PPS-eindrapportage
Over de PPS'en die afgerond zijn dient een inhoudelijke en financiële eindrapportage te worden opgesteld. Voor de financiële rapportage dient een totaaloverzicht van de projectkosten van de realisatie en de financiering te worden gegeven.
De eindrapportages worden integraal gepubliceerd op de websites van de TKI's/ topsector, m.u.v. de blokken Goedkeuring penvoerder/consortium, Mutaties tijdens het project en Kosten/Financiering. Zorg er svp voor dat er geen vertrouwelijke zaken in de overige blokken staat.

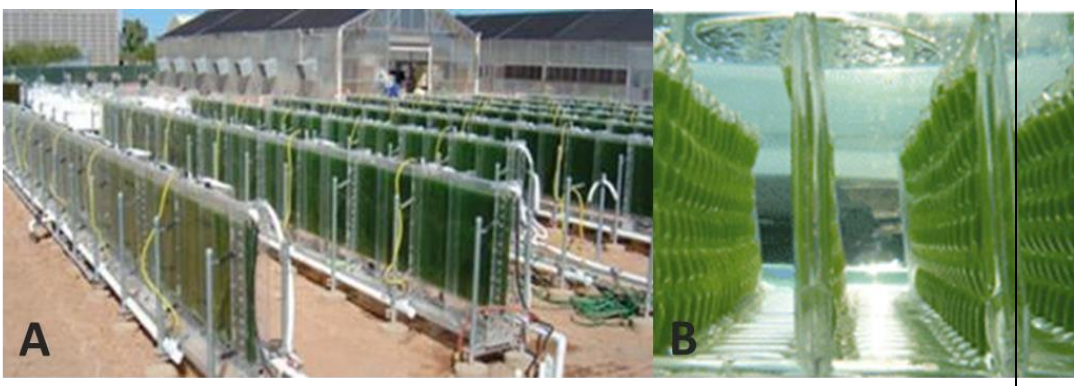
Algemene gegevens	
PPS-nummer	**BBE1601**
Titel	**TKI ALgaePARC Bonaire**
Roadmap/Koepel	
Uitvoerende kennisinstelling(en)	*Wageningen University/ AFSG /Bioprocess Engineering*
Projectleider onderzoek (naam en emailadres)	**René Wijffels**
Penvoerder PPS (namens private partij)	**Tom Sutherland**
Contactpersoon overheid	
Werkelijke startdatum	**November 2015**
Werkelijke einddatum	**Juni 2016**
Korte omschrijving inhoud (bij voorkeur 4 regels, max. half A4)	Microalgae are promising feedstocks for sustainable production of food, feed, chemicals, materials and fuels. Our mission is to develop a commercial and sustainable production chain for commodity products from microalgae. Bonaire would be an ideal location for production because of the climate conditions. Objectives are: - to develop a technology for stand-alone production of algal products on Bonaire for food, feed, chemicals and energy making use of resources available on the island and with that create sustainable economic activities for Bonaire - To develop technology for sustainable production of bio kerosene The state of the art of the technology and the infrastructure and knowledge on Bonaire do not allow direct commercial production of algal biomass. We need to build up the human capital and infrastructure gradually and develop a plan for lab scale and pilot scale production resulting in demonstration projects 5 years from now. The PPP, AlgaePARC Bonaire will focus on a dedicated R&D

	programme of **WU** and **TUI Benelux/TUIfly** to design a pilot plant facility and to develop a research and education plan on Bonaire. The project is the second phase of development of AlgaePARC Bonaire. In phase 1 a feasibility study, supported by the **Government of Bonaire**, is executed. In phase 2 a detailed design of a pilot plan facility plus operational plan is made. Based on the results of phase 1 and 2 funds will be raised for construction and operation of AlgaePARC Bonaire (phase 3). The TKI AlgaePARC Bonaire covers the activities for phase 2. The project is related to the theme **Biobased Economy**, with the main objective to develop biobased and sustainable ingredients for food, feed, chemicals and energy.

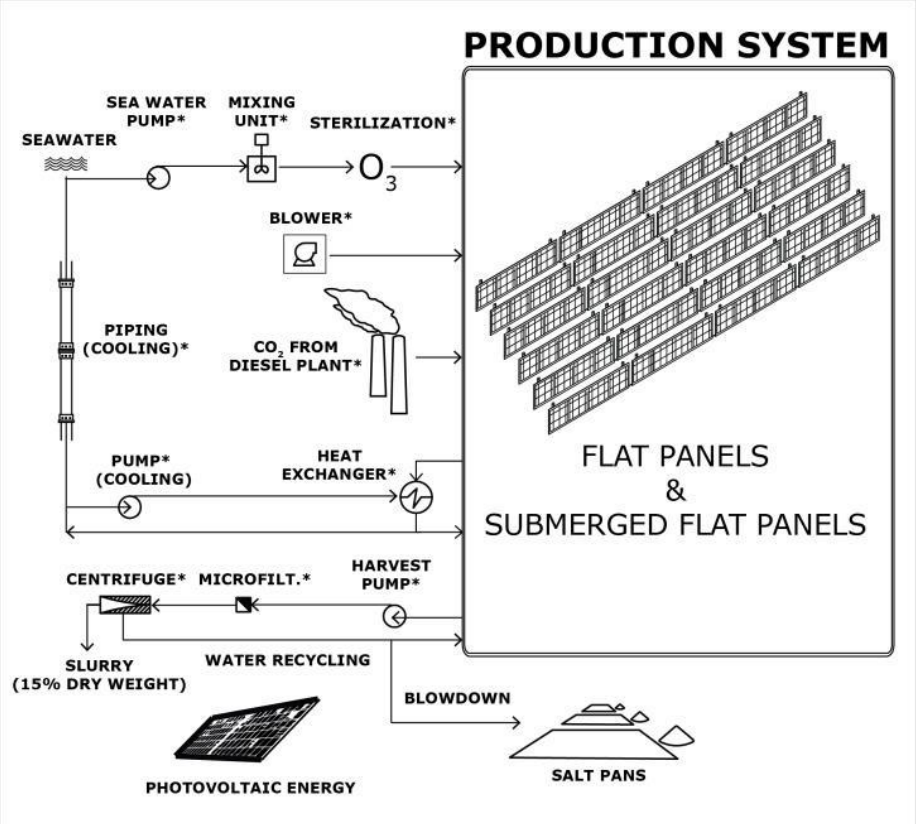
Goedkeuring penvoerder / consortium De eindrapportage dient te worden besproken met de penvoerder/het consortium. De TKI's nemen graag kennis van evt. opmerkingen over de rapportage.	
De penvoerder heeft namens het consortium de eindrapportage	x goedgekeurd □ niet goedgekeurd
Evt. opmerkingen over de eindrapportage:	

Mutaties ten opzicht van het oorspronkelijke projectplan en follow-up	
Zijn er wijzigingen geweest in het consortium / de projectpartners? Zo ja, benoem deze.	**No**
Zijn er inhoudelijke wijzigingen geweest in het project?	**No**
Is er sprake van knelpunten bij de uitvoering van het project?	**No**
Is er sprake van afwijkingen van het ingezette budget/de begroting?	**No**
Is er sprake van een octrooi-aanvraag (evt. first filing) vanuit deze PPS?	**No**
Is er sprake van spin-offs (contract-onderzoek dat voortkomt uit dit project, aanvullende subsidies die zijn verkregen of spin-off bedrijvigheid)	**No**

Resultaten en deliverables	
1. Welke deliverables zijn opgeleverd? (geef een korte	Project deliverables phase 1: D1.1: List of quantities of resources available (nutrients, CO_2, water, electricity): We made these calculations and concludes that Bonaire has enough resources to develop a sustainable production of microalgae. The source of nitrogen and

beschrijving per deliverable uit het projectplan)	phosphorus still has to be found, but in case these nutrients should be imported, maximizing nutrient recycling in the culture would be a priority. A solar plant to produce clean energy to fuel the process should be built on-site. D1.2: Techno-economic model: 3/16 The techno-economic model recently published in Energy and Environmental Science as "Towards industrial products from microalgae" by Ruiz et al. (2016) (DOI: 10.1039/C6EE01493C) was adapted to be able to make projections of microalgae production costs in Bonaire. Cost projections were made for a hypothetical production plant of 1 or 10 ha using flat panels and submerged flat panels as production systems .  **Figure 1** Conventional flat panels (A) and submerged flat panels (B) designs similar to the ones considered in the techno-economic analysis. **Table 1** Preliminary results of the techno-economic analysis for the base case scenarios at 1 ha and 10 ha. | | Conventional FP | | Submerged FP | | | | 1 ha | 10 ha | 1 ha | 10 ha | | Yearly productivity (ton yr^{-1}) | 66 | 658 | 66 | 658 | | Biomass cost (15% w/w solid) (€ kg^{-1}) | 29.7 | 6.3 | 14.2 | 4.4 | | Initial investment (M€) | 16.3 | 28.6 | 3.4 | 13.8 | | CAPEX (M€ yr^{-1}) | 1.1 | 1.9 | 0.2 | 0.9 | | OPEX (M€ yr^{-1}) | 0.9 | 2.2 | 0.7 | 2.0 | | NER | 2.4 | 2.2 | 2.6 | 2.3 | Project deliverables phase 2: D2.1: Basic design of a stand-alone pilot plant facility: A draft of the basic design of the pilot plant has been made. However, in order to finalize it, it is necessary to define the location of the pilot-plant. The ideal location should have already some infrastructure present. it was proposed to locate the pilot plant at the wastewater treatment plant. For cultivation, seawater will be used and the option of having evaporation ponds will be explored. Cooling will not be done with seawater but with irrigation water (i.e. the effluent of the wastewater treatment plant after UV treatment).

WUR is preparing a conceptual design of the pilot plant and making an artist impression to use as the basis of a detailed planning of the pilot facility. Next to that, WUR will make an estimation of the investment costs for pilot plant and supporting activities.



D2.2: Basic design supporting lab facilities:

Offices, control station and laboratory facility should be built in a container. In the laboratory facility only basic measurements (e.g. dry weight of culture, optical density, microscopy, fridge, freezer, storage space) should be performed. Most of the analysis (e.g. biomass composition) should be performed at the WEB laboratory (the granted NWO project is in collaboration with WEB (electricity company in Bonaire, which also have recently built a waste water treatment station) or outsourced.

D2.3: A 5 years research and education plan:

A four-year project proposal with the partners Wageningen University and the WEB (electricity company) in Bonaire has been granted by the Netherlands Organization for Scientific Research (Caribbean research program). This proposal illustrates the first research program we will run at the pilot facility in Bonaire. Focus of our research will be the decrease of production costs. This will be achieved by developing a photobioreactor technology and improving thermo-tolerant strains such that active culture cooling is avoided. In most production facilities, microalgae are cultivated between 20 and 30 ^{0}C. Without temperature control, temperature in the cultivation systems can increase up to approximately 50 ^{0}C because of solar energy absorption by the photobioreactor. Temperature control represents one of the major cost factors

	(Ruiz et al., 2016). To minimize this, we will isolate algal strains from marine biotopes where temperatures are already high (saltpans) and cultivate them at even higher temperatures such that temperature-tolerant strains will evolve. Next to that, we will develop a new submerged photobioreactor technology. Inland basins (saltpans on the islands; will be used as water bodies in which reactors are submerged). WUR will integrate the NWO research proposal with a bigger research program of 5 years which should still be prepared  **Figure 5** Saltpans in Bonaire. D2.4: Supporting material for fund raising for phase A more detailed report has been written and an artist impression has been done.
2. Indien bepaalde deliverables niet gehaald zijn, wat was daarvoor de reden?	
3. Heeft het project onverwachte (neven)uitkomsten opgeleverd, die vooraf niet waren voorzien? Zo ja, benoem deze.	**No**
4a. Binnen hoeveel jaar zullen de private partijen resultaten uit dit project gaan gebruiken in de praktijk?	Within 1-2 years
4b. Kan het gebruik van de resultaten in de praktijk nog worden versneld, en zo ja, wat is daarvoor	Yes with support and commitment from the Dutch government and from the government in Bonaire to make the first steps to build a pilot facility in Bonaire.

nodig?	
4c. Op welke wijze is over het project en de resultaten gecommuniceerd naar de brede doelgroep (incl. niet-deelnemende bedrijven)?	There has been many publicity over this project in Bonaire. There was a press release which exposed the project. Below are the links to differetn publications related to the project. The project has been presented in several international meetings (EABA: European Algal Biomass Association, ABO: Algae Biomass Organization
5. In hoeverre heeft het project bijgedragen aan de ontwikkeling van de betrokken kennisinstel-ling(en)? (bijv. wetenschappelijk track record, nieuwe technologie, nieuwe samenwerkingen)	A more accurate description (qualitative and quantitative) of the means, inputs and output required to develop microalgal technology in a country with high-potential climatological conditions was done in this project. In addition this project has allowed a more strategic alliance with TUI, WEB and with the Government in Bonaire. This has been the basis for the two new projects which have recently been granted.
6. Krijgt het project een vervolg in de vorm van een nieuw project of een nieuwe samenwerking? Zo ja, geef een toelichting.	Yes. The third phase has started. Two new projects have been granted: NWO Caribbean's and OCTA project from the European commission. The NWO project is more fundamental but sets the basis for the development of the technology in the island. Local algae strains will be isolated and characterized and the most promising strains will be cultivated first at lab scale reactors and then pilot scale outdoors. The second project entails a more detailed plan for the facility in order to get the stake holders required to build and operate it. A concrete business plan with stakeholders will come out of this phase.

Highlights: geef **een korte beschrijving van de belangrijkste resultaten**
See information above

Aantal opgeleverde producten in 2016 (geef in een bijlage de titels en/of omschrijving van de producten of een link naar de producten op openbare websites)			
Wetenschappelijke artikelen	Rapporten	Artikelen in vakbladen	Inleidingen/ workshops
	1 (report is sent as attachment together with this report)	1 https://www.wur.nl/en/newsarticle/Bonaire-to-have-its-own-AlgaePARC-1.htm http://www.bonaire.nu/2016/11/08/nieuw-onderzoeksfaciliteit-duurzame-brandstof-	2 The project has been presented in several international

		op-bonaire/ http://www.gelderlander.nl/home/wageningen-universiteit-gaat-algen-telen-op-bonaire-voor-vliegtuigbrandstof~a0e3ee9c/ http://www.luchtvaartnieuws.nl/nieuws/categorie/72/algemeen/tui-en-wageningen-university-kweken-algen-op-bonaire http://www.agro-chemie.nl/nieuws/wur-en-tui-gaan-op-bonaire-algen-kweken-biokerosine/	meetings (EABA: European Algal Biomass Association, ABO: Algae Biomass Organization (Abstract is attached)

Financial report:
see "vaststellingsverzoek BBE-1601"