

## SWEET SOLUTIONS

STEVE FOX\*\*

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The millions of cars, trucks, trains and airplanes that transport us and our belongings also generate an unfortunate byproduct, greenhouse gases, which contribute to air pollution and global warming. But, what if an increasing portion of our energy needs are not met by oil but by vast fields of green plants, with the added advantage of creating jobs for farmers and converting little-used land into a profitable resource?

That's the vision of Professor Vijay Singh, Director of Integrated Bioprocessing Research Laboratory at the University of Illinois at Urbana-Champaign and Deputy Director for Science and Technology at the Center for Advanced Bioenergy and Bioproducts Innovation. His university leads a multi-institutional team of research scientists, which has demonstrated that sugarcane can be genetically enhanced to increase the amount of oil in its leaves and stems, which can be used to create biodiesel, an alternative to petroleum-based fuels. The projects, Plants Engineered to Replace Oil In Sugarcane and Sweet Sorghum (PETROSS), has important possibilities for India, which is a major producer of sugarcane and suffers from high levels of air pollution.

"These crops are going to be renewable and domestically produced, which means that they could have a significant impact on the amount of diesel India has to import, and make the country less reliant on foreign oil," says Singh, who is the commercialization lead for the project. "This would also provide jobs to farmers and give

them a new crop to grow on land that may not be under cultivation now."

Competitively-priced biodiesel has long been a goal of plant scientists because the fuel provides engine performance generally comparable to diesel, but with reduced emissions. However, along with technical obstacles, a major barrier has been cost. For example, soybeans are used in the United States to produce biodiesel, but it's currently more profitable for farmers to use it as food and feed product. By focusing on genetically-modified sugarcane, which can be grown more cost-effectively, the PETROSS team is opening up the possibility of creating a major new source of biodiesel that would be profitable for farmers to cultivate.

Sugarcane, which is grown in many parts of the world, has a number of attractive characteristics as a bioenergy source. It can be grown on wet, hilly land not suitable for other crops, and is very efficient in terms of its ability to convert sunlight into chemical energy stored in the plant. For example, one study found that engineered sugarcane can produce as much as 17 to 20 barrels of oil per acre compared with one barrel of oil obtained from soybeans. While it is a source of sugar and related products like molasses, mass production of biodiesel from sugarcane does not have serious food security implications. This might be a consideration if massive amounts of soybeans, which are consumed by humans and animals, were diverted into biofuel production, Singh's team is also working on efficient production of biodiesel from sweet sorghum, which has high sugar content.

The other PETROSS institutions are University of Florida, University of Nebraska-Lincoln and Brookhaven

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National Lab. The project is funded by ARPA-E (Advanced Research Projects Agency-Energy) within the U. S. Department of Energy.

The PETROSS program, whose team has been able to extract jet fuel (ethanol) from sugarcane, has attracted support from the U.S. Department of Energy in the form of longterm research grants, as well as inquiries from companies interested in the commercial potential of sugarcane-based biodiesel.

“The (Department of Energy) grant is very comprehensive, covering the sustainability of and economics of these crops – what would be the costs of this biodiesel compared with other renewable resources – and also what would be the effects on greenhouse gas emissions.” says Singh.

“There is tremendous interest in what we are doing,” he adds. “We have also received investment proposals for collaboration from people wanting to know when it will be possible to grow that crops and produce the oil

we are talking about. For now, we are still moving forward with the research portion, but we are advancing toward a time when we can produce more oil from the same amount of land.” PETROSS’ work is continuing through a new project, Renewable Oil Generated with Ultra-productive Energycane (ROGUE), with support from the Department of Energy.

Singh cautions that while the potential of PETROSS crops is enormous, the results won’t be seen for some time.

“This is a genetically-modified crop, which means that to get it approved, we have to work with a number of government agencies before the crop can be produced commercially,” he says. “It might be 10 years or so before we actually see this in a farmer’s field.”

There is no single solution to the problem of greenhouse gas emissions, Singh notes, but developing viable alternatives to petroleum-based fuels moves us closer to a greener, cleaner planet. □