



Future European League 4 Microalgal Energy

FUEL4ME e-bulletin Nr.1, September 2013



Editorial

Welcome to FUEL4ME,

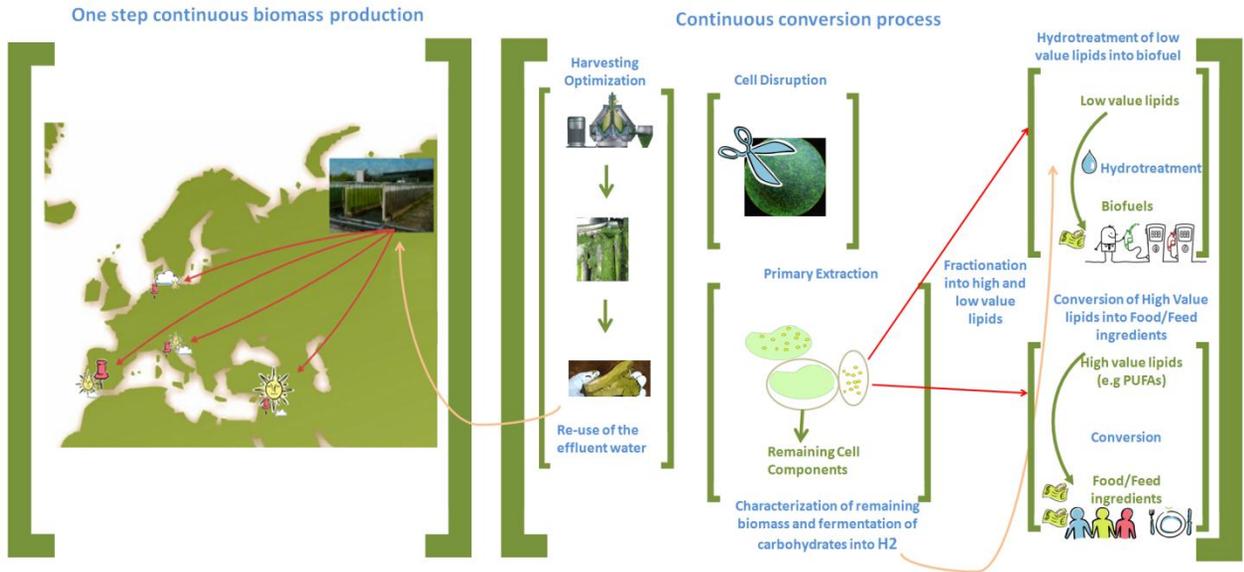
In a bio-based economy, agricultural crops are not only used for production of food and feed but also for chemicals, materials and biofuels. Microalgae are the most promising feed stocks for a sustainable supply of commodities for both food and non-food products. To realize this promise, the scale of production needs to increase with a concomitant decrease in production costs. FUEL4ME aims to exploit one of the unique strengths of algae: the ability to produce lipids using energy from photosynthesis. These lipids form excellent starting material for the production of bulk products. The overall goal of FUEL4ME is to establish a sustainable chain for continuous production of lipids using microalgae as a production platform. For this the largest fraction of the lipids will be used for the production of biofuel and a smaller fraction will be used for food and feed components (ω 3 fatty acids).

The work in FUEL4ME will set the basis required to demonstration scale; from the growth of algae, through the harvesting and extraction of oil obtaining value and use of the remaining biomass, the conversion of the oil into biofuel and system integration with a view to improve cost-competitiveness of biofuels while minimizing the environmental impact of biofuel production. Results are expected to expand the biomass feedstock available for production of bulk products for food/feed and biofuel, assisting the take-off of a large biofuel industry while helping to avoid food/fuel competition for the land use.

To successfully meet this aim, the work has been split into a series of interrelated work packages that cover a four year program. WP 1 and 2 focus on the development of a continuous process in which the lipid productivity in microalgal cultures is maximized. WP 1 provides fundamental knowledge and enabling technology under controlled indoor conditions, whereas in WP 2 this knowledge is used and translated into outdoor production in three different locations, Italy, Israel and The Netherlands. WP 3 has as main objective the development of a continuous downstream process for the conversion of the microalgal lipids produced into biofuel. Demonstration of the production process from biomass to biofuel and co-products, will be performed in WP 4 to test and validate the process at industrial similar conditions (pilot scale). In WP 5 the whole process (both biomass production and conversion into biofuel) will be integrated and subjected to a sustainability assessment. Finally, WP 6 has the task to ensure dissemination and exploitation of the projects results.

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Simplified FUEL4ME process for biofuel production

In this e-bulletin we would like to show the progress being made during the four year program of FUEL4ME. Each bulletin will cover the main aspects of the project and their influence on the whole process. The project started in the beginning of 2013 with the kick-off meeting in March 2013. This is our first e-bulletin. 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 Coordinator
Dr. Maria Barbosa
Wageningen UR-Food & Biobased Research

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FUEL4ME Progress :ongoing WPs

WP1 Fundamental Research and enabling technologies

Nitrogen replete experiments with *Phaeodactylum tricornutum* were performed in photobioreactors (figure 1) to determine the effect of temperature and start biomass concentration on the biomass productivity under standardized day/night light cycles. It was found that highest biomass productivity was reached at a biomass concentration of 2 g/L at 18 °C.

Shake flask experiments have been performed under nitrogen replete and deplete conditions. Cultivation of *P. tricornutum* under day/night light cycles of 14h:10h delayed lipid accumulation compared to similar experiments under continuous light conditions (Breuer et al. 2012). Results of this work is shown in Figure 2. Similar day/night experiments under nitrogen deplete conditions and higher light intensities ($500 \mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) are now performed in controlled PBRs (Figure 1).

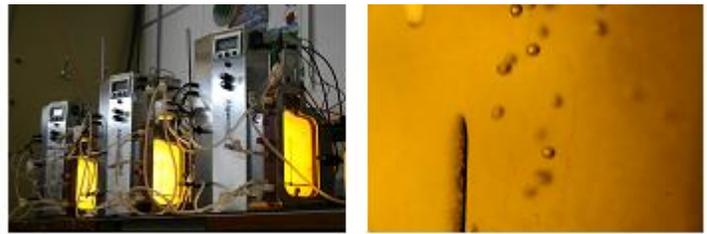


Figure 1 Photobioreactor setup at WUR

The first continuous experiments will be started up this autumn. In parallel, the effect of incident light will be studied on biomass and lipid productivity of *P. tricornutum* under simulated outdoor conditions.

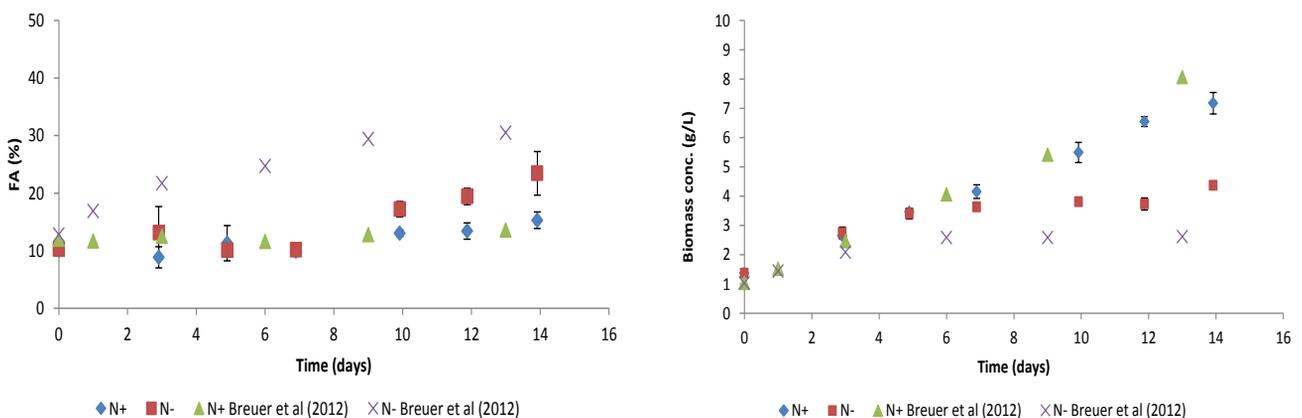


Figure 2 Effect of nitrogen presence and 14h/10h day/night cycles (continuous light by Breuer et al 2012) on the biomass concentration (A) and fatty acid content (B) of *P. tricornutum*.

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FUEL4ME Progress :ongoing WPs

...WP1 Fundamental Research and enabling technologies

Development of omics protocols at WUR-PRI

Two types of cultures were used for the development of omics protocols, *P. tricornutum* grown under nitrogen replete and deplete conditions.

RNA was successfully isolated and used to construct a sequence library. Final tests are performed to identify the quality of the extracted RNA and to optimize the current protocol.

Proteomics methods (lipid droplet isolation, protein extraction) is in progress. A protocol for lipid droplet isolation and protein extraction is currently being optimized.

Experiments for development of protocols for lipidomics (LCMS) and polar metabolites (GCTOFMS) are scheduled for September 2013.

WP2 Translation to outdoors and production

As a first step to achieve the main goal of determining the break-even point between lipid productivity and need of resources for the optimization of a sustainable lipid production process, the three partners that will work with small-scale systems (DLO, BGU, F&M) defined fixed (such as lipid induction procedure, reactor type, light-path and height) and non- fixed (such as cultivation procedure, panel orientation and distance, culture density, mixing rate, culture temperature and pH) parameters for the design of panel photobioreactors and the conduction of the experiment to be followed by the three groups working in the three different locations with the two selected algal species.

Next step will be the construction of small scale plants in The Netherlands, Israel and Italy, as well as the set-up of the large-scale plant in Spain (BIT). Moreover, a list of inputs and outputs to be measured during the trials and to share with WP5 is under preparation.

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FUEL4ME Progress :ongoing WPs

WP5 Sustainability Assessment of the integrated process

WP5 of FUEL4ME focuses on the assessment of the sustainability of a continuous production and conversion process based on the work performed in WPs 1-4. The objective of the work package is to perform a sustainability assessment, including environmental, economic and social parameters based on the whole value chain in a life cycle perspective. The results will be used to guide the development in the desired direction and to be able to determine economic feasibility and environmental sustainability. The first step within the WP5 *Sustainability assessment of integrated process* was the identification of elements for the sustainability assessment. The main elements assessed will be:

Economic elements:

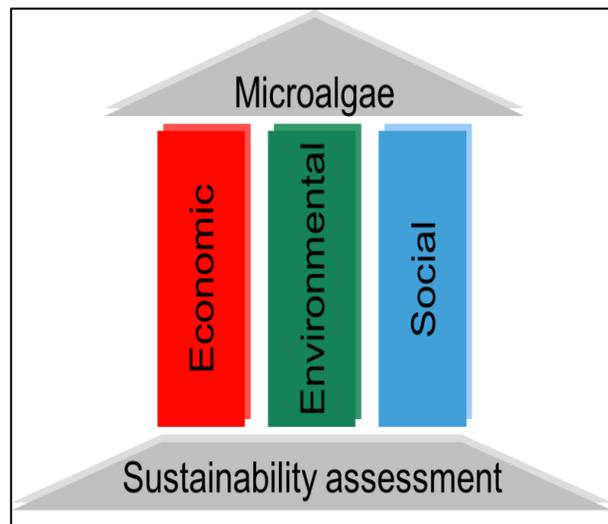
investment costs, production costs, annual costs, annual revenues, market prospect for various products, political aspects of new generation biofuels;

Environmental elements:

global warming potential, energy consumption, water consumption, land use including land use change and competition aspects e.g. for food;

Social elements:

labour practices and working conditions, regional corporate citizenship, product responsibility.



Pillars of sustainability assessment

The next step will be the development of the methodology for the sustainability assessment

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FUEL4ME Dissemination

FUEL4ME consortium wishes to achieve the widest dissemination possible of its project's results, to ensure they take on board all relevant stakeholders and contribute to a better understanding of the importance of biofuels among in the society, thereby speeding up the transition to a sustainable energy model. In order to convey project's objectives and results, the following dissemination materials have been launched:

FUEL4ME Website : www.fuel4me.eu

Where you can learn everything FUEL4ME project, read our publications, join the debate in our posts, keep yourself informed about the latest news and events and download our dissemination materials.

The screenshot shows the FUEL4ME website homepage. At the top left is the fuel4me logo and the European Union flag. A navigation menu includes HOME, ABOUT US, DISSEMINATION, ACTIVITIES, FAQs, and CONTACT. The main banner features the text: "FUTURE EUROPEAN LEAGUE 4 MICROALGAL ENERGY TO DEVELOP A SUSTAINABLE, SCALABLE PROCESS FOR BIOFUELS FROM MICROALGAE AND TO VALORIZE THE BY-PRODUCTS BY 2017". A dropdown menu is open over the banner, listing: FUEL4ME CONCEPT, CONSORTIUM (Partner & Organization), MANAGEMENT STRUCTURE, and UE RELATED PROJECTS. Below the banner, there are sections for OVERVIEW and PARTNERS. The OVERVIEW section includes a photo of a microalgal cultivation system and text explaining the project's goals and the role of microalgae. The PARTNERS section lists various institutions with their respective national flags.

OVERVIEW

Fuel4me is driven by the urgent need of transforming our energy model into a sustainable one, which pursues the European and global energy goals reducing CO2 emissions, finding alternatives to fossil fuels and fostering the renewable energies.

How does Fuel4me contribute to these objectives? Microalgae are one of the most attractive sources of biodiesel, since they can produce energy-rich molecules. Fuel4me aims at developing and demonstrating an integrated and sustainable process for continuous biofuel production from microalgae, and thereby making the second generation of biofuels competitive alternatives to fossil fuels.

PARTNERS

- Stacey Oerist Landbouwkundij Onderzoek
- Wageningen University
- Ben-Carlus University of the Region
- Forestalica & Microbiologica S.L.
- Biotech
- Ecodis B.V.
- Cellulac
- FerysCon Development and Implementation B.V.
- Neste Oil Corporation
- JOHANNES RESEARCH, Forschungsgesellschaft mbH
- Diosdado SL

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FUEL4ME Dissemination

Communication & Dissemination Plan

The D&C Plan defines the strategy to carry out the communication of projects results: most appropriate communication channels and dissemination materials, platforms to allow interaction between the project, stakeholders and public, most relevant events, etc.

Brochure

Tri-fold brochure with an overall information about the project objectives, consortium and activities.



Roll up

To bring with you to the events where FUEL4mE is presented



Social networks

We are starting our activity in:



fuel4me



fuel4me_eu



FUEL4ME_EU

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FUEL4ME: What's Coming next?

FUEL4ME activities

- ✓ The fundamental research to optimize the biomass production, the assessment of the process sustainability and the dissemination activities will continue all along project duration.
- ✓ Flat pannels are being designed and the production of biomass in outdoor pilot facilities in Italy, the Netherlands, Israel is starting in the coming months

Next General Assembly

All FUEL4ME partners will meet soon for FUEL4ME's first General Assembly to discuss about the progress of the project and its next steps.

Upcoming conferences and events

➤ Algae Biomass Summit, Orlando, 30th Sept- 3rd Oct. 2013

This event unites industry professionals from all sectors of the world's algae utilization industries including, but not limited to, financing, algal ecology, genetic systems, carbon partitioning, engineering & analysis, biofuels, animal feeds, fertilizers, bioplastics, supplements and foods www.algaebiomasssummit.org/

➤ EABA Expo& Conference, Florence, 3rd -5th December 2013

Organized by the European Algae Biomass Association, this conference brings together international experts in the algal biomass production sector. FUEL4ME will be presented by some of the project partners. <http://www.eabaconference.org/>

To learn about other conferences relevant to FUEL4ME, please visit www.fuel4me.eu

FUEL4ME Consortium



If you are interested in FUEL4ME activities you are welcome to visit us in www.fuel4me.eu, where you can learn about the progress, events and publications related to the project.