

ExxonMobil and Synthetic Genomics Inc. today announced a breakthrough in joint research into advanced biofuels involving the modification of an algae strain that more than doubled its oil content without significantly inhibiting the strain's growth.

Using advanced cell engineering technologies at Synthetic Genomics, the ExxonMobil-Synthetic Genomics research team modified an algae strain to enhance the algae's oil content from 20 percent to more than 40 percent. Results of the research were published today in the peer-reviewed journal *Nature Biotechnology* by lead authors Imad Ajjawi and Eric Moellering of Synthetic Genomics.

Researchers at Synthetic Genomics' laboratory in La Jolla discovered a new process for increasing oil production by identifying a genetic switch that could be fine-tuned to regulate the conversion of carbon to oil in the algae species, *Nannochloropsis gaditana*. The team established a proof-of-concept approach that resulted in the algae doubling its lipid fraction of cellular carbon compared to the parent — while sustaining growth.

"This key milestone in our advanced biofuels program confirms our belief that algae can be incredibly productive as a renewable energy source with a corresponding positive contribution to our environment," said Vijay Swarup, vice president for research and development at ExxonMobil Research and Engineering Company. "Our work with Synthetic Genomics continues to be an important part of our broader research into lower-emission technologies to reduce the risk of climate change."

"The major inputs for phototropic algae production are sunlight and carbon dioxide, two resources that are abundant, sustainable and free," said Oliver Fetzer, Ph.D., chief executive officer at Synthetic Genomics. "Discoveries made through our partnership with ExxonMobil demonstrate how advanced cell engineering capabilities at Synthetic Genomics can unlock biology to optimize how we use these resources and create solutions for many of today's sustainability challenges — from renewable energy to nutrition and human health."

Algae has been regarded as a potential sustainable fuel option, but researchers have been hindered for the past decade in developing a strain that is high in oil content and grows quickly — two critical characteristics for scalable and cost-efficient oil production. Slower growth has been an adverse effect of previous attempts to increase algae oil production volume.

A key objective of the ExxonMobil-Synthetic Genomics collaboration has been to increase the lipid content of algae while decreasing the starch and protein components without inhibiting the algae's growth. Limiting availability of nutrients such as nitrogen is one way to increase oil production in algae, but it can also dramatically inhibit or even stop photosynthesis, stunting algae growth and ultimately the volume of oil produced.

The ability to sustain growth while increasing oil content is an important advance. Algae has other advantages over traditional biofuels because it can grow in salt water and thrive in harsh environmental conditions, therefore limiting stress on food and fresh water supplies.

Oil from algae can also potentially be processed in conventional refineries, producing fuels no different from convenient, energy-dense diesel. Oil produced from algae also holds promise as a potential feedstock for chemical manufacturing.

"The SGI-ExxonMobil science teams have made significant advances over the last several years in efforts to optimize lipid production in algae. This important publication today is evidence of this work, and we remain convinced that synthetic biology holds crucial answers to unlocking the potential of algae as a renewable energy source," said J. Craig Venter, Ph.D., Synthetic Genomics co-founder and chairman. "We look forward to continued work with ExxonMobil so that eventually we will indeed have a viable alternative energy source."

Since 2009, ExxonMobil and Synthetic Genomics have been partners in researching and developing oil from algae to be used as a renewable, lower-emission alternative to traditional transportation fuels. Swarup said that while the breakthrough is an important step, the technology is still many years from potentially reaching the commercial market.

"Advancements as potentially important as this require significant time and effort, as is the case with any research and development project," Swarup said. "Each phase of our algae research, or any other similar project in the area of advanced biofuels, requires testing and analysis to confirm that we're proceeding down a path toward scale and commercial viability."

ExxonMobil is engaged in a wide range of research on advanced biofuels, partnering with universities, government laboratories, and other companies. Global demand for transportation-related energy is projected to increase by about 25 percent through 2040, and accelerating the reduction in emissions from the transportation sector will play a critical role in reducing global greenhouse gas emissions.

ExxonMobil is also actively researching other emission-reducing technologies, including carbon capture and sequestration. In

2016, ExxonMobil announced its partnership with Connecticut-based FuelCell Energy, Inc. to advance the use of carbonate fuel cells to economically capture carbon emissions from power plants while generating hydrogen and additional electricity. Since 2000, ExxonMobil has spent about \$8 billion to develop and deploy lower-emission energy solutions across its operations.

NOTE TO EDITORS:

Vijay Swarup, Craig Venter and Oliver Fetzner will discuss the research breakthrough and answer questions during a media briefing scheduled for 10 a.m. PDT today at the San Diego Convention Center, located at 111 W. Harbor Drive, in Room 32B on the upper level. The live briefing and replay may also be accessed online via an interactive webcast.

About ExxonMobil

ExxonMobil, the largest publicly traded international energy company, uses technology and innovation to help meet the world's growing energy needs. ExxonMobil holds an industry-leading inventory of resources, is one of the largest refiners and marketers of petroleum products and its chemical company is one of the largest in the world. For more information, visit www.exxonmobil.com or follow us on Twitter [www.twitter.com/exxonmobil](https://twitter.com/exxonmobil).

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About Synthetic Genomics

Synthetic Genomics is programming the operating system of life to create sustainable solutions for humankind's most pressing issues, from the wellbeing of our population to the health of our planet. With an unmatched understanding of how DNA drives the function of cells — the basic biological units of all living organisms — Synthetic Genomics modifies and writes genomes to enable transformative products in the areas of vaccines, medicines, nutrition, and biotechnology research. In addition to designing novel organisms that overcome fundamental hurdles of scientific research and medicine, Synthetic Genomics pursues partnerships with organizations seeking to dramatically improve upon existing products in health care, energy, and other sectors. Continuing its legacy of scientific firsts in genomics and synthetic biology, Synthetic Genomics is harnessing the power of nature to improve quality of life. More information is available at www.syntheticgenomics.com.

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