



**TOPSECTOR**  
TUINBOUW & UITGANGSMATERIALEN

**TKI•BBE**  
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Topsector  
**Agri&  
Food**

### PPP Project Annual Report 2017

*The PPP-projects that have been established under the direction of the top sectors must submit an annual report on their technical and financial progress. This format is to be used for reporting the technical progress. A separate format ('PPP final report') is available for PPP-projects that have been completed in 2017.*

***The annual reports will be published in full on the websites of the TKIs/top sector, excluding the blocks 'Approval coordinator/consortium' and 'Planning and progress'. Please ensure that no confidential matters are left in the remaining blocks.***

General information	
PPP number	BBE-1609
Title	Algae Cycle Danone
Executive knowledge institution(s)	Wageningen University-chair Bioprocess Engineering
Research project leader (name + e-mail address)	Maria Barbosa (coordinator) T: + 31 (0)317 480079   E: maria.barbosa@wur.nl
Coordinator (on behalf of private parties)	Sanne Reuling Danone Nutricia Early Life Nutrition M +31 6 2125 2944   E : sanne.reuling@danone.com
Start date	1-1-2017
End date	1-6-2018

### Approval coordinator/consortium

*The annual report should be discussed with the coordinator/the consortium. The TKIs appreciate being informed of possible feedback on the annual report.*

The coordinator has assessed the annual report on behalf of the consortium:	<input checked="" type="checkbox"/> approved <input type="checkbox"/> rejected
Possible feedback on the annual report:	

### Short content description/aim PPS

In the coming decades, the global population will increase to 9 billion people, with a concomitant rise in food consumption per capita and an increase in energy and chemicals requirements. In order to be able to cope with these future requirements our society needs to move into a circular economy. We need therefore to change from a linear to a circular economy in which "take, make, dispose" is replaced for "take make, reuse". In a circular economy all residual streams must be valorised, reused. A circular economy is an industrial economy that promotes greater resource productivity aiming to reduce waste and avoid pollution by design or intention. Microalgae can play an important role in this circular economy.

Microalgae are photosynthetic microorganisms with higher productivities than agricultural crops, do not require agriculture land and have the capacity of using CO<sub>2</sub> and a variety of different water sources including fresh, brackish, saline, residual waters. Microalgae can produce a wide range of products for the chemical, energy and food industry. Several biomass components are of interest

for food products such as carotenoids, proteins, triacylglycerides and  $\omega$ -3 fatty acids. Microalgae contain more ingredients which can be valuable food or feed ingredients.

In 2016 Danone Nutricia Early Life Nutrition started the construction of a new state-of-the-art factory for powdered infant formulae products located in Haps (Noord Brabant, NLD). The name of the project is Estia. As part of the project, a public contest was started in July 2016, in which participants could propose out of the box ideas to make the new factory more environmentally sustainable. The winning idea was "The algae cycle". It aims at utilizing waste streams that will be generated by the new factory (warm water and CO<sub>2</sub>) to cultivate micro-algae in an algae farm next to the factory. The algae biomass is processed into high grade food ingredients and or other resources that are used as much possible in the factory, thereby creating a circular economy.

The specific objectives of AlgaeCycle are:

- Efficient use of waste streams
- Significant reduction of CO<sub>2</sub> emission
- Production of high quality ingredients and materials
- New science and business concepts with cross-sectorial industrial partnerships, with strong collaboration between science and industry

The Project deliverables:

- Proof of principle on the usage of residual streams from a infant powder milk production plant of Danone Nutricia Early Life Nutrition factory for the cultivation of microalgae .
- Technical and economic feasibility study on the utilisation of residual streams for the cultivation of microalgae
- Development of innovative food/ feed ingredients based on microalgae grown on industrial residual streams
- Business case with partnerships, research & innovation and implementation steps required for the development of the process.

**Planning and progress** *(if there are changes to the project plan, please explain)*

Is the PPP going according to plan? <sup>1</sup>	Yes
Have there been changes in the consortium/project partners?	No
Is there a delay and/or deferred delivery date?	No
Are there any substantive bottlenecks? Provide a brief description	No
Are there any deviations from the projected budget?	The total research costs of WUR in 2017 and 2018 are k€ 108 They are financed by TKI-toeslag from TKI-BBE (k€ 60) and cash contribution of Danone (k€ 48). In addition Danone is providing an in-kind contribution of k€ 12 which exists of the contribution to monthly project meetings, contribution to on site experiments and measurements etc.
Do you expect a patent application to arise from this PPP?	No

**Highlights:** *provide a brief description of the most important results*

we assessed the following aspects:

[1] Feasibility of using Estia's waste streams (WS) to grow microalgae: All 3 effluents can be used to grow microalgae. The constrain is operational, since 2 effluents are not produced in high amounts. The best candidate (cow water) is the effluent that can be used to replace water and is produced in large amounts (38880 m<sup>3</sup>/year). It can sustain year-round microalgae production. The same effluent is produced in Danone's factory in Indonesia, which was included as a second

<sup>1</sup> If applicable, use the explanation from the financial project report

scenario in the economic analyses (next item).

[2] The techno-economic aspects of producing microalgae in the Netherlands (Estia project) or in Indonesia (another factory of Danone Nutricia): As agreed in the consortium, we considered a 1 ha farm in the Netherlands and a 10 ha farm in Indonesia. The annual biomass productivities were estimated at 25 and 52 tons per ha for The Netherlands and Indonesia, respectively. According to our projections, the initial investment needed for a facility of 1 ha placed in **The Netherlands** would be 5.8 M€. Biomass estimated production cost (including harvesting) is **77.8 €/kg (from which 20% is CAPEX and 80% OPEX)**. **In the case of Indonesia**, our projections show that a facility of 10 ha would require an initial investment of 17.5 M€. Biomass estimated production cost (including harvesting) is **5.1 €/kg, from which 45% is CAPEX and 55% OPEX**.

[3] Business possibilities: the microalgae market from the perspective of the AlgaeCycle project. **FEED:** The use of microalgal biomass for as feed replacement might be limited by the biomass relative high costs (4-30€/Kg) when compared with current feed prices (retail prices around 1.8 €/Kg feed); an alternative might be the aquaculture sector, especially organic aquaculture, where feed with higher prices can be accepted (up to 5€/Kg feed). **OILS/FUEL:** The oil market is highly competitive and retail prices are found at 1€/Kg; an alternative is to focus on special oils, such as essential fatty-acids used in infant formula (EPA/DHA), which have retail prices above 20000 €/Kg (they are still a niche market in comparison with bulk-produced oils). **FOOD/PIGMENTS:** this category is the most financially attractive when analyzing microalgae's market, especially because it comprises the microalgae-derived products that are already a reality.

**Number of delivered products in 2017** *(in an appendix, please provide the titles and/or description of the products or a link to the products on public websites)*

Academic articles	Reports	Articles in journals	Introductions/workshops
	1		4

**Appendix: Names of the products or a link to the products on a public website**

Final report – AlgaeCycle Project: Detailed report showing the project's results. The report follows the structure presented in the *Highlights* section above.

Presentation of the Project available online: <https://www.nudge.nl/plans/born-be-green/plan/verduurzamen-met-algen/>

Introduction/workshops: We had 4 project meetings with the stakeholders. A kick-off meeting at Danone's site and 3 following meetings in Wageningen. The meetings were used to discuss partial and final results.