Study: Carbon Emissions from Biomass Power Are 115% Lower Than Natural Gas in First Year; 98% Lower Over 100 Years

Dr. Madhu Khanna, Distinguished Professor in Environmental Economics at the University of Illinois Department of Agricultural and Consumer Economics, and Dr. Puneet Dwivedi, Assistant Professor in Sustainability Sciences at the University of Georgia Warnell School of Forestry and Natural Resources, worked with Biomass Power Association to conduct a study of biomass power carbon emissions. They examined the carbon intensity of a 50-megawatt capacity biomass power facility in New Hampshire with a 43-megawatt net output on the electric grid, comparing it to that of a typical combined cycle natural gas facility. The professors found that the use of organic residues as fuel in a biomass power plant instead of natural gas in a combined cycle facility results in immediate carbon savings of 115%, with 98% carbon savings over 100 years.

Background

Like the vast majority of biomass power facilities in the United States, the subject of the study uses organic residues to generate power supplied to the electric grid. The fuels used at this facility are residues leftover from harvesting fiber for local lumber and paper mills: tops, limbs and other forestry byproducts. These low-value, “waste-like” materials are generated whether they are used for power or left to decay. If not used by biomass power plants, the materials typically remain in the forest as slash piles.

In comparing carbon emissions with a natural gas facility, Dr. Khanna and Dr. Dwivedi took into account the rate of decay of forest biomass, and the carbon and methane emissions from decay that would have occurred if these materials were left on the forest floor rather than used for power generation. They also took into account incidental carbon emissions incurred during harvesting, chipping and transportation.

The study used a landscape level analysis, and considered both biogenic emissions from decay of biomass as well as life-cycle emissions during the process of harvesting, collecting and transporting the biomass to a power plant. The landscape level analysis assumes that biomass would be obtained from a 25-unit landscape with one unit out of the 25 is harvested each year, with the other 24 units growing over time.

Findings

The use of residues for electricity generation is carbon negative in the early years and its carbon intensity is close to zero by year 100.

- In the first year of the study, biomass power shows a 115% carbon savings over natural gas. This amount decreases over time, stabilizing at 98% at the 100-year mark, as the accumulated transportation and chipping emissions “catch up” to the avoided carbon emissions.
- The materials used as biomass fuel and reviewed in this study are produced from the harvesting of wood fiber in a managed forest. Tops and limbs, for instance, are typically not well suited to make into paper or lumber – but they pile up as trees are harvested. Biomass fuels are “leftovers” in the harvesting of trees for other industries and, if they are not used to generate electricity, they will likely remain on the forest floor or, in some regions, be burned openly.
- The avoidance of carbon and methane emissions by removing from the forest and using materials that decay results in a significant GHG reduction over time. While the decay of these materials releases small amounts of methane consistently over time, the methane gas has a 21 times higher global warming impact on the climate than carbon dioxide.
- Even a small amount of avoided methane release can substantially increase the near term benefits of removing harvesting residues and using them for electricity generation instead of leaving them in the forest and continuing to burn natural gas for electricity.

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