



Gatekeepers of the Food Chain:

Rendering's Role in Managing Food Waste and Ensuring a Safer Food Chain

Darling Ingredients' Gatekeeper Greenpaper Series, Issue 1.

Introduction

The rendering industry is often referred to as the Gatekeeper of the Food Chain. In the United States, the human demand for consumable meat proteins generates approximately **56 billion pounds** of unconsumed meat by-products and used cooking oils; these materials are processed and converted into usable proteins, minerals, fats and oils by the rendering industry. Without this conversion process, the majority of these by-products would end up in landfills or composted, having no to little value and potentially causing harm to the environment. By recycling select food waste into sustainable goods, the rendering industry plays an active and critical role in protecting animal, human and environmental health. Through our Gatekeeper Greenpaper series, learn more about this role as we examine the demands, needs, potential problems and sustainable solutions arising from a culture centered around a meat-based diet.

1. Food Waste in America

A nation generating waste

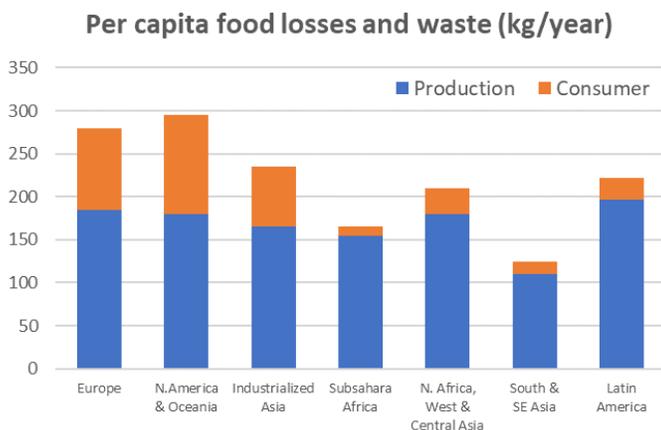
The United States is the third largest producer and largest exporter of food in the world¹. According to the Food and Agricultural Organization of the United Nations (FAO), the world throws away nearly 1.3 billion tons of food each year - roughly a third of what is produced for human consumption². A 2018 Department of Agriculture study found that the **US wastes approximately one pound of food per person per day**, an amount that could feed 2 billion people annually.

The high standard of living in Western cultures generates significantly more food waste than developing nations. The FAO tracks food waste on production, retail and consumer levels globally.² These studies have shown that while developing nations have very little consumer and retail waste, industrialized countries see more than 40% of their waste appear at these stages. Additionally, food manufacturers and retailers routinely supply consumers with more food product than can be consumed.

Cosmetic considerations also play a role in retail/consumer waste generation. As food starts to wilt or discolor, consumers consider it undesirable despite it still having high nutrient value. The EPA reports that blemished and discarded food has become the single largest occupant of American landfills⁴.

As a primarily carnivorous culture, the US consumes approximately **220 pounds of poultry and meat per person per year**⁵. This meat-centered diet results in waste generated by both poor portion control and the inedible by-products created during the meat production phase.

$$\begin{aligned} & \mathbf{220 \text{ lbs/person/year}} \\ & \mathbf{\text{poultry \& meat consumption}} \\ & \mathbf{\times} \\ & \mathbf{329 \text{ million}^{19}} \\ & \mathbf{\text{(US population 2019)}} \\ & \mathbf{=} \\ & \mathbf{72.4 \text{ billion pounds}} \\ & \mathbf{\text{of US meat waste/year}} \end{aligned}$$



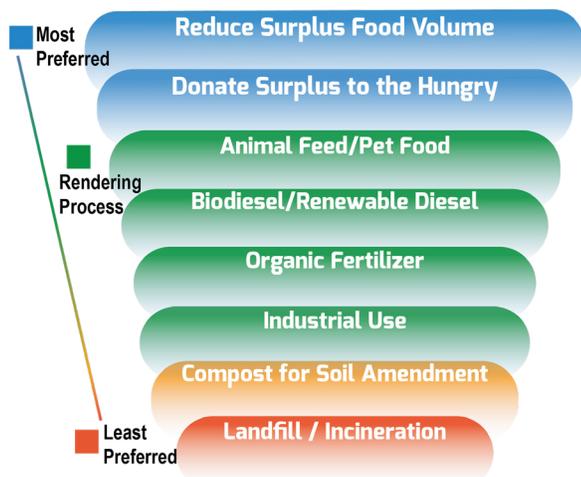
Western countries only consume about 50-60% of an animal, leaving the butcher, meat processor or retailer with roughly a 1:1 ratio of saleable (consumable) meat to inedible meat by-product. Multiply that 220 annual pounds per person by the US population in 2018, and you get over **70 billion pounds of meat waste per year!**

In addition to meat by-products, many food service companies use large quantities of cooking oil to fry meats and produce goods.

Each year the North American rendering industry collects **4 billion pounds of used cooking oil (UCO)** that would have been improperly disposed, and **over 52 billion pounds of the meat by-products**⁶.

This Greenpaper will focus on how an industry that has remained in the shadows for more than a century assists in handling and recycling by-products generated from our meat-based diet and food preparation. It will look at the options for handling food waste and the importance of considering the best use of the material. It will also examine how the value of inedible material can be captured and repurposed into new, sustainable products while simultaneously preventing environmental contamination and greenhouse gas emissions (GHG).

Put Food Waste to Its Best Use



The North American Renderers Association promotes a “Best Use” approach in dealing with surplus food. Using the Food Recovery Hierarchy¹⁸ developed by the Environmental Protection Agency, the rendering industry identifies its place among the most efficient and preferred ways of handling food waste, asking “What is the material’s best use?”

The most sustainable solution

There are 5 main ways food waste is handled:

- » Landfills or burial
- » Industrial Composting
- » Anaerobic Digestion
- » Incineration
- » Rendering

“When comparing or choosing between these methods, it is recommended to consider the material and determine its ‘best use,’” says Ross Hamilton, Ph.D, VP Government Affairs, Related Technology and Biosecurity of Darling Ingredients. “Available landfill space is a growing limitation, and introducing organic, carbon-based materials can cause serious problems if the landfills are not properly equipped and monitored. Meat by-products and used cooking oils decompose and deteriorate in ways that are not safe environmentally. Landfills, composting, digesters and incineration fail to make the best use of the intrinsic value they still possess.”

There are other considerations that play into the comparison of these methods⁷:

- » If the **52 billion** pounds of unconsumed meat by-products that renderers collect annually were to be placed in landfills, it’s estimated the US would run out of space in **4 years**.
- » During the industrial composting process, **45-75%** of carbon from animal by-products is released as CO₂; yet **4-20%** can be released as methane, and nitrogen can emit as ammonia or as nitrous oxide (N₂O) – potentially more harmful GHGs than CO₂.

- » Digesters require time, controls and energy to destroy pathogens that pose a high risk to the environment. If the slurry is stored in open tanks, the GHG emissions are multiplied by 10x.
- » Composting, digestion and burial are not subject to consistent federal regulations on air or wastewater emissions and have no regulations that relate to the spreading of animal disease/pathogens.
- » Although incinerating animal by-products is effective on a small scale, the cost of powering an incinerator and the effect incineration has on air quality make it unsustainable for large-scale use.

By comparison, the rendering industry is subject to regulatory oversight by multiple federal, state and local agencies, including the FDA, EPA, OSHA, USDA and other industry groups. The combination of regulations, high temperatures used during rendering that kill off pathogens, and the repurposing of the material into new products makes rendering the safest and most sustainable way to handle meat-based waste materials and used cooking oils⁸.

Risk to the food chain

Meat by-products not disposed of properly present a real and critical threat to human, animal and environmental health. During natural decomposition, animal by-products provide a cozy breeding ground for pathogens, such as Salmonella and E. coli¹⁰. The material also becomes a food source for rodents and other predatory creatures that can spread disease that threatens both human and animal health.

"The FDA (Food and Drug Administration) is the big guy in ensuring the safety of animal feed," says David Meeker, Sr. VP Scientific Services, North American Renderers Assoc. (NARA) and Director of Research for the Fats and Proteins Research Foundation (FPRF). "Every state has their own feed regulations, but each state complies with the FDA."

In its Compliance Policy Guide (Sec. 675.400 "Rendered Animal Feed Ingredients"), the FDA recognizes rendering's role in diverting waste human food to animal feed, explaining that the rendering process was designed to ensure the resultant animal feed ingredients pose no threat of disease transmission to animals or humans consuming animal products (meat, milk and eggs).

Improperly handled used cooking oil may also disrupt the food chain on an environmental, health and business level. As with meat-based food waste, used cooking oil demands proper handling.

While composting used cooking oil may seem like a viable option, oils left in a compost heap can emit odors, attract disease-spreading rodents and pests, reduce air circulation, and slow down the composting action⁹.



At the commercial level, foodservice businesses that dispose of oil down the drain risk trap blockages and grease spills. These circumstances can cost a business downtime or heavy fines,

particularly if the grease enters municipal storm drains. And on a safety level, employees who handle hot used cooking oil risk spills, falls and burns, which could potentially have a financial and personnel impact on restaurant or business operations.

Our Purpose is to Repurpose

Darling Ingredients, the oldest and largest independent renderer in the US, has been picking up inedible meat by-products for over 135 years. Originally known for converting these by-products into soaps and fertilizers, the company has expanded to producing animal feed proteins and a full array of food, feed and fuel ingredients.

Meat by-products are collected from meat lockers, packing plants, butcher shops and grocery stores, while used cooking oils are collected from restaurants and other foodservice industries.

Although the methodology may vary, the core rendering process is fairly simple, resulting in a safe and efficient way to convert these materials into a variety of value-added ingredient products.

At its simplest, renderers like Darling Ingredients convert these materials under strict regulatory controls into fats and proteins. The proteins are used primarily in the collagen and gelatin markets and as nutritional and functional ingredients for food and feed; the fats are primarily used for biofuel and bioenergy. Fatty acids are a co-product used in numerous products.

Annually
in North America, over
50 billion
pounds of meat by-products
come from ranchers and meat
processing plants;



2.3 billion
pounds of retail meat scraps
are picked up each year from
supermarkets and butchers;



4 billion
pounds of used cooking oil is
collected from restaurants,
fast food chains and other
foodservice businesses.

A Second Life

The rendering process allows for 100% of the materials we collect to be safely transformed into sustainable ingredients. The ingredients that we produce are in turn used by manufacturers in a wide range of industries to make a variety of usable goods the world uses daily, including:

- animal feed • pet food • meat binders
- renewable diesel • biodiesel
- organic fertilizer • green energy
- surgical supplies • nutrition supplements
- pharmaceutical pill coatings • cosmetics
- anti-aging and joint health applications
- natural sausage casings • confectionaries
- industrial goods • household goods

... and much more. Without rendering, manufacturers would have to find other sources to replace the ingredients our industry supplies – sources that likely would not be as sustainable and require more of our world's natural resources to produce.

Safety

Verifying the safety of the meat by-products for use in animal feed is an ongoing mission of industry groups like the **North American Renderers Association (NARA)** and the **Fats and Proteins Research Foundation (FPRF)**. The NARA works to ensure its members operate in compliance with all federal, state, and local regulations regarding human, animal and environmental health. Studies⁹ published by the FPRF report that the high heat used during the rendering process is an effective preventive control for bacterial hazards found in raw beef materials, such as Salmonella.

This industry group assists in setting processing standards for animal food safety plans, which in turn protect the safety of the human food chain.

At its most basic, the first step in the dry rendering process is to grind the material into uniform bits and expose them to high temperatures in a cooker. The fat is rendered out, separating it from the proteins.

Water that is evaporated from the material can be reclaimed and used to help power the plant or be pre-treated for release to municipal water treatment facilities. The fat that is separated is further processed to recover tallow, fats, fatty acids and oils, and the meat and bone are ground into protein meals and minerals. At dedicated and highly regulated food-grade plants, similar but more specialized processes are used to recover gelatin, collagen, peptides and blood plasma.

3 key factors that make rendering the superior option for handling meat by-products:

- It kills off harmful pathogens within the first two minutes
- Reclaims the ~60% of water present in animals
- It separates the fat from meat and bone

Used cooking oil is similarly treated, straining out debris before it is treated to evaporate and reclaim any water. Both the grease and the reclaimed water are treated to meet all standards needed for its end use.

Creating Sustainable Biofuels

Biofuel can be made from several types of feedstock, including animal fats, used cooking oil, corn (ethanol), soy, seed oils, algae and other experimental sources. At Darling Ingredients, **recycled animal fats** and **used cooking oils** are used to produce two types of biofuel: biodiesel and renewable diesel. While these sustainable biofuels are made from the same feedstock, they are produced using different techniques, yielding two distinct products.

Biodiesel refines recycled animal fats and used cooking oils through a chemical process called transesterification¹³. This process results in a clean, biodegradable fuel that emits up to **85% less greenhouse gas emissions** than petroleum diesel when measured at 100%. Because of the presence of oxygen in the fatty acids used to make this type of biofuel, biodiesel can be subject to solidifying in cold weather, separation, instability issues and algae growth. To reduce these risks, it is blended with conventional diesel at ratios of 5% to 20%. Biodiesel meets all government regulations to reduce vehicular emissions, including California's Low Carbon Fuel Standard, and the EPA's Renewable Fuel Standard.

Renewable diesel also uses animal fats and UCO as feedstock. However, Darling's renewable diesel is produced using a hydrocracking method that results in an oxygen-free biofuel with a near identical chemical structure as petroleum-based diesel¹⁴. This similarity means that it isn't prone to the limitations biodiesel may face. Darling produces 275 mill. gallons a year at its **Diamond Green Diesel** facility in Louisiana, expanding to 675 mill. by late 2021.

Benefits of renewable diesel:

- Doesn't solidify in cold weather
- Does not separate
- Isn't susceptible to algae growth
- Requires no engine modification
- Fulfills low carbon mandates, reducing emissions by 85%

Renewable diesel can be dropped into and distributed via diesel pipelines and used in diesel engines without blending. Additionally, renewable diesel burns even cleaner than clean-burning biodiesel, with less carbon emissions and a better cetane rating.

Safe Ingredients for Feed & Food

Recycled meat by-products.

Approximately 40% of the animal fats collected in North America by **DAR PRO Solutions** and **Rothsay**, brands of Darling serving the foodservice industry, are used for biofuel production. The fats not used for biofuel are primarily used as nutritional ingredients in animal feed and pet food.

The proteins recovered from the processed meat by-products have nutritional value and enhance the health and well-being of pets and animals. Darling's **Nature Safe** brand also uses them to produce organic fertilizer at three facilities in the US. At dedicated food-grade plants in Europe and South America, Darling's **Rousselot** and **Peptan** brands produce gelatin and collagen peptides, and **Sonac** produces binders and fillers that are commonly used in processed meats to enhance flavor and texture.

Used Cooking Oils

As mentioned previously, rendered meat by-products are primarily used to produce biofuel, animal feed or pet food. Over 90% of the used cooking oil DAR PRO and Rothsay collect is used to produce biofuel.

Sustainable Ingredients for Industrial & Consumer Products

The processed fats and UCO also yield fatty acids that are used by consumer and industrial manufacturers. Products such as **oleic acid, stearic acid, linoleic acid and glycerin** are used in numerous applications, including:

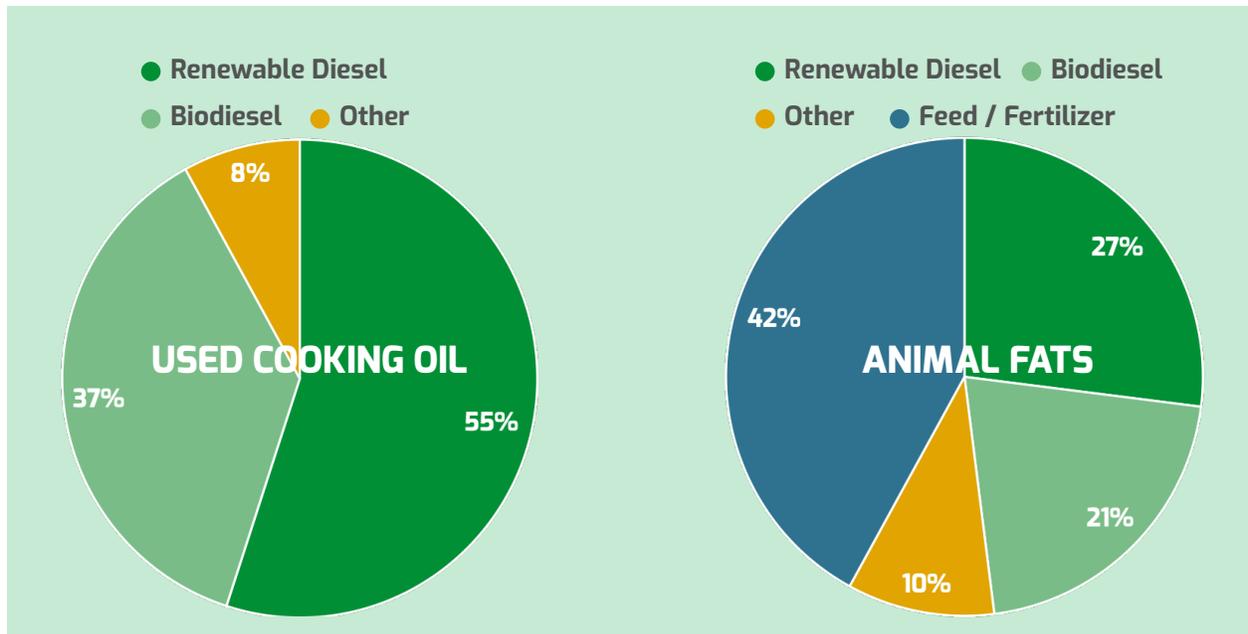
- Textiles · Industrial lubricants · Paints · Shampoos · Cleansers · Plastics
- Emulsifiers · Adhesives · Inks · Rubber · Solvents · Perfumes · Crayons
- Caulk · Antifreeze · and much more

According to the North American Renderers' Association, the rendering industry produces

11 billion pounds EACH

of **Fat & Oil** products and **Protein** products per year in the U.S.

Darling Ingredients processes used cooking oils and animal fats and tallows into sustainable products used in a variety of industries.
(Charts below from 2018 company data)



2. The Role of The Gatekeepers

Although the true impact of the rendering industry is difficult to quantify, it plays a crucial role in protecting the health of humans, animals and the environment. Studies have shown that **66% of consumers will pay higher dollar amounts for sustainable brands**¹⁵. Incorporating low-cost, rendered ingredients may increase a product's profitability and popularity.

Rendered products also reduce demands on finite resources and offer sustainable solutions for our world's food, feed and fuel needs. Without rendered outputs to fulfill production demands, manufacturers and consumers would be forced to turn to finite resources to replace them. This would increase demands on crop land and water and require an increase in the development of alternative products without the benefit of a lower carbon intensity lifecycle that rendered products offer.

Biosecure Solutions for Handling Food Waste

The rendering industry is subject to strict federal and state regulations that help ensure the quality and biosecurity of its products. These measures help control against foreign disease outbreaks and create a lower environmental impact when compared to alternate disposal methods.

Some of the benefits to rendering these meat by-products versus disposal methods such as landfills, composting or incineration include:

- » **Diverting organic materials** from being placed into landfills, compost heaps and ground burials
- » **Capturing carbon and nitrogen** to avoid substantial GHG emissions
- » Providing a **sustainable, safe source of essential nutrients** for living things
- » **Reducing demand for fossil fuels** by recycling fats and used cooking oils used into biofuel and bioenergy
- » **Sparing the comparable space and resources** required to grow crops for animal feed or biofuel
- » Offering a **sustainable solution to the illegal and problematic dumping of used cooking oils** down drains and into municipal water systems

In addition to the environmental benefits of rendering, the industry also plays an active role in their surrounding communities. By providing employment opportunities and charitable donations of time, talent and dollars, individual rendering plants help support their local economies. And through ongoing research that builds from their expertise, the rendering industry assists in developing innovative products and services to improve lives and protect world health.

The combination of the rendering process, regulatory oversight, and the development of a second use for these "waste" materials makes rendering the most sustainable and safest solution for disposing of meat-based by-products and used cooking oil.

Protectors of the Environment

Rendering helps control the spread of disease and pathogens through the safe processing of organic material. This in turn helps protect grazing animals and provides a safe feed ingredient source, thereby protecting our food chain.

Another notable way the rendering industry impacts the environment is in its dramatic reduction of greenhouse gas emissions. Like any industrial operation, rendering facilities have a carbon footprint (ie, energy used in operations, the transportation of raw material, use of freshwater, GHG emissions)⁵. However, **a typical rendering facility prevents 5-8 times more carbon equivalent from entering the atmosphere than it releases**¹⁶. This

**In Darling's
2018 US operations alone**

1.67 billion gallons

**of water was reclaimed
from animal
by-products during the
cooking process....
enough to fill**

2,529

Olympic-sized pools²⁰.



is in part due to preventing carbon-based raw materials from releasing the harmful gases that would be emitted through decomposition or composting.

In total, the rendering industry as a whole **reduces annual GHG emissions by annually removing the 4.7 million metric tons** of carbon-rich material from landfills, composting, burial or incineration, and recycling it into useable products¹⁷.

- As carbon decomposes, it releases carbon dioxide (CO₂). If this material is **not removed** from the waste stream, the CO₂ emitted would be the equivalent of **adding 3.2 million cars** to the nation's roads.*
- As carbon materials decompose, methane and nitrogen (nitrous oxide) can also be released. If we express the emissions as 20% methane and 10% N₂O, each of which have greater global warming potential than CO₂, the effect of **preventing** these methane and nitrogen emissions is the equivalent of **removing 12.3 million cars**.*

(* Based on 4.7 mill. metric tons/yr)

Rendering facilities also function as net producers of water. Meat by-products are composed of approximately 60% water. Through efficient processing, US renderers evaporate **4 billion gallons of water** annually through its cooking process. Although rendering plants use fresh water to run their operations, more water is returned than is used. This pre-treated water can be used by plants during cleaning processes or be returned to the municipal water supply for further treatment.

3 Conclusion

By collecting and recycling both the edible and inedible meat by-products in a safe, regulated and environmentally conscious manner, the rendering industry has quietly taken on the role of Gatekeeper of the Food Chain. Through its various processes, renderers are able to convert some of the ever-growing food waste generated in developed countries and return it as valuable ingredients to a wide variety of industries.

Not only do rendered end products meet consumer demand, they play a critical

role in reducing the carbon footprint of the many products they are used in. And although landfills, composting, burial and incineration have their place in handling some forms of food waste, rendering is the most efficient and sustainable solution for fats and meat-based product.

Because of the ongoing demand for sustainable products and a need to combat an excess amount of nutritional waste, the rendering industry will continue to work in the background, developing solutions to help protect people, animals and planet.

Future greenpapers in our *Gatekeeper of the Food Chain series* will take closer looks at the environmental protection role of the rendering industry, how regulations and biosecurity ensure product safety and help protect the food chain, and how Darling Ingredients has been a pioneer and innovator for the rendering's industry growth and critical position in the world today.

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