Energy use in the open pond algae PBR in Lelystad and potentials for reduction

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Open ponds 250 m²
Photobioreactors

Stock culture mix of Chorella sorokiniana and Scenedesmus obliquus
LED light in photobioreactors
## Algae cost price (€/kg DM) production systems

<table>
<thead>
<tr>
<th></th>
<th>Open pond</th>
<th>Tubular</th>
<th>Flat panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>€ 3.02</td>
<td>€ 3.39</td>
<td>€ 3.83</td>
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<tr>
<td>Water</td>
<td>€ 0.96</td>
<td>€ 0.06</td>
<td>€ 0.05</td>
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<tr>
<td>Fertilizers</td>
<td>€ 0.13</td>
<td>€ 0.10</td>
<td>€ 0.10</td>
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<tr>
<td>Waste water</td>
<td>€ 0.09</td>
<td>€ 0.01</td>
<td>€ 0.00</td>
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</tbody>
</table>
## Actual energy use (pond 250 m²)

<table>
<thead>
<tr>
<th>Harvest</th>
<th>Device</th>
<th>Energy use (KWh/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centrifuges</td>
<td>Blower</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Mixer</td>
<td>22</td>
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<tr>
<td></td>
<td>Centrifuges</td>
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<td></td>
<td>Pump</td>
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<tr>
<td>Flocculation/DAF</td>
<td>Blower</td>
<td>65</td>
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<tr>
<td></td>
<td>Mixer</td>
<td>22</td>
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<td>Flocculation/DAF</td>
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<td>Centrifuge</td>
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<td></td>
<td>Pump</td>
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<td></td>
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</tr>
</tbody>
</table>
Open ponds Lelystad

Outdoor

Indoor

Centrifuges

Flocculation & DAF
Centrifuges
Harvesting with dissolved air flotation
Experiments

- Indoor pond; no sparging
- Indoor pond; daytime sparging
- Indoor pond; daytime sparging
- Indoor pond; 24/7 sparging
- Outdoor pond; full sparging
Optical density during experiments
Flocculants returning to the pond causing flocculation? Cleaning did not help.
Outdoor pond 2014

Sustainable Pathways for Algal Bioenergy

Optical density (a.u.) vs. Days from inoculum

- 27/7
- 7/8
- 14/8

Harvest (kg ds)
Predator count outdoor pond

![Graph showing predator count from June 20 to September 8, with peaks on July 30 and August 29.](image)

Predator count (cells/l)

Date

20/jun 30/jun 10/jul 20/jul 30/jul 9/aug 19/aug 29/aug 8/sep

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[EnAlgae logo]
N & P in outdoor pond

- Ammonium nitrate added
- Strong increase in brachionus
- Potassium phosphate added
Conclusions

Experiments did not result in indications on energy use decrease.

Flocculation/DAF has potential but problem of flocculation in pond needs to be solved.

Unknown cause of growth inhibition possibly interfering with test results (low OD).