



Micro Algae Project

For a sustainable development

Algae for Energy ?



ABOUT US

Founded 1996, we are an engineering office operating in Austria and border countries and in the GCC. “ABC GmbH&CoKG” is a subsidiary of “Chartered Engineering Office DI Deininger” located in Müzzuschlag, Austria. Both companies work together in a partnership whereas “ABC GmbH &CoKG” as the company acting as EPC contractor and “Engineering Office DI Deininger” acts as the planning and design office. We are holding several patents in the mechanical engineering and in environmental engineering.

Starting as design office for industrial engineering, we now realize projects on green field on an EPC (Engineering, Contracting and Procurement) basis for our customers. In this respect we are acting as project management and steering company. In all our projects we are working together with competent partners and/or with the technical universities in Austria such as the Montanuniversität Leoben.

Our customers and references are in the chemical, petrochemical industry and in the manufacturing industry.

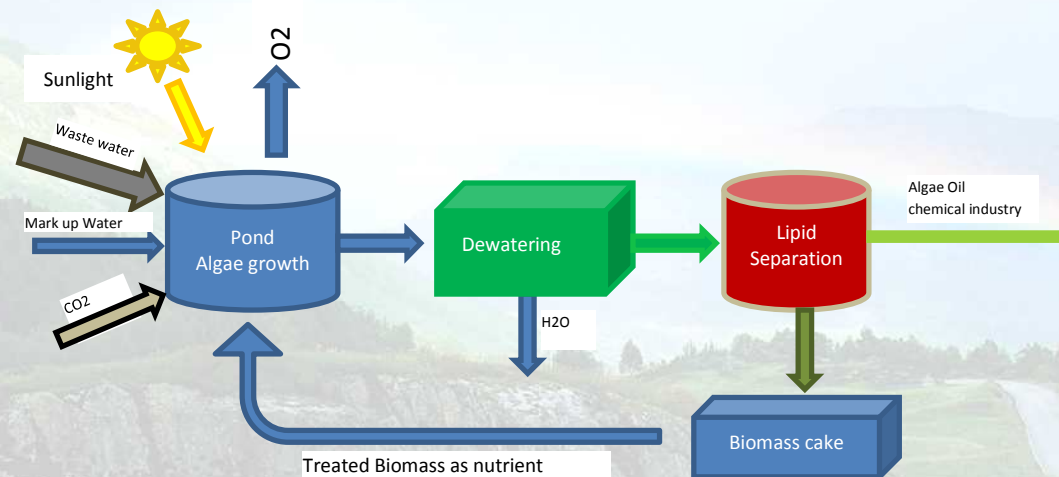
In the micro algae project our company is working in cooperation with reputable process engineering companies and the Universities of Biberach (Germany) and Leoben (Austria), MCI Institute Innsbruck, FH OÖ and with a high reputable R&D Institute in Germany.

Initially we also cooperated with Alga-Labs Inc., which is a spun-off from AirScience Technologies Inc. as a wholly owned subsidiary in 2007 to develop and market the Algafuel® technology. Alga-Labs Inc. is an R&D company with its main laboratory in Montreal, Canada and a new demonstration site also in Canada.



Basic Concept

Cleaning and Production of vegetable oil from micro-algae





Use of Micro Algae and products

At the beginning micro algae were intended to be a substitute for fuel. Some aircraft manufacturers started to test algae fuel as substitute for kerosene / jetfuel.

Use of algae oil for the chemical industry as substitute for different crude based raw materials.

Algae production for production of high value materials, e.g. for the pharmaceutical industry.

Using algae technology for cleaning purposes, like waste from various sources.



Facts about Wastewater and Micro Algae

Micro Algae clean wastewater from natural sources like cattle manure, wastewater from drilling wells coming from the gas- and oil industry, produced at the production of gas or oil, etc.

Micro Algae consume high concentrations of CO₂ which are emitted from power-, cement- and other chemical plants or from the liquefying process of LNG.

It is a mixotrophic process which uses micro-algae to metabolize organic carbon contained in liquid waste and produce biomass and clean water.

The process also collects and concentrates metals from industrial waste water (Co, Mn, Pt, Pd, etc.)



Highlights about Micro Algae

- Micro algae can be used to clean nutrient-laden, CO₂-rich and low-oxygen water and turn it into oxygen-rich, CO₂-low water as it flows back into the ecosystem, while simultaneously producing biomass for e.g. oil.
- The overall economics for algae-based wastewater treatment are made more favorable when factoring the credits applicable for wastewater treatment.

All over the world, municipalities and utilities spend enormous sums to treat wastewater and sewage and remove them of pollutants and impurities. Some of the pollutants in the wastewater and sewage are nutrients on which algae thrive.

Fact is that the micro algae that grow in sewage have high content of high value products.



Algae for Biodiesel

Price development of Algae oil products

<http://www.indexmundi.com/commodities/?commodity=rapeseed-oil&months=60¤cy=eur>

Biodiesel:

The use of vegetable oils for engine fuels may seem insignificant today. But such oils may become in the course of time as important as the petroleum and coal tar products of the present time"

Rudolf Diesel, 1912



Price alternative fuels

TABLE 2
National Average Fuel Prices
Conventional and Alternative Fuels, July 2015*

Fuel Type ⁴	April 2015	July 2015	Change in Price April-July	Units of Measurement
Gasoline (E10)	\$2.42	\$2.82	\$0.40	per gallon
Diesel	\$2.88	\$2.93	\$0.05	per gallon
CNG	\$2.09	\$2.12	\$0.03	per GGE
Ethanol (E85)	\$2.13	\$2.36	\$0.23	per gallon
Propane**	\$2.93	\$2.90	-\$0.03	per gallon
Biodiesel (B20)	\$2.92	\$2.93	\$0.01	per gallon
Biodiesel (B99/ B100)	\$3.77	\$3.55	-\$0.22	per gallon

*Includes public and private stations

**Includes primary and secondary stations



Price alternative fuels

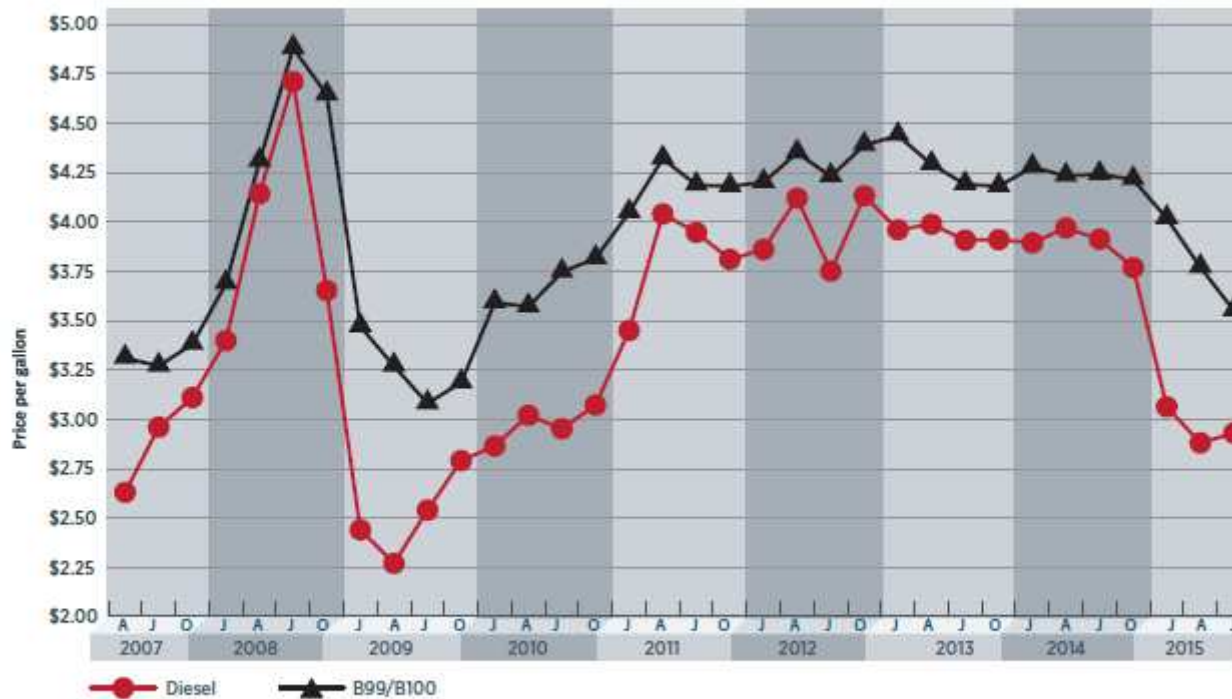


FIGURE 13
HISTORICAL B99/B100 PRICES VERSUS DIESEL



Biodiesel versus high value products

Biodiesel: fuel for engines, agriculture, trucks, etc.

jetfuel

heating purpose

versus

Harmin /Norharman:

is a bio-active β -Carboline and monoamine oxidase inhibitor (Pharma)

Sebacic Acid Dibutyl Ester:

plasticizer for plastics, chem. industry;

Softener for cosmetics

pharmaceutical industry

Astaxanthin:

pharmaceutical industry, antioxidant



Applications

The process can be applied to:

- Animal farming waste (cattle manure, etc.)
- Biogas slurry / residues cleaning
- Oil industry sludge
- Food processing liquid waste (Cheese whey, etc.)
- Industrial sludge (terephthalic acid mud, etc.)
- Waste industry liquids (landfill leachate, etc.)
- Cleaning of mining waste
- Etc.



Application: Biogas residues as feedstock for micro algae

From agricultural production → „Biogas-Gülle“

From residues or waste material → “Gärrückstand”

Nutrients for agricultural production

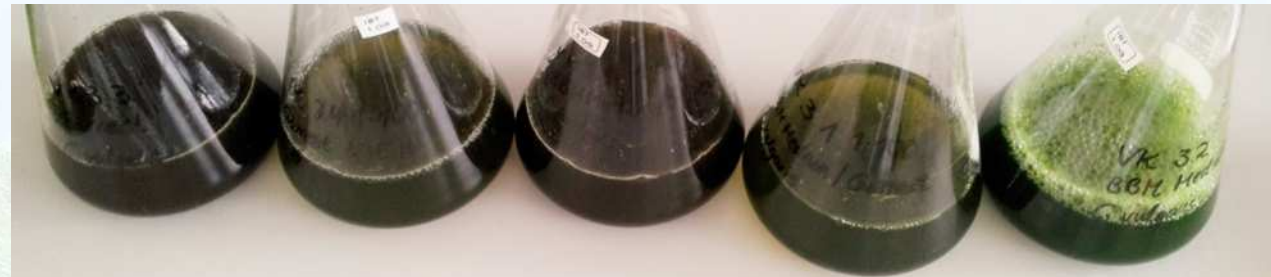
- limitation due to nitrogen content
- costs for transport, storage- und application on fields

Biogas plant 500 kW_{el} produces 100t nitrogen per year

Feasible amount of nitrogen 227 kg/ha.a → fields of 440 hectare necessary



Application: Biogas residues as feedstock for microalgae



	Pure media	Slurry/media 1:100	Slurry/media 1:10	Slurry/water 1:100	Slurry/wat er 1:10
OD ₆₈₀	4,07	1,63	0,15	1,74	0,12

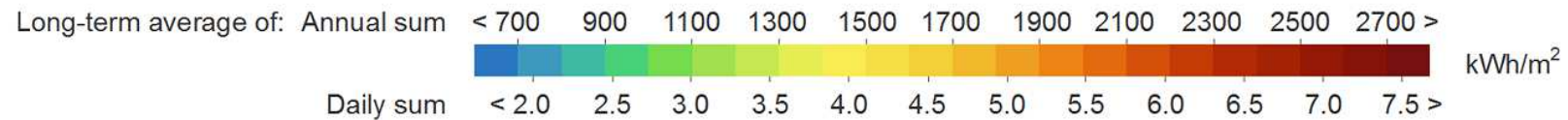
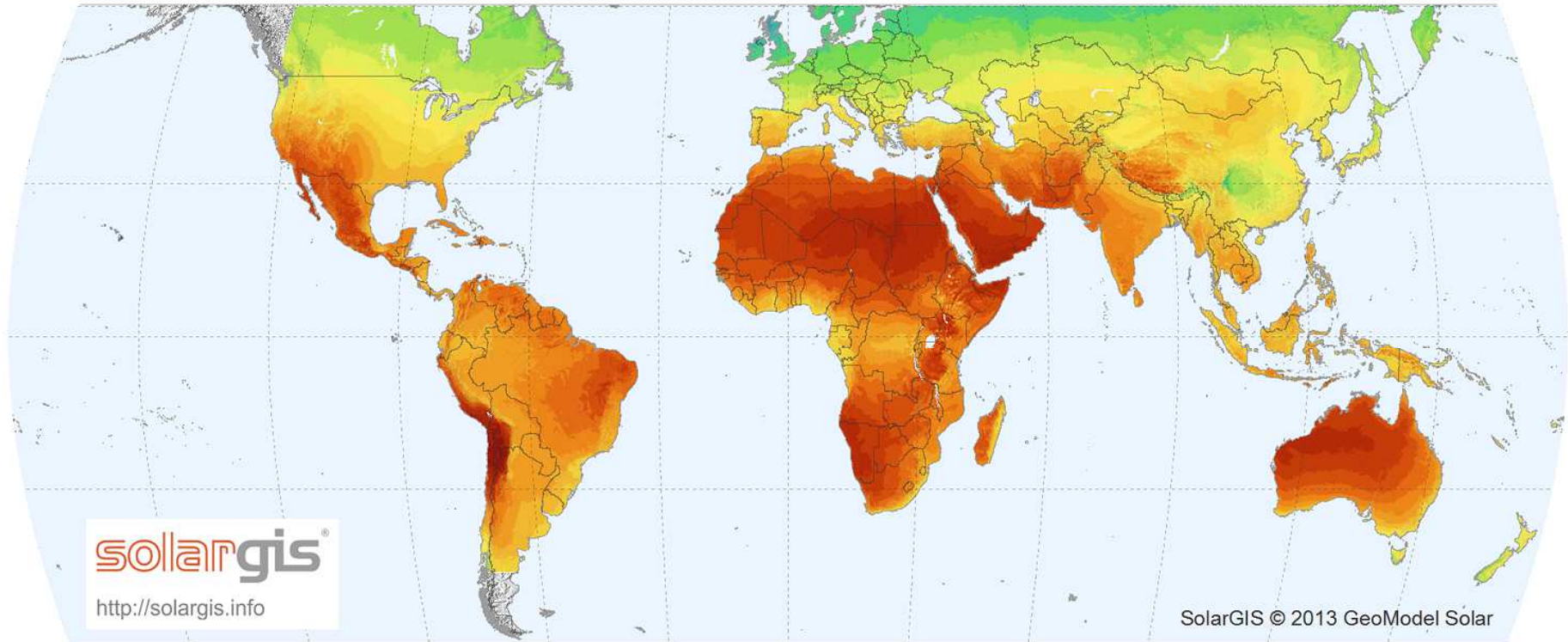
- distinctly reduced growth rates and biomass concentrations compare to pure media
- slurry shows to be a substitute for nutrients and trace elements compare media and water addition



Relevant areas with adequate climate

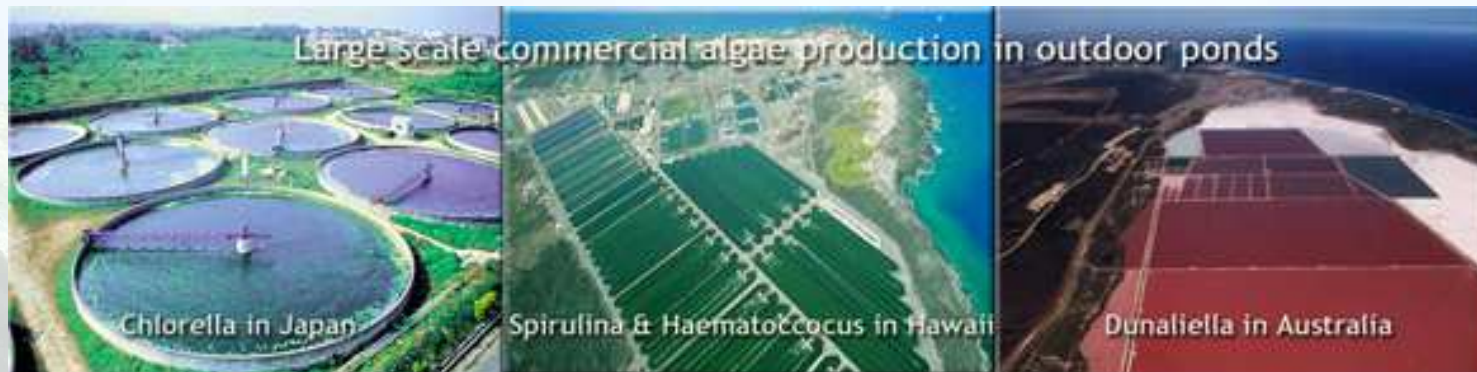
WORLD MAP OF GLOBAL HORIZONTAL IRRADIATION

GeoModel
SOLAR





Open pond systems in Operation



Raceways scale to any size and have the advantage of simple, low cost construction and maintenance. Most algae production today is in open raceways because ponds are cheap to build and operate. Ponds are more productive in tropical, subtropical and temperate areas with warm temperatures, low rainfall and little cloud cover.

*Vgl. January 6, 2013
Algae Industry Magazine*



Present Algae plants





Primary Advantages

Algae do:

- Wastewater treatment
- Flue gas treatment (CO₂ cleaning)
- Production of Bio energy (algae oil)
- Production of high value products, like Harmane, Norharmane, Sebacic Acid, Dibutyl Ester, Astaxanthin

Criteria for the implementation of an algae plant

- Sufficient supply of wastewater , sludge → nutrients
- Sufficient supply of CO₂ (Flue gas or CO₂ enriched gas)
- Availability of Water (sea water or freshwater)



Contact

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Thank you