Technology meets ecology and economy; different cases on 'bio-economy systems' in Europe
Hugo de Vries, Mechthild Donner, Monique Axelos

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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

www.worldometers.info/
What do we need? > **we need to redefine the limits**
> **ecology as driver**

Vitality / ‘richness’

Non-vital planet earth: chaos

Scenario 1

Non-vital planet earth: rigid, dead

Scenario 2

2015

Time 2050

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

Luxurious products/services

Primary needs

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

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

French National strategy for protein transition

Novel dry fractionation & transformation steps

New Nutritional advantages

Approval?
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

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

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

*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

hugo.de-vries@inra.fr