

## 1.2 Project Idea for Technology 1: Co-Firing of Biomass with Coal

### 1.2.1 Introduction and Background

In an attempt to increase the share of renewable resources based electricity generation, the government of Sri Lanka has introduced a scheme to attract the private sector to engage in this sector. Although many small hydro power projects have been commissioned in the past, the total capacity of biomass based electricity generation is very small. There are two primary reasons for this poor performance in this sector.

(a) The capital cost of establishing a complete set of biomass based boiler-turbine-generator system is very high. (b) The consumption biomass fuel required to generate one unit of electricity in these conventional system is also very high. For the above two reasons, the financial viability of these projects are inadequate to attract private investors.

In the co-firing technology, as biomass and coal are used as fuels, a significant part of the machinery already installed is utilized for this purpose. Moreover, as the scale of operation is relatively large, the efficiency of electricity generation is much higher than conventional small scale biomass projects.

In the proposed technology, it is intended to use biomass and coal as fuels utilizing a part of the machinery already installed to generate electricity. Although several options are available for co-firing biomass with coal, consultations with the stakeholders of energy experts and representatives of relevant institutions the following option taking into account the need to minimize the extent of interference with the existing equipment at a coal fired power plant was recommended.

Use a separate biomass boiler to generate steam at the same temperature and pressure as that of the steam produced at the coal boiler. Steam produced in the biomass boiler is connected to a common steam header. Steam from this header is used to drive the existing steam turbines. This method is the most expensive option. But it has the following advantageous:

- The existing equipment such as coal conveyor, coal crusher, coal boiler etc. is not tampered with.
- The percentage share of biomass could be varied from 0% to 100%.

It is proposed to install this boiler adjoining the 300 MWe coal fired boiler in Nurachcholai, in Puttalam District in Sri Lanka.

## 1.2.2 Objectives

- To reduce GHG emissions
- To reduce the consumption of coal in the generation of electricity.
- To increase the share of electricity generation using indigenous resources.
- To enhance the rural economy by providing a market for locally cultivated biomass.

## 1.2.3 Outputs of the Proposed Project

- Availability of a Feasibility Report on Co-Firing of Coal with biomass.
- Reduction of imported coal by 96,000 tonnes /year.
- Generation of biomass based steam equivalent to 240 GWh of electricity per year.
- An annual income of US\$ 31.2 million to the local community by way of purchase of wood for steam generation.

## 1.2.4 Relationship to the country's sustainable development priorities

According to the National Energy Policies and Strategies of Sri Lanka of October 2006, the policy is to generate at least 10% of the total electrical energy from new renewable energy resources by the year 2015. And as per "*Mahinda Chinthanaya: Vision for a New Sri Lanka. A 10 Year Horizon Development Framework, 2006 -2016*" this share is expected to be 20% by the year 2020. This project will enable the country to achieve these targets.

By increasing the indigenous share of electricity and other forms of energy the following social goals would be achieved:

- (a) Increase in income for the rural community thus decrease in the gap between the rich and the poor.
- (b) Poverty reduction in the country particularly in the rural areas.
- (c) Better health and productivity amongst the rural agricultural communities.

### **1.2.5 Project Deliverables**

- A comprehensive feasibility report on the financial and technical viability of co-firing coal and biomass to generate electricity. Such a document is a basic requirement from the point of view of local project approving agencies, particularly in the allocation of limited resources amongst competing project proposals.
- Installation and operation of a biomass boiler with a capacity of 30 MWe supplying steam to a 300 MWe existing coal-fired power plant. This will be done in collaboration with an identified private sector developer and the relevant government institutions such as the Sustainable Energy Authority, Ceylon Electricity Board etc. The annual generation of electricity generated by this project is estimated to be 240 GWh. This step of commissioning the first biomass based steam generation to be used in existing coal based generation would serve as the pilot project which would lead to the commissioning of many other larger units in the country.
- A reduction of 288,000 tCO<sub>2</sub> emission per year. Sri Lanka, though not a member of Annex 1 countries of the UNFCCC classification, as a responsible country towards global environmental enhancement, such reductions in CO<sub>2</sub> emission would demonstrate the sincerity of the country.
- Development of 6,000 hectare equivalent of Gliricidia plantations in underutilized lands in the region. This activity will be carried out in collaboration with institutions such the National Livestock Development Board, who has large extent of underutilized lands in the region. Also most of the rural homestead owners in the region will be incorporated in the cultivation and sale of Gliricidia wood to the biomass boiler operator. The total amount of biomass expected to be purchased by the boiler operator is about 200,000 tonnes per year.

### **1.2.6 Project Scope and Possible Implementation**

The scope of the project is to facilitate the private sector investors to invest in a 30 MWe biomass boiler to supply steam to a 300 MWe existing coal fired power plant there by reducing 10% of imported coal consumed in the existing power plant. Based on the success of this phase of the project, similar or much larger biomass co-firing boilers could be installed. Presently, this technology could be gradually expanded to meet a larger share of the 300 MWe coal-fired power plant already installed and operated.

In due course, this technology could be extended to all future coal power plants to be installed in the country. The total capacity of coal based power generation by the year 2020 is expected to be 1945 MW. The proposed feasibility report is expected to cover all necessary features of the project to facility the project approving agencies to take a favourable decision.

## 1.2.7 Project activities

The project activities are divided into two categories as direct activities and supporting activities. Direct activities include activities directly relevant to the biomass to energy conversion process. Supporting activities include government policy revisions related to promoting the transfer and diffusion of the technology.

**Direct Activities** (Activities directly relevant to the biomass to energy conversion process):

1. Preparation and publication of a Feasibility Report on the Financial and Technical viability of a 30 MWe equivalent biomass boiler to supply steam to an existing 300 MWe coal fired power plant.
2. State sector and private sector collaborating in the investment, construction, operation and maintenance of a 30 MWe biomass fired boiler and supplying steam to an existing 300 MWe coal-fired boiler through a PPP (public private partnership) program.
3. Donor Agencies to provide funds at low interest rate for renewable projects.
4. Making arrangements for the investors to cultivate Gliricidia as an agro-energy crop in underutilized lands.
5. Establishment and operation of Agro-energy plantations in underutilized lands and in home gardens by the investors of this project.

**Supporting Activities** (Policy revisions related to promoting the transfer and diffusion of the technology).

1. Eliminating Government taxes imposed on local construction in respect of renewable energy and energy efficiency projects.
2. Sustainable Energy Authority to incorporate co-firing as an option for electricity generation in Sri Lanka.
3. Sustainable Energy Authority to invoke the provision in the Act to impose a levy on fossil fuels and use this revenue to finance renewable energy and energy efficiency projects.
4. During generation planning the costs of impacts fossil fuel use on external entities (such as health, agriculture) to be added to the direct costs of electricity generation.

## 1.2.8 Timelines for the proposed activities

**Table 1.2: Timelines for the Proposed Activities of Project 1**

The time frames of year 1, year 2 and year 3 to 25 are chosen taking into account the project initiation, commissioning and operational phases of the project.

No	Activity	Year 1	Year 2	Year 3 to Year 25
<b>Direct Activities</b>				
1.	Feasibility Report on co-firing biomass and coal			
2.	Investment, construction, operation and maintenance of a 30 MWe biomass fired boiler and supplying steam to an existing 300 MWe coal-fired boiler through a PPP.			
3.	Donor Agencies to provide funds at low interest rate for renewable and energy efficiency project			
4.	Making arrangements for the investors to cultivate Gliricidia as an agro-energy crop in underutilized lands.			
5.	Establishment and operation of Agro-energy plantations in underutilized lands and in home gardens by the investors of this project			
<b>Supporting Activities</b>				
1.	Elimination of government taxes on local construction			
2.	SEA to incorporate co-firing as an option for electricity generation in Sri Lanka.			
3.	SEA to invoke the provision in the Act to impose a levy on fossil fuels and use this revenue to finance renewable energy and energy efficiency projects			
4.	During generation planning the costs of impacts fossil fuel use on external entities to be added to the direct costs of electricity generation.	 		

## 1.2.9 Budget/Resource requirements

**Table 1.3: Budget Estimate for Proposed Activities of Project 1**

The budget values assigned for “international” are expected to be raised as grant component from donor agencies without burdening the national consumers. The “local” component of the budget is ultimately expected to be provided by the consumers and citizens of this country.

No.	Activity	Proposed Budget (US \$)		Remarks
		International	Local	
<b>Direct Activities</b>				
1.	Feasibility Report on co-firing biomass and coal	150,000	Nil	Outright Grant
2.	Investment, construction, operation and maintenance of a 30 MWe biomass fired boiler and supplying steam to an existing 300 MWe coal-fired boiler through a PPP (public private partnership) program	Nil	Nil	To be incurred by the investors
3.	Donor Agencies to provide funds at low interest rate for renewable and energy efficiency project.	15,000,000	Nil	Low interest loan
4.	Making arrangements for the investors to cultivate Gliricidia as an agro-energy crop in underutilized lands.	Nil	Nil	Policy
	Establishment and operation of Agro-energy plantations in underutilized lands and in home gardens by the investors of this project.	Nil	Nil	To be incurred by the investors
	<b>Sub total</b>	<b>15,150,000</b>	<b>Nil</b>	
<b>Supporting Activities</b>				
1.	Elimination of taxes on local construction	Nil	Nil	Policy
2.	SEA to incorporate co-firing as an option for electricity generation in Sri Lanka.	Nil	Nil	Policy
3.	SEA to invoke the provision in the Act to impose a levy on fossil fuels and use this revenue to finance renewable energy and energy efficiency projects	Nil	15,000,000	Guarantee fund for investors to secure loan for

				the project
4.	During generation planning the costs of impacts fossil fuel use on external entities to be added to the direct costs of electricity generation.	150,000	Nil	Outright grant by donor agencies
	<b>Sub total</b>	<b>150,000</b>	<b>15,000,000</b>	
	<b>Total</b>	<b>15,300,000</b>	<b>15,000,000</b>	

### 1.2.10 Measurement/Evaluation

**Monitoring:** The progress of project activities will be monitored and periodically evaluated by the committee coordinating the project. This committee will be constituted with representatives from the following institutions:

- Sustainable Energy Authority
- Ceylon Electricity Board
- Ministry of Environment
- Ministry of Finance
- Ministry of Plantation Industries

**Evaluation:** The Monitoring Committee is expected to nominate a suitable external evaluation team to evaluate the performance and progress of the project and recommend appropriate corrective measures.

The monitoring committee is expected to formulate quantitative and measurable indicators such as hectares of Gliricidia plantations established, tonnage of wood generated and the tonnage of coal replaced on a timely and regular basis.

### 1.2.11 Possible Complications/Challenges

The following complications and challenges need to be met:

- Although co-firing of biomass and coal are practiced extensively in many parts of the world, in Sri Lanka this is a new phenomenon. Moreover, the use of coal for electricity generation was reintroduced to Sri Lanka recently. The new system of coal based electricity generation has been encountering numerous technical problems. Hence the introduction of co-firing needs to be done with due care.
- The use of underutilized state lands for agro-energy plantations by the private sector is a new activity in Sri Lanka. This too should be carefully handled.

- Inadequate support from some government institutions in the energy sector for full implementation of supporting activities proposed in the project may cause obstructions for implementation of these activities. Without full implementation of supporting activities it may not be possible to achieve proposed project targets as expected. Therefore it has to be treated as a risk factor.

## 1.2.12 Responsibilities and Coordination

The project will be coordinated by a committee consisting of representatives from the institutions and their respective responsibilities as per table given below.

**Table 1.4: Responsibilities of Project Coordination**

Institution/ Stakeholder	Responsibilities
1. Private sector developer	<ul style="list-style-type: none"> <li>• Project Implementing Agency.</li> <li>• Raising necessary finances, acquiring the technology, procurement of equipment, installation, commissioning and operation of boiler.</li> <li>• Arrangements to cultivate and purchase necessary quantity of biomass fuel.</li> </ul>
2. Sustainable Energy Authority	<ul style="list-style-type: none"> <li>• Incorporating co-firing as an option for private sector participation in power generation including a provision to sell steam to the power utility.</li> <li>• Facilitating private sector developers in the establishment, operation of co-firing facility and sale of steam.</li> <li>• Collection of levy from fossil fuels and creation and operation of a renewable energy/energy efficiency guarantee fund.</li> </ul>
3. Ceylon Electricity Board	<ul style="list-style-type: none"> <li>• Cooperating with the private developer in the operation of co-firing facility and sale of steam.</li> </ul>
4. Ministry of Environment	<ul style="list-style-type: none"> <li>• Determining the costs of external impacts (such as on health) of fossil fuel use.</li> </ul>
5. Ministry of Finance	<ul style="list-style-type: none"> <li>• Receipt and disbursement of donor contributions</li> </ul>
6. Ministry of Plantation Industries	<ul style="list-style-type: none"> <li>• Arrangements of underutilized lands for cultivation of Gliricidia</li> </ul>

## **Implementing Agency:**

This project will be **implemented by a private or state sector project developer** identified by a process formulated by the Sustainable Energy Authority, Ceylon Electricity Board, Ministry of Power and Energy and the Ministry of Finance. This developer has the responsibility of raising the necessary capital, identifying and acquiring the technology, procuring, installing, commissioning and operating the boiler. In addition the developer is expected to arrange the cultivation of Gliricidia in lands arranged by the government as well as private land owners including homesteads. The developer should also arrange to purchase and store biomass fuel (Gliricidia wood).

A number of local promoters have expressed their desire to undertake the task of inviting private sector project developers from overseas.

### **1.2.13 List of References**

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7. Mahinda Chinthanaya: Vision for a New Sri Lanka. A 10 Year Horizon Development Framework, 2006 -2016, Department of National Planning, Ministry of finance and Planning.
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