# Supplementary material

## *S1 Calculation of the PHB content in the cyanobacterial biomass as percent of dry weight*

$$\%_{\mathrm{dw}} = \frac{PHB\ [\mathrm{mg\ L^{-1}}]}{dw\ [\mathrm{mg\ L^{-1}}]} \cdot 100$$

## *S2 Calculation of the nitrogen mass balance*

$$N_{lost}\ [\mathrm{mg\ L^{-1}}] = N_{supplied}\ [\mathrm{mg\ L^{-1}}] - (dw\ [\mathrm{mg\ L^{-1}}] \cdot N_{cells}\ [\%]) - N_{medium}\ [\mathrm{mg\ L^{-1}}]$$

## *S3 Calculation of the nitrogen conversion ratio*

$$biomass\ [\mathrm{g\ L^{-1}}] = dw_{end}\ [\mathrm{g\ L^{-1}}] - dw_{start}\ [\mathrm{g\ L^{-1}}]$$

$$nitrogen\ conversion\ ratio\ [\mathrm{mg\ g_{dw}^{-1}}] = \frac{N_{supplied}\ [\mathrm{mg\ L^{-1}}]}{biomass\ [\mathrm{g\ L^{-1}}]}$$

## *S4 Conversion of PPFD (µmol $s^{-1}$ $m^{-2}$) into power (kW) and energy (kWh) per area ($m^2$)*

The number of absorbed photons was measured with two PAR sensors that were placed above (PAR 2) and below (PAR 1) the glass cultivation platform of open cultivation system. During the first five to six days, the reactor was shaded to prevent the cultures from bleaching. To take this into account in the calculations, the measured value of PAR 1 was divided by the factor 2 (only 50 % of light passed through the shade cloth) during the period of shading.

$$absorbed\ photons\ [\mathrm{\mu mol\ m^{-2}\ s^{-1}}] = PAR\ 2\ [\mathrm{\mu mol\ m^{-2}\ s^{-1}}] - PAR\ 1\ [\mathrm{\mu mol\ m^{-2}\ s^{-1}}]$$

$$power\ per\ area\ [\mathrm{kW\ m^{-2}}] = absorbed\ photons\ [\mathrm{\mu mol\ m^{-2}\ s^{-1}}] \cdot 0.000219\ [\mathrm{kW\ \mu mol^{-1}}]$$

$$\Delta t\ [\mathrm{h}] = \frac{time_{i+1}\ [\mathrm{sec}] - time_i\ [\mathrm{sec}]}{3'600}$$

$$energy\ per\ area\ [\mathrm{kWh\ m^{-2}}] = power\ per\ area\ [\mathrm{kW\ m^{-2}}] \cdot \Delta t\ [\mathrm{h}]$$

## *S5 Calculation of the energy conversion ratio*

$$area\ [\mathrm{m^2}] = 18$$

$$volume\ in\ reactor\ [\mathrm{L}] = 200$$

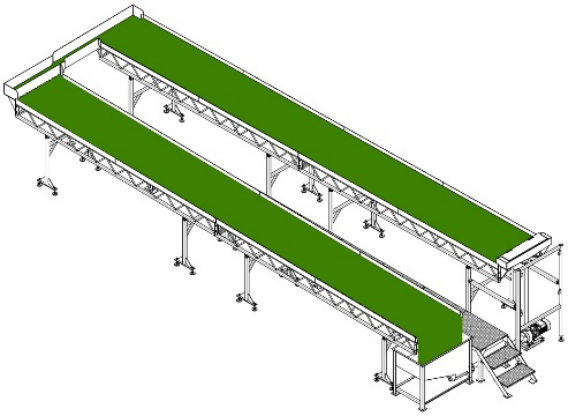
$$total\ energy\ [\mathrm{kWh}] = \sum energy\ per\ area\ [\mathrm{kWh\ m^{-2}}] \cdot area\ [\mathrm{m^2}]$$

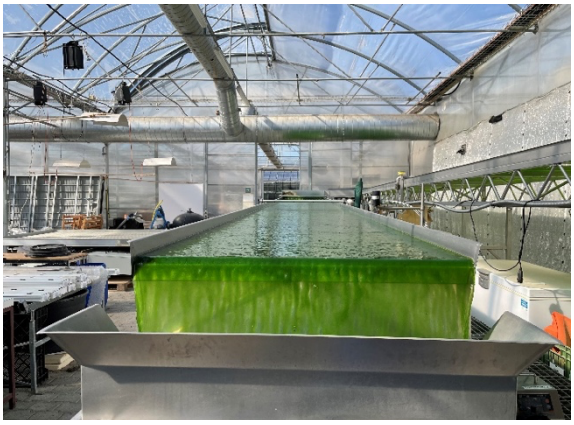
$$total\ biomass\ [\mathrm{g_{cdw}}] = (cdw_{end} - cdw_{start}) \cdot volume\ of\ reactor\ [\mathrm{L}]$$

$$energy\ conversion\ ratio\ [\mathrm{kWh\ g_{dw}^{-1}}] = \frac{total\ energy\ [\mathrm{kWh}]}{total\ biomass\ [\mathrm{g_{dw}}]}$$

## *S6 Open thin-layer photobioreactor*

The open cultivation system used in this study is an open thin-layer photobioreactor (Doucha & Lívanský, 2014) with a volume of 200 L and a sun-exposed surface of 18 $m^2$. It is in a greenhouse of the Institute of Natural Resource Sciences IUNR of the Zurich University of Applied Sciences ZHAW on the campus Grüental in Wädenswil, Switzerland.





## *S7 Dependency of biomass yield on nutrient supply*

According to Doucha and Lívanský (2006), 84.9 mg $L^{-1}$ nitrogen and 9 mg $L^{-1}$ phosphorus are needed to yield 1 g $L^{-1}$ microalgal biomass. Here, this is assumed to be the case for the cyanobacterium *Synechococcus leopoliensis* as well. The mineral medium used in this study is Z-medium (Staub, 1961), which contains, when concentrated one-fold, 76.96 mg $L^{-1}$ nitrogen and 5.51 mg $L^{-1}$ phosphorus. Dividing the nutrient concentration of Z-medium by the nutrients needed for 1 g $L^{-1}$, the biomass yield that can be achieved with a one-fold concentrated Z-medium can be calculated.

Calculation for nitrogen:

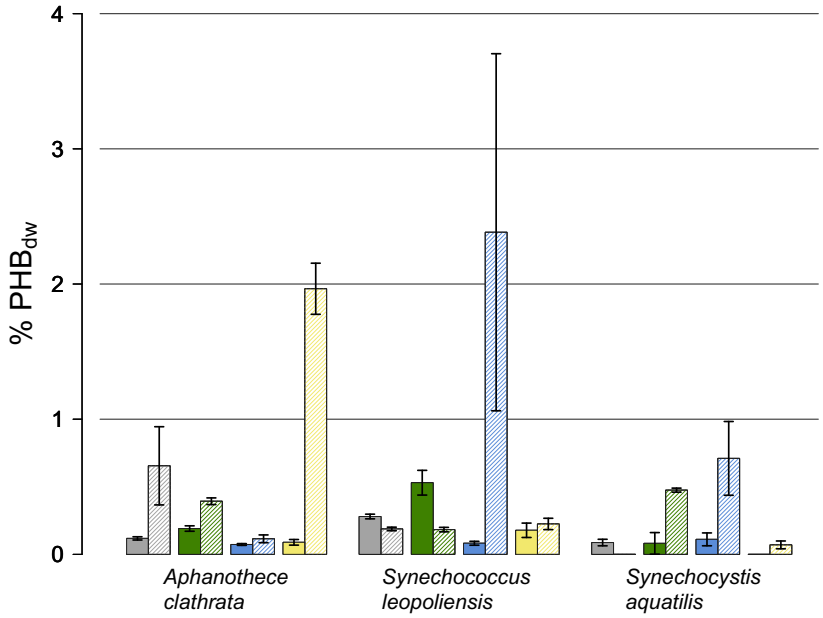
$$achievable\ biomass = \frac{76.96\ mg\ L^{-1}}{84.9\ mg\ L^{-1}} = 0.9\ g\ L^{-1}$$

Calculation for phosphorus:

$$achievable\ biomass = \frac{5.51\ mg\ L^{-1}}{9\ mg\ L^{-1}} = 0.6\ g\ L^{-1}$$

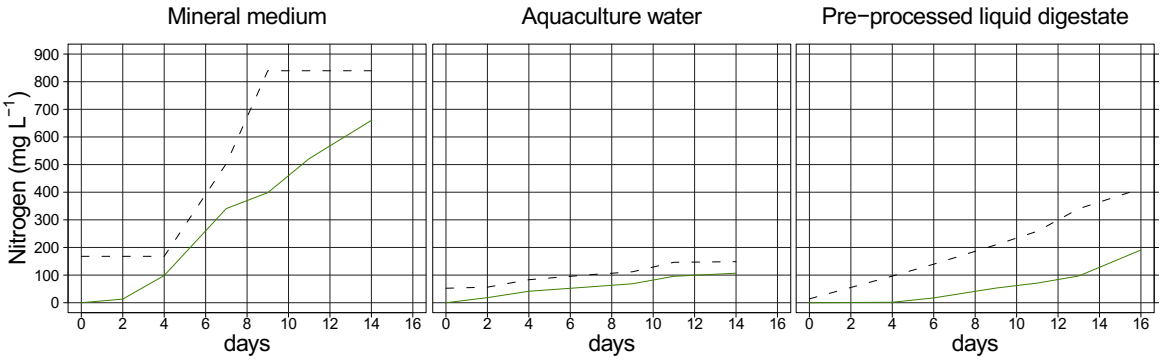
According to the calculations, phosphorus is the limiting nutrient and therefore a one-fold concentrated Z-medium can yield 0.6 g $L^{-1}$ biomass.

*S8 PHB contents in the cultures of the laboratory experiments*



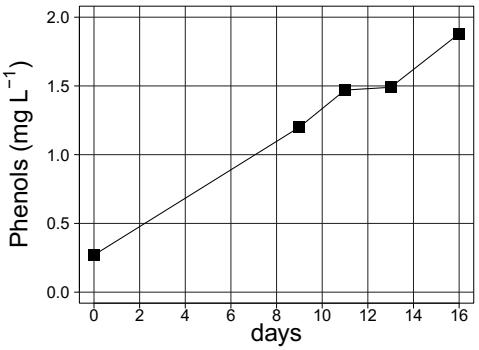

The figure shows the PHB content at the 7$^{th}$ day of the starvation phase in the laboratory experiments. Three cyanobacterial species were cultivated in four different media each (from left to right: mineral medium (grey), medium with filtered aquaculture water (green), medium with unfiltered aquaculture water (blue), medium with liquid digestate (yellow). The experiment was repeated twice, and data show mean values of three (1$^{st}$ experiment, solid) and four (2$^{nd}$ experiment, striped diagonally) replicates and the standard error of the mean.

*S9 Nitrogen supply and assimilation in the cyanobacterial cells*

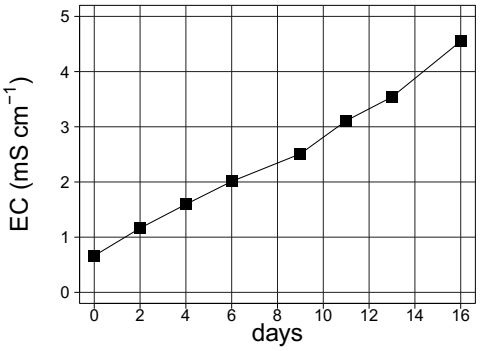



The figure shows the absolute values of nitrogen that was supplied (black, dashed) to the cultures in the open system and nitrogen that was assimilated (green, solid) by the cyanobacteria over the course of the corresponding cultivation.

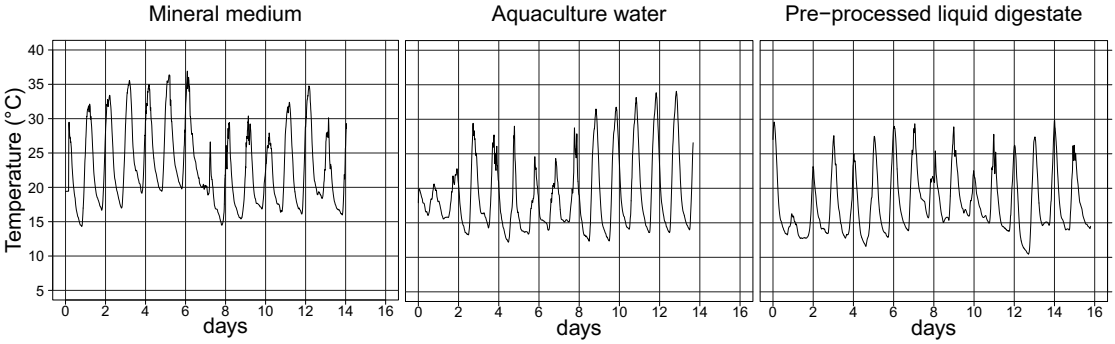
*S10 Concentration of phenols in the cultivation with medium containing pre-processed liquid digestate*



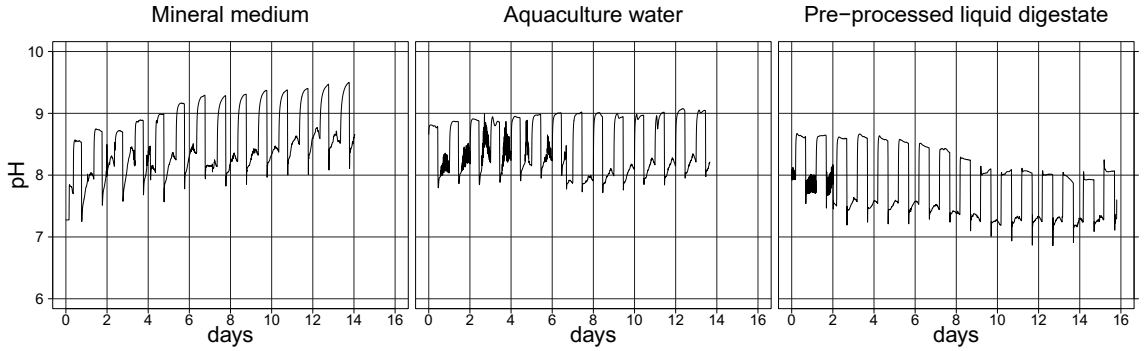

*S11 Electrical conductivity (EC) in the cultivation with medium containing pre-processed liquid digestate*




*S12 Temperature of the medium during cultivation in the open system*



*S13 pH of the medium during cultivation in the open system*




## References

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J. Doucha, K. Lívanský, High density outdoor microalgal culture, in: R. Baipai, A. Prokop, and M. Zappi (Eds.), Algal Biorefineries, Springer, 2014, pp. 147-173. https://doi.org/10.1007/978-94-007-7494-0_6

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