A Study on Climate Change Mitigation and Adaptation Initiatives in Energy Sector in the state of Karnataka

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Abstract - Rising temperature, flooding cities, continued drought a phenomenon that has become a daily affair is the result of climate change. On earth human activities are changing the natural greenhouse. Over the years the burning of fossil fuels like coal and oil have increased the concentration of Carbon dioxide in the atmosphere. The expansion of human civilization and industrialization, agricultural activities, and deforestation has released higher quantities of greenhouse gases. It is high time for the Governmental agencies and the human society to respond to these impacts. In this context, the mitigation and adaptation activities play a major role. Government of India has taken up several initiatives domestically which are not necessarily dependent on global climate change actions. India has developed National Action plan on Climate Change (NAPCC) in 2008 at the national level to combat the impacts of climate change.

Key words: Climate Change, Energy, mitigation, adaptation

I. INTRODUCTION - CLIMATE CHANGE

Rising temperature, flooding cities, continued drought… a phenomenon that has become a daily affair is the result of climate change. On earth human activities are changing the natural greenhouse. Over the years the burning of fossil fuels like coal and oil have increased the concentration of Carbon dioxide in the atmosphere. A lesser contribution is also made by deforestation and other human activities in increasing the levels of carbon dioxide. Increased levels of carbon dioxide can influence plant responses to limit water, light and nutrient availability and other environmental factors (IPCC report). The expansion of human civilization and industrialization, agricultural activities, and deforestation has released higher quantities of greenhouse gases. It is high time for the Governmental agencies and the human society to respond to these impacts. In this context, the mitigation and adaptation activities play a major role. The working group of SRREN presents an assessment based on the literature of scientific, technological, environmental, economic and social aspects of contribution of various sources of renewable energy to mitigate climate change. The report reflects the demand for energy and other allied sectors for human development. This demand is met by nonrenewable sources mostly which contribute to increasing levels of greenhouse gas emissions.

Causes of Climate Change

The Earth's climate system works on a simple mechanism, the sun's energy is reflected off the earth and reflected back into space. This energy gets trapped in the atmosphere due to the presence of greenhouse gases leading to warmer planet. This process is influenced by both natural and human induced factors.

Natural causes of climate change

Our planet has experienced warmer and cooler phases in the past even before the evolution of the humans on earth. Some of the major forces which contributed to climate change are:

Volcanic eruptions: Volcanic eruptions release a large amount of sulphur dioxide, water vapour, dust and ash into the atmosphere, trigger climate change by increasing planetary reflectivity causing atmospheric cooling. There are around 500 active volcanoes on earth, leading to 40-50eruptions during a year. Volcanic eruptions produce hazardous effects for the environment, climate and the health of the exposed persons. Further it affects the water quality, damages crops and there by leads to deterioration of social and economic conditions. **Sun Intensity:** The energy from the sun is the ultimate source of energy of earth's climate system. A minor change in these energy levels will lead to changes in earth's climate system. Changes in the sun's energy output can cause climate to become warmer during periods of stronger solar intensity and cool during periods of weaker solar intensity.

Human Induced factors

One of the major reasons for global warming is greenhouse gases. The increase in GHG is linked to level of human

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activities, which also believed by most scientists around the world. The massive use of **fossil fuels** is the main source of global warming. Burning coal, oil and gases produces carbon dioxide which is the major contributor along with nitrous oxide. Trees help in absorbing the this carbon dioxide in the atmosphere, but due to **excessive deforestation** this positive effect is also lost and cutting of trees will lead to release of CO2 stored in trees into atmosphere further warming the planet. Another reason for global warming is **intensive farming** not only with the ever increasing livestock but also plant protection products and fertilizers. The livestock produces large amounts of methane when digesting their food , while fertilizers produce nitrous oxide emissions .Other forces like **unscientific waste management methods , large scale mining activities and overconsumption of natural resources** have contributed significantly for global warming and there by climate change

India and Climate Change

Climate variations and change caused by external forcing's predictable because of human induced activities such as emission of greenhouse gases. The effects of climate change are expected to be greater in the developing world, especially in countries which are more reliant on primary production for major income. Geographical features of India make it more vulnerable to the impacts of climate change. Government of India has taken up several initiatives domestically which are not necessarily dependent on global climate change actions. India has developed National Action plan on Climate Change (NAPCC) in 2008 at the national level to combat the impacts of climate change. This initiative is driven by having missions for various sectors which are more vulnerable to the impacts of climate change. Even the Intended Nationally Determined Contribution (INDC) have stressed on the need for better investments in developing mitigation and adaptation activities for India. As NAPCC was established adopted at national level, the state governments were expected to come up with their State Action Plan on Climate change.

Objectives of the Study

1. To understand the impact of climate change on the Energy sector in Karnataka
2. To study the various mitigation and adaptation initiatives in Energy sector undertaken by government of Karnataka

II. METHODOLOGY

The proposed study aims to study the mitigation and adaptation initiatives undertaken by the government of Karnataka to combat the impacts of climate change in energy sector. The study is based on the secondary data available from various government and non-government agencies.

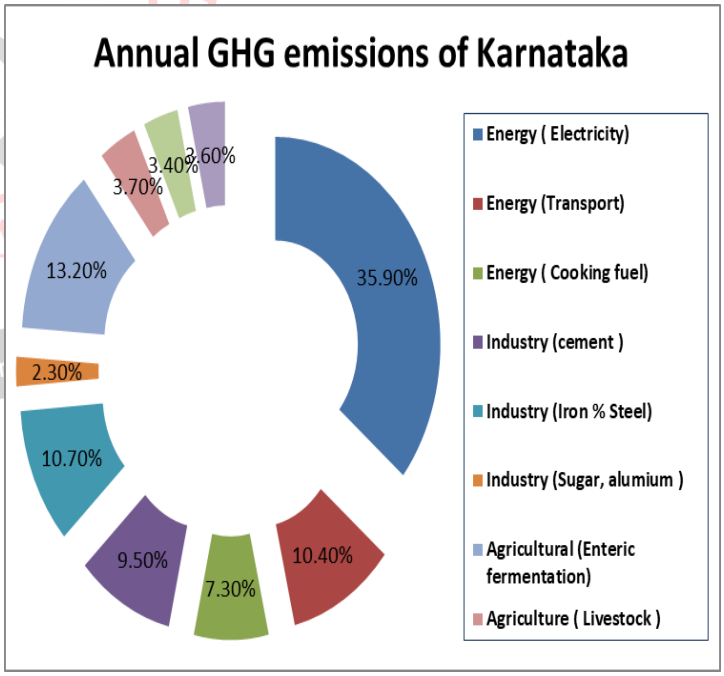
III. ANALYSIS AND DISCUSSIONS

Karnataka's State Action Plan on Climate Change

In line with this requirement, the state of Karnataka has prepared "Karnataka State Action Plan on Climate Change". This document provides a detailed analysis of climate data of the state and has stated that the temperature in the northern districts have risen over a period of 100 years. The report also highlights the decline in rainfall experienced in north eastern and south western parts of the state. A warming trend has been observed for the period June to September in northern interior Karnataka. Both the minimum and maximum temperature was found to have risen by up to 0.6% over the last 100 years. The report has inferred that the overall reduced precipitation and continuous warning is possible probable scenario for Karnataka.

The report also provides a comprehensive detail of the greenhouse gas emissions of the state. In Karnataka, annual emissions of major greenhouse gases are estimated to amount to 80million tons, out of which 73% is of carbon dioxide, 23% of methane and 3.3% of nitrogen.

Figure 1: Annual Sectorial GHG emissions of Karnataka



Source: SAPCC of Karnataka

In terms of sectorial distribution, electricity generation accounts for 35.9% of annual GHG emissions, industry for 22.6%, agriculture and allied sectors for 20.2%, transport for 10.4%, households (excluding electricity) for 7.3% and waste for 3.6%.

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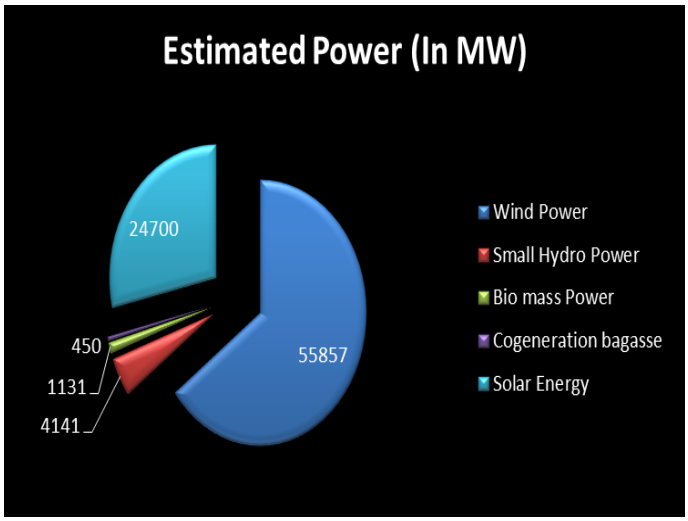
Figure 2: Karnataka's Estimated Potential of Renewable Power as on 31/03/2018 (in MW)



❖ **Source : Energy Statistics 2019**

The above figure indicates the estimated potential of Renewable Power in the state of Karnataka. It is evident from the figure that, there is large potential in wind and solar energy sector for growth. The state has all the pre-requisite to become self-reliant in energy generation from renewable sources.

IV. ENERGY SECTOR

Government of India's climate actions are mainly focused on addressing issues such as improving energy security, greater energy access and reducing expensive energy imports. Concerns surrounding energy have compelled the government to look at renewable energy and policies stemming from such concerns have resulted in addressing the challenges of climate change as a co-benefit. Karnataka a state with bigger potential for harnessing renewable energy has an installed power generation of 9702MW excluding power plants governed by centre. Better access to energy multiplies the ability of an economy to scale up development. In this context, the Energy sector of Karnataka has undergone a transformation and moved from energy deficient to energy surplus state today. The state has issued "Renewable Energy Policy 2009-14 "followed by the "Solar Policy 2014-2021".The renewable policy enabled capacity addition of 2104 MW during 5 years. Considering this huge untapped potential for renewable energy, the state initiated the Solar Policy which sets aggressive solar capacity additions targets for the coming years.

Karnataka Renewable Energy Development Limited (KREDL) is the nodal agency for promotion for renewable energy and energy efficiency.

Major Mitigation and Adaptation Initiatives in Energy Sector

1) Promoting Solar Energy

Renewable energy plays a twin role by tackling climate change while improving energy access and energy security. It has vast carbon potential and is a key option for mitigating climate change impacts. Karnataka is endowed with potential for wind, solar and hydro power. Karnataka has about 86792MW of estimated Renewable energy potential, making it one of the country's top five RE rich states. Karnataka has an installed electricity generating capacity of about 33282.15MW out of which 13942.37 MW is from RE sources. In wake of this potential, The Karnataka Renewable Energy Development Limited has taken a lead and prepared the Renewable Energy Policy 2009-2014, followed by Solar Policy 2014-2021.The policy assesses Karnataka's renewable energy potential as 10,000 MW2 for solar energy and 18,500 MW3 for other forms of renewable energy. The presently installed capacity of 2,987 MW constitutes about 10.5% of the combined potential.

Highlights of the Karnataka Renewable Energy Policy

- Increase renewable installed capacity from 2,400 MW to 6,600 MW by 2014. This implies increasing the share of renewable energy in the electricity mix from 11.5% to 20% by 2014.
- Saving 7,900 million units of energy (equivalent to 900 MW of installed capacity) over the five-year period through effective measures of energy conservation and energy efficiency.
- Creation of a Green Energy Fund through a cess of INR 0.05 per kWh for commercial and industrial consumers to generate about INR 55 crore annually
- Increase wind power installed capacity from 1,121 MW to 3,500 MW by 2012 (contributing about 8,260 million kWh per annum) and 7,500 MW by 2018 (contributing about 17,700 mn kWh/a)
- Increase installed mini and small hydro capacity from the current 416 MW to 900 MW by 2012 (contributing 2,754 mn kWh/a) and 1,500 MW by 2018 (contributing 4,590 mn kWh/a)
- Increase grid-connected solar PV and thermal power generation capacity to 200 MW by 2012 (about 290 mn kWh/a) and 1,000 MW by 2018 (about 1450 mn kWh/a).

2) Solar Rooftops

Unutilised space on rooftops and space around buildings provides a large collective potential for generating solar power. Keeping this potential in

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mind, the government of Karnataka has devised a policy for solar rooftop within the Solar Policy. This helps the small quantities of power generated by each individual household, industrial building, commercial buildings or any other building to partially fulfil the requirement of the building occupants and to feed any surplus availability to the grid. The concerned authority, BESCOM in case of Karnataka will purchase this surplus power at the prescribed tariff through Power Purchase Agreement (PPAs) which are executed for a period of 25years. The government of Karnataka has planned to achieve 2.3 GW of rooftop solar by the year 2022.

3) Solar Parks

Barren unutilised land, open unutilised space on rooftops of individual household, industrial building, commercial building or any other type of building provide large potential for generating sola power completely/partially fulfilling the requirement of the building occupants or surplus. The solar park concept is essentially to optimize the infrastructure cost incurred by Solar PV power projects. The cost of infrastructure varies in Solar PV power projects in terms of Land, connectivity, power evacuation etc. The aim of this initiative is to reduce the cost of solar power generation in the country and to achieve grid tariff parity by the year 2022 through long tern policy measures, large scale deployment goals, aggressive R&D and Domestic production of critical raw materials, components and products.

MNRE has proposed for development of Solar Parks and Ultra Mega Solar power projects to achieve development of one lakh MW of solar projects in the country.

Under this scheme for development of solar Parks in Karnataka, a JV company "M/s. Karnataka Solar Power Development Corporation Ltd (KSPDCL)" has been formed by KREDL and SECI. 11,000 acres of land has been identified at Pavagada Taluk in Tumkur District, Karnataka for this purpose.

4) Solar water heating

In order to facilitate the implementation of the Energy Conservation Act, 2001 Government of Karnataka notified in 2007 the mandatory use of solar water heaters, CFLs, ISI marked motor pump sets and integration of energy efficiency and renewable energy in new buildings.2 The use of solar water heaters was made mandatory for a wide range of establishments within municipal corporations in the same year. The notification covers hospitals, hotels, canteens, housing complexes and residential buildings with a built-up area of at least 600 ft2 on sites measuring 1,200 ft2 and above, all government buildings and even industries with water heating requirements.

5) Energy efficiency

The Karnataka Renewable Energy Policy also sets a strong emphasis on energy efficiency. It aims at conserving nearly 8,000 million kWh of electricity in the five-year period, equivalent to the avoidance of roughly 900 MW of generation capacity. Interventions to achieve this include energy efficient appliances, energy efficient building designs, which are commonly referred to as demand side management (DSM). Interventions also extend to reducing transmission losses, which is a supply-side measure. Energy audit and adopting energy efficiency measures are prescribed as mandatory for industrial and commercial installations of 600 kVA of contract demand and above.

The policy aims to facilitate the implementation of the Energy Conservation Act 2001, for which KREDL has been notified as designated agency. The following programmes are scheduled under the policy for energy conservation:

- SME Programme: Energy efficiency improvement in small and medium enterprises.
- Work Bright Programme: Commercial high-efficiency lighting programme (CFLs/LED lamps/solar lighting).
- Motor Renewable Energy Power: High efficiency motor rewinding programme.
- Agricultural Efficiency: Energy efficiency improvement in agriculture by modification and retrofitting, star rated pumps/solar pumps, non-metallic PVC/polyethylene pipes for suction and delivery, friction free foot valves.
- Bright Streets: Municipal street lighting programme deploying advanced technology (CFLs, LED lamps, solar, on-off timer).
- Green Buildings Programme: Constructing one or two model "Green Buildings" in each district in accordance with the Energy Conservation Building Code. The concept will be made mandatory for corporate buildings and buildings constructed by developers in city corporations by the amendment of building by-laws.
- Municipal Energy Efficiency Programme: Improvement of energy efficiency in municipal water pumping and for effluents

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In order to measure the effectiveness of mitigation strategies, energy usage is taken as a key indicator. Data around the world, shows that there has been considerable increase in energy demand despite measures to encourage energy conservation. Whitmarsh, L.(2009) has tried to study the actions taken out of climate change concern and energy conservation practices undertaken in UK. The study have revealed a complete diversion between actions prescribed by policy makers and those taken by public to mitigate climate change. It was also noted that, some measures taken to conserve energy is with the motive to save money rather than having environmental impact. These findings reveal that surveys conducted using energy reduction as a measure to indicate the public response to climate change could give wrong implications of the actual facts.

A Study conducted by Andrew and William, reveals that India's struggle between energy demand and supply is exacerbated by the impacts of climate change, where GDP is expected to decrease by 3-9% by 2100 as a result of a 4 degree increase although both energy security and climate change have been the major driving forces for the implementation of policies, regulations and investments in the renewable energy (RE) sector. India's energy demands are projected to sharply increase as it experiences population growth, rapid industrialization and an increase in per-capita consumption. This places a substantial amount of pressure on unsustainable energy sources and the power grid often leading to power shortages due to the demand outstripping the supply. It is anticipated that the country's fossil fuel supply will last around 50 years with current consumption patterns, despite how over 50% of the country has yet to be electrified.

Issues to be tackled **in achieving Energy Efficiency:**

Energy efficiency failed to make substantial inroads.

The concept of Energy audit still has to achieve greater visibility and also professional capacities for the same has to be developed.

The Energy Conservation Building Code (ECBC) is yet to be notified at state level,

The concept of Green Rating for Integrated Habitat Assessment (GRIHA) is also not in force as it is a part of ECBC.

The Market Transformation for Energy Efficiency (MTEE) under the NAPCC are not on the horizon in Karnataka yet.

V. CONCLUSION

From the above study it is very clear that, Karnataka is one the highest renewable power generator in the country. The State being urban and industrialised, can expect a high consistent demand. The state has been able to get the investors' confidence through open access projects and rooftop solar projects. Karnataka state has the highest renewable energy rate that is 27% of its power generation is from renewable energy. Karnataka state has shown great success rate in installation and adaption of renewable energy over the last few years. Here, all the credit goes to Karnataka's renewable energy policies include solar energy plant development, open access, bringing forth hybrid wind-solar development, reduced coal import. The Pavagada industrial solar park in Karnataka is said to be the largest solar power development in the world and the decision of establishing various solar industrial parks has really increased the awareness and the solar panel adaption rate. The state of Karnataka fulfils a significantly high percentage of its energy requirements through the usage of renewable resources and emerges as the country's highest renewable energy producer this year

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