Supply challenges in the biofuels industry

By **Sam A. Rushing** on Apr 01, 2020

The biofuels industry is the most significant sector of the US carbon dioxide (CO_2) supply chain, as a function of the number of operating CO_2 plants using this by-product feedstock. On a plant percentage basis versus other source types, ethanol (biofuels) represent over 40% of this grand total; therefore, ethanol is absolutely vital to the health of the merchant CO_2 sector.

Over the years, there have been shortages of CO_2 product from certain ethanol sources, caused by a shortage of corn, which was often driven by drought, and the lack of sufficient corn planted due to flooding. All of this sounds familiar through the prism of climate change. With the flooding which occurred last year, there are concerns surrounding inadequately planted corn fields, where such fields often remained covered with flood water. Further on the biofuels front, since the tariffs began, there were a number of ethanol plants which had to shutter due to a lack of shipments to China.

While tariffs, and flooding last planting season, are reasons for concern, the industry continues to operate relatively well, and most of what the CO_2 industry has invested in ethanol remains in place. Further, most of the relatively recent CO_2 plant startups have occurred from operating ethanol by-product, that being in California and Oregon, and of course these are from long existing ethanol plants.

The reality is there are few to no alternatives for raw gas from today's strategically located ethanol plants, that being sources of CO_2 of a viable nature, which are concentrated, and of a quality which make it possible to invest. Most of the proposed new chemical by-product plants which were slated to start up in recent years never came to fruition. These projects were to be supplied by cheap natural gas. The high failure rate among these many proposed projects was due to a lack of investors, and a pushback against fracking.

Locations are key

Ideally, the industry is striving to locate CO2 production close to demand centers. The cost of distribution is the most expensive part of the total cost of product in most markets. There are little or no viable source alternatives to ethanol in strategically located places. The reality with respect to ethanol by-product sources, is they have been much of the success found in the domestic CO2 industry over the last two decades – while being the most significant single source type as well. Per Ethanol Producers Magazine, there are presently 201 ethanol plants in the US, while a few are dormant. Of the total number of ethanol plants which source the merchant CO2 industry, this value is about 40 such plants. If the cost of distribution were not such a significant factor, logically, many more ethanol sources could 'bridge the gap' between supply and demand between supply and demand. This has been the theme over the last number of years, when shortages have occurred, and plant outages have been an issue. On the other hand, should significant CO2 sources from ethanol become widespread, due to plant closings, or reduced operating capabilities from lack of corn, for example, alternate ethanol plants might be the only reasonable solution to the problem of adequate supply of CO2. The industry will then have to pass along added costs to the customers.

With respect to average cost of distribution, the cost per ton, charged round trip, averages about $30 for over the road trucks. The typical trucking limitations from a plant to a customer tends to be about 200 one-way miles; or less. As to rail transportation, over the years, I was often amazed how affordable certain routes via rail were possible, with established traffic, customers, and vendors. On the other hand, published rates via rail are almost always unaffordable; outside of well-established traffic on the rail. Rail often has further served to supplement product during plant downturns, outages, or turnarounds, and force majeures often pay for the hardships caused by a number of problems.

Advanced biofuels – what happened?

During the rapid expansion of the traditional dry mill ethanol plant build-up, there were ever growing plans for development of an advanced biofuels production sector as well – that being from generally cellulosic ethanol operations. As most of these operations developed plans for such new projects, technologies often underperformed, or investors were pulled out, and companies became impatient. I can think of numerous such ventures which were possibilities for new CO2 production in places such as Southern California, the Carolinas, and the Middle Atlantic. What developments did occur, were generally in over supplied corn-based ethanol markets, most of which came to an impasse. The sector will continue to work toward commercialization, with development of technologies which really work, and can be scaled up competitively. It will take more time than originally thought.

But many ethanol firms think things are going absolutely fine and see the CO2 options as greater than ever, even in markets saturated with ethanol plants. Given this mindset, a few such advanced biofuels plants which have recently been under development, such as Element, LLC, a joint venture between ICM and Andersons, in Colwich, KS, which is planned to be 70 million GPY capacity, but is far from a well operating project. A very small cellulosic project for North Dakota called New Energy Biomass, slated to be 16 million GPY, is too small to help the merchant network.

Beyond the largely Midwestern cellulosic ethanol project attempts, the addition of advanced biofuels projects has largely been a disappointment. A few cellulosic and biomass ventures are under consideration, and even on the drawing boards currently, however, commercialization is a long way off. That being said, it is difficult to think in terms of new merchant CO2 sources from advanced biofuels and biomass at this time. In the past, the major gas companies displayed little interest in such sources, until they are well-proven. Corn-based ethanol is probably the fallback position for the foreseeable future, should ethanol plants close which serve the CO2 market. Today, there are mechanisms surrounding tax credits which can serve as a CO2 sink for sequestration; however, this does not help supplying the CO2 merchant market.

If the right combination of technologies were capable of being scaled up, combined with affordability, then advanced biofuels would become a significant factor.

Other source alternatives

In the US, we have around 200 total ethanol plants, and about 40 CO2 sources from ethanol, that represents probably a fair amount of opportunity for ethanol sources to help bridge the gap between supply and demand. The cost of relocating a CO2 plant from one ethanol facility to another, could run from $1-3m, as a bare minimum; plus, the potential for more expensive distribution costs; however, this is probably the best solution; unless other viable source types become available.

One potentially obvious source for CO2 which has been discussed, is biogas. I evaluated CO2 from biogas feasibility in recent years, and technically speaking, the product is as pure or more so, than other source types, after refinement. On the other hand, since so much of the biogas is sourced from sources such as manure from hogs, sheep and other livestock; or even worse, human waste, the concept of deriving CO2 from most of the biogas sources is an absolute turn off, from a consumer, producer, and conceptual point of view. Should such sources become viable, when using manure or like organic matter in the feedstock for the digesters, there would be almost an infinite supply available; however, I cannot imagine such product being accepted by major food, beverage, and most industrial CO2 consumers, sourced with such waste matter. Strictly speaking, should specific biogas facilities be sourced by non-manure operations, this could perhaps provide a source type for a CO2 plant; however, such source types would probably be too small to make sense of commercial operations.

As to flue gas, I worked with cogeneration developers in the 1990s, where many such companies considered CO2 recovery and the merchant markets (merchant markets via CO2 firms more specifically), which is a great source in my view. Most of the CO2 projects considered and evaluated never came to fruition in this sector; the only developments which were commercialized were two 200 TPD and one 350 TPD plants, which were economically subsidized via the requirement as a thermal host. The only way we can make flue gas work, with traditional technologies, primarily proven MEA (monoethanolamine) solvent recovery methods, is to have economic subsidies, perhaps in the form of greenhouse gas recovery and carbon trading legislation.

Ongoing consolidation

Last year, the ethanol industry endured some of the worst margins in a decade. Many experts and ethanol producers would place the trade war with China as the number one factor in the wave of poor margins, prompting a wave of consolidations. Another factor has been the growing list of blending exemptions granted for the oil refining sector. The pain continues with a poor corn planting season last year, which may alone precipitate plant closings. In light of the trade war, producers have been seeking alternate markets, including expanding exports to Brazil, and development of markets such as Mexico, India, and southeastern Asian countries. This has precipitated consolidations, such as ADM Corporation, which is planning to spin off their ethanol assets. Recently, Valero agreed to buy three ethanol plants from Green Plains. Further, The Andersons, Inc., indicated the ethanol industry will consolidate further, and they purchased Lansing Trade Group, perhaps to facilitate such opportunities.

Adaptation and opportunities

On the other hand, the hope is ethanol export markets perhaps will help fill the void caused by Chinese tariffs, and we hope of easing of the trade war, which will then lead to improved ethanol sales. Further, higher-cost ethanol producers will likely realign their operations, via acquisitions and mergers, and future corn planting seasons must be more successful. As the industry regains efficiency, there will be a return to normalcy and better profits. However, the majority of ethanol will most likely come from corn.

There remains the fact where up to 200 ethanol plants exist domestically, around 40 are committed to CO2 production. Given the many untapped CO2 sources from ethanol, there remain opportunities to develop some of these sources for merchant CO2 service. Of course, closing, dismantling, moving and reconstructing an existing plant from a shuttered or unproductive ethanol source to another ethanol plant is expensive in more than one way. This avenue surrounding replacement of raw feedstock from ethanol sources is the most likely way to replace lost supplies simply due to an almost sheer lack of alternate quality raw CO2 feedstock. This is the case in many markets, unless we are able to develop affordable alternate sources, such as subsidized flue gas projects; or expansion of other source types.

In the end, should more ethanol plants become shuttered, which provide CO2 to the markets, then the logical alternative is moving the CO2 operations to existing, promising ethanol plants located regionally. There are numerous challenges which have been experienced over the last couple of years, and we hope many of these challenges are not permanent, such as tariffs, expensive and unavailable corn. Once the ethanol industry has consolidated further, which is likely to occur, the end result will eventually represent stronger players in the industry and if coupled by abundant corn availability, and open markets, the industry will prosper well.

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