

Microalgal cultivations integrated with wastewater treatment: the example of the MEWLIFE project

Fabrizio Di Caprio

Department of Chemistry, Università Sapienza di Roma, Rome (Italy)

High Tech Recycling (HTR) – Inter-University Centre



The project **MicroalgaE biomass from phototrophic-heterotrophic cultivation using olive**

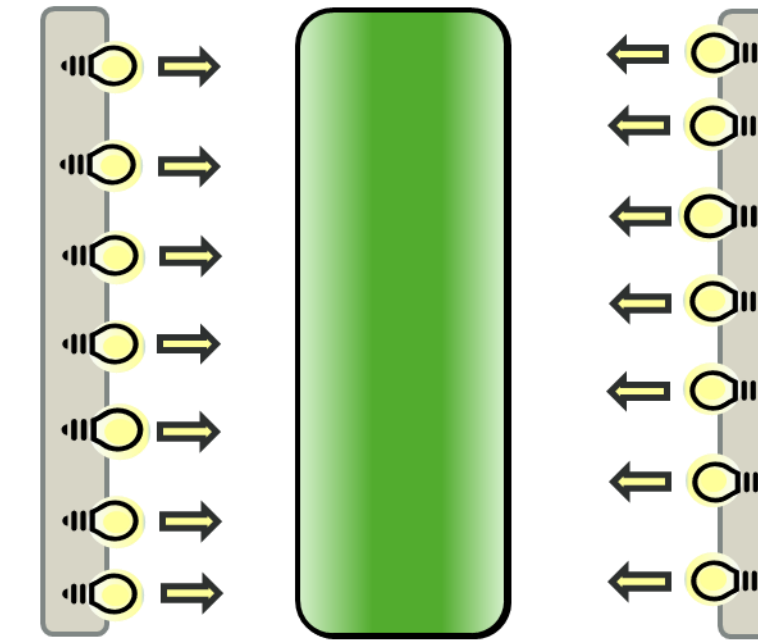
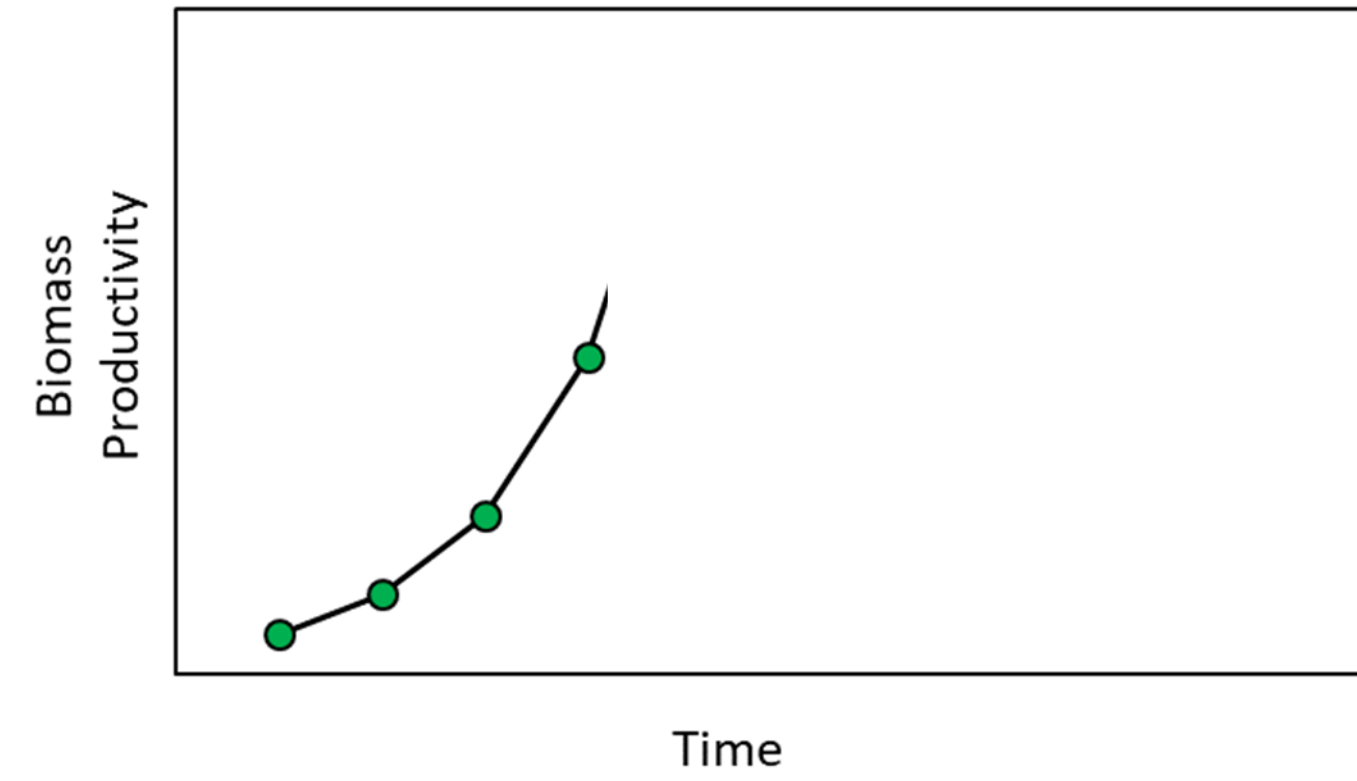
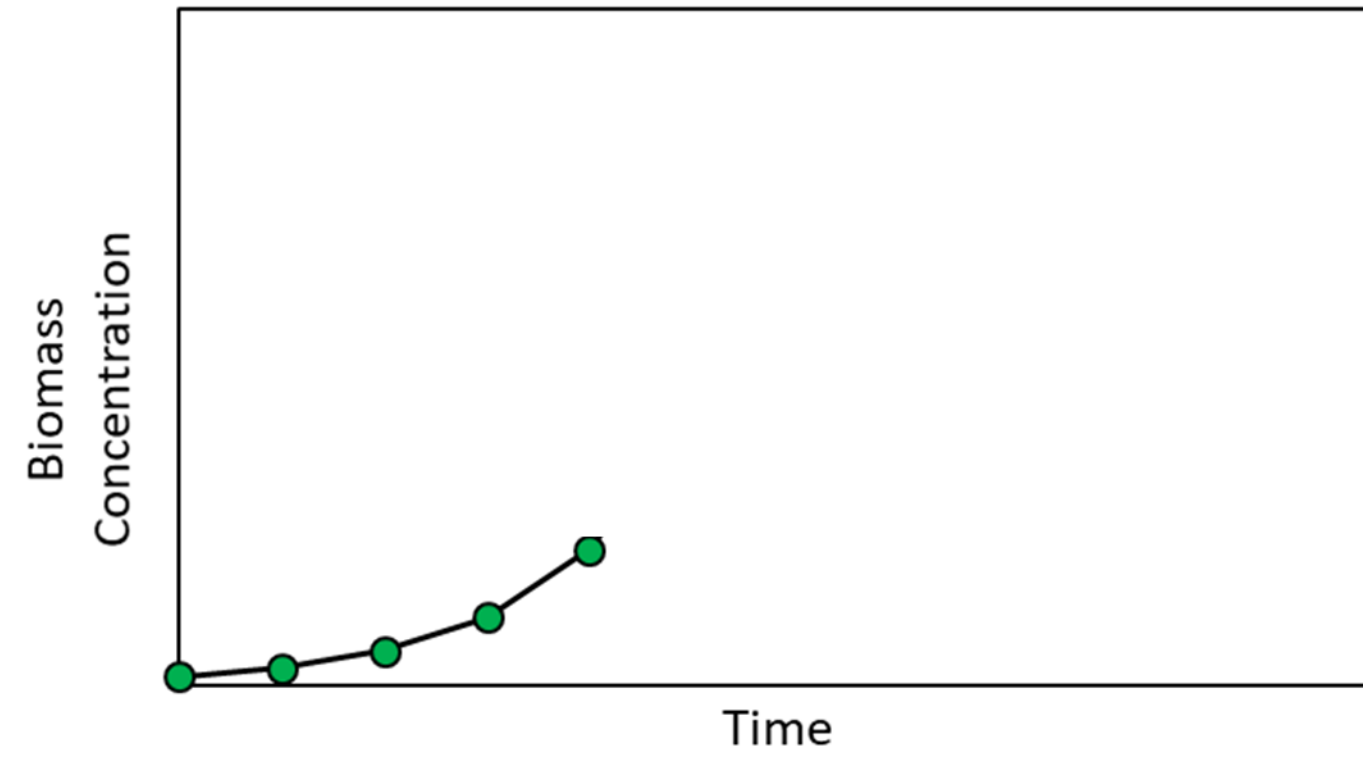
oil Wastewaters – MEWLIFE is co-funded by the LIFE Programme of the European Union (LIFE17 ENV IT 000180).



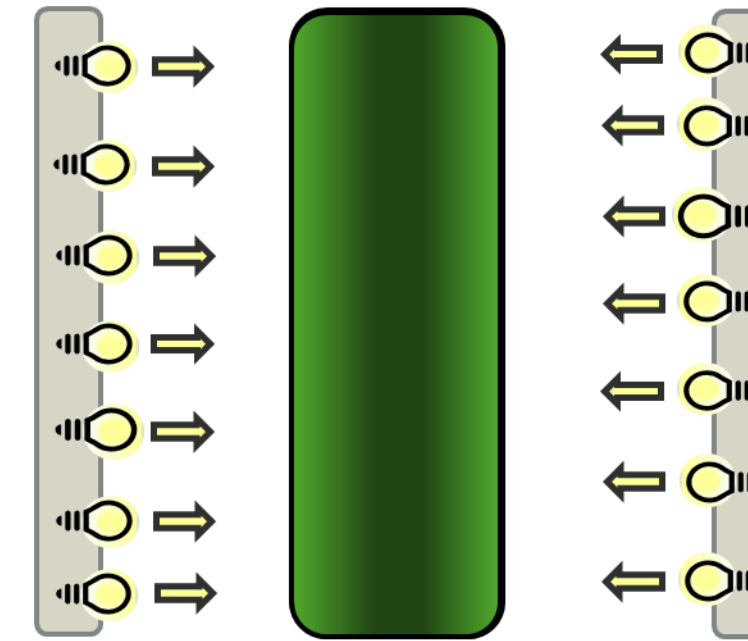
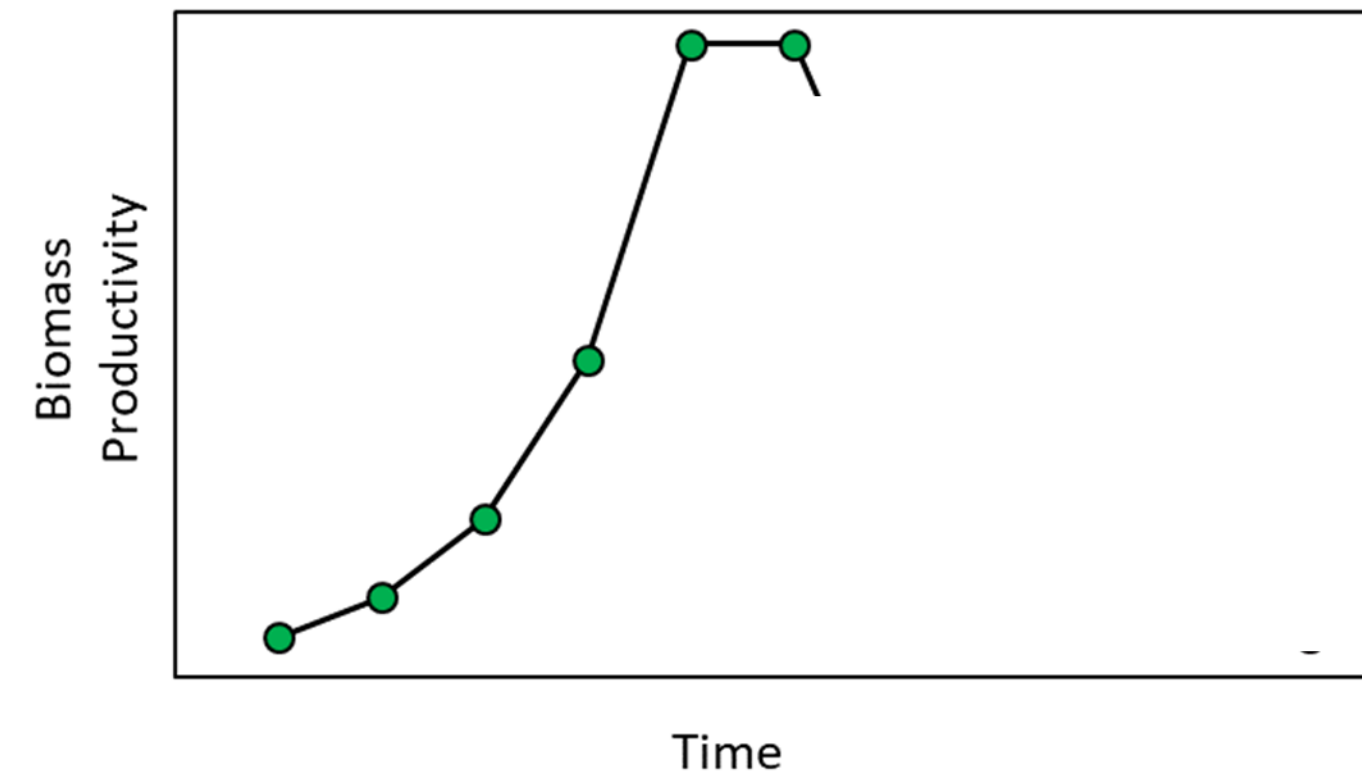
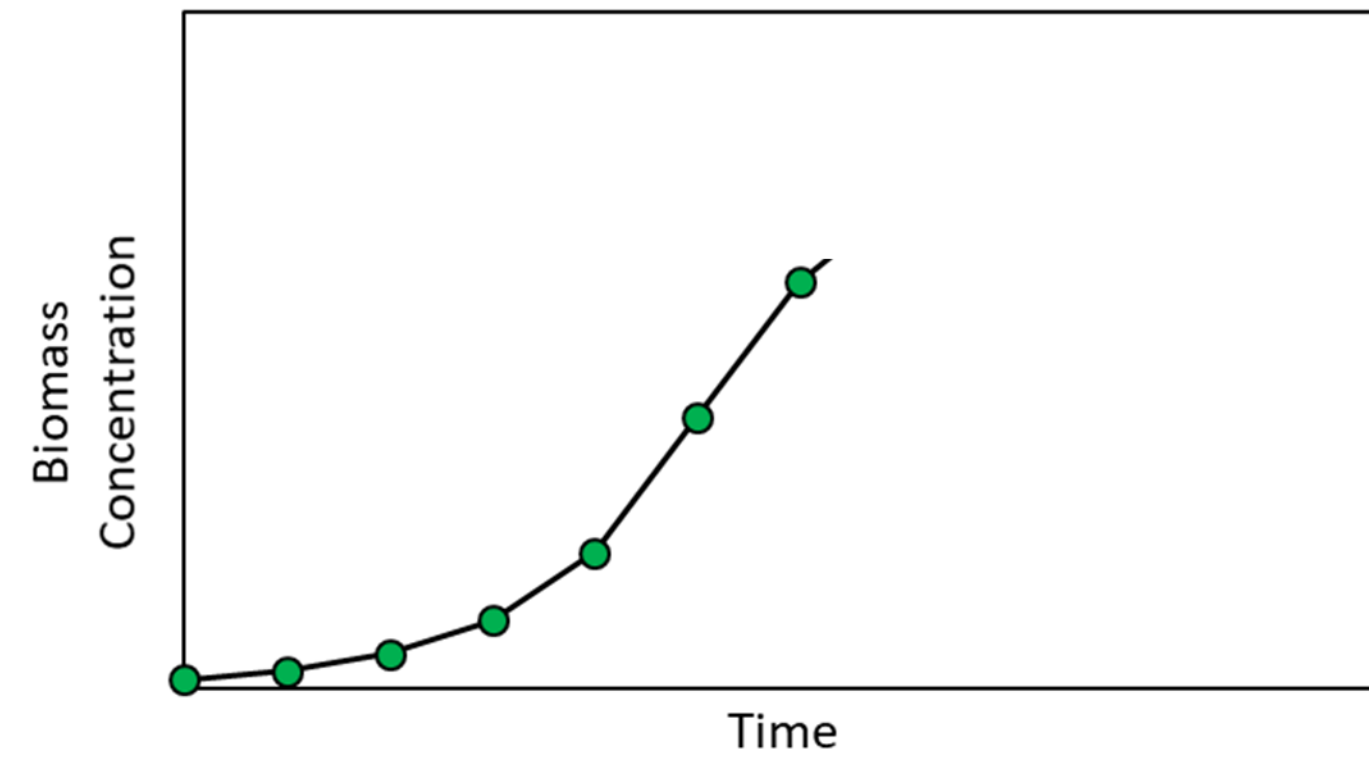
MEWLIFE

www.mewlife.eu

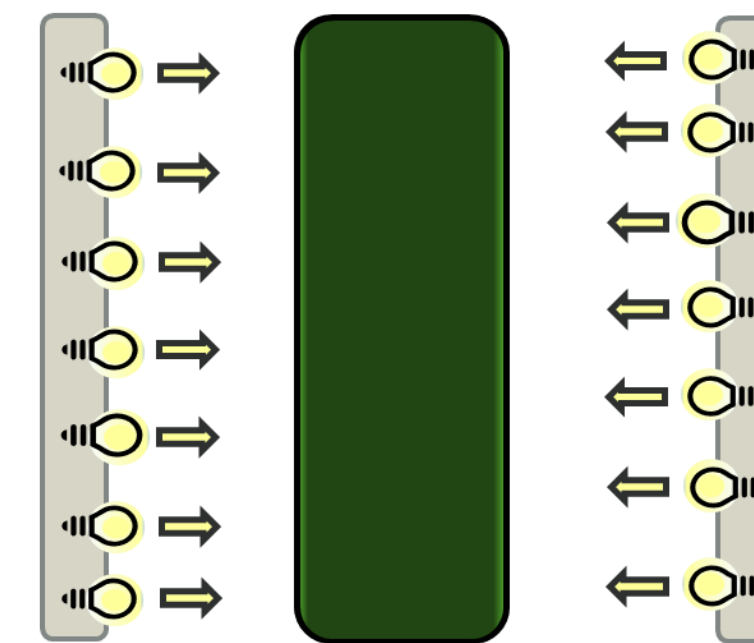
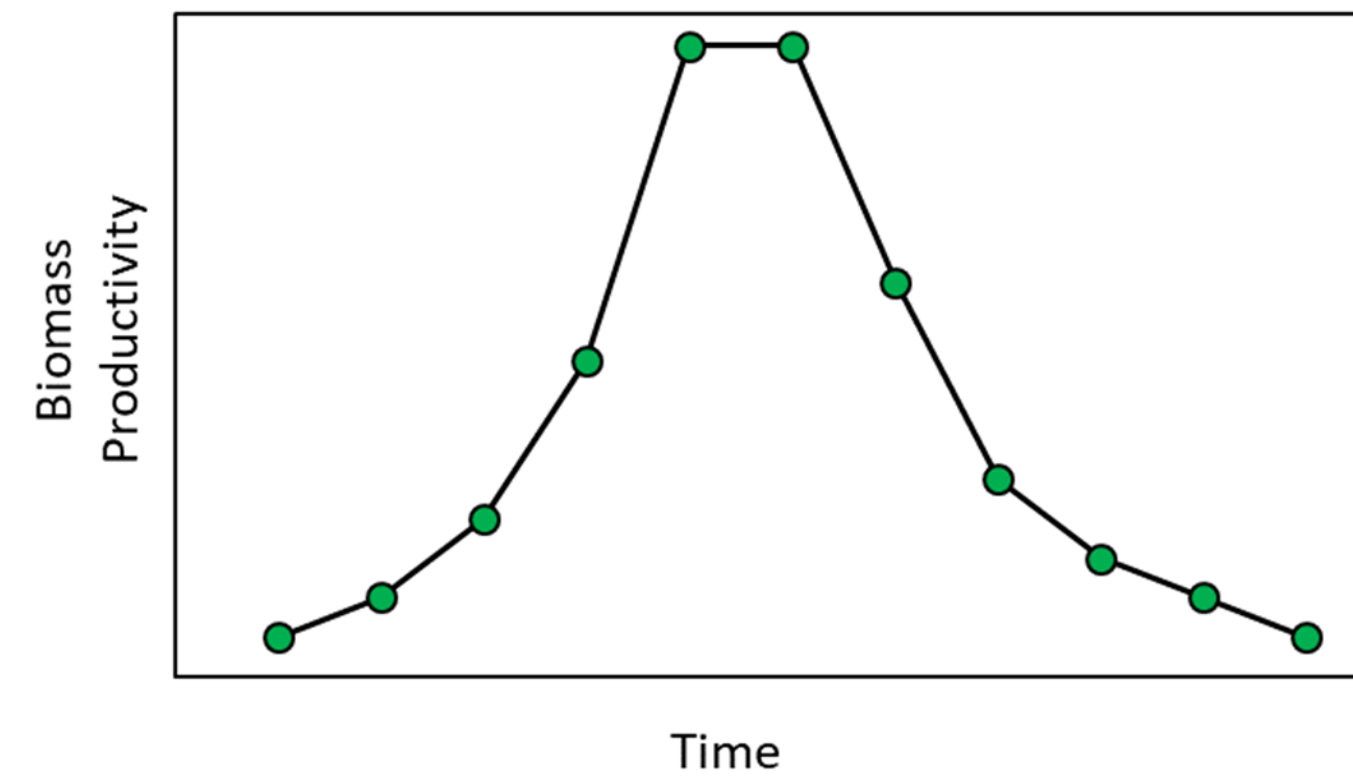
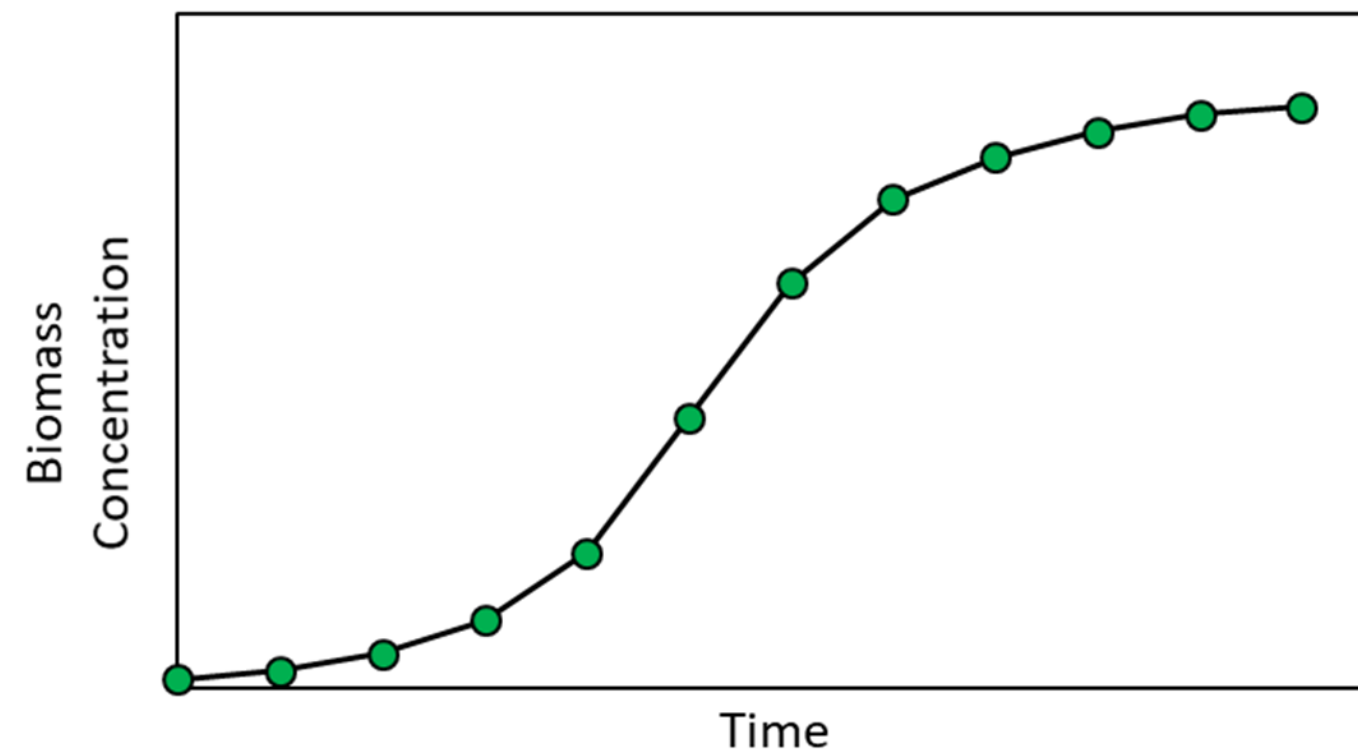
Main limits in phototrophic processes



Main limits in phototrophic processes



Main limits in phototrophic processes



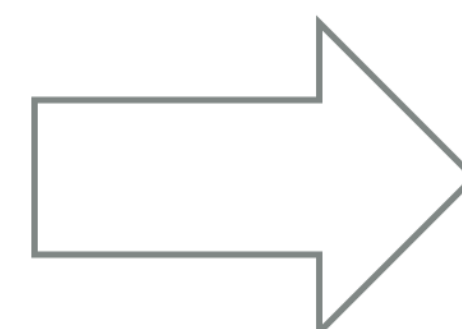
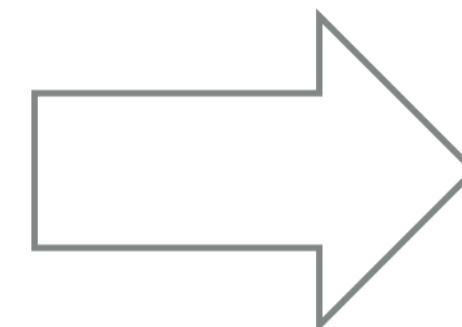
Productivity increment by increasing **S/V** ratio

Open Pond

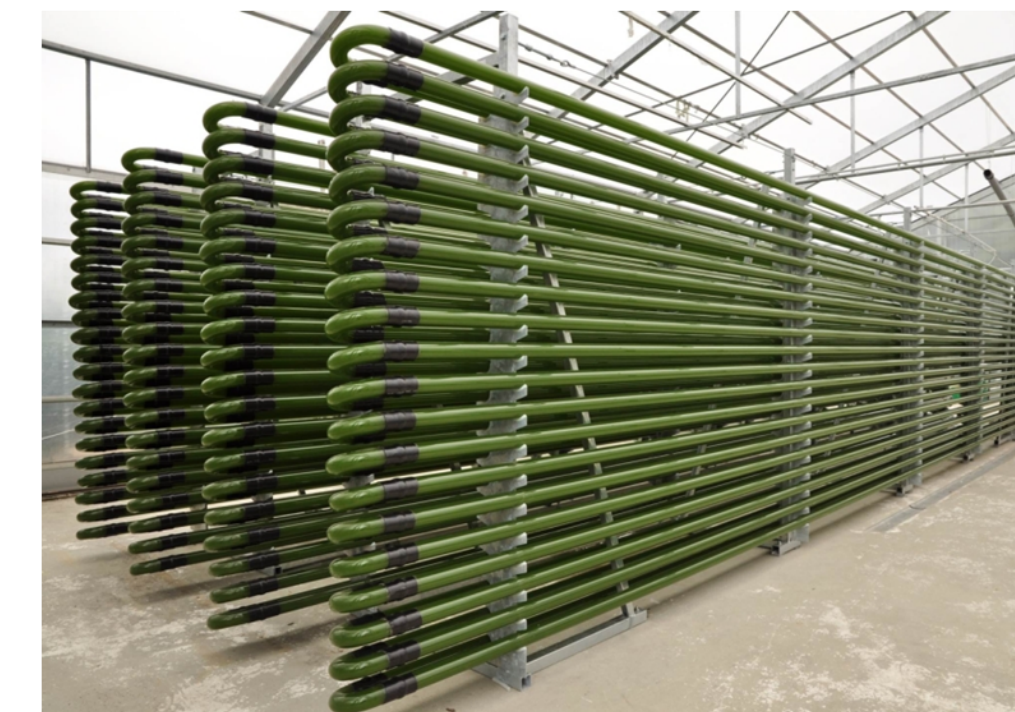


$$P_x \text{ (g m}^{-2} \text{ d}^{-1}) = 10$$

$$P_x \text{ (g L}^{-1} \text{ d}^{-1}) = 0.03$$



PBR



$$P_x \text{ (g m}^{-2} \text{ d}^{-1}) = 20$$

$$P_x \text{ (g L}^{-1} \text{ d}^{-1}) = 0.6$$

High S/V ratios require high capital and operative costs

Costs for microalgae production



Open Pond



Low O&M costs
Low productivity
High costs for harvesting



High O&M costs
High productivity
Low costs for harvesting

M. Tredici et al. Algal Research 19 (2016) 253–263

J. Ruiz et al. Energy Environ. Sci., 2016, 9, 3036

S. Schade and T. Meier. Algal Research 40 (2019) 101485

Costs for microalgae production



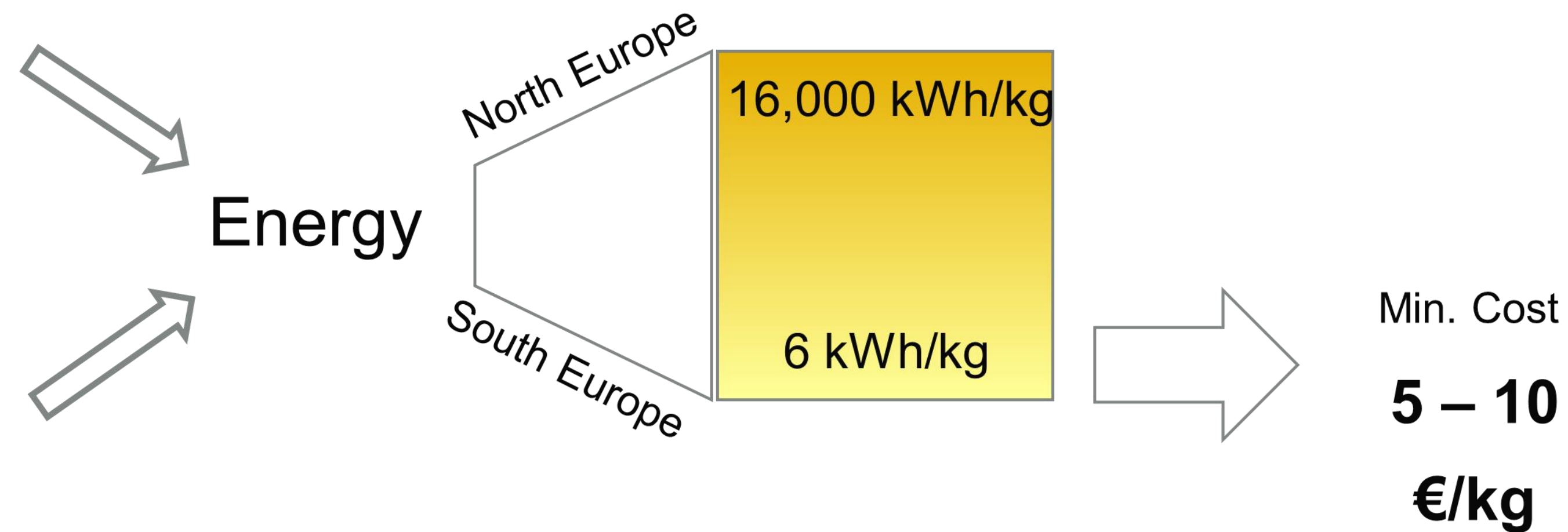
Open Pond



Low O&M costs
Low productivity
High costs for harvesting



High O&M costs
High productivity
Low costs for harvesting



Light is free
BUT
Maintaining microalgae exposed to light is costly

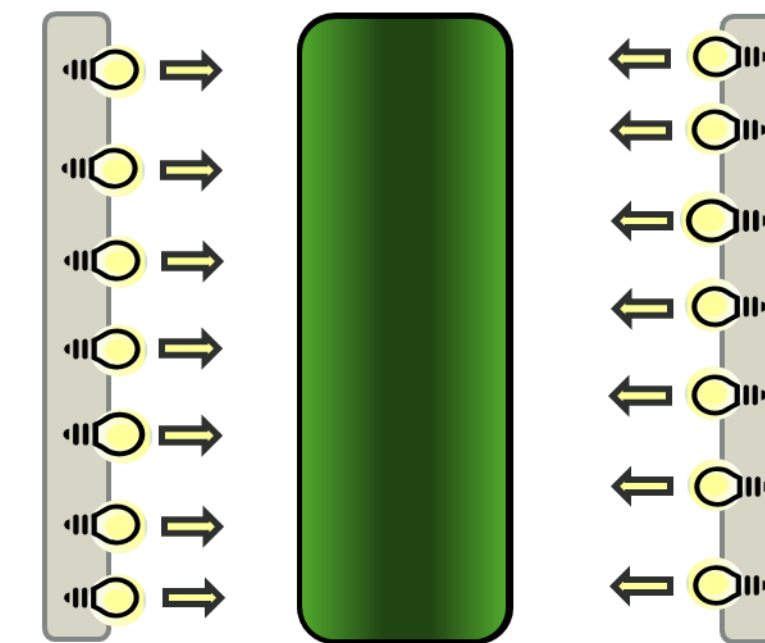
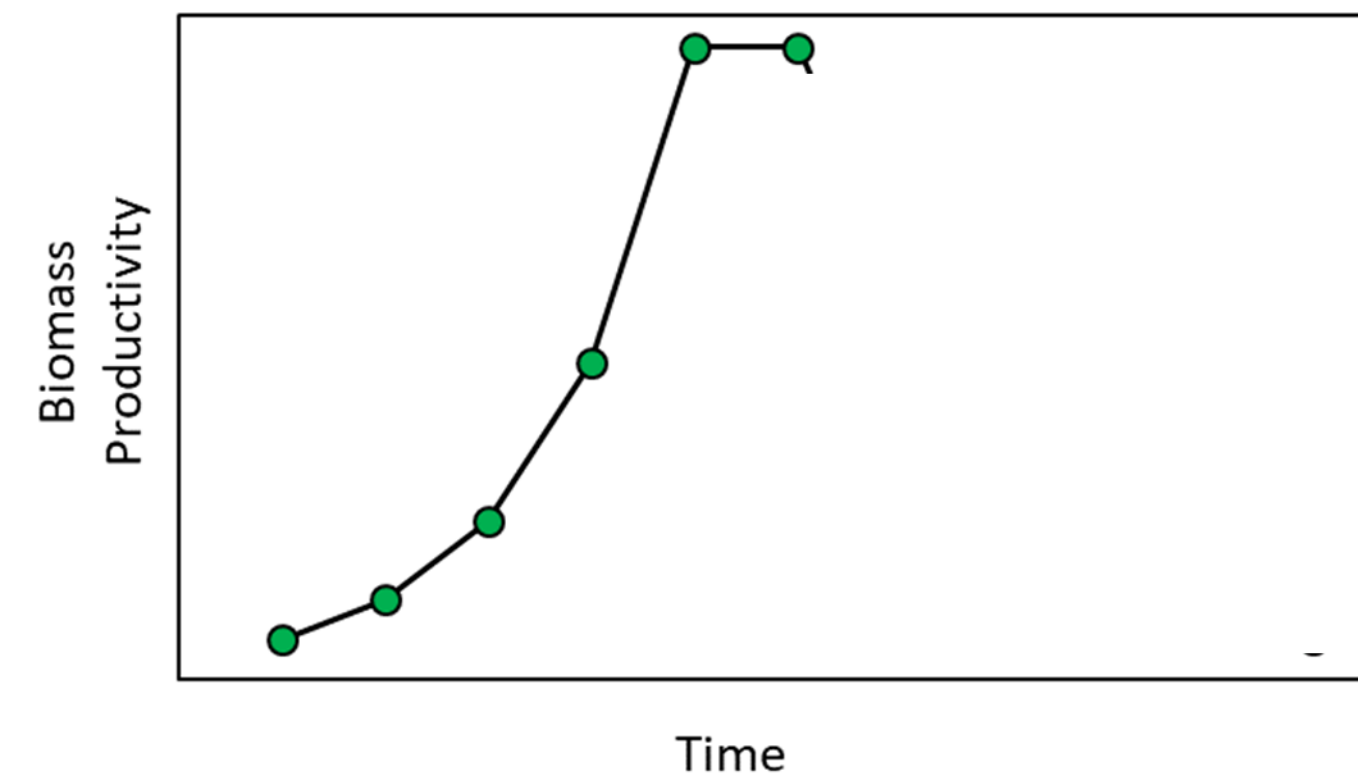
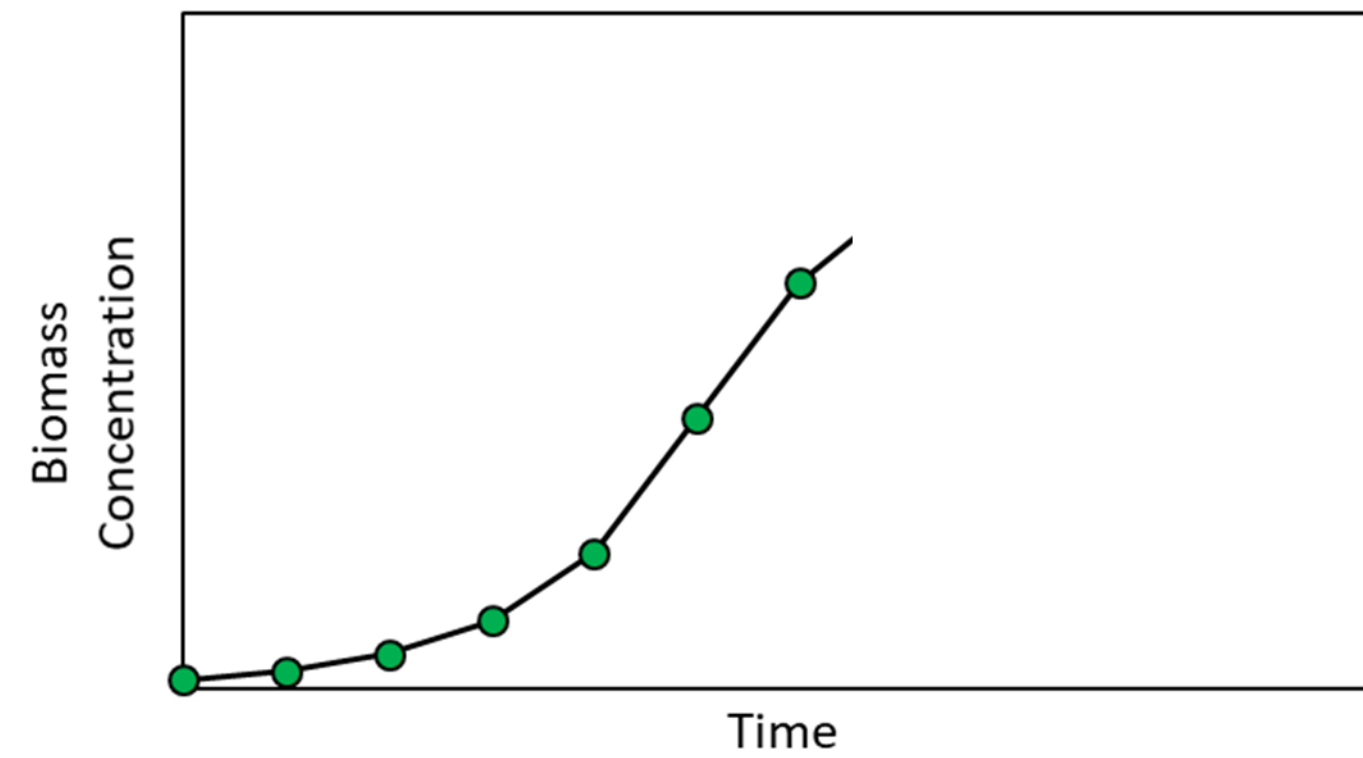
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Two-stage photo-heterotrophic cultivation

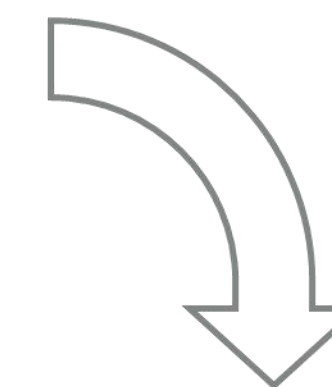
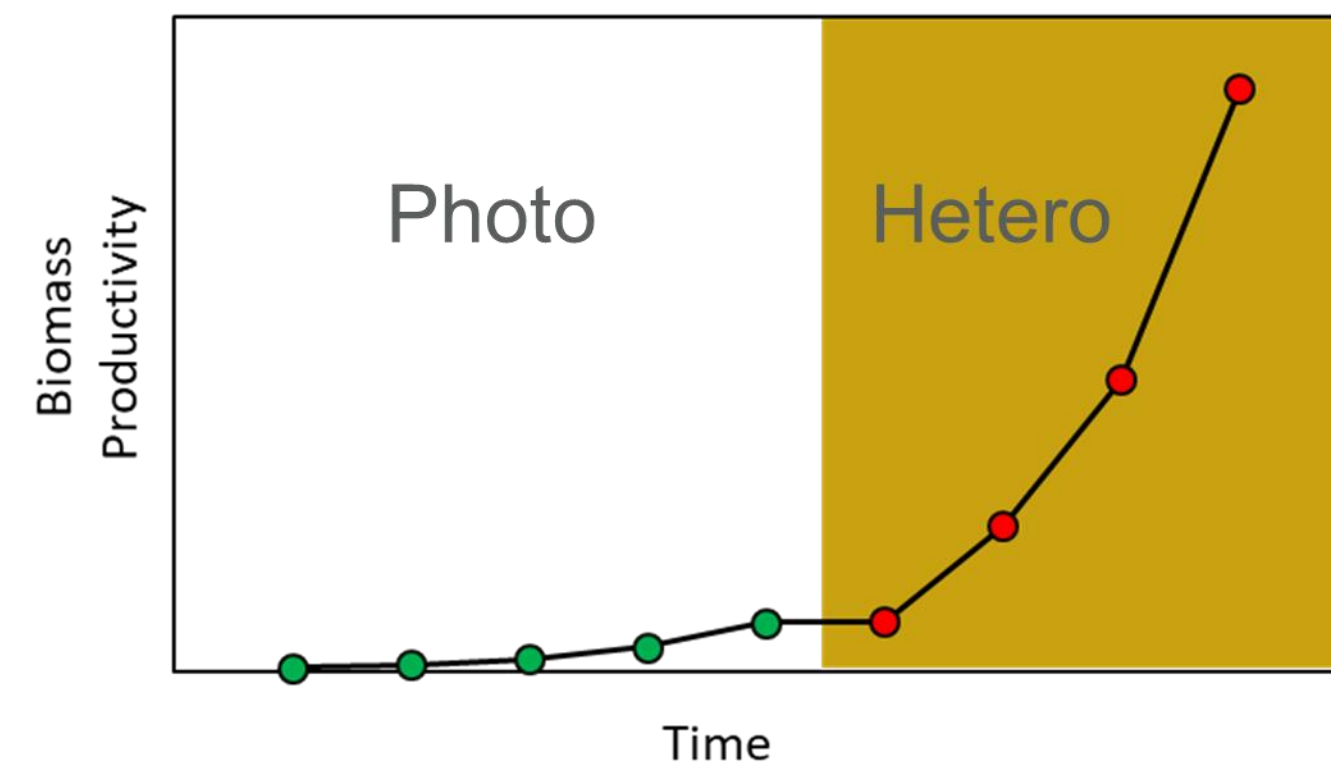
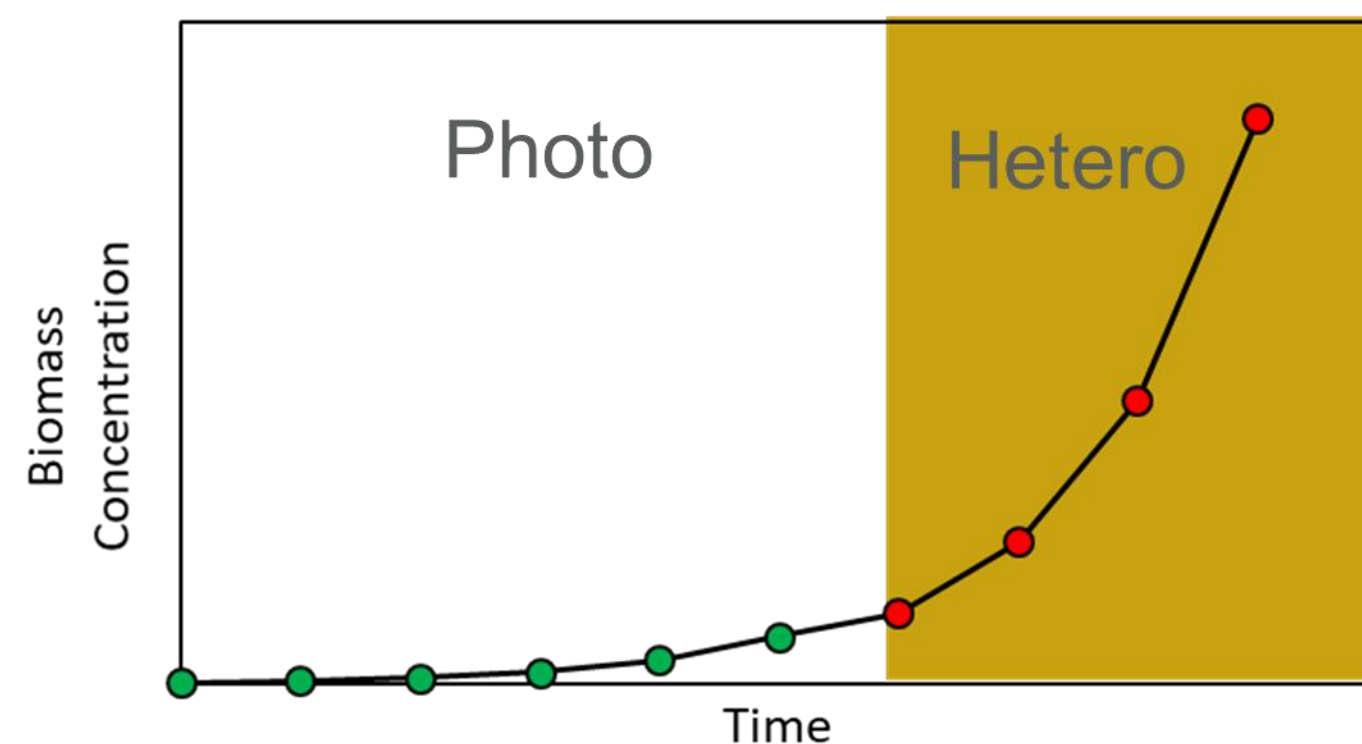


Exploiting organic substrates to feed high density cultures



Two-stage photo-heterotrophic cultivation

Organic Substrates



Heterotrophic metabolism

High biomass concentration and productivity (also for low S/V)



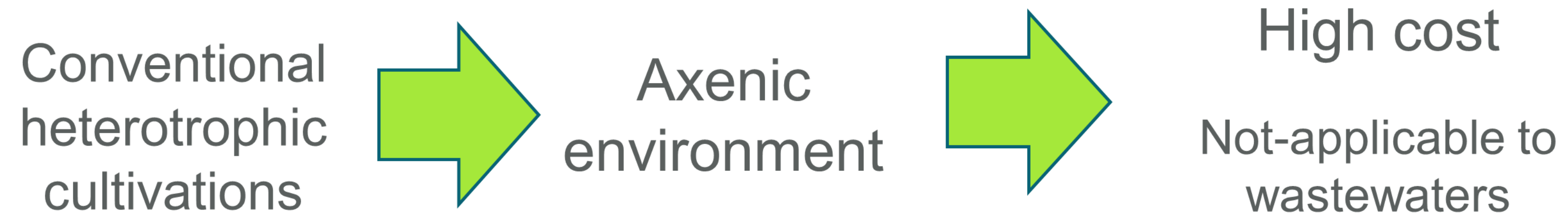
Up to 100 g/L and 20 g/L d

Wastewaters treatment



Substrate: organic pollutants

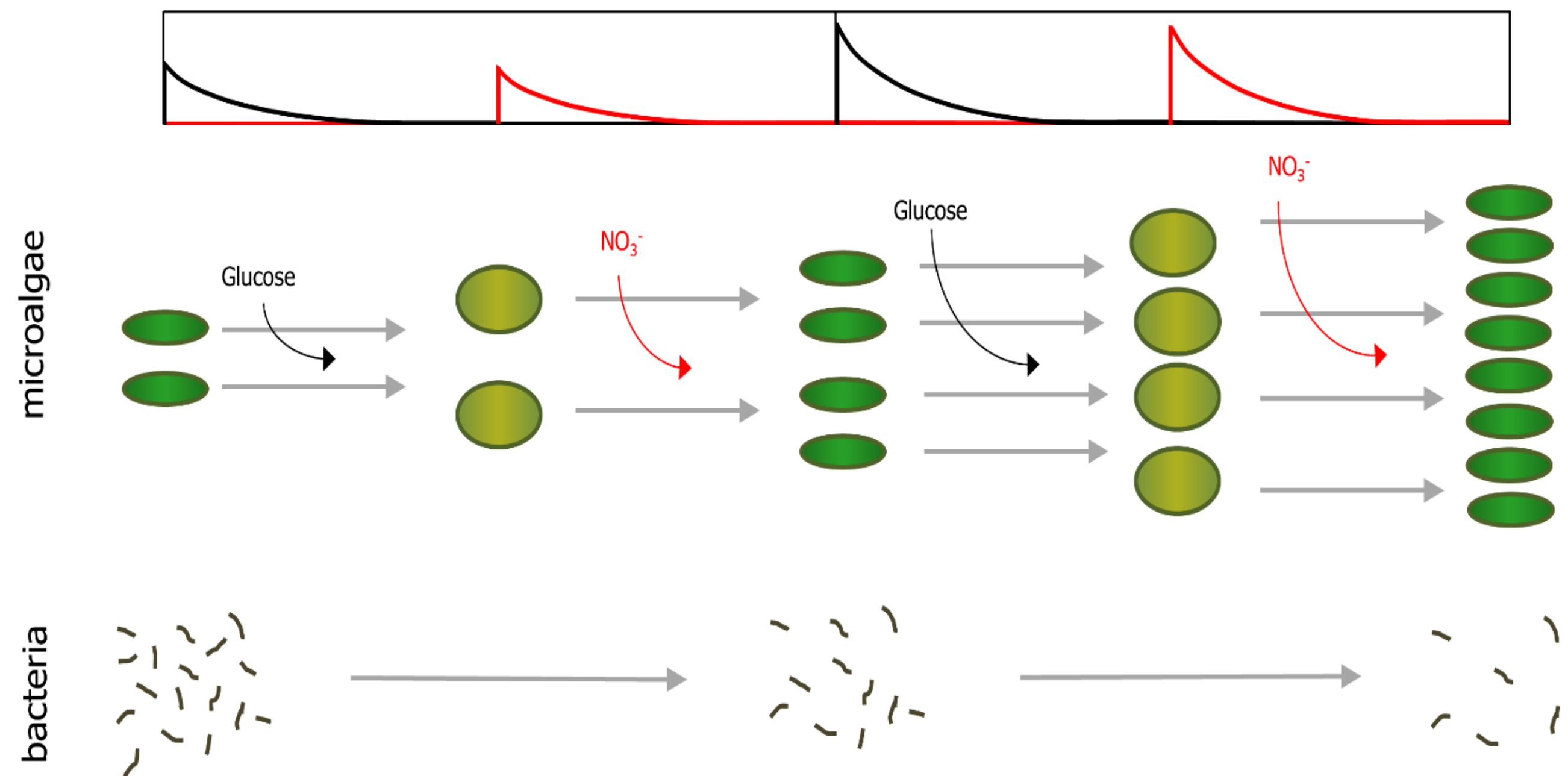
Contamination issues



Overcoming contamination in open reactors by a tailored environment to favour microalgae



Uncoupled nutrients feeding

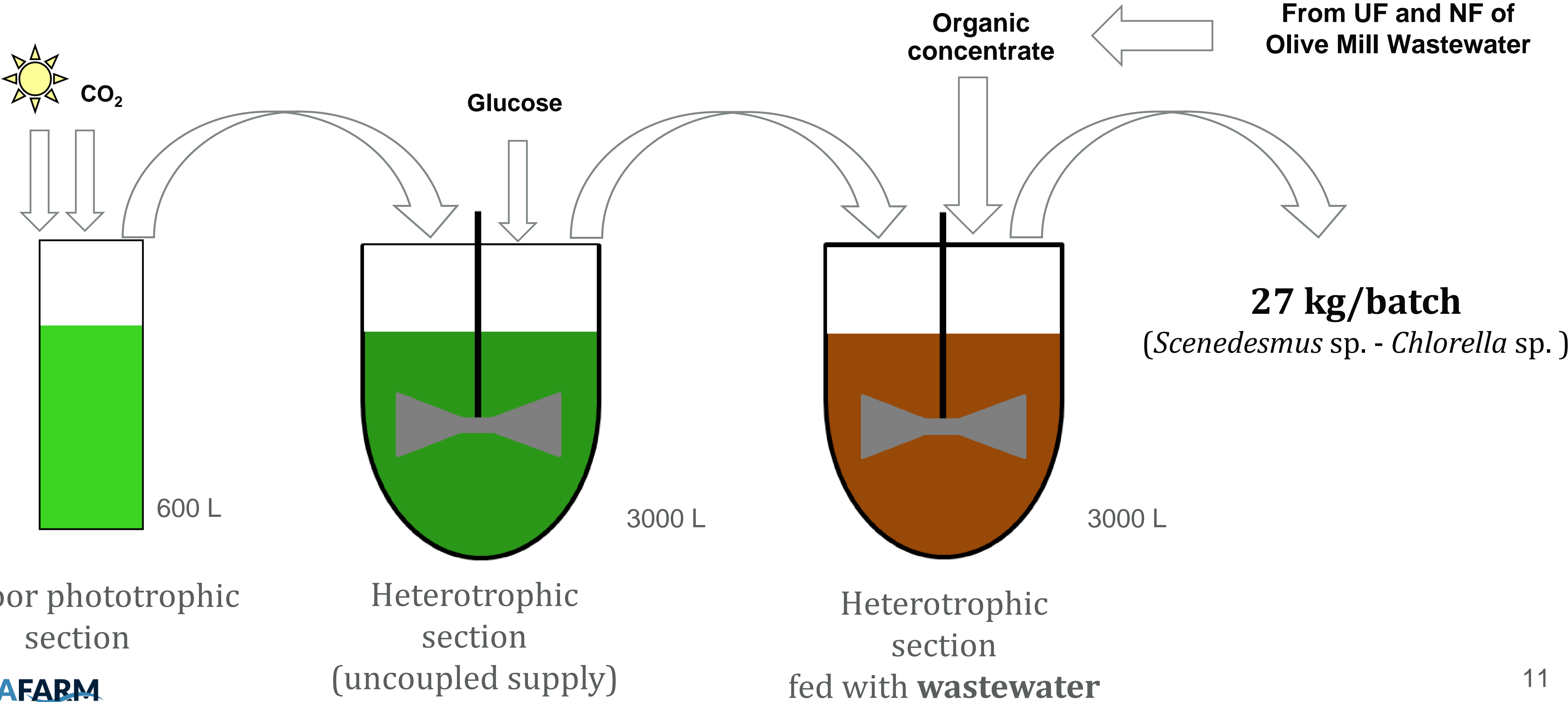


Di Caprio et al. Biochemical Engineering Journal - Vol. 145, 2019 Pag. 127-136

Integration with wastewaters treatment



The example of the MEWLIFE project



Outdoor phototrophic section

Heterotrophic section (uncoupled supply)

Heterotrophic section fed with wastewater

Olive Mill Wastewater (OMW): from an issue to a resource



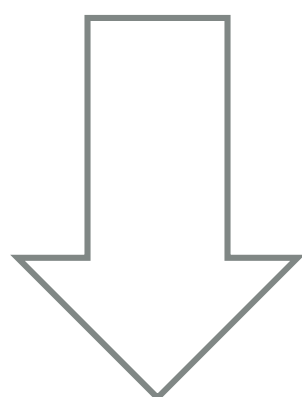
98 % of worldwide Olive Oil production is in the Mediterranean area.

2-3 millions m³ of OMW are produced in Italy every year.



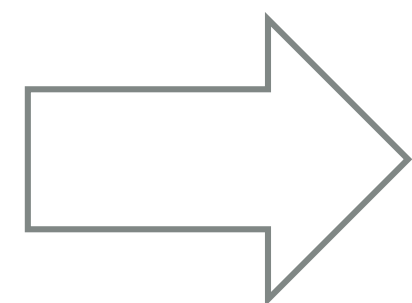
COD	30 – 130 g/L
Phenols	3 – 15 g/L
pH	4 - 5.5

Legge 574/96



OMW spreading on the fields:

50 – 80 m³/ha/y



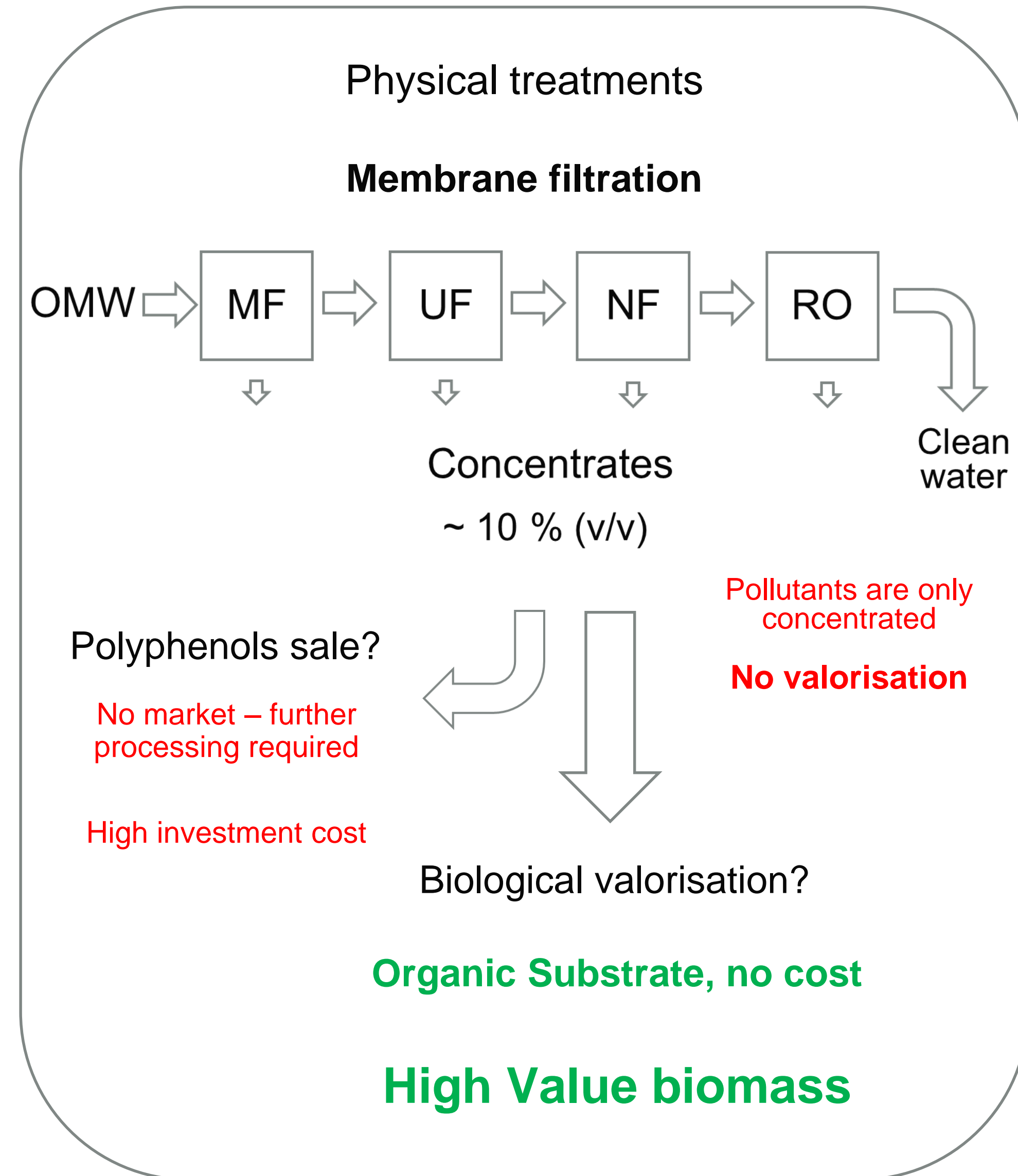
Illegal disposal

Cost: 5 -20 €/m³

Soil acidification

Groundwater contamination
(COD, phenols, P)

Antimicrobial and phytotoxic
effects (phenols)



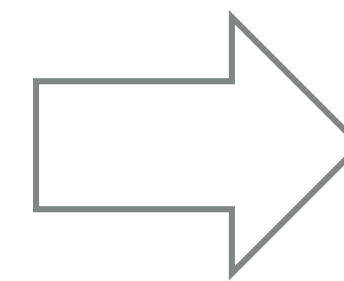
Olive Mill Wastewater valorisation in MEWLIFE project



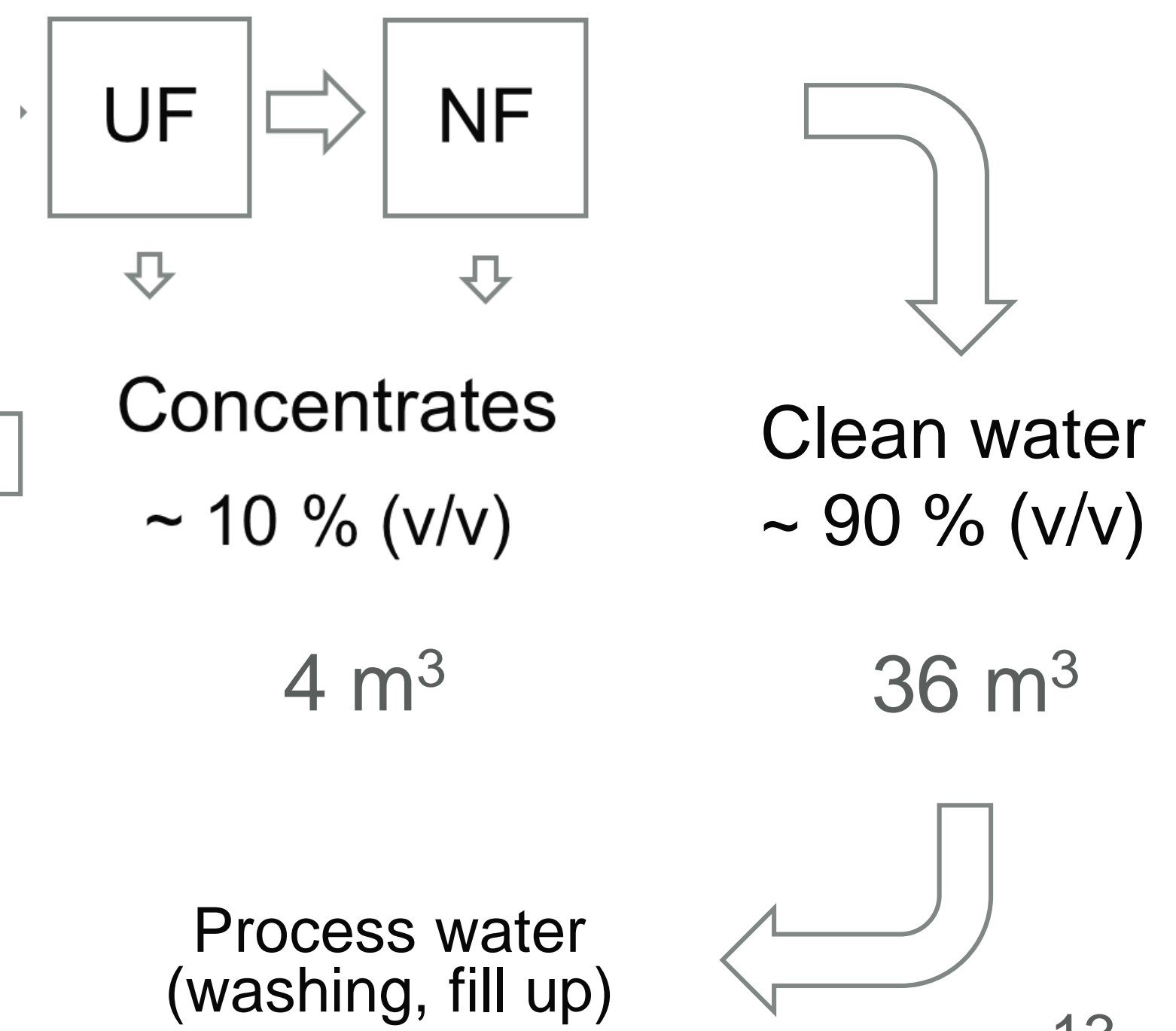
Olive oil production plant



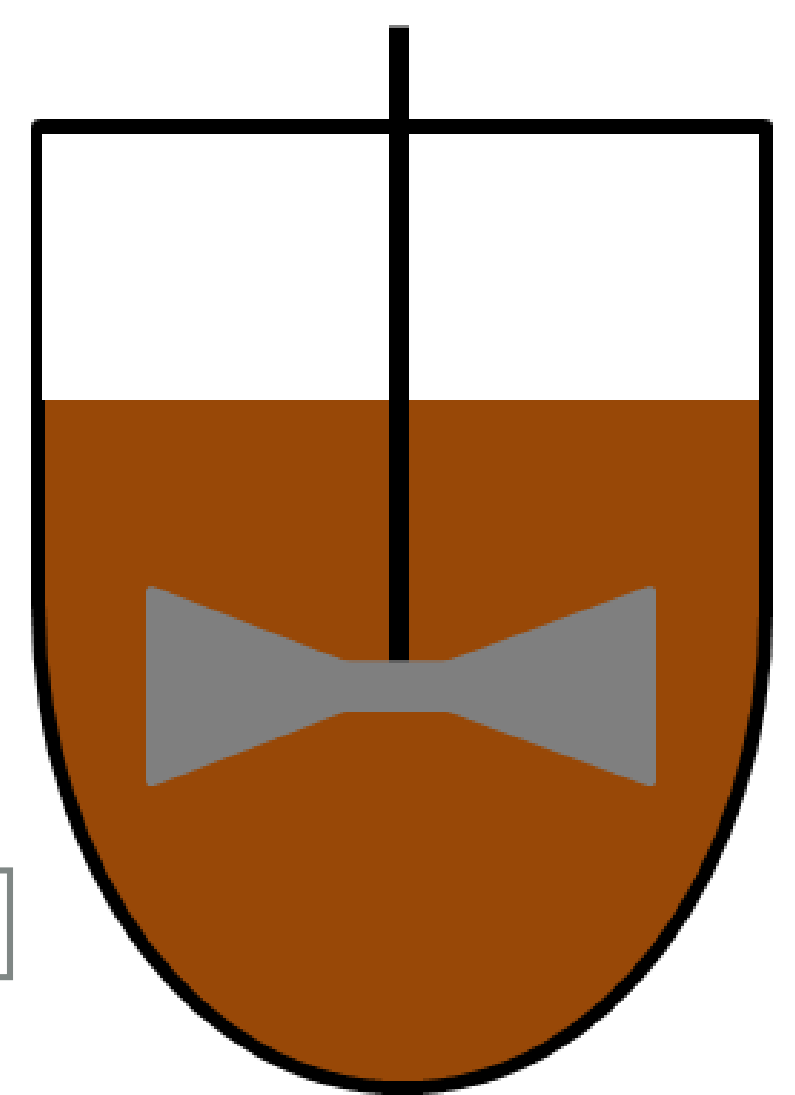
Membrane treatment (Labor - Roma)



40 m³



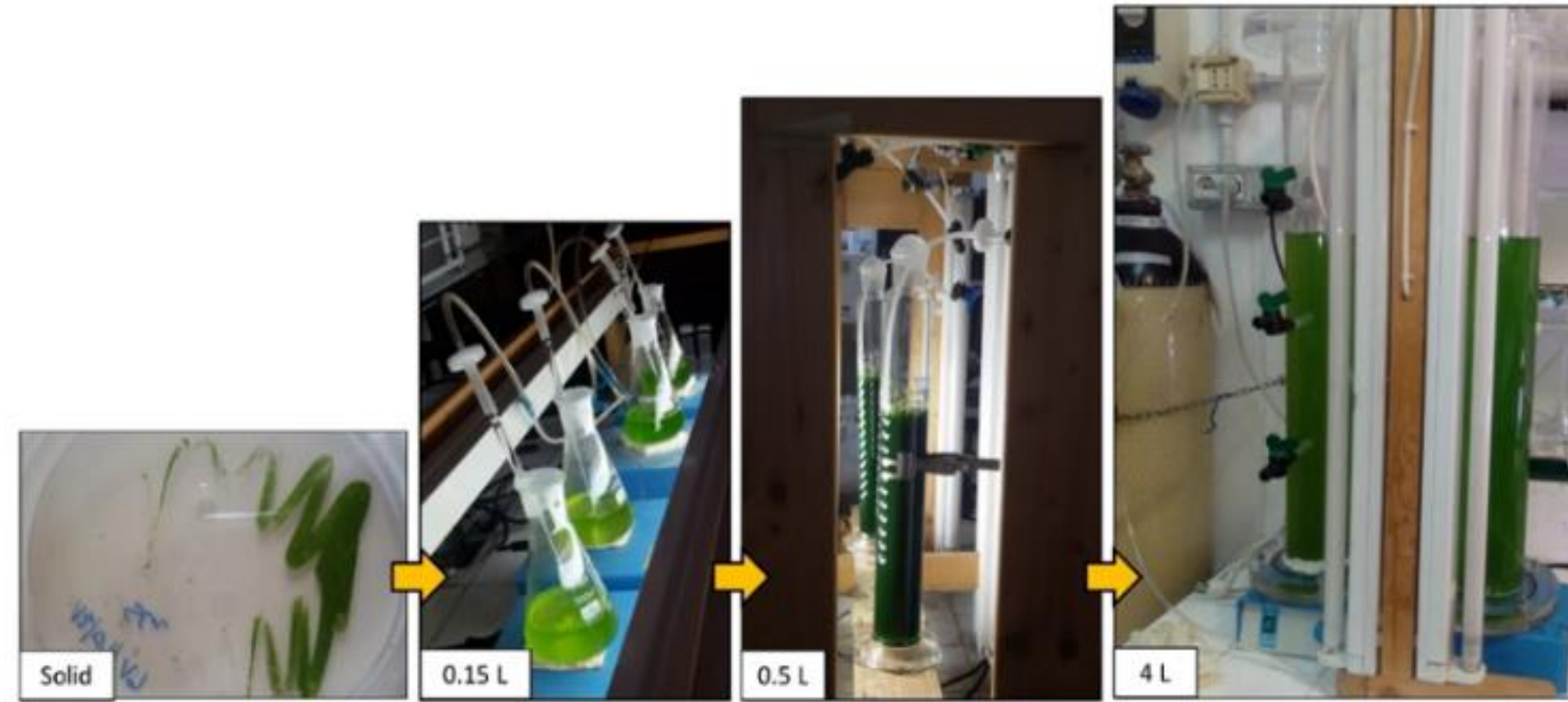
Microalgae: 1000 kg
Phenols: - 60 %
COD: - 40 %



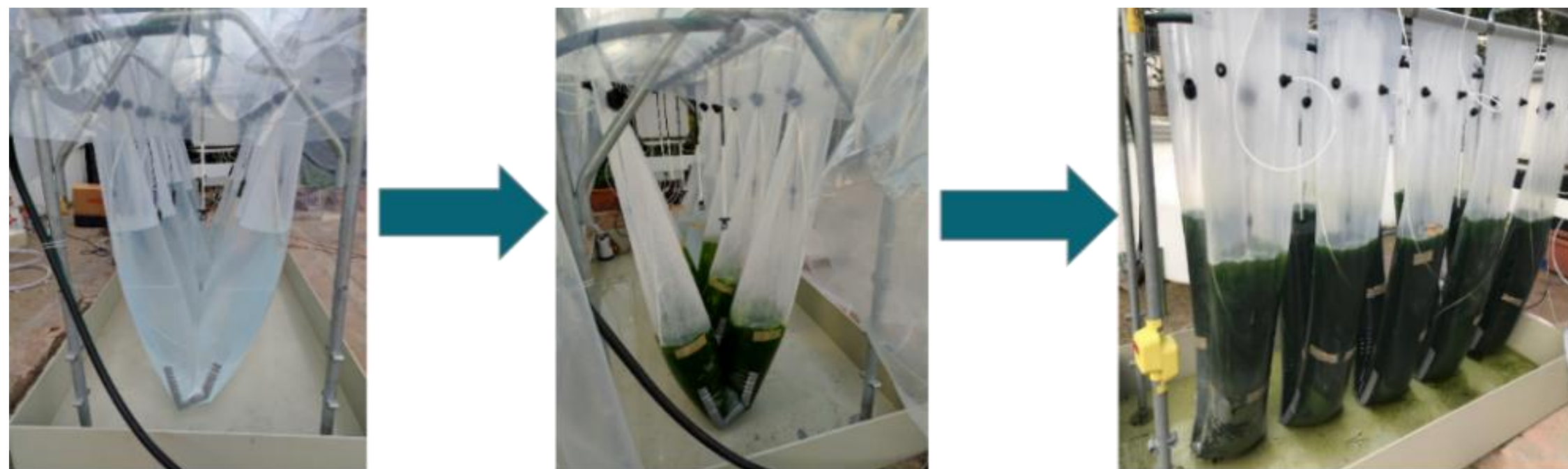
Storage
Phenols: 160 kg
COD: ~ 2000 kg



Microalgae Biomass production



Laboratory scale-up – Roma



Phototrophic prototype scale-up – Roma **BIO - P**



Heterotrophic prototype

Biomass Harvesting and Valorisation

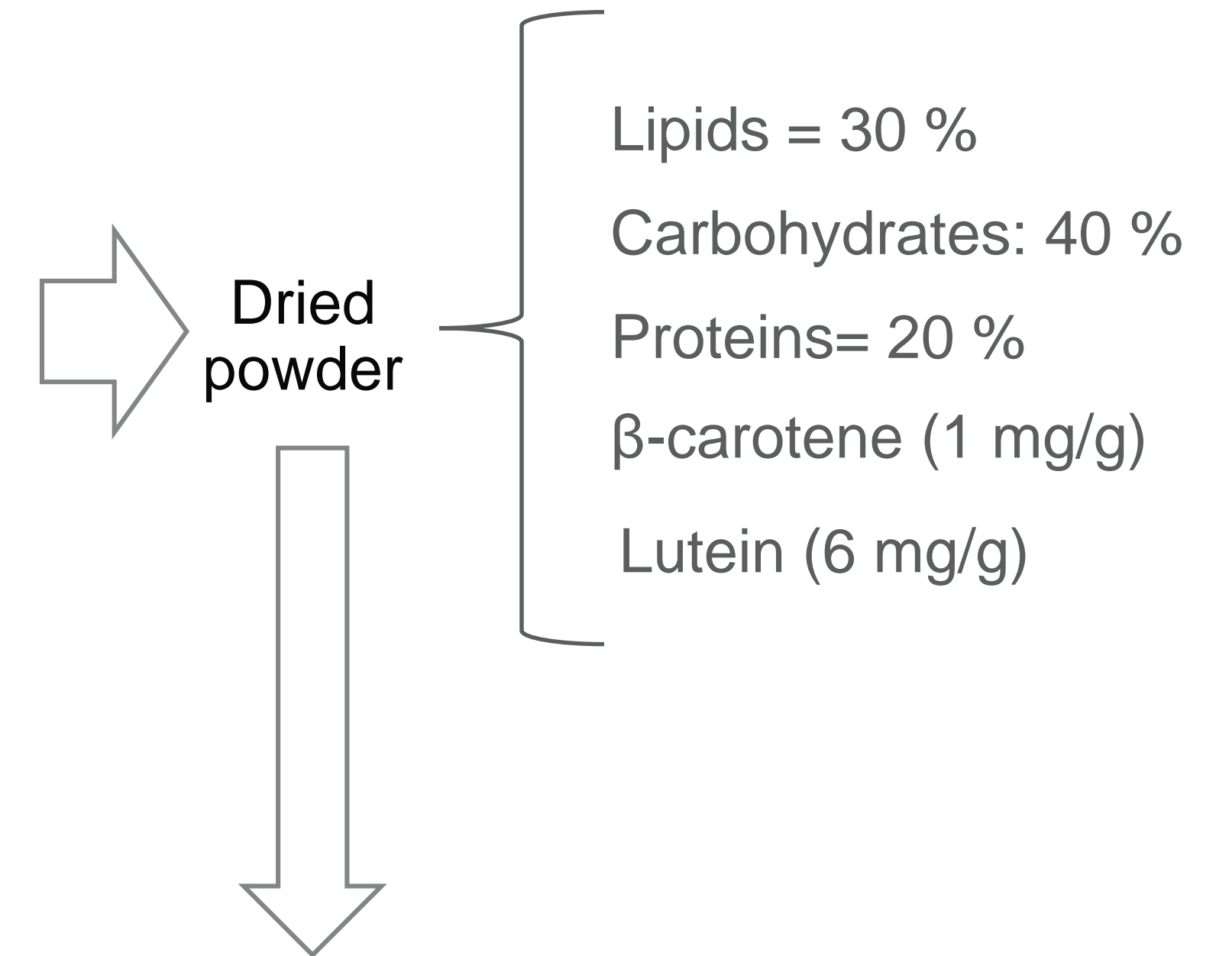


Centrifugation

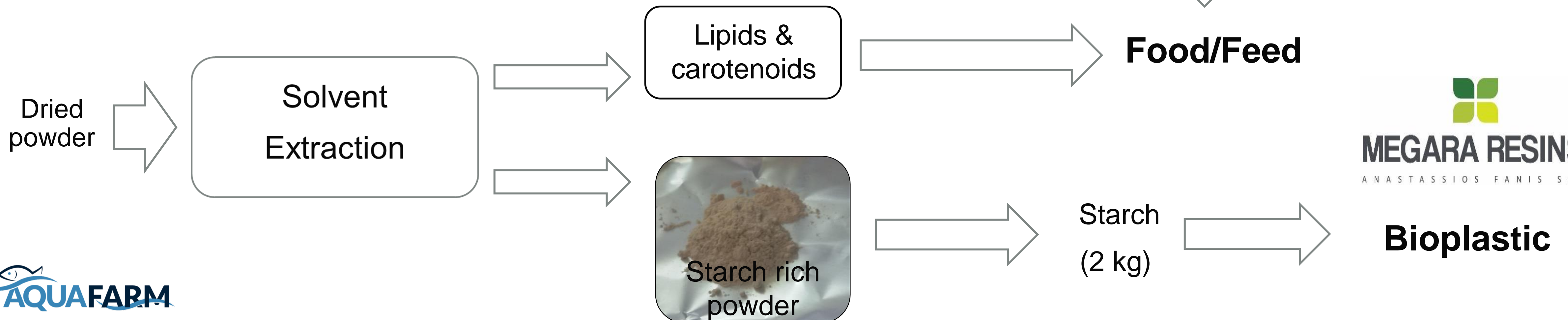
Spray dryer



Expected composition



A biorefinery process will be tested at laboratory level



Thank you for your attention

Fabrizio Di Caprio
fabrizio.dicaprio@uniroma1.it



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MEWLIFE

