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Recycling America's Food By-products Into Renewable Energy

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[As North America's leading producer of animal fats and proteins, Darling International and Griffin Industries have pioneered the development and production of rendered animal fats and used cooking oils for use in renewable fuels (the two rendering companies merged in December 2010 and launched their DAR PRO Solutions brand in fall 2012). This paper provides a rendering industry perspective as well as highlights our company's related role in biodiesel and renewable diesel development.]

A Recycling Heritage: Rendering is the world's oldest recycling method. For thousands of years, animal fats and tallows have been effectively used as candles, soaps and skin protectants. By the 1800's, what would become a precursor to today's rendering industry was born when a solution was found to transform the abundance of inedible materials (i.e. not used for human food) from meat production into animal feed supplements and fertilizers. This tradition of seeing a need and finding a solution has fueled the rendering industry's growth, thus earning it the nickname, "The Original Recycler".

According to research conducted in 2011 by the United States Department of Agriculture, the average American consumes approximately 185 lbs. of meat, 85 lbs. of fats and oils, 415 lbs. of vegetables and 630 lbs. of milk and related dairy products annually. Yet, when it comes to food, Americans are very inefficient. The National Renderers Association (NRA) estimates there are 86 billion pounds of red meat, pork and poultry consumed each year in the U.S., resulting in more than 60 billion pounds of inedible by-products. In addition, the NRA estimates another two billion pounds of used cooking oil is generated each year from restaurants and hotels. It's the rendering industry's role to recycle these inedible by-products, as well as used cooking oils, into a broad array of products from feed ingredients and fertilizers to materials used in a host of industrial and consumer products.

From a renderers' perspective, success is equal parts recycling efficiency and effectiveness along with market development innovation. Finding new uses for rendered products is critical to maintaining the economic viability of our recycling operations. As independent renderers, we compete with other disposal methods such as landfills, incineration or composting for the raw material we recycle. Therefore, in order to create the safest and most sustainable service, our industry must continually research and develop new uses for the products renderers manufacture. The Fats & Proteins Research Foundation (FPRF) along with the NRA play vital roles in these market development efforts, which also include the geographic expansion and distribution of rendered products around the globe.

Developing a New Market: Since the 1990's, it was recognized that animal fats and recycled cooking oils can also play a key role in fueling production facilities, generators and diesel trucks, buses and tractors. In 1998, our company constructed the first and longest continually producing, flexible feedstock biodiesel plant in the U.S. The facility, which pioneered animal fats/used cooking oil-to-biodiesel production, still operates in Butler, KY and plays a key role in an emerging industry that has made biodiesel a household term and a critical part in our nation's energy future. By being an early adopter of biodiesel, our company and our industry was positioned as a more knowledgeable and responsive feedstock supplier for other biodiesel manufacturers that have since emerged around the country. Working with the National Biodiesel Board (NBB), our industry was instrumental in ensuring feedstock neutrality, leveling the playing field for plant-derived oils (soy, palm and canola) with rendered products. In addition, renderers were active participants in the creation of ASTM specification D6751, which would ultimately be the determining factor of biodiesel fuel quality as well as the creation of a BQ-9000 certification program for biodiesel manufacturers. These quality assurance measures were critical to establishing a foothold in the fuel market and further catapulted biodiesel's rapid growth and acceptance, as shown in Figure 1 (Source: <http://www.eia.gov/biofuels/biodiesel/production/?src=Renewable-f2>).

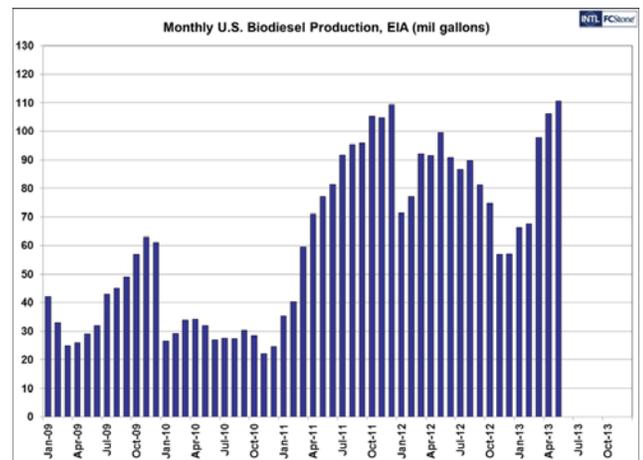


Figure 1.

Taking Renewable Energy to Another Level: Through the above biodiesel experience, Darling International learned the value and importance of creating a partnership within the petroleum industry. A renewable fuel must be seen as an integral part of the energy puzzle. Rather than threaten the petroleum industry, a renewable fuel should actually extend the finite life expectancy of petroleum-based fuels. The federal government's establishment of a Renewable Fuel Standard (RFS2) created that focus. An RFS mandate further translates into the catalyst to develop new technologies that can seamlessly integrate into our nation's general fuel supply.

To capitalize on the above, in early 2011 Darling International created a 50:50 joint venture with Valero Energy Corporation and formed Diamond Green Diesel®, a facility dedicated to repurposing animal fats and used cooking oils, as well as selected vegetable oils, into renewable diesel. The construction phase of the 137 million gallon refinery was completed in June 2013, and is now capable of producing 9,300 barrels of renewable diesel daily. With over \$400 million of unsubsidized corporate investment split between Darling and Valero, Diamond Green Diesel, situated adjacent to Valero's existing Port Charles refinery in Norco, LA, is North America's largest renewable diesel production facility.



Darling International and Valero Energy Corporation's Diamond Green Diesel® facility will produce up to 137 million gallons of renewable diesel per year, fulfilling Valero's obligation under the RFS2 government mandate for biomass-based renewable fuel production.

Renewable diesel, unlike biodiesel, is a hydrocarbon which actually meets the ASTM specification for diesel fuel (D975). While renewable diesel still utilizes animal fats and recycled greases, it can be distributed through existing pipelines and used as an RFS2 compliance tool in support of Valero's 5,000+ service stations around the country. Higher cetane values further enhance diesel fuel's overall performance characteristics.

In addition to the consumption of rendered materials and cooking oils, Diamond Green Diesel can use distillers corn oil (DCO) as a feedstock. DCO is a derivative of corn-based ethanol production. The implementation of RFS2 has exploded ethanol's growth, thereby creating a DCO by-product stream that can be effectively repurposed with the advent and growth of renewable diesel.

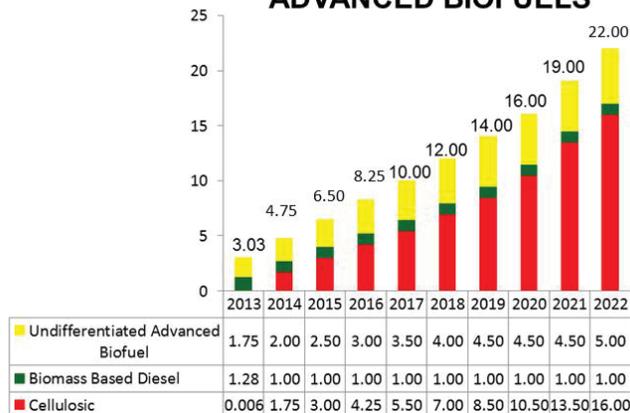
A Food versus Fuel Solution: A common challenge many wage against renewable fuels involves the food vs. fuel debate. Ethanol in particular is targeted because cellulosic ethanol opportunities are more theoretical than practical, meaning that the vast majority of ethanol's 13 billion gallons of annual U.S. production is derived from corn as opposed to cellulosic sources (data reported by the Renewable Fuels Association). However, biodiesel and renewable diesel made from animal fats, used cooking oils and distillers corn oil does not result in additional acreage being planted for the sole purpose of renewable energy. Their use as feedstocks in biodiesel or renewable diesel in fact increase their demand and therefore their value, encouraging recycling of these materials. Given that independent renderers typically pay for the material they ultimately recycle, this value enhancement is highly correlated to rebates paid to the raw material suppliers.

This situation is clearly illustrated in the case of the thousands of restaurants the rendering industry services in the collection of their used cooking oils. A decade ago, the value of Yellow Grease (refined used cooking oil) was often less than half the price routinely paid for the actual unprocessed grease today. Due in large part to the innovations and growth in the renewable fuels market, the value of this used cooking oil has risen dramatically. Under current market conditions, rather than charging restaurants a fee to collect their used cooking oil, restaurant owners can anticipate an incoming revenue stream for the collected and recycled material.

Other Benefits: The EPA's certification of fuels under RFS2 ensures that these renewable fuels are clean, safe, efficient and, ideally, do not replace agricultural acreage in order to be produced. Renewable fuels such as biodiesel and renewable diesel burn much cleaner than petroleum-based fuels, reducing greenhouse gas emissions and help improve air quality. In fact, the EPA estimates that biodiesel for example, reduces greenhouse gas emissions by 57% to 86% compared with petroleum diesel.

On a global scale, extending the finite life of petroleum reserves through the addition of renewable fuels into the general fuel supply helps reduce our nation's dependency on foreign oil. A growing world economy needs an abundance of energy. It will be a long road before our country can claim self-sufficiency from foreign oil supplies, but domestically-produced renewable energy certainly helps enhance America's opportunities for

Renewable Fuel Standard (RFS2)
Billions of annual gallons
ADVANCED BIOFUELS



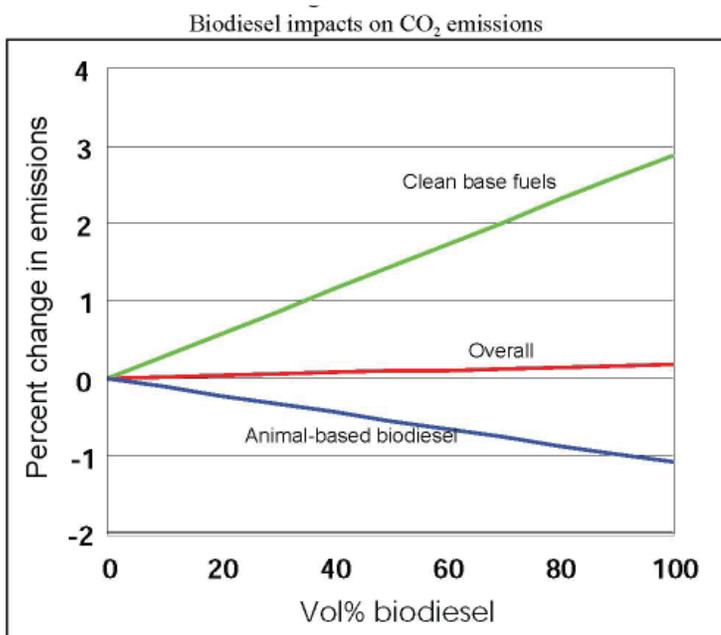
Both biodiesel and renewable diesel produced from animal fats and cooking oils are EPA certified biomass-based fuels that meet the RFS2 mandate.

The red bar illustrates cellulosic ethanol with a very ambitious forecast.

(Source: Federal Register, Aug. 15, 2013)

continued growth and prosperity.

Finally, renewable energy stimulates a new economy, growing green jobs that further support domestic economic development. To illustrate this point, the National Biodiesel Board reports that biodiesel production in 2011 accounted for 41,000 jobs and \$4 billion in U.S. Gross Domestic Product (GDP).



This chart published in the EPA's "Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions," dated October 2002, illustrates that as more animal fat-based biodiesel is mixed into diesel fuel, fewer CO₂ emissions are produced when compared to using plant-based (clean base) biodiesel as the additive. (Source: <http://www.epa.gov/otaq/models/analysis/biodsl/p02001.pdf>)

In Conclusion: The rendering industry will continue to play a critical role in the development, production and use of renewable fuel in both our country and the world. The animal fats and used cooking oil recycled by renderers have been proven as effective boiler fuels without further treatment or modification. Our ability to recycle these materials into feedstocks that are used in the creation of biodiesel and renewable diesel results in reducing our nation's dependency on foreign oil, improving air quality through lower greenhouse gas emissions while sowing the seeds for a new economy. Competition for energy is global. A key success factor for our country will always be our ability to produce clean, affordable energy – biodiesel and renewable diesel can play a vital role in those efforts.

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