Clariter Recognized for

2021

Technology Innovation Leadership

European Chemical Upcycling of Plastic Waste Industry

Excellence in Best Practices

FROST & SULLIVAN

Best Practices Criteria for World-Class Performance

Frost & Sullivan applies a rigorous analytical process to evaluate multiple nominees for each award category before determining the final award recipient. The process involves a detailed evaluation of best practices criteria across two dimensions for each nominated company. Clariter excels in many of the criteria in the commitment to innovation, commitment to creativity, commercial success and application diversity, customer acquisition and growth potential space.

Commitment to Innovation and Creativity

Headquartered in Luxembourg, Clariter is a global clean-tech innovation company specializing in the development of a chemical recycling (i.e., upcycling) process that provides a solution to the global challenge of plastic waste incineration and landfill issues.

According to the United Nations Conference on Trade and Development, pollution due to plastic waste was already one of the greatest threats to our planet before the start of the COVID-19 pandemic. However, due to the coronavirus outbreak, there has been a sudden boom in the use of plastic-based products such as gloves, plastic face masks, food packaging, and hand sanitizer bottles. While designed to prevent the spread of infection, it is making plastic pollution worse[1]. Recycling is a solution to mitigate the growing amount of single-use, industrial, municipal, and other streams of plastic waste.

Mechanical recycling is a commonly used technology to recycle plastic waste. However, it is limited as this technique does not recycle all polymeric materials and mixed plastic waste[2]. As a result, waste handlers and municipalities must burn or dump the waste. Moreover, constantly changing environmental regulations make burning or dumping plastic waste difficult to manage. As a result, plastic packaging and

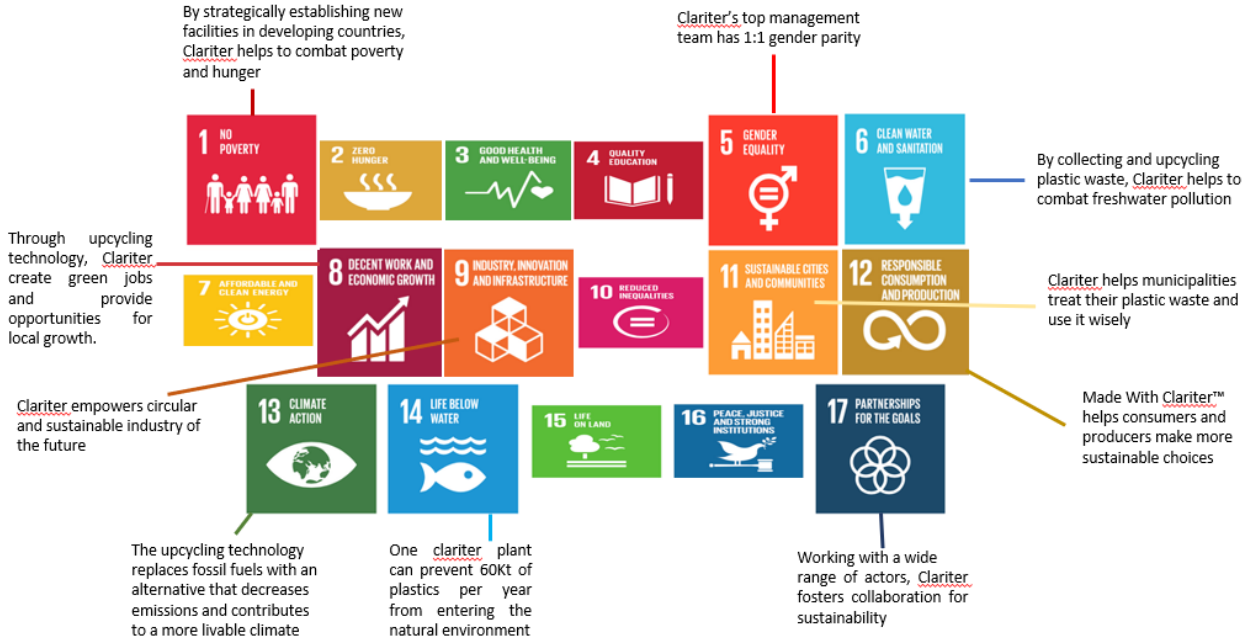
[1] https://unctad.org/news/growing-plastic-pollution-wake-covid-19-how-trade-policy-can-help
[2] Frost & Sullivan; December 2020; "Technological Advancements Enabling Plastics Recycling"

petrochemical brand owners observe a growing consumer demand for cleaner and more sustainable solutions. To address growing consumer demand, most stakeholders in the recycling value chain are converting waste plastics into fuel, energy, or other plastics[3].

Clariter's commitment to providing a clean technology solution has advanced beyond the aforementioned stakeholders. Its unique chemical upcycling technology results in products with a multitude of applications. Moreover, Clariter's solution enables the proactive ability to clean the planet of plastic waste, fossil fuel-free manufacturing, and the creation of environmentally friendly products. The company's revolutionary chemical upcycling technology is also empowering the recycling industry to meet sustainability regulations, reduce the CO2 footprint, create green jobs, and build a stronger community.

Figure 1: Sustainability Development Goals (SDGs)

Clariter's chemical upcycling technology directly contributes to 10 out of 17 United Nations' SDGs



Source: Clariter, Institute of Entrepreneurship Development (iED)

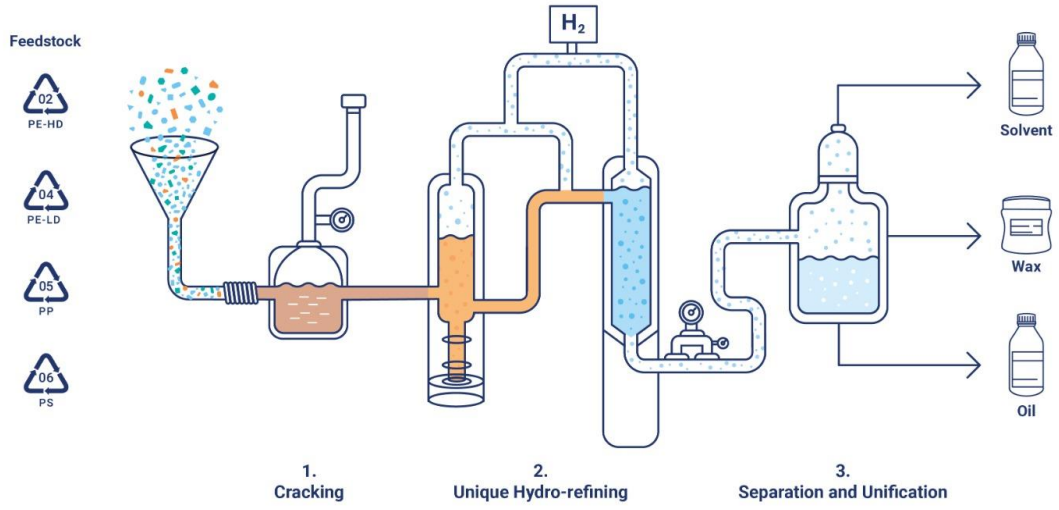
Clariter's patented upcycling technology involves a unique chemical process that allows dynamic control of every parameter, including process temperature, sensitivity to feedstock contamination, and the polymer breakdown level. As a result, the company ensures the highest product quality output compared to complementary technologies such as mechanical recycling, pyrolysis, catalytic cracking, or solvent-based recycling.

[3] Frost & Sullivan; December 2020; "Growth Opportunities in Recycling Technologies"

The company's proprietary technology consists of three stages:

1) **Continuous Thermal Cracking:** Waste plastic (mainly polylefins) is converted into a large range of hydrocarbons.
2) **Multi-stage Hydro-Refining:** Clariter improves hydrocarbon properties by removing impurities (e.g., heteroatoms such as sulphur, chlorine, and nitrogen) and transforming olefin and aromatic compounds into paraffinic and naphthenic hydrocarbons.
3) **Distillation and Separation:** The distillation of refined fractions allows for the creation of stable three products' families (i.e., solvents, oils, and waxes), which are subsequently blended into multitude of consumer end products.

Figure 2: Clariter's Three-step Chemical Process



Source: Clariter

Compared to other waste treatment routes for polyolefins, Clariter's upcycling technology shows several benefits, such as:

- The company's unique upcycling technology has achieved a net negative carbon footprint, meaning it does not add to, but rather depletes carbon from the planet. The results stem from an independent initial Life Cycle Analysis (LCA) carried out by CE Delft, the renowned research and consultancy firm. The LCA determined that Clariter's carbon footprint is below zero indicating a net environmental benefit, with the solution actually reducing carbon emissions. At the moment, we know of no other recycling technology that really cleans the planet, as opposed to simply reducing pollution.
- The benefits of Clariter's upcycling technology supersede commonly used processes such as pyrolysis. For example, while pyrolysis can be used to produce fuel, energy, or new plastics, thereby prolonging the life of plastics, Clariter transforms plastics into high-value, pure industrial products which are then used "as-is" as ingredients for a multitude of consumer end products

such as metal working fluids, coatings, paints, cleaners, inks, greases, polishes, waxes, candles, furniture, silicone sealants and others.

- A full-scale plant leveraging Clariter's upcycling technology demonstrates favorable energy use compared to municipal solid waste incineration processes.
  Clariter's technology uses challenging plastic waste streams as feedstock, allowing it to recycle the majority of all plastic waste. Also, the technology requires limited pre-treatment of feedstock due to its high tolerance to a variety of mixed plastic resins

Commercial Success and Application Diversity

The seed of Clariter's upcycling technology was conceived by Professor Andrzej Bylicki, a Polish chemist. The concept was further developed due to a strong research and development (R&D) team, allowing Clariter to perfect the upcycling process. Today, the company's technology is already in use at two sites: a 300 square meter R&D plant in Gliwice, Poland, and a 15,000 square meter industrial-scale demonstration plant in East London, South Africa. Clariter has also started the rollout for several facilities across the Middle East and Europe. Together, these facilities are expected to transform approximately 240 kilotons of waste plastic, resulting in an annual production of approximately 200 kilotons of clean, pure, and high-value products.

Frost & Sullivan notes Clariter's upcycling technology ability to convert polyolefins into wax, solvents, and oils can support the creation of multitude crude oil-free consumer products. For example:

- **Clariwax®:** is a paraffinic wax produced from Clariter's technology. It can be used for the manufacture of candles, wax emulsions, greases, wood coatings, leather care, anti-corrosive protection, petroleum jelly, personal care and others.
- **Solventra®:** is an aliphatic solvents range that can be used in inks, coatings, metal working fluids, industrial cleaning, dry cleaning, households' cleaners, tire manufacturing, adhesives and sealants, carrier for offshore drilling fluids, carrier of crop protection agents, coalescing agent in water-based paints, metal surface dewatering, and more.
- **Oilter®:** is a white oil that can be used for the manufacture of inks and resins, silicon sealants, oil for personal care and cosmetics, carrier for fragrances, defoaming oil, functional fluid for transformers, process oil for rubber production, oil for aluminum rolling, metal working fluids, lubricants, a liquid-to-liquid extraction process solutions, and others.

Frost and Sullivan recognizes the ability of Clariter's proprietary technology to be useful across a range of applications and also to aid end users in becoming more self-sufficient and less carbon-intensive. Such capabilities are a competitive differentiator and best practice.

"Clariter's upcycling process produces oil, wax, and solvent products that are pure and have no sulfur or toxins. Unlike competing technologies whose produced products have an off-smell, products formulated using Clariter's upcycling process are non-aromatic."

- Piyush Bhade, Senior Analyst

Customer Acquisition and Growth Potential

Clariter has been increasing its customer base since the launch of its proprietary upcycling technology in 2003. In the near future, the company expects to expand its sales by 50%. Frost & Sullivan notes that such a projection is due to Clariter's key differentiating features and benefits compared to other commercially available polyolefin-based recycling technologies. Moreover, the company is opting for partnership and collaboration strategies with key industry participants to boost revenue growth in the near future further. For instance, in 2021, Clariter signed a strategic partnership with Royal DSM to employ its recycling solution for DSM's ultra-high-molecular-weight polyethylene fiber (Dyneema®)-based products. Furthermore, in December 2020, Clariter collaborated with Manufacture France Produits d'Entretien, a French-based wood and leather care manufacturer, to produce a wide range of sustainable, consumer-based products upcycled from waste plastics.

The cleantech company is supported by highly experienced sales, marketing, and business development teams that work closely with its technical team to address diverse client needs by developing customized solutions from its upcycled products. Clariter's industrial-scale plant, located in East London, South Africa, is specifically designed to serve as an industrial plant, R&D and training facility, and flagship demonstration plant. Through this plant, Clariter helps service providers, suppliers, licensees, and clients establish business plans, ensuring its customers gain a complete understanding of the final product's properties. The facility also allows for specific product testing as per the customer's demand.

Clariter's strategy of in-house R&D to support fossil fuel-free manufacturing and the creation of environmentally friendly products, coupled with robust online support to licensees, suppliers, and service providers, is superior compared to other commercially available recycling technology providers. As a result, it can attract more customers. Frost & Sullivan research finds that, unlike other technology providers converting plastic to plastic, or plastic to energy or fuel, Clariter is the only technology developer offering a climate-neutral and resource-efficient plastic-to-products solution.

Conclusion

Existing recycling technologies face limitations such as the inability to recycle all polymeric materials and mixed plastic waste, coupled with the inability to exert dynamic control over parameters such as process temperature, sensitivity to feedstock contamination, and the level of polymer breakdown. With rising consumer demand for cleaner and more sustainable solutions, Clariter is addressing industry challenges and emerging as a key participant due to its breakthrough chemical upcycling technology. Unlike other commercially available technologies, Clariter's proprietary and carbon-negative solution cleans the planet by accepting most waste plastics, even hard-to-recycle, problematic and mixed plastic streams. With its innovative climate-neutral and resource-efficient plastic-to-products solution, Clariter is an industry standout.

For its strong overall performance, Clariter earns Frost & Sullivan's 2021 Technology Innovation Leadership Award in the European chemical upcycling of plastic waste industry.

What You Need to Know about the Technology Innovation Leadership Recognition

Frost & Sullivan's Technology Innovation Award recognizes the company that has introduced the best underlying technology for achieving remarkable product and customer success while driving future business value.

Best Practices Award Analysis

For the Technology Innovation Leadership Award, Frost & Sullivan analysts independently evaluated the criteria listed below.

Technology Leverage

Commitment to Innovation: Continuous emerging technology adoption and creation enables new product development and enhances product performance

Commitment to Creativity: Company leverages technology advancements to push the limits of form and function in the pursuit of white space innovation

Stage Gate Efficiency: Technology adoption enhances the stage gate process for launching new products and solutions

Commercialization Success: Company displays a proven track record of taking new technologies to market with a high success rate

Application Diversity: Company develops and/or integrates technology that serves multiple applications and multiple environments

Business Impact

Financial Performance: Strong overall financial performance is achieved in terms of revenues, revenue growth, operating margin, and other key financial metrics

Customer Acquisition: Customer-facing processes support efficient and consistent new customer acquisition while enhancing customer retention

Operational Efficiency: Company staff performs assigned tasks productively, quickly, and to a high-quality standard

Growth Potential: Growth is fostered by a strong customer focus that strengthens the brand and reinforces customer loyalty

Human Capital: Commitment to quality and to customers characterize the company culture, which in turn enhances employee morale and retention

About Frost & Sullivan

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The Growth Pipeline Engine™

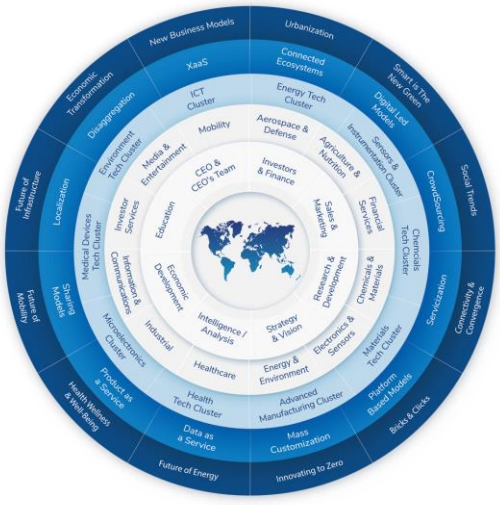
Frost & Sullivan's proprietary model to systematically create on-going growth opportunities and strategies for our clients is fuelled by the Innovation Generator™. Learn more.

Key Impacts:

- **Growth Pipeline:** *Continuous flow of Growth opportunities*
- **Growth Strategies:** *Proven Best Practices*
- **Innovation Culture:** *Optimized Customer Experience*
- **ROI & Margin:** *Implementation Excellence*
- **Transformational Growth:** *Industry Leadership*

The Innovation Generator™

Our six analytical perspectives are crucial in capturing the broadest range of innovative growth opportunities, most of which occur at the points of these perspectives.



Analytical Perspectives:

- Mega Trend (MT)
- Business Model (BM)
- Technology (TE)
- Industries (IN)
- Customer (CU)
- Geographies (GE)