

# Algae for biofuels for road transportation

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IRENA  
Cyprus Event on Renewable Energy Applications  
for Island Tourism

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# Presentation Overview

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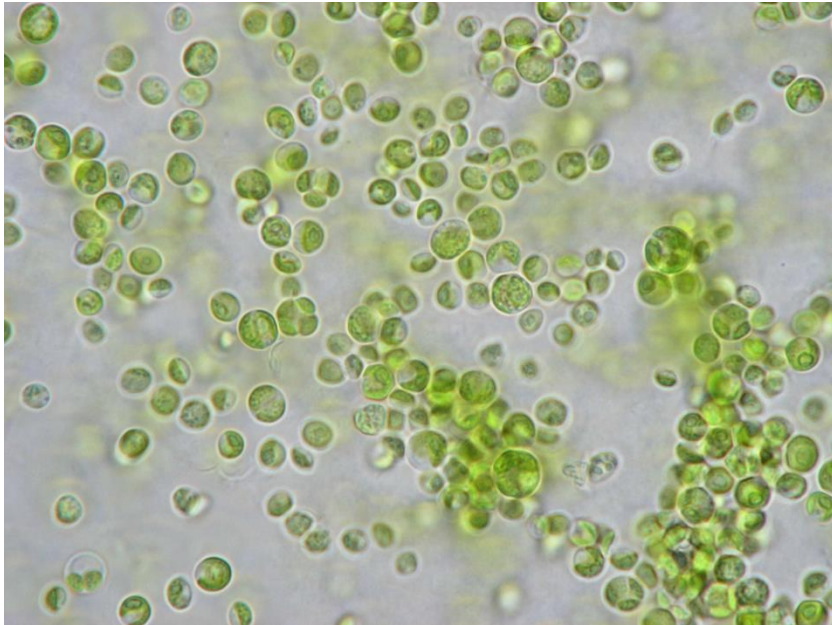
- Introduction
  - Micro- and Macro- algae
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- Algae work in Cyprus
  - Microalgae
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- Conclusions



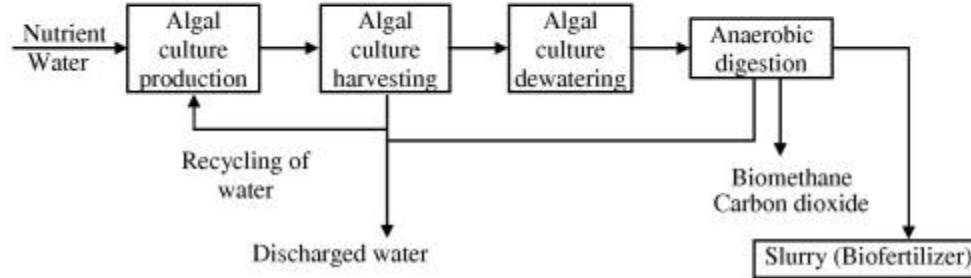
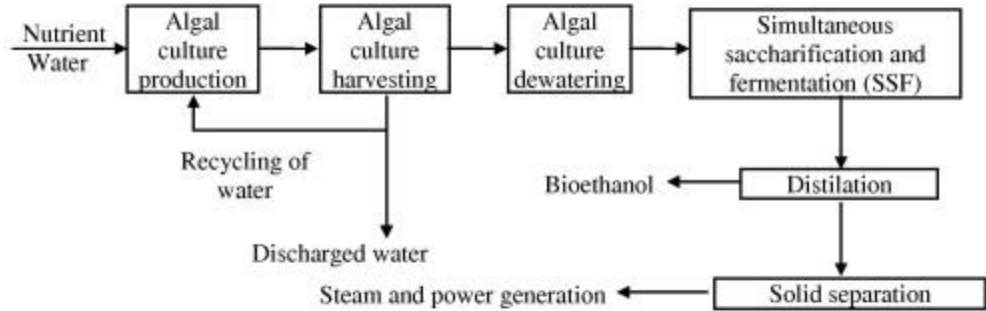
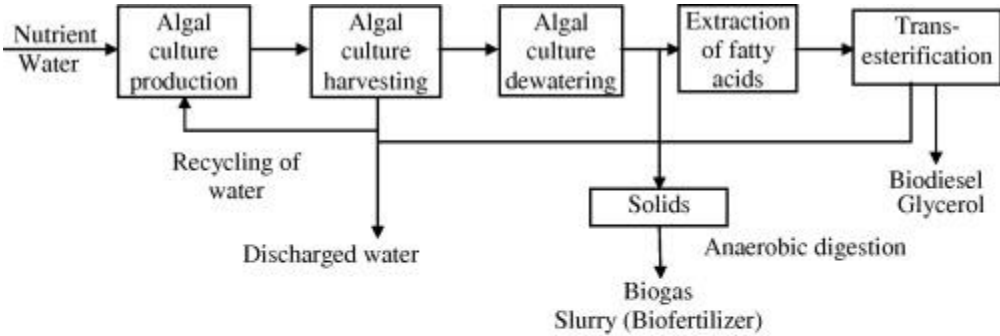
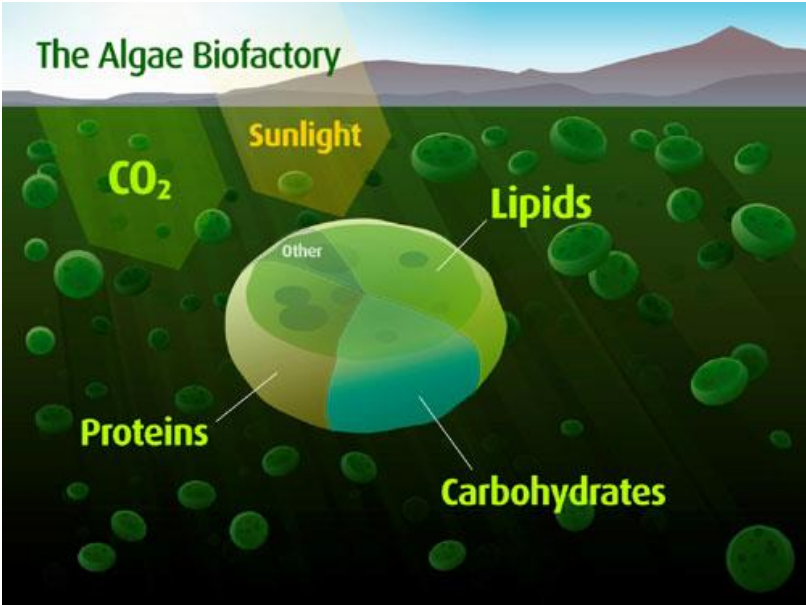
# Introduction – Microalgae and Macroalgae

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- **Microalgae** covers all unicellular and simple multi-cellular microorganisms, including both prokaryotic and eukaryotic microalgae and diatoms, while
- **Macroalgae** (seaweed) are large-celled, photosynthetic algae (red, brown and green algae)



# Cultivation - Introduction



Source: Singh and Olsen, 2011



# Cultivation – Open ponds/ Bioreactors



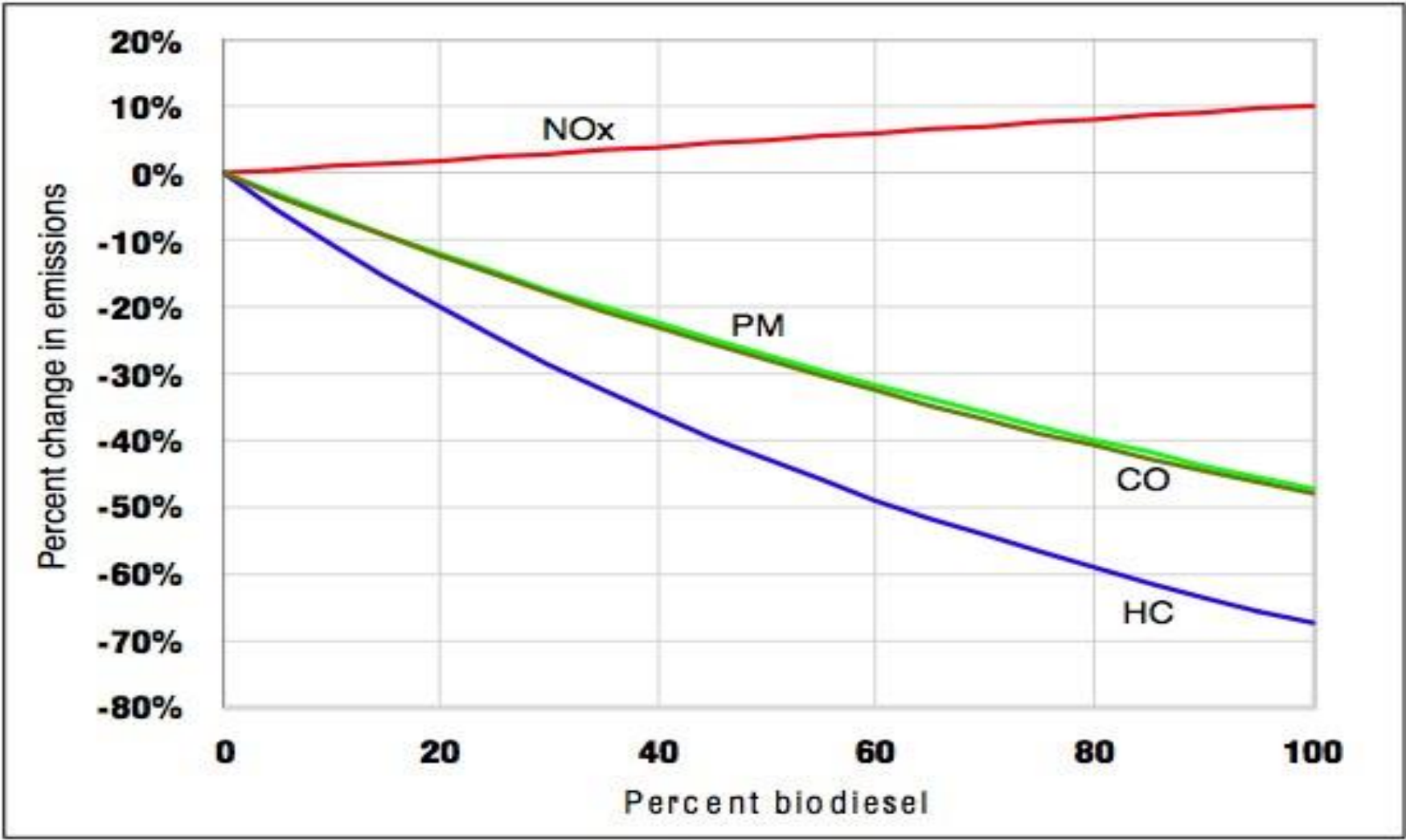
# Cultivation – Advantages

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- Advantages:
  - (1) **All year** round production,
  - (2) Can grow in aqueous media, but need **less water** than terrestrial
  - (3) Can be **cultivated in non-arable land**,
  - (4) Can utilize nutrients such as nitrogen and phosphorous from a variety of **waste water sources**.
  - (5) Have a **rapid growth potential** (30 times) & many species have high oil content
  - (6) Can also **produce valuable co-products** such as proteins and residual biomass
  - (7) Can tolerate and utilize substantially higher levels of CO<sub>2</sub> than terrestrial plants hence they can utilize CO<sub>2</sub> emitted from petroleum-based power stations
  - (8) Can be **converted into different fuel forms**, such as biogas, liquid and gaseous transportation fuel, kerosene, ethanol, aviation fuel, and biohydrogen.
- But, it takes considerable energy to produce algal biofuels with current technology



# LCA and Emissions of Algal Biofuels



# Other benefits?

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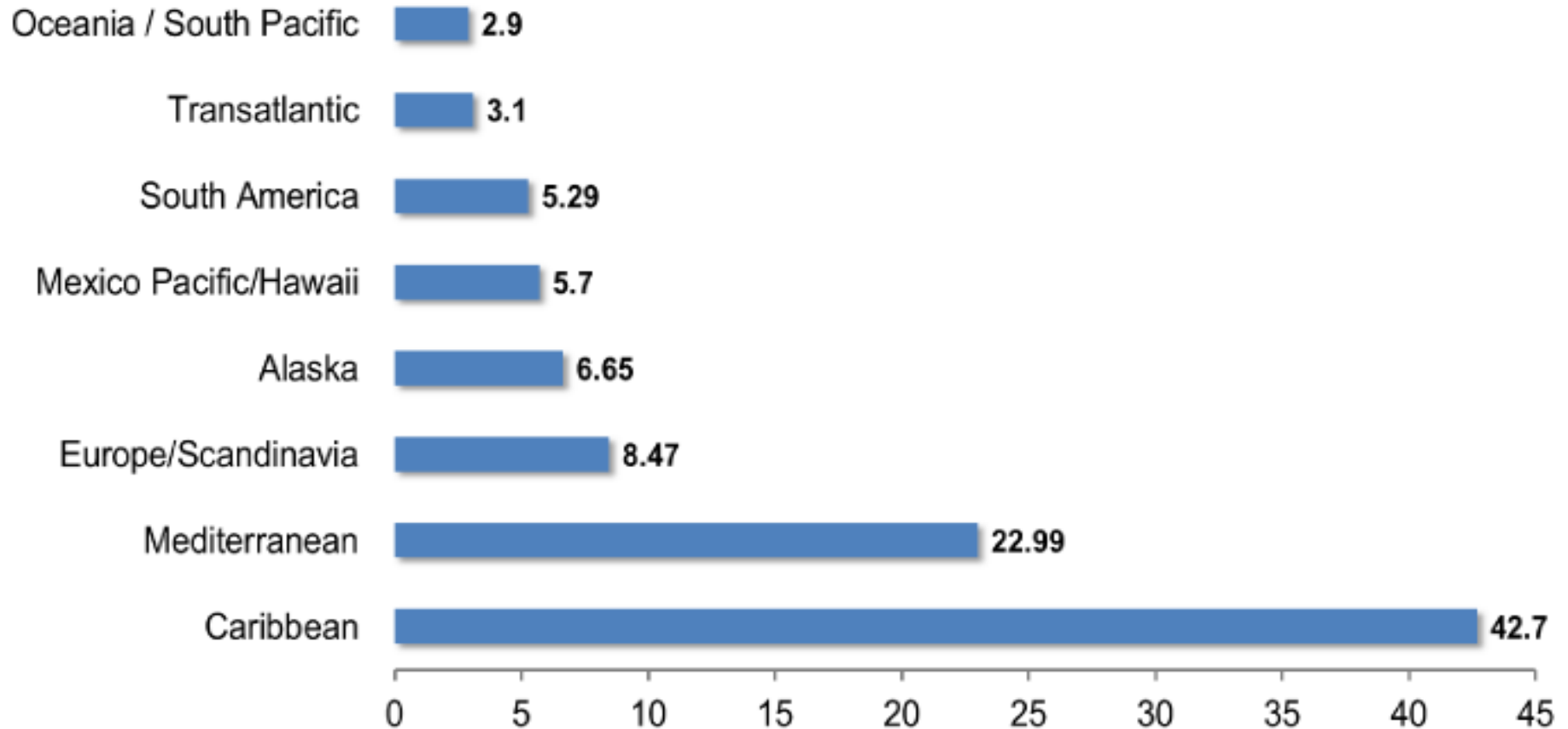
- EU has placed strict restrictions for the quality of the effluents that can be disposed from agricultural waste streams.
- To comply with the 96/61/EC and 2000/60/EE Directives, industries have to install means of wastewater treatment to remove excess nutrients and organic load.
- Worldwide studies showed that algae in general can act as a biofilter
  - *Removal of heavy metals* (Schiewer, 1997; Apiratikul et al., 2008)
  - *Removal of nutrients* (Oswald et al., 1957; Tsagkamilis et al., 2009)
  - *Macroalgae as aquaculture waste biofilters* (Ryther et al., 1975; Chow et al., 2001)
  - *Macroalgae vs microalgae* (Oswald, 1963; de-Bashan et al., 2004)



# Transport and Tourism

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Capacity in million bed-days



Source: Cruise Lines International Association

# Work in Cyprus – Microalgae I

## Overall objectives of the project:

- to investigate, assess, and establish a mechanism to enhance production of bio-fuels and by-products from microalgae supporting the efforts to tackle climate change - and to enhance local and regional development in the Mediterranean Area.

## Project data

- ENPI CBCMED
- Starting date: 7 December 2011
- Budget: 2.000.858,54 Euro
- JMA and JTS, Cagliari, Italy
- Agricultural Research Institute, ARI (PM)

Med-algae  
Production of Biodiesel in selected Mediterranean Countries

Production of Biodiesel from Algae in Selected  
Mediterranean Countries  
(MED-ALGAE)

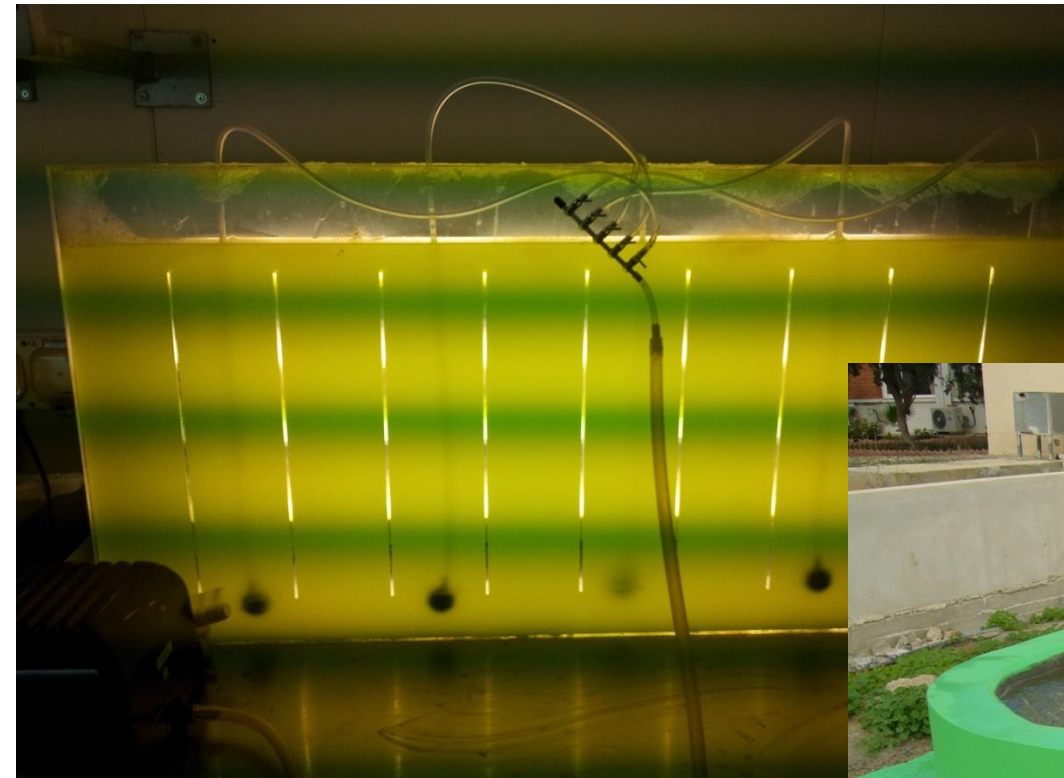


Med-algae  
Production of Biodiesel in selected Mediterranean Countries



ENPI  
CBCMED  
CROSS-BORDER COOPERATION  
IN THE MEDITERRANEAN

# Work in Cyprus – Microalgae II



Cyprus University of Technology  
Alexandros Charalambides

Med-algae  
Production of Biodiesel in selected Mediterranean Countries



ENPI  
CBCMED  
CROSS-BORDER COOPERATION  
IN THE MEDITERRANEAN

# Work in Cyprus – Macroalgae I

## Overall objectives of the project:

- to develop a suitable methodology for the swine's waste water treatment using macroalgae and the use of the excess Macroalgae biomass to produce biofuels such as biodiesel and bioethanol.

## Project data

- ΠΕΝΕΚ/0311/21
- Starting date: 1 June 2012
- Budget: 87.500 Euro
- Cyprus University of Technology

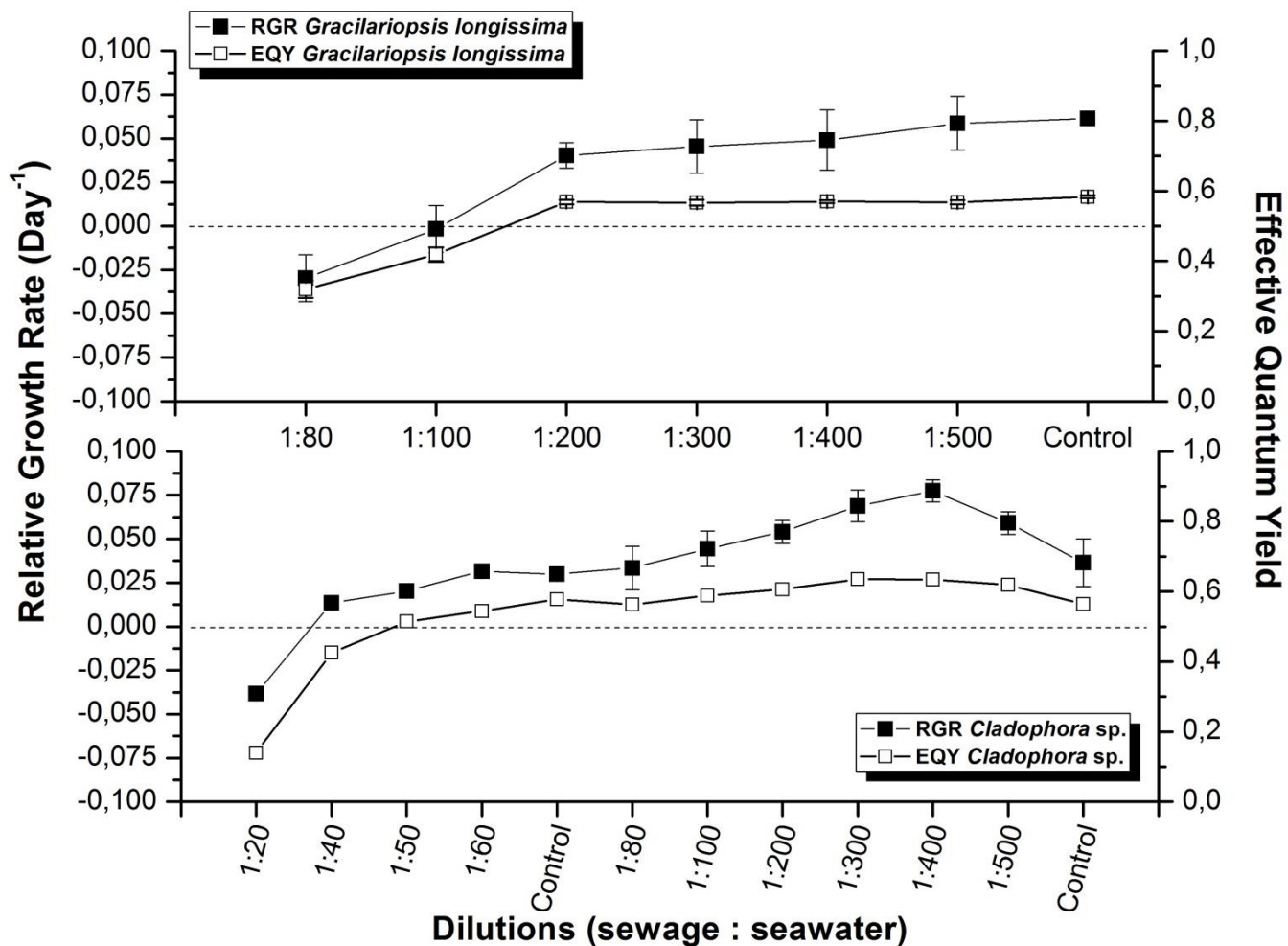


*Gracilariopsis longissima*  
(**Rhodophyceae**)



*Cladophora* sp.  
(**Chlorophyceae**)

# Work in Cyprus – Macroalgae II



Comparison of the of EQY and RGR for the different dilutions (sewage: seawater) on *G. longissima* and on *Cladophora sp.*, within a cultivation period of 9 days.



# Conclusions

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Algae can be used for the production of biofuels, ...

... but more work is still needed.

# Thank you

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