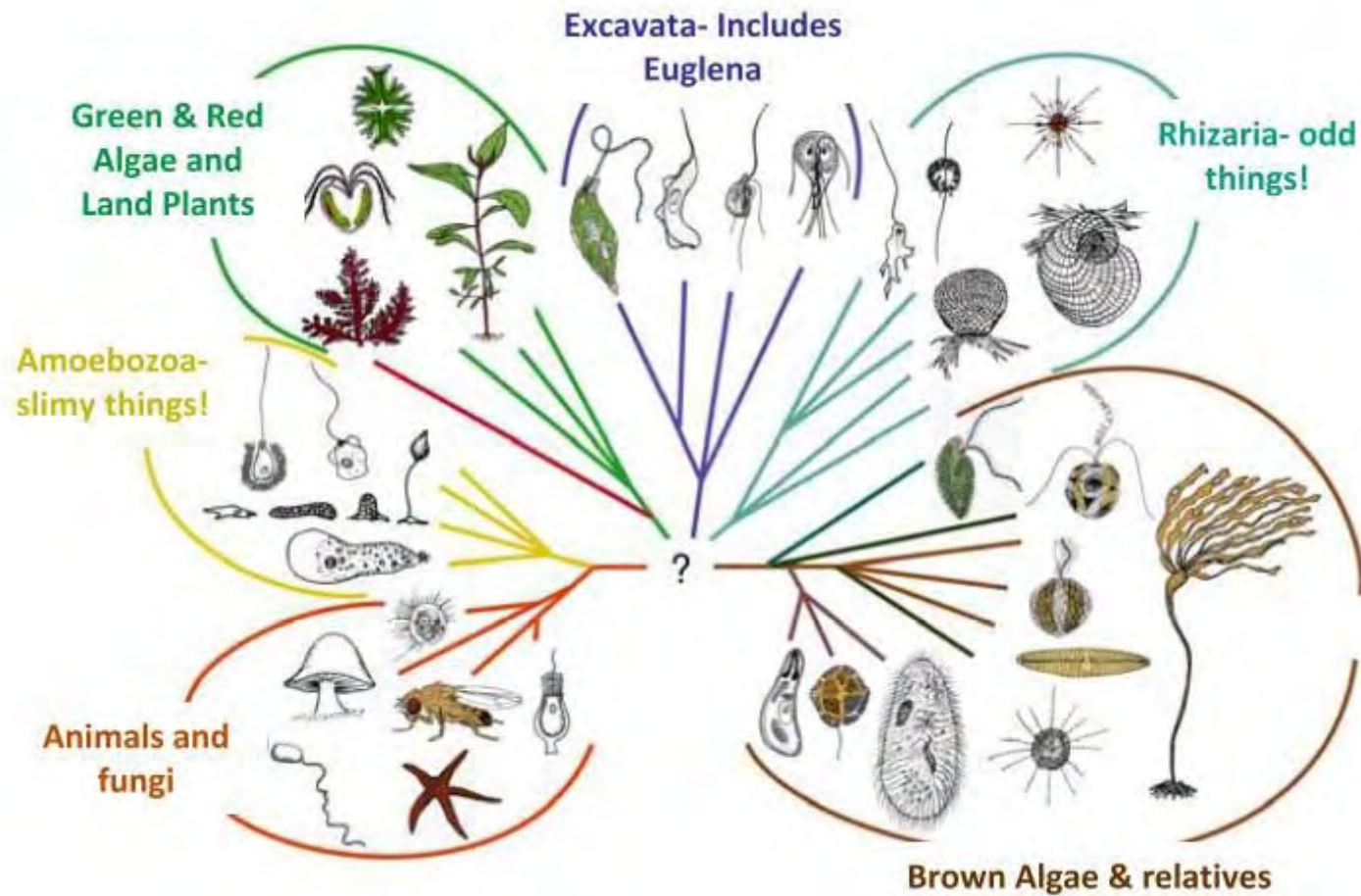


ecoduna®

ecoduna is the European innovation leader in algal photo bioreactors, Ecoduna has been several fold awarded for its outstanding technology.

The company was funded 2008 by Franz Emminger and Martin Mohr, changed into an Austrian limited company (GmbH) in 2010 and reinforced by Energy Park Bruck as core investor





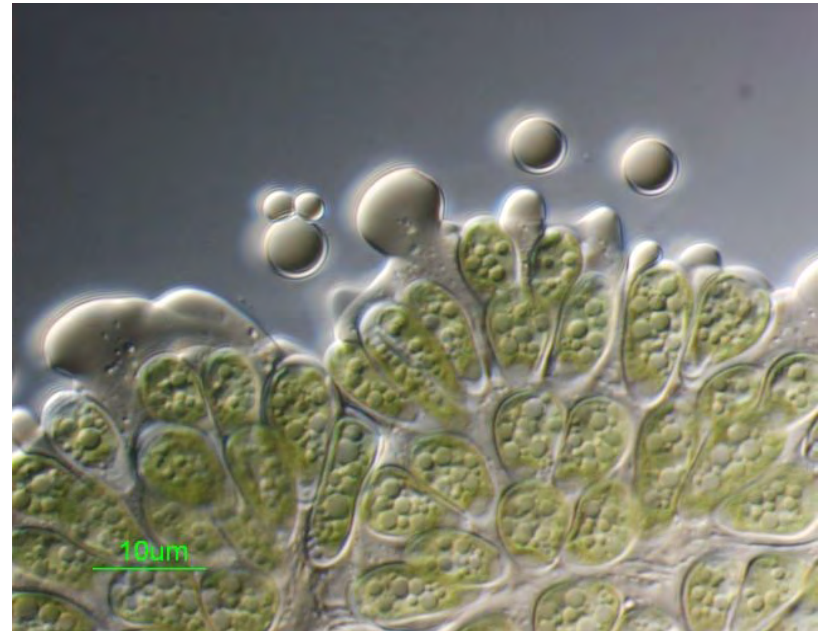
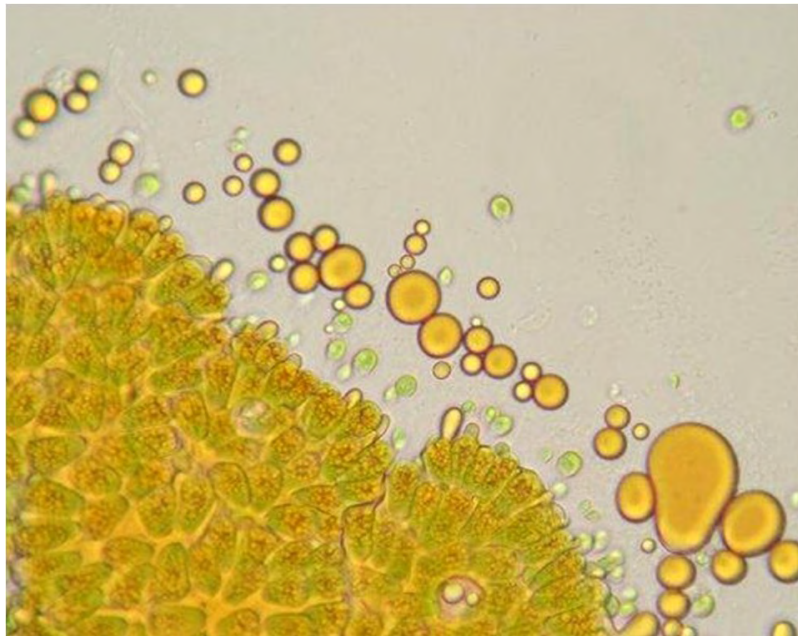
Products from algae are the most promising renewable recourse

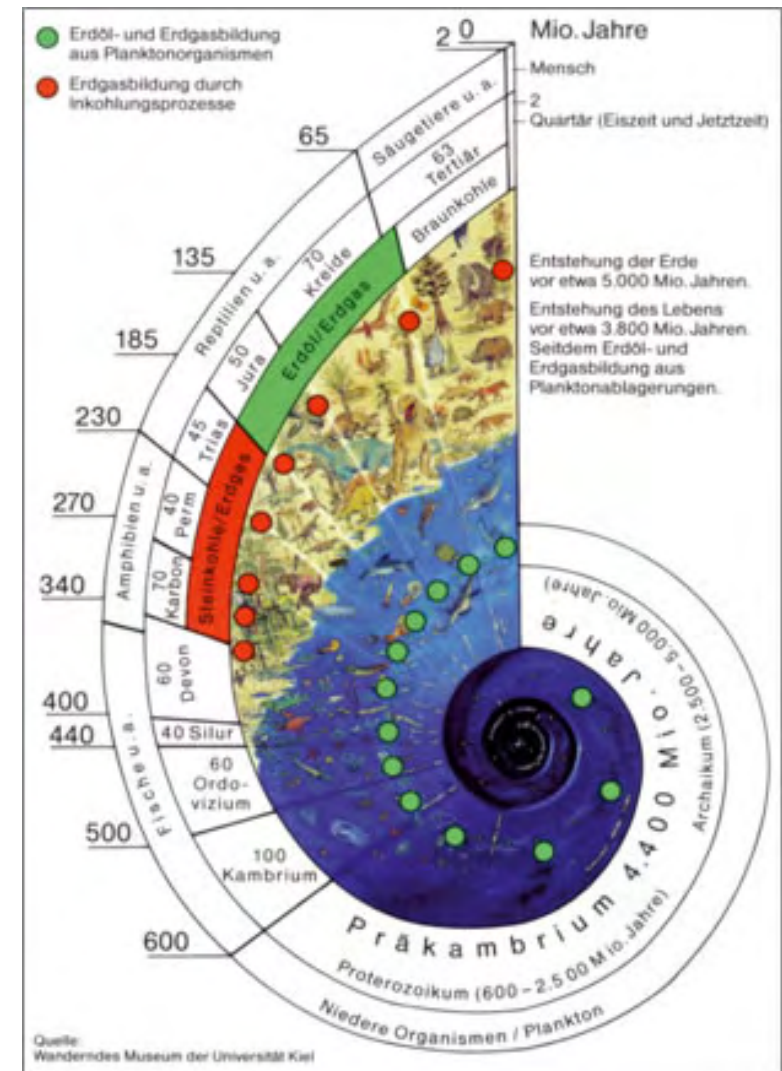
The measured quantity of global biomass from algae is only 0,2%



Algae can have a high conversion

Therefore the total annual global biomass from algae adds up to 55%







First 7000 years

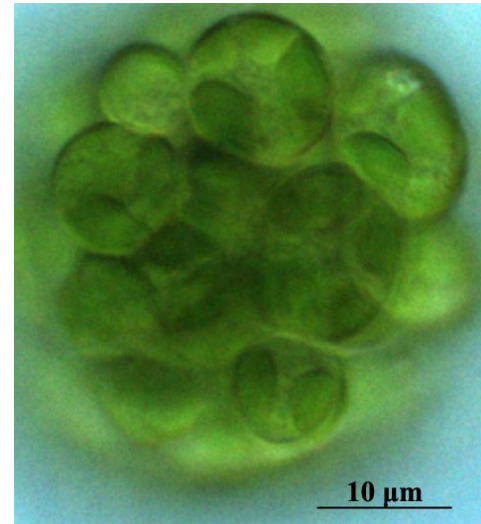


200 Y. till do day



No limits in variations

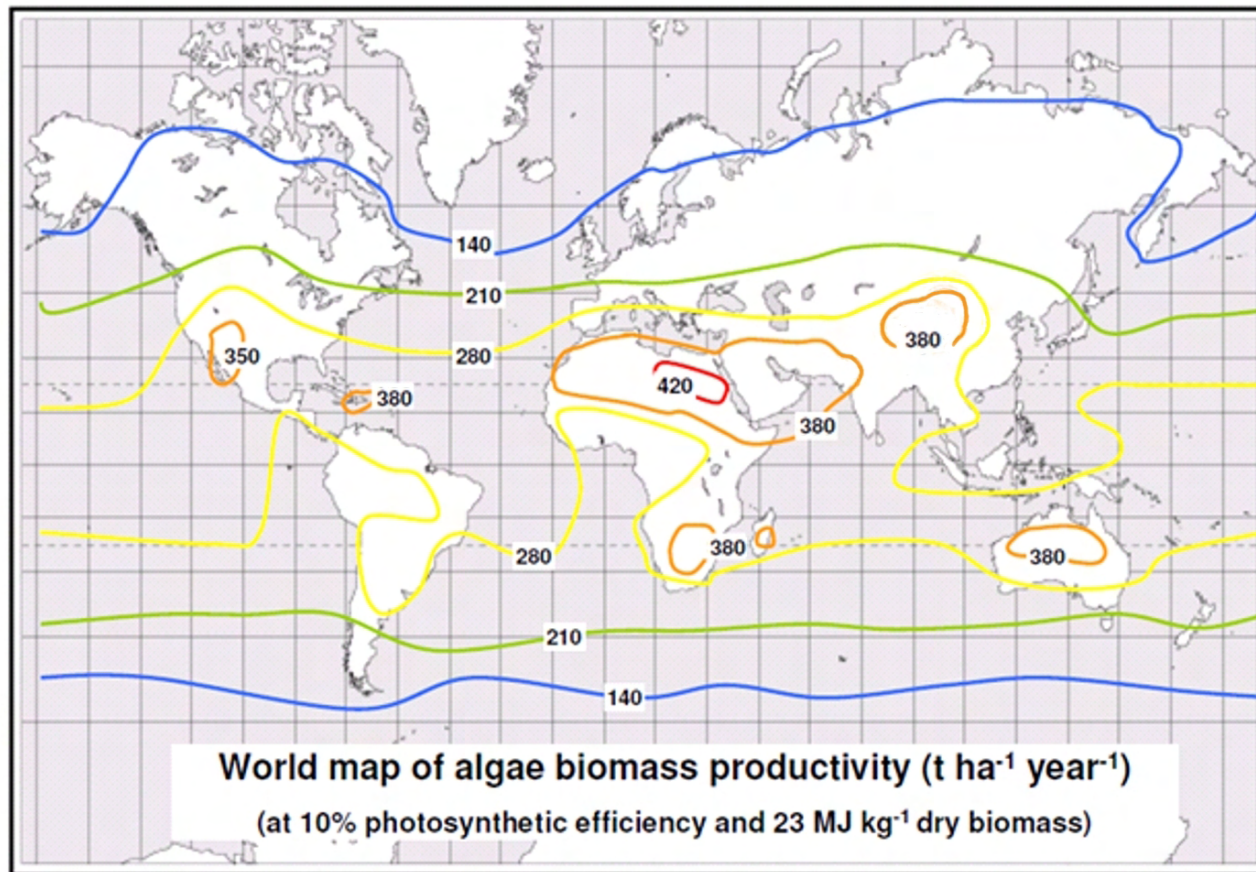
There are thousands of species of algae to start the breeding process.



- Algae can divide within hours, up to 1000 generations are possible within 1 year.
- Genetic selection will help to quicken up the and advance the process additionally
- GMO

$$6\text{CO}_2 + 6\text{H}_2\text{O} + 6 (9.4 \text{ moles photons (quanta)}) = \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \text{ (eq. 1)}$$

$$\text{PE} = (2808 \text{ KJ mole}^{-1} \text{ of glucose} / 209 \text{ KJ} \times 9.4 \text{ mole photons} \times 6) \times 0.45 = 10.7 \%$$



**This is a lab experiment
comparing the growth of an
alga to wheat plants within
a 24 hour period**

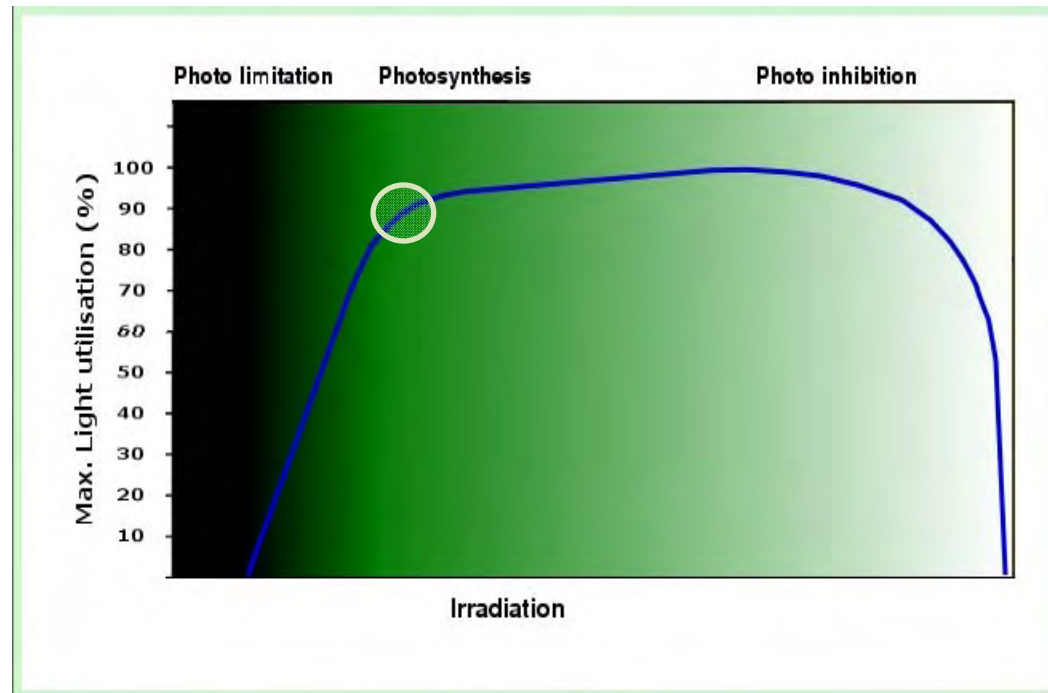
The biomass is multiplying 250 times in 24 h

PHOTOSYNTHESIS RATE TO LIGHT INTENSITY

The ecoduna technology avoids the disadvantages of other processes in the utilization of light.

Light from the sun is diluted from **80.000** down to **1.500 – 2.500** lux irradiation, the optimum for algae growth.

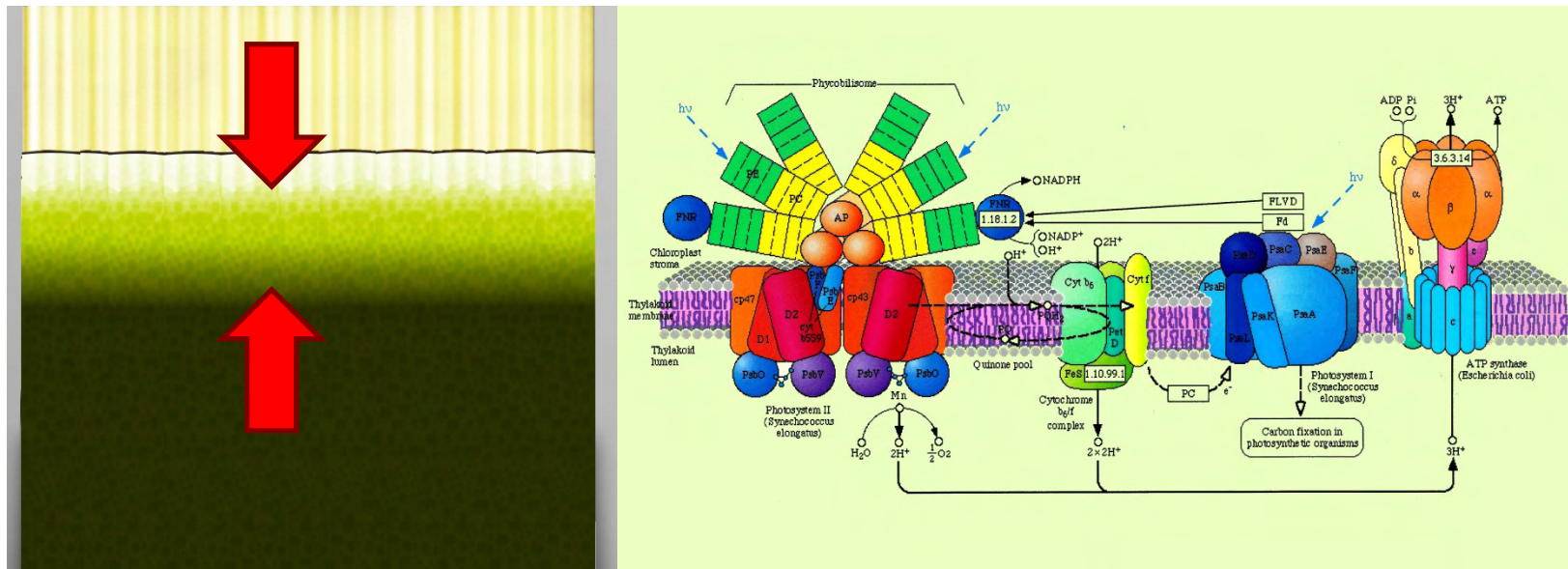
$$80,000\text{lux} / 2,500\text{lux} = 32$$



By diluting the sunlight by the factor 32, ecoduna is obtaining the optimal light-density for algae growth.

TROPHOGENIC ZONE; PHOTO ACTIVE VOLUME

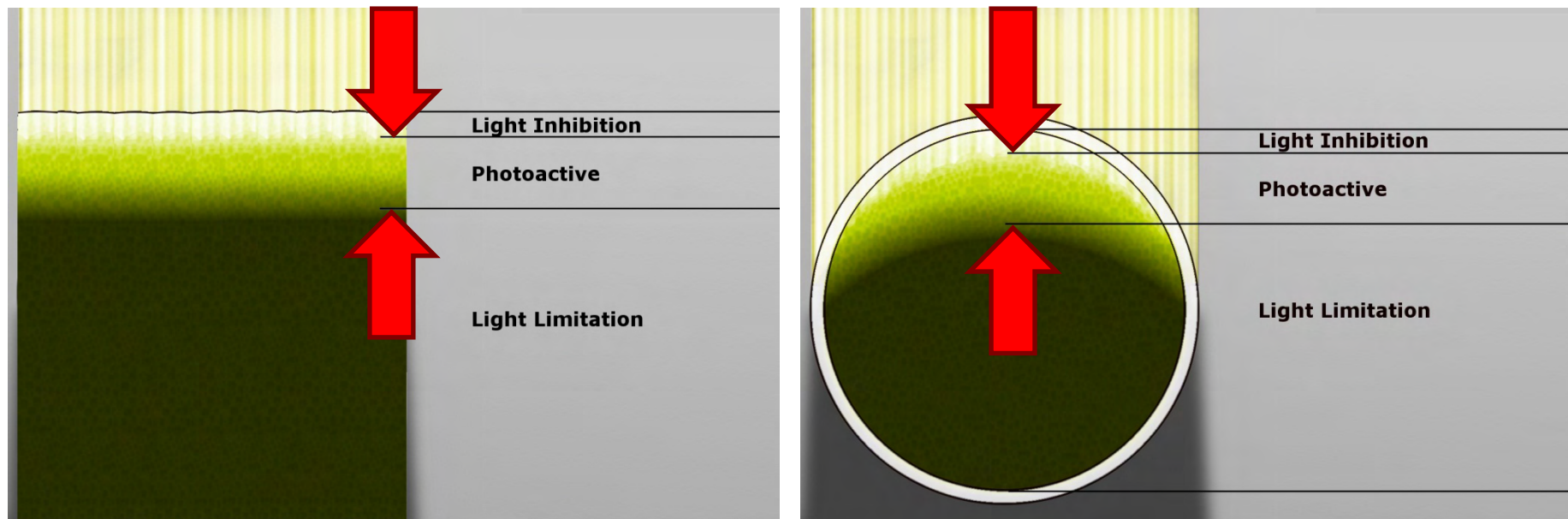
To understand the significance of photo-bio-reactors, the most important terms are **photo active volume** and **trophogenic zone**



Only the **trophogenic zone** matters, all the rest volume only expands costs

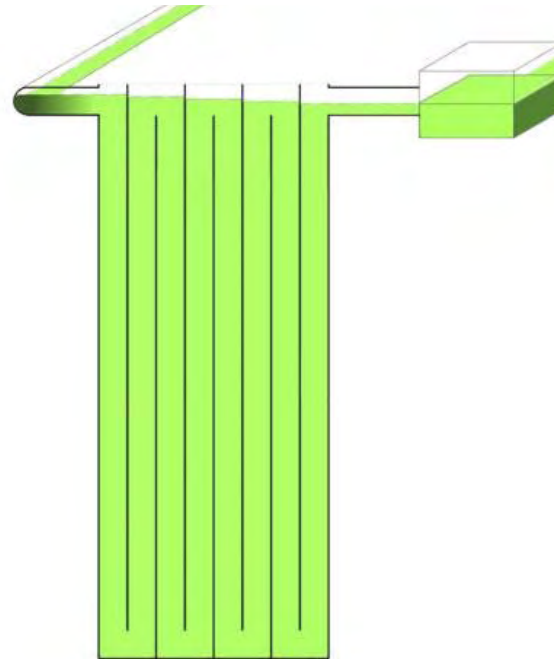
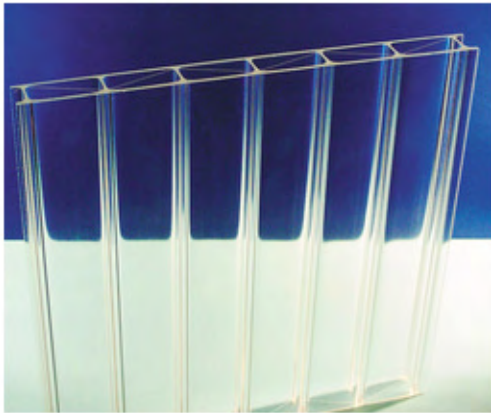
TROPHOGENIC ZONE; PHOTO ACTIVE VOLUME

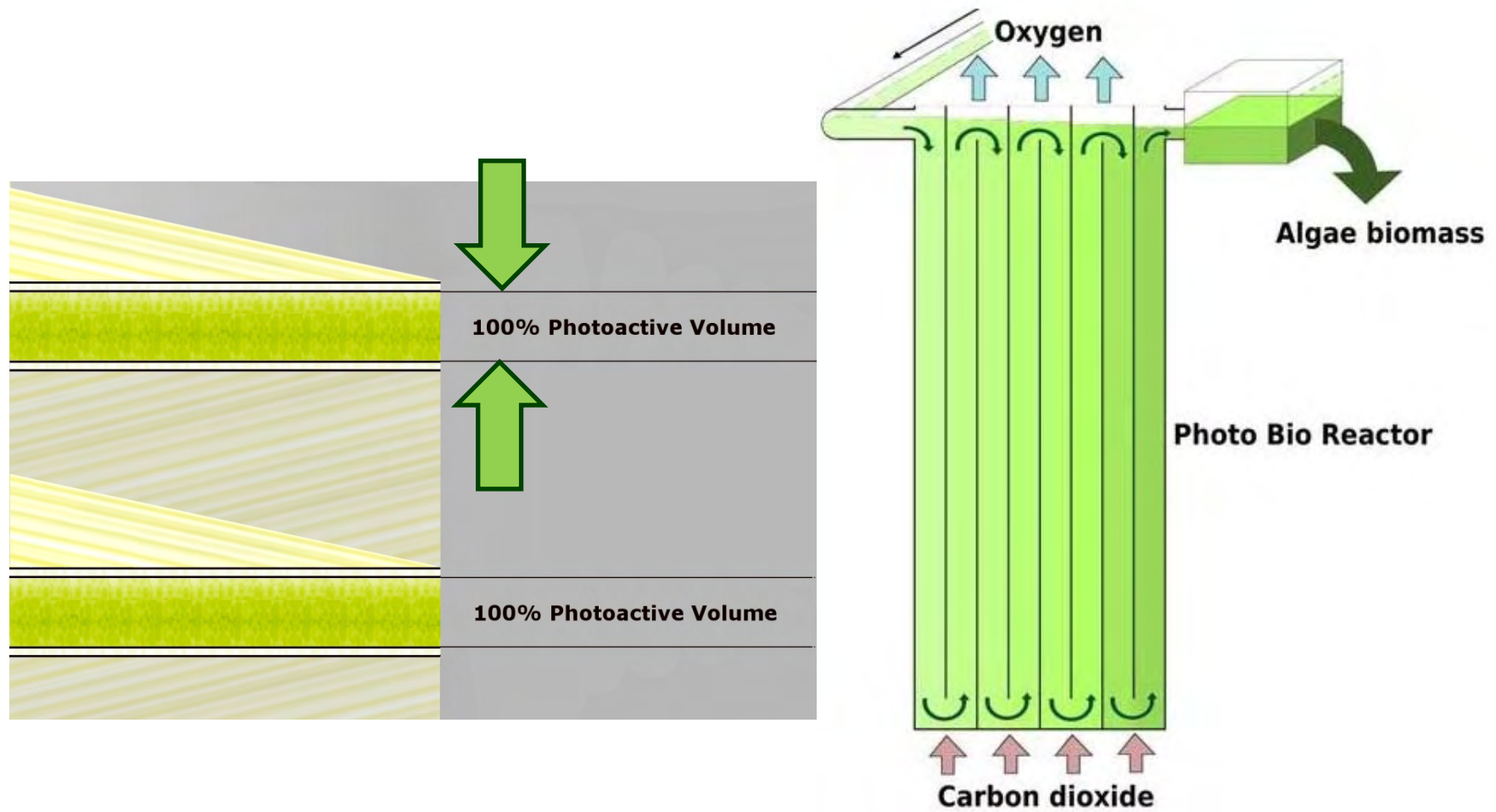
Ponds must have a certain depth to puffer temperature, pipes are of a certain diameter because of material and assembling costs.



Both systemic approaches neglect the ideal form for light integration

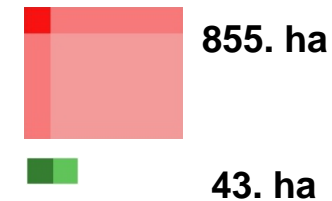
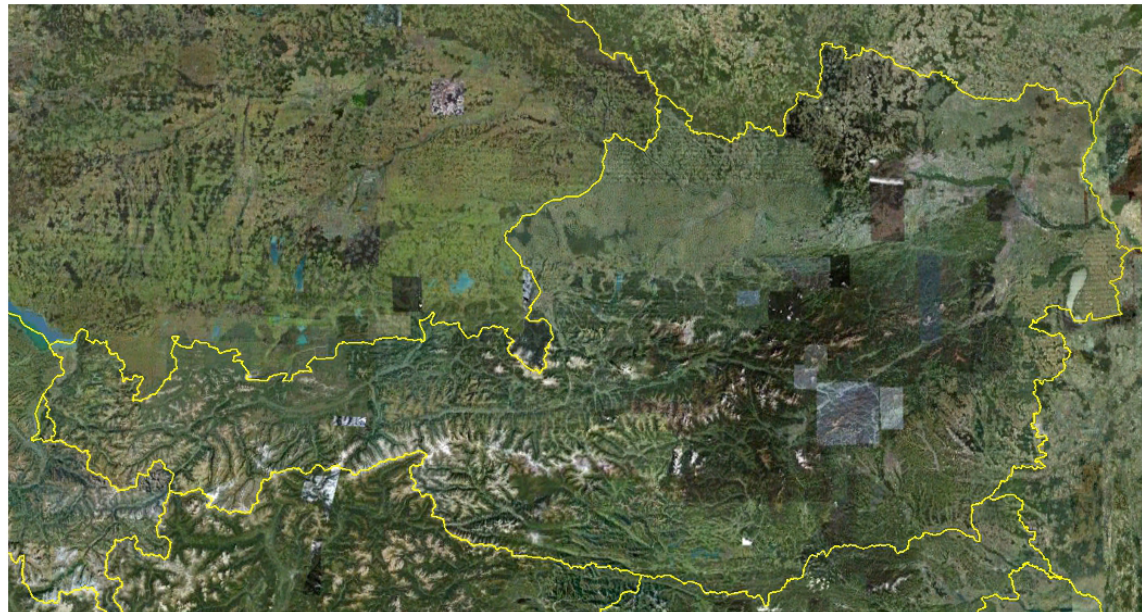






2007 was the year of the highest fuel consumption; 8,36 Mil tons*

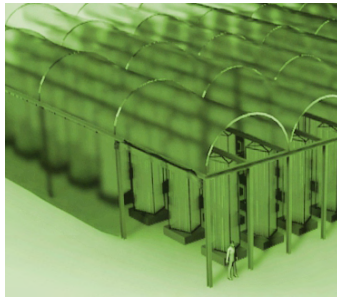
The total area needed of fuel production for Austria would be 8550km²
(30 times the Neusiedler See, if open Pond is used)**



**Only 2 times the
Neusiedler See, if
ecoduna PBR are
used**

* BMWA 2009

** Prof Spitzer, IEA Graz 2011



Algae versus oilseeds



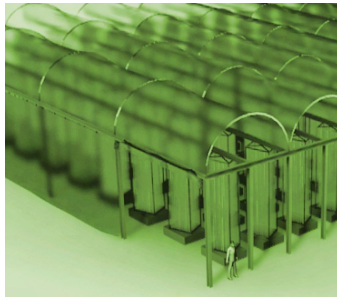
Algae oil costs €2,5 to €4 /litre today

No competition with food production

10 to 20 times less land demand for the same amount of biomass

Far less water demand than agriculture

Competitive price range is in reach (economy of scale)



Algae versus Photovoltaic



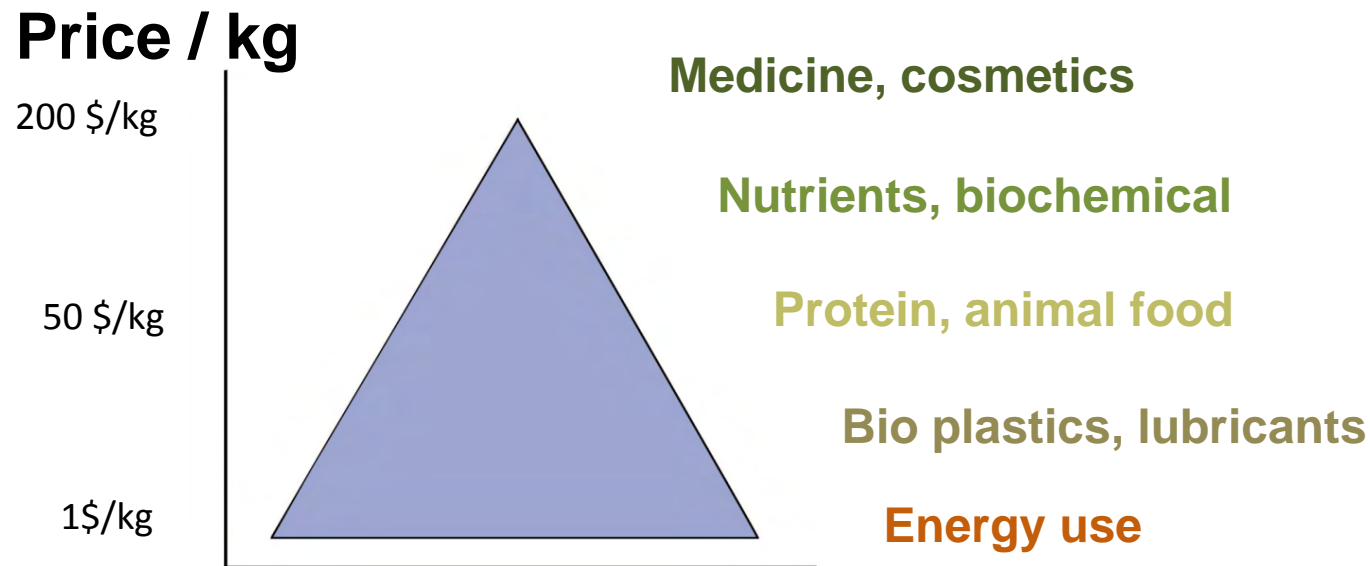
Photosynthesis is limited to a max. efficiency of 11% of light utilisation today

Light shifting in cultivation systems will give the efficiency a substantial raise in future

No rare earth elements are needed

A energy carrier/fuel with high energy density is produced; it can be stored easily and utilised on demand

At present the cost estimate is at approx. 4-6 €/litre



Valuable biomass can support the fuel production by cascading use of total biomass in a bio-refinery



The European Union has granted ecoduna a substantial fund under the “Competitiveness and Innovation Framework Programme” (CIP).

ecoduna will build and run the second largest photo bioreactor unit for microalgae in the west, from September 2011 on in Bruck an der Leitha

Volume 90.000 litres



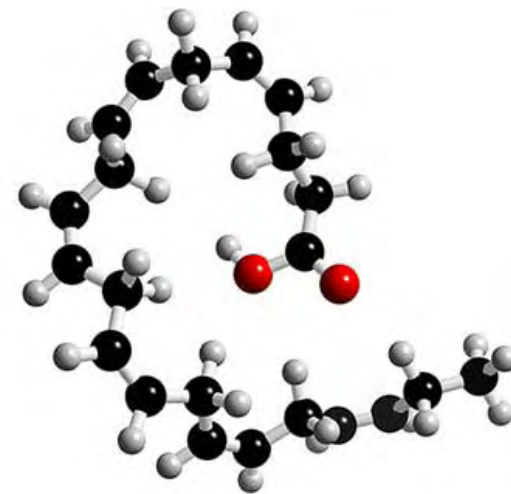
**Docosahexaenoic acid (DHA) is an omega – 3 fatty acid.
In chemical structure, DHA is a carboxylic acid with a 22-carbon chain**

DHA is a major fatty acid in sperm and brain phospholipids, particularly in the retina.

Dietary DHA may reduce the risk of heart Disease by reducing the level of blood triglycerides humans.

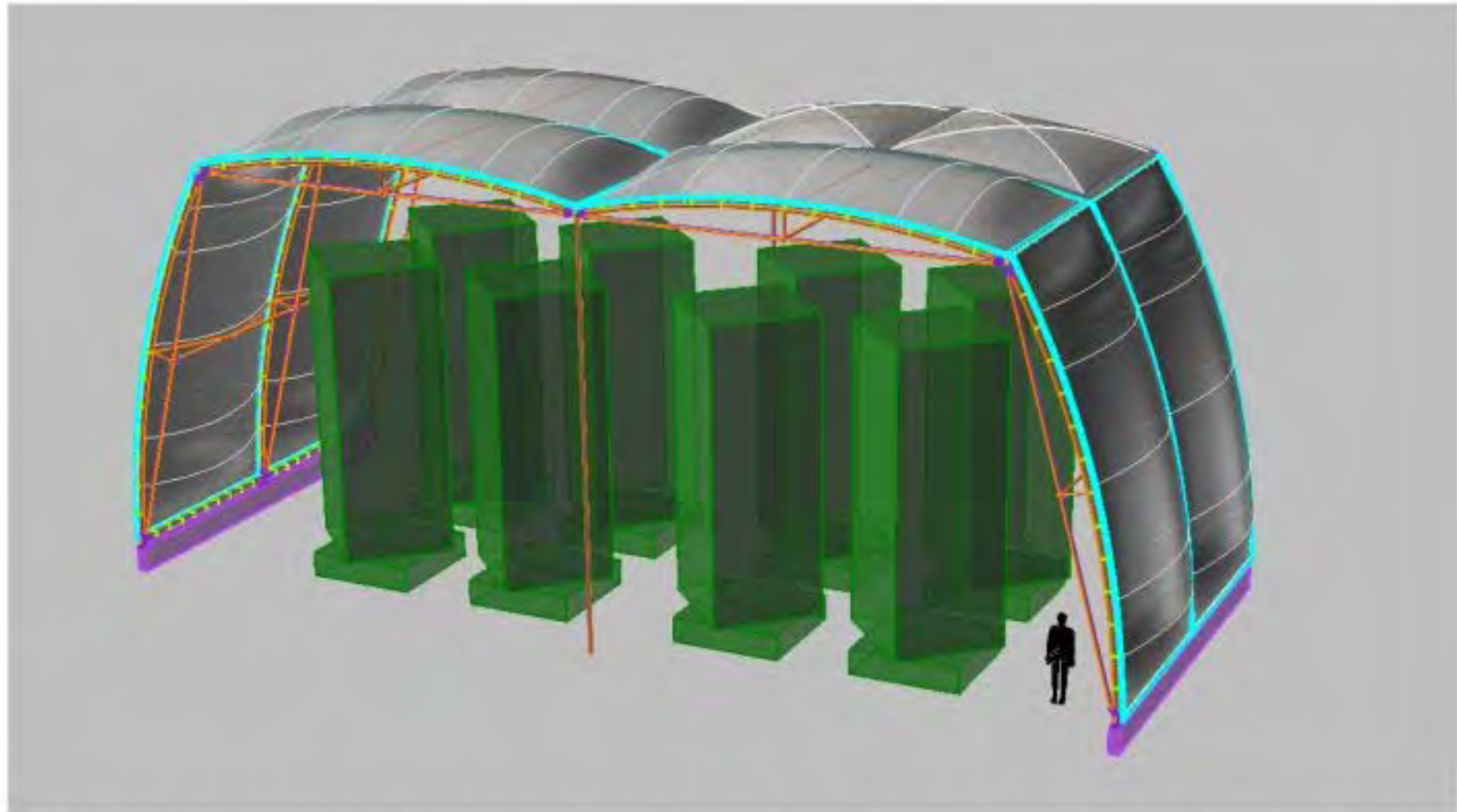
Low levels of DHA have been associated with Alzheimer disease.

The market of omega 3 fatty acids nutrition products has exceptionally grown over the last years (24,3% annually), predicted to reach 1,6 bill\$ in 2014 in Europe and there is no reason conceivable why this dynamic trend should stop.
(Frost & Sullivan, 2008).



ecoduna[®]

BUILDING



Algae photo bioreactors will ideally be built next to a carbon emitting industry.

Understanding CO₂ as a resource and utilising it for Biomass production.

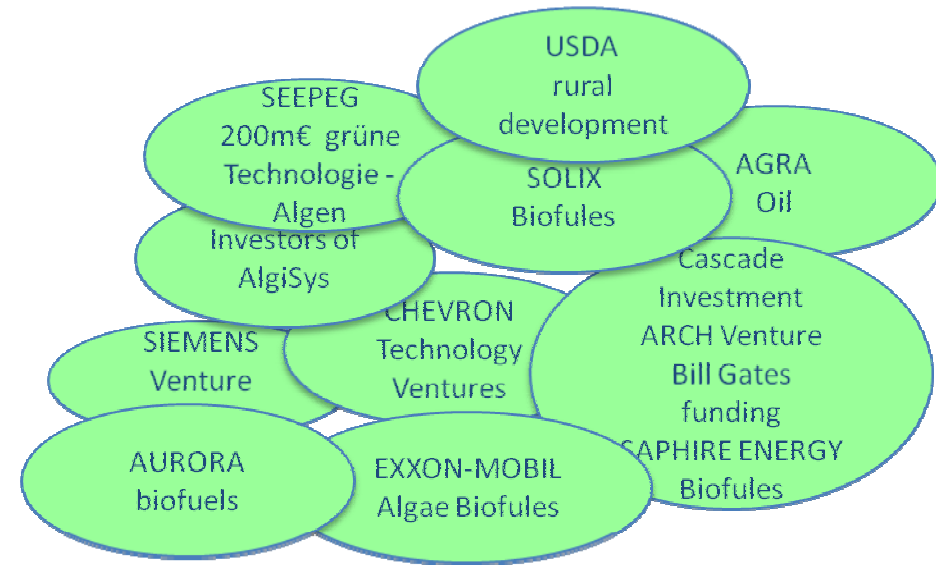
A Base for renewable chemical products and a renewable energy source, not conflicting with food production



55 of the top 100 global Clean-Tec cooperates are located in the USA
14 of the 100 are specialised on BIOFUELS specialised.
In last two years there was vast investment placed in the industry
„\$ 14.500.000.000,-- (\$14.5 bill)“

DAVOS 2011

The future of biofuels in the state ISRAEL *could* be given a significant boost by a INS2bn (\$560m) programme to reduce its dependence on foreign oil in 2011, which was announced by Israel's Prime Minister Benjamin Netanyahu in September 2010



- Algae production is jet a *small industry*; the largest European producer is producing 50 ton/a
- Economy of scale and industrial digression did not jet *hammer* the costs down
- There are still some questions open I the downstream processes
- In Europe/Austria there are still limited scientific resources and competences
- Algae still seem *alien* to most opinion leaders
- New opportunity's always come along with risks

- Algae, produced in cultivation systems are the only way to “*produce*” biomass and reduce industrial CO₂ at the same time
- If combined with a higher value product, production is already economical feasible today
- Algal biomass/energy production liberates from dependency's from imports of “crude oil” and “rare earth elements”
- Scarce resources like arable land and water stay available for food and feed production
- Today, in times of relatively cheap and available energy and rich resources is the ideal time to start the green industry

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THANK YOU FOR YOUR ATTENTION, YOUR QUESTIONS ARE WELCOME

