Renewable Biogas: Next RFS Darling or Marginal Fuel?

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In this article, Pike Research biofuels guru and noted Digesterati Mackinnon Lawrence marches us (gingerly) across the wastescape: Recently, Japanese toilet company Toto Ltd. debuted a first-of-a-kind poop-powered, three-wheeled motorcycle, christened the Toilet Bike Neo. Adorned with a toilet as a seat and a roll of paper flowing from the back, Toilet Bike Neo — or what many are calling the “poop-mobile” — is actually powered by a combination of fertilized, purified livestock waste and gray-water. Amazingly, each tank of excrement can take the Toilet Bike Neo up to 180 miles.

Desperate times calling for desperate measures aside, the poop-mobile is the kind of innovation that leaves you scratching your head, trying to figure out what utility it might possibly offer. The answer is not much, at least from what may be gleaned from its kitschy design, but utility was not likely Toto’s primary intent. The Toilet Bike, though, brings to light questions around the broader potential for biogas as a renewable transportation fuel, an application that has been gaining increased attention in recent years. Still, biogas fuel’s broader market potential is still relatively undefined and mostly overshadowed by shale gas.

Taking Stock of Biogas Production

With broad application across power, heat, fuel, and chemical markets, biogas is a versatile energy carrier. In Pike Research’s recent Renewable Biogas report, we estimated that 1.6 trillion cubic feet of raw biogas would be produced annually by commercial bio-digesters and captured from landfills worldwide by 2022. That

represents a doubling of current capacity, which is mostly concentrated around 7,000+ digesters in Germany and around 575 landfills across the United States.

Capacity expansion is expected across a number of industrial applications — landfills, agricultural waste, wastewater treatment facilities, and various industrial applications. The bulk of this production is currently dedicated to power and heat applications.

A byproduct of anaerobic digestion (AD) — in which bacteria break down organic matter in an oxygen-starved environment — biogas is typically composed of about 50 percent methane. Raw biogas must be upgraded or purified to concentrate the methane component for transportation fuel applications, an expensive process that's only justifiable under narrow economic circumstances. The resulting gas goes by many names, but most commonly: biomethane or renewable natural gas (RNG).

Today, RNG production accounts for just a fraction of the total raw biogas market. An estimated 11 billion cubic feet of production was installed worldwide in 2012, just 1 to 2 percent of the total biogas market. That share is expected to grow five-fold over the next decade, a quantity that is still just a drop in the bucket in the broader transportation fuel market.

With almost no hazardous emissions and very little greenhouse gases, however, RNG is one of the cleanest vehicle fuels commercially available. Its greatest advantage is that it can be injected into natural gas infrastructure, giving it broader market access both geographically and for a range of end-use applications.

Early RNG Commercialization in Niche Markets

Could the poop-mobile's launch be a harbinger of expanding RNG market share? Despite increased interest, RNG niche status is likely to remain so over the next decade.

Today, RNG is typically compressed into bio-liquid natural gas (bioLNG) or bio-compressed natural gas (bioCNG) for vehicle transportation applications. It has gained a limited foothold in developing markets, like Brazil and Pakistan, and in developed markets across Europe. Sweden is a global leader in the utilization of biogas as a transportation fuel, with the renewable fuel now at 65 percent of all compressed natural gas sold.

In the United States, RNG use is concentrated in captive fleets like city buses and dump trucks that return to a base refueling station regularly. This hub approach allows the refueling infrastructure to be concentrated, reducing investment costs in the process.

Poised for Broader Adoption?

As Toto's poop-mobile demonstrates, marketing biogas as a transportation fuel makes for an interesting challenge. Biogas-powered vehicles, according to potential adopters, lack the nostalgic quality of liquid fuel and the innovative sleekness of

electric power. Poop power, meanwhile, doesn't necessarily fall neatly into the clean-technology lexicon.

In those countries where RNG has gained the most traction, the following factors are usually present:

1. High levels of vertical integration between biogas producers and municipal transport fleets.
2. Low electricity prices that force biogas producers to seek new market opportunities.
3. High diesel and gasoline prices that increase demand for alternative fuels.

These conditions appear to be taking root in the United States. With power markets straining to absorb cheap natural gas, biogas' higher cost makes it a challenging sell for electrical grid applications. Many of the quantifiable green attributes that help offset investment and operating expenses (e.g. renewable energy credits or RINs) are drying up, forcing producers to seek revenue in new markets.

Meanwhile, a divergence in the natural-gas-to-oil ratio is making gas-based fuels more attractive as a transportation fuel. The result has been an uptick in efforts to expand natural gas and RNG use as a vehicle fuel. Under the RFS2 in the United States, bioLNG and bioCNG eligibility for Type-A RIN credits could potentially improve the economics of RNG production.

Still, uptake for RNG as an alternative transportation fuel remains limited. Although RINs offer an additional source of revenue, due to the fact that it is a spot market with high volatility, credits have limited potential to mitigate construction and financing risks.

And while environmental concerns, such as air quality, climate change, and waste management infrastructure development, have proven to be important catalysts for RNG adoption, its long-term success is ultimately tied to expansion in natural gas vehicle (NGV) markets. Although full of potential — according to Pike Research's Natural-Gas Trucks and Vehicles, these markets are expected to grow a modest ~12 percent per year — NGV growth is hemmed in by a number of forces, including: limited refueling infrastructure, higher costs, and uncertain fuel price dynamics.

Ultimately, biogas's long-term success depends on a permanent divergence between natural gas and crude oil prices and, in the United States, a long-term policy shift. With investments pouring into new cellulosic, hydrotreatment, and thermochemical biorefineries to produce liquid biofuel alternatives, such a shift is unlikely in the near-term.

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