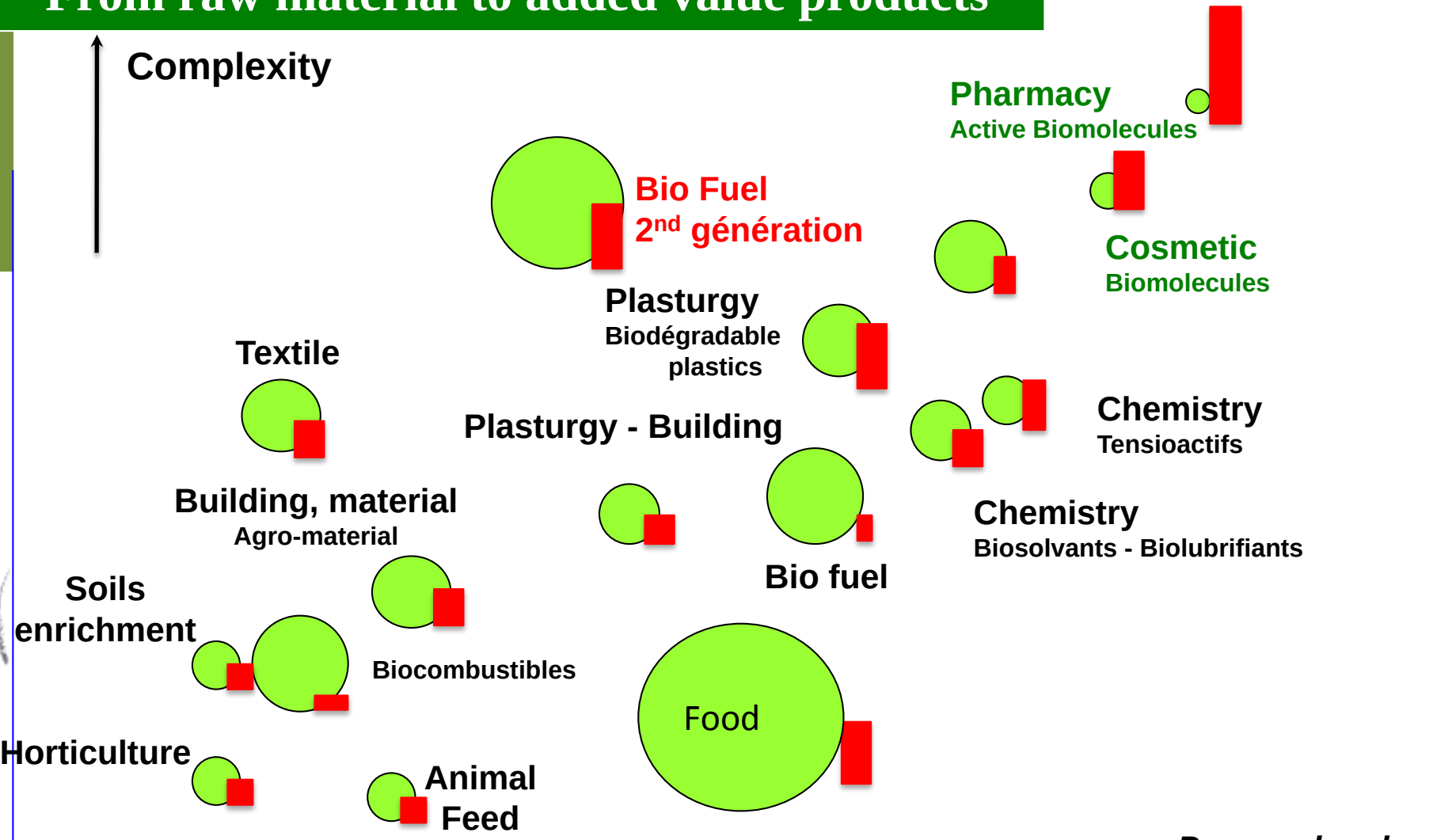
Agri chain transformations towards the sustainable Dévelopment Goals

Professor Gilles Trystram

General director AgroParisTech

JRU Food and Food Process Engineering (AgroParisTech, INRA)

Agri Food Chain: From raw material to added value products



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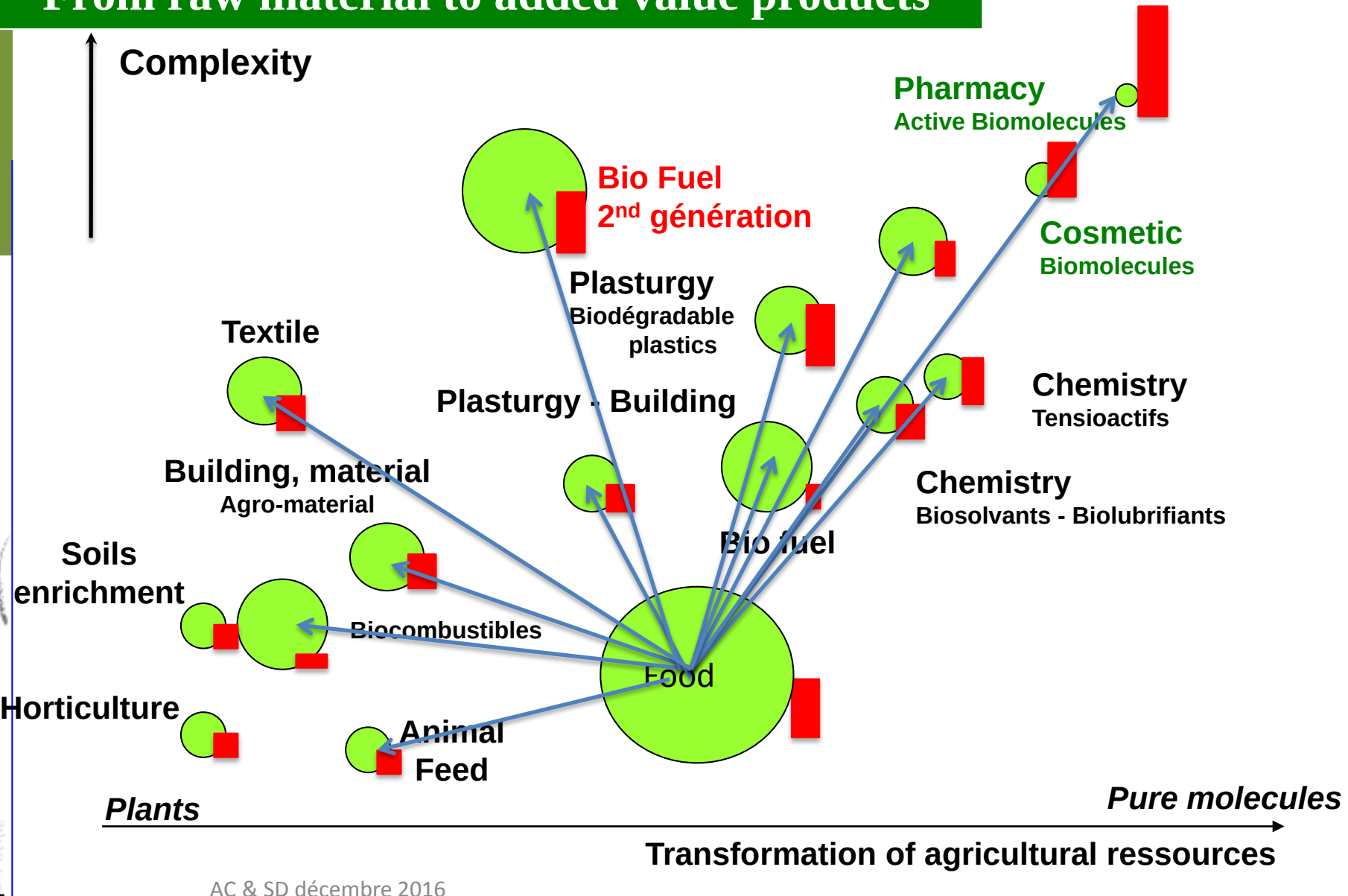


New stakes ?

1 NO POVERTY

2 ZERO HUNGER

3 GOOD HEALTH AND WELL-BEING

4 QUALITY EDUCATION

5 GENDER EQUALITY

6 CLEAN WATER AND SANITATION

7 AFFORDABLE AND CLEAN ENERGY

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

13 CLIMATE ACTION

14 LIFE BELOW WATER

15 LIFE ON LAND

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

17 PARTNERSHIPS FOR THE GOALS

SUSTAINABLE DEVELOPMENT GOALS

Mass production

Global changes
Society constraints
Health, Precision agriculture
Diversity of productions
Organic farming
Ecological intensification

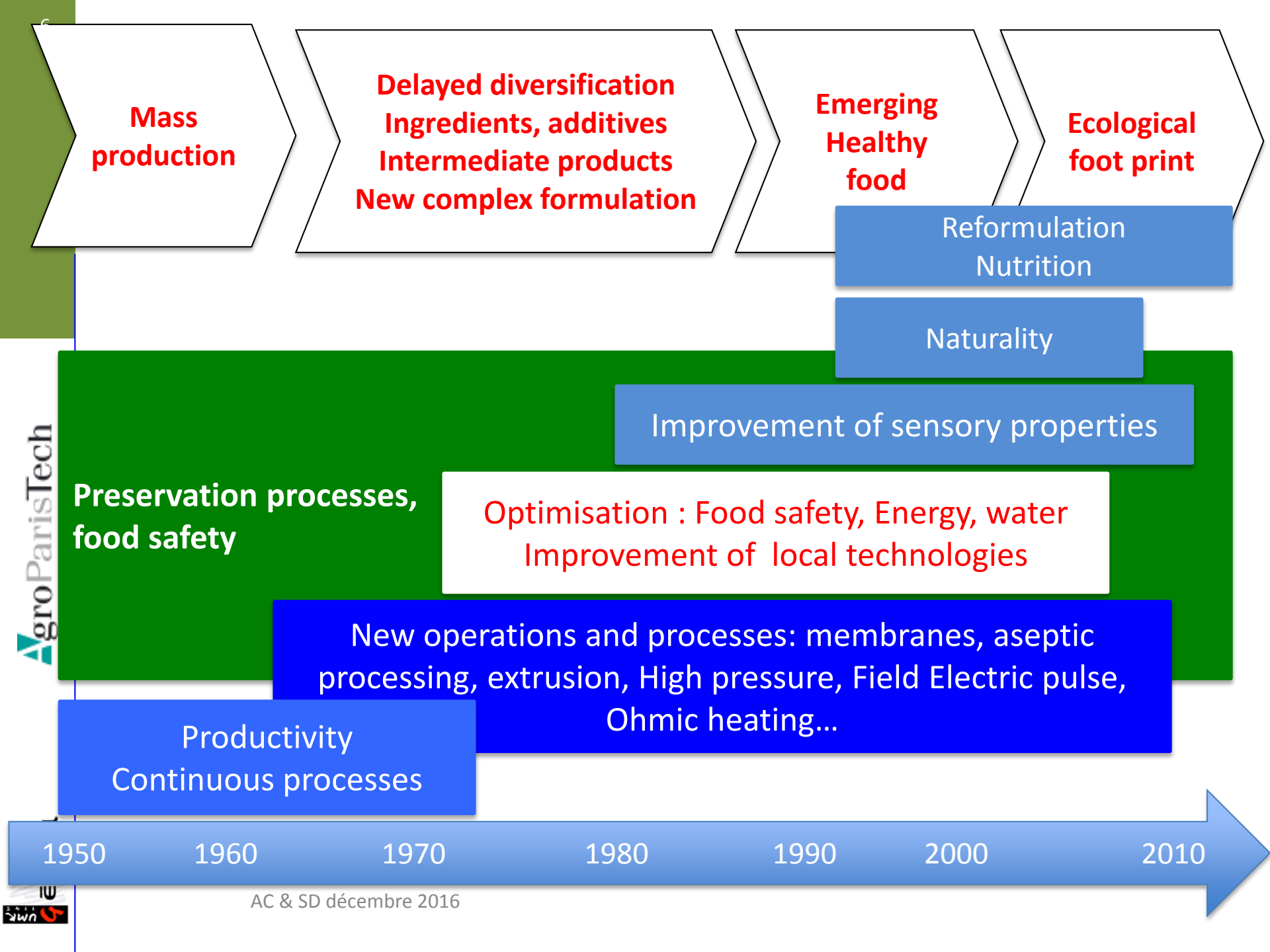
Low level on fertilizers
Varieties mix
Species mix
Agroforestery
Permaculture
Organic agriculture

Diversification of Agriculture
AGroEcology
Biodiversity

Intensive agriculture, use of fertilisers from Chemical industries, high yields Mechanisation, ..

Small farmers, diversity of farms, activities, locations

1950 1960 1970 1980 1990 2000 2010


Mass production
Delayed diversification
Ingredients, additives
Intermediate products
New complex formulation
Emerging Healthy food
Ecological foot print
Reformulation
Nutrition
Naturality
Improvement of sensory properties
Preservation processes, food safety
Optimisation : Food safety, Energy, water
Improvement of local technologies
New operations and processes: membranes, aseptic processing, extrusion, High pressure, Field Electric pulse, Ohmic heating…
Productivity
Continuous processes
1950
1960
1970
1980
1990
2000
2010

Towards Sustainable Development Goals?

- Numerous **transitions** are in progress: agriculture, global changes, Energy, globalisation, human behaviour, ..
- No unique solution for building Food Systems: each situation is a specific one (geography, climate local conditions, soils performances, consumer behaviour, social situation, ..
- sustainable diets: a key question for the whole agri food chain: building diversity, facing nutrition sensitive landscape, …
- …

The main challenges of food systems sustainability

- "The food system is the way in which Men organise themselves in space and time to obtain and consume their food. » L. Malassis, 1978

The FAO (2010) Sustainable food Systems challenge

- To be protective and respectful of biodiversity and ecosystems
- To be culturally acceptable and accessible
- To be economically fair and affordable
- To be nutritionally adequate, safe and healthy
- To optimise natural and human resources

Food Systems (sustainable)

Food systems are a way to go towards SDGs

They imply diversity.

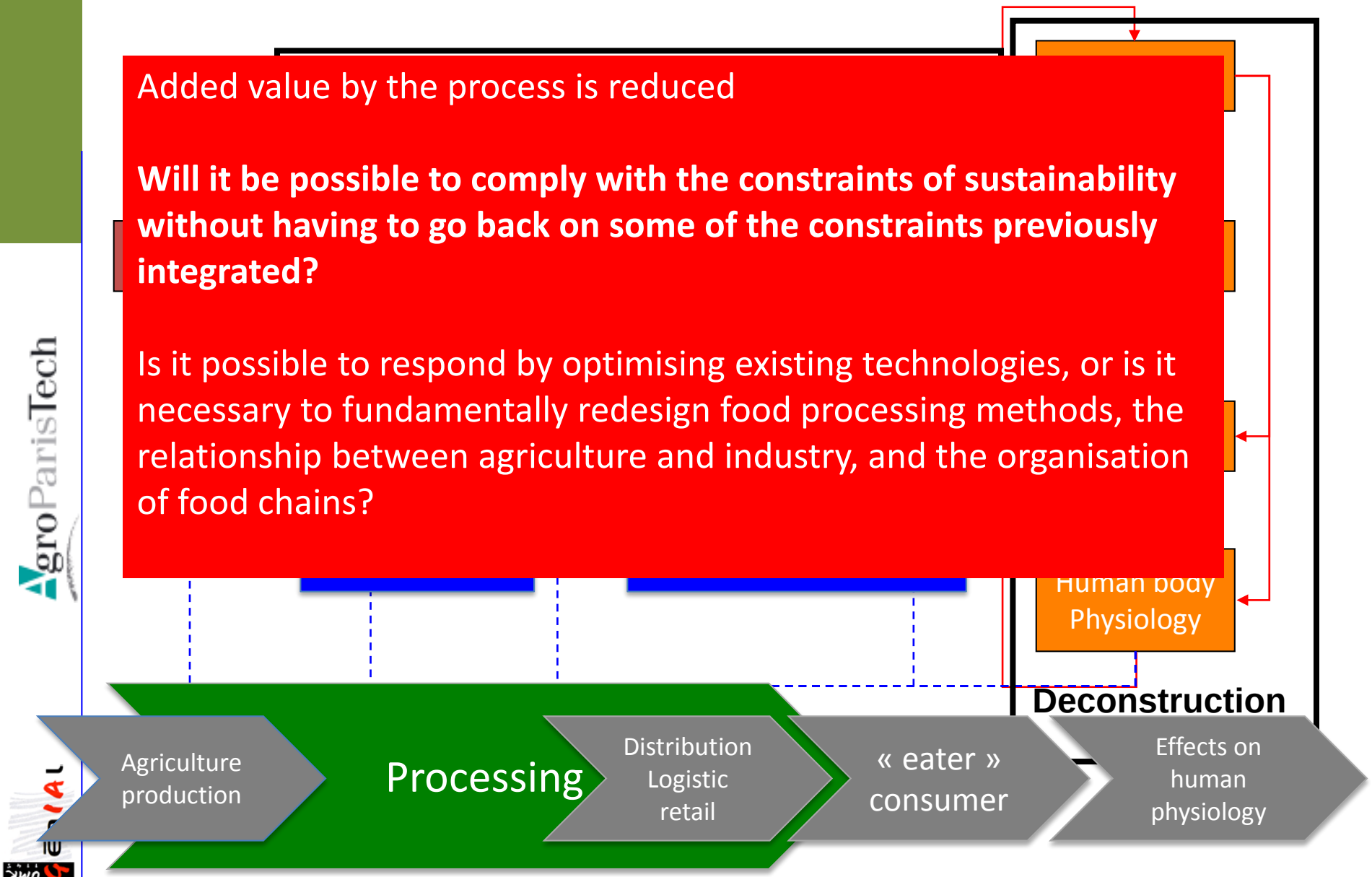
Food system is a way for the reconciliation between agriculture and transformation

- **Resources production** (fair, ecologically compatible, ..)
- Build up **functions** expected by consumer or public policies (health, **nutrition, sanitary, sensory, ..)**
- **Involving the creation** of value, Bioeconomy
- That permits **access to food** (logistic, economical access and access to the necessary knowledge in order to use the product for sustainable diets)
- Able to **quantify impacts**: economical, social, sustainable impacts

Added value by the process is reduced

Will it be possible to comply with the constraints of sustainability without having to go back on some of the constraints previously integrated?

Is it possible to respond by optimising existing technologies, or is it necessary to fundamentally redesign food processing methods, the relationship between agriculture and industry, and the organisation of food chains?



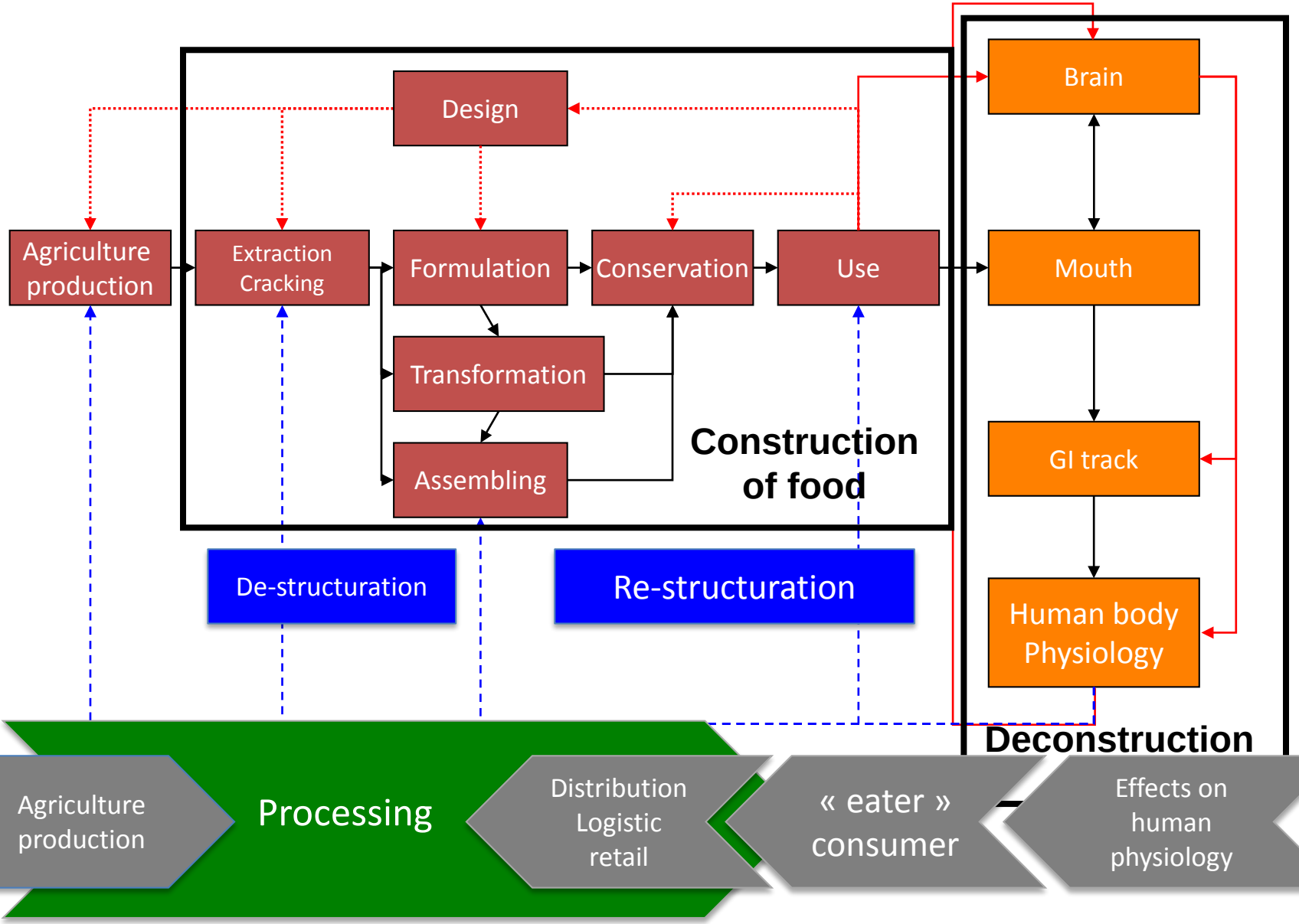
New paradigm: Diversity

- In the past, "standardisation" of agricultural raw materials and an industrial downstream shift of the drivers behind the creation of variety in the supply of products (by deconstruction/formulation)
- Increased diversity of agriculture: species, varieties, agroecology concepts, selection of agriculture conditions for improving nutrients contents, ..
- Increased variability in the supply of raw materials raises the question of the desired extent of deconstruction activities, so as to exploit and generate subjacent functionalities
- How does the down stream and upstream sector contribute to the creation of product variety, through distinctive characteristics of raw materials, and how does the downstream sector contribute through additional functionalities formed by processes?

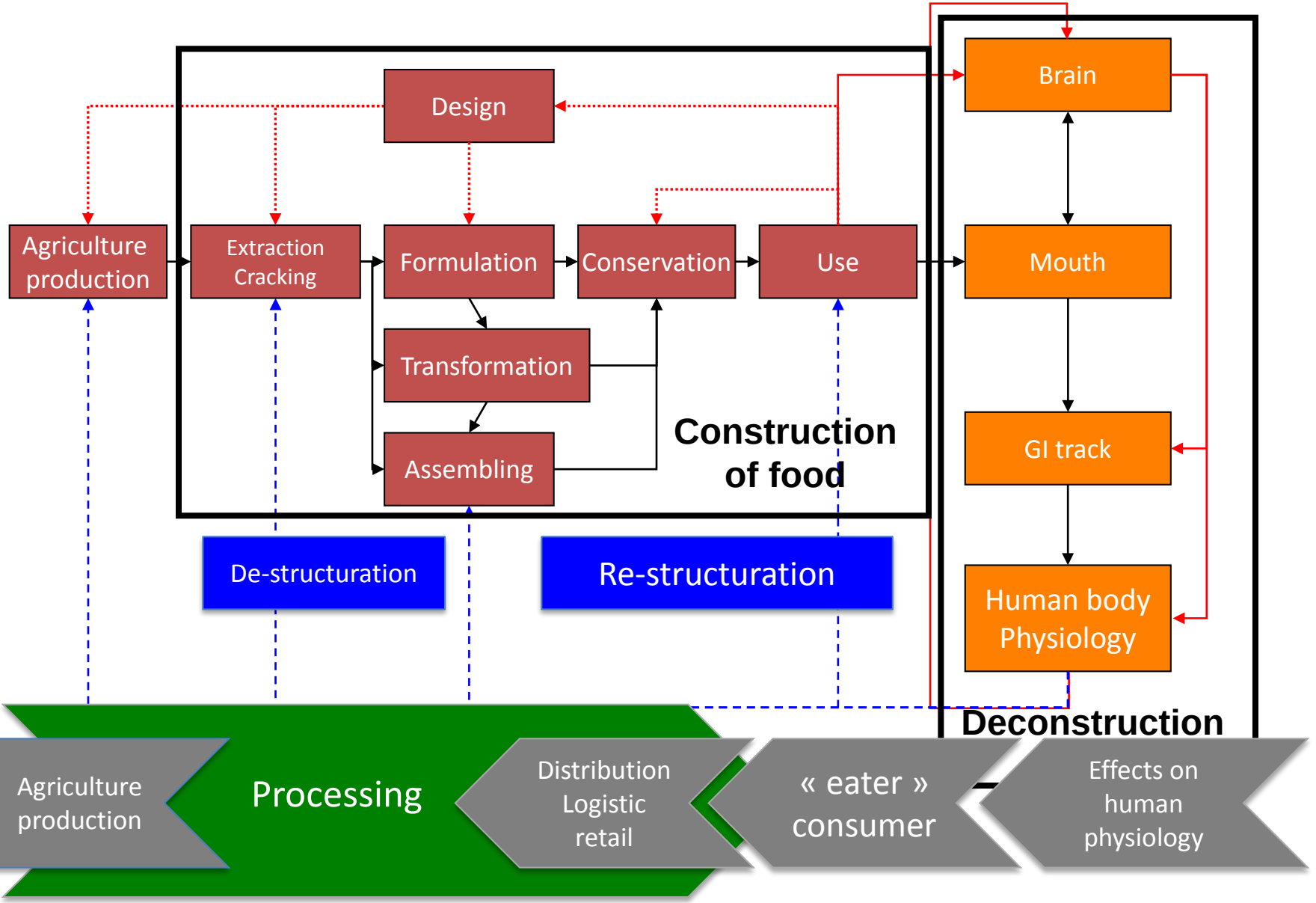
New paradigm: Recycling thinking

- Losses and waste are critical (25% to 30% in north countries, higher (50%) in south countries (mainly due to logistics)
- A challenge is to reduce Green House Gases
- At cultural practice level: loss of fertility
- Urbanization imply no return to agriculture of Biomass
- Thinking product design and management with ability of recycling as the main goal ?

New paradigm: Reverse thinking



New paradigm: Reverse thinking



New paradigm: Systemic thinking

- Facing complexity, numerous interactions
- Multi scale
  - In Space
  - In time
- Agro Bio ecosystem are necessarily dynamic
  - Modeling ability
  - The data revolution
- What is Biomass?
  - Water, matter, energy
  - Total valorization is necessary

New paradigm: Resilience thinking

- **Increased variability** in the supply
- Increased **transient situations** with climate crisis, lack of water, fluctuating energy prices, competition in the world for the resources, ..

- The question is than: how to adapt, or how to design the Agri Food Chain in order to be able to adapt to unknown emerging constraints?

Optimisation and modelling

- A lot of studies for multi criteria optimization taking the search of the best method, but **the key question is what do we have to minimize ?**
- Are we generally solving the right optimization problem ?
  - Minimum for design or operating conditions of the difference between quality and goal, of operational costs (and now) ecological footprint
  - Min for design or operating conditions of the variability of qualities properties taking into account variability of raw material, energy used, under constraints of ecological footprint, operational costs, ..
    Resilience Optimization problem

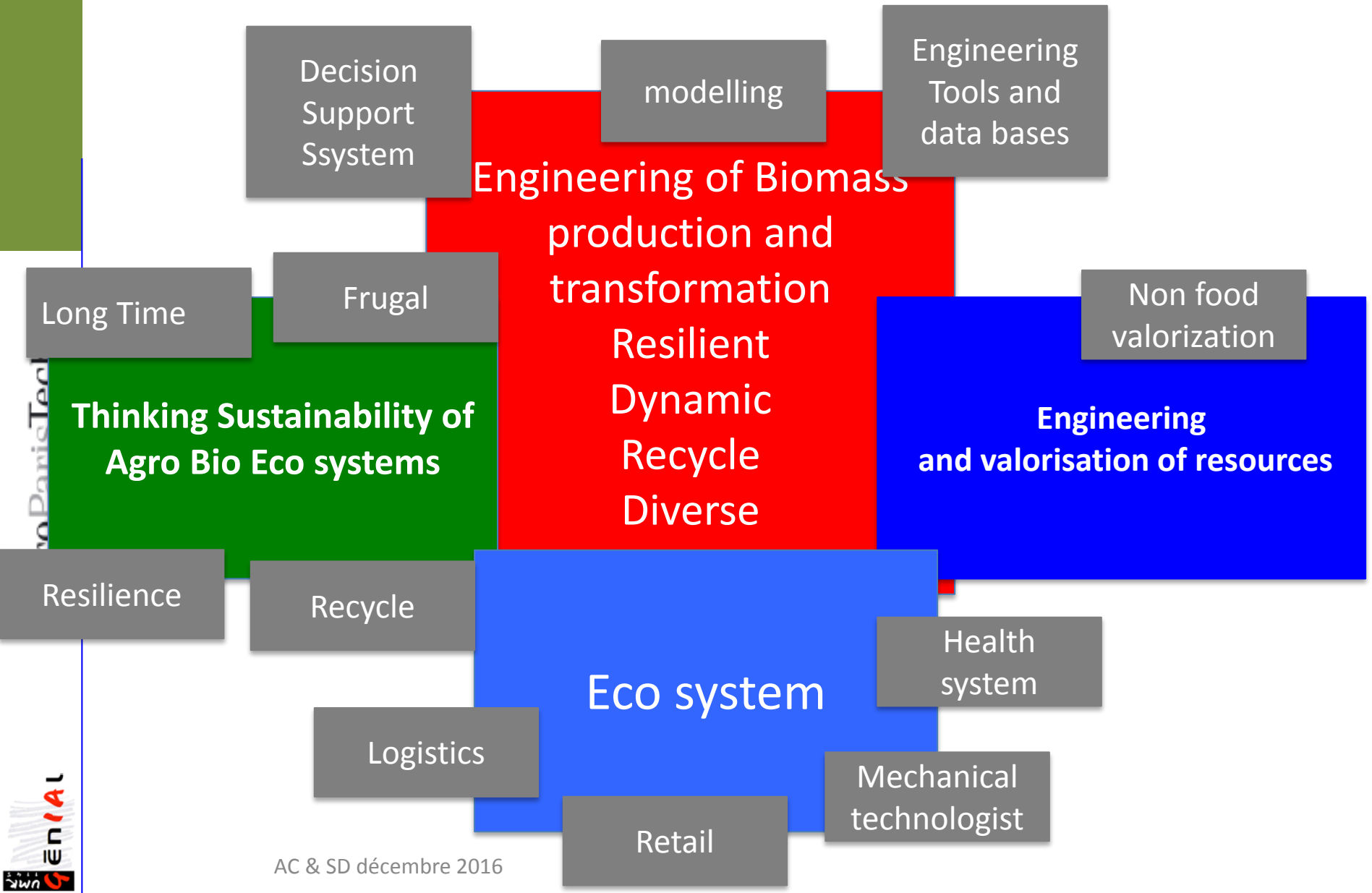
New paradigm: Co engineering

- **Engineering** is a key (design, calculation, proof of concept, demonstration, impact quantification)
- But engineering on technical bases is not enough
- Coupling with Social and Human sciences
- Increasing the ability of doing functional analysis
- **Design by/for use**
- Co engineering is **first** the ability of coupling different sciences
- **Second**: design and related engineering must be established in coordination with management ability

New paradigm: Education and higher education

- To educate to transition or to be able to face new transition?
- Necessary cooperation between universities and stakeholders
- More flexibility for education
- Field, real situations are necessary to confront concept, method and reality
- Combine life sciences, engineering sciences and social sciences
- Not one but many curricula

Conclusion


Decision Support Ssystem
modelling
Engineering Tools and data bases
Engineering of Biomass production and transformation
Resilient
Dynamic
Recycle
Diverse
Long Time
Frugal
Thinking Sustainability of Agro Bio Eco systems
Non food valorization
Engineering and valorisation of resources
Resilience
Recycle
Eco system
Health system
Logistics
Mechanical technologist
Retail

Thank you for your attention