Final PPP report

General information	
PPP number	**BBE-1609**
Title	**Algae Cycle Danone**
Topsector	Topsector BBE
Research organisation	Wageningen University, Chair BioProcess Engineering
Project manager (research)	Maria Barbosa (coordinator) T: + 31 (0)317 480079 | E: maria.barbosa@wur.nl
PPS coordinator (on behalf of private partners)	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
Short description	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 from the new factory (warm water and CO2) to cultivate microalgae in an algae farm next to the factory. The algae biomass can be processed into high-grade food ingredients and/or other resources that are used as much as possible in the factory, thereby creating a circular economy. The specific objectives of AlgaeCycle are: • Efficient use of waste streams • Significant reduction of CO2 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

Approval consortium	
The PPS coordinator on behalf of the private partners	x□ Approved □ Not approved
Remarks	

Planning and progress (please explain any changes with respect to the original project plan)	
Were there any changes in the consortium/ project partners?	No
Were there any changes in the content of the project?	No
Are there bottle necks in the execution of the project?	No
Are there changes in the budget?	No
Is there a patent application from this PPP?	No

Are there spin-offs (contract research, other projects)?	No

Results and deliverables	
1. Which deliverables were achieved? (give a short description for each deliverable)	- Proof of principle on using residual streams from Estia Factory for cultivating microalgae (three different streams tested at lab-scale). - Technical and economic feasibility study on setting up an algae farm in the Netherlands and in Indonesia (locations agreed during the consortium meetings). - Development of innovative food/feed ingredients based on microalgae grown on industrial residual streams. A market analyses was done to discuss different applications of the produced biomass. - Business case with partnerships, research & innovation and implementation steps required for the development of the process.
2. If specific deliverables were not reached, what was the reason for this?	Not applicable
3. Did the project result in unexpected outcomes?	No
4a. When will the partners use the project results?	The industrial partner already used the results to discuss internal possibilities of funding an algae farm at one of Danone's location. The partner indicated to be still discussing the idea internally and using our input to build businesses cases.
4b. Is it possible to enhance the use of results by partners, and if yes, how?	Yes. The Research partners already indicated to be available to form new consortiums to further develop the idea, both from an industrial or R&D perspective.
4c. How was the dissemination of project results organised?	We organized workshops with the partners, went on technical visits together (Strasburg, France), participated in conferences together, and placed information on online platforms.
5. How did the project contribute to the knowledge development of the research institute involved?	At WUR, research has been done in cooperation with industry. From this consortium, we got more input for our techno-economic analyses, increasing the reliability of our estimations and models. Also, we increased our expertise in industrial wastes recirculation and on producing microalgae on industrial organic effluents.
6. Will the project be continued by new projects or new cooperation?	The possibility was discussed and both parties are willing to work together in another consortium.

Highlights: give a short description of the main 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^3/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 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			
Academic articles	Reports	Articles in journals	Introductions/workshops
	1		4

please provide the titles and/or description of the products or a link to the products on public websites:

- 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.
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