IN4ACT WEBINAR SERIES

RETHINKING SUSTAINABILITY IN THE CIRCULAR ECONOMY: CHALLENGING SOCIOECONOMIC MODELS IN INDUSTRY 4.0

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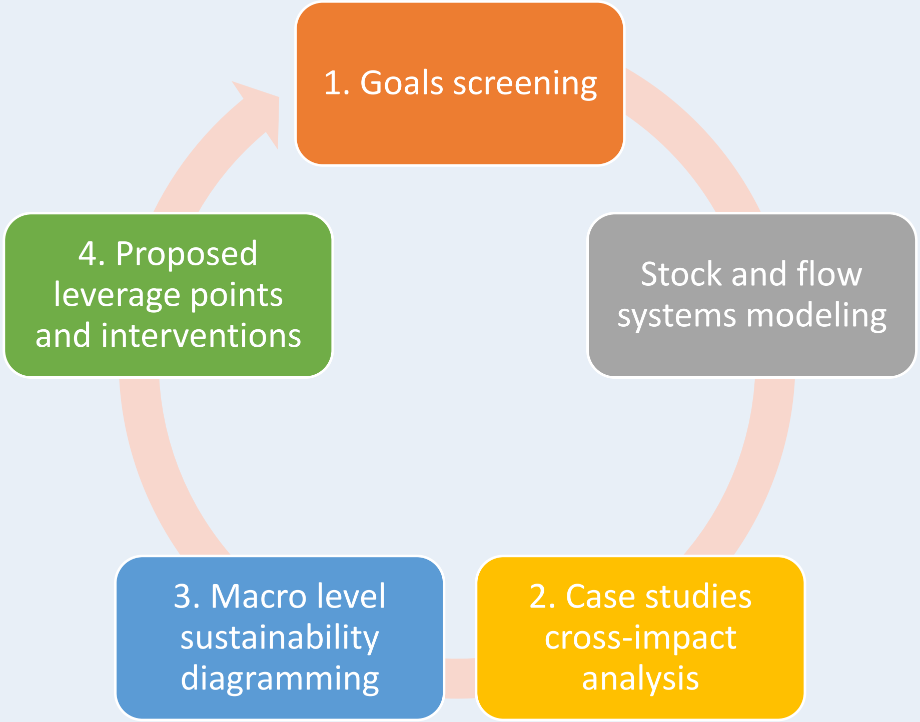
Overview

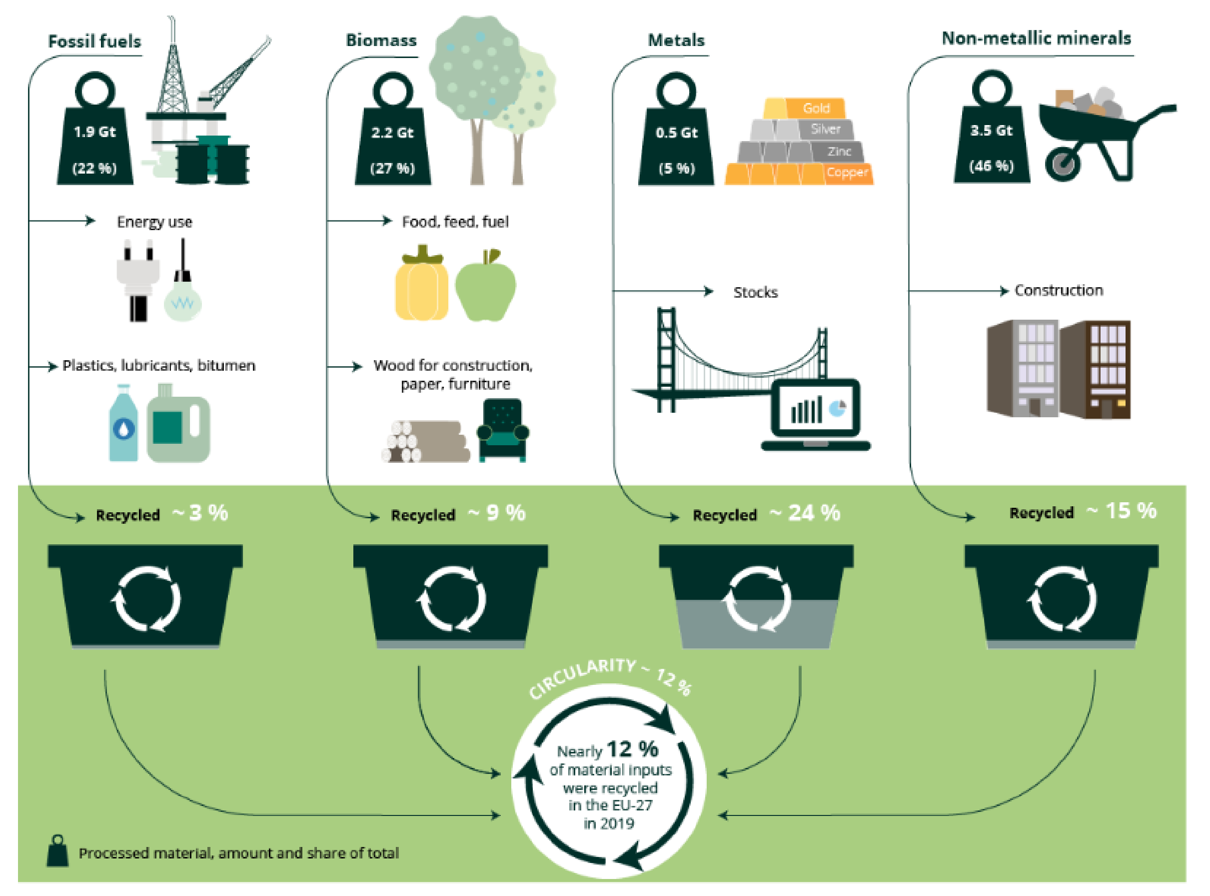
1. Bullet points
2. Anchor concepts
    1. Circular economy
    2. Sustainability
3. Circular economy limitations
4. Circular economy challenges
5. Discussion



1. Conclusions
2. Exploring synergies and collaboration opportunities

1. Bullet points

- **Circular economy** may not deliver **sustainability**
- The acknowledgement that **100% circularity is impossible** means that now we can reinvent a new sustainable model



Schematic representation of limits of circularity in the EU-27, 2019. Source: Data from Mayer et al. (2019) for processed material and Eurostat (2020) for recycling rates.

2. Anchor concepts (1/2)

- Circular economy

CE promotes resource minimization and the adoption of cleaner technologies (Merli et al., 2018) while maintaining the value of products, materials and resources in the economy for as long as possible, minimizing waste generation. The so called 3R's Principles are specially related to sustainable use of resources in the case of circular economy (Blomsma, 2018; Korhonen et al., 2018).

2. Anchor concepts (2/2)

- Sustainability paradigm
    - 2030 Agenda (UN General Assembly, 2015)

- Strong sustainability

Substitutability between natural and human related capital. It brings to the forefront the limits and adverse impacts of accelerating material and energy use *(Pelenc and Ballet, 2015; Dedeurwaerdere, 2014; Ekins et al., 2003)*

3. Circular economy limitations (1/2)

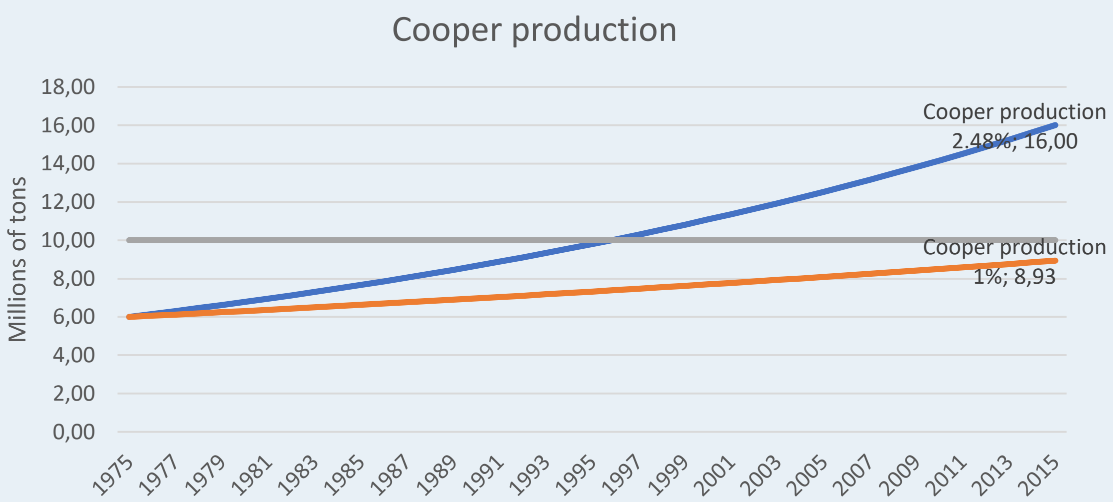
The low potential for circularity is because a very large share of primary material throughput is composed of:

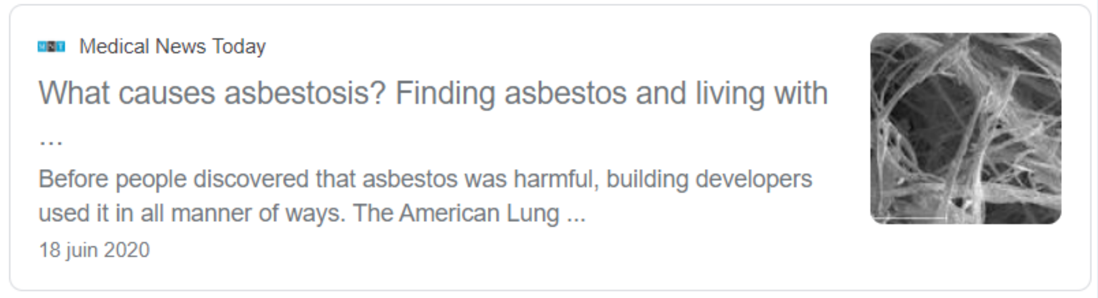
1. Energy carriers, which are degraded through use as explained by the laws of thermodynamics and cannot be recycled,

2. Temporal system boundaries

   a) **Product durability**. Many of the impacts human mobilized material flows generate in nature are currently unknown, extending product life-time might create economic and organizational structures that risk unsustainability in the long-term.

   a) **The product's remaining time in the economy**.




Medical News Today

What causes asbestosis? Finding asbestos and living with ...

Before people discovered that asbestos was harmful, building developers used it in all manner of ways. The American Lung ...

18 juin 2020

Recycling rate: 60%
Remaining time in the economy: 40 years

3. Circular economy limitations (2/2)

3. **Spatial system boundaries**, CE projects that have been implemented in the micro scale will always be local or regional at most, therefore nowadays, it is hard to consider the global net sustainability of CE.

4. **Limits Posed by Physical Economic Growth**: Rebound Effect, Jevon's Paradox and the Boomerang Effect

5. **Path Dependencies and Lock-in**

6. **The concept of waste has a strong cultural and social influence** on its handling, management and is always dynamic and changing.

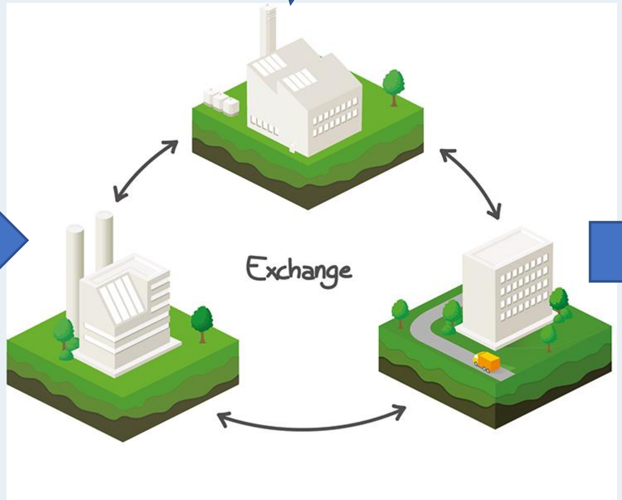
4. Circular economy challenge

Society needs coherent tools and means capable to recognize and mitigate negative interactions (trade-offs) and maximize positive interactions (synergies) to better address contemporary sustainable issues from the circular economy paradigm.

5. Discussion

Ecological economics, complexity sciences and systems thinking approach integration

Longitudinal
Case studies



- Recycling rate
- Waste reduction rate

Optimization & reductions in the net flows of materials entering the system

1. Goals screening

Stock and flow systems modeling

2. Case studies cross-impact analysis

3. Macro level sustainability diagramming

4. Proposed leverage points and interventions

5.1. Circular economy & sustainability goals

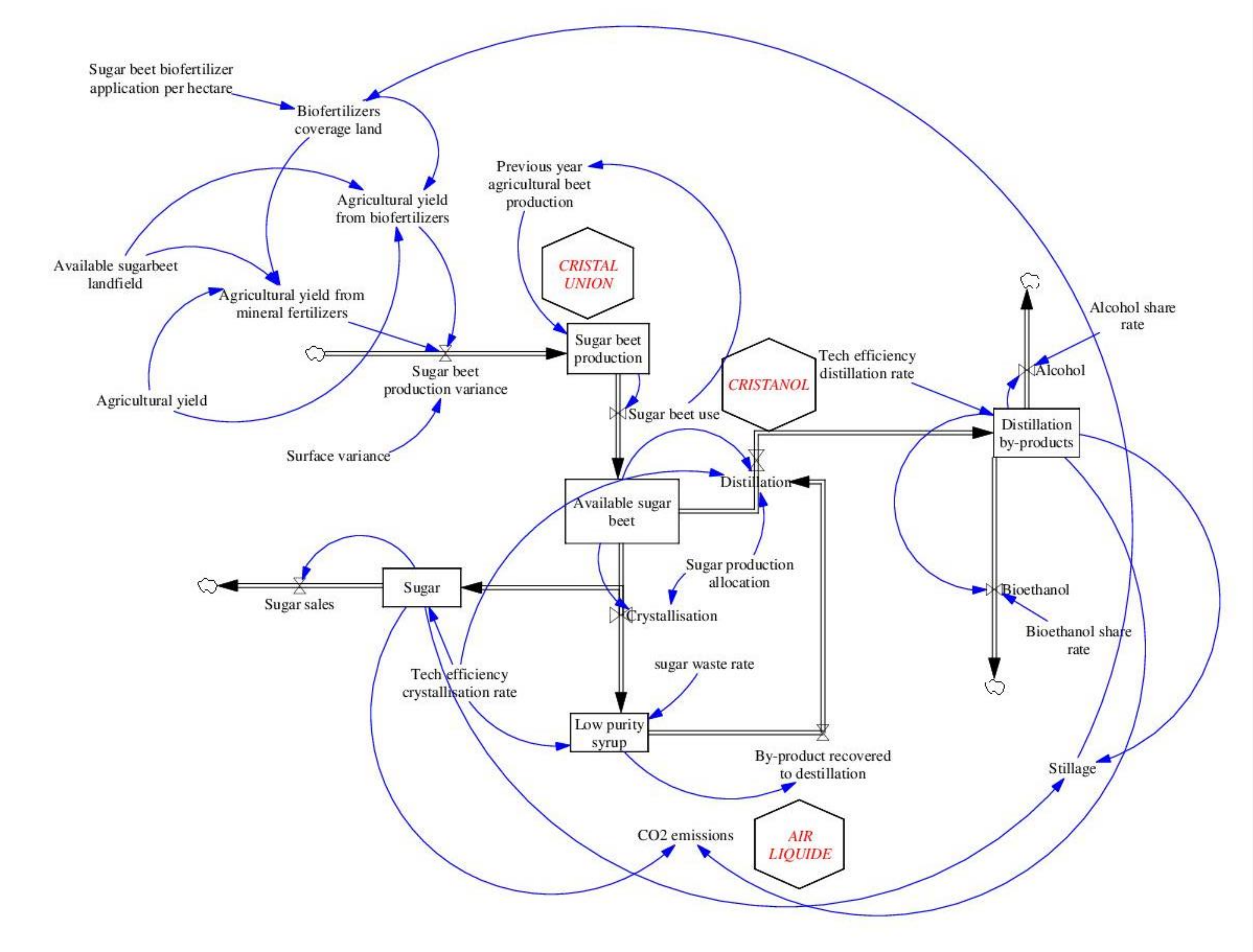
Circular economy goals (CEG)

1. To achieve **closed and extended loops** production systems (recycling, composting, cascading, industrial symbiosis, etc.)
2. To extend **product life** through eco-design and long-life loops.
3. To tap into the **underused capacity**, intensifying loops (sharing economy, alternative use, etc.)

Sustainability goals (SG)

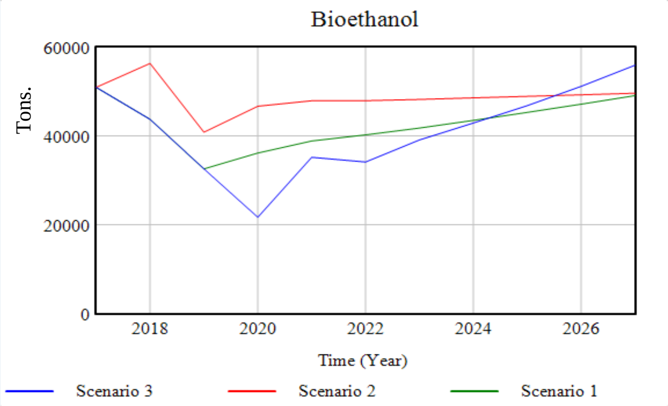
1. To increase the share of **renewables in the energy** mix (SDG target 7.2)
2. To increase the rate of **energy efficiency** improvements (SDG target 7.3)
3. To reduce the **waste generation** rate (SDG target 12.5)
4. To achieve structural change in the ecosystem to allow for greater **diversity** (Resilience)
5. To maintain critical natural capital (**Ecosystem functioning**)

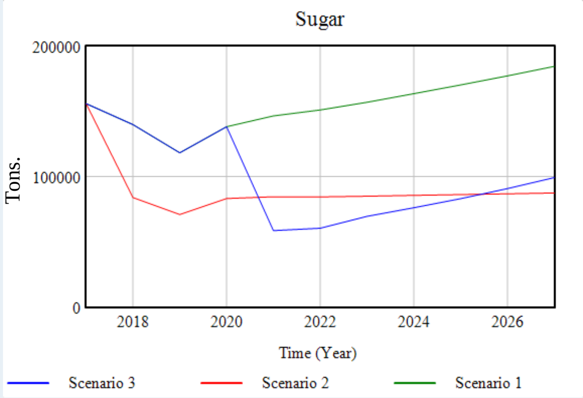
5.2. Stock and flows systems modeling (1/2)

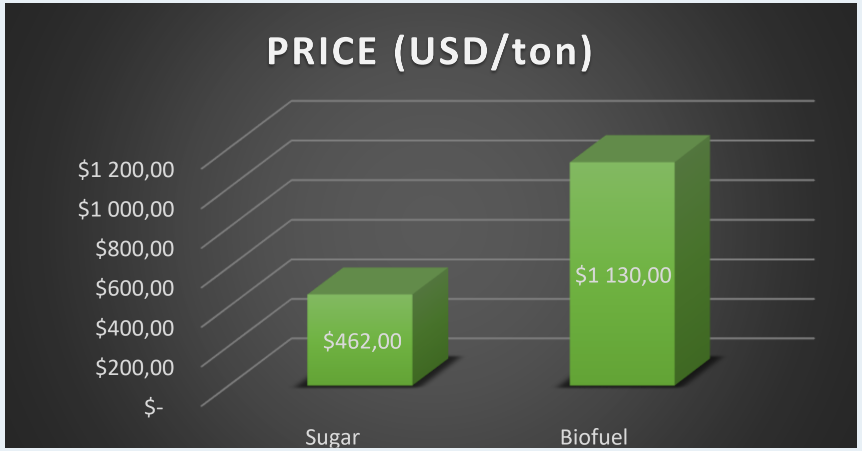


Sugar beet flow and stock diagram of the Bazancourt-Pomacle Biorefinery

5.2. Stock and flows systems modeling (2/2)







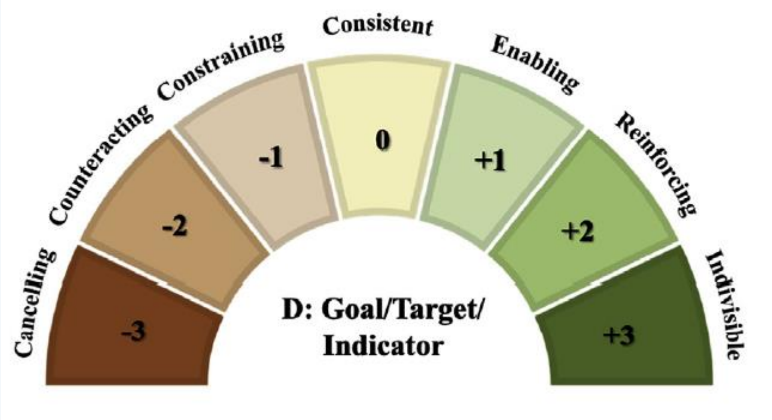
System dynamics methods aim stochastic models analyzing fluctuations around agroindustrial systems.

- **The application of biofertilizer** from beet according to the replacement rate of chemical fertilizers defined by the public actors in the territory.
- **The rate of technological development** that impacts the agricultural yield of beet production.
- **The variance of the agricultural land designed for beet production**, defined by the foresee of international market prices and expected added value.
- **Internal strategy of the biorefinery** which makes it possible to define the percentage of beet production intended for the production of sugar, alcohol and / or bioethanol. The dynamic of this meso-scale model also seeks to test the viability of a circular production system in the value chain by performing a sensitivity analysis to demonstrate the reliability of the model influenced by the uncertainty in demand.

5.3. Case studies cross-impact analysis

Pomacle-Bazancourt, France

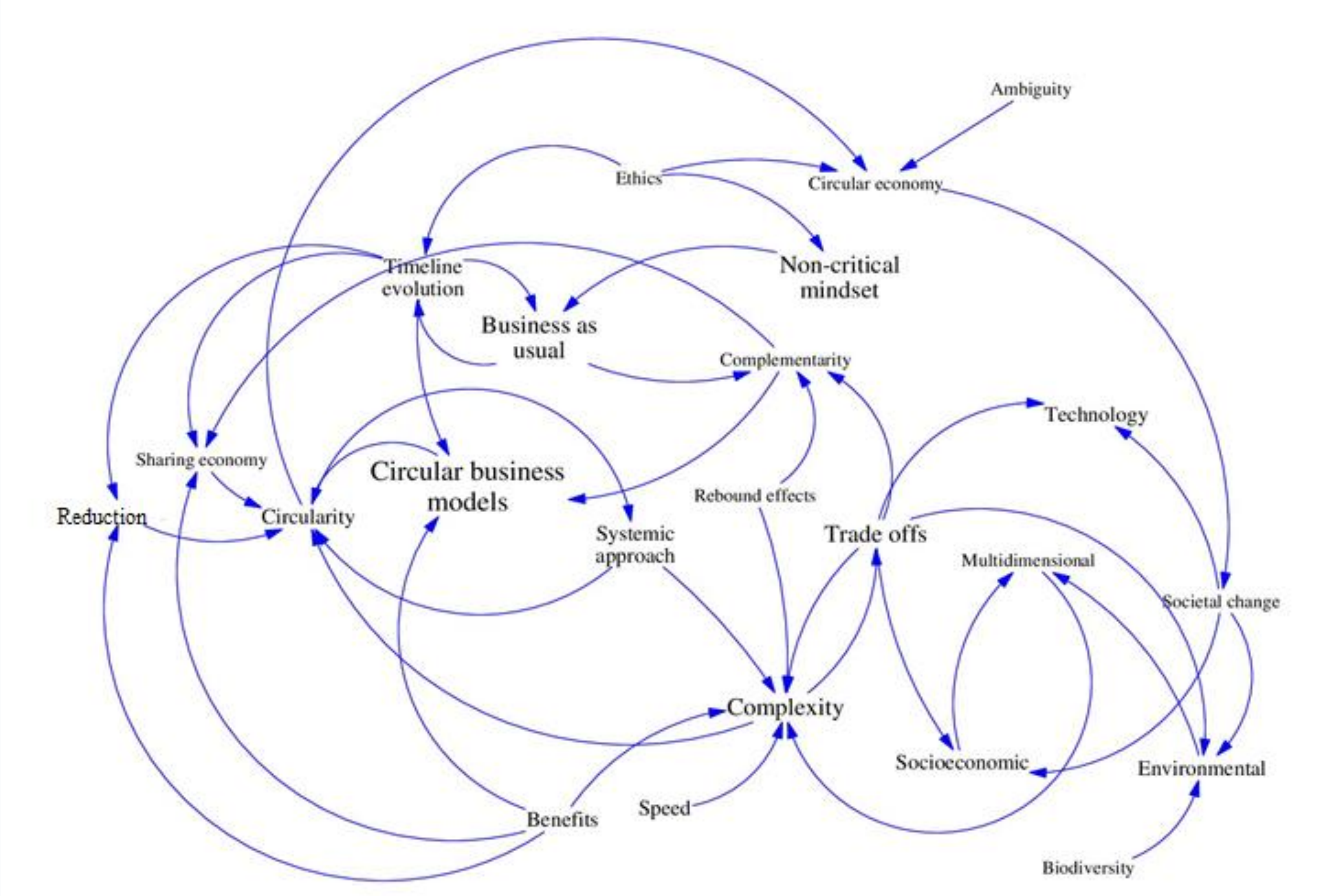
*Trade-offs in terms of competition for resources inputs between S and CE goals



Closed-loops
Products innovation
Underused capacity
Renewable energy
Energy Efficiency
Diversity
Ecosystems functioning

POMACLE-BAZANCOURT, FRANCE								
Goals	CEG1	CEG2	CEG3	SG1	SG2	SG3	SG4	SG5
CEG1	-	1	2	3	1	3	2	3
CEG2	1	-	1	1	2	3	1	2
CEG3	2	1	-	1	2	3	1	2
SG1	3	1	1	-	1	2	-1	-1
SG2	1	1	2	1	-	1	1	2
SG3	0	1	1	3	1	-	-1	1
SG4	3	1	2	0	1	2	-	3
SG5	3	2	3	1	1	1	3	-

5.4. Macro-level French sustainability framework in CE



5.5. Proposed leverage points and interventions

- **A first cluster of coherent goals** emerged in the French agroindustrial system demonstrating the potential to leverage synergies between encouraging the products innovation in the bio-based economy (CEG2), Renewable energy (SG1) and Waste reduction (SG3).

Extend the products life loops (eco-design and innovation) → Renewable energy → Waste reduction

- **The second cluster of coherent goals** unfolds the potential to leverage bio-based ecosystem diversity (SG4), providing an opportunity to encourage closed loops production systems (CEG1) looking to improve resilience with the maintain of natural capital, ensuring the agroindustrial French ecosystem functioning (SG5).

Bio-based diversity in biorefinery → Closed loops systems → Ecosystems functioning

6. Conclusions

- The contradiction between sustainability and circular economy push most of scholars and practitioners to use mere quantitative circular indicators in the micro-scale, thus avoiding to shed light over the multiple feedbacks and rebound effects challenging the socioeconomic models in Industry 4.0 to a systemic implementation.
- Applying analytical frameworks in a way that supports a higher degree of stakeholders participation could be a way to enable learning, critical discussion and ownership of Industry 4.0.

7. Exploring synergies and collaboration opportunities

The European Green Deal

- Demonstration of systemic solutions for the territorial deployment of circular economy.
  - CONSORTIUM build up
    - New Institute Hamburg
    - Millenium Institute
    - ERASME – Universite Clermont Auvergne
    - Western Norway University of Applied Sciences
- Circular economy European framework of regional implementations
  - Missing case studies from countries in the Eastern Europe and Southern Europe.

THANK YOU

CONTACT INFORMATION

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