

Small versus large scale microalgae production

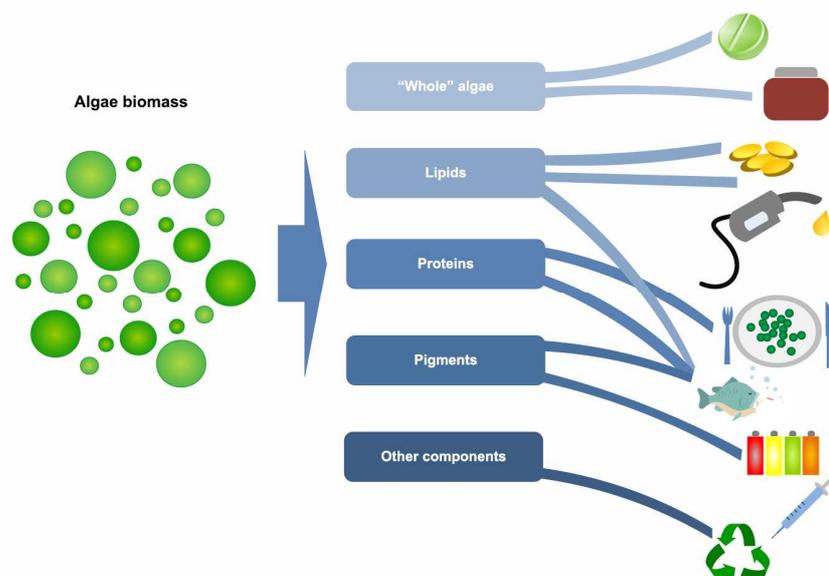
BFF congres, 10 April 2013

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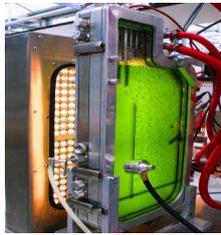


Algae for biorefinery – driven by potential for fuel



Need: commercial production

Currently



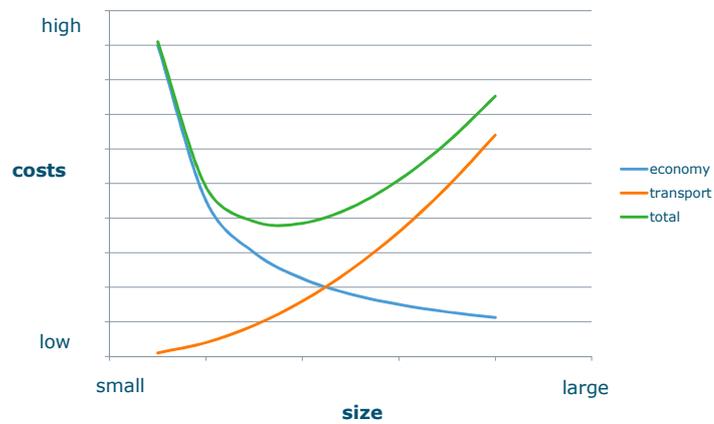
?



Desired



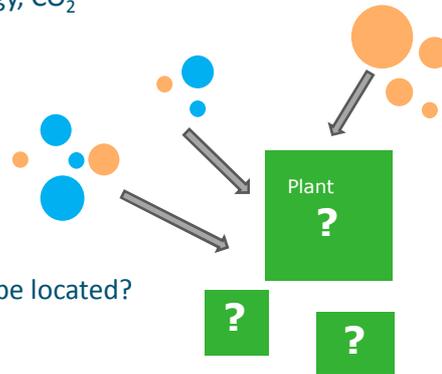
Economy of scale?



Algae logistics

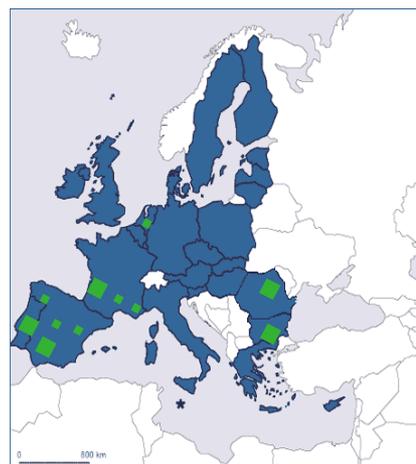
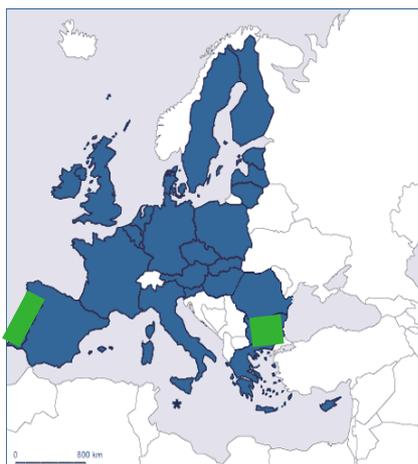
Algae cultivation is connected to the supply chain for resources

- Availability of water, energy, CO₂
- Infrastructure density



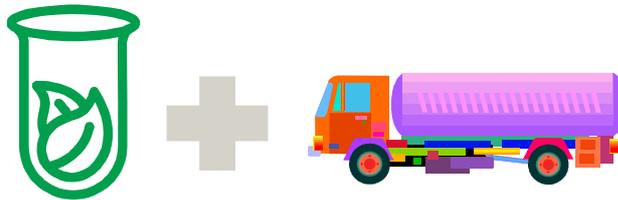
- Where should algae production be located?
- What size is best for logistics?
- How much does transport contribute to energy consumption?

Possible result?



Approach

- Combine algae cultivation (potential productivity) with logistic analysis
 - Models for algae cultivation in various reactor design
 - Logistic model (BeWhere)



Growth depends on

Location



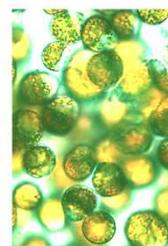
Light input
 Solar angles
 Weather conditions

Design



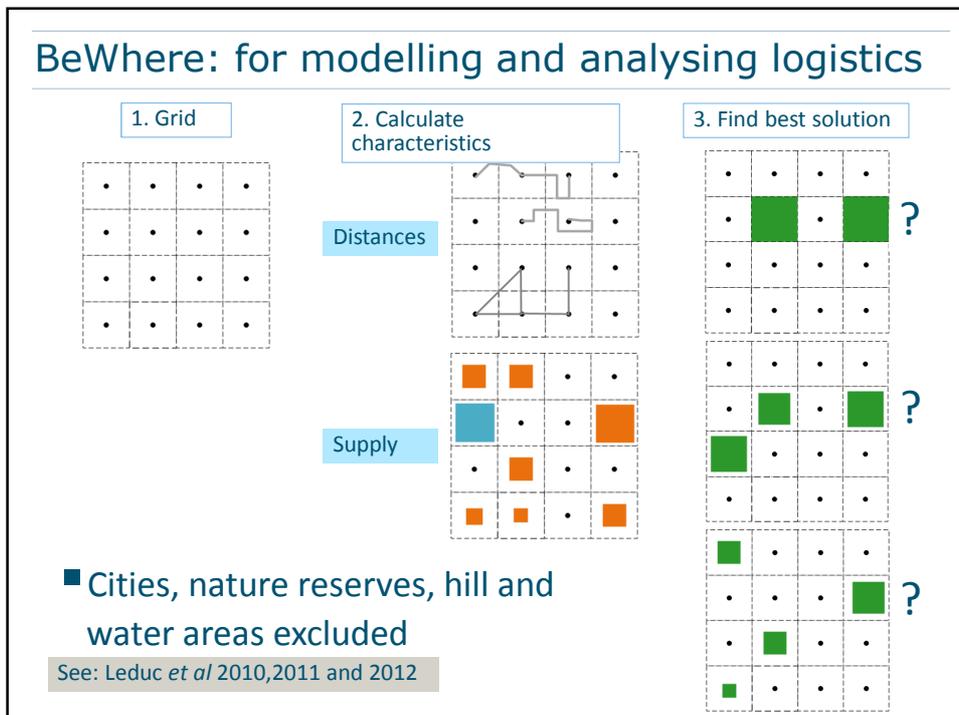
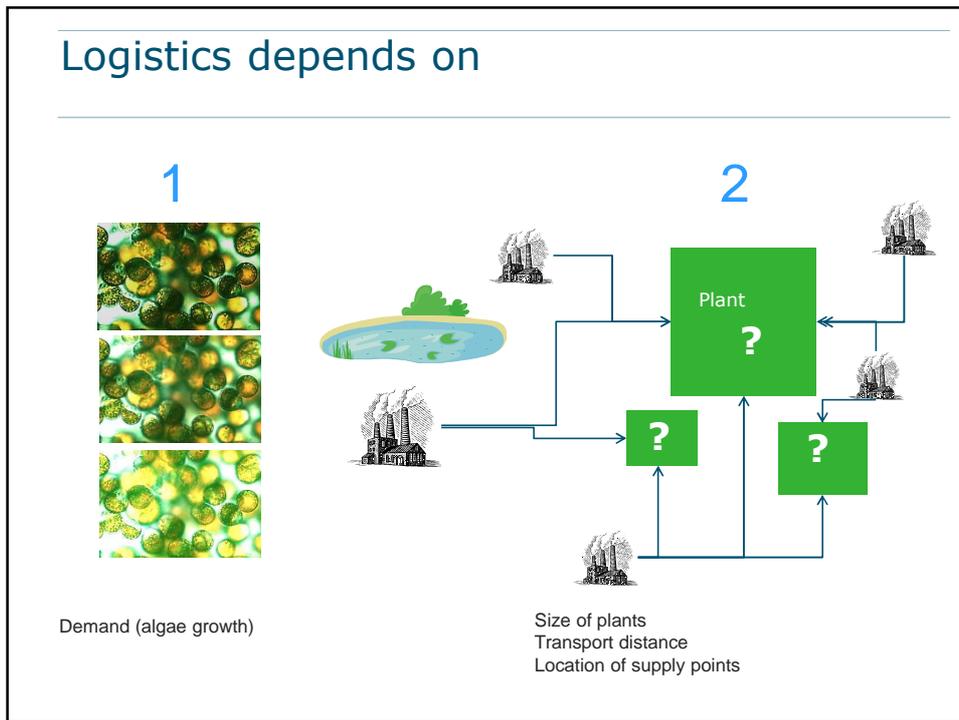
Light path
 Horizontal spacing
 Height of system
 Vertical distance in stack
 Reactor material
 Ground material

Algae culture



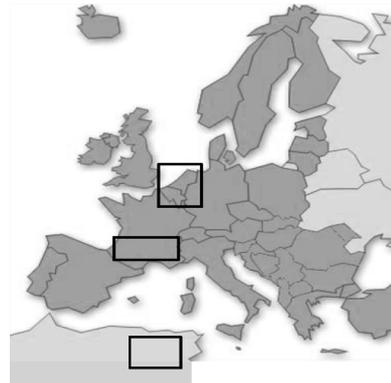
Algae species
 Biomass concentration

See: Slegers *et al*, *Applied Energy* 2011 and 2013



Scenario studies

- Sustainability versus economy
- Interest in **energy**: aim at sustainable algae production for fuel so positive energy balance important
- MILP-optimization
- 3 locations:
 - Sunlight conditions
 - Infrastructure
 - Supply of water & CO₂
 - Different infrastructure



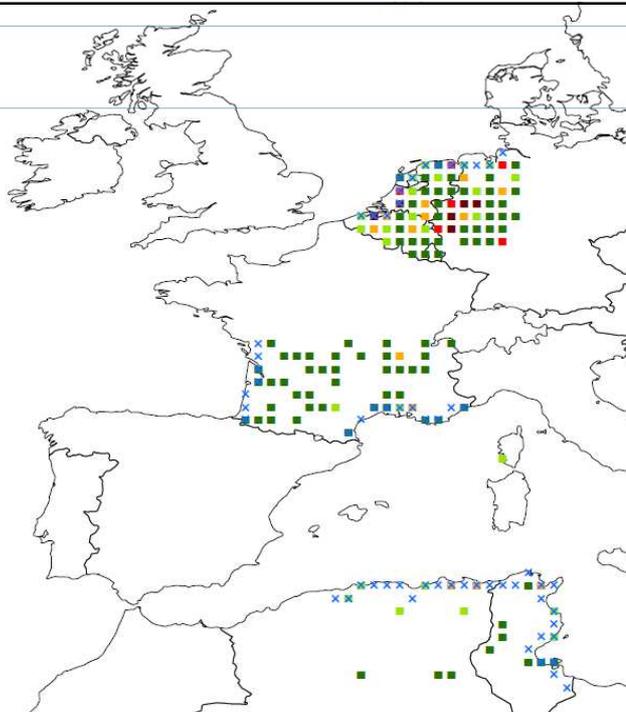
Supply

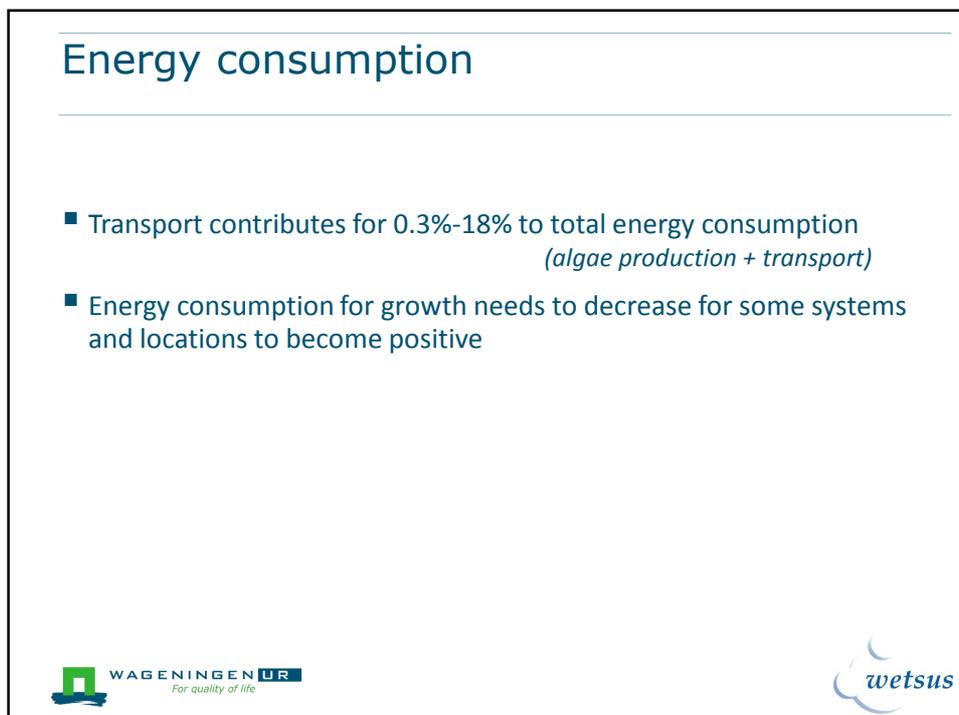
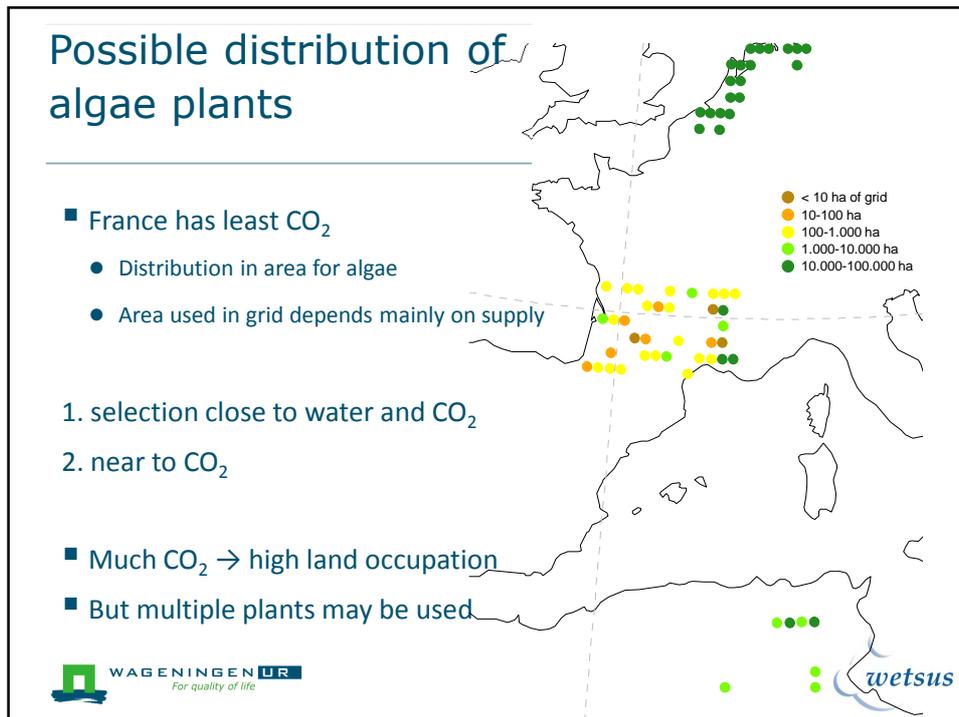
Supply of CO₂

0.5 < 5 < 30 Mton/yr

Supply of sea water x

Infrastructure is included (roads, pipelines)





Small beats large?

- Method to analyse small versus large scale production/processing
- Algae cultivation currently not limited by logistic energy uptake
- Smaller grids lead to detailed analysis: plant sizes instead of production areas

Small competes with large?

