Researcher studying ways to handle huge quantities of biomass

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Switchgrass bales on a truck ready for shipment to a biorefinery.

(PhysOrg.com) -- As scientists scramble to develop ways to generate enormous amounts of energy from cleaner-burning, renewable fuels to replace coal and oil, promising agricultural crops such as switchgrass have made headlines. But selecting the plants from which to make energy is just part of the challenge. Systems to handle huge volumes of biomass to feed power generators also must be devised.

Jude Liu, assistant professor of agricultural and biological engineering in Penn State's College of Agricultural Sciences, is one of the researchers working on the logistics of handling massive quantities of biomass. He recently received a $100,000 grant from the Sun Grant Initiative to support his work.

The Sun Grant Initiative, authorized by Congress in the 2002 Farm Bill, is a national network of land-grant universities and federally funded laboratories working together to establish a bio-based economy. Primarily funded through the U.S. Department of Transportation, with substantial funding support from the Department of Energy and the Department of Agriculture, the initiative enables research and innovation involving bio-energy and biofuels production.

Establishing systems for handling the amount of biomass needed to feed energy-generation stations is a gigantic undertaking, Liu said.

"Some estimates indicate a commercial-scale cellulosic ethanol bio-refinery designed for 24-hours-a-day, seven-days-a-week, year-round production would require a minimum of 1,000 tons of feedstock material per day," he said. "This equates to approximately 1,800 large rectangular bales of switchgrass every day (assuming one bale is 1,120 pounds). One can imagine the number of trucks required and costs of handling these bales."

The question on Liu's mind, and on the minds of other like-minded agricultural scientists, is how to handle all of that material and how to reduce those costs. It is difficult to exaggerate the importance of their research because the federal Department of Energy has set a goal for the United States to use biomass to supply 5 percent of the nation's power, 20 percent of its transportation fuels and 25 percent of its chemicals by 2030.

"By then, 1 billion dry tons of lignocellulosic feedstocks will be needed annually to achieve this goal," said Liu. "This goal presents significant challenges for logistics and necessary machinery development to harvest and handle the anticipated billion tons of biomass feedstocks. Not only do farmers have to grow the crops for energy and prepare them for shipping, but society must figure out how to handle, transport and store

all of that biomass."

To address these concerns, Liu's research focuses on bale-handling and bale-densification technologies.

"Long-term goals are to develop efficient logistics systems and required mechanical devices for handling biomass feedstocks in a safe, low-cost and efficient manner," he said. "We are designing some mechanical devices to compress and transport bales. These devices will save storage space, utilize load capacity of transport trucks, and speed up the loading and unloading processes."

Because the amount of feedstocks required for industrial production of energy will be gargantuan, the resulting costs of feedstock will be extremely high -- and the quality of biomass will have a significant impact on the overall economics of a bio-refinery, Liu said. "In addition, given public concerns and landowners' expectations, biomass feedstock must be harvested, collected and handled in a sustainable manner," he said.

As a result, biomass supply logistics will be a critical issue in bio-energy production. "There is a high demand for improving existing equipment and developing new technologies, equipment, and systems to increase efficiency, reduce costs and minimize negative environmental impacts in bio-energy production," Liu said. "We have a lot of work ahead of us if we are to make this bio-energy concept a reality."

Provided by Pennsylvania State University (news : web)