

## Where Has All the TOFA Gone?

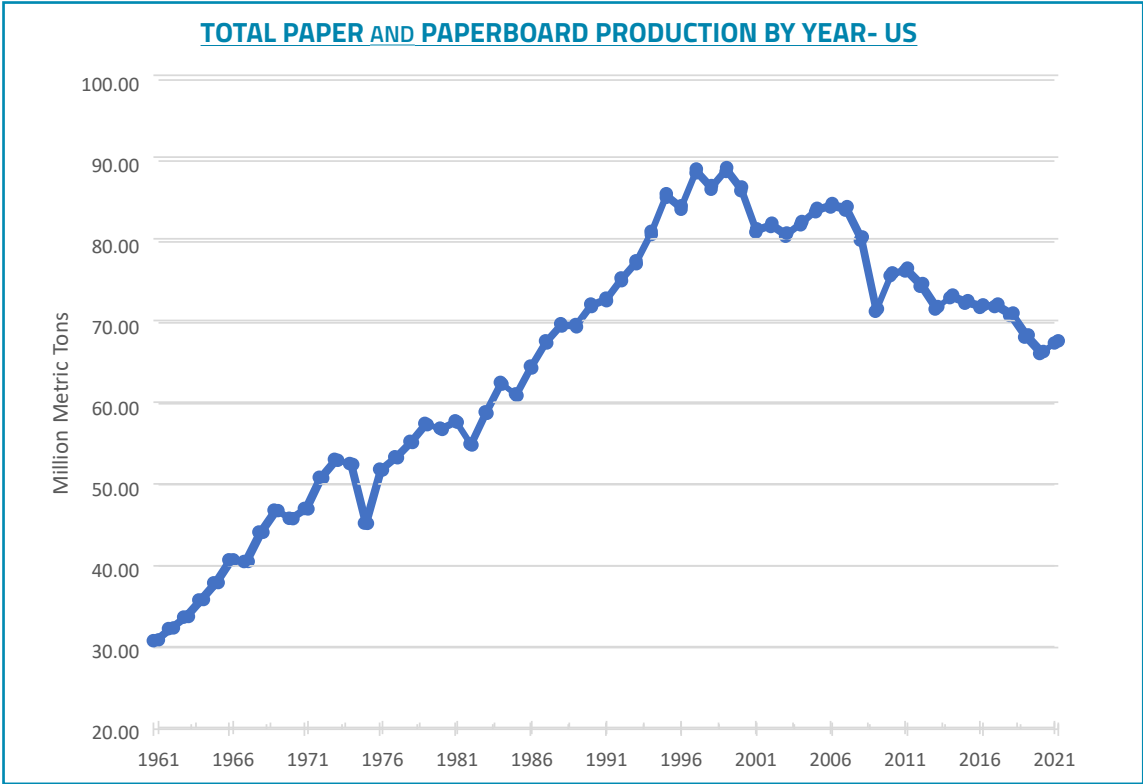


Tall Oil Fatty Acid (TOFA) is a versatile chemical with many uses. And this is becoming a problem. TOFA has traditionally been favored by chemical intermediate producers and formulators of consumer and industrial products such as paints, alkyd resins, metalworking fluids, rubber, etc. These sectors are now caught in TOFA's supply chain *perfect storm*: reduced supply of the raw material used to make TOFA and increased demand for TOFA by the renewable fuel industry.

Alternatives to TOFA exist, but to date, none have been chemically similar enough to TOFA to directly replace it in a wide range of applications. However, an advanced catalyst-enabled hydrolysis process has emerged from vegetable oil feedstocks, sourced locally in North America, as a viable approach to producing a new class of true TOFA alternatives.

### Less Demand for Paper Reduces TOFA Supply

TOFA is produced from a single raw material, crude tall oil (CTO), which is a byproduct of the Kraft pulping process. The supply of TOFA is therefore limited by the production of virgin paper and paper board. Kraft operations require massive amounts of energy and water while producing lesser amounts of CTO. The production of paper and paperboard has been declining for years. U.S. production peaked in 1999 at 88.7 million metric tons and has since declined 24%.



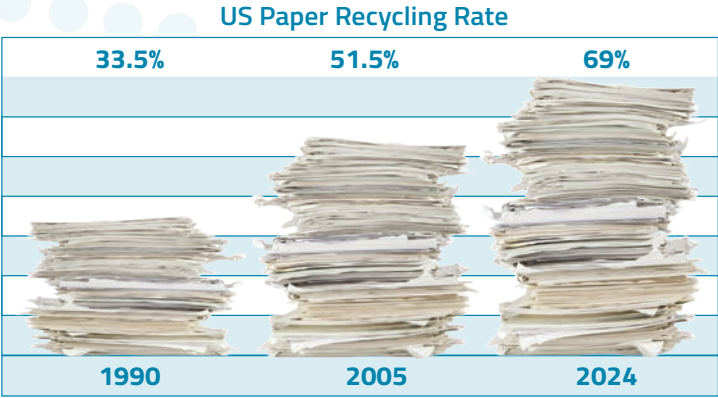
Source: Food and Agricultural Organization of the United Nations

### Environmental Awareness Contributes to Reduced Tofa Supply

According to the American Forest & Paper Association (AFPA) nearly 68% of paper consumed in the U.S. was recycled in 2022.

“Paper recycling is a success story, and our industry’s commitment continues,” says Heidi Brock AFPA President and CEO. “We are working to use even more recycled paper in manufacturing and set a goal to increase the use of secondary materials, like recycled paper, in new paper products to 50% by 2030. These recycled paper products are a key component to our circular value chain.”

Paper recycling preserves trees and other natural resources, reducing the need for virgin pulp, thereby reducing the availability of CTO to produce TOFA.



American Forest and Paper Association

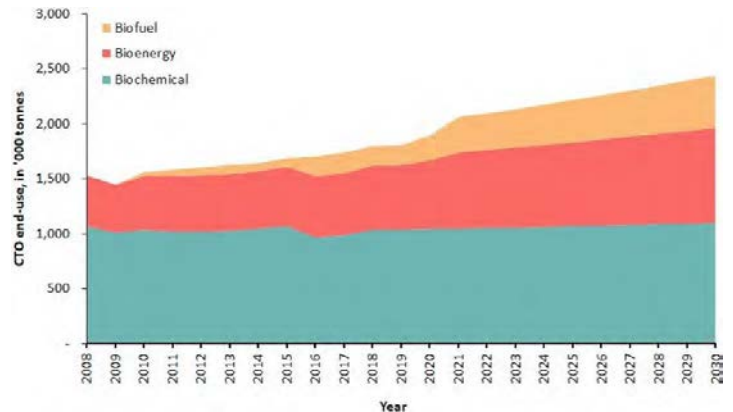
## Bioenergy and Biofuels Consume an Ever-Increasing Share of CTO

As the preference for bio-based energy and fuels has increased, the amount of CTO used for these purposes has risen, increasing from 500,000 tons in 2008 to over 800,000 tons in 2019.

In 2018, the European Union revised their Renewable Energy Directive (RED II), increasing the use of clean energy across all sectors. This mandate has been legally binding since 2021.

The directive incentivizes the use of CTO for bio-energy and bio-fuels, leading to the establishment of facilities to fractionate CTO. For example, in 2022, Fintoil (Finland) completed construction on a facility to fractionate 200,000 tons of CTO per year.

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## Effective TOFA Alternatives

Driven by tight supply and rising prices, TOFA users are searching for alternatives. Some processes can tolerate a switch from CTO to whole-cut fatty acids, such as soybean fatty acid. In the U.S., seed oil production industries are historically resilient, long-established, and easily capable of meeting high market demand. Oleochemical manufacturers located close to the American vegetable and seed production heartland can also take advantage of short supply chain routes to minimize incoming and outgoing delivery lead times. However, there is no whole-cut fatty acid that matches the characteristics and performance of TOFA. Achieving the properties of TOFA requires blending of various vegetable oil fatty acids.

The emergence of a proprietary biocatalytic splitting technology (BST), an oleochemical innovation developed by Trucent Renewable Chemicals, (Van Wert, OH) produces high-quality fatty acids from over a dozen different vegetable oils and vegetable oil blends, closely matching TOFA's properties and performance. Trucent's BST proprietary process utilizes an advanced bioreactor design to ensure consistent product production with up to 75% reduction in energy consumption compared to conventional oleochemical processes. In 2021, Trucent's Renewable Chemical Division constructed the first-of-its-kind BST commercial facility.

BST production, with its catalyst-enabled hydrolysis process, produces plant-based, oil-derived TOFA alternatives. Distinguished by an innovative bioreactor design, BST efficiently generates fatty acids on an industrial scale, bypassing the need for the traditional Kraft process that generates CTO to make TOFA, by meticulously isolating the triglycerides in seed and vegetable oils into their elemental fatty acids—stearate, oleate, and linoleate.

## TruFA: The Definitive TOFA Alternative

In response to the demand for effective TOFA alternatives, Trucent Renewable Chemicals introduces TruFA, a precisely engineered line of fatty acids that addresses the challenges faced by industries seeking an alternative to increasingly elusive TOFA. Drawing upon the advancements of Trucent's biocatalytic splitting technology, TruFA emerges as the quintessential TOFA alternative, delivering exceptional performance without the traditional constraints associated with the Kraft process, CTO, or TOFA.

### Close Attributes to TOFA

TruFA closely mirrors the attributes of TOFA, providing a seamless transition for industries accustomed to the properties of traditional tall oil fatty acids. The composition of TruFA, achieved through a catalyst-enabled hydrolysis process, is the result of Trucent's commitment to replicating the characteristics that have made TOFA an industry staple.

### Benefits of TruFA

**Sustainability:** Derived from over a dozen different seed and vegetable oils, TruFA™ aligns with sustainable practices, contributing to a significantly reduced environmental footprint. Unlike traditional raw materials sourced from trees, which require decades of growth before harvest, seed oils are cultivated and harvested annually, often multiple times per year. This accelerated growth cycle enhances the sustainability profile of TruFA, ensuring a renewable and eco-friendly source to produce tall oil fatty acid alternatives. This commitment to a more efficient and environmentally responsible raw material underscores TruFA's dedication to a sustainable future.

**Supply Chain Efficiency:** Leveraging the proximity of the American heartland of vegetable and seed production, TruFA ensures shortened supply chain routes, minimizing lead times for incoming and outgoing deliveries. The raw material for TruFA, sourced from the farms of the North American breadbasket, represents a *farm to product* shortened supply chain. The strategic location of Trucent Renewable Chemicals in Van Wert, Ohio, not only enhances supply chain efficiency but also underscores a commitment to supporting local agriculture and ensuring a traceable, quality raw material for the production of our exceptional tall oil fatty acid alternative.

**Consistent Quality:** Trucent's advanced bioreactor design guarantees the consistent production of high-quality fatty acids on an industrial scale, providing reliability in every batch.

### Why TruFA is the TOFA Alternative:

TruFA is a formidable alternative, actually surpassing TOFA with unique benefits such as a low carbon footprint, plant-based seed oil sourcing, and a resilient supply chain. By isolating seed and vegetable oil triglycerides into essential fatty acids — stearate, oleate, and linoleate — TruFA exceeds industry standards. As a result, TruFA becomes the catalyst for reducing market dependence on CTO-based TOFA production and setting new benchmarks for excellence in the oleochemical industry.

### Rethinking Oleochemistry with Trucent

Visit [trucentrenewables.com](http://trucentrenewables.com) for technical data on TruFA and to determine its suitability for your specific application. Discover firsthand the reliability, sustainability, and exceptional performance that TruFA can bring to your industry.