

Jay Schmuecker (left) with David Toyne (center) and Dennis Crow, an area farmer.



On-Farm Plant Fuels Tractor And Feeds Crops

Jay Schmuecker makes demonstration amounts of hydrogen and ammonia on his Iowa farm from solar power, air, and water to fuel tractors and feed crops. The plant he and David Toyne, a California-based engineer, built showed it could be done.

Now, the Schmuecker Renewable Energy System is being used to benefit small farmers as far away as Africa. Closer to home, at a co-op in Boone, Iowa, anhydrous ammonia will be produced in a 75,000-sq.

ft. production plant and distribution center.

"This project started as a memorial to my father," says Schmuecker. "He supported hydrogen as an alternative to fossil fuels."

Some years earlier, Schmuecker had purchased his grandfather's farm in Iowa. Newly retired after 52 years at Caltech's NASA Jet Propulsion Laboratory in 2008, Schmuecker started thinking about generating hydrogen on the farm. The first question was what he could do with it if he made it.

"There weren't any tractors at the time that could run on it," recalls Schmuecker. "The farmer who rents my cropland suggested using at least a 150 hp. We bought a 7810 Deere, and a guy in Algona, Iowa, converted it with an engine block he converted to run on hydrogen or a combination of hydrogen and ammonia."

The tractor is equipped with four 10-ft. long composite tanks containing 80 lbs. of hydrogen and one tank containing 50 gal. of ammonia.

Two years earlier, Schmuecker attended a conference in California on ammonia as a fuel. He shared his interest in demonstrating making ammonia and hydrogen for tractor fuel and crop fertilizer. The goal was to be carbon-free. When he began designing and installing a demonstration system, he realized he needed help. He turned to fellow Californian David Toyne, an inventor with 45 years of experience in new design and installation of specialized equipment. They focused on making ammonia, an excellent hydrogen carrier that allows it to be used as a fertilizer and as fuel when mixed with more hydrogen. It also doesn't require high storage volumes and pressures.

"We discussed how great it would be if an ammonia generation system could be solar powered and installed by agricultural co-ops in their communities," recalls Schmuecker.

Toyne took the lead on the detailed design and installation of the system. By 2021, they were up and running with a multi-stage system plus control centers for monitoring and management.

Electricity from 36 solar panels powers a proton exchange membrane unit to break water down into hydrogen and oxygen gases. It also powers all the pumps, compressors and controls.

The nitrogen generator uses a dual bed pressure swing adsorption unit to make 99.995 percent pure nitrogen from compressed air. The hydrogen and nitrogen are stored in tanks, and the oxygen is vented into the atmosphere.

The residual mixed gases are compressed to about 3,000 psi and passed through a preheated reactor to produce liquid ammonia. When the tractor needs to be fueled, ammonia

is pumped from the storage tank, and hydrogen is dispensed from its pressurized storage tanks.

Schmuecker moved to the Iowa farm in 2017. He financed the demonstration plant and oversaw the project, which can produce about a pound of hydrogen per day. Schmuecker estimates the original 320-acre farm would require about 3,000 lbs. of hydrogen for fuel and another 5,500 lbs. to generate ammonia for the 150 acres devoted to corn annually.

Schmuecker and Toyne christened the operation the C-Free Renew system. Schmuecker shared his decade-plus of work on his website. In 2021, a transition from demonstration to full-scale production began.

"Hiro Iwanaga saw my website and contacted me," recalls Schmuecker. "He was interested in providing ammonia to African farmers with farms of only a few acres."

Iwanaga and Toyne formed TalusAg to develop the world's first commercial-scale, fully contained, automated, modular, zero-carbon, green ammonia production system.

By 2024, TalusAg was completing an installation in Kenya, and two were being installed in Iowa. A fourth is being delivered to Spain for use by a mining explosives manufacturing company. In all cases, Talus Ag continued to own the production plants, and the ammonia was sold to its customers.

The Boone, Iowa, facility will produce 82-0-0 slow-release ammonium nitrate for Landus Cooperative. The green ammonia is less expensive but as efficient as conventional ammonium nitrate.

Further development of the Schmuecker Renewable Energy on-farm system is on hold as Toyne is heavily involved in TalusAg. Schmuecker serves as a key advisor to the company. Meanwhile, he continues to work on his tractor.

"I've added catalytic converters to reduce NOx emissions," says Schmuecker. "We're fine-tuning the amounts of ammonia and hydrogen used in the tractor and conducting emission testing."

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Gator Remodeled Into A Dump Trailer

By Lydia Noyes, Contributing Editor

Dan Walters of Nashville, Ind., transformed an abandoned UTV into a tow-behind dump trailer. "The trailer started life as a 6x4 John Deere Gator diesel model. A 2002, to be exact," he says. "My wife's family had bought it gently used around 2008, and it's lived a hard life since then."

He brought it home around 2018, welding a square tube 'spine' up its unibody to overcome a severe case of rust that had it bowed nearly in half. "We used the gator like this for a few more years until my mother-in-law passed away, and then the whole homestead was virtually abandoned," he says. "The Gator was mine if I wanted it, so it came home with us. We used it without any updates for another few years."

Eventually, Walters decided to swap the Gator's diesel engine into a 4x4 Kawasaki Mule. "The Gator was effectively relegated to the scrap pile until I started selling parts from it," he says. "The plastics, steering, the main gearbox and pulleys, and so on. I was left with just the chassis and wheels."

These scrap pieces inspired a vision for a simple dump trailer for use behind a garden

tractor. "I don't consider myself a hoarder," he laughs. "I simply see potential in things others would consider trash. Which is exactly what a hoarder would say."

Walters set to work by cutting the trailer in half. "From there, all I needed to add was a wagon-style tongue, and I had a utility trailer. But knowing it was a dump bed from the factory (with an electric 'cylinder' which was also borrowed for the Mule), I wanted an easy way to be able to dump it."

His idea was simple. "If you redirect forces, it's not difficult to turn a pulling force into a pushing force," he says. "A bell crank, basically a lever on a fulcrum, allows a hand-crank winch to push the front of the bed up on its hinges."

The final result has proven well worth his effort. Says Walters, "Once I had the basics, it was only a little more grinding, welding, and painting before a completely mechanical upcycled dump trailer was born."

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DIY PTO Cover Reduces Mess

John Pittman of Glencore, Ky., made a custom PTO cover that reduces grease and oil spillage. "After years of having grease fly off the PTO shaft onto miscellaneous equipment and landing all over my glass and fenders, I came up with an idea of removing the factory PTO cover and making a longer cover out of an old mud flap," he says. "I came up with the idea because I keep my tractors in tip-top shape, and I got tired of cleaning grease off the cab, fenders and anything else it would fly onto."

Each tractor has a factory PTO cover with two bolt holes to hold it in place. "I just removed the factory cover," says Pittman. "I had an old plastic mud flap off of a semi, so I bent it over the place where the factory cover goes, marked the hole locations, drilled out the places I marked, and installed bolts in the original holes." Next, he cut the mud flap on an angle on each side to improve visibility while installing PTO shafts.

"It took me less than 5 min. to make this cover," says Pittman. "Because it's longer, it catches all of the grease that flies off the PTO shaft. I can remove and reinstall the new cover in less than a minute using the bolt iron stalled in the original holes." Overall, he considers it 5 min. well spent. "I wish I'd thought of this earlier because globs of grease are a pain in the butt to clean off," he laughs. "The piece I made came out a lot further than the factory cover." To be clear, it doesn't stop



"It took me less than 5 min. to make this cover," says Pittman. "Because it's longer, it catches all of the grease that flies off the PTO shaft."

the PTO shaft from slinging grease. However, it catches the grease it does sling instead of throwing it all over."

Pittman believes anyone can follow his design with a flexible piece of plastic or rubber. "This PTO cover has only been on one season, but it's working great. I recommend it."

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