



The Horizon for Technologies in Future Proofing Food Systems

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The Horizon for Technologies in Future Proofing Food Systems

Hugo de Vries
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Content

- What are **Future Proofing Food Systems**?
- Where are we?
- What do we need?
- And for **food science and technology** > radical innovations?
- Examples of potential solutions?
- A need for a **food systems approach**?

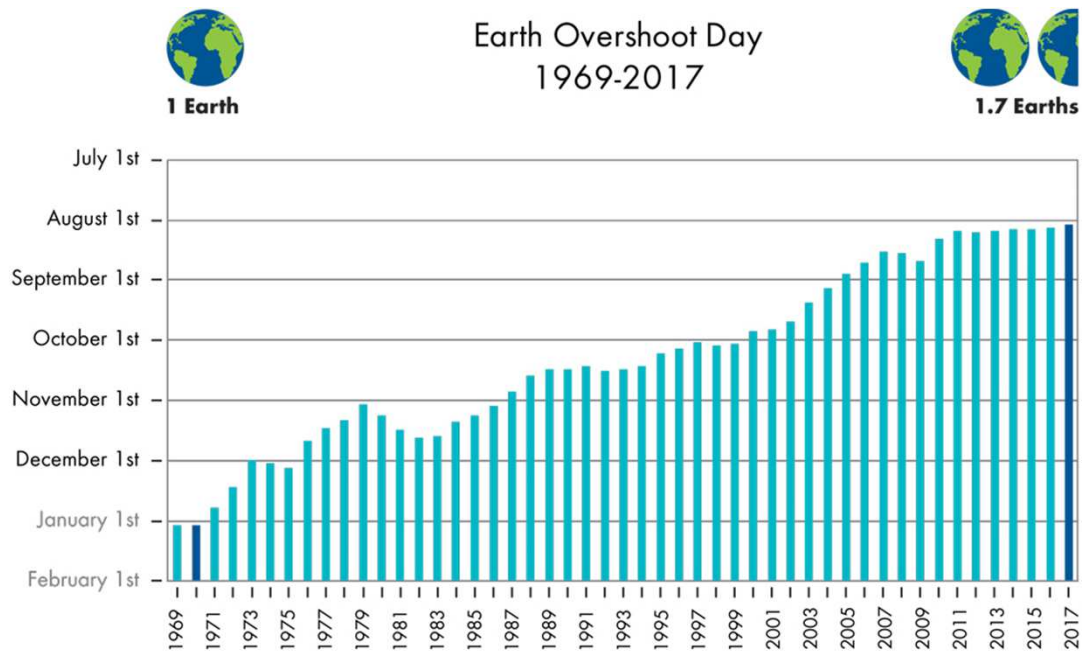


What are Future Proofing Food Systems?

- HLPE (2017) : *“a food system that ensures food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition of future generations are not compromised”.*
- The definition lacks references to:
 - *circular (bio-)economy,*
 - *cultural aspects and*
 - *optimal usage of natural and input from human resources;*
- The questions evokes key issues as *inclusiveness, consumption behaviour, affordability in economic terms, policy measures, nutrition in either ‘sufficient calories’ or ‘balance diets’ and ICT and digitalisation.*

Where are we?

- An enormous challenge



Source: Global Footprint Network National Footprint Accounts 2017



Combien de Chine faut-il pour subvenir aux besoins des Chinois?

CHINE 2.7

Qu'en est-il des autres pays?

FRANCE 1.4

U.S.A 1.9

INDE 2.0

ALLEMAGNE 2.1

GRECE 2.6

G.B. 3.0

EGYPTE 3.2

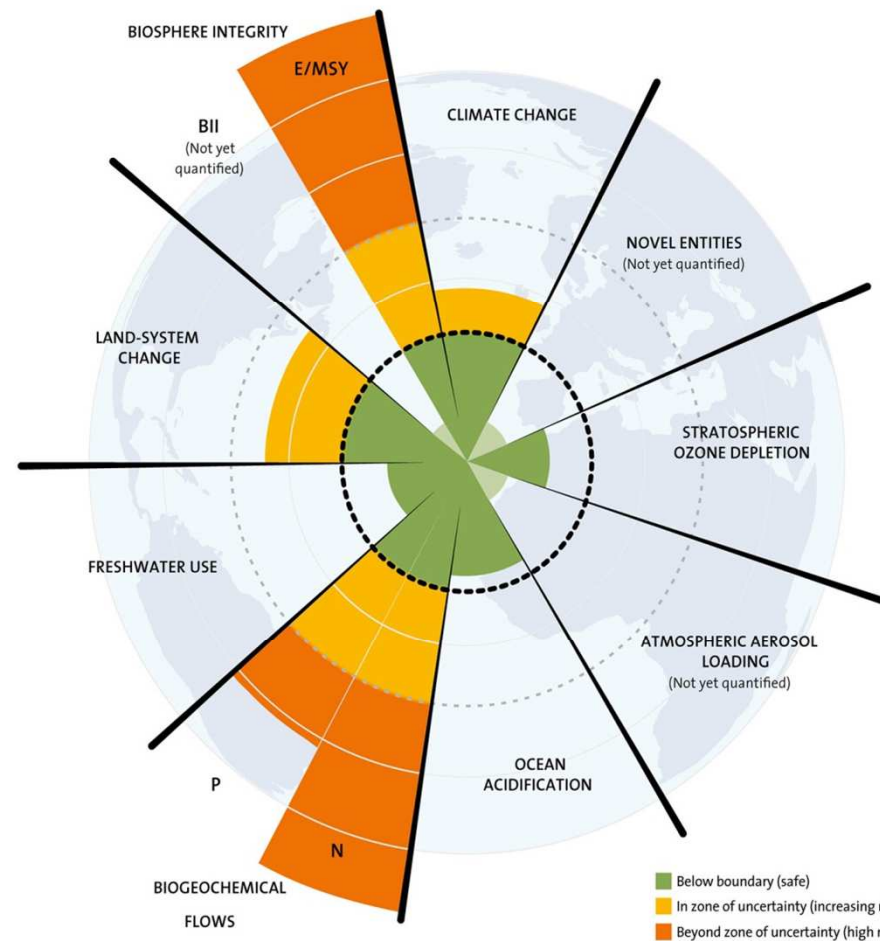
SUISSE 3.5

ITALIE 3.8

JAPON 5.5

MONDE 1.6

And yet in some alarming zones



<https://www.stockholmresilience.org/research/planetary-boundaries.html>

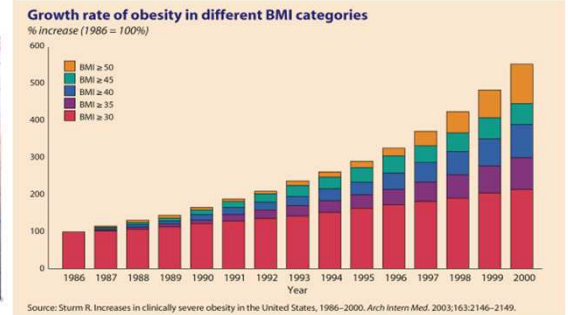
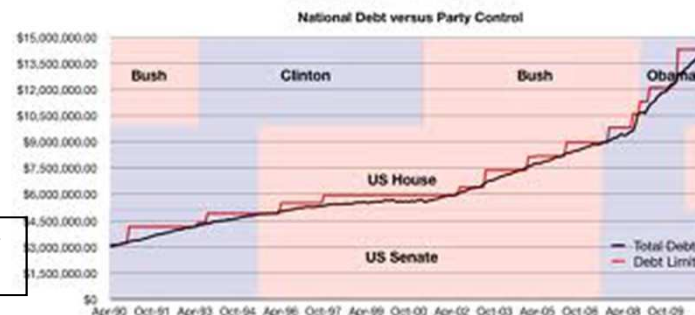
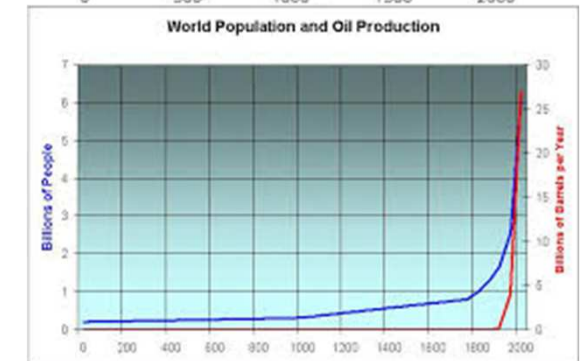
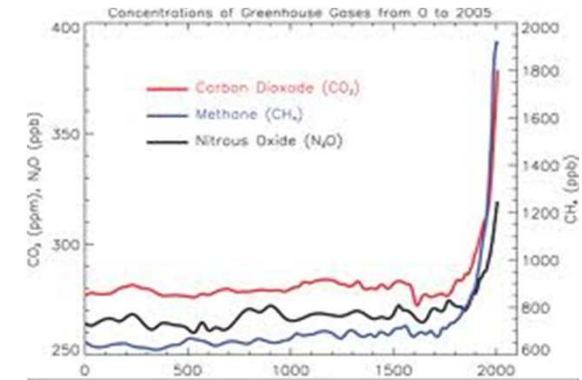
And other major challenges?

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



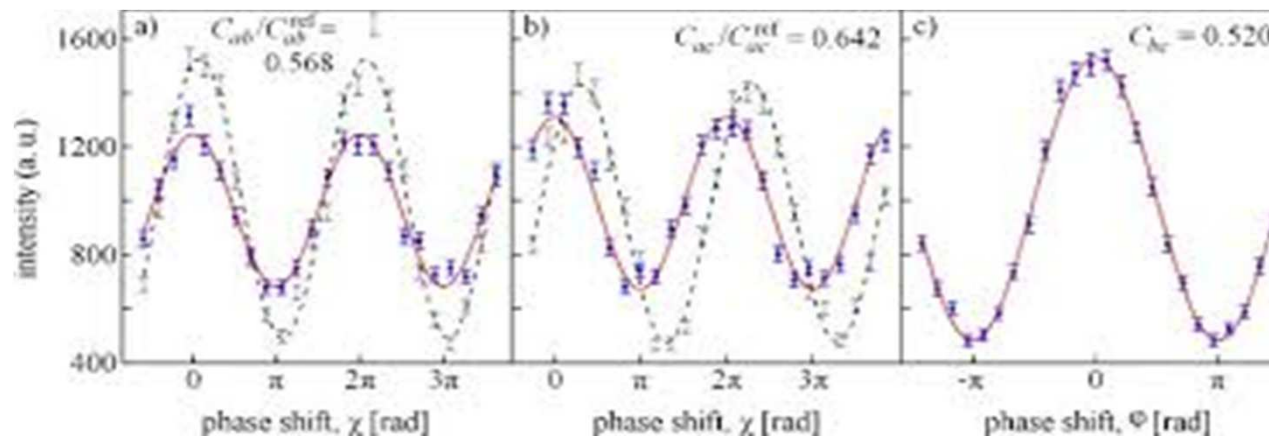
<http://www.worldometers.info/>

What do we need?

A viable planet!, in terms of:

- *Healthy inhabitants*
- *A viable habitat / environment*
- *A pleasant & respectful socio-economic context*
- *An aesthetic image*

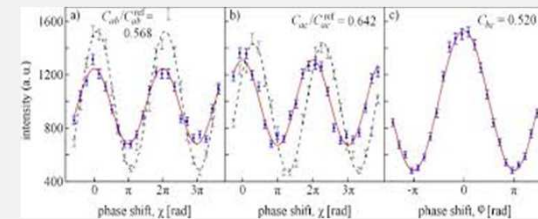
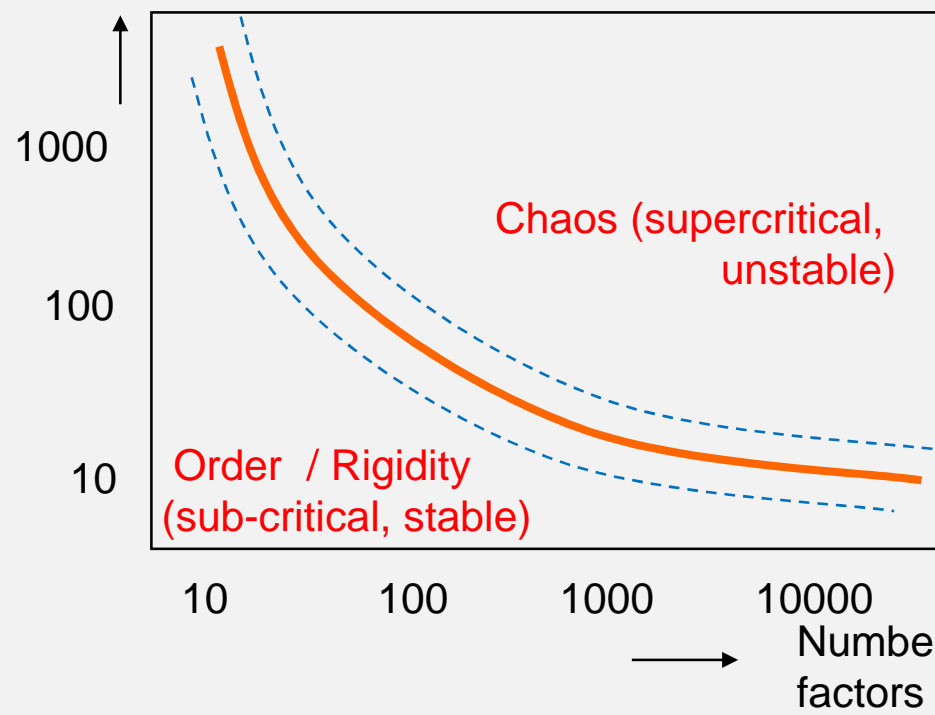
Sinusoidal curves



A frame where we balance at the edge of order and chaos

Originating from physics, in particular from **thermodynamics: for systems, food matrices, ..**

Interactions between persons, constituents (in e.g. biomatter) /factors/..

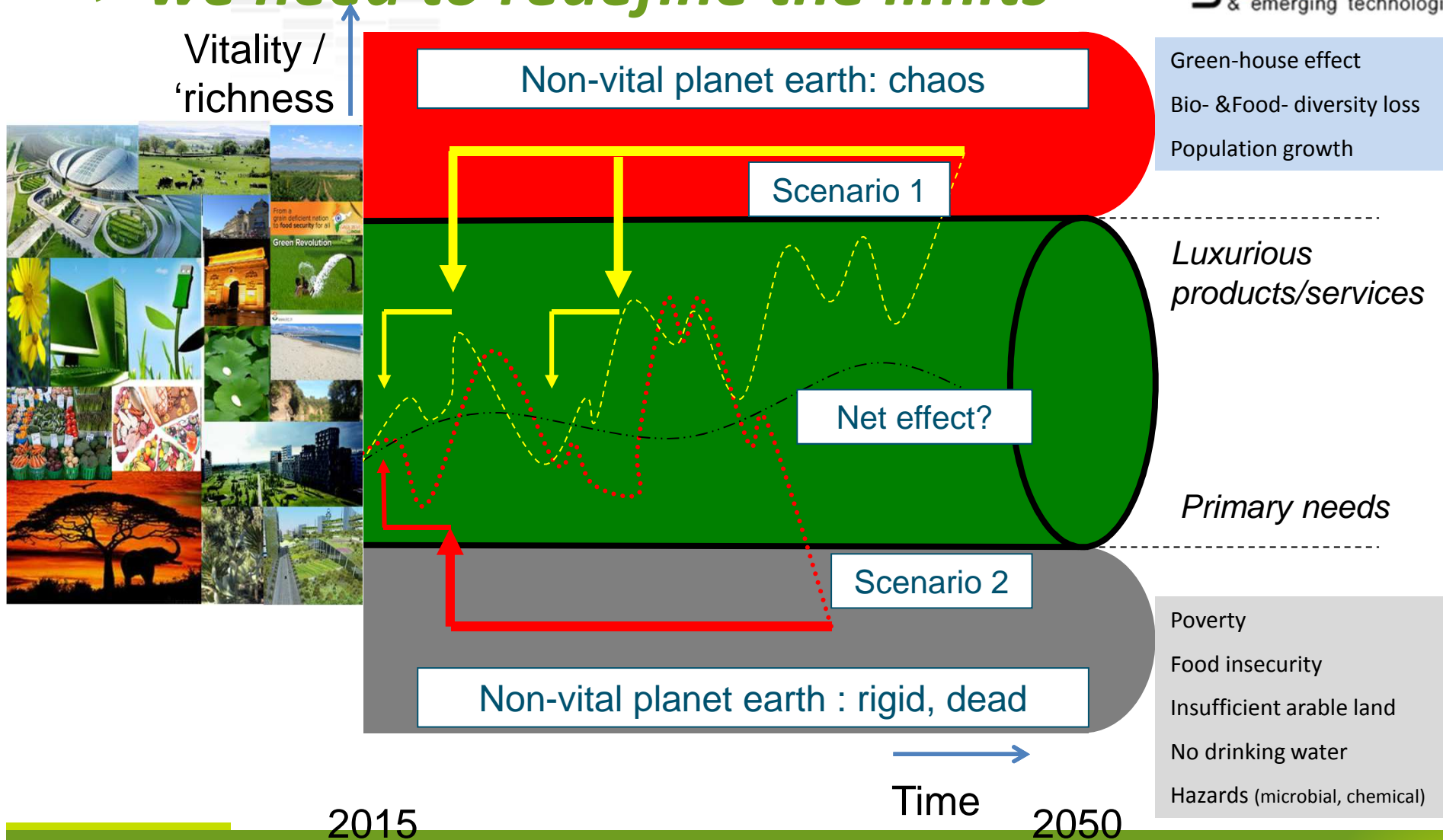


Evolutions characterized by sinusoidal patterns

'melting zone': self-organized dynamics > favorable domain

What does it mean for food?

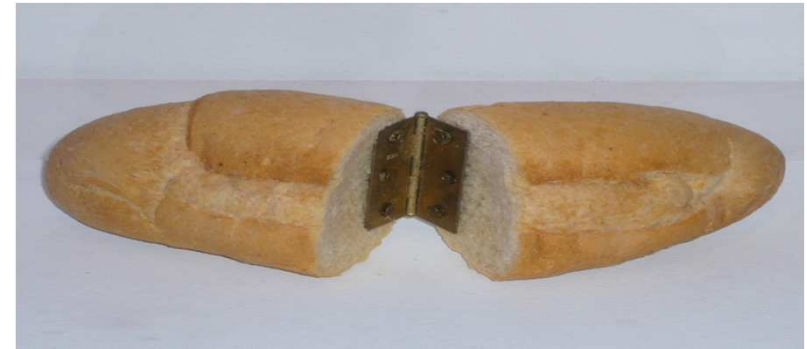
> *we need to redefine the limits*



Radical innovations needed in Food / ruptures (I)

1. Avoiding unnecessary exploitation of resources:

- from products towards services & **de-materialization**,
- low density – high **satiety** food,
- **alternative protein** sources
- utilization the richness of nature's structures (**biomimetics**),
- **waterless** systems,
- **synthetic biology** pathways,
- energy **only from the sun** (avoid the use of biomass) ,
- new breeding strategies for **entire** plant usage,
- ..



*Museum Booymans van
Beuningen, Rotterdam*

Radical innovations needed in Food technology / ruptures (II)

2. Efficiently transforming and using agro-resources :

- autocatalytic systems,
- targeted processes (not over-dimensioned)
- process intensification,
- local bio-refineries at the farm (no transport of water & air),
- new ICT driven processes (virtual design, domotics, 3D printing, ...),
- eco-efficient dynamic storage (products in coma),
- high precision water-droplet systems,
- energy efficient desalting of sea water,
- novel biomaterials & packaging concepts, etc.


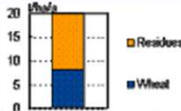

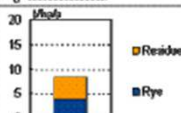

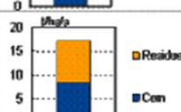

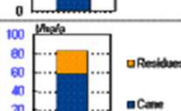




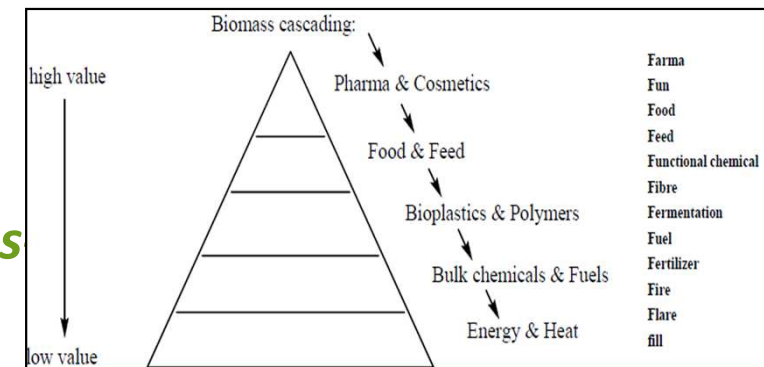
Radical innovations needed in Food systems / ruptures (III)

3. Valorizing new co-products and waste streams and re-valorize all biomass:

- **eco-pyramid** valorization,
- aquaponics systems,
- new **salt tolerant** species,
- diverse **agro-ecological**-based products
- **industrial ecology business** concepts,
- **circular economy** concepts
- ,...

Food Science becomes more and more trans disciplinary (management, economics, genetics,...)

Feedstock	Crop yield kg/ha/a (fresh)	Residues kg/ha/a	Fractions
Wheat 	8000	11800	
Rye 	3800	4400	
Corn 	8180	8700 Type MC Share d.w. Stalk 70-75 60 Leaf 20-25 20 Cob 50-55 20 Husk 45-50 10	
Sugar cane 	58000-88000	24000-37000	
Sugar beet 	69300	4700	



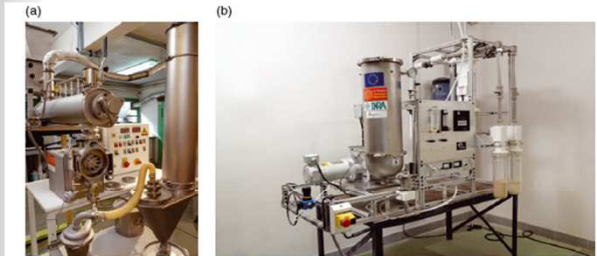


Figure 5. Pilot equipments for cryomilling (a) and electrostatic sorting (b) at INRA-IATE.

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

Ex. entire plant usage; Grap'Sud

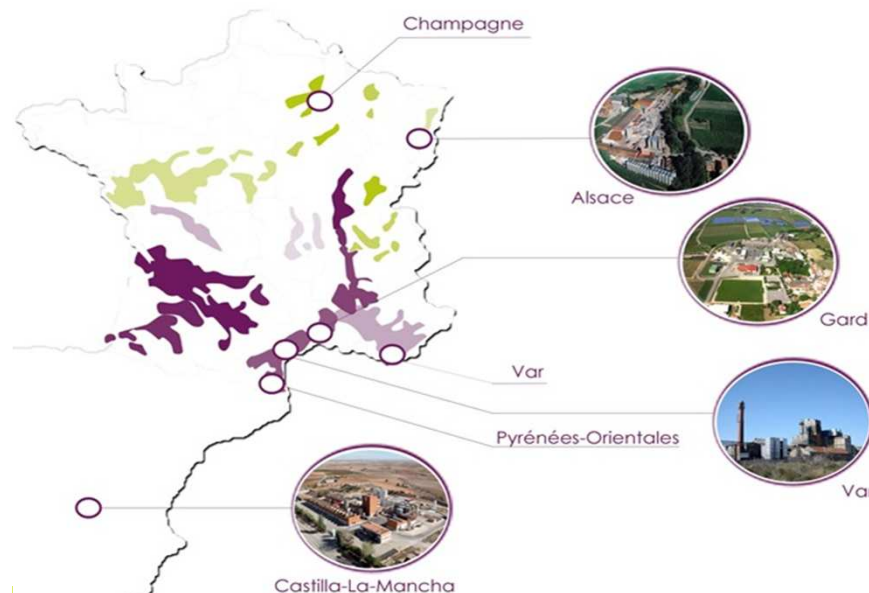
→ GrapSud, a union of 7 wine cooperatives located in the South of France, with 210 employees on 6 production sites

Waste valorised:

125 000 tonnes of grape marcs

270 000 hl of wine lees

600 000 hl of wine most



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

→ New biorefinery and processing schemes.

Ex. alternative proteins sources & products



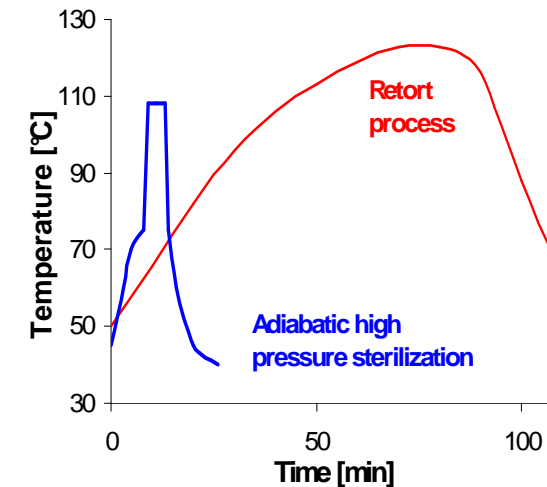
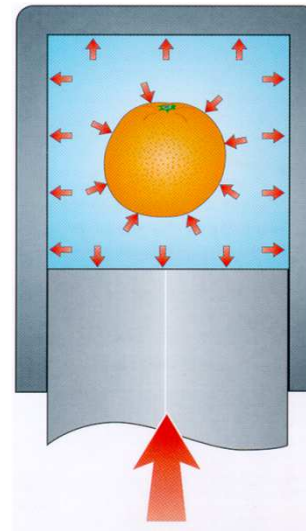
meat alternatives on basis of new plant, algae and insect protein sources

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

15

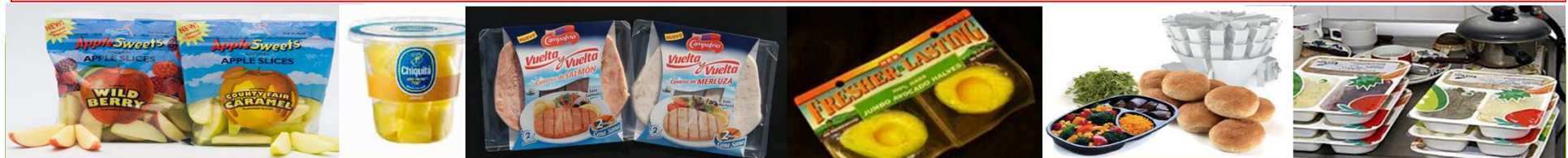
NovelQ

Ex. process intensification: HPHT



Why rupture? Adiabatic heating \gg time for processing enormously reduced & No re-packing $>$ treatment in the package itself

EU IP FP6 NovelQ: To develop and successfully demonstrate - eco-friendly - novel processing technologies (HPP, PEF, Plasma, microwave, radio frequency, ohmic heating and new packaging materials) for improved quality food and new products (fresh-like character, extended shelf-life)



Ex. targeted processing > EME

- PEF: highly efficient
- Plasma >> most targeted technology (at the edge of thermodynamics and electromagnetism)



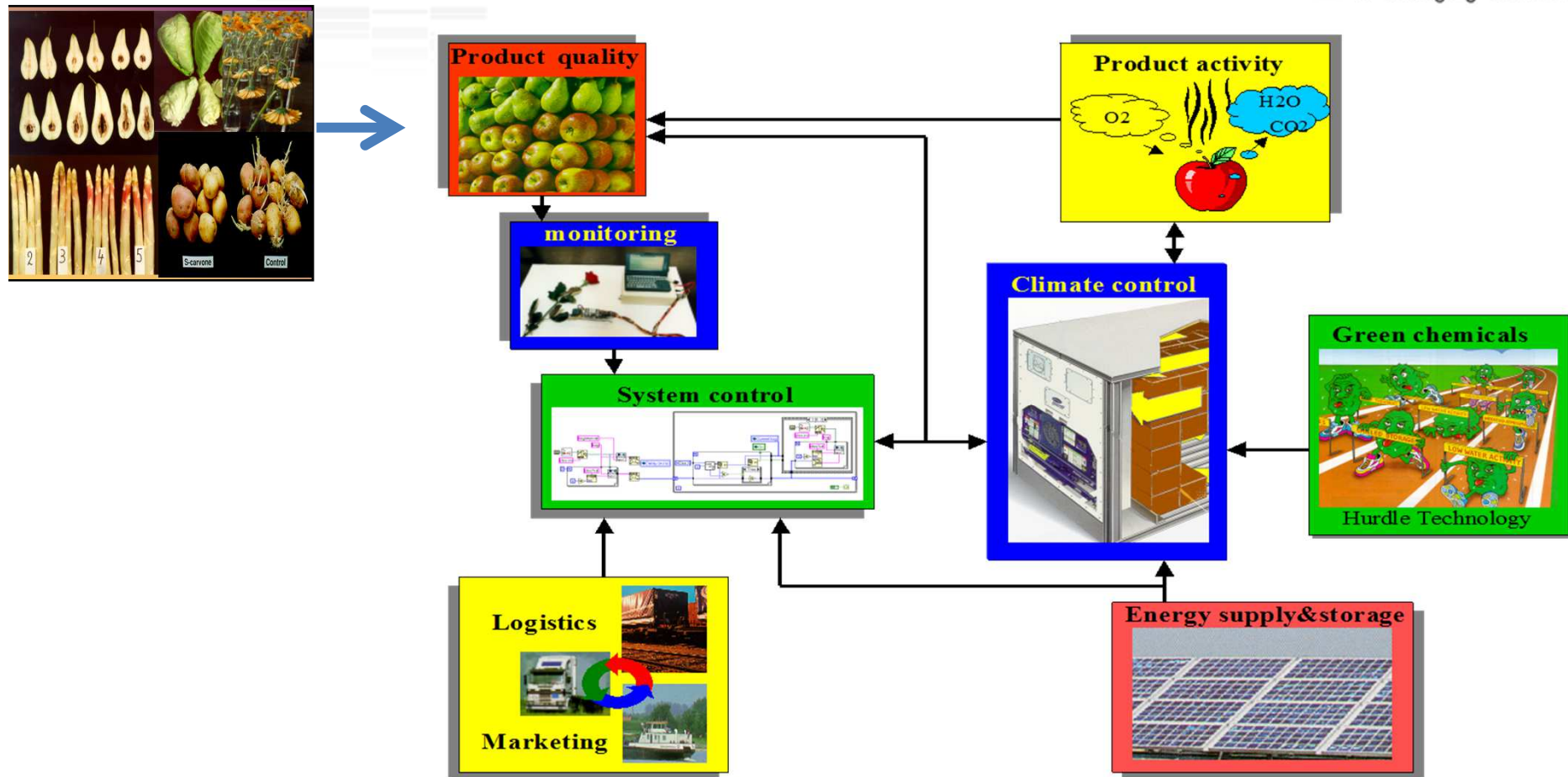
EC FP6 Integrated Project



<http://www.innovation-xl.com/en/nutripulse.html>

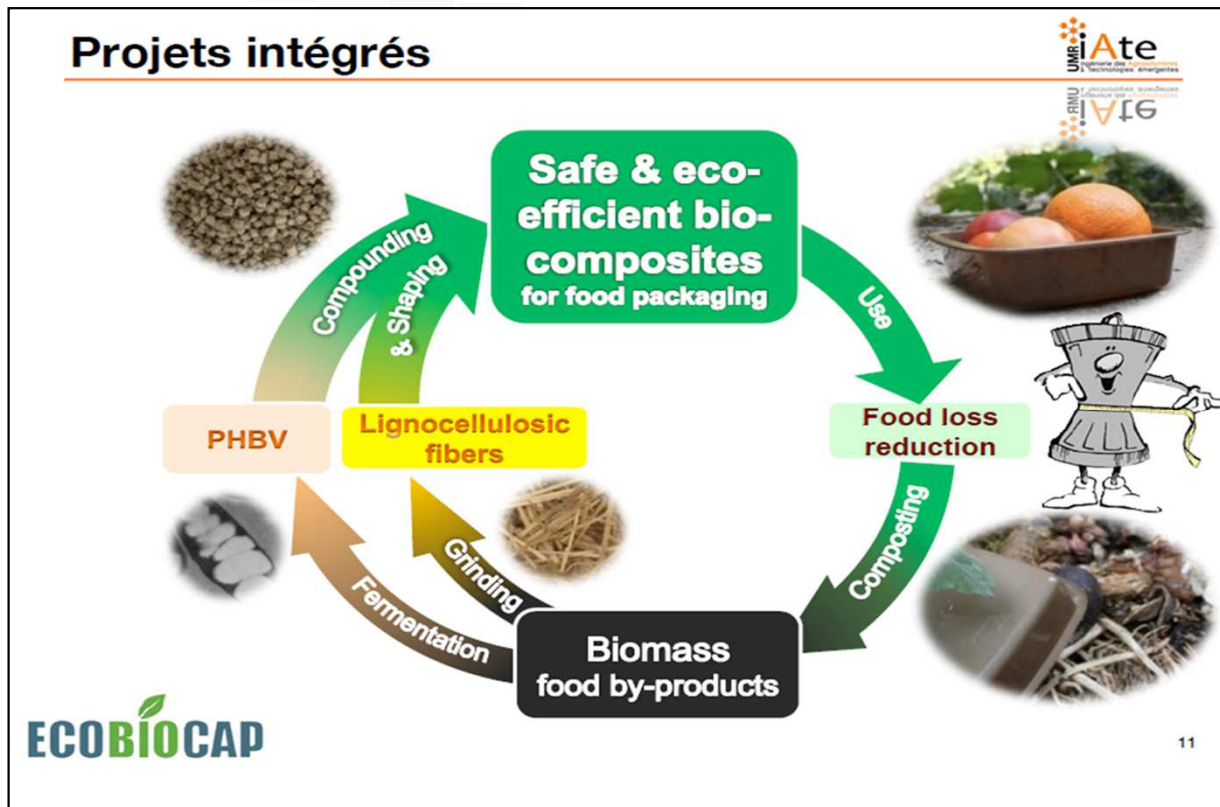
WHY RUPTURE? Energy for cooking 80% reduced & inactivation of spores at room temperature ...

Ex. Eco-efficient dynamic storage



WHY RUPTURE? ... Energy for climatisation during transport 70% reduced & stand alone & reduction of product loss

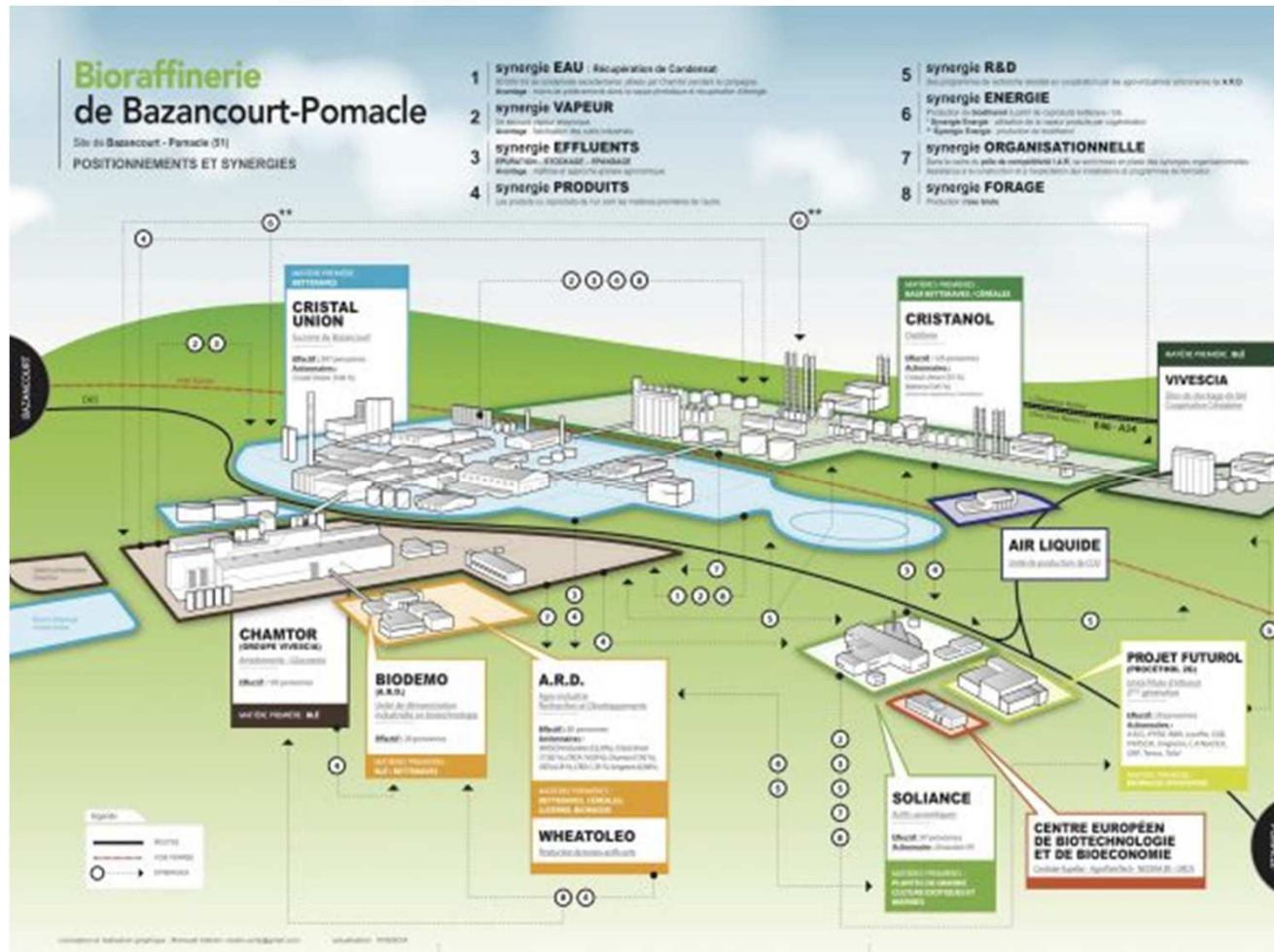
Ex. biodegradable packaging materials



EC-FP7 project,
Gontard et al

WHY RUPTURE? Valorization of largely unused co-products (approx 50% of all biomass) and waste (plus replacing synthetic materials, potential benefits due to biodegradability, ...)

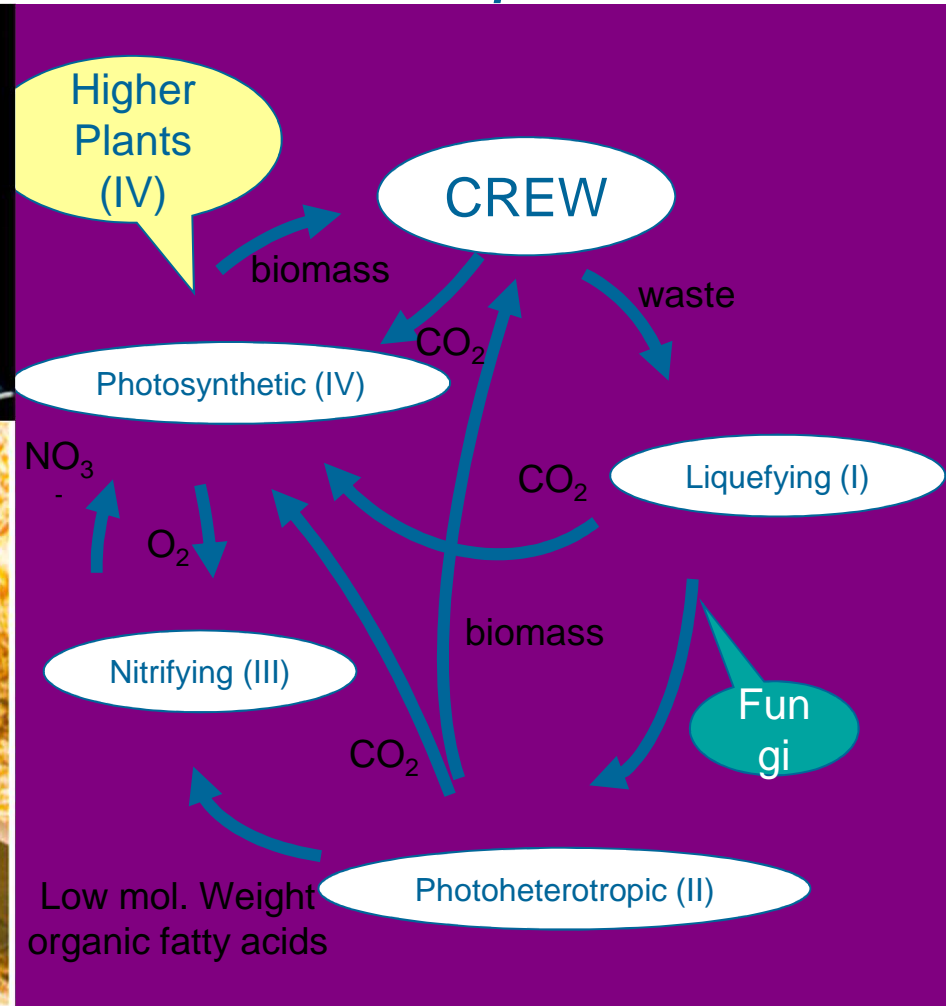
Ex.Industrial ecology concept



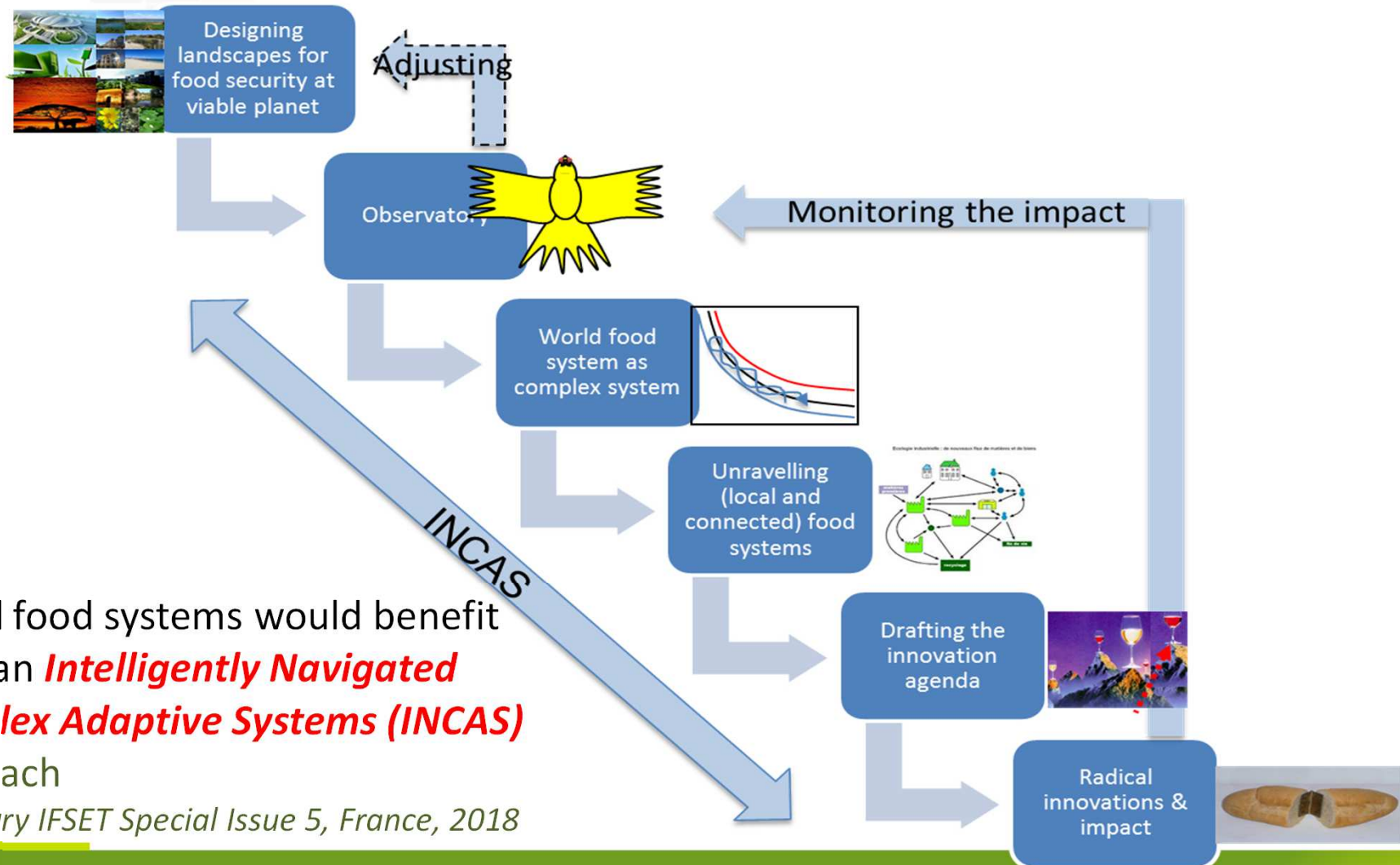
WHY RUPTURE?
Closed
circles/spirals locally
> zero waste
(potentially), new
cooperation forms

Ex. circular economy concept: MELISSA project

Micro-ecological life support alternative *in space*



Need for food systems approach



World food systems would benefit from an **Intelligently Navigated Complex Adaptive Systems (INCAS)** approach

Summary IFSET Special Issue 5, France, 2018

We need inspiration & creativity

Thanks to MC Escher

Diversity interconnected



Thinking in spirals, not in circles



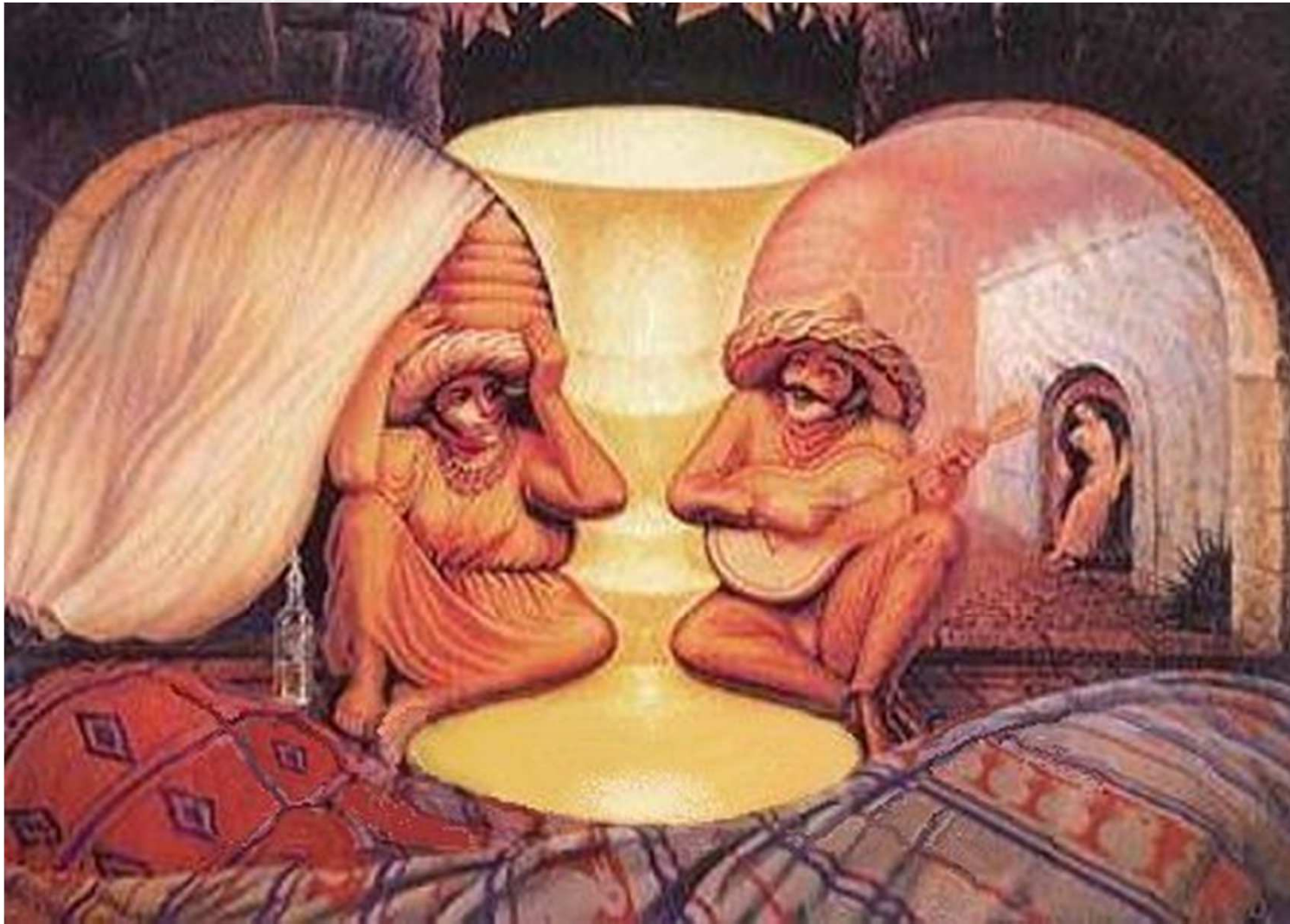
Changing the landscapes & melting zones



Creating ruptures



We need different views; we need you!



Many thanks for your attention



Bioeconomy conference, Paris, 29 – 30 October 2019

*EFFoST Conference on sustainability & food, Rotterdam, The Netherlands,
12 – 14 November 2019*

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