



# Future European League 4 Microalgal Energy

FUEL4ME e-bulletin Nr.2, March 2014



## Editorial by Dr. Packo Lamers (Wageningen UR – Bioprocess Engineering – AlgaePARC), Work Package 1 leader

This e-bulletin gives an update of the progress made so far by the partners of FUEL4ME. We are now one year into the project which started with a kick-off meeting in March 2013. The first experimental evaluations of microalgae performance in laboratory-scale photobioreactors are finished, analytical -omics protocols have been developed and will be combined with detailed laboratory studies on optimization of continuous lipid production, which are currently running.

With Spring starting early this year in Europe, it is good to see that the development of the outdoor cultivation systems is on schedule: all systems in Italy, Israel, the Netherlands and Spain will be converting sunlight, seawater and CO<sub>2</sub> into biomass and lipids this Spring!

Besides cultivation, the FUEL4ME partners have undertaken their first steps towards development of next generation fatty acid extraction protocols, and the development and description of the methodology for the sustainability assessment (economic, environmental and social assessment) is finished.

In the next years we hope to show you interesting results leading up to a sustainable process for continuous production of lipids from microalgae. We believe microalgae will become an important sustainable feedstock for production of commodities by innovative research. Through collaboration between research institutes, universities and industrial partners these innovations can be realized in a biobased economy.

## FUEL4ME Progress: ongoing activities

### Fundamental Research and enabling technologies by Dr. Packo Lamers

The effect of incident light intensity in two-stage batch cultures of *Phaeodactylum tricornutum* was evaluated. In the first stage, *P. tricornutum* grew to a fixed biomass density in the presence of a nitrogen source. The second stage started when all nitrogen was consumed and the microalgae switched their metabolism towards accumulation of lipids. This work showed that *P. tricornutum* is rather sensitive to a combination of nitrogen depletion and high light intensities, leading to rapid cell death at high incident light intensities. The highest lipid yield can be obtained at relatively low light intensity combined with nitrogen depletion.



If you are interested in FUEL4ME activities you are welcome to visit us in [www.fuel4me.eu](http://www.fuel4me.eu), or follow us on



where you can learn about the progress, events and publications related to

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Currently, experiments for continuous one-stage lipid production in nitrogen-limited *P. tricornutum* cultures are ongoing. These experiments will be coupled to transcriptome, proteome and metabolome analyses, for which the basic analytical protocols have been set-up or are currently being finalized. The combination of these highly controlled photobioreactor experiments and the broad-scale ~ omics analyses will generate fundamental insight in the mechanisms underlying lipid accumulation in *P. tricornutum*, and will also give directions for the cultivation strategies that will be tested outdoors in Work Package 2 (Translation to outdoors and production).

Simultaneously, various two-stage and one-stage cultivation strategies are being evaluated for *Nannochloropsis* in both indoor and outdoor experiments.

## Translation to Outdoors and Production by Liliana Rodolfi

The Work Package 2 (Translation to outdoors and production) dedicated the activity of the last months to the detailed engineering definition for the Pilot (10 m<sup>2</sup>) and Demo (250 m<sup>2</sup>) plants at BGU, F&M, WU and BIT. A common basic design (flat panel reactors) was chosen for all the locations, but detailed engineering, based on the specific knowledge of each group, will result in four different systems, three of them made by flexible plastic film and one by rigid glass sheets. F&M will adopt the Green Wall Panel design based on its patent (WO2011/013104), BGU will adopt the disposable reactor based on its patent (WO 2005/006838), WU will use a rigid glass panel and BIT will use the ProviAPT system.

In some of the locations the reactors are already in place, in others they are in course of realization. All the Pilot plants are expected to be in operation in April 2014 and the Demo plant is expected to be fully operative in May-June 2014. The Demo plant will include two series of photobioreactors, a larger system for the production of biomass for the downstream process and a smaller system to obtain growth data over a longer period.

Thanks to the previous work carried out by WP2 (Translation to outdoors and production) partners, together with WP1, the strains of *Phaeodactylum* and *Nannochloropsis* to be used in the four plants were identified.

Together with WP5 partners the list of inputs and outputs to be measured during the outdoor experiments for LCA evaluation and the procedures to be used for the measurement of the different parameters were defined.



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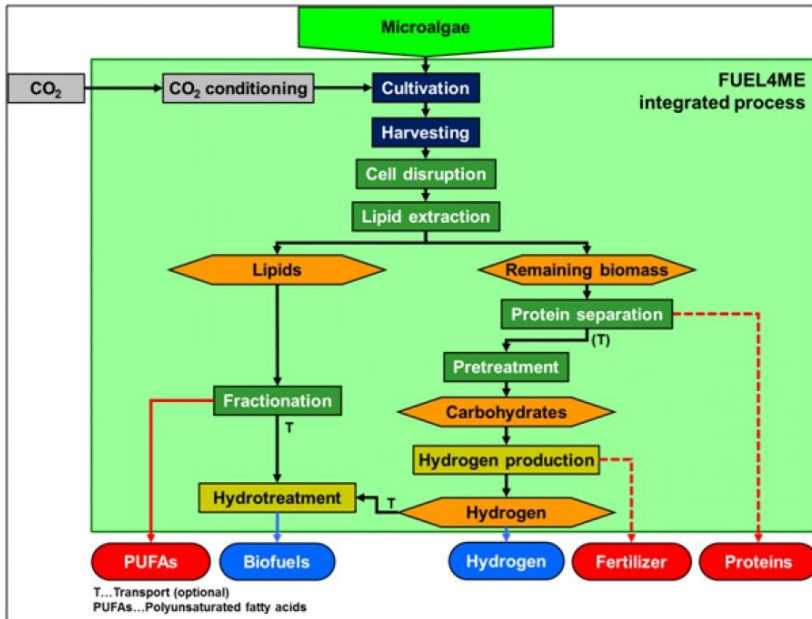


Figure 1 Simplified scheme of whole value chain of the FUEL4ME integrated process

## Sustainability Assessment of Integrated Process by Maria Hingsamer and Gerfried Jungmeier

Work package 5 of FUEL4ME (Sustainability assessment of integrated process) focuses on the assessment of the sustainability including environmental, economic and social parameters of a continuous production and conversion process based on the work performed in WPs 1-4. The results will be used to guide the technical development and future implementation in the desired direction and to be able to determine economic feasibility and environmental sustainability.

Actually the development and description of the methodology for the sustainability assessment (economic, environmental and social assessment) is finished. The whole value chain of the FUEL4ME integrated process (see Figure 1), different algal concepts for the assessment (e.g. plant sizes, location, algae species), the reference system with conventional products, system boundaries and functional units have been defined. Within the sustainability assessment the whole value chain including cultivation of algal biomass, harvesting, transport to conversion centers, conversion to biofuels, disposal of wastes, transport to user, use in a final energy product of the FUEL4ME integrated process will be considered.

## FUEL4ME Consortium



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