Green biorefinery as the tool for disruption of Northwestern European agriculture

Senior Scientist Uffe Jørgensen, Department of Agroecology
Head of Aarhus University Centre for Circular Bioeconomy (www.cbio.au.dk)
Northwestern European agriculture is challenged

Productivity & competitiveness

• Biomass for food, feed, material and energy
• Stagnating yields
• Large import of protein feed

Environment

• High nutrient leaching (Nitrate and Water Framework Directives)
• High pesticide use
• Soil and wind erosion
• Agriculture must contribute to EU climate goals (EU climate policy)

Time to look for radical innovation instead of just incremental
Agriculture is locked-in by highly specialised cropping system technology and network actors.

Marie-Benoit Magrini et al., 2016. Ecological Economics, 126, 152-162
It seems hard to increase yields (sustainably) in existing crops in Europe

There are strong drivers for change - e.g. N emissions to water from agricultural land (Englund et al., 2019)
Strategic perennialization

Example
Fields can look this different in autumn – we decide
Biomass production can be doubled and nitrate leaching halved

Manevski et al., 2017; 2018
Other environmental benefits from conversion of annual crops to grass

- Reduced soil erosion
- Reduced GHG emission (0.5-3.5 ton CO$_2$-equiv/ha)
- Reduced pesticide use (by factor 40-50)
- Increased biodiversity
So, what to do with all that grass?
Crude protein yield higher in grasses than in other crops

A radical new crop production paradigm can be un-locked by green biorefineries.
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 862674
Feeding experiment with green protein to pigs, cows, broilers & egg layers
Business evaluation of decentralized green biorefineries in Denmark

Economic assumptions:
• Biorefinery CAPEX: 3.36 mio EUR
• Depreciation time: 15 year
• 5% Interest rate, 5% Maintenance

• Grass price
  • Organic: 0.15 EUR/kg
  • Conventional: 0.13 EUR/kg
• Protein price (soya)
  • Organic: 0.67 EUR/kg
  • Conventional: 0.34 EUR/kg
• Fiber pulp price
  • Identical to grass price

• Residue juice is not given any cost or value - it is used for internal energy production at the biogas plant.

<table>
<thead>
<tr>
<th></th>
<th>Organic</th>
<th>Conventional</th>
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<tbody>
<tr>
<td>Income</td>
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<tr>
<td>Protein concentrate+</td>
<td>4.70</td>
<td>3.25</td>
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<td>Fibre</td>
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<tr>
<td>Expenses</td>
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<tr>
<td>Grass</td>
<td>3.33</td>
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<td>Energy and salary</td>
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<td>Maintenance</td>
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<tr>
<td>interest</td>
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<tr>
<td>Result</td>
<td>0.66</td>
<td>-0.34</td>
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Source: Morten Ambye-Jensen
Demo plant for green biorefinery now ready to pave the way for market introduction

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Green Valleys

Interreg

Öresund-Kattegat-Skagerrak
European Regional Development Fund

CBIO
AARHUS UNIVERSITY CENTRE FOR CIRCULAR BIOECONOMY

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GREEN BIOREFINERIES CAN DISRUPT LOCKED-IN AGRICULTURAL SYSTEMS BY CREATING NEW MARKETS AND ENSURE

• Better solar radiation use
• Less nutrient losses
• Less pesticide use
• Soil carbon storage
• Farmers licence to produce

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EUROPEAN UNION

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