

Gevo CEO Dr. Patrick Gruber on why a system approach to supply chains and production is key to fighting GHG emissions

# Paradigm busting

**T**his year may very well be a turning point for biofuels. It seems as if we, the collective industry, finally know enough to address greenhouse gas (GHG) emissions from mainstream products that have the potential to make a difference for transportation fuels like jet and gasoline itself. The interest in addressing GHG emissions and global warming in a more serious way is increasing. Several technologies have moved beyond the lab and have largely been de-risked from a technology point of view. Technology improvements have also been made in agriculture, and feedstock sourcing, where just because something is grown on purpose does not mean it is not sustainable. Agriculture is one of the world's biggest production systems. After the ocean, the soil is the world's largest carbon sink. Perhaps we should push more carbon into the soil, sequester it, reducing the amount we push into the ocean and atmosphere? In thinking about feedstocks, imagine if we could have used slash and forest residue for making biofuels, rather than just letting it burn in forest fires. Would it not be better to burn it flying airplanes? It is possible that we can change the paradigm of what can be done.

The way to discuss GHG emissions is to help people realise that every time any of us burns a fossil-based carbon in a transportation fuel, it releases carbon into the atmosphere. This is a technical fact. The debate we see these days is about the impact of those GHG emissions on the climate, and the associated



Dr. Patrick Gruber, CEO of Gevo

economic costs. Most projections predict that a continued increase of GHG emissions will eventually result in bad things happening to our world. We can argue about impacts, timing, economic damage. Fact is, by burning fossil carbon fuels for transportation, and electricity for that matter, we are polluting. The probability that we are doing things to harm the environment is high. Consumers, especially younger ones, know this. They will be the paying customers, the influencers of the future. What the biofuels industry needs to ensure is that they all know that technologies exist today to address GHG emissions in a meaningful way. Sustainable business systems are being put into place now to combat GHG emissions. And most importantly, people need to know that it's possible to grow raw materials without ruining land or compromising the food chain.

Because we (the industry), have to deploy new capital, establish at least a partial new supply chain and meet extra regulatory requirements that fossil fuels don't face (like proving sustainability), we have extra issues to overcome. We are making products that pollute less

and provide a benefit that is desired by consumers. This new generation of advanced fuels are worth more than fossil fuels. Good, stable incentives; practical and reasonable regulations regarding feedstocks; intermediates and incentives that promote food and recognise that not all raw materials are the same or have the same footprint, and reward improvements, are needed. The LCFS (Low Carbon Fuel Standard) system in California provides a good model.

Gevo has developed technology to convert carbohydrates into mainstream transportation fuels. The production

processes work, the products work. We make jet fuel and isooctane for gasoline that has, according to customers, superior properties, such as energy density, lower sulphur, lower freezing point, and can reduce GHG emissions on a per gallon basis by 70% or greater compared to fossil-based carbon products. By improving our business system and production efficiencies, Gevo can see a path to 100% or greater reduction of GHG emissions, but it takes cooperation across the whole of a business system: from growing raw materials (even waste wood or cellulose) or biogenic municipal solid raw



Isobutanol production fermenter



AvFuels Gevo jet tanker truck

materials have to be grown somewhere, somehow), to obtaining low carbon energy for electricity and natural gas, through production, through distribution, through end use, and to consumer. It takes work to do, but it is being put into place.

### Capturing nutritional value

Gevo currently uses non-food corn (corn that is not grown for direct human consumption) as a feedstock because it is a practical, inexpensive way to generate feedstocks that are also sustainable. Not all corn cultivation is the same. We are seeing a change in perception about raw materials like corn. As concern over feeding the world increases, generating protein to prevent malnutrition matters. We process the corn by stripping away the carbohydrates

from the protein. We sell the protein into the food chain. By stripping away the carbohydrates, we make a value-added protein feed (it's interesting to note these feed products used properly are reported to generate fewer GHGs from the cows!). We essentially capture 100% of the nutritional value and send it into the food chain. We produce about 5kgs of protein and animal feed per gallon of jet fuel or isooctane. Not all corn is the same. The field corn grown in our area is produced by exceptional farmers. The majority of farmers near our production facility in Luverne, Minnesota, use advanced agricultural practices: low till, no till, manure fertiliser, precision agriculture, drain tiles to protect water and crop rotation.

Using corn sourced from our region, for every gallon of

jet fuel or isooctane produced up to 1kg of carbon dioxide is being sequestered into the soil. We believe that more can be done to reduce the footprint further, but it takes a business system that rewards those farmers that make improvements. As we move forward maybe we can break the paradigm, and get through to more people that raw materials like corn are not necessarily bad, and in fact can provide a benefit in addressing GHG emissions in a sustainable way. Paradigm busting. No more broad brush. Not all corn is the same. Not all business systems are the same. Where practical, we should be encouraging protein production, along with generating low-carbon carbohydrates for use in fuels. Corn provides for such a system. But corn, big as it is, isn't big enough for what we will ultimately need. Corn only makes sense as a feedstock if the protein is captured and sold. So corn will grow in size across the world as demand for meat rises. The demand for protein is what matters. Food wins. But, in order to address GHG emissions in a meaningful way, we will ultimately need more sustainable carbohydrates than corn will provide.

### New feedstocks

We need other feedstocks. This is why Gevo has partnered with Praj Industries and Renmatix. Praj has developed production

technology to convert bagasse, and other grass types of materials, to carbohydrates that work with Gevo's fermentation technology. Renmatix has developed an elegant technology that converts woody materials into quality carbohydrates suitable for Gevo's fermentation technology, along with quality lignin.

Not longer should biofuels be limited to the corn-belt. We can envision production facilities wherever feedstocks are located. Because Gevo has demonstrated that it has de-risked its technology to convert carbohydrates into mainstream hydrocarbon fuels, like jet and isooctane, it may now be possible to combine Gevo's technology with the technologies of Renmatix and Praj. This combination has the potential to enable the world of cellulosic carbohydrates in a meaningful way.

The outlook is good. Interest in solving GHG emissions is increasing. Gevo, Renmatix, Praj, and several others have practical solutions and technologies that work. By taking a system approach to the production and supply chains, applying the principles of sustainability, and incentivising business systems to improve through policy changes, it is possible and practical to change our trajectory on GHG emissions while not compromising the environment or food production systems detrimentally. It is not "one size fits all". It is groups of committed companies along with raw material producers and everyone in between, working across the business systems who will drive the change. ●



Gevo jet fuel and isooctane plant

### For more information:

This article was written by Dr. Patrick Gruber, CEO of Gevo. Visit: [www.gevo.com](http://www.gevo.com)