Electricity Generation from Renewable Energy in Sri Lanka: Future Directions

Presented by

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In the present world trend of increasing importance placed on energy security and sustainable development, role of renewable energy has become ever more significant. Sri Lanka, a small island nation located south of the Indian subcontinent in her own special way, has embraced renewable energy in electricity generation setting many trends. Vast strides have been already made, realizing a 4% contribution to power generation from Non-Conventional Renewable Energy at present, through the employment of several innovative policy instruments. This paper, presents the Sri Lankan case in renewable energy development and also looks at the potential for future growth for renewable energy for power generation in Sri Lanka.

1. Introduction

Comprised of a total terrain of 65,610 square kilometers, Sri Lanka is home to a population of 20 million. Approximately 76% of the population lives in the rural areas where the main occupation is agriculture.

Sri Lanka’s energy sources consist primarily of biomass, hydro-electricity and petroleum that contribute to 47%, 8% and 45% of total energy respectively. In the power sector, the installed capacity for electricity generation from hydro, thermal and wind power presently stands at 2,407 MW, compared to 1,409 MW in 1999. 80% of the households are enjoying the grid connected electricity while another 2% of households are provided with basic electricity connection through off-grid systems. The demand for electricity is estimated to rise at an annual pace of 8% - 10%. Per capita consumption of electricity meanwhile reflected 394 kWh / person per annum in 2006.

A combination of factors has contributed to the emphasis in recent times for generating electricity through non conventional renewable sources. Electrification of rural areas, for instance poses many challenges, foremost amongst which are the high capital investment, operational costs and the difficulties associated with extending grid connected electricity lines to remote areas. In this context, renewable sources of energy including solar power, small scale hydro power have emerged as an economical and sustainable alternative source to promote medium term electricity generation to the rural populace, albeit in small measures.
2. National Energy Policy

The national energy policy envisages providing basic energy needs, ensuring energy security, promoting energy efficiency, conservation and indigenous resources and adopting an appropriate pricing policy. The government endeavours to reach a minimum level of 10% of the grid electricity using non conventional renewable energy by 2015 and 6% of the households to use off-grid electricity systems by the year 2010.

The 10 year horizon development framework of the Government commenced in 2007 emphasises on sustainable development of energy sources & delivery systems at competitive prices. It targets at increasing fuel diversity and security through investing in both conventional sources and non conventional renewable energy. The grid and off grid energy systems are planned to ensure the access to electricity to 98% of the households by 2016. Together with economic benefits, renewable resources provide the advantage of achieving ecological efficiencies as minimizing pollution and mitigating adverse climatic factors through the provision of clean environment friendly energy.

3. Hydro Energy

Due to the geographical configuration having a rain fed central hill zone, Sri Lanka enjoys a good hydropower potential. The country has used this resource for conveyance of irrigation water for many millennia, and for electricity generation during the last two centuries. Early days of grid electricity generation saw hydro as the major component in electricity generation, accounting for more than 90% of the total generation. Recently, this component has been reduced to 35% mainly due to the exponential load growth, which cannot be met by this limited resource.

Major hydropower potential will be fully developed with the commissioning Upper Kothmale Hydropower Project in 2010, totalling an installed capacity of 1,355 MW.

However, significant portion of small hydro potential remains to be developed. Potential sites have capacities ranging from a few hundred kW to 40 MW, and the total potential is estimated to be around 500MW. Of this total, both CEB and private sector developers have developed 148 MW and Provisional Approvals to develop the remaining capacity had been
already issued. Thus, total energy potential that can be realized by developing this portion stands at 1,500 GWh (360 Thousand toe) per annum.

**Off grid renewable power generation**

Off grid power generations are one of the major technologies used in small scale renewable energy power systems. It may be possible to have more than 5% of homes still without access to grid electricity by the year 2016. Hence off-grid electrification had been a very important option in the rural economic development effort, a component in the coordinated rural electrification plan. Initially the rural areas, where less number of people live and the grid expansion is very expensive, will be selected for off-grid option.

There are about 350 villages in Sri Lanka electrified by village micro hydro schemes and many other houses by pico hydro schemes that tap the waters passing by the side of the homes. Due to extensive private sector involvement, micro credit institutions and the support from the provincial Governments, about another 120,000 households are estimated to be electrified by solar home systems. Using mostly a locally developed technology, about 100 houses get electricity from small wind turbines (using about 50 domestic units and 3 community based wind turbines). Bioenergy is used for electricity generation using both solid and liquid forms. There are about 10 villages electrified by dendro power while about 30 houses use electricity generated by biogas.

Due to economies of scale, the cost of production of electricity by large power plants are obviously attractive than small scale off-grid plants. Promoting use of off-grid renewable power is therefore suitable only to sparsely populated areas (whether by human settlements or electricity applications such as for industries & large farms) where the cost of extending of the grid is cost prohibitive.

Use of off-grid electricity brings many advantages over the other options. Ability to meet basic needs, cost, controllability, local value addition and employment creation are some of them. Country being blessed with many natural resources that can generate off-grid electricity shows a considerable potential. In the case of community based schemes, the satisfaction gained by the communities is something that is very hard to quantify.
Off grid electrification is unavoidable for Sri Lanka in the foreseeable future to reduce the social disparities between those who have electricity and those who don’t. Decisions on what technology to choose from the available sources with their economies will have to be made more on a case by case basis.

4. Funding

The endeavour to implement renewable energy technologies have been facilitated through dedicated credit support extended by external lending agencies. The World Bank and the Global Environment Facility [GEF] assisted Energy Services Delivery [ESD] Project introduced in 1997, at a time when more than half of the population did not have access to electricity, provided an initial invaluable boost to the sector. Following the success of this project the Renewable Energy for Rural Economic Development [RERED] Project was launched in 2002 to provide electricity access to rural households and small and medium enterprises through the deployment of off-grid renewable energy technologies as well as to promote private sector power generation from renewable energy sources. The credit support made available under both projects played a pivotal role in nurturing the sector.

5. Institutional Arrangement

Renewable energy has been recognised by the government as a means of achieving long term stability of energy prices and a tool for income distribution. Accordingly, a dedicated agency for renewable energy development and energy efficiency by the name of Sri Lanka Sustainable Energy Authority (SLSEA) has been established and an Energy Development Fund, by the name of Sri Lanka Sustainable Energy Fund (SLSEF) and a host of other integrative measures has been already approved by the Government.

As a first step in the direction of developing the full potential of renewable energy, the Government has offered a cost based generation tariff to project developers. With the new system, all other technologies such as wind, biomass and even hitherto undeveloped low head hydropower have received investor interest, and had caused a hive of activity in the sector. The cost based tariff will initially require additional financial resources, as the Ceylon Electricity Board (CEB), the national electricity utility will pay only a portion of the cost of the new cost based tariff. SLSEF is expected to act as a cushion between the project
developer and CEB, by providing additional financial support by way of Government funds. It is envisaged to progressively reduce dependence on treasury funds by several methods.

(a) Attracting a portion of CERs (Certified Emission Reductions) received for energy sector projects.

(b) Levying a cess on energy sales.

(c) Charging an energy resource royalty from renewable energy power plants operating under standardised power purchase agreement (SPPA) on expiration of agreement after 15 years.

(d) Channelling a portion of savings from energy efficiency improvement / fuel switching projects.

The finances will be also utilised to carryout resource development activities, which prepares the resources to a level of maturity so that a bankable project can be developed for that particular resource. Similarly, auxiliary costs such as network strengthening for renewable energy absorption could be met with the finances available from the SLSEF.

Other than a good price for energy generated from renewable energy resources, there are many other measures that are required to drive a successful development programme such as providing a conducive policy and regulatory framework, mobilisation of investment capital, speedy approvals, development of suitable technologies and infrastructure and development of knowledge bases in view of creating investor confidence. These measures will be combined to form a package of measures that will be the task of the Sri Lanka Sustainable Energy Authority of the Ministry of Power & Energy.

**Renewable Energy as an Economic Opportunity**

Renewable energy provides sound economic opportunities, especially for local enterprises. This is due to the nature of all renewable energy resources, *i.e.* the occurrence within the boundary of a country and the thin dispersion of the resource. Unlike petroleum and other fossil fuel resources, which are confined within the boundaries of very few countries, renewable energy occur almost in all countries, and is considered a very *democratic* resource. The opposite is the oil resources, of which 60% of known resources are located within the boundaries of three countries. The wide dispersion of renewable energy resources means unlike a highly concentrated form of energy, the harnessing will essentially be confined to the
local area of occurrence of the renewable energy resource, resulting in local involvement and creation of room for local investments. Further, the thin dispersion means wide distribution of harnessing activities, resulting in quite a large number of energy conversion facilities (e.g. large number of mini hydropower stations dotting the hill country) rather than a single central plant.

However, these same characteristics make it difficult for harnessing the renewable energy, as the occurrence of the resource and consumption of the converted energy happen to be on two geographical locations. The issue of transportation or transmission crops up due to this fact. Further, renewable energy is considered a non-firm energy, as most forms of renewable energy tend to vary in magnitude with time. For an example, our hydro resources display a substantial seasonal variation, whilst wind energy also follows a seasonal variation and an hourly variation as well. These characteristics of renewable energy limit our ability to fully exploit these resources. Another complexity is the difficulty of storing energy. Other than biomass energy, non of the renewable energy sources available to us cannot be economically stored, for release on demand.

Considering the above characteristics and limitations, the Government has envisaged to develop the renewable energy resources to reach 10% of total electricity by 2016. The investment opportunities available in these areas are given below.

<table>
<thead>
<tr>
<th>Year</th>
<th>Type</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
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<th>2014</th>
<th>2015</th>
<th>2016</th>
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<tr>
<td></td>
<td>Electricity Generation</td>
<td>Biomass</td>
<td>20</td>
<td>31</td>
<td>42</td>
<td>53</td>
<td>64</td>
<td>75</td>
<td>80</td>
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<td></td>
<td>Cumulative Capacity (MW)</td>
<td>Mini Hydro</td>
<td>134</td>
<td>151</td>
<td>168</td>
<td>186</td>
<td>203</td>
<td>220</td>
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<td>Wind</td>
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<td>54</td>
<td>78</td>
<td>102</td>
<td>125</td>
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With the vast renewable energy resource base, Sri Lanka can look forward for a better future than most other countries. The pivotal role of the renewable energy development programme will be developing indigenous knowledge, technology and capacity. As a nation, our primary focus ought to be in this area, as economic development of any nation is still very much the child of the marriage between the Engineering industry and Energy industry.