

LIFE TECHNOLOGIES™
SYNTHETIC BIOLOGY



Empowering development of biofuels & energy crops

Comprehensive workflow solutions to meet a growing demand

life
technologies™

Engineering clean, sustainable energy alternatives

Life Technologies offers a comprehensive portfolio of tools and services designed for metabolic engineering, enabling a more effective approach to optimizing organisms and bioproduction pathways, empowering the development of biofuels, energy crops, biobased chemicals, and CO₂ sequestration methods.

Genes and genetic tools for *improved energy crops*

- Tailored bioenergy crops
- Crop productivity and protection
- Stacked traits

Pathway engineering tools, techniques, and biodesign software for *optimized microbial conversions*

- More efficient pathways
- More robust and productive microbial hosts
- Increased tolerance for products and resistance to inhibitors

Optimized hosts for *drop-in end-products*

- Tailored end-products
- Enabled pathways for the production of drop-in fuels
- Biofuels (i.e., diesel and jet fuel)
- Biobased chemicals (i.e., alcohols, acids, and olefins)

Comprehensive, everyday workflow solutions

At Life Technologies you'll find the best means to complete these everyday workflow steps, regardless of which generation of biofuels you are developing.

Analyze

Utilize sequencing platforms to characterize organisms and the effects of different production environments

Design

Apply rational *in silico* design software to optimize gene expression for predictable and productive outcomes

Construct

Rapidly and easily create improved strains using powerful and flexible molecular construction products and services

Produce

Implement your solution, from small-scale research to industrial production

Supporting biofuel research and production across all platforms



Seeds or grains of edible food crops such as corn, rapeseed, palm, and soybean



Specialized nonfood crops and plants such as *Jatropha* and switchgrass



Waste biomass including stalks and wood chips



Algae

Case study: optimizing the workflow to produce engineered algal strains

Life Technologies sees the potential in creating new energy sources with algae. Our active partnerships attest to this dedication, as does our expanding product portfolio, which now includes GeneArt® Algae Engineering Kits. Contact us today to explore the potential for Life Technologies™ solutions in your production environment.

GeneArt® Algae Engineering Kits





New GeneArt® Algae Engineering Kits for *Chlamydomonas reinhardtii* and *Synechococcus elongatus* are the first commercially available genetic modification and expression systems for photosynthetic microalgae. These kits are designed for rapid scale-up and production, as well as consistent, defined quality.

- Algal cells arrive ready to resuscitate, grow, and transform, or store at -80°C until ready to use
- Every cell lot is manufactured using a standardized manufacturing protocol, so every experiment begins with quality control
- Optimized media, vectors, cells, and protocols permit robust selection and expression

To learn more, go to lifetechnologies.com/algaekit



Development strategy for GeneArt® Algae Engineering Kits

Characterization	Sequencing, annotation, and transcriptome analysis	Design and development	Process scalability improvements
			
<p>Goal: Determine suitability for scale-up under local growing conditions.</p> <p>Benefit: Selecting wild algae strains that exhibit the best lipid production and scalability potential mitigates the risk of late-stage failure.</p>	<p>Goal: Develop protocols for high-quality genomic/total DNA isolation; sequence the genomic DNA; develop genetic optimization tool kits specific for each algal strain.</p> <p>Benefit: Sequencing data provides key insights in developing metabolic models and protocols for optimizing algal growth and/or lipid production.</p>	<p>Goal: Metabolic engineering to generate prototypes for lipid production, screening, and testing.</p> <p>Benefit: Engineered algal strains optimized for lipid production and/or rapid growth demonstrate readiness for production and scale-up.</p>	<p>Goal: Propagate optimized algal strains in sun tubes or raceways to validate production capabilities.</p> <p>Benefit: Selecting wild algae strains that exhibit the best lipid production, robustness in real environments, and scalability potential mitigates the risk of late-stage failure.</p>

GeneArt® *Chlamydomonas* Engineering Kits. All kits come with algal cells and an expression vector (either pChlamy_1/D-TOPO® or pChlamy_1).

We also offer kits that include One Shot® TOP10 Chemically Competent E. coli and Gibco® TAP Growth Media. Go to lifetechnologies.com/algaekit for more details.





Biofuels: an emerging global solution

Few things are certain in life, but one constant remains: a finite supply of fossil fuels cannot sustain the needs of a world population of 7 billion people. The need for biofuels is rapidly evolving at a global scale.

The answers are growing

With a limited natural supply and a growing global demand, synthetic biology provides emerging, alternative energy solutions. At Life Technologies, we're partnering with the industry's most forward-thinking organizations and employing the most innovative, rigorous, and robust tools on the market to provide comprehensive solutions to the biofuel industry to develop, optimize, and mass produce new, renewable energy sources.

Inspired, connected, and driven partnerships



The synthetic biology group at Life Technologies understands that progress does not happen in isolation. Biofuel industry leaders look to us for the innovation and expertise to make biofuels a global reality, and we welcome the opportunity to discuss different forms of collaboration and strategic partnerships.



Genome sequencing and next-generation biofuels

From medicinal use to biofuels, the relatively small seeds of *Jatropha curcas* carry huge impact. Life Technologies and SG Biofuels, Inc., a bioenergy crop company, partnered to complete the sequencing of the *Jatropha curcas* genome to 100x coverage, using the SOLiD® 4.0 System. The sequence significantly accelerates the identification of key traits for the oilseed-producing crop and advances its development. Resistant to drought and pests, and able to thrive in locations not desirable for food crops, these oil-packed, nonedible seeds are a high-yield, low-cost source for next-generation biofuels.



Investing in innovation

Life Technologies made equity investments in Synthetic Genomics, Inc. (SGI), and a representative now sits on the board of directors of the private company. SGI's main areas of focus include the development and commercialization of solutions for synthetic gene and genome construction, bioenergy, food and nutritional products, next-generation vaccines, agriculture, and clean water. SGI have partner programs in the bioenergy space with Exxon Mobil and BP.



From research to implementation

In partnering with the San Diego Center for Algae Biotechnology (SD-CAB) at the University of California, San Diego, Life Technologies is supporting the development of innovative, sustainable, and commercially viable algae-based biotechnology solutions for energy, green chemistry, bioproducts, water conservation, and CO₂ abatement challenges.

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