ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

**IJARCCE**

International Journal of Advanced Research in Computer and Communication Engineering

**PCON-2019**

National Conference and Seminar on Innovations in Engineering & Technology

Govt Polytechnic College, Palakkad

Vol. 8, Special Issue 1, January 2019

# Study on Extent of Utilization of Renewable Energy Sources in Kerala

**Indukala M. P.[1], Bincy M. Mathew[2]**

HOD, Department of EEE, St. Mary's Polytechnic College, Palakkad, India[1]

Faculty, Department of EEE, St. Mary's Polytechnic, Palakkad, India[2]

**Abstract:** Renewable energy sources and technologies have potential to provide solutions to the long-standing energy problems being faced by the developing countries. In the present scenario, adopting responsible renewable energy techniques and taking positive steps towards reduction of carbon emissions, cleaning the air and ensuring a more sustainable future is inevitable. In India, from the last two and half decades there has been a vigorous pursuit of activities relating to research, development, demonstration, production and application of a variety of renewable energy technologies for use in different sectors. This study aims to evaluate the extent of utilization of Renewable Energy Sources in Kerala in terms of Renewable energy potential of the state, renewable energy projects, possibilities of hybrid grid power and associated challenges. According to the International Energy Agency (IEA), India would be the fastest growing energy consumer and market till 2040. This forecast and fast-declining initial expenses of solar and wind energy promises the growth of renewable energy sources in the power sector. Right now various grid management challenges are being faced and sophisticated forecasting, frequent rebalancing & ability to ramp up or down conventional generation quickly to offset the gap created by increase or decrease in renewable generation through-out the day would help to address the challenges.

**Keywords:** Renewable Energy Potential, International Energy Agency, Kerala State Electricity Board, Agency for Non-conventional Energy and Rural Technology, Ministry of New and Renewable Energy

## I. INTRODUCTION

Energy is the key factor in development of a State and is highly useful if it is available in the form of Electrical energy. Power Sector in Kerala plays a vital role in all developmental activities in Kerala. Obviously power crisis is the prime obstacle to start new initiatives in the industrial field. The need for power is increasing and the production of power should also increase accordingly. Kerala's power sector is presently facing severe techno-economic and resource constraints. The average power consumption in the state has almost touched 64 million units. This may rise to 80 or 82 million units in the peak of summer. It is expected to settle somewhere between 75 to 78 million units throughout the summer. The state mainly depends on hydro electric power generation which in turn depends on inflow of water to reservoirs. The recent flood that hit Kerala further limits extensive dependency on reservoirs. Kerala has very few fossil fuel resources and much of its large hydro potential is already harnessed. The emissions from coal based or gas based power projects in coastal Kerala may adversely affect both the forests as well as the fragile marine ecosystems of Kerala, as well as the health of the population. Given such myriad constraints, Kerala faces a future threat to its energy security. It is acknowledged that most renewable energy technologies have low environmental impacts; hence a planned transition to renewable energy would be desirable for the sustainable development and energy security of Kerala. According to WWF-India and World Institute of Sustainable Energy, the state of Kerala can meet over 95 per cent of its energy demand with renewable sources by 2050. This state specific report (The Energy Report-Kerala) provides a vision for a 100 per cent renewable and sustainable energy supply by 2050.

The efforts to meet the rapid growing energy demand of the State did not fructify in the past. According to Power projections, even under the most conservative estimate the energy requirement of the State by the year 2020 will be around 33,000 MU which is about four times the present requirement. High capital investment would be necessary to set up additional power stations to meet this demand. This again brings into focus various socio-economic issues having direct bearing on the development of the State. It is important to formulate and review future strategies for meeting Kerala's electricity demand in a least cost and environmentally sound manner.

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE
International Journal of Advanced Research in Computer and Communication Engineering
PCON-2019
National Conference and Seminar on Innovations in Engineering & Technology
Govt Polytechnic College, Palakkad
Vol. 8, Special Issue 1, January 2019

The state government, according to sources has given a clear indication to Kerala State Electricity Board (KSEB) that it need not to embrace more financial liabilities in its efforts to ensure uninterrupted power supply. At present the board imports around 57 MU of power to meet the daily demand. Of this 29 MU, the state get as central share and the rest is brought to the state through long, medium and short-term power purchases. The average internal generation is only 14MU per day. Power corridors getting congested in the peak of summer, curtails the power evacuation limits from other states. Though there is a provision to purchase seven million units a day from NTPC plant at Kayankulam, the cost is around rupees eight per unit.

## II. ENERGY STATISTICS

The use of renewable resources of energy is rapidly increasing worldwide and according to the International Energy Agency (IEA), India would be the fastest growing energy consumer and market till 2040. Solar power, one of the potential energy sources, is a fast developing industry in India. The country's solar installed capacity has reached 12.28 GW in year 2016-17 as compared to 6.76 GW during the year 2015-16. India has expanded its solar generation capacity by 5.52 GW in just one year which has led to downward trend in the cost and has increased usage. It clearly signifies that proper integration of policy interventions holds the key to achieve the sustainable development goals.

## III. RENEWABLE ENERGY POTENTIAL AND UTILIZATION IN KERALA

Kerala is one of the small states of the country and is blessed with an abundance of natural resources like sunlight, wind, water etc. The State has been harnessing energy from the rivers in hilly terrains which are ideal locations for hydro-power stations. Until a decade ago, the energy from these hydropower stations was sufficient for the requirements of the State. However with growth in industry and changes in the domestic front like an increased dependence on new generation home appliances, there was an increase in energy requirements. The State has a storehouse of hydropower that can be tapped but greater concerns about its effects on the environment have caused the State to look at other viable forms of energy, particularly renewable energy. The Agency for Non-conventional Energy and Rural Technology (ANERT), the State Nodal Agency responsible for implementing renewable energy programmes in the State.

### A. Solar Energy:

Kerala state is located in the western coast of the country, which has a good potential for solar energy harvesting and receive the annual average solar insolation of over 5.5 KWh/Sq.m/day. Also, the state has a very good potential for various solar energy harvesting methods such as roof top solar photovoltaic plants, grid connected plants in wasteland, decentralized wind-solar hybrid plants, off grid solar plants etc. Solar energy is utilized as both Grid interactive system and as off grid system. Kerala has 25KWp grid interactive system and 44.7KWp capacity standalone solar power plants. Solar Thermal Energy Programme of ANERT is aimed at supplementing thermal energy requirements at various temperatures for different applications like cooking, water heating, Industrial process heating, crop drying, space heating, water desalination, etc. by harnessing solar energy and converting it into heat using various solar thermal devices and systems.

Kerala has a total wasteland area of 2445.63 $km^2$. Electrical energy that could be developed in that area using solar PV system is 1093.68 MU/day. Annual electrical energy which can be generated in that area is about 3,99,195 MU. This shows that the electricity thus generated would be several times higher than the present demand. Harvesting of solar energy in waste land could meet the present as well as future demand. Since solar energy is cleaner and renewable, source pollution and energy deficiency problems can be eliminated. Solar energy systems can be decentralized and roof mounted which enables the remote area electrification and thus reduces the load on a central power grid. Solar energy grids may also supply the conventional grid and can become a profitable venture in down the line. Also, solar – wind hybrid systems could prove to be viable solution.

### B. Wind Energy:

ANERT began studying the potential of wind power way back in 1990 with technical backup from the Field Research Unit (FRU) of the Indian Institute of Tropical Meteorology (IITM). This was under the project called 'Wind Monitoring Project' of the then Department of Non-conventional Energy Sources (DNES), Government of India. Later, along with the Centre for Wind Energy Technology (C-WET), the ANERT conducted many studies throughout the State for identifying potential sites for wind power generation. The wind energy potential is estimated to be about 605 MW. Even though Kerala is blessed with such a high wind potential, the State could not harness it fully for its

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE
International Journal of Advanced Research in Computer and Communication Engineering
PCON-2019
National Conference and Seminar on Innovations in Engineering & Technology
Govt Polytechnic College, Palakkad
Vol. 8, Special Issue 1, January 2019

effective utilisation. 32 MW wind energy generators have been installed in Kerala (Idukki, Palakkad districts) with active private participation. ANERT has provided technical approval to M/s Ahalia Alternate Energy Pvt Ltd. Palakkad for wind electric power generation and 8.4 MW Wind Energy project has been commissioned. Apart from this, ANERT has installed 137 wind water pumps in various parts of Kerala. The first machine in Kerala to produce electricity from wind power was the 100 kW wind machine installed by the Kerala State Electricity Board (KSEB) at Kottamala of Palakkad district in 1995. This was dismantled recently.

Later the KSEB installed a 2.025 MW wind farm at Kanjikkode of Palakkad district with Central Financial Assistance (CFA) with annual generation capability of 4 MU. Nine machines of 225 kW capacities were installed there and are still working, but with a very low plant load factor (PLF). This is the first of its kind in the State and is the only one in the Government sector till now. Two more wind farms were installed – one at Kuruvikkanam and Pushpakandam in Idukki and the other at Attappadi in Palakkad. At Kuruvikkanam and Pushpakandam, the total installed capacity is 14.25 MW. Here 19 machines of 750 kW capacities each were installed. At Attappadi, 31 machines of 600 kW capacities were installed for a total capacity of 18.6 MW. Independent power producers (IPP) have installed these wind farms that are now working satisfactorily. The important factor is that these wind farms have a PLF that is above the national average. Wind data collection was done for a total 21 sites, of which presently only 5 wind monitoring stations are recording wind data. In case of wind energy, the initial enthusiasm is later getting dropped. The major challenges are availability of land, difficult terrain at potential sites, high cost of development of transmission infrastructure & low utilization.

Though wind energy potential of Kerala was identified years ago, there were no remarkable efforts made to harness it. The reasons for this are many, beginning with the geography of the sites to the fact that the State was enjoying the benefits of abundant and cheap hydro power. The hilly terrain of the identified sites is a major hindrance for the development of wind power in the State. Moreover the sites are located in remote areas, many of which are not connected by proper roads. Most of the available roads are narrow and the curves are too sharp making it impossible to transport the long blades to the respective sites. As a consequence the capacity of the single units often has to be reduced even though higher potential is available at these sites. Government land is available at many sites but the access to most of the sites is very difficult. Private lands available at the potential sites are mainly agricultural fields and hence land cost is high. As a practice, cranes are used to erect the high wind towers. However the hilly terrain makes this task difficult and expensive. Additionally due to the remoteness of the locations, power evacuation facilities are also not easily available.

### C. Biogas Energy

Bio-gas is a gas produced by the decomposition of organic materials such as municipal waste, sewage, plant materials, food waste, green waste, crop etc. Bio-gas is the combination of so many gaseous particles. They are 65 percent Methane, 30 percent Carbon-DI-Oxide, 4% Hydrogen, and 1% sulphur-DI-Oxide. Biogas programmes are implemented by ANERT with financial assistance from MNRE (Ministry of New and Renewable Energy) and with active participation of beneficiaries. ANERT has installed 102 large size biogas plants since its inception with central financial support. An average of 10lakh cubic metre bio gas is being generated every year.

Present options available

1. Household level Bio gas plant for cooking – which can be focussed in tribal areas and used for cooking or heating
2. Institutional level biogas plant – which can be used for cooking or heating
3. Community level biogas plant - which can be used for cooking or heating or electric power generation

Efficiency of electrical energy generation from biogas plants from solid waste is yet to be proved and it is better to utilize the biogas generated as such for cooking or heating purposes.

### D. Biomass Energy

Biomass can be used for different applications such as cooking, process heating, electricity generation, steam generation and mechanical or shaft power. There are several conversion technologies that can convert biomass resources into power and heat for various potential uses. Most common biomass conversion technologies used for meeting power generation and thermal energy requirement in India are biomass combustion, biomass cogeneration (combined heat and power) and biomass gasification.

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE
International Journal of Advanced Research in Computer and Communication Engineering
PCON-2019
National Conference and Seminar on Innovations in Engineering & Technology
Govt Polytechnic College, Palakkad
Vol. 8, Special Issue 1, January 2019

In Kerala, the state level biomass resource assessment study was carried out at the time of development of Biomass Resource Atlas of India (2002-04). According to Biomass Resource Atlas of India, biomass power generation potential in Kerala is around 500 MW. No separate state level assessment has been done for assessing the biomass potential for the state; however, The Kerala Energy Report 2011 projects the potential biomass availability up to year 2050. The main agricultural crops in Kerala are paddy, coconut, rubber, arecanut, and tapioca. Presently, most of the agricultural residues generated in the fields are either used as fodder, thatching material or burnt to prepare the soil for the next cropping season or it is left on the farm to mulch and improve soil's nutrition level. Table 1 gives an idea about the availability of crop residues in Kerala for biomass energy generation.

Table 1: Availability of Crop Residues in Kerala for Biomass Energy Generation

| **Type of residue** | **Available quantity (metric tonnes/year)** |
|---|---|
| Paddy straw | 78,300 |
| Paddy husk | 10,440 |
| Coconut fronds | 3,08,000 |
| Rubber wood | 1,60,269 |
| Areca nut husk | 7,993 |
| Tapioca stalks | 1,77,006 |
| Agro based wood processing | 10 ,90,958 |
| **Total** | **18,32,966** |

So far, there is no large scale biomass projects reported and energy plantation based biomass energy production is a viable option considering the wastelands in the State.

E. Small Hydro Power

Small Hydro Power (SHP) potential of the State is observed as one of the renewable energy sources that could cater to the needs of a section of remote, isolated habitations and could support existing grid to enhance energy availability of the villages in high lands. ANERT had carried out reconnaissance survey of probable SHP sites. The survey covered 875 sites of varying capacities. Geo spatial details and spot discharge data of these sites are compiled with the support of Local Self Government Institutions and Non-Governmental Organizations. Kerala State Land Use Board is preparing maps relating to the location and catchments of these sites. At present there are only 17 SHPs under Kerala State Electricity Board Ltd. and total installed capacity is 76.4 MW.

## IV. CONCLUSION

Considering the long term energy security scenario, presence of sensitive ecosystems and the increasing demand for energy, a renewable energy future for Kerala is to be seriously thought off. Also, Kerala has very good potential and favouring energy policies for various solar energy harvesting methods such as roof top solar photovoltaic plants, grid connected plants in wasteland, decentralized wind-solar hybrid plants, off grid solar plants etc. Extensive awareness programmes, proper support and guidance shall improve the extent of utilization of renewable energy sources in the state, and lead the state towards enhanced energy security and sustainable development with minimum social and environmental impact.

## REFERENCES

[1]. https://www.wwfindia.org/about_wwf/reducing_footprint/cce/our_work/low_carbon_development_framework/re_studies/
[2]. http://www.kseb.in/index.php?option=com_content&view=article&id=68&Itemid=713&lang=en
[3]. https://biomasspower.gov.in/
[4]. https://www.iea.org/countries/India/
[5]. Government of Kerala's GO(MS) No.73/2011/LSGD; dated 01-03-2011
[6]. Energy Statistics 2018 by Central Statistics Office, Ministry Of Statistics and Programme Implementation, Government of India.
[7]. https://www.anert.gov.in/

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering

PCON-2019

National Conference and Seminar on Innovations in Engineering & Technology

Govt Polytechnic College, Palakkad

Vol. 8, Special Issue 1, January 2019

## BIOGRAPHIES

**Indukala M.P**. received B. Tech. degree in Electrical and Electronics Engineering from Nehru College of Engineering & Research Centre, Thrissur under University of Calicut and M. E. in Power Electronics and Drives from Easa College of Engineering & Technology, Coimbatore. Since August 2011, she is with St. Mary's Polytechnic College, Palakkad as Faculty in Department of EEE and became Head of the Department in 2013. Her current research interest includes renewable energy sources and renewable energy technologies. She is a Life Member of the Indian Society for Technical Education (ISTE).

**Bincy M. Mathew** received B. Tech. degree in Electrical and Electronics Engineering from Mar Baselios College of Engineering & Technology, Thiruvananthapuram under University of Kerala and M. Tech. in Power Electronics and Drives from Karunya Institute of Technology & Sciences, Coimbatore. Since June 2016, she is with St. Mary's Polytechnic College, Palakkad as Faculty in Department of EEE. She has authored the paper Novel Single Phase Buck PFC Converter and the papers she has co-authored includes Modified Single Stage AC-AC Converter, Stability Analysis & Limit Cycle Behaviour in DC-DC Boost Converter and Direct AC/ AC Converter. Her current research interest includes renewable energy sources and renewable energy technologies. She is a Life Member of the Indian Society for Technical Education (ISTE) and SPOC of NPTEL Local Chapter.