis for the sharing of 15percent of carbon credit value during the first five years. This is an area where the Carbon Fund may seek to develop in-house expertise to advise against a fee; a performance based charge is a good pricing principle.

7.3 Manufacturers of equipment

The company Lanka Gasifiers Ltd manufacturers produces small-scale gasifiers.

A large scale investment program in dendro-power offers the prospect of developing a market for national manufacturing of components for dendro-power plants larger than 1 MW. For the development of national manufacturing capacity foreign technical assistance is needed to transfer advanced technology for biomass power generation with high efficiency steam turbines (to minimize fuel wood consumption rate and viable operation).

7.4 Institutional issues to address in a dendro-power support program

It is recommended that the preparatory activity for the dendro-power development program delivers the following outputs:

- Preparation of sample woodfuel supply contracts for the most typical cases
- Analysis of the need to create a specialised fuelwood plantation authority, and if confirmed, analyse the pros and cons of creating the authority as an extension of the Tea Smallholders Authority.
- Comment on the prospects for developing commercially competitive manufacturing in Sri Lanka of components for dendro-power plants and, if needed to develop it, what specific incentives be given
- Advise on needs to provide capacity building assistance to the strengthening of CDM-expertise in the country
- Advise on channels for getting in contact with qualified foreign investors and ways to get them interested.

ANNEXES: TOR

Annex I: TOR for Foreign Biomass Power Generation Expert

1. Background

By December 2009, Sustainable Energy Authority (SEA) had received 55 project applications for biomass based power projects with a projected capacity of 329 MW. Classified by sources of biomass supply, the projects can be divided into three categories, listed by order of complexity:

- The 2 *sugar cane projects* with a capacity of 52 MW and implemented by sugar cane producers that use their own supplies of bagasse as fuel to generate power
- The 25 *solid waste projects* with a capacity of 188 MW, where power plant developers depend on contracts with municipalities to gain access to the resource
- The 27 *dendro, paddy husk, coconut shell and agricultural waste projects* with a capacity of 89 MW, where the power plant developer depends on contracts with a number of outside private suppliers to get access to the biomass resource.

The last category of projects is believed to have the largest resource potential: it is estimated that somewhat more than 1000 MW of dendro power plants can be established in Sri Lanka; the exact number depends also on the competing demand for biomass from industries switching from oil to biomass as their fuel source for the production of thermal energy.

The challenge for developers of dendro-power projects is daunting: they must organise commercial fuel wood chains from the scratch simultaneously with the construction of the dendro-power plant.

The *Report of the Inter-Ministerial Working Committee on Dendro Thermal Technology* dated June 14, 2005 recommended the implementation of a 5-year Action plan to realize 100 MW capacity though a three-phased effort (10+40+50 MW), which comprised:

4. two parallel programs of (a) launching the dendro thermal technology, (b) building confidence in project developers and planting communities to invest;
5. institutional framework with the mandate and responsibility + attractive finance,
6. investment

Early 2009 progress is modest. Project developers have submitted a number of applications for preliminary project permits to SEA. But a concerted action program has not been launched and SEA is concerned that the implementation of biomass energy projects for industrial process heat and for grid connected power generation may continue to be low. Despite the existence of a good biomass potential, a conducive feed-in-tariff, creative entrepreneurs, well thought-out concepts for the organisation of fuelwoood and a well-managed Biomass Energy Association as lobbyist, investments in dendro-power plants are not moving forward. There are several reasons for this, the most important being (i) slow procedures for land assignment, (ii) low equity of project developers, (iii) financial sector uncertainty about the risks of dendro-thermal technology and sustainability of fuelwood supply.

The ice can be broken through the implementation of a *Presidential Priority investment program* aiming at the implementation of at least ten dendro-power projects. Such a "big push" program will achieve several results simultaneously, giving it character of "action research": (i) it will force the development of regulatory standard procedures and institutional innovations, (ii) spread knowledge about dendro-power projects in the finance community, in public authorities and in the consultant community, (iii) give quality information about the costs of fuelwood supply and dendro-power technology, (iv) because of its scale trigger larger foreign equity investor interest, (v) permit the development of a *"Program of Activities (PoA) by the Carbon Fund*, (vi) due to Presidential prestige "force" national finance institutions to engage in financing and approval authorities to accelerate the processing of required permits. A *RE-specific transmission development plan by CEB* would be prepared and implemented in parallel.

SEA intends, therefore, to use funds under the ADB-financed project "TA 7011 SRI Building the Capacity of SEA" (managed by Sofreco) to fund TA to address legal, organisational, logistical, regulatory, technical and financial obstacles that prevent biomass-based power generation projects to move forward. The TA will also advise on the feasibility of developing a "Programme of Activities" scheme ("programmatic CDM" /"policy CDM") for renewable energy based power plants that are paid a feed-in-tariff for their sales to the grid. The latter effort is expected to be co-financed by the Carbon Fund.

2. Overall task

Assisted by a team of Sri Lankan consultants composed of a fuelwood supply expert, a dendro-power expert and a CDM-expert, you are to advise on how obstacles to progress in project implementation can be removed and a Presidential priority investment program in a minimum of 10 dendro-power plants can be implemented. The obstacles are preferably analysed concretely, acting as transaction advisor for one or projects presently under preparation. As a side activity, you are to advise on how simultaneously, promotion of oil substitution through fuelwood can be promoted in rural industries.

3. Deliverables:

Assisted by the national consultants, whose work you are to supervise and guide, you are expected to deliver the following outputs:

Choice of dendro-power technology

- Analyse the economics of alternative power technology options in Sri Lanka as a function of biomass supply prices and international coal prices (economic and financial analysis of costs and benefits). In particular, analyse the pros and cons of using Indian steam turbine technology versus fuel-cell technology. Assess the maturity of fuel-cell power, and adjust project economics for differences in technology risks. Establish at what level of fuelwood prices, fuelcell technology becomes the lowest life-cycle cost option.

- Comment on the prospects in Sri Lanka for developing commercially competitive manufacturing of components for dendro-power plants and whether specific incentives are required to trigger such investments.

Attracting foreign investors:

(a) write a short strategy paper for foreign investment, giving answers to the following:

- What framework conditions do foreign equity investors look for as a condition for market entry?

- Is the CDM-project opportunity essential for attracting foreign investor interest?

- The preparation of high quality (pre)feasibility studies by national project developers being a pre-requisite for this, is the introduction of financial support to the preparation of feasibility studies is justified, or are market forces sufficiently strong to generate sufficient activity?

- Are foreign investors interested in engaging in joint ventures or other forms of Public Private Partnerships (PPPs) with state plantation companies for the production of biomass?

- Recommend an approach (strategy and instruments) for attracting foreign investors to dendro-power and how to get in contact with them. How to do proper marketing of project opportunities? Advise on channels for getting in contact with qualified foreign investors and ways to get them interested.

(b) Write an information note for foreign investors

- With inputs from the national consultants, change the present "Development of Grid Connected Biomass" report into an information note for foreign investors on resource, legal, incentive and regulatory conditions for dendro-power in Sri Lanka

Securing low cost debt-finance.

Write a short note giving answers to the following:

- Is the introduction of a dendro-power bond issue – based on the securitisation of a bundle of individual bank loans – technically and commercially feasible? If yes, does it expand the supply of finance for RE in Sri Lanka?

- Is there a need for a guarantee facility for loans to fuelwood supply projects? If yes, who is ti administer it and where is the money to come from?

- Is there need for introducing a specific micro-finance programm for fuelwood? If yes, how is it going to be organized and where is the money to come from?

- The year 2005-report by the Inter-Ministerial Working Committee on Dendro Thermal Technology recommended the establishment of a Development Fund to mobilize farmers into dendro farming initiatives financed by (i) existing government budget funds, (ii) funds from poverty alleviation and development programs and (iii) "green fund" for R&D, O&M costs in villages at initial stages, pilot projects. Is this modality feasible? If yes, who will manage the Development Fund?

- Give Sri Lankan bankers a presentation to on the risks of dendro-power projects and risk mitigating instruments. The presentation should provide bankers with a check list for project evaluation.

- Analyse the *pros and cons of revising the formula for the fuel-component* in the feed-in-tariff and make a concrete proposal.

Preparation of 10+ Investment Program

Based on the analysis of the items mentioned above, prepare a short document describing the proposed 10+ investment program, which can be used to seek approval as Presidential priority investment program.

4. Qualifications

Engineer with in-depth knowledge of dendro-power technologies and substantial experience with acting as transaction advisor for dendro-power projects worldwide, including preparation of CDM-projects.

5. Mandays

40 mandays

Annex II: TOR for National Biomass Supply Expert

1. Background

By December 2009, Sustainable Energy Authority (SEA) had received 55 project applications for biomass based power projects with a projected capacity of 329 MW. Classified by sources of biomass supply, the projects can be divided into three categories, listed by order of complexity:

- The 2 *sugar cane projects* with a capacity of 52 MW and implemented by sugar cane producers that use their own supplies of bagasse as fuel to generate power
- The 25 *solid waste projects* with a capacity of 188 MW, where power plant developers depend on contracts with municipalities to gain access to the resource
- The 27 *dendro, paddy husk, coconut shell and agricultural waste projects* with a capacity of 89 MW, where the power plant developer depends on contracts with a number of outside private suppliers to get access to the biomass resource.

The last category of projects is believed to have the largest resource potential: it is estimated that somewhat more than 1000 MW of dendro power plants can be established in Sri Lanka; the exact number depends also on the competing demand for biomass from industries switching from oil to biomass as their fuel source for the production of thermal energy.

The challenge for developers of dendro-power projects is daunting: they must organise commercial fuel wood chains from the scratch simultaneously with the construction of the dendro-power plant.

The *Report of the Inter-Ministerial Working Committee on Dendro Thermal Technology* dated June 14, 2005 recommended the implementation of a 5-year Action plan to realize 100 MW capacity though a three-phased effort (10+40+50 MW), which comprised:

7. two parallel programs of (a) launching the dendro thermal technology, (b) building confidence in project developers and planting communities to invest;
8. institutional framework with the mandate and responsibility + attractive finance,
9. investment

Early 2009 progress is modest. Project developers have submitted a number of applications for preliminary project permits to SEA. But a concerted action program has not been launched and SEA is concerned that the implementation of biomass energy projects for industrial process heat and for grid connected power generation may continue to be low. Despite the existence of a good biomass potential, a conducive feed-in-tariff, creative entrepreneurs, well thought-out concepts for the organisation of fuelwoood and a well-managed Biomass Energy Association as lobbyist, investments in dendro-power plants are not moving forward. There are several reasons for this, the most important being (i) slow procedures for land assignment, (ii) low equity of project developers, (iii) financial sector uncertainty about the risks of dendro-thermal technology and sustainability of fuelwood supply.

The ice can be broken through the implementation of a *Presidential Priority investment program* aiming at the implementation of at least ten dendro-power projects. Such a “big push” program will achieve several results simultaneously, giving it character of “action research”: (i) it will force the development of regulatory standard procedures and institutional innovations, (ii) spread knowledge

about dendro-power projects in the finance community, in public authorities and in the consultant community, (iii) give quality information about the costs of fuelwood supply and dendro-power technology, (iv) because of its scale trigger larger foreign equity investor interest, (v) permit the development of a *"Program of Activities (PoA) by the Carbon Fund*, (vi) due to Presidential prestige "force" national finance institutions to engage in financing and approval authorities to accelerate the processing of required permits. A *RE-specific transmission development plan by CEB* would be prepared and implemented in parallel.

SEA intends, therefore, to use funds under the ADB-financed project "TA 7011 SRI Building the Capacity of SEA" (managed by Sofreco) to fund TA to address legal, organisational, logistical, regulatory, technical and financial obstacles that prevent biomass-based power generation projects to move forward. The TA will also advise on the feasibility of developing a "Programme of Activities" scheme ("programmatic CDM" /"policy CDM") for renewable energy based power plants that are paid a feed-in-tariff for their sales to the grid. The latter effort is expected to be co-financed by the Carbon Fund.

2. Tasks:

You are to write a short paper giving answers to the following:

- *Analyse the trade-offs between expanded fuelwood production and other forms of agricultural production. Establish the most likely opportunity costs for fuelwood production for the three typical cases of (i) small farm-plots, (ii) intercropping at plantations and (iii) dedicated fuelwood plantations.* Establish guidelines for identifying both clear-cut cases, where decision Goivernment taking on an application for land is an administrative formality, as well as cases where political preferences have to decide.

- Is there a need for a guarantee facility for loans to fuelwood supply projects? If yes, who is ti administer it and where is the money to come from?

- Is there need for introducing a specific micro-finance programm for fuelwood? If yes, how is it going to be organized and where is the money to come from?

- The year 2005-report by the Inter-Ministerial Working Committee on Dendro Thermal Technology recommended the establishment of a Development Fund to mobilize farmers into dendro farming initiatives financed by (i) existing government budget funds, (ii) funds from poverty alleviation and development programs and (iii) "green fund" for R&D, O&M costs in villages at initial stages, pilot projects. Is this modality feasible? If yes, who will manage the Development Fund?

- Would Government institutions owning land be willing to go into joint ventures with biomass developers to supply fuelwood? If yes, would this reduce the political hurdle for investor access to Government owned land?

- Analysis of the need to create a specialised fuelwood plantation authority, and if confirmed, analyse the pros and cons of creating the authority as an extension of the Tea Smallholders Authority.

- Is there a need for financial support to the development of biomass supply schemes. If yes, what are the criteria for giving support, which Government institution is to finance it and who is to administer it?

Preparation of standard documents

- Standard application document to authority with the developers plan for use of land
- Sample land-use contracts
- Preparation of sample woodfuel supply contracts for the most typical cases

Inputs to the preparation of information note for foreign investors

As requested by the team leader, draft relevant sections in the information note to investors

3. Qualifications

Previous experience with rural development projects in Sri Lanka involving out-growing, preferably from the tea industry.

4. Expected mandays

30 man-days

Annex III: TOR for National Dendro-Power Expert

1. Background

By December 2009, Sustainable Energy Authority (SEA) had received 55 project applications for biomass based power projects with a projected capacity of 329 MW. Classified by sources of biomass supply, the projects can be divided into three categories, listed by order of complexity:

- The 2 *sugar cane projects* with a capacity of 52 MW and implemented by sugar cane producers that use their own supplies of bagasse as fuel to generate power
- The 25 *solid waste projects* with a capacity of 188 MW, where power plant developers depend on contracts with municipalities to gain access to the resource
- The 27 *dendro, paddy husk, coconut shell and agricultural waste projects* with a capacity of 89 MW, where the power plant developer depends on contracts with a number of outside private suppliers to get access to the biomass resource.

The last category of projects is believed to have the largest resource potential: it is estimated that somewhat more than 1000 MW of dendro power plants can be established in Sri Lanka; the exact number depends also on the competing demand for biomass from industries switching from oil to biomass as their fuel source for the production of thermal energy.

The challenge for developers of dendro-power projects is daunting: they must organise commercial fuel wood chains from the scratch simultaneously with the construction of the dendro-power plant.

The *Report of the Inter-Ministerial Working Committee on Dendro Thermal Technology* dated June 14, 2005 recommended the implementation of a 5-year Action plan to realize 100 MW capacity though a three-phased effort (10+40+50 MW), which comprised:

10. two parallel programs of (a) launching the dendro thermal technology, (b) building confidence in project developers and planting communities to invest;
11. institutional framework with the mandate and responsibility + attractive finance,
12. investment

Early 2009 progress is modest. Project developers have submitted a number of applications for preliminary project permits to SEA. But a concerted action program has not been launched and SEA is concerned that the implementation of biomass energy projects for industrial process heat and for grid connected power generation may continue to be low. Despite the existence of a good biomass potential, a conducive feed-in-tariff, creative entrepreneurs, well thought-out concepts for the organisation of fuelwoood and a well-managed Biomass Energy Association as lobbyist, investments in dendro-power plants are not moving forward. There are several reasons for this, the most important being (i) slow procedures for land assignment, (ii) low equity of project developers, (iii) financial sector uncertainty about the risks of dendro-thermal technology and sustainability of fuelwood supply.

The ice can be broken through the implementation of a *Presidential Priority investment program* aiming at the implementation of at least ten dendro-power projects. Such a “big push” program will achieve several results simultaneously, giving it character of “action research”: (i) it will force the development of regulatory standard procedures and institutional innovations, (ii) spread knowledge

about dendro-power projects in the finance community, in public authorities and in the consultant community, (iii) give quality information about the costs of fuelwood supply and dendro-power technology, (iv) because of its scale trigger larger foreign equity investor interest, (v) permit the development of a *"Program of Activities (PoA) by the Carbon Fund*, (vi) due to Presidential prestige "force" national finance institutions to engage in financing and approval authorities to accelerate the processing of required permits. A *RE-specific transmission development plan by CEB* would be prepared and implemented in parallel.

SEA intends, therefore, to use funds under the ADB-financed project "TA 7011 SRI Building the Capacity of SEA" (managed by Sofreco) to fund TA to address legal, organisational, logistical, regulatory, technical and financial obstacles that prevent biomass-based power generation projects to move forward. The TA will also advise on the feasibility of developing a "Programme of Activities" scheme ("programmatic CDM" /"policy CDM") for renewable energy based power plants that are paid a feed-in-tariff for their sales to the grid. The latter effort is expected to be co-financed by the Carbon Fund.

2. Tasks:

Under the supervision of the international dendro-power specialist contracted by ADB/SEA, you are expected to provide the following deliverables:

Incentive regime

- Analyse whether there is a need for support to the preparation of (pre)feasibility studies for dendro-power plants, or whether market forces are sufficiently strong to bring forward sufficient studies. Check whether for the 10+ dendro-power plant program a case can be made for partial grant-finance of feasibility studies since it is essential that the projects all succeed if the financial community is to be convinced of the feasibility and viability of dendro-power in Sri Lanka.

- Analyse the *pros and cons of revising the formula for the fuel-component* in the feed-in-tariff and make a concrete proposal.

Institutional innovations

- Analyse the need to create a specialised fuelwood plantation authority, and if confirmed, analyse the pros and cons of creating the authority as an extension of the Tea Smallholders Authority.

- In the short term, cooperation between SEA, The Carbon Fund, CEB and the Presidential Secretariat is essential for getting the 10+ dendro-power investment program off the ground. For the longer term, something along the institutional reforms proposed by the Inter-Ministerial Working Committee on Dendro Thermal Technology may be the ideal solution. Show how the proposed institutional set-ups can be tested at pilot scale through the priority program.

Inputs to the preparation of information note for foreign investors

As requested by the team leader, draft relevant sections in the information note to investors

3. Qualifications

Engineer. Previous experience with dendro-energy, preferably dendro-power projects in Sri Lanka.

4. Expected mandays

30 man-days

Annex IV: TOR for National CDM Expert for Biomass Power Projects

1. Background

By December 2009, Sustainable Energy Authority (SEA) had received 55 project applications for biomass based power projects with a projected capacity of 329 MW. Classified by sources of biomass supply, the projects can be divided into three categories, listed by order of complexity:

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The challenge for developers of dendro-power projects is daunting: they must organise commercial fuel wood chains from the scratch simultaneously with the construction of the dendro-power plant.

The *Report of the Inter-Ministerial Working Committee on Dendro Thermal Technology* dated June 14, 2005 recommended the implementation of a 5-year Action plan to realize 100 MW capacity though a three-phased effort (10+40+50 MW), which comprised:

13. two parallel programs of (a) launching the dendro thermal technology, (b) building confidence in project developers and planting communities to invest;
14. institutional framework with the mandate and responsibility + attractive finance,
15. investment

Early 2009 progress is modest. Project developers have submitted a number of applications for preliminary project permits to SEA. But a concerted action program has not been launched and SEA is concerned that the implementation of biomass energy projects for industrial process heat and for grid connected power generation may continue to be low. Despite the existence of a good biomass potential, a conducive feed-in-tariff, creative entrepreneurs, well thought-out concepts for the organisation of fuelwoood and a well-managed Biomass Energy Association as lobbyist, investments in dendro-power plants are not moving forward. There are several reasons for this, the most important being (i) slow procedures for land assignment, (ii) low equity of project developers, (iii) financial sector uncertainty about the risks of dendro-thermal technology and sustainability of fuelwood supply.

The ice can be broken through the implementation of a *Presidential Priority investment program* aiming at the implementation of at least ten dendro-power projects. Such a "big push" program will achieve several results simultaneously, giving it character of "action research": (i) it will force the development of regulatory standard procedures and institutional innovations, (ii) spread knowledge

about dendro-power projects in the finance community, in public authorities and in the consultant community, (iii) give quality information about the costs of fuelwood supply and dendro-power technology, (iv) because of its scale trigger larger foreign equity investor interest, (v) permit the development of a *"Program of Activities (PoA) by the Carbon Fund*, (vi) due to Presidential prestige "force" national finance institutions to engage in financing and approval authorities to accelerate the processing of required permits. A *RE-specific transmission development plan by CEB* would be prepared and implemented in parallel.

SEA intends, therefore, to use funds under the ADB-financed project "TA 7011 SRI Building the Capacity of SEA" (managed by Sofreco) to fund TA to address legal, organisational, logistical, regulatory, technical and financial obstacles that prevent biomass-based power generation projects to move forward. The TA will also advise on the feasibility of developing a "Programme of Activities" scheme ("programmatic CDM" /"policy CDM") for renewable energy based power plants that are paid a feed-in-tariff for their sales to the grid. The latter effort is expected to be co-financed by the Carbon Fund.

2. Tasks:

Under the supervision of the international dendro-power specialist contracted by ADB/SEA, and in close collaboration with an international specialist in PoA, contracted by the Carbon Fund, you are expected to provide the following deliverables:

Development of baseline methodology

- Dendro-power projects in Sri Lanka generate CO_2-reductions through (i) fuel switching in power generation and (ii) from expanded biomass production on marginal lands. Develop a (baseline) methodology for quantifying the CO_2-reduction benefits of reforestation on degraded lands in Sri Lanka which is acceptable to UNFCCC.

- Develop a (baseline) methodology for quantifying the additional CO_2-reduction benefits from the dendro-power plants as such.

PoA

- With reference to the work by UNEP-Risoe on a Program of Activities (PoA) for municipal waste to energy, analyse the pros and cons of a PoA for dendro-power.
- Outline the scope and structure of a PoA for dendro-power. In consultation with the UNEP-Risoe consultant, analyse the pros and cons of having a single PoA for municipal waste and fuelwood.
- If the conclusion about the advantage of a PoA is positive, develop the documents for the PoA with the help of an international consultant specialised in PoAs.

Sharing of CER-revenue

- Develop principles for the sharing of CER-revenue between owners of the dendro-power plants and fuelwood suppliers in stand-along CDMprojects.

- Advise on needs to provide capacity building assistance to the strengthening of CDM-expertise in the country

Inputs to the preparation of information note for foreign investors

As requested by the team leader, draft relevant sections in the information note to investors

3. Qualifications

Previous experience with developing the full cycle of documentation for CDM-projects in Sri Lanka

4. Expected mandays

35 man-days