

Renewable energy resource of Sri Lanka! A review

S.Sayanthan¹, N. Kannan²

Faculty of Agriculture, University of Jaffna, Jaffna, Northern, Sri Lanka-40000

Abstract— *Energy and related sectors play a key role in the developmental profile of Sri Lanka. Energy demand is going up and up with time due to population growth and industrial revolutions. In order to meet such growing needs probably we are relying on fossil fuel in a large fraction, which is leading to many negative environmental impacts. Hence the government decided to take off many long term as well as short term planes to promote renewable energy sector in Sri Lanka as it gives minimum impact to environment and its quality than the fossil fuel. This paper gives basic information about renewable energy resources of Sri Lanka and their development & future perspectives.*

Keywords— *Renewable Energy, Fossil fuel, Sri Lanka, Environment.*

I. INTRODUCTION

Renewable energy is generally defined as energy that comes from resources which are naturally replenished on a human timescale. Types of renewables include solar energy, wind energy, tidal energy and geothermal energy. Energy can be called renewable if it can neither run out nor be easily replaced (like slow-growing trees). Renewable energy is any form of energy, which can be used by the present generation without affecting the future generation's ability and right to use the energy resource. The basic forms of renewable energy are based on solar energy. All these renewable energy forms depend on the solar radiation, except geothermal energy, which again is a renewable energy resource, independent of solar energy. (11)

Renewables are great for our energy portfolio because they are inexhaustible and won't pollute the planet. However, nearly every town has access to sunlight, wind, and the geothermal power from the Earth. therefore harnessing these sources of renewable energy could be a great democratizing force, offering affordable and plentiful power to every corner of the globe. It is therefore important to propose possible renewable energy resources to meet the energy demand without polluting the environment and quality.

II. GROWTH AND DEVELOPMENT OF RENEWABLE ENERGY SECTORS IN SRI LANKA

Sri Lanka has a long history of using renewable energy for its power generation from early 20th century by most of the tea plantation companies. with the installation of small hydro power plants.(10)

It is now recognized that for developing countries like Sri Lanka, meeting the energy needs of an economy aspiring to achieve rapid growth, while ensuring environmental sustainability, is a key challenge. 'Energy Challenges in the Knowledge Economy' was an important theme. With steady economic growth, the demand for energy is of paramount importance especially for a developing country like Sri Lanka. The national planners should give priority to energy security and formulate a national energy policy by identifying a sustainable energy mix keeping in mind the various growth sectors specially industry and services.(5)

Sri Lanka is on the path towards becoming an internationally competitive middle-income country. This power and energy sector development plan is aligned to the country's development drive, and has been prepared to provide affordable, high quality and reliable energy for all citizens, rich or poor, equally by conserving country's precious natural environment, giving priority to the indigenous energy sources, and minimizing regional disparities in energy service delivery.(9)

The power and energy sector vision is to capture the full potential of all renewable and other indigenous resources in order for Sri Lanka to become a nation self-sufficient in energy. The total energy requirement of the country was around 11,125 ktoe in 2013, and the primary energy supply mainly consisted of 4,814 ktoe of biomass, 4,582 ktoe of fossil fuels, and 1,442 ktoe of hydro. Accordingly, 56% of total energy consumption is from indigenous (biomass + hydro).(9)

2.1 Biomass Energy

Sri Lanka has a vast potential of producing biomass from a unit area as a result of high plant growth rate due to high incidence of solar energy and rainfall. It is estimated that approximately 40 Billion kg of biomass can be generated by converting marginal land to fuel wood plantations, and improving productivity of other crop land and home gardens [Energy Conservation Fund. 2005). Total potential of this resource is estimated to be about 16 Million ton oil equivalents (Mtoe) per

annum. But around 70% of biomass energy production is informal.(8) Most widely-used renewable energy in Sri Lanka is biomass. (8)

TABLE 1
PLANT FACTORS OF BIOMASS POWER PLANTS

Badalgama BMP	42.93%
Tokyo BMP	26.03%
Kottamurichchana BMP	15.11%

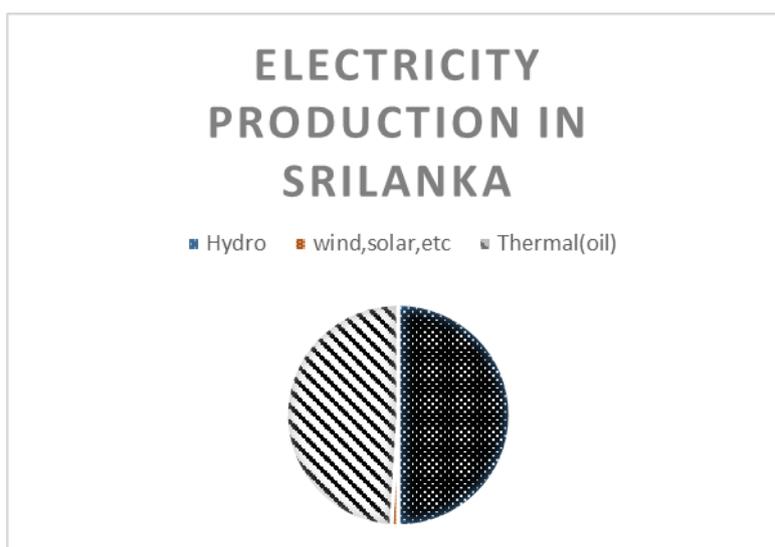
2.2 Hydro power

As of the geographical configuration with a rainfed central hills, Sri Lanka enjoys a good hydropower potential. Hydro-power potential is defined by two aspects of the water resource which is either moving or flowing body of water, i.e., the amount of water that passes through a point during a given period and the vertical drop through which the body of water passes through. Hence, large volumes of water and sudden drops are termed good hydropower resources. 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 65% of the total. Recently, this component has been reduced to 35% mainly due to the exponential load growth, which cannot be met by this limited resource. (8)

Graph 1 indicates the contributions of different energy sources in electricity production in Sri Lanka

TABLE 2
PLANT FACTORS OF SMALL HYDROPOWER PLANTS

Rathganga MHP	67.56%
Hapugastenna - 2 MHP	66.70%
Somerset MHP	61.90%
Kotanakanda MHP	61.85%
Batatota MHP	58.47%
Wee Oya MHP	57.30%
Palmerston MHP	54.82%



GRAPH 1: CONTRIBUTIONS OF DIFFERENT ENERGY SOURCES IN ELECTRICITY PRODUCTION IN SRI LANKA

2.3 Solar Energy

Energy from sunlight is captured in solar panels and converted into electricity. Sri Lanka is blessed with an impressive solar energy resource (Located near the equator) . From the earliest times, this resource had been utilized for drying purposes such

as crops, clothes, etc., and has remained largely a non-commercial energy resource. Two thirds of the country's lowland area receives a radiation of 4-5.5 kWh/m² per day, whilst the remaining area in the central hills receives a lower radiation of 2-3.5 kWh/m² per day, due to persistent cloud cover in those areas(1). It is interesting to compare these energy yields with daily electricity consumption of a typical household as both are in the same range of 4-5kWh per day (7). However, it is dangerous to assume that all houses can be provided with a solar panel of 1m² , as conversion losses and energy storage requirement of such a system is well beyond the reach of a typical family.

TABLE 3
PLANT FACTORS OF SOLAR POWER PLANTS

Solar PV SPP	69.56%
Gonnoruwa I SPP	13.81%
Gonnoruwa II SPP	10.68%

2.4 Wind Energy

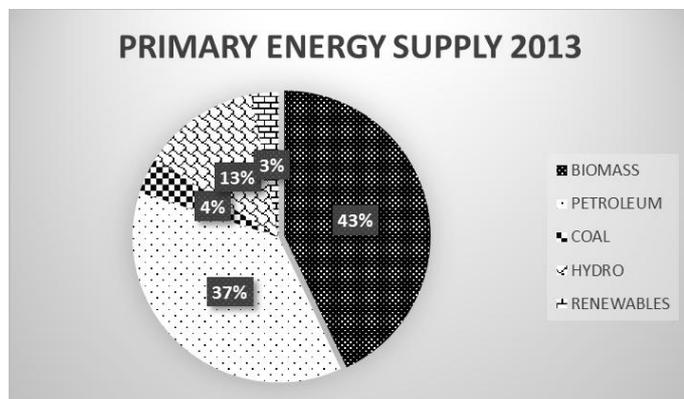
Sri Lanka is located in the Indian Ocean facing a vast Swath of uninterrupted ocean, providing solid wind energy potential. The country experiences two main wind climates, namely the South-Western monsoon (May-August) and the North-Eastern monsoon (October-December). Archaeologists have proven that iron smelting using South-Western monsoon without the use of a bellows to pump air to smelting furnaces had been widely used technology during the period of 300-200 B.C. in the Balangoda area, making Sri Lanka the earliest country to utilise wind energy for productive work(Gill Juleff 2003) As in the case of hydropower, wind energy is derived from a moving body of wind, by transferring the kinetic energy of the moving body of wind to a turbine rotor, Due to the very low density of wind.(8)

TABLE 4
PLANT FACTORS OF WIND POWER PLANTS

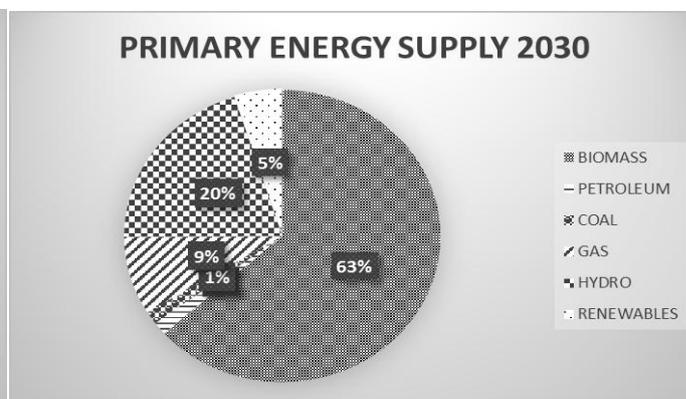
Nirmalapura WPP	49.36%
Vidatamunai WPP	35.93%
Seguwantivu WPP	31.69%
Mampuri WPP	31.12%
Willpita WPP	13.92%
Hambantota WPP	10.13%

2.5 Other Renewable Energy Sources

In addition to the four resources mentioned above, there are other forms of renewable energy such as wave energy, ocean current energy, geothermal energy and (Ocean Thermal Energy Conversion (OTEC) energy which could be useful for Sri Lanka in the distant future. Presently, these resources are evaluated and technologies being developed for energy conversion, and early breakthroughs are eagerly awaited by the research communities worldwide. Hence, no attempt will be made to describe these forms of energy. (8)



GRAPH 2 INDICATES PERCENTAGE CONTRIBUTION OF EACH SOURCES FOR ENERGY SUPPLY IN 2013



GRAPH 3 INDICATES PERCENTAGE CONTRIBUTION OF EACH SOURCES FOR ENERGY SUPPLY IN 2030

III. BARRIERS TO RENEWABLE ENERGY

- Market -Highly controlled energy sector, Lack of information and awareness,Restricted access to technology, High investment requirements.(2)
- Economic and financial-Economically not viable, High initial capital cost Lack of access to capital, Lack of financial institutions to support RETs, lack of instruments (2)
- Technical-Lack of standard and codes and certification, Lack of skilled personnel/training facilities, System constraints. (2)
- Social, Cultural and Behavioural - Lack of consumer acceptance of the product, Lack of social acceptance for some RETs, Environmental externalities (2)

IV. RENEWABLE ENERGY TOWARDS FUTURE NEEDS

Sri Lanka's new government expects a big increase in renewable energy investment by the public and private sectors as it unveiled an ambitious plan to gain energy self-sufficiency in the next 15 years. By 2030 the island aims to phase out fossil fuel imports which account for 25-30 percent of the total import bill and burns up 40 percent of export earnings, according to the Sri Lanka energy sector development plan for 2015-2025.

"If current trends in fossil fuel imports continue, soon export earnings will not be enough to meet the fuel import bill," Power and Energy Minister Patali Champika Ranawaka said. About half the island's primary energy supply is imported today, making it vulnerable to international supply shocks, he said. The government intends to replace these imports by developing indigenous energy sources and reducing energy usage and waste, Ranawaka told a forum held to launch the new energy plan. (4)

About 20 percent of imports would be replaced by developing to the fullest potential non-conventional renewable energy such as wind and solar by 2030, he said. "We will also reduce the technical and commercial losses of the electricity transmission and distribution network from 11 percent to eight percent, which is the international norm, by 2020."The government also aims to reduce annual energy demand growth by two percent through "through very rigorous conservation of energy and efficient use," he said. (4)

The plan aims to increase the share of electricity generation from renewable energy sources from about half today to 60 percent by 2020 and finally to meet the total demand from renewable and other indigenous energy resources by 2030.(3)

Current total installed power generation capacity is about 4,050 MW, consisting of 900 MW of coal power, 1,335 MW of oil burning thermal power, 1,375 MW of hydro power and 442 MW of non-conventional renewable energy sources such as wind, mini hydro, biomass and solar power plants. (9)

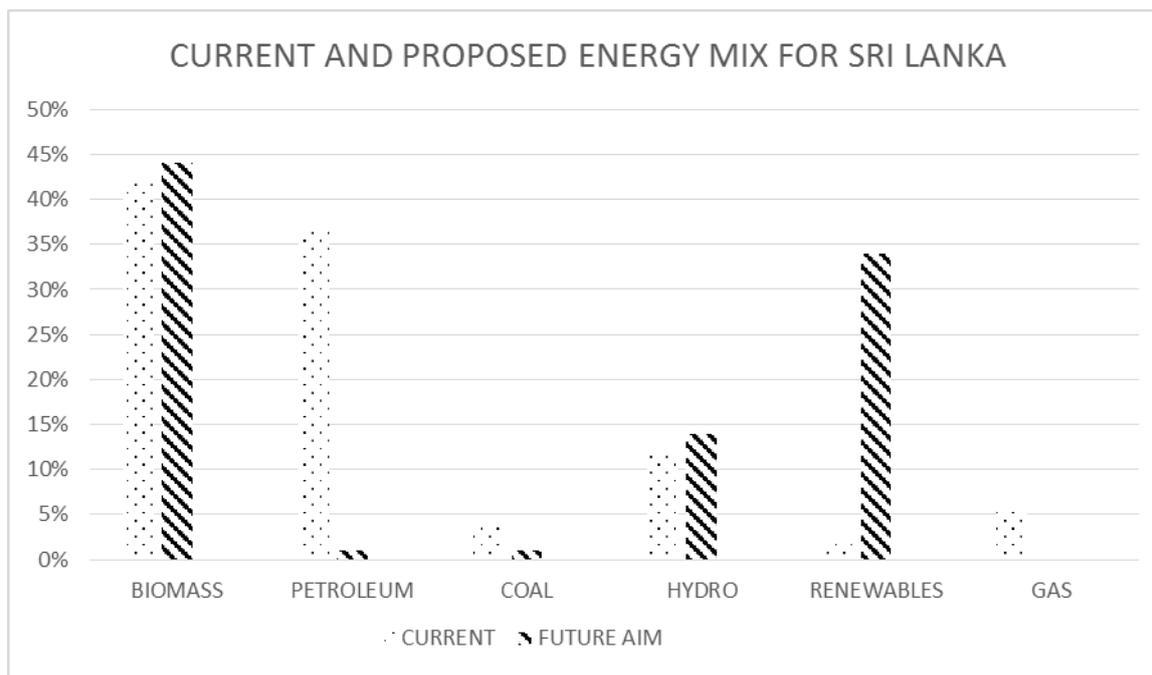
V. CAN SRI LANKA BECOME AN ENERGY INDEPENDENT COUNTRY?

Sri Lanka annually imports 2 MMT of crude oil, 4 MMT of refined petroleum products and 2.25 MMT of coal. This costs approximately 5 billion USD and covers 44% of the energy requirements. It also accounts to 25% of the import expenditure and almost 50% of the total export income. As a result, Sri Lanka's energy demand puts immense pressure on the national budget and on exchange rates. In addition, oil burning emanates various gases, intensifying air pollution. (8)

Therefore, it is essential that the country's energy policy puts more emphasis on renewable energy production to ensure the country does not depend on imported oil and oil products or contribute to air pollution. However, whether there is sufficient motivation to do this and whether it is a possibility are interesting questions to be debated. The Ministry of Power and Energy has developed an energy sector development plan that looks into increasing the use of renewables in energy production while reducing the dependence on imported oil and oil products. Analysis of the current composition of energy production and the aims of the new plan would provide a better idea on what areas Sri Lanka can expand on with respect to renewable energy and how soon that can be done.

Graph 4 indicates that the new energy sector development plan aims to reduce the petroleum contribution from 37% to 1%. The dependence on coal is to be reduced from 4% to 1%. Contributions from bio-mass and hydro are to remain more or less the same. In correspondence with the reduction on the dependence on imported oil, the new plan aims to increase the contribution from 3% to 34% with more emphasis on wind and solar power generation. Additionally, Sri Lanka hopes to

provide a 6% contribution from the recently discovered gas resources. While this is an ideal vision for Sri Lanka to answer its issues on establishing energy independence, there are several key concerns over the proposed future development.



GRAPH 4: CURRENT AND PROPOSED ENERGY MIX FOR SRI LANKA

VI. CONCLUSION

Requirement of energy in Sri Lanka also increasing in an increasing rate like other countries, So Energy needs to be conserved to protect our environment from drastic changes, to save the depleting resources for our future generations. The rate at which the energy is being produced and consumed can damage our world in many ways. In other words, it helps us to save the environment. We can reduce those impacts by consuming less energy. The cost of energy is rising every year. It is important for us to realize how energy is useful to us and how can we avoid it getting wasted.

Other prominent strategy is utilization of renewable energy. The vast renewable energy resource base of Sri Lanka will be developed to increase the dominance of indigenous energy in both electricity and thermal energy supplies. This initiative will cover the whole value chain of the electricity sector from electrification of remote locations through off-grid solutions to large scale infrastructure development to absorb wind, solar, remaining hydro and other renewable energy resources based power generation to the national grid.

REFERENCES

- [1] Dulip Jayawardena 2010, 'Potential for renewable energy in Sri Lanka', Business Times, October 31, p.1, viewed 15 September 2016, <http://www.sundaytimes.lk/101031/BusinessTimes/bt09.html>.
- [2] Garrett Richards, Bram Noble & Ken Blecher 2012, 'Barriers to renewable energy development: A case study of large-scale wind energy in Saskatchewan, Canada, vol. 42, pp. 691–698.
- [3] Oshani Perera 2016, 'Investing in sustainable energy: The case for solar technology in Sri Lanka', April 23, viewed 14 September 2016, <http://www.ft.lk/article/537645/Investing-in-sustainable-energy:-The-case-for-solar-technology-in-Sri-Lanka.html>.
- [4] Adaderana 2015, 'Sri Lanka targeting affordable renewable energy', June 10, viewed 17 September 2016, <http://www.adaderana.lk/news/31206/sri-lanka-targeting-affordable-renewable-energy.html>.
- [5] The curionomist, 2015, 'Enhancing Knowledge Capacity for Sri Lanka's Energy Sector: Takeaways from the Energy Symposium', July 1, viewed 14 September 2016, <https://thecurionomist.wordpress.com/2015/07/01/enhancing-knowledge-capacity-for-sri-lankas-energy-sector-takeaways-from-the-energy-symposium.html>.
- [6] Renewable Energy World Editors 2015, '10 Most-read Articles of 2015 on Renewable Energy World', December 25, viewed 15 September 2016, <http://www.renewableenergyworld.com/articles/2015/12/10-most-read-articles-of-2015-on-renewableenergyworld-com.html>.
- [7] Philip Jennings 2009, 'New directions in renewable energy education', pp 435–439, Physics and Energy Studies, Murdoch University, Murdoch, WA 6150, Australia.

-
- [8] Public Utilities Commission of Sri Lanka 2011, 'Achievements of Renewable Energy Targets in Sri Lanka 2011'. Sri Lanka Sustainable Energy Authority 2010, 'historical generation data', Colombo. http://www.energy.gov.lk/sub_pgs/hom_hgdata.html.
- [9] Ministry of power and energy 2016 Energy empowered nation Sri Lanka energy sector development plan for a knowledge-based economy 2015-2025.
http://powermin.gov.lk/sinhala/wp-content/uploads/2015/03/ENERGY_EMPOWERED_NATION_2015_2025.pdf. (2016.09.10)
- [10] PriyanthaDCWijatunga,2011,'Regulation for Renewable Energy development: lessons from SriLanka experience'.
http://www.ep.liu.se/ecp/057/vol10/020/ecp57vol10_020.pdf
- [11] Australian Government, Australian Renewable Energy Agency,(2016). <http://arena.gov.au/about-renewable-energy/>.