FLYING ON GARBAGE? FULCRUM BIOENERGY'S TRASH TALK

The founders of Fulcrum Bioenergy had a fabulously marketable idea: turn garbage destined for overburdened landfills into fuel for cars and airplanes. Fulcrum is just one of a multitude of biofuel companies rising up to profit from a veritable tidal wave of policy supports and subsidies on offer for "decarbonizing" aviation using "sustainable" aviation fuels (aka SAF). While SAF can be produced from processes that use vegetable oils and animal fats, large-scale supply of those feedstocks are both costly and environmentally destructive given their vast land area requirements. Hence there is much interest in production of SAF from various other feedstocks, including both biogenic and fossil sources.

Using unwanted garbage seems especially attractive. On their website, Fulcrum pronounces "*From your trash can to the sky*" (never mind the imagery of trash blowing around among the clouds…). Garbage as a feedstock for fuel would be plentiful indeed, and cheap - so cheap and plentiful that perhaps one could get paid to dispose of it. Turning garbage into fuel, often called "waste to energy", sounds like the ultimate "win - win" solution that would reduce pressure on landfills and provide what Fulcrum refers to as "*net carbon zero, sustainable aviation biofuel*".

The appeal of using garbage[1] to make fuel has been irresistible to investors and policymakers most of whom evidently have not studied these technologies much. But basic common sense tells us that, given that much of the waste-stream of garbage is

[1] Burning garbage is not "new"; incineration of mixed waste for generating electricity has a long and sordid history as a major source of toxic air pollution in (mostly black and brown low income) communities where they are usually located. A recent analysis of greenhouse gas emissions from waste incineration, even in spite of using unrealistically conservative metrics, concludes that waste incineration is by.

plastics, made from petro-chemicals, then using plastic to make fuel is not much improvement over burning petroleum directly. The problems with waste disposal and perhaps especially plastic wastes is real, but burning it, and subsidizing it as "sustainable" biofuel" is no solution.

A 2021 report from Global Alliance for Incinerator Alternatives (GAIA), siting Fulcrum example, states: "*Such proposed solutions tend to facilitate a facade which outwardly supports corporate and governmental responsibility in the short term, but in the long term, provides a distracting diversion from the need to reduce waste production, ban single-use plastic, and leave fossil fuels in the ground*."

Fulcrum claims their fuel reduces greenhouse gas emissions by 80% compared to fossil fuels. A 2015 Lifecycle analysis they submitted to gain eligibility for credits under California's Low Carbon Fuel Standard (LCFS) concluded that Fulcrum's fuels reduced emissions by a more 60% relative to petroleum fuels[2]. How either of these figures is calculated is not obvious. Lifecycle assessments of this kind are based on all manner of assumptions and lack transparency or verification.

The 2015 lifecycle assessment states: "*Converting MSW into biofuels or landfilling the material both result in GHG emissions. The landfilling of biomass results in emissions when the biogenic material decomposes into landfill gas ("LFG")… The total GHG emissions are equal to those associated with the FT fuel production process minus the avoided emissions from landfilling the MSW. The recovery of recyclable material also results in lower GHG emissions by displacing the production of new metals and plastics as well as producing ash which can be put to a beneficial use (e.g. cement production*)." Sorting, recycling and materials recovery are good practice, But should incentives for doing so be used by a fuel producer to discount their emissions? Or should subsidies and incentives rather go to supporting municipalities struggling to reduce and manage waste?

The lifecycle analysis claims the feedstock is 80% biogenic material, and refers to food, yard waste, wood, cardboard, textiles etc. How was the "80% biogenic" figure derived? There is no mention of plastics - except in the context of discounting emissions for some plastics recovered during sorting, and thereby presumably displacing production of some new plastics. Overall, the prevalence of plastics in Fulcrum's feedstock is played down[3].

Plastics are made from petrochemicals and their use to produce fuels by Fulcrum should be accounted for as such. In October 2023, six US Senators (democrats) wrote to the IRS, urging them to disqualify plastic-to-fuel processes from eligibility for tax

[2] Inside Climate News queried Fulcrum about the discrepancy between the claimed 80% emissions reduction figure they claim publicly and the 60% reduction figure from the 2015 assessment, and were told there had been an updated analysis, though it was not shared with the reporter.

[3] One possible reason is that because plastics generally do not decompose and release gases from landfills, there is no discount for "avoided landfill gas emissions" to be gained. If Fulcrum's feedstock were 75% biogenic instead of 80%, would they still have come up with an emissions reduction figure suitable for credit under the LCFS and other incentives.

credits such as those granted via the Inflation Reduction Act and “clean” fuel production. Citing the many environmental and public health problems created by plastics, they warn against providing incentives for production rather than reduction.

On their website, Fulcrum states that they have “*developed and are operating a proprietary, patented and proven process for converting landfill waste into net-zero carbon transportation fuels. Our process utilizes gasification and Fischer Tropsch technologies - proven technology which has been in in use in operations for years in refineries - to produce renewable drop-in fuels, including SAF*.” Just how reliable are these claims? Is it really possible to make fuel from garbage? Are the technologies that Fulcrum is using really “proven”? Have government agencies, investors and policy makers done necessary due diligence prior to offering lucrative incentives? Biofuelwatch has followed the biofuel industry for nearly two decades, including research on various topics including gasification and pyrolysis. We are sceptical - very highly sceptical - of Fulcrum’s claims and mystified that investors and policymakers continue to line up behind them, and not only Fulcrum, but one after another bioenergy start-up making hyped up claims.

In Nevada, Fulcrum has partnered with Waste Management and Waste Connections to supply the trash, which must be sorted, dried, shredded and transported from landfill to refinery facility. The shredded trash, composed of plastics, papers and other components, is to be fed into a gasification unit, where, at very high temperature (requiring large amounts of energy) it is converted into a gas, called syngas, composed of a mixture of many chemical components, some of which are undesirable for fuel production and must first be separated out (though a persistent problem with this approach has been difficulties with obtaining a syngas “clean enough” to be further refined into useable fuel). To prepare the syngas further, it is fed into a “scrubber” and then further into a Fischer Tropsch (FT) reactor, sometimes called a “reformer”. Here some unwanted components are removed and the product is converted to an oily liquid referred to as “syncrude” or “bio-oil”. Assuming all has gone smoothly to this point, (a big assumption as we will see), the oily liquid is then moved into a “hydrocracker” and a “fractionator” for further “upgrading” into useable forms of hydrocarbon molecules.

If this process sounds elaborate (and energy intensive), that’s because it is. A recent paper, titled “*Fires, explosion and chemical toxicity hazards of gasification energy from waste*” opens with: “*In recent years there have been an increasing number of attempts to develop commercial- scale gasification of municipal solid waste. The results have been widely disappointing, with many high profile and often catastrophic failures*.” The author, Andrew Rollinson, reviews the history, stating: “…*evidence from repeated failures combined with a greater understanding of the historical evidence of gasification’s limitations, has led most to now accede that the concept is overtly challenging, to question the feasibility of positive efficiency, and to assert that gasification of mixed waste is only possible when operating in close-coupled combustion mode and/or stabilised using fossil-fuels. (Consonni and Viganò, 2012, Dong et al., 2016; Quicker et al., 2015)*.” The closest thing to a successful gasification of mixed waste is in Japan where it has been co-fired in a mixture with limestone, coal,

oil or gas.

Rollinson provides useful details of how gasification is supposed to work, why mixed waste is especially problematic, and describes some of the shockingly frequent and catastrophic failures, resulting from "*flammable, toxic, and corrosive gas mixtures, the auto-ignition of stored feedstocks, multiple explosive atmospheres due to both overpressure and underpressure, combined with many ignition sources, plus heightened risk at times of start-up, shut-down or during testing*." Workers at these gasification facilities experience very high rates of injury and death.

Yet Fulcrum claims their technology is "proven" and has "*been in use for years in refineries*". Gasification with FT reforming has been almost entirely limited to small pilot-scale efforts, and has not involved such heterogeneous feedstocks as mixed waste (again, the more heterogeneous the feedstock the more challenging). Scaling up production to commercial levels using these technologies, even with more homogenous and amenable feedstocks, has not met with much success.

Rollinson points out, there has been a remarkable failure to learn from history of experience with gasification. He attributes the ongoing support and promotion of mixed waste gasification to a "*preference for novelty*" by policy makers and indifference of equipment providers to ensuring safe and successful operation following sales.

In spite of the long history of failed efforts using similar technology, Fulcrum has won lucrative supports, including a USD $70 million grant from the Department of Defence, which seeks to use greener fuels for the US military, and USD $104 million loan guarantee from the USDA. The company has also won major investments, partnerships and offtake agreements from BP, Marathon, Marubeni, World Fuel Services, Blue Arrow Biojet Holdings, and SK Innovation (which Fulcrum views with visions to expand into South Korea and beyond in Asia).

The Marathon refinery in California, undergoing a highly problematic conversion from petroleum to renewable diesel production, has an offtake agreement to take Fulcrum's synthetic crude oil and further process it ("upgrading"), with the lucrative accreditation of the Low Carbon Fuel Standard.

United Airlines purchased a $30 million stake in the company. Cathay Pacific and Japan Airlines have invested and signed offtake agreements, should SAF ever be produced in volume. Fulcrum's website claims: "*These agreements provide for Fulcrum to sell approximately 290 million gallons of net-zero carbon sustainable aviation fuel and other renewable fuels annually*."

Fulcrum's first completed "Sierra" plant, in Reno, Nevada, has an 11 million gallon per year (G/yr) capacity. Just the materials involved in construction of this massive facility will result in significant carbon emissions! Long in the planning and constructed under an EPC contract with Abengoa signed in 2015, the company announced they anticipated fuel production would begin in 2017. Construction was not completed until 2021.

In 2022, it was announced with fanfare that Sierra had succeeded in producing fuel - though it is not clear how much fuel - was it one eyedropper full or enough to fly a max jet or two across the Atlantic? In February 2023, it was announced that one single railcar of product from Sierra had been shipped off to the Marathon facility in California for upgrading, the result of which may or may not have been successful. Transporting synthetic crude by rail introduces risk of potential spills and accidents.

In spite of their remarkably meager performance and lack of transparency over what has actually been produced, Fulcrum continues to enthusiastically state on their website that they have "*identified more than ten future plant locations in the U.S. with the capacity to produce approximately 400 million gallons of renewable, net-zero carbon transportation fuel each year. And we're collaborating with international partners to bring our process and garbage-to-fuels process to select countries around the globe*."

As a first step in achieving such lofty expansion goals, the company announced plans to construct a facility in Gary, Indiana. Residents of Gary are less than enthusiastic about having a garbage gasifier in their neighbourhood. Gary is a predominantly black and brown community, recognized to be among the most polluted communities in the USA. Residents there long ago learned to smell a rat given their long history of experience being dumped on by polluting industries and then saddled with the collateral damages. A local organization, Gary Advocates for Responsible Development (aka GARD), has been mounting opposition to the Fulcrum plant. They filed a civil rights complaint with the EPA, and are petitioning the state of Indiana to revoke the air permit granted for the facility.

Fulcrum also claims to be developing plans to construct a 31mil G/yr "Trinity" fuel facility in the Gulf Coast region, supposedly to be commissioned in 2026, though it does not appear that construction has yet begun. In 2017 Fulcrum extended its operations into the UK with a subsidiary, Fulcrum Bioenergy Ltd.. In 2021, partnering with Essar Oil, they announced plans to develop the 100mil liters/yr capacity "Northpoint" facility in Cheshire, in the NW of England. This facility is supposed to produce aviation fuel from mixed waste to begin commercial production in 2025.
While Fulcrum continues to enthusiastically tout their garbage to fuel plans, unfortunately, but, from our perspective quite predictably, the company is facing financial difficulties. In November 2023 it was announced that Fulcrum had gone into $289 million forbearance on bond financing for the Sierra facility. The company is being required to work with the UMB Bank to develop an accelerated repayment schedule.

That Fulcrum was having financial difficulties was apparently evident long before the recent announcement they had defaulted on bonds. In both the 2021 and 2022 annual reports from Fulcrum's UK subsidiary, it is stated that: "*In order for Fulcrum to continue to provide finance to the [UK]Company, Fulcrum must secure additional debt or equity financing. The presence of these conditions, which is based on an assessment of what is known or reasonably knowable as of the date these financial statements are issued, raises substantial doubt about the Company's ability to continue as a going concern*

within one year after the date that the financial statements are available to be issued."

Yet, in spite of these concerns raised repeatedly, the UK government offered Fulcrum a grant of £16.764 million, ($21.29 million) as one of five grants given to similar (and similarly hopeless) SAF projects in 2022.

Following the announcement of Fulcrum's default on their bond payments, GARD spokesperson, Carolyn McCrady, quoted in the Post-Tribune, stated: "*Over and over again Gary residents have questioned the feasibility of the project, and over and over again, Fulcrum has said we should look to its Sierra plant as a successful example of what it plans to do in Gary," she wrote. "Well now we know. They have not produced fuel at scale and cannot pay back their investors. This is just further evidence that this is an ill-gotten venture that is bad for Indiana taxpayers and should be abandoned*."

We couldn't agree more. We offer this review of Fulcrum as just one example of how startup bioenergy companies hype their processes, make unfounded claims and are consistently rewarded generously with financial, and policy supports. This in spite of clear evidence from a history of prior experience.

Policymakers, eager to demonstrate a commitment to addressing climate change and environmental degradation have too often failed to undertake due diligence prior to committing taxpayer funds to supporting costly projects that can easily be predicted to fail. They also fail to question claims about fuels being 'low carbon', even when there is overwhelming evidence that they are not. Private investors similarly would be advised to do their homework. That investment in companies like Fulcrum continues to flow suggests that the structure of incentives provides lucrative financial returns ***whether or not*** promises of clean carbon neutral net zero climate friendly, environmentally beneficial wonder-fuels are fulfilled. In other words, scamming the system is, unto itself, profitable enough. It is difficult to draw any other conclusion!

biofuelwatch
Biofuelwatch.org.uk | biofuelwatch@gmail.com
@biofuelwatch8317 @biofuelwatch biofuelwatch