09-11-2017
Product or Service? Orchestrating the Win-Win
MASH Biotech is a spin-out from the Technical University of Denmark. This is also where the underlying pyrolysis has been developed and tested. MASH has operated and validated the technology at a full scale.
Using optimised low-tech, low-cost solutions enables us to **match commodity prices** in the market, while at the same time providing **fully sustainable products**.
Turning an invasive plant species (Prosopis) into Electricity and heat using Gasification.

Turning sewage sludge into sustainable "bio crude" oil and fertilisers using Pyrolysis.

Turning an used car tyres into cheap crude oil and carbon black using Pyrolysis.

Turning Cashew shells into bio-diesel and fertilisers using Pyrolysis.
Stopping to reflect

Create value here?

… or here?

<table>
<thead>
<tr>
<th>Feedstock (input)</th>
<th>Technology (process)</th>
<th>Product Sales (Output) (biooil, -char, electricity)</th>
<th>Practical / Legal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory vetting</td>
<td>Process optimisation</td>
<td>Pro-forma sales</td>
<td>Find location</td>
</tr>
<tr>
<td>Small-scale Process trials</td>
<td>FS Supply contracting</td>
<td>Pre-orders</td>
<td>Get permits / lease / staff</td>
</tr>
<tr>
<td>Full-scale operations and continued scaling</td>
<td>Supply chain dry run</td>
<td>Product delivery</td>
<td>Civil works on site</td>
</tr>
</tbody>
</table>
South Africa is rich on mineral resources and therefore mines can be found across the country.

Mines create jobs, but have a wealth of negative effects on the environment.
A difficult place to start a sustainable economy...
**Phase 1: Bio-Diesel and Char**

- Import Cashew shell (commodity) from Mozambique
- Produce bio-diesel for mining company (10% of demand).
- Produce char for soil improvement.

<table>
<thead>
<tr>
<th></th>
<th>Economic Value</th>
<th>Environmental Value</th>
<th>Social Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mining Company</strong></td>
<td>↑ DKK 0.8M</td>
<td>↓ 74k t CO2</td>
<td></td>
</tr>
<tr>
<td><strong>Local Community</strong></td>
<td></td>
<td>↓ Acidification</td>
<td>↑ 180 jobs</td>
</tr>
<tr>
<td><strong>MASH</strong></td>
<td>↑ DKK 5.1M</td>
<td>↓ 74k t CO2</td>
<td></td>
</tr>
</tbody>
</table>

Cashew shell from Mozambique

Bio Diesel

Bio Char
Phase 2: Bio-Diesel, Char & Cashew

- First cashew harvest!
- Establish processing facility.
- Supplement cashew imports with local production.
- Produce char for soil improvement.
- Plant cashew trees.

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<td>Mining Company</td>
<td>↑ DKK 0.8M</td>
<td>↓ 74k t CO2</td>
<td></td>
</tr>
<tr>
<td>Local Community</td>
<td>↑ DKK 2.2M</td>
<td>↓ Acidification</td>
<td>↑ 220 jobs</td>
</tr>
<tr>
<td>MASH</td>
<td>↑ DKK 6.9M</td>
<td>↓ 74k t CO2</td>
<td></td>
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</tbody>
</table>

Cashew shell from Mozambique

Bio Diesel

Bio Char

Own shells

Cashew kernel export
**Phase 3: Major Bio-Diesel and Cashew exporter**

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<th>Social Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mining Company</strong></td>
<td>↑ DKK 7.4M</td>
<td>↓ 750k t CO2</td>
<td></td>
</tr>
<tr>
<td><strong>Local Community</strong></td>
<td>↑ DKK 45M</td>
<td>↓ Acidification</td>
<td>↑ 5000 jobs</td>
</tr>
<tr>
<td><strong>MASH</strong></td>
<td>↑ DKK 42M</td>
<td>↓ 1M+ t CO2</td>
<td></td>
</tr>
</tbody>
</table>

- Area has become a major cashew producer.
- Bio-diesel production exceeds local need and exports have begun.
- Production of Bio Diesel is entirely reliant on local cashew shells.
A Standard unit for PSS based operations

Our units are all containerised, allowing…
- Easy relocation (pick it up!)
- Minimal asset integration.
- Minimal site preparations needed.
- Exchange of entire units for service.
Creating a "Win Win" and other reflections

- Western countries have established value chains for most waste- and biomass streams.
  - Barriers to entry for circular economy models and Product/Service-Systems (PSS).

- Luckily, Danish (and European) countries are uniquely positioned to address systemic dysfunction in the developing world by implementing PSS. The need is there!

- Perception of challenges in 3rd world based on EU-centric assumptions on technology and market.
  - Building a PSS from scratch is easier than re-configuring existing systems.
  - Solutions in the developing world will NOT look like the ones we know from e.g. Europe.
  - Asset ownership is generally not wanted due to lack of liquidity.
THANK YOU!

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