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Study shows value of combining solar thermal energy with biomass gasification to produce natural gas substitute

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Even at historically low natural gas prices, bioenergy may not be out of the running—it just may need a little help from the sun. A new study from researchers at the University of Minnesota examining the financial viability of solar-heated biomass gasification technologies that produce a natural gas substitute product concludes that combining these renewable resources can make economic sense.

In traditional biomass gasification, 20 to 30 percent of the biomass feedstock is burned to produce heat for the process. But if the required thermal energy is supplied from a concentrated solar source, all of the biomass can be converted into useful synthesis gas. The study, funded by the Initiative for Renewable Energy and the Environment at the

University of Minnesota Institute on the Environment and published in *Biomass and Bioenergy* this week, developed a financial feasibility metric to determine the breakeven price of natural gas at which the produced syngas could be sold at a profit. The study suggests that solar-heated biomass gasification systems could break even at natural gas prices of $4.04-$10.90 per gigajoule, depending on configuration.

"While the cost of adding solar energy generation to a biomass gasification facility can approach one-third of a plant's total capital costs, other equipment required in traditional plants can be avoided and the amount of syngas produced per ton of biomass—a major variable cost of production—increases significantly," said senior author and former University of Minnesota College of Food, Agricultural and Natural Resource Sciences student Tom Nickerson.

"With average U.S. natural gas prices at $4.80 per gigajoule in 2014, two of the four configurations modeled were economically competitive," said co-author Timothy Smith, director of the NorthStar Initiative for Sustainable Enterprise, IonE resident fellow and CFANS faculty member. Though government incentives could significantly reduce the risks associated with volatile energy markets, demonstrating that the gap isn't insurmountable is an important step toward environmentally preferred energy solutions. "Utilizing solar technologies to get more energy out of each acre of biomass reduces the impacts to the landscapes producing it," Smith said.

Though no commercial plants currently exist, the technologies modeled in this study are being developed at the Solar Energy Laboratory at the University of Minnesota under the direction of Jane Davidson and lead research scientist Brandon Hathaway of the College of Science and Engineering.

"Our novel approach to gasification has demonstrated its benefits at the

bench scale, and testing with our 3 kW prototype is ongoing in the University of Minnesota's High Flux Solar Simulator," said Hathaway. "We hope to find industry partners to join us in the next steps as we scale up the process and move towards testing on-sun," Davidson added.

More information: *Biomass and Bioenergy*, www.sciencedirect.com/science/ … ii/S0961953415000033

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