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## An outlook on microalgae production chains

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An outlook on microalgal production and biorefinery, from sunlight to products will be given. Algal production needs to develop from a craft to a major industrial process for the production of commodities. Major challenges are to reduce production costs and energy requirements and increase production scale. Although microalgae are not yet produced at large-scale for bulk applications, recent advances – particularly in the methods of systems biology, genetic engineering, process control, and biorefinery – present opportunities to develop this process in a sustainable and economical way within the next 10 to 15 years. Production costs have been recalculated based on experimental data of pilot plant studies. In addition costs for biorefinery have been included. Total costs of the production and biorefinery chain have been compared to the market values resulting from different combinations of end products from microalgae to assess economic viability of an industrial production chain. A description of the model for cultivation will be provided. The outlook is given for different locations. Production costs have been done based on state of the art of technology. Improvement in production costs will be shown, supported by real production data and a more detailed insight on the process and technology. A research overview of various projects will be addressed to show examples of various approaches to improve productivity and decrease production costs. The effect of improvements was studied by means of a sensitivity analysis for the most promising systems. Industrial microalgae chains are within reach, a number of market combinations could already be possible if the systems are scaled up to industrial production units. Further reduction costs will allow more market combinations.

### Biography

Dorinde M M Kleinegris is a Senior Scientist in the field of microalgae at the Research Institute Food & Biobased Research at Wageningen UR. She completed her MSc degree in 2005 with thesis on microalgae, followed by a PhD thesis in Bioprocess Engineering, Wageningen University on the milking of microalgae, where her work focused on unraveling the mechanism of extraction of carotenoids from *Dunaliella salina*. In 2010 she successfully defended her PhD thesis entitled "Milking of microalgae revisited". After a Postdoc on innovation of education at Bioprocess Engineering, Wageningen University, she currently holds a position as Researcher of Microalgae at Food & Biobased Research of Wageningen UR (2011 – recent). Here she is involved in several research projects in the field of microalgae cultivation and the combination with a biorefinery approach for the production of commodity products, as food, feed, chemicals and biofuels, from the microalgal biomass. She is project leader of several projects, and works on project acquisition and many bilateral and smaller, national proposals. Moreover, she supervises two PhD theses and is involved in supervision of research assistants, BSc, MSc and visiting PhD students.

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