ExxonMobil Algae Biofuels Research and Development Program

ExxonMobil

Taking on the world's toughest energy challenges.™

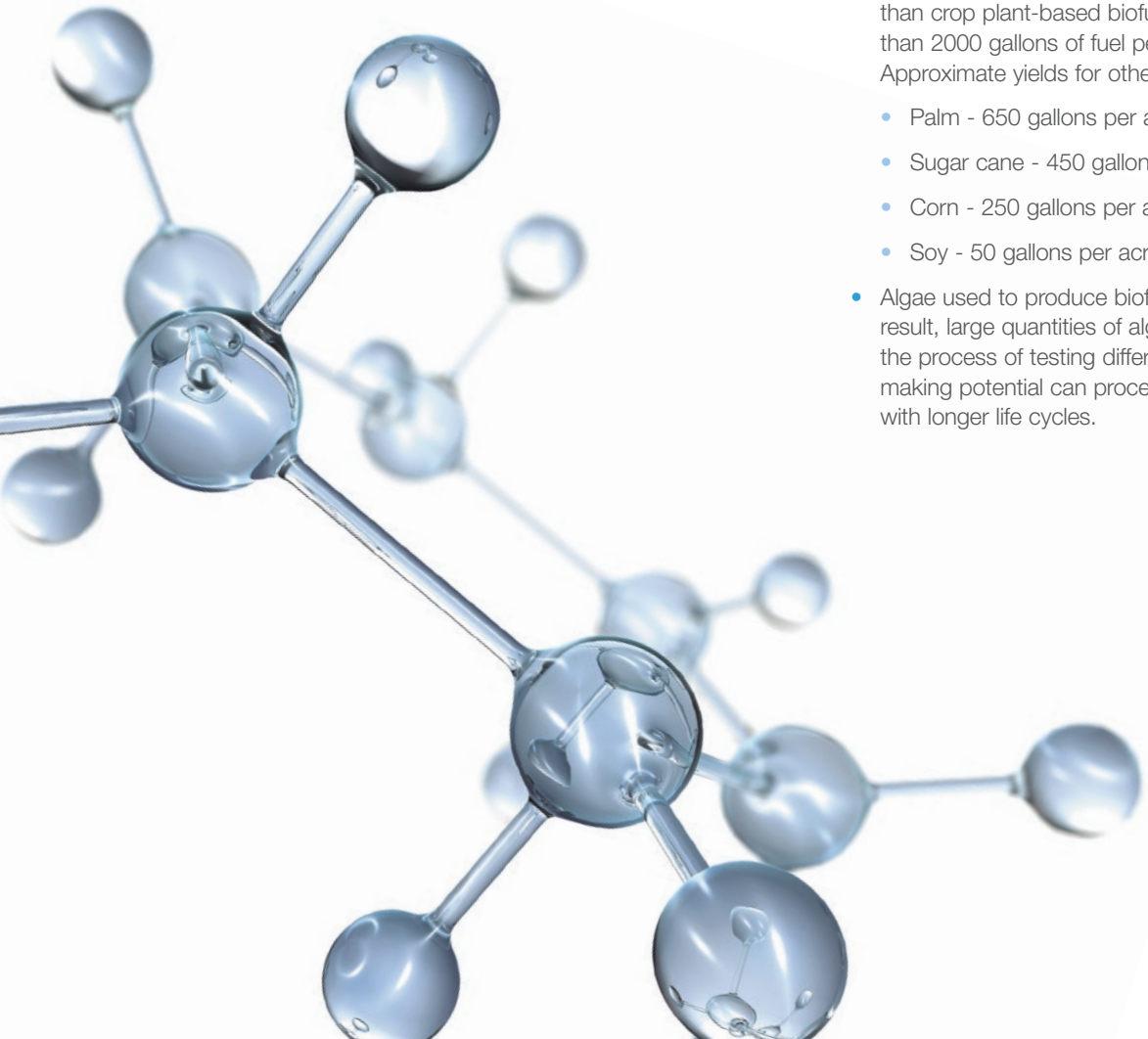
Advantages of Algae

The ExxonMobil Algae Biofuels Research and Development Program is a new long term investment focused on biofuel production from photosynthetic algae. If successful, these next generation biofuels could augment the world's transportation fuel supply and assist in reducing greenhouse gas emissions in the decades to come.

If research and development milestones are successfully met, ExxonMobil's expected spend for this program, which includes a strategic alliance between ExxonMobil Research and Engineering Company (EMRE) and Synthetic Genomics, Inc. (SGI), is more than $600 million.

The potential benefits of biofuel from photosynthetic algae could be significant:

- Algae can be grown using land and water unsuitable for crop plant or food production, unlike some other first and second generation biofuel feedstocks.
- Select species of algae produce bio-oils through the natural process of photosynthesis, requiring sunlight, water and carbon dioxide, supplemented with nutrients.
- Growing algae consume carbon dioxide, providing greenhouse gas mitigation benefits
- Bio-oil produced by photosynthetic algae and the resultant biofuel will have molecular structures that are similar to the petroleum and refined products we use today. This helps ensure the fuels are compatible with existing transportation technology and infrastructure.
- If successful, bio-oils from photosynthetic algae could be used to manufacture a full range of fuels including gasoline, diesel fuel and jet fuel, which meet the same specifications as today's products.
- Algae yield greater volumes of biofuel per acre of production than crop plant-based biofuel sources. Algae could yield more than 2000 gallons of fuel per acre of production per year. Approximate yields for other fuel sources are far lower:
  - Palm - 650 gallons per acre per year
  - Sugar cane - 450 gallons per acre per year
  - Corn - 250 gallons per acre per year
  - Soy - 50 gallons per acre per year
- Algae used to produce biofuel are highly productive. As a result, large quantities of algae can be grown quickly, and the process of testing different strains of algae for their fuel-making potential can proceed faster than with other crops with longer life cycles.



EMRE and SGI Strategic Alliance

ExxonMobil Research and Engineering Company

EMRE is the research and engineering arm of Exxon Mobil Corporation, a leading global oil, natural gas, and petrochemicals company whose subsidiaries have operations in nearly 200 countries and territories.

Synthetic Genomics, Inc.

SGI is a privately held company founded in 2005 dedicated to developing and commercializing genomic-driven solutions to address global energy and environment challenges. The company's main research and business programs are currently focused on the following major bioenergy areas: designing advanced biofuels with superior properties compared to ethanol and biodiesel; harnessing photosynthetic organisms to produce value added products directly from sunlight and carbon dioxide; developing new biological solutions to increase production and/or recovery rates of subsurface hydrocarbons and developing high-yielding, more disease resistant and economic feedstocks.

Synthetic Genomics is led by:

- **Dr. J. Craig Venter**, CEO, a leading scientist and entrepreneur who has been a driving force in genomics for more than three decades, known for the sequencing and analysis of the human genome. Dr. Venter is also Chairman and President of the J. Craig Venter Institute
- **Dr. Artistides Patrinos**, President, known for developing and launching the US Government's Genomes to Life Program, a research program dedicated to developing technologies to use microbes for innovative solutions to energy and environmental challenges
- **Dr. Hamilton Smith**, Co-Chief Scientific Officer, winner of the 1978 Nobel Prize for his work on the discovery of restriction enzymes, which are critical tools used in the field of recombinant DNA technology

Alliance Activities

Through aggressive and comprehensive research and development, EMRE and SGI will work together to develop innovative solutions for the challenges of large scale production and commercialization of biofuels from photosynthetic algae. These challenges include:

- Identifying or developing algal strains that can achieve high bio-oil yields at lower cost
- Determining the best production systems for growing algal strains - either in open (ponds) or closed (e.g. tubular) photobioreactors
- Determining how to supply the large amounts of carbon dioxide needed to grow algae, which could provide benefits for mitigating greenhouse gas emissions
- Developing the large, integrated systems required for full scale, economic production, upgrading and commercialization of biofuels

In the coming years, biofuel advancement from photosynthetic algae will proceed through six phases, each representing an essential step in the production chain:

- Phase One – Algae development and growth
- Phase Two – Algae harvesting
- Phase Three – Recovery of bio-oil produced by algae
- Phase Four – Transport and storage of bio-oil
- Phase Five – Conversion of bio-oil to biofuel
- Phase Six – Production of commercial products

EMRE's primary roles:

- Leadership role in engineering, process development and scale up
- Key role in determining which type of production systems to utilize to grow algae
- Key role in upgrading bio-oil produced by photosynthetic algae into finished products, and total process integration for development and commercial applications

SGI's primary roles:

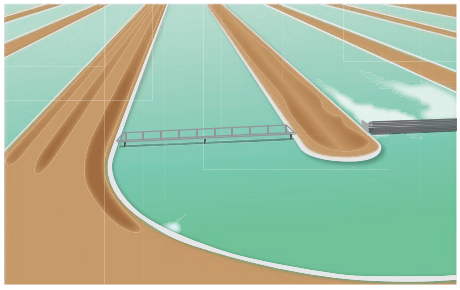
- Leadership role in biological research for algae strain development, growth and harvesting
- Key role in determining which type of production systems to use to grow algae
- Key role in bio-oil recovery research and development

Producing Biofuel from Algae

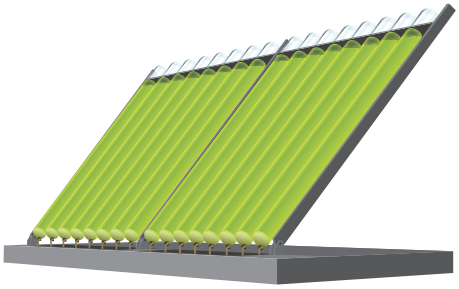
Algae, like all plants, undergo photosynthesis to grow:

sunlight + carbon dioxide + water + algae = more algae + oxygen

Algae are grown in either open or closed photobioreactors:

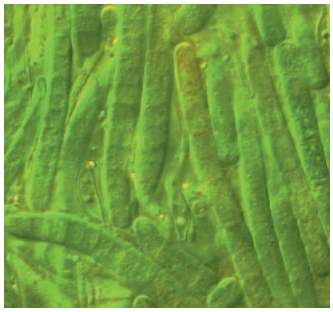


Open (Ponds)



Closed (e.g. Tubular)

As they grow, algae accumulate fats and bio-oils that have similar molecular structures to traditional crude oil.



The bio-oil is extracted or harvested from the algae

Bio-oil will be further processed in existing refineries, just as crude oil is refined today, to produce a range of products including gasoline, diesel, jet and marine fuel.