Renewable Energy Development in Indian power Sector for Low Carbon Scenario: a Case Study of Madhya Pradesh

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Abstract: Electricity which is form of energy is one of the driving forces for the development of economy of Indian society. Growth of a state or a nation depends solely on energy consumption and requirement factor. Power plays an important role in the development of agricultural, industrial and commercial sectors which in return brings revenue for the country, Which also portray growing supply/demand gap, inherent inefficiencies, enviromnet unsustanibilty & socio-political influences. Madhya Pradesh is one of the 29 states of india, located in central india. Total installed capacity in 2005 was 6449 MW out of which renewable accounts for two percent. Currently share of renewable energy in MP accounts for 6 percentage This paper computes renewable energy trajectories under future scenarios over a 30 year horizon from 2005 and 2035 and the resultant policy suggestions .it also integrates present evaluation of factors that are likely to penetrate.

Keywords: AIM/Enduse, climate change, power generation, renewables, sustanibilty

1. INTRODUCTION

The Indian power sector is characterized by large demand supply gap . India faces energy inadequacy with increase energy prices and energy insecurity . Renewable which is an upcoming and promoising prospect for the future scenarios which can also lead to be the alternative of conventional energy sources. The total potential of renewables in the country is estimated at 100,000 MW. With this current capacity addition in Indian power sector renewable acconts for 12% were as Till date in Madhya Pradesh 78% of the power is being generated with thermal power plant, hydro accounts for 18% while 6% is being generated by renewable energy sources.

Madhya Pradesh (MP),one of the 29 state of india, is located centrally. Its electricity generation is considerably inclined towards coal based power generation. Capacity of coal based technology increased by 2.3 times from 2005 to 7294 Mega Watt (MW) in the year 2014. Total power generation from Madhya Pradesh was accounted to be 6449.25 MW in 2005, [2] which was nearly 17% of the total power generated in western region and 5% of total power generation in India. Presently, total power generation has increased to 12370 MW in Jan 2014, which is nearly 5.5% of total power generation in India, [3]. In which renewable sources has a share of only 6 percentage.

With this growth in power generation sector, economy of MP has improved and other sectors have enhanced as well. Emission made by coal in MP ranked no. 1 in terms of CO_2 emission with an average annual growth rate of 23.93 percent in year 2008, mean emission was recorded to be 32 million metric tonnes of carbon for the same year [4]. This is one of the major factor which lead to the enhnacment of renewable technology penetration in MP power generation sector. The paper mainly focuses on the total power generation capacity and emission reduction potential for low carbon development up to 2030 with increase in percentage share of renewable energy for the future trends.

Table 1: no. of power generating station available in MP

Power Plant Generation	Coal based	Hydro power based	Renewable based
State Govt owned	4	8	2
Central Govt owned	1	3	0
Private owned	2	0	7

2. SCOPE OF RENEWABLE IN MADHYA PRADESH:

Electricity from renewable sources, such as biomass (combustion and gasification), small & micro hydro-electricity, solar photo-voltaic, solar thermal and even wind power, has grown significantly in the last few years. Currently, Madhya Pradesh has 6 percent power from renewable technologies and is estimated to increase to about 17% in coming few years. Renewable energy sources has a wide scope for the development of power generation sector. Madhya Pradesh receives solar intensity of 5-6.2 Kwh /Km^2/day. Presently 140 MW is been generated by solar PV power plant and expected to increase to about 1900 MW within 2 year span. Wind is widely distributed resources and easily available with an average wind power density equal to or above 200W/m^2 above 50 meter height above ground level. Current capacity of wind power plant is nearly 350 MW and is expected to increase to 2100 MW by 2015 so it become one of the promising sources to meet the power supply demand in grid connected, stand alone system as well in remote applications. Hydro based power generation up to 25 MW capacities, classified as small hydropower, offers a number of advantages for electricity generation. Madhya Pradesh has an installed capacity of nearly 100 MW by small hydro power plant which is estimated to increases by 300 MW by 2015. Bio energy is an ideal form for decentralised power applications as well as grid connections applications. in MP Power generation systems range from small scale (5-100 kW) to medium scale (1-10 MW)biomass power plants are not site specific thus can be installed at any location with surplus biomass availability.nearly 40 MW is generated using biomass.

3. METHODOLOGY

Various technologies were identified to be the past, present and future for Madhya Pradesh power generation trends. AIM/Enduse model is being used for the analysis purpose which is a bottom-up energy model. Originally AIM is an 'integrated top-down and bottom-up' model and AIM/Enduse which is its component model focuses on the end-use technology selection and energy consumption. In this model two scenarios are being taken into consideration namely Business-as-Usual (BAU) and Low Carbon Society (LCS) scenario.

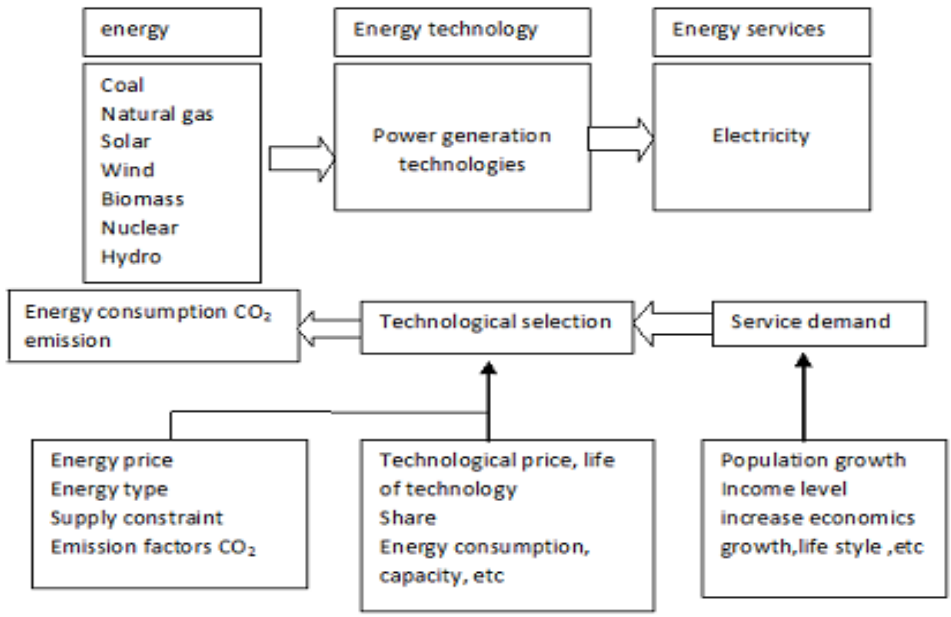

Figure 1: AIM/Enduse structure

A case study for Madhya Pradesh has been taken for a duration of 30 years. Various technology selections were taken into consideration which comprises of technologies used for the power generation namely, fossil fuel, hydro, renewable energy technologies. In the current simulation for Madhya Pradesh, 2005 has been taken as the reference year, and the simulation has been done till the year 2035.

Many diverse data sources were employed since there was no consolidated database available covering all data, these include reports published by government of India, state government, several other government organizations, institutions etc. From these reports, 18 technologies were identified as the most suitable technologies .

Plants' initial cost, operational and maintenance cost efficiency details were taken into consideration for each of the technologies. Specific service output and input for each technology, fuel cost and energy cost were also calculated for each technology, it was seen that specific coal usage at these thermal power plants is less than 0.6 kg/kWh [5].

4. SCENARIO DESCRIPTION:

Two scenarios were made which are business as-usual scenario (BAU) and low carbon scenario (LCA). These two scenarios solely depend on the development path human society chooses in terms of economic, agricultural, and technological growth. Analyses are being made by accounting various parameters like economic growth, population growth, indigenous technology change, energy usage, infrastructure development, sustainable development, etc.

a) Business as usual scenario (BAU)

In business as-usual scenario (BAU) present situation of year 2005, was considered as a base for future calculation and no GHG policy intervention was assumed over the 30 years horizon. Based on previous GDP growth rate, service demand was projected assuming GDP growth with compounded annual growth rate of 5%, population growth data has-been analysed from the past data available

b) Low Carbon Scenario (LCA)

In low carbon scenario (LCA) scenario with baseline as existing policy intervention of high emission taxes on pollution creating gases, energy taxes on fossil fuels, subsidies on clean technologies, etc., was taken into consideration as a major concern for a sustainable development this scenario, deals with high growth rate implementation of carbon taxes were made with a constant tax of Rs.2500/t-C Logistic regression method is used for end-use demand projections for, while maintaining overall consistency with the macroeconomic projections. The demand technology assumptions cover the average energy efficiency of various existing technologies, the future technology spectrum and their characteristics, the penetration levels, prices, etc. Improved versions of existing technologies (retrofit options) and new technologies expected to penetrate are introduced in later years as energy efficient options.

5. RESULT & DISCUSSION

Results obtained for the state level analysis are summarized below:

Two scenarios BAU and LCS were compared under various parameters taking a baseline of the year 2005

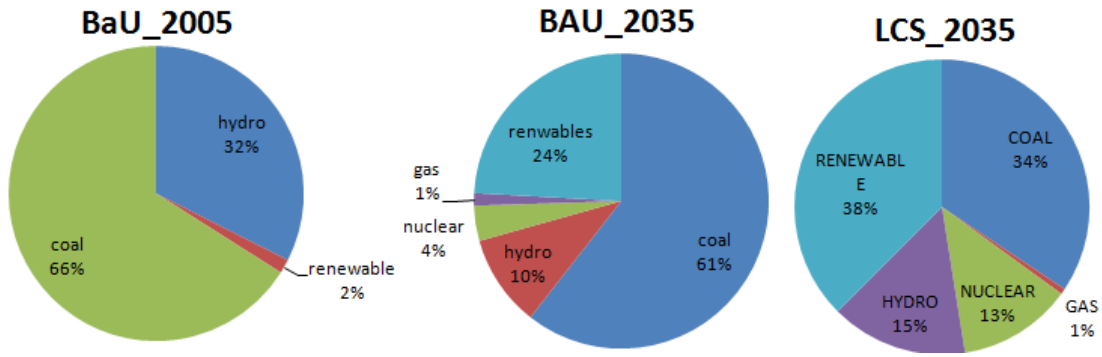

Fig: percentage share of energy in 2035

Fig shows percentage share of various energy source representation for both the scenario BAU and LCS for the year 2035, a demand of 50,387 MW is built up, it is estimated that under business as usual scenario percentage share for coal will be dominating with 61%, whereas increase in percentage share of renewable is creditable with 24% share of hydro is less with 10% nuclear and gas accounts on 4%, 1% respectively, under low carbon scenario with the implementation of carbon taxes there was considerable decline in percentage share of coal is seen with a percentage share of 34%, and a high growth is been seen under renewable with increase in percentage share of 38%, hydro and nuclear percentage share are nearly 15% and 13% respectively, share of gas is less with 1%.

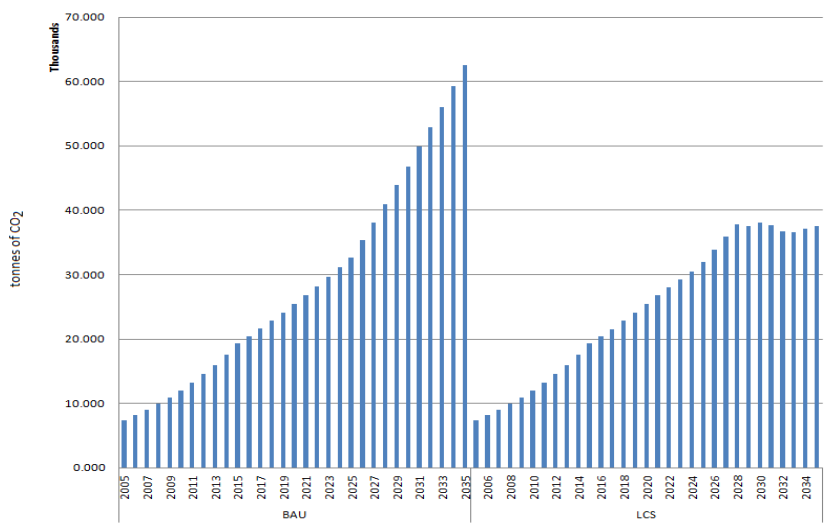

Fig: CO_2 emissions in BAU scenario and LCS scenario

A comparison between two scenarios was made in which it was estimated that in BAU scenario CO_2 emissions in 2035 registered as 62606 '000 metric tonnes and under low carbon scenario (LCS), carbon tax implementation from the year 2015 at a rate of Rs 2500 per tonne which was further increased for each interval of 10 years, helped in reducing CO_2 emission. After implementation of carbon tax and subsidies to efficient and renewable technologies, CO_2 emissions was registered to be 37527 '000 metric tonnes. This implies that there was a decrease in 40 percent of emission noticed when comparing both scenarios.

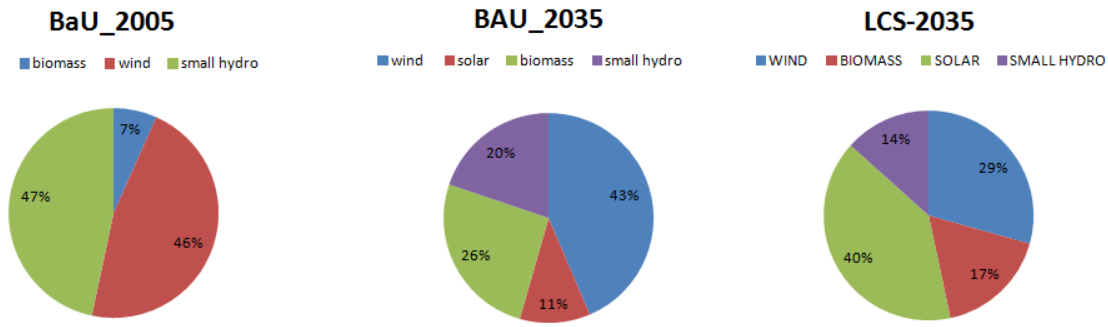

Fig: percentage share of renewable energy in 2035

Fig shows that percentage share for the baseline year 2005 was very low - it accounted only for about 75MW which was increased in the span of 30 years. It was estimated that in BAU scenario renewable accounted to be 12,716 MW, wind accounted 43% share, solar accounted 11% share, whereas biomass and small hydro accounted for 26% and 20% respectively. While in LCS scenario renewable accounted to be 18,892 MW and wind, solar, biomass and small hydro accounted for 29%, 40%, 17% and 14% respectively. This implies that when compared to base year, percentage share of renewable has increased widely.

6. CONCLUSION

The exhaustion of natural resources and the accelerated demand of conventional energy have forced planners and policy makers to look for alternate sources. Renewable energy is energy derived from resources that are regenerative, and do not deplete over time. Renewable energy offers our planet a chance to reduce carbon emissions, clean the air, and put our civilization on a more sustainable footing. This paper is an outcome of an ongoing study that analyzes the future demand and future stock of power generation in terms of primary energy sources for the year 2035 and the emission reduction pattern of carbon dioxide seen with the help of various clean technology selection option. With new and improve central & state Government policies provides subsidy to renewable technologies to promote the use of these sources and reduce the dependence on primary

energy which are carbon emitter. Thus implementation of national action plan on climate change should be encouraged for the usage of alternative source of energy and authorities should focus on achieving energy efficiency before making any energy related policy. Strong leadership, clear action plan and the discipline to implement policy will make the state of Madhya Pradesh - a state with surplus power.

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