Technology meets ecology and economy; different cases on 'bio-economy systems' in Europe
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Technology meets ecology and economy; different cases on ‘bio-economy systems’ in Europe.

Hugo de Vries, Mechthild Donner and Monique Axelos
Inra, France
Content

• Where are we?
• What do we need?
• And for **technology and new business models** > which radical innovations?
• Examples of potential options for both technology and new business?
• Need for a **bio-economy systems approach**?
Where are we?

- An enormous challenge!

Earth overshoot day 2019 is July 29!
Major challenges?

*Exponential curves*

We are currently **extending the expiry date** of our planet.

We are not heading towards a sustainable, circular bio-economy (spiral)
We are not able to take away the uncertainties about a well-balanced society
What do we need? > *we need to redefine the limits*

> *ecology as driver*

Vitality / ‘richness’

Non-vital planet earth: chaos

Net effect?

Scenario 1

Non-vital planet earth: rigid, dead

Scenario 2

Luxurious products/services

Primary needs

Green-house effect
Bio- & Food- diversity loss
Population growth

Poverty
Food insecurity
Insufficient arable land
No drinking water
Hazards (microbial, chemical)

2015

Time

2050
Options from the technology perspective
Innovations in technology with consequences for business: 

*avoiding unnecessary exploitation of resources* (I)

<table>
<thead>
<tr>
<th>New Technologies</th>
<th>Business proposition</th>
<th>Business model</th>
</tr>
</thead>
<tbody>
<tr>
<td>From products to services &amp; de-materialization</td>
<td>Consultancy, support structure, cross-sector alliance</td>
<td>Individual / cluster of companies</td>
</tr>
<tr>
<td>Low density – high satiety food</td>
<td>New value proposition</td>
<td>Individual company</td>
</tr>
<tr>
<td>Alternative protein sources</td>
<td>New value proposition, cross-sector alliance</td>
<td>Individual/ cluster of company</td>
</tr>
<tr>
<td>Utilization the richness of nature’s structures (biomimetic),</td>
<td>New value proposition, cross-sector alliance</td>
<td>Individual/ cluster of company</td>
</tr>
<tr>
<td>Waterless systems</td>
<td>New value proposition</td>
<td>Individual company</td>
</tr>
<tr>
<td>Synthetic biology pathways</td>
<td>New value proposition</td>
<td>Individual company</td>
</tr>
</tbody>
</table>

*In red: example will be shown*
Innovations in technology with consequences for business: efficiently transform and use agro-resources (II)

<table>
<thead>
<tr>
<th>New Technologies</th>
<th>Business proposition</th>
<th>Business model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autocatalytic systems</td>
<td>Autocatalytic firms?</td>
<td>Not yet known</td>
</tr>
<tr>
<td>Targeted processes (not over-dimensioned)</td>
<td>New value proposition</td>
<td>Individual company</td>
</tr>
<tr>
<td>Process intensification</td>
<td>Cluster of companies</td>
<td>Cluster of companies</td>
</tr>
<tr>
<td>Local bio-refineries at the farm</td>
<td>Bio-refinery plant</td>
<td>Cluster of companies</td>
</tr>
<tr>
<td>New ICT driven processes (virtual design, domotics, 3D printing, ...)</td>
<td>New value proposition</td>
<td>Individual company</td>
</tr>
<tr>
<td>Eco-efficient dynamic storage</td>
<td>Cross-sector Alliance</td>
<td>Cluster of companies</td>
</tr>
<tr>
<td>High precision water-droplet systems</td>
<td>New value proposition</td>
<td>Individual company</td>
</tr>
<tr>
<td>Energy efficient desalting of sea water</td>
<td>New value proposition</td>
<td>Individual company</td>
</tr>
<tr>
<td>Novel biomaterials &amp; packaging concepts</td>
<td>New value proposition</td>
<td>Individual company</td>
</tr>
</tbody>
</table>
Innovations in technology with consequences for business: (re-)valorising co-products and waste streams (III)

<table>
<thead>
<tr>
<th>New Technologies</th>
<th>Business proposition</th>
<th>Business model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eco-pyramid valorisation of resources</td>
<td>Agro-parks, Bio-refinery Plant, Cross-sector Alliance</td>
<td>Cluster</td>
</tr>
<tr>
<td>Aquaponics systems</td>
<td>New value proposition</td>
<td>Individual company</td>
</tr>
<tr>
<td>New salt tolerant species</td>
<td>New value proposition</td>
<td>Individual company</td>
</tr>
<tr>
<td>Diverse agro-ecological-processing methods</td>
<td>Cooperative, Bio-refinery plant, Agro-park, Industrial ecology</td>
<td>Cluster</td>
</tr>
</tbody>
</table>

Sources: Poyry and Sanders
Options from the business perspective
Innovations in business with consequences for technology with ecology/environment as driver

<table>
<thead>
<tr>
<th>New Business concepts</th>
<th>Business proposition</th>
<th>Technology impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>New company activity in the chain (standard business model)</td>
<td>Product or technology innovation</td>
<td>New product or technology</td>
</tr>
<tr>
<td>Cluster of companies in the chain with multiple innovations</td>
<td>Product or technology innovations</td>
<td>A series of new products or technologies</td>
</tr>
<tr>
<td>Cluster of companies for valorizing products in a cascading manner</td>
<td>Cross-sector alliance, Multiple product or technology innovations</td>
<td>A series of new organizational clusters, products or technologies</td>
</tr>
<tr>
<td>Circular business models</td>
<td>New value proposition cross-sector alliance</td>
<td>New products should be recyclable, new technology</td>
</tr>
<tr>
<td>New cross-sector network of companies</td>
<td>Radical innovations</td>
<td>Both product, technology and organizational</td>
</tr>
</tbody>
</table>
Examples in new business & technology, going hand in hand
Example 1

New technology and business for valorising a co-product ‘innovation in the chain’
New technologies for extracting proteins from by-product streams

To be used as meat alternatives on basis of new plant, algae and insect protein sources or for bio-based products (coatings, paints, dermatology)

WHY RUPTURE? .... Substantial reduction of environmental pressure due to protein-conversion factors and greenhouse gas emissions (CH4, etc.), challenges with nutritional profiles, ...

Example: BBI Green Protein Project;
New business concept for protein valorisation: IMPROVE consortium or BBI Greenprotein team

WHY RUPTURE? .... New cooperation forms between companies, sharing of facilities, co-investments, ...
Example 2

New technology and business with multiple innovations in the chain

‘cluster in a chain’
Examples: Innovation from the field to the plate:

Rupture: New type of agriculture

Reduction of fertilizers

% wheat/legumes > new mixed resources

Novel dry fractionation & transformation steps

New Nutritional advantages

Approval?

Ref: « Flexiprocess » project M.H. Jeuffroy & C Michon
« Vegage » project V. Micard
« Defi Blé Dur » project B. Cuq

French National strategy for protein transition
New but temporary network of companies

*BPI France Défi Blé Dur*

- 1 R&D centre, **INRA**

- 7 *industrial partners* (SME and multinationals):
  - Pasta chain companies (95% of the total production) and couscous (100% of the total production), **Alpina Savoie, Heimburger, Panzani (coordinator), Pastacorp, Tipiak Epicerie**

- 2 support structures / companies: **ETIA, ENGIE Cofely**
Example 3

New technology and business for entire plant usage, ‘cascading usage’

Cross-sector alliance / cooperative
Ex. technologies for full plant resource usage: dry fractionation

Cereal whole plants (wheat, soja, rice, barley, ..)

WHY RUPTURE? .... Integral use of biomass, no water added during processing (thus no drying), local applicability, avoiding water transport, local employment

Abecassis et al., 2013,..
Ex. New business model for entire plant usage; Grap’Sud

→ GrapSud, a union of 7 wine cooperatives located in the South of France, with 210 employees on 6 production sites

Waste valorised:
125 000 tonnes of grape marc
270 000 hl of wine lees
600 000 hl of wine most

→ A diversity of new value-added products issued from by-products

→ Alternative cooperative structure focused on multi-market business.

M. Donner, Naxos conference, 2017
Also, EU NOAW project
Ex. New Association Bâtir-en-Balles

→ New association formed focused on non-food business

→ Cross-sector valorization: rice husks in the Camargue for eco-construction
Example 4

New technology and business for industrial ecology

‘circular business model’
Industrial ecology parks / symbiosis for regional development:
- Large scale: Pomacle
- Small scale: Biovallée
Example 5

New technology and business as cross-sector innovation

‘network approach’
Ex. Efficient dynamic storage for maritime transport

WHY RUPTURE? ....Energy for climatisation 70% reduced & stand alone & less product loss & cross-sector network
The way ahead (I)

Understanding what are the consequences of *new technologies for business* and what are the consequences of *new business & value propositions for technology development*

*always with the ambition to strive for substantial environmental and/or social improvements to maintain our planet viable*
The way ahead (II) Need for bio-economy systems approach and joint platforms

World food systems as Intelligently Navigated Complex Adaptive Systems (INCAS)

- Summary IFSET Special Issue 5, France, 2018
- De Vries, 2017
We need inspiration & creativity

*Thanks to MC Escher*

Thanks to all colleagues, young and many years young

*Thanks to you*

Diversity interconnected

Thinking in spirals, not in circles

Changing the landscapes & melting zones

Creating ruptures

Bioeconomy conference, Paris, 29 – 30 October 2019

EFFoST Conference on sustainability & food, Rotterdam, 12 – 14 / 11 / 2019

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