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Carbon-negative fuels in the spotlight as Ohio State, Argonne National Labs, Energy Vision make material progress

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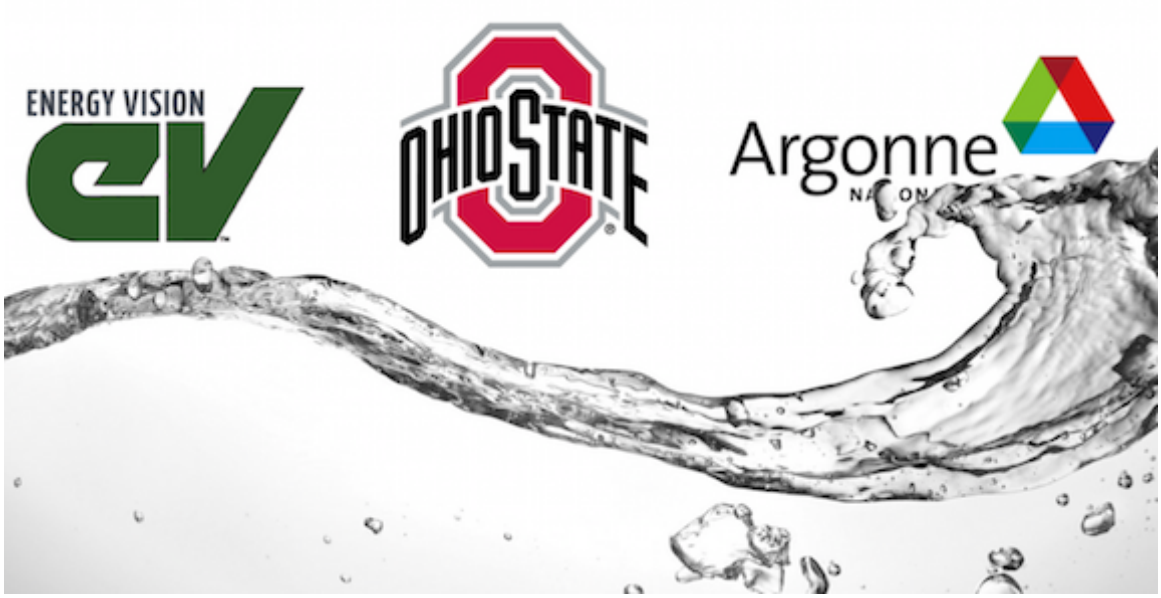

OK, you know the climate change drill. Burning liquid fuels releases CO2 and that leads to global warming. It's one of the reasons that eco-warriors drive electric cars.

But is that paradigm shifting?

The biggest news along that front represents early-stage technology, but we read here that engineers at **Ohio State** announced that they've devised a process that under certain circumstances can convert coal, shale gas and biomass into electricity or syngas, while consuming carbon dioxide at the same time. In some cases, the technology not only consumes the full amount of carbon dioxide it produces, but also additional carbon dioxide from outside sources – and that's the carbon negative moment.

Even more interestingly, the techno-economics (at a very early stage) indicated to the Ohio State team that they could lower the capital costs in producing syngas by about 50 percent compared to the technology traditionally used for this process.

The process

It's called "Chemical Looping": using tiny metal oxide particles to transport oxygen into high-pressure reactors. As these particles cycle through the system, they burn fossil fuels and biomass without the presence of oxygen in the air, causing a chemical reaction that doesn't emit carbon dioxide.

In 2013, the team demonstrated the potential of this technology, but the final challenge was to keep the particles from wearing out. Since then, increased the lifespan of the metal oxide has jumped from 100 cycles to more than 3,000 cycles, extending plant operation from eight days to eight months and ensuring the technology is significantly more economical for commercialization.

The team and where to find more

Dr. Liang-Shih Fan, Distinguished University Professor in Chemical and Biomolecular Engineering at Ohio State, has been working on this research for more than 40 years and recently published his findings in two papers for the Energy and Environmental Science journal (the first is here, the second is here). They look at a cleaner, more efficient and sustainable process for burning fossil fuels, with the ability to reduce coal consumption by 25 percent. The university has already began collaborating with companies including the The Linde Group, a world leading supplier of industrial, process and specialty gases; and Babcock & Wilcox, which produces clean energy technologies for power markets.

The impact

Well, syngas is used not only for electricity, but for renewable liquid fuels and chemicals — and technologies that use syngas have been obtaining it from more traditional and proven gasification systems that aren't going away tomorrow. But the owners of those gasifier systems might be looking into chemical looping as a next-gen technology for their customer base.

Over to renewable natural gas

This week, we heard the "carbon-negative" magic words via Argonne National Labs, According to this source, **Argonne National Labs** GREET model is showing that under certain circumstances R-CNG produced from anaerobic digestion of food waste is net-carbon negative over its lifecycle, including production, use and avoided emissions. That means making and using it actually results in lower atmospheric GHG than if the fuel were never made or used.

Now, that conclusion is coming from a sustainable NGO, **Energy Vision**, which co-sponsored the two case studies with Argonne on anaerobic digesters to capture the biogases from decomposing organic waste.

One study looks at **Fair Oaks Farms**, a large dairy cooperative in Indiana with roughly 36,000 cows. It converts manure to R-CNG using a large anaerobic digester, and uses the fuel to power its milk tanker trucks. The other study assesses the Sacramento BioDigester, the first food-waste digester in California to turn commercial organic waste into R-CNG vehicle fuel using anaerobic digestion.

Argonne is being a tad more conservative on the findings. Marianne Mintz of Argonne National Laboratory's Energy System Division, who co-authored the case studies, opined that "R-CNG can achieve the greatest GHG reductions of any transportation fuel today — 70% or more as compared to gasoline or diesel."

Nationwide, renewable natural gas has grown over 70% annually in recent years -production for transportation totaled 151 million gasoline gallon equivalents in 2017, up from 125M GGEs in 2016 and 90M GGEs in 2015. Also, there's good news on associated pollutants. compared to diesel, it reduces carbon monoxide up to 70%, nitrous oxide up to 87%, and particulate matter up to 90%, as well as reducing noise up to 90%.

And, it reduces the carbon footprint of dairy operations.

Fair Oaks Farm's digester generates enough R-CNG to displace some 1.5 million gallons of diesel, and to cut annual GHG emissions by 19,500 tons CO2e. That's a 43% reduction in carbon emissions per gallon of milk, a selling point that helped the company negotiate an exclusive supply agreement with the national grocery chain Kroger.

The **Sacramento BioDigester** was built by a public-private partnership in 2013. Atlas Disposal and other haulers collect the organic wastes from area businesses and deliver it to the digester, which produces enough R-CNG to displace 500,000 gallons of diesel a year and divert up to 40,000 tons of organic waste from landfills.

The Bottom Line

Small projects in the case of r-CNG — and early-stage in the case of the Ohio State technology — but carbon-mighty in each case.