



Renewable chemicals naturally designed and engineered to deliver the performance that adds value to industrial products.

Renewable and Bio-based Products for Industrial Use

Renewable Products

Green Biologics is a producer of 100 % renewable n-butanol and acetone, which we aim to provide to all industries to enhance the sustainability of global manufacturing, repair, and service processes and products. Our renewable products are produced through selective fermentation of C₅ and C₆ sugars by proprietary *Clostridium* biocatalysts and have as much as an 85 % lower carbon footprint than petroleum-based alternatives. Our renewable n-butanol and acetone, and their derivatives, are chemically equivalent to the petroleum-based products they replace, with little or no redesign of process work or formulations. Green Biologics is collaborating to chemically synthesise our platform chemicals into higher value derivatives, including butyl oleate, a metal working lubricant of high utility, as well as acetyl tributyl citrate (ATBC), a potential 100 % natural plasticizer that can be an alternative to toxic phthalates.



n-Butanol – Our product name for renewable n-butanol is GB nC4-OL™. It is a four carbon primary alcohol used as a solvent for a variety of cleaning and manufacturing processes such as dyes, gums, and pharmaceuticals. n-Butanol is a powerful paint and stain remover, and is an intermediate in the production of butyl glycol ethers and myriad of butyl esters, several of which are common facets of industrial maintenance and manufacturing. n-Butanol is a HAPS-compliant solvent, exhibits markedly low toxicity, and is readily biodegradable.

Acetone – Our product name for renewable acetone is GB C3-ONE™. It is a three carbon symmetrical ketone, and acetone is a highly valued cleaning solvent in myriad of applications. Acetone is a VOC-exempt solvent, allowing for use in many applications without the restrictions of other more hazardous volatile chemicals. Acetone is an excellent solvent for work with acrylic fibers, extraction, machinery manufacture and repair, as well as the manufacturing of insecticide, pharmaceuticals, polystyrene, rubber, and semiconductors. Additionally, acetone is a platform chemical for other cleaning ingredients such as isopropyl alcohol (IPA) and various ketones (MIBK, MIAK, MAK)



Bio-Based Products

Acetyl Tributyl Citrate – A nontoxic and readily biodegradable plasticizer, acetyl tributyl citrate can be made using entirely renewably sourced components (acetic and citric acids in addition to Green Biologic’s *n*-butanol). This biodegradable plasticizer has its primary use in plastic materials that need to be safe for contact with human mouths such as food packaging, children’s toys, and nail polishes. In addition to being safer phthalates, it has improved properties when used in cellulose nitrate films including resistance to yellowing and better adhesion to metal surfaces.



Butyl Acrylate – An extremely reliable and robust monomer with a growing market presence, butyl acrylate is a valuable material for food packaging producers. Butyl acrylate containing polymeric containers, films, and trays are recognized as safe by the FDA and EFSA. While research into a bio-derived acrylic acid is still underway in various research institutions and industrial facilities, a bio-based butyl acrylate made from Green Biologic’s *n*-butanol would be 57.8 % bio-based.

Butyl Lactate – A butyl ester produced from lactic acid and *n*-butanol, butyl lactate is typically used as an environmentally friendly, high boiling point solvent with a slow evaporation rate that makes it useful for dispersion of chemicals such as pesticides and herbicides. Lactic acid is a well-known carboxylic acid that occurs naturally in the human body and can be produced through industrial fermentation. Use of renewable *n*-butanol to make a bio-based butyl lactate would result in a 100 % bio-based product.

Butyl oleate – An ester of *n*-butanol and oleic acid, this monounsaturated ester is useful for its great solvency properties which allow it to be formulated into a variety of oils. Used by itself or in combination with metal-working oils, butyl oleate retards the accumulation of static energy and inhibits rust formation. The compound also has broad uses in the cosmetic industry due to its nontoxic nature where it adds moisturizing abilities to lipsticks and lotions.

Butyl stearate – The completely saturated analog of butyl oleate, butyl stearate is used more with PVC materials than metals, but still is renowned for its ability to repel water and add lubricity to junctions that move frequently. These properties make it an excellent choice to lubricate plastic mouldings and PVC pipes that carry aqueous solutions. Additionally, butyl stearate has uses as an emulsifier and plasticizer in the manufacturing of polymeric plastics and textiles.

