



## All you need is sunshine and dirty water

In April, the TransAlgae project team went to Chiclana de la Frontera in Spain to visit the company Aqualia and see the All-gas project developed from laboratory scale to large demonstration scale. This study visit was like walking around in the future when we have achieved our intention to contribute to a large-scale production of algae as a raw material. After this inspirational visit followed many fruitful and useful discussions among all project partners.

### ALGAE CULTIVATED IN WASTEWATER

At one of the city's Waste Water Treatment Plants (WWTP), we met Maikel and Esteban from Aqualia. Within the EU-project All-gas, Aqualia has been able to develop a large scale cultivation of algae and cleaning of waste water. The algae are cultivated at three different scales, harvested, digested to biogas and upgraded to vehicle fuel grade biomethane.



The pilot scale cultivation unit consists of six raceway's of each 32 m<sup>2</sup>.

### THREE LEVELS OF CULTIVATION

In 2011, six pilot scale raceway ponds of each 32 m<sup>2</sup> in size were installed. During this phase, the cultivation as well as the anaerobic digestion was developed. The systems are very similar to the one's SLU and Processum have at Dåva in Umeå.

-It was very impressive and inspiring to see this in reality, says Carolin Nuortila from the University of Vaasa.

In 2014, two raceway systems of each 500 m<sup>2</sup> were installed, see the panorama picture above. The main purpose was to study the effect of process up-scaling. A new patented turbine system (right) that consumes less energy as compared to the ordinary paddlewheel (left) has been developed.



Maikel Fernández Boizán at Aqualia describes the large demonstration unit of 1 hectare that produces biomethane for 20 cars.

### TREATS EFFLUENT FROM 5 000 INHABITANTS/HA

In 2017, the building of an industrial plant was completed with 4 systems of each 5200 m<sup>2</sup>. With more than 2 hectares it is the world largest facility for generation of biofuels from microalgae.

The system enables treatment of effluent from 10 000 inhabitants. After treatment with algae, the water is clean enough to be released. Moreover, the WWTP produces algae biomass, an excellent resource to make profit from. It is easy to apply in small and medium sized cities, and a goal is to implement the technology at new and old WWTP's.



The large demonstration plant, total 2 hectares.

-This is the future for sustainable WWTP's and circular economy and it is very interesting for our own work on market potential, says Petra Berg from the University of Vaasa.

### HARVESTING WITH NANOBUBBLES

To harvest microalgae effectively and cheap is a challenge. Here they use Dissolved Air Flotation. Nanobubbles from the bottom of a cyclic cylinder move the algae to the top of the cyclon where they can be harvested as a slurry.



Harvesting of microalgae using nanobubbles.

### BIOMETHANE PRODUCTION FOR 20 CARS

In the digestion plant, a mixture of algae, primary and secondary sludge were anaerobically digested. The methane in the raw biogas is in the upper normal range and further upgraded to fuel grade biomethane. Both the CO<sub>2</sub> and the nutrients are returned to the raceway systems.

-It is interesting to see them achieve a positive energy balance with the anaerobic digestion of their algae. We have used thermophilic temperature conditions in TransAlgae this far, but at Aqualia they had reached the conclusion that mesophilic is better, says Andreas Willfors, Novia UAS.



Biogas is produced from anaerobic digestion of pure algae.

At the plant, there was a filling station as well. From 1 ha, it is possible to serve 20 cars of each driving a distance of 30 000 km annually with algae based biomethane.



-Biogas can be excellent combined with high value-added products, which is our ambition at SLU, says Sandra Lage.

### PROJECT MEETING

During our fifth project meeting, representatives from each partner presented the achievements from the last months and the work for the upcoming season. A lot of data have been collected last year, and data analysis for some parameters is still going on. Also, scientific publications are being prepared. In a workshop held by Petra Berg, we were discussing sustainable business models for microalgae based biogas using the PESTEL analysis tool. The next project meeting will be held in Vaasa in autumn.

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