Feasibility Study of Biomass Waste for Bioenergy Generation in Mississippi

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Background. Fossil fuel use dominated the electricity mix in the US for many decades. Even though a significant change has occurred from coal-dominated supply to natural gas supply and an increase in renewable contribution has been observed, there is still potential to improve biomass contribution in rural communities which depend majorly on forest-related activities. Wood waste, a renewable source that is underutilized, has the potential to produce electricity in communities which can offset the contribution of electricity generated from fossil fuels and assist in greenhouse gas savings and supporting sustainable development.

Approach. A techno-enviro-economic assessment has been conducted to determine the economic and environmental benefits associated with replacing the fossil fuel contribution with bioenergy generated using wood residue available locally as feedstock in a direct combustion grate boiler. This study also considers the effect of carbon tax applied to the electricity generation sector and determines the amount of economic savings that can occur by replacing the fossil fuel energy sources in the electricity mix. Furthermore, the variation of feedstock supply, conversion efficiency, and boiler parameters on the annual electricity output was explored along with the effect of feedstock price, discount rate, and inflation rate on economic output (LCOE).

Results/Lessons Learned. With an average nominal and actual levelized cost of electricity (LCOE) of 12.77 cents/kWh and 10.87 cents/kWh, respectively, the results imply that selected counties in Mississippi have the ability to replace the incumbent electricity supplier, supporting energy independence and security. The fossil fuel percentage of the energy mix supplied to the counties can be reduced, lowering greenhouse gas emissions and their impact on global warming. Furthermore, when a carbon tax was placed on Mississippi, the averted CO_2eq emissions led to significant carbon tax savings. A savings of $2 to 2.9M per year in carbon tax can be achieved with bioenergy advancements.

Conclusion. Electricity generated from wood waste can reduce the contribution of greenhouse gas emissions while competing with existing supplier LCOE. The inclusion of carbon policy can further reduce the LCOE of the bioenergy facility as compared to fossil fuel enabling energy security and promoting sustainable development. Further extension can be to introduce heat demand for the county and operate the power plant as combined heat and power to estimate the total cost and environmental impacts based on end-user demand.