

# An Economic Study on the Efficiency of Biomass Energy for Different States in India

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**Abstract:-** The present study is an attempt to analyze the potential of biomass energy for power generation in India. India being an agrarian economy needs to review the management of the surplus waste it produces from agriculture, forestry etc. Power capacity of the plant is the technical input and the surplus biomass availability is the raw material suited to this carbon neutral energy form. The key factors with respect to infrastructure and their relationship with unutilized renewable energy is taken up. In the study given, the power potential of the region is a proxy variable for the renewable energy unutilized. For the purpose of the study, the technique of multiple regression will be used with power potential as the regressed and power capacity and surplus as the repressors. Once the availability and magnitude of these factors from reliable sources are taken into consideration, and a suitable statistical tool i.e. Multiple Regression is used to study their relationship with the dependent variable, the study delves into the possible reasons behind leaving the renewable energy unutilized despite its significant relationship with the aforementioned aspects of infrastructure. The research paper will also look into the future scope of biomass energy in India as compared to other energy sources.

**Keywords:-** Biomass Surplus, Power Capacity, Power Potential, Renewable Energy, Multiple regression.

## I. INTRODUCTION

Biomass energy is gaining importance due to its renewable nature. India is the seventh largest country and covers a resonating area of three hundred million hectares with a good share of households, which need resources to fulfill their needs. It promotes the usage of renewable resources. It is agrarian society biomass energy plays a vital role due to its availability. The utilization of biomass energy and a complex class of the major agriculture sector that is feedstock has different technologies for the recovery of the energy in the environment. The production of biomass energy ranges about 450-500 million tonnes per year according to UNDP. At present, India uses 32% of the primary energy that is available to the country. India has 4,946 MW grids connected and 994 MW off-grids power plants.

The main aim of the country is to use infrastructure to its fullest, along with a pressing concern at the global front regarding the usage of fossil fuels, as it is a renewable source

of energy. It has become imperative for our nation to switch to the renewable energies as soon as possible. According to a study conducted by British Petroleum Review of World Energy, India has consumed 724 million tonnes oil that is equivalent in the category of primary energy. The statistics show us that the divided coal among with an approximation of 412 million tonnes that is nearly 57%; oil, 213 million tonnes being natural gas that is 29%; natural gas, other gases accounting to 5%; hydrogen & nuclear energy, biomass and other renewable energies, amounting to 17 million tonnes that is 4% of the total.

There is a loins share of coal and oil due to the requirement of the energies is high in India. Intended nationally determined contributions (INDC) plans to reduce the GHG emissions till 2021. It is inclined towards the COP21 agreement by INDC. The increase in the share of installed capacity of biomass energy to 10 GW by the year 2022 is one of the main aims of INDC. The study is a further attempt to the analysis of the scope of biomass energy as a renewable source and the potential it carries in the generation of power.

### ➤ Resource potential for biomass energy

It is defined as the availability of the residue in the water centric vegetation, organic waste or forest waste, crop production by-product, agro or food industrial waste. There are a plethora of biomass energy resources in various forms.

#### • Crop Residue as Input Resource

India brims with land area under agriculture and residues are produced here in massive amounts. These residues are produced here in massive amounts. These residues act as the contents of biomass feedstock to be further used for generation of the energy. The organic entities that are produced as remnants from processing the harvest of the crop are referred to as agricultural residues. Residue obtained in the field at the time of yield is primary residue; those assembled during processing are known as secondary residue.

#### • Biomass and Installation Capacity

The capacity installed of several grid- interactive Biomass power during the commencement of the 11th Plan period in the country stood at 1,184 MW. It had increased to the tune of 4,123 MW in March 2014, which accounted for

23 per cent of India's Biomass potential standing at 17,981 MW.

- *The Costs of Biomass Energy in India*

The costs associated with the production of biomass energy fall in an erratic and wide range on account of the variety of feedstock being used. The cost of biomass energy also depends upon the distance of the feedstock from the power plant. Also, some forms of Biomass costlier than others. Co-generation plants or CHP plants are known to be the cheapest biomass plants while the standalone biomass plants which are capable of using a variety of feedstock are in fact expensive in nature. Unlike the solar and wind power, the investing in power plants of biomass is usually not fixed.

The comparative study is to be done in order to analyze the benefits of biomass energy over other energies. It is important to protect resources for the future generations. The production of biomass energy is easier.

➤ *Objectives*

- To study the effectiveness of biomass energy in India
- To analyze the independent variables
- To interpret the availability of bio energy in the country

## II. REVIEW OF LITERATURE

In the past few years, debates have straddled perspectives on the issue whether biomass fuel is sustainably useful or not. Many researchers have dwelled their perspective on this issue by looking into the feasibility matters. The researches on this study have helped us gain perspective on numerous benefits that help society become a better place by using renewable energies like biomass.

V. Rangathan and Syed hued(2018) stated in their study 'Biomass gasifier for electrification' that biomass has had a huge impact on the economy of the country due to its population. It is important for the country to restore renewable energy sources. The Government has built up policies and has laid emphasis on the power generation. Biomass energy fulfills the requirements of rural and urban sectors. The main aim is the reduction of the production costs. It helps in decreasing the demand for the petroleum.

The objective of the study is to analyze the uses of the Karnataka power generation and to do an outcome analysis on the same. There are various solutions being offered by the Author to overcome the repercussions of the renewable energy. This paper focuses on the impact and importance of the biomass energy in different states of India. It has a huge scope and wide range of uses. The competency of the jobs in the rural sector increases. The use of biomass has improved the potential of the migration to rural areas. There is increased scope in industrialization as well. It is increasing the opportunities in service and manufacturing sector. The

biggest advantage of the biomass energy is that it keeps the environment clean and helps in meeting the target of sustainable development by 2020. It is one of the most important missions.

The methodology used is secondary study. The variable used for analyze is regression analysis. The scheme used is RPO. It is used for the electricity generation and power generation in rural households. It is important for the sustainability and environmental balance. It helps in increasing the caloric value of the energy.

The conclusion drawn out of the study is to switch to renewable sources of energy. It is a cheap source of energy. There is a large store of capacity of renewable energy. The population of the country is increasing at an increasing rate. It is important for the economy to grow as a whole.

In a delve of study 'Use of biomass for electricity generation' by Alice, Julia, Vanice and Andreas(2018) wrote that the utilization of biomass can be done in several ways. It is prevalent globally that it impacts health in adverse ways. Potential sources have been used to study the effect of biomass by determining its life cycle in an extensive study. There are several stages of conversion and combustion. Incident of biomass leakage and impact has been studied in this research paper.

The introduction begins with the climate change that impacts the global growth of the environment in future. According to a study conducted by World Health Organization; it states that the death rate has increased due to the harmful pollutants in the combustion process of biomass. Biomass has its uses but harmful impact as well. There are agricultural residues as well that are released into the environment. The burning of biomass energy causes respiratory diseases. Bioenergy plants are there in the country such as vegetable oil, woodfire and landfill plant.

There are several health impacts on the pollution level that has not changed since a while. The study conducted is secondary study due to which the occupational setting for the people. Human health is prime concern that is related to the human safety. Electricity generation comprises of the life phases. Data is categorized on the basis of extracts from various studies.

The conclusion is on the basis of the result that has been draw after studying various reports that shows fossil fuels and hydro electricity and other equal forms of energy. The help of biomass energy does electricity generation.

Rijul Dhingra, Abhinav Jain and Srishti Mahajan(2018) in their study have assessed the renewable energy in India. Biomass being a renewable source of energy is much in demand. India is a vast country that stands sixth in the world for its environmental impacts and fuel supplies to attain

sustainable development. The focus is on the clear energy and seeing its enormous potential sources. Biomass has a wide potential and needs a stage for growth. The gap is between the demand and the supply of the energy due to the increase in the population of the country. India has a growing concern that is due to increasing population. There are large number of consumers of fossil fuels, coal and crude oil that can use biomass as an alternative to it.

The study focuses on the solution to be provided for the attainment of sustainable development that can be done by replacing the non-renewable energies by renewable energies such as hydro power, biomass, solar, wind, geothermal, nuclear power etc.

The findings as listed by the author are that the best renewable source for energy is hydro energy. Hydro energy can be converted with minimum wastage and is about 80% efficient. It requires a huge amount of land. The carbon dioxide very high in biomass energy and renewable energy is low in emissions.

Ashwani Kumar, Kapil Kumar, Naresh Kaushik and Saroj Mishra (2018) have delved in their study 'Renewable energy in India – Current and future potential' that India being 7th largest in the population and with a rapidly growing population needs new avenues for energies. The renewable energies gaining importance such as wind energy, solar rooftops, hydropower energies and thermal power. It is important to switch to alternatives of the non-renewable energy to fulfill the energy requirements.

About half of the natural resources such as fossil fuels have been consumed due to the huge industrial requirements. Fossil fuel depletion is leading to energy shortcomings. Renewable energies will not deplete over time and fulfill the energy requirements. The annual growth rate of the country is 1.78%. It is made of the organic matter decomposition. It reduces the carbon emissions and provides a cleaner environment to breathe in. Renewable energy is basically produced out of the natural resources that can be built again. It is produced in abundance so that there is no deficiency of the same. It has also reduced the traditional power generation. It leads to better irrigation facilities in the country. India being an agrarian economy needs much better irrigation facilities. It is important for the country to improve its irrigation facilities for growing at a rapid pace as its population.

The author has concluded the paper by major achievements done in the renewable sources over past 10 years as industrialization gained importance. There have been several incentives taken up by the Government to improve our dependency on renewable sources. It is for the growth and improving the potential of the country to rely on the renewable energies.

S.N Srinivas and G.S Prabhu(2017) assert that bioenergy for rural India in the production of combustion that generates heat and steam then electricity is production. Electricity is used in industries in rural areas. Rural operation is feasible and financial viability. Number of barriers is technical, institutional, regulatory and financial. It produced to serve the hunger of the urban areas and industries. The vision of the BERI is basically revealed in the study the concerns availability. The objectives of the households in villages serve the hunger of the urban and rural areas. Their are a lot of avenues that are discovered by the upcoming with the employment and social mobility; availability of electricity and better irrigation. It is social mobility of the people are divided. The demand of the energy is generated in rural areas. There is a raise in the demand of the bioenergy and a sink in demand for coal and fossil fuels. It helps in increasing afforestation. There are smokeless stoves and a decrease in illnesses. It is among the women and dependent children. It is mostly in small and marginal farmers. The agricultural inputs have improved. BERI help people in rural area by water right and land holding members of the community.

The economic conditions of the group of beneficiaries are improving with time, as there is a change of the source of the energy. There are risk factors are sudden reduction and there is cost reduction. The empowerment of the village areas takes place. There are decision-making changes that take place due to the better infrastructure.

The use of biomass energy is improving infrastructure. The biomass requirement for the power plants is considered to be optimal source of electricity generation. Mostly this renewable source of energy is used in the households to fulfill the domestic needs and in the industries. There is a significant improvement in the agricultural areas and the employment opportunities have risen. The participation of women has also shown improvement.

Siripurapu Sriram, P.K Srividhya (2017) delved in their study 'Technologies involved in biomass energy conversion and its utilization in India' the usage of biomass in India. The main objective of the study was to analyze significantly the role of biomass across the country. The increase in the price of the oil served as an alternative to the fossil fuel. There is reduction of global warming. The effects of greenhouse gas emissions are uncontrollable and have dangerous consequences. The availability of biomass energy in India is abundant. The significant role of this energy is that the crisis in developing nation. Biomass is the world's third largest renewable energy source that is used for the generation of the electricity. Hydro power plants are used to generate power among the viable sources. The source that is available at a global scale that is used for heating is biomass.

The composition of the biomass energy is done by the decomposition of the organic matter that is available in abundance. The sources for the same are plants, agriculture

and other crops wastes. The waste that is readily available in the municipalities and industrial waste in the form of bio energy can also produce it. There are four types of biomass energy available in India that is wood and agricultural products, solid waste, landfill gas and biogas and biofuels. The technologies are available in India on a large scale. It can be in the form of co-firing, gasification and anaerobic matter.

The conclusion drawn out of the same is that the biomass is meeting the future requirements with disturbing the nature and providing a viable source of renewable energy. There are future energy needs that are available.

Rajeev Anna Luru(2017) asserted in his study 'Managing the power grid ramping challenges critical to success of India's renewable energy targets' that the solar power, hydropower and wind energy are in use by replacing the renewable energy.

The objective of the study is to analyze the biomass energy and its forms in use of India. The total requirement of the solar power is to run on sunlight. The main aim of the solar power is to provide a substitute to the solar energy. It is a power grid operator in India to meet the energy requirements of the country.

The methodology conducted by the author is secondary study. It is majorly to dispatch the system. It increases the capacity of the energy. It is done to achieve the sustainability goals. It is to be achieved by 2020. The paper focuses on the overall growth of the economy. The sources of energy that can be used are to be studied. The power generation is done by biomass energy. It is important for the growth of the biomass energy to maintain a cost effective method of production. It is used for the industrial, commercial and household purposes. The incremental price and the carbon price is to be recovered in the production process. The policy implementation should be done in a manner that it promotes the usage of renewable sources. The major reason for the same is that coal, fossil fuels and natural gas is on the verge on the depletion. The use of biomass will prevent the greenhouse gas emissions and makes the air quality better.

The conclusion drawn is that the only solution for the biomass energy is that the effective carbon price scenario. It is the need of the hour to switch to renewable energy sources. The load of the energy is divided by this method. The use of biomass will increase the price of the energy but will save the energy for the future generations.

Rakesh Kumar, Amit R. Patel and Prabir(2017) present in their paper that the spectrum of biomass availability is increasing globally due to its viable uses. India being an agrarian economy needs biomass energy to sustain the source of the energy and put to use the biomass energy. The major objectives of the paper are to assess the effectiveness and efficiency of the utilization of the biomass energy. Humans

are the primary users of the biomass energy and it is the first ever energy source that provides a substitutes of fossil fuels and oil which is cheap and abundant in nature.

The source of the study is secondary. Biomass is the oldest and renewable source due to that the carbon particles are reduced. It has viewed as a source to replace the non-renewable sources such as petrol, Natural gas and coal. Biomass potential is larger than any other source due to its availability and carbon structure. The process of production is cheaper and raw materials are easily available. The contribution of the energy is that it is primary energy demand. The utilization of the biomass fuel offers employment opportunities to the people in the rural areas. There are advantages and disadvantages of employing rural people. The sources of the biomass for energy production are huge.

It is heterogeneous in nature. There is an increase in the moisture due to the drying of the wood. It is essential for the effective heat release. There is an increase in the agriculture residues that are husk, rice, straw etc. The principal crop residue is cotton stalk that is attractive.

The biomass energy production has several disadvantages that are as follows. It leads to a poor supply chain management. The poor volume density and low caloric value adds dust particles to the environment. Biomass is the feedstock that produces the sustainability of a fuel as an option. It is a boiler fuel.

The advantages of the biomass are that it is renewable and is low in cost. The great challenge is that the usage of biomass is difficult. It is used to power generation.

Pallavi Purohit and Vaibhav Chaturvedi, 2016 wrote in their study "Technology-economic assessment of biomass pellets for power generation in India " that biomass is the primary source of electricity generation. European Union targets the bioenergy policies wherein the production has increased considerably as the demand has also increased substantially. Technology-economic study is being done to assess the feasibility of the biomass energy. The biomass energy has surplus availability in agricultural sector, forestry and wasteland production areas. The cost of electricity has significantly reduced due to the availability of the biomass energy as a substitute for fossil fuels and coal. There is a reduction in the usage of fossil fuels due to the fact that it is on the verge of depletion and to avoid the adverse climatic conditions. Biomass usage is increasing over the time due to its availability. It is used in the household for various uses like cooking, irrigation, etc. The low-density bulk and inhomogeneous quality of biomass has made its availability easier. The pellet sector is gaining importance due to its usage. India being an agrarian economy needs better irrigation facilities for the growth of the forest residues.

There are various disadvantages of the biomass energy. First being its cost. It is not cost effective. Second, it has a relatively low calorific value than other sources such as coal, fossil fuels etc. Third, The variability of the quality and the calorific value is not up to the mark. Fourth, The difficulty in controlling of pollution due to burning of the wood for the production of the biomass energy. Fifth, The rapid burning of the wood cannot be stopped.

There is increasing bulk density that leads to raw agricultural residues. There are two seasons for growing the crops in India; namely Rabi and Kharif. Both the crops require irrigation facilities that are brought catered by fodder for cattle. There is a creation of employment opportunities in the rural areas. Both large and small-scale industries use biomass pellets for power generation and is important to stimulate the need for the local economy. There is hastening industrial development that leads to increase in employment opportunities. The cost of biomass has also improved over the time. The transport facilities and storage costs are improving. There is increasing carbon resource.

The target of biomass energy is devising strategies for the electricity-based generation. Sustainable development is observed in the country after the usage of biomass energy.

S.N Singh(2016) delves in his study 'Renewable energy sources in India and its present scenario' that the sustainable development sources of the energy are gaining importance due to the increasing population of the country. India is considered to be the 7th largest country in terms of the population and energy requirements. The goal is self-sufficiency and development of India. The sustainable development goal is to be achieved by 2020. The world energy consumption has risen by one-third. It is depicting the dire need to switch to renewable sources of energy to meet the energy requirements.

The author analyzes the achievements by the implementation of the policies in support of the usage of renewable sources. The policies in favor of renewable sources are MNRE schemes. Firstly, It is providing fiscal incentives to the country. Secondly, Research and development is gaining pace. Thirdly, the Government is planning the provision of the hydropower plant in different states.

Author explains the trend of appreciation and depreciation in the country. The main aim of biomass is power generation in different states. It has alternative uses such as husk, rice, coconut and saw dusk. It is important to analyze whether biomass is serving as a cost effective measure or not. The main aim is the promotion of the technologies. It is helping in the growth and development of the country. The small hydropower conversion is in the states such as Karnataka and Tamil Nadu. It reduces the environmental pollution and helps in maintaining clean air. It

prevents the industrial wastes to decay. There are few repercussions to the usage of the biomass energy that it is not cost effective. The installation cost is high.

According to a study by Niramssriram; 2016 Biomass is discussed as source of energy that is composed of the entire organic product. The study conducted is secondary study collected by various reliable sources. Biomass promotes the evolution of mankind. One of the simplest forms of energy is biomass energy. After the usage of biomass energy the usage of fossil fuels has decreased. The process of the conversion of biomass is explained. Biomass is a better version of fossil fuels.

This paper laid emphasis on the benefits of biomass energy. It showed the relationship between fuels and biomass. The economic performance of renewable energy is on the basis of the economic cost. The biomass plant has a good experience all together. It operates well except for the fact that sometimes there is a boiling problem due to chlorine, sulfur, alkane and other contaminants. The air quality is perfectly fine. Biomass is one of the oldest and easiest methods of producing electricity. In a country like India, It is a great opportunity due to the agrarian nature. It should be tapped on intelligently in order to yield maximum benefits. It offers immense scope to expand its horizon on. It can be further used to the generation of other energies by combining it with potential energy. It was the first grid based energy that was ever produced.

The biomass projects in different parts of the world majorly in North America. Biomass energy is about 7% in European Union as per the statistics and about 65% of total renewable energy. It is a good base to build a pillar upon. In South East Asia biomass energy plays a vital role due to the combination of power and heat. In India the need for renewable energies is increasing due to the worsening of the climatic conditions. Biomass energy can be used in running the small-scale industries and households. It is a source of electricity. It can be converted easily that promotes its uses. The transformation of the biomass energy is easier. Biomass energy is a power generation system that is a source of non-hydro renewable power due to its wide range of uses. It takes less time to get converted. Biomass energy satisfies the needs of the society. It can be installed in the rural areas to promote the use of electricity. It is also used a heat producing object. It provides no smoke, better healthcare facilities and larger rural electrification. Biomass energy cannot only be used for the electricity generation but irrigation as well. It leads to a better standard of living.

The author draws a conclusion that the scope for the biomass energy is growing due to the diversification of needs of people. It is gaining importance not only in India but growing worldwide. It is a renewable energy that is used extensively. Fossil fuels are fast depleting and non-renewable source of energy. It is important to save fossil fuels. Fossil

fuels are on the verge of depletion in order to save fossil fuels biomass can be used, as it is a renewable energy. Biomass energy is developing. It promotes better technology promotion. It can be grown in most of the parts in the world due to its viability.

Anil Kumar, Nitin Kumar and Prashant Baredar and Ashish Shukla(2015) wrote in their paper renewable and sustainable energy that communication of biomass energy resource have potential resources. It constitutes of about household activities and other regular needs. India is a surplus agricultural and the forest cover was about 500 million tons of biomass available per year. There are policy and financial incentives in the generation of power. The policy mechanism has become stringent to cover the household activities using biomass energy. There is an increase sustainable energy and decrease in non-renewable sources. It is mainly to reduce the impact of coal on the environment. It is to reduce the non-conventional sources. The climatic conditions are on the verge of collapse. The availability of the biomass energy is the residue of the water-based vegetation. India being an agro-based economy needs biomass energy. The organic waste is put to use and renewable source is generated. India has a huge amount of agriculture and crop production is the main source of income. The use of biomass is to improve the irrigation facilities. The feedstock is to use the energy generation in a way that crops like rice straw and sugarcane can be produced. There are about 5 main feedstock uses. Firstly, Feedstock is used to create energy crops. Secondly, Forest waste is put to use by conversion into a renewable source of energy. Thirdly, Agro-based industrial waste is used in a way that it generates biomass energy for consumption. Fourthly, It is to convert the municipal solid waste into a source of energy. Last but not the least, Agricultural waste is utilized.

There are biomass energies in large quantities. There are huge benefits as crops are converted into fuel that generates energy. Biomass energy can be gasified based on the power plants for producing electricity, which is locally available for biomass resources. Biomass is produced by the conversion of feedstock into the bio fuels. There are about two technologies, which are used for the conversion; one is thermo-chemical energy and other is bio-chemical or biological energy. The process is restored several times to ensure adequate supply of the energy. The energy conversion has a sustainable way of development; it can be off-grid and on-grid. Fossil fuels, coal and oil are to be replaced by renewable sources.

Prof. Sadhan Ghosh(2015) delves in his study Potential of utilization of biomass waste in India; the analysis of the relation of biomass energy. There are three factors that are influenced by supply chain management of biomass such as sustainable development; affordability and SDGs. Biomass wastes are the carbon neutral wherein the availability is very wide. The SDGs goals are not accomplished due to the

scarcity of fossil fuels. Use of energy is being shifted its usage from domestic to industrial.

The data is taken from UNFAO, 2015. The urban waste is being treated. There is public health, which is improved over the time. There are incentives that Government is taking to uplift rural areas. There are renewable sources of energy wherein biomass energy is being used globally. There are a lot of sources of biomass energy, not only in India but globally.

Biomass is an important source of energy due to its usage in power generation. About 70% of the energy source that is consumed is by the rural sector of the country. The household sector of the society consumes biomass energy in the form of electricity. It is also used for the improvement of the irrigation facilities.

The industrial use of biomass energy is mainly in the farming sector that helps in the production of energy crops, forest products, agricultural residues and animal manure. The chain moves in the cycle by land demand then land use by that the energy crop production is done.

The study holds a comparison between India and China wherein the objective is to promote technologies; optimum use of country's biomass due to rice husk and straw. Biofuel is produced effectively and efficiently by the production cost.

The challenge is to reduce the production cost and feedstock production. The co-product is to induce development in the society. There should be economic utilization of the biomass and waste should be considered in mission mode. The gap between the implementation of biomass waste and small businesses is reduced.

Suresh Chauhan(2015) stated in his paper, ' Biomass resources assessment for power generation' represents a case study from Haryana state. India is a country with diverse cultures where in about 370 million tonnes of renewable energy is generated that is biomass energy. Haryana is an agro-based industry as a product base of agriculture. It produces by product as biomass energy. In the rural areas of the state husk is being produced by the rice mills production machines. The major source of power is through the dams that generate electricity. There are several areas in the state as rural, urban and modern wherein the conventional source is biomass. The crop production takes place as a by-product. There are household in the rural sector that need biomass energy for upholding their daily needs and regular tasks. The demand for biomass is increasing mainly in households. Rural areas have a problem in connecting to the grid due to the only viable non-conventional source that is biomass energy. Depending upon the climatic conditions in Haryana, it is important to look in the production process in the state. Major state crops are for consumption purposes that is rice, sugar and saw mills. The reason for the same is the

availability of the raw material and production process is eased. Electricity generation takes place in Haryana that was planned in 10th and 11th Five Year plan. There are different sizes and categories of the same.

The author to draw a conclusion of the assessment on biomass energy usage structure is conducting primary study. Taking personal interviews does the study. The purpose of the study is the classification of the biomass energy in different parts of Haryana state. There are two types of crops in Haryana depending upon the climatic conditions such as kharif and rabi crop. Two of the crops require the usage of biomass.

The export and import of the biomass energy takes place in the state. It can be traded in the form of raw material, paddy husk etc. Raw material is imported and paddy husk is exported.

The conclusion of the study is that in Haryana agriculture requires biomass energy, as the state is agro-based. The general criteria are looked upon that is cropping. According to a report by UNCED, It states that there is a lot of potential for the growth of the state by depending upon the biomass energy for agricultural activities. The usage of non-conventional form of energy is substantial. The rice mill owners believe that the quality of the crop will also improve in the near future by changing the source of energy. The major impact will be upon the irrigation facilities. It will not only improve the agricultural conditions but will hamper the growth of the environment. The scope of the study is extensive. It is an environmental friendly approach and is sustainable in nature.

Mairi and Goetz(2015) in their study 'Mapping out global biomass projections' delved in their study the uses of biomass energy. There is a dying need of biomass energy. Fossil fuels are on the verge of depletion. It also harms the environment. Biomass is a renewable source of energy, which is required to maintain the sustainable goal. The usage of biomass reduces the greenhouse effect in the environment. It leads to better climatic conditions. The sustainability of feedstock provides with a priority to the principle. The usage of biomass is basically to reduce the effect of greenhouse gases.

The author asserts that the use of biomass has an impact on both social as well as economic factors. It is leading to afforestation. There is an increase in yield of crops due to better irrigation facilities. It leads to stabilization. Urbanization is taking flight.

Biomass has had a major impact on the environment. It is important for the Government to understand the dire need of the biomass energy in the country like India. India has a growing population at a rapid pace. It is important for the country to switch to the renewable sources of energy. There

are several disadvantages as well due to the high installation cost. It is also important at the same time to understand that the goal of sustainable development can only be accomplished by switching to a reliable source of energy. Fossil fuels and coal are on the verge of depletion.

Author asserts that though there are pros and cons of the usage of the biomass energy still switching to biomass is a much better idea. It will fulfill the energy requirements of the country in a long run.

Arun Singh Tomar and K.K Gautam(2015) have delved in their study 'Renewable energy sources in India' those renewable sources of energy in India. It is important for a developing country like India to gain its perspective on the renewable sources of energy. India has different ministries for each department. There is one main department for power generation as well.

Author asserts the impact of renewable energy on the environment. It has social, economic and political changes in a long run. Biomass is an energy that is continually produced as per the requirement of it. The usage of biomass can certainly improve the quality of the air and make the environment cleaner. The consumption of biomass is growing at an increasing pace because of the increasing population.

The largest producer of the green energy products is India. India is largely running on solar energy and biomass is gaining importance. There are several new incentives being taken up like wind power, green energy corridor, net metering policy, raising of bonds, skill development and solar rooftops. There are different renewable energy sources such as wind power, solar power, bio energy, small hydropower and tidal energy.

According to the author, there are several changes observed in the renewable energy sources. Firstly, It has a high installation cost. Secondly, It does not have a broad economic sense. Thirdly, It has dependent conditions. It is dependent on the wind and solar energy for its production process to hold. After industrialization in India, Renewable energy has gained importance. It is a major factor for the human quality of life to keep growing with the evolving time. It is possible only when we switch to renewable energy sources. India being a capital-intensive country needs to grow at a larger pace for the utilization of the energy in all the aspects.

Karthiyan, Natarajan , Petri and Anas(2015) in their study 'Biomass in India- Barriers and policy' wrote that the environment for accelerating the use of bioenergy technology. India being an agrarian economy the population is increasing and growing at a rate of 8%. The demand is increasing due to the increasing demand. There is a reduction in the usage of fossil fuels. Biomass is creating employment

in the rural sector. The renewable source of energy is used. There is an increase in the potential due to the environmental concerns.

There are several factors for the usage of biomass energy. Firstly, Increasing demand for the energy in rural areas. Secondly, GHG emissions are harming the environment and fossil fuels are depleting. It contributes to the climate change. The expanding market for the renewable energy is a big contributor to the increased production of the biomass energy.

Biomass is made up from the combustible gas for use. There is need for electricity in the rural households. The supply of the sustainable source of energy that is biomass is needed. There is fossil fuel substitution. There is improving efficiency of the traditional biomass.

The Government has implied policies and law that are implied in order to reduce the cost of performance by financial incentives. Households in villages rely heavily on biomass for electrification. The states where it was a success are Karnataka, Rajasthan and Orissa. They are self-reliant and efficiency community.

Author asserts that biomass is produced out of the organic matter and is useful for the households in the rural areas. Research and development due to the usage of biomass is leading to cost reduction, reliability and large-scale production of renewable energy.

MSR Murthy, R Kotru , H Gilani and K Uddin(2014) asserts in their study 'Multi-scale forest biomass assessment of the Hindu Kush Himalayan region in India' that there is enough forest cover in India. India has a wide variety of flora and fauna. It is important to utilize the forest resources and organic matter.

The objective of the paper is to analyze the forest cover for the country can be used for the generation of biomass energy and hydropower. Both the sources of energy can be used for the irrigation and household facilities in the rural areas.

The paper examines the various sources that can be used to generate the biomass energy in the near future. It is important for the country to switch to the renewable energy sources according to the growing demand of the country. Supply creates its own demand. There are various energy sources in the country that can be used to generate energy. There are supply and demand of the renewable energy in the recent times.

The research methodology used is second study. Analyzing the impact of the forest cover does it. The energy in use is the biomass energy and it is being used as the primary source of energy in most of the villages that can

afford it. There is the reduction in green house effect gases. The prime cause of global warming is fossil fuels, coal and natural gas.

The conclusion drawn out from the same is that the multi scale variable that draws out in Himalayan region. The programs of the integral part of the forest region are community based. There is a lot of scope for the biomass energy to grow in future.

P.R Shukla(2014) delves in his study biomass energy in India - its policies and aspects the major policy implications that took place in the country during the installation of the biomass energy. The focus of this study is biomass energy is rapid decrease in fossil fuel use share of biomass. Substantial health is improved by usage of biomass. Renewed interest is the major advantage of biomass. The commercial viability of biomass is the demand and supplies in industrialization that is household in India. The main objectives of the study is that the policies and plans in India. History of planning and program inventions are planning promoting biogas, cook stoves and rural energy sources. Rural energy crisis and increase oil imports are multi-pronged biomass strategy to increase efficiency. They are increase in supply of biomass energy. It is technology-based source. Early policy perspective for biomass based electric power. Increase biomass use and primary traditional uses in cooking rural areas. The Government policies are made in respective of the biomass energy.

Preeti Narnaware, Ramesh Sursose and Swati Gaiwad(2013) asserted in their study 'Current status and future potentials of renewable sources of energy' that India should switch to renewable energy sources. The population of the country is growing at a rapid pace. Renewable sources of energy are needed for meeting the energy demands of the population. It is important for India to explore alternative sources as fossil fuels and coal are on the verge of depletion. Solar energy and biomass are alternatives of the same.

Author explains the process of the biomass conversion. It is made up by the decomposition by the organic matter. It is a building block for the same. It ensures sustainable future development goals. It is important for India to analyze the importance of biomass. Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra and Gujarat are working on the progress of the renewable energy source, as there is an apt requirement of the energy. There is labor force to produce energy and population to consume. Supply creates its own demand.

There are various energies such as wind energy, solar power, Biomass and biogas energy that are renewable in nature. There is huge investment being made in each of the sector of renewable energy production. The installation cost is high. It is not cost effective in some areas of the country.



B. Sudhakaran Reddy and Hippu Nathan (2012) in their study 'Energy in the development strategy of Indian households' delved that energy requirements are growing with the increase in population.

The objective of the study is to analyze the means that provides the energy to maximum population. It is important to realize the fact that India has a large population with problems like poverty and illiteracy prevailing. The use of biomass will increase the employment not only in urban areas but also in rural areas. It is more useful in households than the industrial usage. The cost can be covered in the long run. It is a fact of matter that the renewable energy sources are expensive but we can save in the long run. The different uses of renewable energies are cooking, irrigation, industrial usage, lighting, pump activities etc. The condition of women is explained in the rural areas. It is to improve the condition of people in rural areas. The policy implementation should be done in a manner that it promotes the usage of renewable sources. The major reason for the same is that coal, fossil fuels and natural gas is on the verge on the depletion.

The methodology used to conduct the study is secondary study. It is laying the framework on the basis of multivariate regression. The study is based on data from the reliable sources. It lays emphasis on the gender equality and poverty issues.

The conclusion drawn out of the same is that household consumption demand is fulfilled. The need for the same is to save the energy for the future generation. The fuel is used for cooking and electricity consumption in rural areas. There are more uses of the same. Women in the rural areas are over burdened with work. It is to reduce the gender gap. There are high and low literacy bars set for the people in the rural and urban areas.

D.N Reddy, Narsimhulu Sanke(2012) in their study "Biomass for power and energy generation" have stated the usage and need for the biomass energy in India. The author has referred to biomass as a term used for living matter that is produced by the process of photosynthesis of plants. Biomass denotes the products derived from the living matter; wood from the trees etc. It can also be produced using the aquatic life. Biomass is a processing facility that is generated using two sources; one is by electricity and by aquatic plants.

Objective of the study is delved upon the usage of the renewable energy sources by replacing the non-renewable energy. The need for the same is for the automotive invention of the steam engines and steam heating. The solar energy is also produced using the process of photosynthesis.

There are various uses of the biomass energy in household activities such as cooking and thermal process in small industries; fuel for the boiler but it can be transformed into gaseous and liquid fuel. The technology used in the bio-

diesel is also biomass instead of coal. Solid biomass is used in the form of ethanol.

The usage of biomass in rural areas has increased the job opportunities for the rural areas. Biomass is a sustainable fuel that offers gasification.

Azeem, Rashid and Muhummad(2011) delve in their study 'Biomass as a sustainable energy source study in India' states that population of India is the main reason for it to rely on the sources of energy. There are sources such as coal and fossil fuels that are on the verge of depletion in the country. Biomass has resulted in a primary source of dependence due to its renewable nature. It is a potential source for the country to generate wealth and fulfill the requirements in the long run.

According to the author, Major dependence on the biomass is due to the household requirements. The fuel helps in cooking requirements. There is maximization of the economic power as there is a divide in the consumption of the energy. It is an eco-friendly fuel that helps in the production. It is clean and helps the environment to remain clean. Organic matter does the production only. It sums up energy is made by combustion of organic matter and does not harm the environment in any way. For a developing country like India it also prevents deforestation.

This study delves around the usage of the biomass energy and its effect on the environment. It is essential for maintaining sustainability. It helps to keep the environment clean and green. It is an alternative to fossil fuel and coal. The Government helps in the implementation of the policies that are in favor of the biomass energy consumption.

Suresh Chauhan and C.C. Silori(2011) wrote in their study 'Assessment of biomass energy for power generation in Uttaranchal' how the state can contribute to the production of biomass energy. Solar energy is being produced on a large scale and biomass is a by-product of solar energy. Uttaranchal is a state that has a large forest cover. Biomass is produced out of the decomposition of the organic matter. It does not cause any deforestation. It is important to protect forests. The means to protect forests is to switch to renewable source of energy.

A sample survey is conducted on the basis of which the data is analyzed. There are different sectors such as forestry, agricultural and surplus biomass. The rural household requires a renewable source of energy. Household activities such as cooking are done by bio energy.

Author asserts that not only infrastructure but in the local markets. The efficiency of the energy is improving with time. There is no waste in the agriculture area. The organic matter is being converted into the bio-energy that is used for power generation and irrigation facilities.

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Craig A. Hart; M.L Rajore (2009) asserted in their study 'Overcoming institutional barriers to biomass power in India'

Biomass is the ideal source of fuel for the power generation in India. Coal and fossil fuels are depleting. There are several barriers such as institutional and technical to the usage of non-renewable sources of energy. The production of biomass involves a specific process. There are security and food issues that take place in the country due to the production of biomass. India's population is increasing in order to meet the demand the production of biomass increases. There is increasing demand and to meet the institutional arrangements in the application of biomass energy. The usage of the bio energy is meets the demand in a sustainable manner. The increasing demand is rapid.

The advantage of biomass energy is mainly in developing countries because of the requirement of infrastructure development. The need of biomass energy in

rural areas is to fulfill the household demand of the energy. The primary motive of biomass is significantly decreasing. Power generation is done by biomass energy. There are barriers in the consumption of biomass. Firstly, There is no adequate supply of biomass at an economical price. Secondly, The market of biomass energy is not organized. Thirdly, It is seasonal in nature. Fourthly, The density of biomass is low. There are a lot of farms. Biomass electricity generation competes with other uses of biomass. The sources of supply for construction materials such as bricks and roofs. The household income is low. The sugarcane farming in India requires better irrigation facilities.

Delving into one study conducted by N.H. Ravindanath, Somanshekhar and Jayasheela Reddy(2000) at the Indian Institute of Science, Bangalore, on the performance of a gasified in the village of Hosahalli, Karnataka, a 20kw generator was used for lighting the village along with a provision of drinking water supply was provided using biomass electricity since the year 2000, catering to electricity needs of the village, 85 per cent of the time for the past six years. The study conducted is secondary study according to that an analysis is drawn. Mainly household purposes are to be fulfilled with minimum carbon emissions. Consumption of fossil fuels is to be reduced. It is the threat to the environment if incase we continue to use non-renewable resources for daily consumption needs. There are gas emissions that create carbon emissions. There is energy supply and demand to interacting with each other. It is used in both primary and secondary activities. The usage of biomass has decreased the energy prices and the total effects on the total energy. The figures are given in the figure that delves the following results.

The measurement of the energy intensity is to be measured which states that in Asia; Most of the continents require renewable energy to carry out household activities. There are exports of biomass energy. It reduces the carbon emissions. It increases efficiency in the energy. The planning of sustainable development has lead to the era of industrialization in India and other developing countries. There are a lot of reasons for switching from coal to biomass energy. Firstly, it is the poor quality of the coal does not help to satisfy the need of the household needs of people. Secondly, there is a rise in oil imports. Thirdly, There is natural gas demand due to that energy related land degradation. Water storage is also an issue. Coherent, It is an integrated policy. Fossil fuels driven energy system that is due to the renewable energy usage has increased.

Planning leads to the depletion of fossil fuels. The capacity is building and policy is shifting in the plans. There is a rise in solar energy rise. All the energies are increasing. The energies such as wind energy and solar energy are also gaining importance. Local employment has also increased during these years.

### III. RESEARCH METHODOLOGY

In this chapter research methodology is defined, the research methodology used is secondary study. First, There is a brief about the quantitative data and secondary study that explains the statistical method and tools used. Second, it helps gain a perspective on various collection methods used. Third, it outlines the research process as to how is the research conducted.

#### A. Definition of Quantitative Data and Secondary Study

It is a method wherein the research involved uses statistical tools for the analysis of the outcome using computing techniques or software like MS excel 2010 or Statistical package for the social sciences. It makes the vision clearer and better for the analysis.

To give an overview of the research methodology used is considered so that the relation between different variables is drawn out to a valid conclusion. Quantitative research process is used in order to link different variables of research together.

Secondary study refers to the study conducted on the basis of the data collection from various sources. In this research project, the sources that are mainly taken up are previous studies and the data is from various websites that have been approved by the Government.

The data is collected from the reliable sources such as UNDP, MNRE etc. Secondary study is conducted on the basis of which the data is analyzed using multivariate regression. There is also a pie chart, which represents the distribution of energies. It helps in providing the direction as to how effective have these energies been in the past. Biomass energy is taken as a primary energy and is compared to the total usage of the energies to draw a conclusion to the consumption of the energies.

The representation of the data is in a table wherein the energy consumption of states and union territories is indicated in India. It is to analyze the potential of each energy source. The data is then represented in the form of pie chart. Pie chart is a representation of the data that is converted to percentage in order to see the share of each and every sector. Here the pie chart representation is done to observe hydropower, wind power, solar power and biomass energy.

Multivariate regression is basically a statistical tool which used incase there are more than one variable to be compared to. It is generally done to draw out a conclusion of the various variables available. The variables can be in two forms one is dependent and the other is independent. It is important to analyze the impact of the variable to find out a valid and clear conclusion.

To evaluate the role of biomass energy and other renewable energies in India the statistics model of multivariate regression is run in excel. To facilitate an easy and clear picture of the usage pattern the model was developed in MS Excel, 2010. MS excel contains a tool set due to which a program can be run that helps in the outcome analysis. This study involves the usage of the statistical tool pack that provides the research with the outcome of the regression and pie chart of the data that was picked by the UNDP website. Further, the data had to be cleaned as there were several energies as to which the data was found missing on one source and was compared with the other.

The research paper shows a flexible usage of the model due to which the results can be crossed checked and reliability of the data improves further. The data available is the cross sectional data due to which the usage of several models is not possible. It is important to conduct an in-depth study on the results of the model. The results provide us with various values like T-stat, Chi square value, R-square value and P-value.

The rationale behind choosing the topic is dying need to switch to renewable sources of energy to fulfill the goal of sustainability in the long run. The major concern is to realize the importance of biomass in India due to its huge population and energy consumption. Number of barriers is technical, institutional, regulatory and financial. The reliability of the data is considered to be of prime importance due to the sensitivity of the issue. It is important for the country to restore renewable energy sources. The Government has built up policies and has laid emphasis on the power generation. It is important for the sustainability and environmental balance. The main aim of biomass is power generation in different states. It has alternative uses such as husk, rice, coconut and saw dusk. It is important to analyze whether biomass is serving as a cost effective measure or not. The main aim is the promotion of the technologies. It is helping in the growth and development of the country. The small hydropower conversion is in the states such as Karnataka and Tamil Nadu. It reduces the environmental pollution and helps in maintaining clean air. It prevents the industrial wastes to decay. There are few repercussions to the usage of the biomass energy that is it is not cost effective. The installation cost is high due to which the usage of the energy is reduced in the long run. India being a developing country witnesses a problem of poverty.

#### B. Data Collection

The data is collected from various websites like UNDP, MNRE and other sources like journals, research papers, case studies and books. The related information could be found on the Government websites due to the regular census happening in the country. The data for every five years is available. It is important to study the trend of different states and union territories for the comparison between specific timeframe.

An extended study has been conducted by giving a great importance to the literature review. There are about 28 research papers from authentic sources to gain a clearer perspective on the topic. All the research papers have been selected out of renowned journals and books. There are citations available on these topics of sustainable development due to the major part of the economy is witnessing a problem of drainage of the resources. The country has a dire need to shift to the renewable energy sources to fulfill the goal of sustainable development. The information is accessible free of cost due to that it becomes very convenient. Each literature review is minimum of about 500 words. It gives an insight into the data analysis and helps gain a better perspective towards the energy sources of the country.

It is done to achieve the sustainability goals. The sustainability goals are to be achieved by 2020. The paper focuses on the overall growth of the economy. The sources of energy that can be used are to be studied. The power generation is done by biomass energy. It is important for the growth of the biomass energy to maintain a cost effective method of production. It is used for the industrial, commercial and household purposes.

The alarming use of renewable energies makes it the way interesting to study this topic. Government encourages the development of the renewable energies and the information is easily accessible on the sites. There are various renewable energies that are available in India by conducting this study the potential of biomass is to be brought in light. Biomass energy is available and is cheaper. The aspects of various energies are weighed in order to understand the importance of biomass.

The research project contains a detailed analysis of renewable resources. The research paper shows a flexible usage of the model due to which the results can be crossed checked and reliability of the data improves further. The data available is the cross sectional data due to which the usage of several models is not possible. It is important to conduct an in-depth study on the results of the model.

Secondary study is conducted on the basis of which the data is analyzed using multivariate regression. There is also a pie chart, which represents the distribution of energies. It helps in providing the direction as to how effective have these energies been in the past. Biomass energy is taken as a primary energy and is compared to the total usage of the energies to draw a conclusion to the consumption of the energies.

A key feature of the study is to study the trend of the renewable energies and promote them by putting a way forward into the matter. The percentage of the energies gives an insight into the matter of concern that is the percentage of biomass ranges below five percent. Secondly, there is an application of the multivariate regression being carried out. It

is one of the major objectives to lay down emphasis on the renewable sources of energies. The major concern is to realize the importance of biomass in India due to its huge population and energy consumption. Number of barriers is technical, institutional, regulatory and financial. The reliability of the data is considered to be of prime importance due to the sensitivity of the issue. It is important for the country to restore renewable energy sources. The Government has built up policies and has laid emphasis on the power generation. It is important for the sustainability and environmental balance. The target of biomass energy is devising strategies for the electricity-based generation. Sustainable development is observed in the country after the usage of biomass energy.

In India, there is a transparency in the maintenance of the data on the sites that are accessible to every citizen of the country. The policies in favor of renewable sources are MNRE schemes. Firstly, It is providing fiscal incentives to the country. Secondly, Research and development is gaining pace. Thirdly, the Government is planning the provision of the hydropower plant in different states.

#### *C. Research Process*

There are various deductive and inductive methods used to study the data and information available on the sites of Government to broader the horizon on the most discussed topic these days. There are various theories taken into consideration to make the understanding of the topic clearer. It is to make the data understandable by using statistical tools.

There are observations taken into consideration which are to be analyzed using the concepts of MS excel. The interpretation and conclusion is to be drawn out in a way that it is understandable and fulfills the objective of the study. The way that is selected is grounded theory. Grounded theory refers to the concept that is based on the previous experiments, surveys, interviews, results and data available. The notions that were previously available are given due importance and further analyze is conducted on the basis of that.

## **IV. DATA ANALYSIS**

This chapter focuses on analyzing and interpreting the results using various statistical tools. There are different figures such as table and pie chart used to show the data. The introduction of each figure is given below. The interpretation is done accordingly. The major concern is to realize the importance of biomass in India due to its huge population and energy consumption. Number of barriers is technical, institutional, regulatory and financial. The reliability of the data is considered to be of prime importance due to the sensitivity of the issue. It is important for the country to restore renewable energy sources. The Government has built up policies and has laid emphasis on the power generation. It

is important for the sustainability and environmental balance. The main aim of biomass is power generation in different states. There is a detailed analysis carried out further to give

a better insight of the data. The figures that have been used are to give a basic idea of the renewable energy sources in India.

S.NO.	States/ UT's	Wind Power	Hydro power	Solar Energy	biomass	Total
1	Andhra Pradesh	14,497	978	38,440	1,001	54,916
2	Arunachal Pradesh	236	1,341	8,650	8	10,236
3	Assam	112	239	13,760	220	14,330
4	Bihar	144	223	11,200	992	12,559
5	Chhatisgarh	314	1,107	18,270	260	19,951
6	Goa	-	7	880	26	912
7	Gujarat	35,071	202	35,770	1,683	72,726
8	Haryana	93	110	4,560	1,707	6,470
9	Himachal Pradesh	64	2,398	33,840	144	36,446
10	Jammu & Kashmir	5,685	1,431	111,050	43	118,208
11	Jharkhand	91	209	18,180	100	18,580
12	Karnataka	13,593	4,141	24,700	1,581	44,015
13	Kerala	837	704	6,110	1,080	8,732
14	Madhya Pradesh	2,931	820	61,660	1,442	66,853
15	Maharashtra	5,961	794	64,320	3,424	74,500
16	Manipur	56	109	10,630	15	10,811
17	Meghalaya	82	230	5,860	13	6,185
18	Mizoram	-	169	9,090	3	9,261
19	Nagaland	16	197	7,290	10	7,513
20	Orissa	1,384	295	25,780	268	27,728
21	Punjab	-	441	2,810	3,517	6,768
22	Rajasthan	5,050	57	142,310	1,101	148,518
23	Sikkim	98	267	4,940	2	5,307
24	Tamil Nadu	14,152	660	17,670	1,671	34,152
25	Telangana	-	-	20,410	-	20,410
26	Tripura	1	47	2,080	3	2,131
27	Uttar Pradesh	1,260	461	22,830	3,043	27,593
28	Uttarakhand	534	1,708	16,800	29	19,071
29	West Bengal	22	396	6,260	544	7,222
30	Andaman & Nicobar	365	8	-	-	373
31	Chandigarh	-	-	-	6	6
32	Daman and diu	4	-	-	-	4
31	Delhi	3	-	2,050	131	2,181
34	Lakshwadeep	-	-	-	-	-
35	Puducherry	120	-	-	3	123
36	Others	-	-	790	1,022	1,812
37	<b>Total</b>	<b>102,772</b>	<b>19,749</b>	<b>748,990</b>	<b>25,090</b>	<b>896,602</b>

Fig 1:- Renewable energies in states and union territories

Source: Data is collected from UNDP, 2017

The table illustrates the energy consumption of five years. The source of the data is United Nations development Program. There are four energies taken up that are hydropower, wind energy, solar energy and biomass energy. The impact of biomass energy is to be analyzed.

There are a total of 37 states and union territories. There are the statistics of four energies that is given wind power, hydropower, solar energy and biomass energy. The mostly used energy is wind power and least used energy is hydropower. The wind energy is mostly used in Maharashtra. Hydropower is mostly used in Uttarakhand due to the regional availability. Solar power has the highest consumption in Jammu and Kashmir whereas maximum consumption of biomass is in Punjab.

The total of all the energies suggests that in a labor abundant country like India there is a huge requirement of the energies. It needs renewable energies to fulfill its requirements. A strong and huge base is required for the manufacturing industries to be able to produce the required materials. The Government of India is laying emphasis on the usage of the renewable energies. It is recommended to use renewable energy instead of non-renewable energies so that it prevents the depletion of the energies. This project of renewable energy is taking a turn due to number of developed countries are following this model.

India ranks fifth in the consumption of the energy wherein wind power is taken into consideration. There are several new objects taken up to encourage the production of renewable energy in India wherein the population is increasing at an increasing rate. There is a steady rise in production of the solar power in the country.

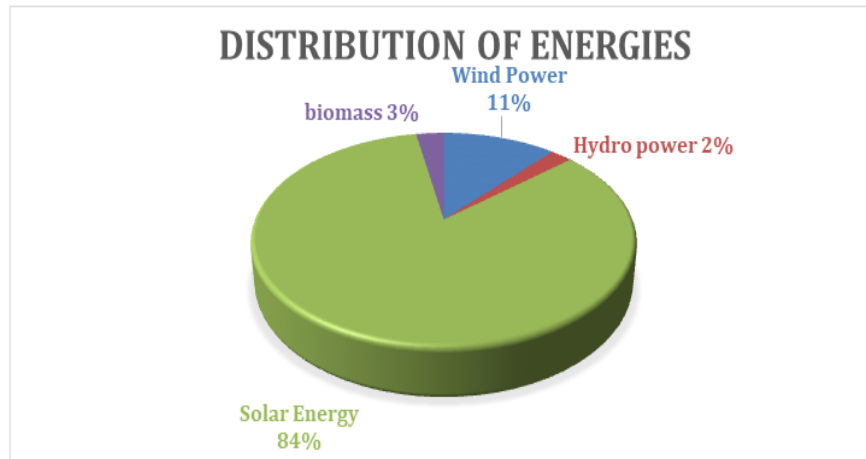


Fig 2:- Distribution of energies in India during 2013-18

The pie chart given below represents the distribution of energies in states and union territories of the country. There are four types of energies taken up as a source of renewable energy source. The energy, which is mostly used, is solar energy that is eighty four percent of the total. Then is the wind power that is eleven percent, and then is biomass energy is about three percent and merely two percent is hydropower.

The representation of the data is in a table wherein the energy consumption of states and union territories is indicated in India. It is to analyze the potential of each energy source. The data is then represented in the form of pie chart. Pie chart is a representation of the data that is converted to

percentage in order to see the share of each and every sector. Here the pie chart representation is done to observe hydropower, wind power, solar power and biomass energy.

The distribution of the energies is between different states of the country and union territories that is the renewable energy sources are encouraged but it mainly solar energy gaining momentum due to the potential to save in the long run. The cost of installation makes it difficult for the country like India to rely more on the solar power. The experience of the biomass energy in India has been for a few years still the percentage is very bleak due to the installation is not put to use.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.35
R Square	0.13
Adjusted R Square	0.07
Standard Error	962.27
Observations	36.00

ANOVA

	df	SS	MS	F	Significance F
Regression	2.00	4,369,292.94	2,184,646.47	2.36	0.11
Residual	33.00	30,556,799.06	925,963.61		
Total	35.00	34,926,092.00			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	513.57	197.49	2.60	0.01	111.78	915.37	111.78	915.37
X Variable 1	0.05	0.02	1.96	0.06	0.00	0.10	0.00	0.10
X Variable 2	0.08	0.20	0.42	0.68	0.33	0.49	0.33	0.49

Fig 3

Source: Regression analysis

The table illustrates the values of the regression that is run in excel. The variables can be in two forms one is dependent and the other is independent.

To evaluate the role of biomass energy and other renewable energies in India the statistics model of multivariate regression tells that the value of T-stat and P value. The value of T-stat is 2.60 that is showing this model rejects the null hypothesis.

There are two types of variables taken into consideration one is dependent and the other is independent. It is basically to see the effect of dependent variable in the independent. There are dependent variables that are hydropower, wind energy and solar energy consumption in various states and union territories in India during the last 10 years. The dependent variable is the total of all the energies in order to draw out the conclusion. The data has been taken from United Nations Development Program website. The data is of five years of states and union territories.

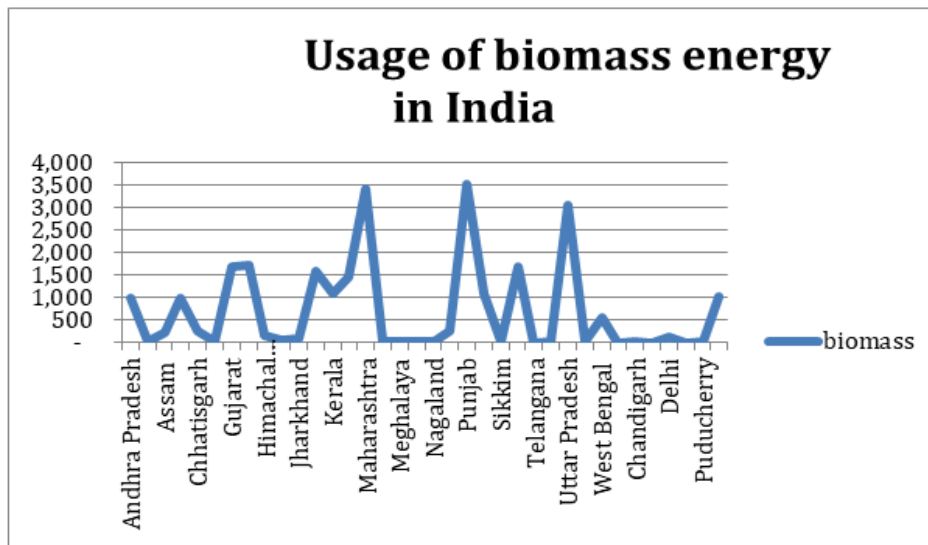


Fig 4:- Usage of Biomass energy in different states of India

Note: Clustered trend analysis

The line chart illustrates the usage of biomass in different states and union territories in India. According to the chart, maximum consumption of the energy is in Maharashtra and minimum is in Goa. Biomass has had a huge impact on the economy of the country due to its population. It is important for the country to restore renewable energy sources. The Government has built up policies and has laid emphasis on the power generation. Biomass energy fulfills the requirements of rural and urban sectors. The main aim is the reduction of the production costs. It helps in decreasing the demand for the petroleum. It is a cheap source of energy. There is a large store of capacity of renewable energy. The population of the country is increasing at an increasing rate. It is important for the economy to grow as a whole.

The use of biomass energy is improving infrastructure. The biomass requirement for the power plants is considered to be optimal source of electricity generation. Mostly this renewable source of energy is used in the households to fulfill the domestic needs and in the industries. There is a

significant improvement in the agricultural areas and the employment opportunities have risen. The participation of women has also shown improvement.

Biomass is the oldest and renewable source due to that the carbon particles are reduced. It has viewed as a source to replace the non-renewable sources such as petrol, Natural gas and coal. Biomass potential is larger than any other source due to its availability and carbon structure. The process of production is cheaper and raw materials are easily available. The contribution of the energy is that it is primary energy demand. The utilization of the biomass fuel offers employment opportunities to the people in the rural areas. There are advantages and disadvantages of employing rural people. The sources of the biomass for energy production are huge.

It is heterogeneous in nature. There is an increase in the moisture due to the drying of the wood. It is essential for the effective heat release. There is an increase in the agriculture residues that are husk, rice, straw etc. The principal crop residue is cotton stalk that is attractive.

## V. CONCLUSION

The paper focuses on the impact of the biomass energy in various states of India depending on its availability and utilization. There are various statistical measures that are being used to measure the effectiveness of biomass energy in the country.

The alarming use of renewable energies makes it the way interesting to study this topic. Government encourages the development of the renewable energies and the information is easily accessible on the sites. There are various renewable energies that are available in India by conducting this study the potential of biomass is to be brought in light. Biomass energy is available and is cheaper. The aspects of various energies are weighed in order to understand the importance of biomass.

The research project contains a detailed analysis of renewable resources. The research paper shows a flexible usage of the model due to which the results can be crossed checked and reliability of the data improves further. The data available is the cross sectional data due to which the usage of several models is not possible. It is important to conduct an in-depth study on the results of the model.

Secondary study is conducted on the basis of which the data is analyzed using multivariate regression. There is also a pie chart, which represents the distribution of energies. It helps in providing the direction as to how effective have these energies been in the past. Biomass energy is taken as a primary energy and is compared to the total usage of the energies to draw a conclusion to the consumption of the energies.

A key feature of the study is to study the trend of the renewable energies and promote them by putting a way forward into the matter. The percentage of the energies gives an insight into the matter of concern that is the percentage of biomass ranges below five percent. Secondly, there is an application of the multivariate regression being carried out. It is one of the major objectives to lay down emphasis on the renewable sources of energies. The major concern is to realize the importance of biomass in India due to its huge population and energy consumption. Number of barriers is technical, institutional, regulatory and financial. The reliability of the data is considered to be of prime importance due to the sensitivity of the issue. It is important for the country to restore renewable energy sources. The Government has built up policies and has laid emphasis on the power generation. It is important for the sustainability and environmental balance. The target of biomass energy is

devising strategies for the electricity-based generation. Sustainable development is observed in the country after the usage of biomass energy.

There are very strong drivers for the impact of biomass on the growth and development of the country. It has been observed that biomass is the oldest and renewable source due to that the carbon particles are reduced. It has viewed as a source to replace the non-renewable sources such as petrol, Natural gas and coal. Biomass potential is larger than any other source due to its availability and carbon structure. The process of production is cheaper and raw materials are easily available. The contribution of the energy is that it is primary energy demand. The utilization of the biomass fuel offers employment opportunities to the people in the rural areas. There are advantages and disadvantages of employing rural people. The sources of the biomass for energy production are huge.

To evaluate the role of biomass energy and other renewable energies in India the statistics model of multivariate regression is run in excel. This study involves the usage of the statistical tool pack that provides the research with the outcome of the regression and pie chart of the data that was picked by the UNDP website. Further, the data had to be cleaned as there were several energies as to which the data was found missing on one source and was compared with the other.

There are two types of variables taken into consideration one is dependent and the other is independent. It is basically to see the effect of dependent variable in the independent. There are dependent variables that are hydropower, wind energy and solar energy consumption in various states and union territories in India during the last 10 years. The dependent variable is the total of all the energies in order to draw out the conclusion. The data has been taken from United Nations Development Program website. The data is of five years of states and union territories.

It is recommended to increase the reliability on renewable energy. India ranks fifth in the consumption of the energy wherein wind power is taken into consideration. There are several new objects taken up to encourage the production of renewable energy in India wherein the population is increasing at an increasing rate. There is a steady rise in production of the solar power in the country.

Government can imply a policy that particularly promotes the usage of renewable energy. It will prove to be better for the environment in the long run and it will enhance the quality of living. It is the need of the hour to do this.



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