BioDiesel from MicroAlgae

Microalgae are the **most promising biomass exploitable for energy purposes**:

- no impact on food market
- no agricultural land required
- they can grow on wastewater streams allowing their purification (removal of nutrients and solute organic matter)
- they have a production yield of vegetable oil significantly higher than other plant species; the vegetable oil is convertible into fuel for diesel engines
- contrary to agricultural and forest crops, they allow the use of the latest technological innovations normally used for control of biotechnological processes (mixing of carbon sources, dosing of nutrients, control of key process parameters, monitoring of species in growth phase, etc.).

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Microalgae contain **lipids and carbohydrates**, which are convertible into automotive fuels, and **valuable substances**, such as carotenoids and polyunsaturated fatty acids. Nowadays they are grown to provide these products to nutritional, pharmaceutical and cosmetic markets.

To move from markets with low capacity (thousand tonnes per year) and great value (price of the order of thousands of dollars per pound) to the energy sector with high volumes (million tonnes per year) and considerably lower prices (hundreds of dollars per ton) intense research efforts are required with the aim of:

- develop stable and economic **cropping systems** with high photosynthetic efficiency and production capacity;
- use **currents of carbon dioxide and waste water** from industrial plants
- develop procedures for the **extraction of fractions convertible into biodiesel** and exploit the residual material, preferably for energy.

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With regard to **growing**, the Eni project was developed in **laboratory** (selection of stocks, development of growing conditions) and at **bench-scale** (testing of the system consisting of three open ponds of 2.5 m^2 each and two tubolar photoreactors of the same surface), both on flue gas from domestic heating boilers and on flue gas from the Gela refinery.

Thanks to the promising results (availability of algal species capable of growing on flue gases from the Texaco plant in Gela refinery and aqueous streams from the wastewater treatment plant of this refinery; promising capacity; etc.) the experiments were done on a **larger scale** in order to obtain biomass samples to be used for subsequent extraction of vegetable oil and to test new stocks and growing conditions to raise the fat content.

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The plant was designed by Saipem and built in Gela.
The start-up was in late 2009.

The bench scale plant in Gela refinery

The one-hectar plant in Gela refinery

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In addition to research on cultivation, R&D activities were carried out to obtain **lipid material convertible into biofuels** to replace fossil diesel.

Procedures were identified and patented that are based both on the use of solvents or on heat treatment.

The data obtained allowed the development of the process design for a plant to be built downstream for the cultivation of one hectare; it is under construction in Gela.