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Interrogating Concepts and Practices from the Human and Social Sciences

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Session POSTER

From Interest to Actual Use: The Importance and Performance of Factors Influencing Consumer Decisions on Biobased Apparel

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Over recent decades, the rapid growth of the textile and fashion industry has significantly impacted the environment, highlighting the urgent need for a shift toward more sustainable practices. Biobased apparel presents an opportunity to reduce environmental harm. However, understanding the factors driving consumer acceptance is crucial for a successful transition, making this knowledge essential for marketers and policymakers. Despite the importance of this shift, research on consumer decision-making regarding biobased apparel remains limited. To address this gap, this study examines consumers' decision-making processes related to biobased apparel and identifies the importance and performance of factors influencing their behavioural determinants, providing insights for further managerial actions.

To assess the importance and performance of factors for managerial attention and actions, this research employs the Comprehensive Behavioural Decision Model for Biobased Products (CBDM-BBP) alongside Partial Least Squares Structural Equation Modelling (PLS-SEM) and the Importance-Performance Matrix Analysis (IPMA), an advanced technique in PLS-SEM. The IPMA contrasts the total effects of latent variables/manifest variables on a target variable (impact) with their rescaled average latent variable scores (performance), allowing for a clear graphical representation of critical areas for attention and action. The IPMA results categorise factors into four key areas based on their importance and performance for managerial actions: high priority (first area), important (second area), low priority (third area), and not impactful (forth area). Based on data from a survey of 525 consumers in the Republic of Ireland, a recognised test market with strong government commitment to the bioeconomy and abundant natural resources, the findings from two layers (latent variables and manifest variables) highlight that marketers and policymakers should target specific areas for development and intervention at each behavioural stage.

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It is recognised that social norms and willingness to pay are of high importance but show relatively low performance with use behaviour (the first area). Similarly, for interest, intention, and willingness to pay, social and personal norms are highly important but underperform compared to other latent variables in the proposed model. Therefore, these factors should be prioritised for improvement, as enhancing their performance could significantly impact overall outcomes. Further, analysis of manifest variables highlights that injunctive social norms (what others do) demonstrate greater importance but lower performance than descriptive social norms (what others say) in influencing consumer use behaviour. For personal norms, a sense of moral obligation and feelings of guilt are more important but underperform in driving consumer interest and intentions. In contrast, the manifest variable compatibility with consumers' morals, located in the second area, exhibits both greater importance and performance in influencing consumer willingness to pay. Among the manifest variables for willingness to pay, intention to pay a premium and interest in paying a premium respectively have shown greater importance but lower performance in influencing consumer use behaviour.

Moreover, the second area of the matrix highlights that trust holds significant importance and performs strongly across all behavioural determinants. Similarly, attitude demonstrates high importance and strong performance for interest, intention, and use behaviour. Among the behavioural determinants, interest and intention consistently show both high importance and performance for intention, use behaviour, and willingness to pay. These factors play a critical role in shaping behavioural outcomes and, given their strong performance and significance, do not require immediate improvement. However, efforts should focus on maintaining their effectiveness to ensure continued support for achieving desired outcomes. Within the trust manifest variables, trust in products and trust in governments show higher importance but lower performance (area one) in shaping consumer interest, intentions, and use behaviour (—values— $>$ mean score). Conversely, trust in nongovernmental agencies and academia exhibits both higher importance and performance in influencing consumer interest and intentions (second area). Additionally, trust in products is also positioned in the second area for its role in influencing consumers' willingness to pay a premium.
For the remaining latent and manifest variables in the model (i.e., awareness of consequences of negative effects of conventional products, sense of responsibility, perception, awareness, objective knowledge, and subjective knowledge), the resources allocated to these areas could either be redirected to more impactful factors without significantly affecting the overall results (area three) or are generally considered lower priorities for improvement or resource allocation (area four).

Keywords: consumer behaviour, sustainable textiles, biobased apparel, bioeconomy, importance, performance analysis

Uncovering the power relations expressed by policy instruments in the implementation of the French bioeconomy strategy

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Social science research on bioeconomy policies has studied the specific design (e.g. policy design frameworks) and content (e.g. focus on sustainability and resilience) of such policies across countries and time. However, understanding whether and how bioeconomy policies are implemented and the effects of such implementations have not been studied so far. Especially, the power relations occurring at the implementation stage through the calibrations of bioeconomy policy instruments have received very little attention. We address this research gap by studying the implementation of the policy instruments contained in the French bioeconomy strategy to unveil the power relationships at stake. In particular, we focus on the state-citizen relationship expressed by the instruments. We do this by tracking the calibrations of the policy instruments contained in the strategy. In a first step, we develop a framework of instrument calibration and use it to collect data through semi-structured interviews with the actors involved and all the available government, scholarly and grey literatures. The goal is to collect data on each calibration dimension of our framework for several policy instruments. In a second step, we analyze the data collected using the political sociology approach to policy instruments to determine the state-citizen relation(s) in the French bioeconomy strategy. In particular, we will investigate potential differences regarding this relationship at the design and at the implementation stages. In tracking the implementation of policy instruments through their calibrations, we expose how power is exercised *throughout* the French bioeconomy policy process.

Keywords: bioeconomy strategy, policy implementation, policy instrument, instrument calibration, power, political sociology, policy process

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Involvement of Energy MNC in Biogas Sector in Europe - Poland Case study

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This Poster offers a general view of the topic, research question, theoretical and methodological framework of the PhD project of Dolores Komljenovic

Keywords: Energy MNC, biogas production, Technological Innovation System, mixed research method

*Speaker

1.A : Relationship between Agriculture and Ecological Bioeconomy : New Ressources for Biogas Production and Opportunities

Profitable expansion of biomethane production considering biomass intake and digestate offtake-A mixed method Swedish case study

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Background

The COVID-19 pandemic and the Russia-Ukraine war have underscored vulnerabilities in global supply chains, emphasizing the need for robust systems to ensure continuous supply of energy and food. Anaerobic digestion has emerged as a key technology in addressing these challenges, and as a result, ambitious biomethane production goals have been set within the EU (EC, 2022). By converting low-grade biomass, such as manure and agricultural residues, into biomethane and nutrient-rich digestate, biogas plants contribute simultaneously to renewable energy generation and nutrient recycling (Lindfors et al., 2022). But like any other large-scale bioenergy generation, they rely on extensive transportation of biomass across the landscape.

Expanding biomethane production requires scaling up in a way that balances profitability, resource efficiency, and environmental constraints. Several interlinked trade-offs should be considered. Increased biomass intake and improved substrate mixes will lead to more biomethane output and thereby more revenue, but also lead to higher costs for biomass acquisition, transport, and potentially necessary preprocessing. Additionally, larger volumes of digestate necessitate off taking over larger areas to avoid over-applying nutrients such as nitrogen (N) and phosphorus (P). This leads to additional distribution costs as raw digestate usually contains ca 95% water. Digestate processing could help mitigate prohibitive distribution costs over long distances.

Digestate processing can be done in different ways. For example, phase separation can generate solid and liquid biofertilisers, while further processing of the liquid phase through evaporation or ammonia stripping can create a concentrated liquid biofertiliser (Feiz et al., 2022). An expansion solution respects the spatial limits on nutrient demand and the trade-off between the cost of digestate processing, cost of transporting biofertilisers, and the market preferences for biofertiliser products, i.e., farmers' willingness to pay for them. Therefore, a spatially explicit trade-off analysis is essential to guide profitable expansion (Metson et al., 2020).

Aim

In this paper we will investigate how biogas plants can sustainably and cost-efficiently expand

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their production considering the spatial variability of biomass supply and regional demand for nutrients. We also investigate how market factors-such as biomethane selling prices and the price differentiation between synthetic fertilisers and alternative biofertiliser products-can affect solutions for profitable expansion.

Method

We base our study on a case biogas plant in Sweden and apply an integrated approach comprising spatial analysis, techno-economic analysis, and optimization. This includes:

- Spatial analysis: We use geospatial databases to map biomass availability (manure types, cereal straw, other green residues, and ley crops), nutrient demand based on crop data, and the road network. We create a grid consisting of 5 km x 5 km cells and use actual road distances to assess the cost of transporting solid and liquid materials between the cells.
- Techno-economic analysis: Together with biogas companies, we construct a model for biomethane production under varying scenarios. This includes revenues from biomethane and biofertilisers as well as processing and transportation costs.
- Optimization: We employ optimization to find a solution for maximized economic returns while meeting the constraints of not overapplying nutrients. The model optimizes biomass selection (types, quantities, and supply cells), digestate processing strategies (no processing, partial, or full processing), and nutrient redistribution (matching biofertiliser products with demand cells).

Expected Results

The study will provide methodological insights for investigating opportunities and constraints for sustainable expansion of biomethane production considering regional supply of biomass and offtake of digestate. Specifically, the paper will:

- Demonstrate a tested method for finding a combination of biomass intake, digestate processing techniques, and nutrient redistribution that maximizes profit but avoids overapplying nutrients.
- Improve our understanding of how market dynamics (price of biomethane and different types of fertilisers) influence solutions for profitable expansion.
- Discuss the broader methodological implications considering integration of spatial and economic analysis using optimization, offering a relevant approach for other biomass-to-bioenergy systems as well as biorefineries.

This paper aims to fill critical knowledge gaps for sustainable biogas production expansion, contributing to the dual goals of energy security and enhanced nutrient recycling, thus the transition toward a resilient and circular bioeconomy.

References

EC, 2022. REPowerEU Plan (Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions No. COM(2022) 230 final). European Commission, Brussels.

Feiz, R., Carraro, G., Brienza, C., Meers, E., Verbeke, M., Tonderski, K., 2022. Systems analysis of digestate primary processing techniques. Waste Management 150, 352–363. https://doi.org/10.1016/j.wasma

Lindfors, A., Hagman, L., Eklund, M., 2022. The Nordic biogas model: Conceptualization, societal effects, and policy recommendations. City and Environment Interactions 15, 100083. https://doi.org/10.1016/j.cacint.2022.100083

Metson, G.S., Feiz, R., Quttineh, N.-H., Tonderski, K., 2020. Optimizing transport to maximize nutrient recycling and green energy recovery. Resources, Conservation & Recycling: X 100049. https://doi.org/10.1016/j.rcrx.2021.100049

Keywords: agricultural residues, anaerobic digestion, biomethane, nutrient redistribution, optimisation, profitability, spatial analysis

Narratives and identity of biogas solutions on the way to 350 TWh in Europe

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Narratives and identity of biogas solutions on the way to 350 TWh in Europe
During 2022, a goal for production and use of 35 bcm (approx. 350 TWh) biomethane by 2030 was launched as a part of the REPowerEU Plan by the European Commission. The improved self-reliance on energy for Europe was an important reason behind this new goal. This has fueled the expansion of the sector; new digestion plants are being built and upgrading plants are added to existing digesters around Europe. Data from European Biogas Association suggest a rapid growth, however unclear if the goal will be reached.

Under the umbrella of the term biogas solutions, any system that generates methane through anaerobic digestion of renewable organic sources can be included. Advocates for biogas solutions have historically often highlighted their versatility as an asset. Any organic feedstock can be used as input and the energy output could be used for heat, electricity generation, grid injection, transport fuel, energy use in industry and as raw material to produce chemicals. Even the digestate has been suggested to be used for many different purposes, especially after fractionation. However, the use as biofertilizer is the most common option. This versatility of biogas solutions is an asset; however, it may also bring difficulty in communicating about their societal role and creating an unclear identity for policy makers on different levels.

In the Nordic countries, biogas solutions mainly evolved in the waste and sewage sectors where the actual gas was a by-product to the waste treatment. During the 1990s, the importance of gas production grew, and more often, the raw biogas became upgraded to biomethane to the transport sector where the willingness to pay for renewable fuel was high1. Researchers in the Biogas Solutions Research Center (BSRC) found it useful to term this a "Nordic biogas model" (NBM) to denote the different characteristics, for instance in relation to, the most well-spread biogas solution in Europe which was crops to electricity in the German case 2.

NBM is starting from extremely low-value, even difficult, inputs like waste from slaughterhouses, dairies, sewage treatment and source-separated food waste and, on top of the waste treatment, generate two renewable products substituting those of fossil origin, biomethane mainly used for transport and biofertilizer. The quest to raise value the most is the underlying principle behind NBM. Newer additions to the model include carbon capture and utilization (CCU) and fractionation of digestate into several nutrient fertilizer products. There is thus an inherent and sometimes expanding multi-functionality in the NBM.

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NBM has been suggested to be of global relevance and could be implemented in any city and region 3. There are three main prerequisites for its realization: (i) significant amount of organic matter of low value, (ii) a need for transport of goods and people, or in a broader sense, any other applications where a versatile energy carrier such as methane is required and (iii) a surrounding area with a need for nutrients. Obviously, these conditions can be found in many cities around the world and often to a much larger extent than in the Nordic countries.

However, when you want to realize the full potential of sustainability contribution of biogas solutions, NBM is merely one component out of several needed. In a Swedish governmental inquiry about biogas solutions completed in 2019, it was obvious that most of the potential for expansion was to be found in the agricultural sector 4. Manure, by-products from crops like straw, intercropping and ley grass crops are useful feedstocks for biogas production from the agricultural sector. Agricultural biogas solutions can range from questionable in a sustainability assessment to very good. Concepts like Biogasdoneright and carbon farming are concepts that denote crop-based biogas systems that do not compete with food or feed production but instead make agricultural practices more sustainable 5. Intercropping, digestion of manure and soil carbon buildup, partly through addition of biofertilizer, are components making it possible to simultaneously deliver energy and nutrients while mitigating climate change. There is a lot of support for the idea that most of the untapped potential for expanding biogas solutions is to be found within the farming sector.

So, how could the agricultural biogas solutions and the NBM together make it possible to reach the EU goal of 350 TWh biomethane? Small-scale biogas production in farms will typically not generate upgraded biomethane, rather electricity and heat, due to high investment necessary for up-grading. Building large-scale production, supplied with feedstock from many farms, enables a higher value creation. However, with a large share of manure in the feedstock mix, gas production will be low and being able to add industrial and domestic food waste (NBM) to such a production system build scale and makes better use of the investment. Furthermore, low-grade organic feedstocks typically have higher nutrient concentration per biomethane produced compared with primary biomass making the resulting biofertilizer more valuable for use in agriculture 6.

A production system that combines the waste sector (NBM) and the agriculture sector (Biogasdoneright) is a promising concept for Europe and could be crucial in reaching the quantitative goal. Considering spatial aspects, it makes sense to direct the waste-based feedstocks to large-scale plants situated in agricultural areas to minimize transport and close nutrient cycles between cities and their surroundings.

The identity of biogas solutions should not be defined only by their versatility, probably neither through their capacity to deliver significant amounts of renewable energy. The latter being something that can be achieved in many ways. It is instead the multifunctional aspects of a wide and dynamic value creation including nutrient circulation that cannot be replaced by other technologies or approaches.

Humanity needs its bioeconomy, and the bioeconomy needs a long-term sustainable nutrient supply, indicating that all cities and regions need to include a biogas solution in their infrastructure portfolio. Employing the NBM and the Biogasdoneright concept would create a European narrative to be widely communicated fueling the processes towards the 350 TWh biomethane and beyond.

References

1. Fallde M, Eklund M. Towards a Sustainable Socio-Technical System of Biogas for Transport: The Case of the City of Linköping in Sweden. *Journal of Cleaner Production* 2015; 98: 17–28.

2. Lindfors A, Hagman L, Eklund M. The Nordic biogas model: Conceptualization, societal effects, and policy recommendations. *City and Environment Interactions* 2022; 15: 100083.

3. Feiz R, Kanda W. Nordic biogas model in international contexts: Early-stage decision support for adaptation. *Waste Manag Res* 2024; 0734242X241261998.

4. Biogasmarknadsutredningen. *More biogas! For a Sustainable Sweden/ Mer biogas! För ett hållbart Sverige. SOU 2019:63.* 2019.

5. Dale BE, Sibilla F, Fabbri C, et al. BiogasdonerightTM: An innovative new system is commercialized in Italy. *Biofuels, Bioproducts and Biorefining* 2016; 10: 341–345.

6. Carraro G, Feiz R, Tonderski K, et al. Unaccounted energy saving from the nitrogen output of biogas plants. *Resources, Conservation & Recycling*; 209. Epub ahead of print October 2024. DOI: 10.1016/j.resconrec.2024.107768.

Keywords: Biogas solutions, Nordic biogas model, Biogasdoneright, RepowerEU, Biomethane, Narrative

Grouiez P. "Challenging ecological bioeconomy: from farmers' autonomy to their strategy of biomass supplier in their insertion within biogas production industry in France"

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The article studies the diversity of models of sustainable bioeconomy by focusing on the productive strategies of the farmers who engage in biogas plant projects. To account for this diversity, we use the framework of analysis of Malerba (2002, 2005) and his concept of sectoral innovation system. We apply this framework analysis to the results obtained through a qualitative survey of 60 farmers in the Grand Est region (France) and Brittany region (France) involved in the biogas production between 2017 and 2025. We identify four models for the agricultural biogas production that fit into various value chains and which approach sustainability issues differently.

Keywords: Biogas production, Farmers' strategies, Sectoral Innovation System

*Speaker

1.B : The Biomass & Human and Social Sciences Research Collective (1)

L'invention du recyclage et de la valorisation énergétiques : retour sur la fabrique d'une rhétorique justifiant l'incinération des ordures ménagères

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Dans les années 1970 et 1980, au nom de la protection de l'environnement et de la recherche d'économies d'énergie générée par la crise pétrolière, on assiste à l'invention du " recyclage thermique " puis " énergétique ", et plus communément de la " valorisation énergétique ", des déchets ménagers et urbains. Ces expressions oxymoriques cachent en vérité leur incinération et donc la linéarisation des cycles des éléments naturels qui les constituent. Sur le plan idéel, elles permettent de verdir une technique reconnue jusque-là comme destructive. En retraçant leur origine et leur diffusion au sein des acteurs industriels et des institutions qui ont promu l'intégration déchets-ville-énergie au détriment du recyclage matériel, cette présentation vise à dénaturaliser une évidence contemporaine : le caractère supposément vertueux de l'utilisation des déchets à fin de production énergétique.

Keywords: Ordures ménagères, plastiques, incinération, valorisation énergétique, système énergétique

*Speaker

‘There won’t be enough for everyone’. What methanisation policy(ies) in a context of restricted access to biomass?

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The methanisation sector has been promoted by public institutions in France since the 2000s. The first units, built by breeders, were initially small-scale, located on farms or close to farm buildings and based on a closed circular system for supplying and using the energy produced. However, the fact that methanisation has become an integral part of public policy on energy and climate change since 2010 has transformed the way the sector is structured. The increasing number of units and the trend towards larger units raise questions about the availability of the biomass required. Questions are being asked about the sustainability of the almost systematic use of dedicated crops and intermediate crops for energy purposes, about the categories of economic players who have a legitimate claim to sectoral leadership, about the territorial roots of economic cooperation and exchanges of flows (inputs, digestates and biogas), and about the hierarchy of biomass uses (food, livestock, methanisation, other economic sectors). Using our sociological and political science analysis, we aim to clarify the interplay of players, the coalitions mobilised, the perceptions and antagonistic futures, and the configurations and arrangements at work between the political, economic and administrative fields.

Keywords: Methanisation, Biogaz, Biomass, Public policy, Crops, Energy, Agriculture

*Speaker

How can social sciences of waste contribute to the analysis of the circular bioeconomy? The example of urban food waste in France / Quels apports des sciences sociales des déchets à l'analyse de la bioéconomie circulaire ? L'exemple des déchets alimentaires urbains en France.

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EN. Food waste is subject to a growing interest in a context where its source-sorting and recovery are encouraged. We focus on urban food waste (produced by households, businesses, non-agricultural companies, etc.), which source-sorting has become mandatory for everyone since the beginning of 2024. Different actors are positioning themselves in this emerging sector with a diversity of products in perspective (energy, fertilizers and amendments, but also bioplastics, biomolecules, etc.). While it is indeed an organic matter and therefore a biomass, its management and transformation encounter specific issues linked to its detrital nature. This dual nature, both organic and residual, is a source of both challenges (legal, logistical, economic, social) and opportunities, in that it would make the bioeconomy more circular. In this communication, we propose to show how social sciences of waste (or rudology) can help to understand the circular bioeconomy of food waste, based on field work on the French case. FR. Les déchets alimentaires suscitent un intérêt croissant dans un contexte où leur tri à la source et leur valorisation sont encouragés. Nous nous intéressons plus particulièrement aux déchets alimentaires urbains (produits par les ménages, les commerces, les entreprises non agricoles, etc.), dont le tri à la source est devenu obligatoire pour tous depuis début 2024. De nombreux acteurs variés se positionnent sur cette filière émergente avec une diversité de produits en perspective (énergie, fertilisants et amendements, mais aussi bioplastiques, biomolécules, etc.). S'il s'agit bien d'une matière organique et donc d'une biomasse, sa prise en charge et sa transformation rencontrent des enjeux spécifiques liés à sa nature détritique. Ce caractère dual, à la fois organique et résiduel, est source tant de défis (juridiques, logistiques, économiques, sociaux) que d'opportunités, en ce qu'il permettrait de rendre la bioéconomie davantage circulaire. Dans cette communication, nous proposons de montrer en quoi les travaux en sciences sociales des déchets (ou rudologie) permettent d'éclairer les logiques à l'œuvre dans la bioéconomie circulaire des déchets alimentaires, à partir d'un travail de terrain sur le cas français.

*Speaker

Keywords: biowaste, circular bioeconomy, rudology, social sciences, biomass, biodéchets, bioéconomie circulaire, rudologie, sciences sociales, biomasse

Biomass, Bioeconomy, Biotechnology, Biodiversity: Clarifying "organic concepts" in the European Union

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Current EU strategies on bioeconomy, biotechnology, and biodiversity, focus on various aspects of organisms and organic matter-such as biological resources, biomass, or bioproducts. These policies require a comprehensive and precise categorization of these resources and products. This presentation aims to analyze whether EU policies are relevant from this perspective. It distinguishes between different concepts that are implemented in EU strategies to refer to organisms and organic matter based on different criteria. It assesses whether the current categorization helps the EU to improve sustainability. Showing that this is not the case with several examples, it recommends more comprehensive and precise categorizations, highlighting the need to recognize the multifaceted aspects of organisms and organic matter. It argues for more inspiration from the concepts used in the ecological sciences. The paper also advocates for a unified EU' Organisms and Ecosystems Strategy, which would harmonize existing policies.

Keywords: biomass, bioeconomy, organic

*Speaker

1.C : Towards an Ecological Bioeconomy: Concepts and Perspectives

A Circular Bioeconomy ? A revisit of its supposed genealogy

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Since 2018, the concept of a "circular bioeconomy" has become a clear horizon for European public policies on bioeconomy (European Commission, 2018). As productive sectors evolve or reorganize around the use of biomass as the primary resource for non-food applications, it is worth examining how bioeconomy can concretely align with the objectives promoted by advocates of the circular economy.
The circular economy is currently a shared goal among diverse actors in industrial, political, and activist domains (Winans et al., 2017 ; Korhonen et al., 2018 ; Corvellec et al., 2022 ; Giampietro, 2023). It offers a compelling promise: the integration of production and consumption activities into natural or technical cycles, reducing resource consumption and minimizing environmental impacts. However, similar to the enthusiasm surrounding the bioeconomy concept, the apparent consensus around the circular economy and its objectives is not self-evident.

It is remarkable and surprising to note that one common thread among the multiple definitions and variations of the circular economy is the systematic reference to David Pearce and R. Kerry Turner's 1990 book, *Economics of Natural Resources and the Environment.* This work is recognized as one of the key theoretical foundations of the circular economy and its connection to sustainability models.

We propose revisiting this seemingly well-established genealogy to take a critical perspective. This will lead us to analyze how Pearce and Turner depict the controversy between K. Boulding (1966) and N. Georgescu-Roegen (1966) during the 1960s and 1970s on the recyclability of matter. While Pearce and Turner appear to side with Georgescu-Roegen in this debate, they actually distort his argument. Indeed, they execute a dramatic shift in perspective, positioning the circular economy as a conceptual innovation characteristic of emerging ecological economics, whereas for Georgescu-Roegen, it belonged to a standard economic framework that denies reciprocal interactions between the economy and the environment.

The concept of bioeconomy has been subject to a "hijacking" (Vivien et al., 2019). The same, therefore, applies to the circular economy. What, then, do you think has happened to the circular bioeconomy ?

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References

Boulding K.E. (1966) " The Economics of the Coming Spaceship Earth ", In H. Jarrett (ed.), *Environmental Quality in a Growing Economy*, pp. 3-14. Baltimore, Resources for the Future/Johns Hopkins University Press.

Corvellec, Hervé, Alison F. Stowell, and Nils Johansson. 2022. " Critiques of the Circular Economy ". *Journal of Industrial Ecology* 26, no 2 : 421-32. https://doi.org/10.1111/jiec.13187.

European Commission, 2018. *A Sustainable Bioeconomy for Europe: Strengthening the Connection Between Economy, Society and the Environment.* Updated Bioeconomy Strategy. Brussels, Belgium.

Georgescu-Roegen N. (1966) *Analytical Economics : Issues and Problems*, Cambridge (Mas.), Harvard University Press.

Giampietro, Mario. 2019. " On the Circular Bioeconomy and Decoupling: Implications for Sustainable Growth ". *Ecological Economics* 162:143-56. doi: 10.1016/j.ecolecon.2019.05.001.

Giampietro, Mario. 2023. " Reflections on the Popularity of the Circular Bioeconomy Concept: The Ontological Crisis of Sustainability Science ". *Sustainability Science.* doi: 10.1007/s11625-022-01267-z.

Korhonen, Jouni, Antero Honkasalo, et Jyri Seppälä. 2018. " Circular Economy: The Concept and Its Limitations ". *Ecological Economics* 143:37-46. doi: 10.1016/j.ecolecon.2017.06.041.

Pearce D.W., Turner R.K. 1990. *Economics of Natural Resources and the Environment*, Hertfordshire, Harvester Wheatsheaf.

Vivien F.-D., Nieddu M., Befort N., Debref R., Giampietro M. (2019) " The Hijacking of the Bioeconomy ", *Ecological Economics* 159:189-97. doi: 10.1016/j.ecolecon.2019.01.027.
Winans, K., A. Kendall, et H. Deng. 2017. " The History and Current Applications of the Circular Economy Concept ". *Renewable and Sustainable Energy Reviews* 68:825-33. doi: 10.1016/j.rser.2016.09.123.

Keywords: Circular Bioeconomy, genealogy, Pearce & Turner, Georgescu, Roegen, Boulding

Nicholas Georgescu-Roegen: A Retrospective Examination of his Activist Role in Ecological Bioeconomy, Degrowth and the Anthropocene

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Our paper critically explores the pivotal role played by Nicholas Georgescu-Roegen in both intellectual and activist realms, particularly during key moments in the environmental discourse surrounding the 1972 Earth Summit. Our study analyses the Georgescu-Roegen's contributions and their enduring significance within the framework of an ecological bioeconomy and the Anthropocene.

Contrary to the misconception of Georgescu-Roegen as a secluded academic, this paper unveils his active participation in the intellectual landscape of the early 1970s. Levallois (2010) underlines the collaboration between Georgescu-Roegen and Meadows in response to criticisms from mainstream economists advocating perpetual growth. Georgescu-Roegen actively engaged in the 1972 Stockholm Conference, collaborating with the international pacifist movement Daï Dong to draft a declaration addressing the environmental crisis and necessary socio-economic transformations. Although the envisioned economists' conference did not materialize, Georgescu-Roegen and others endorsed the manifesto "Toward a Human Economics," published in 1977. We will trace the evolution of the author's commitment over time and his pursuit of a paradigmatic shift among neoliberal economists, leading him to adopt a more radical stance in favor of an engaged human economy.

Our contribution proposes to study the basement of ecological bioeconomy including the redefinition of economic objectives, emphasizing the preservation of the human species while acknowledging solidarity with the biosphere. Georgescu-Roegen's ecological bioeconomics serves as a cornerstone for reassessing the interdependence between economic activities, social society, and nature. The emphasis on justice and biosphere respect within the degrowth framework prompts an analysis of various limits, encompassing the biosphere, growth, technology, population, and economic activities. The concept of the Anthropocene underscores the threats posed by economic excess, compelling a reconsideration of societal priorities and the fundamental purpose of the economy. **References**

Debref R., Vivien F.-D. (2021). Quelle bioéconome écologique ? Retour sur le débat des années 1970-1980, Economie rurale, n○ spécial " La bioéconomie : organisation, innovation, soutenabilité et territoire ", n○376, pp. 19-35.

Ferrari S. (2023). Nicholas Georgescu-Roegen et la bioéconomie, Ed. Le Passager Clandestin.

Ferrari S. (2023). Bioeconomics, In N. Wallenhorst & Ch. Wulf (eds.), Handbook of the Anthropocene. Springer, pp. 1095-1099.

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Levallois C. (2010). Can de-growth be considered a policy option? A historical note on Nicholas Georgecu-Roegen and the Club of Rome. Ecological Economics, n○ 69, pp. 2271-2278.

Keywords: Nicholas Georgescu, Roegen, environmental activism, ecological bioeconomy, degrowth, planetary boundaries, bioeconomics, Anthropocene

Biomass and the ethics of non-human living.

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In this communication, we discuss some key ethical dimensions underlying the concept of biomass and its growing use in the environmental policy agenda on bioeconomy at national and European levels (National Strategic Plan on Forest-Wood, on Low carbon strategy, National strategy on biomass mobilization among others) in the context of limited non renewable and renewable natural resources and the crossings of planetary boundaries (Rockstrom et al. 2009; Steffen et al. 2015). Over the last decades, environmental ethics merged as an important field of research to advance in the recognition of the responsibility of human towards their environment. A further step and ontological shift is proposed by the emerging field of the ethics of non human living to discuss the concept of biomass and its role in bioeconomy policy agenda. Our analysis is organized along three questions. First, what dimensions of the ethics of living support the concept of biomass? Second, what ontological levelling down is operated when considering the ethics of non human living? Last, what are the consequences in terms of policy making and territorial development? After reviewing the different meaning of the concept of biomass across scientific disciplines, we explore the different ethical theories at stake and the specific visions of the non-human living, as well as the ethical dilemma as stake when applied to the concept of biomass. We then highlight how this concept of biomass in its current used introduces a levelling down of the non-human living when considering the protection of biodiversity, as well as the sensibility and shared responsibility. Naming the non-human living and the specific ontological dimensions appears then as crucial dimensions contrasting with the abstract logic of quantification and measurement of the biomass, and its massification within the policy agenda. We illustrate our reasoning and the consequences of using the concept of biomass using few recent examples in the forest sector and the development of bioenergy. To conclude, we reaffirm the importance of naming and of ontologies when considering the ethics of non human living from an ecological bioeconomy perspective.

Keywords: Ethics, Living, Non Human, Bioeconomy Biomass

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1.D : What diversity of territorial anchoring models from the bioeconomy?

Understanding the local embeddedness of CBE initiatives to design regional CBE policies: the example of Occitanie.

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Context and objectives

The bioeconomy is a multi-faceted political issue for governments: sovereignty of production sectors (energy, manufacturing, agriculture); technological innovation capacity; ecological transition (preservation of natural resources and biodiversity); regional planning and local development. Over the last few years, the notion of circular bioeconomy (CBE) has emerged, designating a bioeconomy based on the "cascading" principle (Jarre et al., 2020; Stegman et al., 2020).

The EU is one of the most ambitious regions with respect to the subject and has adopted a global policy associated with funding instruments to support it. The guidelines embodied in the European CBE policy reflect the overall representation of the bioeconomy by the EU, strongly focused on the objective of mobilizing biomass from different sources and sectors and supporting biotechnological innovations and biorefineries to increase the value of biomass (De Besi and McCormick, 2015; Vivien et al., 2019). As a member state, France also supports CBE with national policies and instruments that contribute to designing a policy framework for implementing CBE in French regions. The primacy given by those policies to technological research and biomass availability suggests a bioeconomy based on a specific and single innovation and development dynamic around biotechnology and a key role of biomass as development factor.

However, some studies show the existence of a diversity of bioeconomies (Nieddu et al, 2014; Benoit, 2021; Donner and de Vries, 2023). This refers to a diversity of technologies used (Nieddu et al, 2014), innovation patterns (Benoit, 2021; Birch, 2009) and business models (Donner and de Vries, 2023). It is associated (as within circular economies) with a diversity of needs as regards resources (including biomass, support, collaboration) and with a diversity of spatial patterns and territorial embeddedness. By focusing on biomass and biotechnologies, regional policies may be based on a limited understanding of CBE dynamics, their basis and what can

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they bring to local economies. This is particularly the case in regions where biotechnologies and the biorefinery industry are relatively limited but where other sectors may support CBE.

The objective of the communication is thus to propose a framework for portraying the diversity of CBE initiatives within a region and understanding its different dynamics and patterns.

Material and methods

Data collection and analysis is carried out using a mixed method research design.

For the quantitative part, a digital survey that consists in analyzing 23 digital platforms dedicated to the recovery of biomass or waste was first conducted. Then, a telephone survey among regional institutional actors and, at the departmental level, among chambers of agriculture, chambers of commerce and industry.

The structure of the database is divided into two sub-sections:

- Data relating to the project leader (date of creation of the project owner, company size, legal status, project launch date, activity sector, location and size of the municipality where the project is based).

- Data relating to type of activity (type of raw material, valorisation yield, core technology, number of target markets, degree of maturity of the initiative, type of innovation). In the second subsection of the dataset, we used Nieddu et al. (2014)'s collective productive heritages typology to characterize the technological profile of each project. We have adapted it by extending it to the mechanical technology involved in the circular and cascading model (Hildebrandt et al., 2017). This variable is called "Extended Technological Heritage" (ETH).

The data collected from 183 initiatives each filled in on 26 variables, were the subject of a Correspondences Factor Analysis (CFA) on 17 variables (with maximum 15 modalities) to study the proximities between the characteristics of the initiatives identified and deduce a typological classification by Ascending Hierarchical Classification (AHC) using Modalisa software (KYNOS), version 9.

Qualitative inquiries were then carried out for each type of initiative obtained with H.A.C. The 13 interviewed cases (Appendix 5) studied were selected on the basis of diversity within each type in terms of category of bioresource exploited, age, sector and location. The objective was to collect information from CBE project leaders about the initiative's trajectory, local support, business model and other elements of the local / regional context. Each interview was recorded and then transcribed. The corpus was then analysed by theme using thematic method classification.

Results

The HAC reveals 4 types of initiatives. The FAC then allowed us to characterize the types according to common variables.

"*Biotech R&D initiatives*" (type B) first reflects the existence of start-ups focused on research and second the technical experiments conducted by distilleries on other valorisation of by-products strategies.

"*Methanization units*" (type C) use radical thermal deconstruction of animal and plant co-

products with the objective of producing energy (biogas for electricity and heat) and agricultural inputs (digestate used as a fertilizer).

"Artisanal agro-industrial initiatives" **(type D)** reflect the growth of local projects aimed at creating a wider network of biobased stakeholders or a renewed industrial dynamic focused on non-food uses (materials).

Initiatives aiming to broaden agricultural value chains **(type A)** is a more heterogeneous category. It mostly involves various products for professionals (animal feed, chemical products and other substances, essential oils, alcohol, packaging, cleaning products, etc.) and – but much less frequently – private customers (mostly herbal products: dyeing, cosmetics, healthcare).

Each of the four classes of initiatives is dominated by one or two particular collective heritages (Nieddu, 2014) ranging from the use of radical biotechnological deconstruction technologies to the mechanical deconstruction of bio-resources. Although there are some biotechnologies and biorefineries, many activities strongly relate to the agricultural sector (especially in types A and C), a key economic sector in Occitanie. More than a creation of brand-new activities by new stakeholders, most of the 183 initiatives appear to be diversification activities of existing economic stakeholders and idiosyncratic changes in local value supply chains. They are thus embedded in existing innovation dynamics and value-chains as pointed out by Benoit (2023) and Birch (2009) and relate to sector-specific innovation patterns (Wilde and Hermans, 2024).

The spatial distribution of the initiatives also reveals different geographical patterns according to the category.

Although a robust characterization of CBE spatial patterns in Occitanie would require further research, we can at least distinguish some specific characteristics in terms of location according to CBE type, especially for types B, C and D (Figure 4). This reflects the territorial and sectoral embeddedness of CBE initiatives. In line with what is highlighted by Chembessi et al. (2024), Gonçalves et al. (2022) and Veyssière et al. (2022), proximity to material and immaterial resources is important for all the projects. But the degree and nature of their requirements vary from one type to another. The logic of location of these activities seems to strongly reproduce the spatial divide in innovation geography between urban and rural areas and the role of specialization and agglomeration externalities. It is particularly visible in type D (artisanal agro-industrial initiatives) where CBE initiatives are based on the historical specialization of some medium-sized towns in textile and leather activities.
From an operational perspective, our results provide an alternative method for assessing regional CBE dynamics compared to the NOBR (National Observatory of Biomass Resources) results based on biomass assessment.

Keywords: Bioeconomy, cascading, producive heritage, spatial patterns, embededness

The territorial anchoring of biowaste recovery : between constraints and opportunities. Lyon's metropolitan area a case study

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Biomass management can be rooted in different forms of territorial anchoring, such as the use of local resources (Bahers, Durand and Béraud, 2017; Benoit, 2021) or organisational forms that allow the creation of local supply chains (Berdier and Maillefert, 2024). Territorial anchoring oscillates between the management of opportunities and constraints that may or may not allow the emergence of a transition model. By examining the specificities of territorial anchoring in the recovery of household bio-waste in the Lyon's urban area, we show that it has appeared as a constraint (1), but also as a facilitator in the construction of a recovery sector (2). However, it does not form part of a clear agri-food transition policy or a truly transformative coordination of actors (3). The assessment of territorial anchoring is based in particular on the methodology of the ELIPSE project, developed in collaboration with ADEME (Boyer et al., 2016). This methodology is used to assess the territorial sustainability of bio-waste management experiments, by comparing the industrial sector with local composting.
There are a number of reasons why household biowaste should be recycled locally: legal (local authorities are obliged to sort it at source), biochemical (putrescible materials need to be processed quickly) and economic (its weight and low value make it difficult to transport). In fact, the territorial anchorage of these processes is encouraged by the need for proximity. This constraint takes various forms. Firstly, in the development of long-established industries in the Lyon area for activities such as green waste management, in partnership with local authorities. Secondly, in the development of hyperlocal management methods for the management of household biowaste in a context of community management (Dumain and Rocher, 2017; Lehec, 2019).

Lyon's recycling systems are based on specific local features that can facilitate their implementation: the presence of actors with composting and vermicomposting skills (a), long-standing habits of sorting at source with community composting (b), and citizens' associations that organise events on environmental themes (biodiversity, food, composting, etc.) (c). The Lyon conurbation has relied on local resources and skills to meet the legal obligation of 1 January 2024. However, according to Zimmermann (2005, p. 35), "the search for one-off productive efficiencies" can run counter to the long-term nature of territorial anchoring. In this respect, our work raises questions about the sustainability of these sectors in the event of changes in supply or territorial forms of organisation. For example, the massification of flows could raise

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the question of outlets, their acceptability and their proximity.

While the semi-industrial composting sector (supported by **Lyon's metropolitan area**) has a positive socio-economic impact by creating jobs that cannot be relocated and by creating local value (transition from bio-waste to compost) (Maillefert and Robert, 2020), we can question the development logic of this model: is it transformative and how? The creation of a recycling network can be an opportunity to change the economic model and move towards a territorial transition, provided that we question the value creation model and the forms of coordination, particularly from the point of view of the interdisciplinary nature of collective action (Maillefert and Robert, 2020). It seems that, in the case of Lyon, the region is currently still seen as a receptacle for activities that are not really linked to an agri-food transition policy or to broader forms of stakeholder coordination (e.g. farmers are excluded from the ecosystem - Berdier, Girault, Maillefert, 2024).

For example, the outlets for the compost produced by composters remain dependent on price constraints. If they are currently part of a territorial cycle through local agricultural use, this is due to the effect of geographical proximity: institutional proximity has yet to be built. Similarly, the actors do not propose a debate on how to ensure the long-term viability of the existing channels by maintaining a stable supply of bio-waste and green waste: for the moment, these supplies are very fragile and depend on an unregulated pricing policy. Finally, local composting facilities are threatened by the introduction of composting bins (a semi-industrial sector), which risks drying up their bio-waste supply. There is no guarantee that this fundamental territorial, social and educational contribution will be maintained.

These various constraints and opportunities will be analysed in order to identify the levers that can be used to anchor these bio-waste management activities, taking particular account of the concept of territorial service (Maillefert, 2024).

Bibliographie

Bahers J.-B., Durand M. et Béraud H., 2017, " Quelle territorialité pour l'économie circulaire ? Interprétation des typologies de proximité dans la gestion des déchets ", *Flux*, n○109-110, vol.3, pp. 129-141.

Benoît S., 2021, " Biodéchets et diversité des ancrages territoriaux ", *Économie rurale*, n○376, pp. 77-91.

Berdier C. et Maillefert M., 2024, " Les enjeux du compostage des biodéchets ménagers. De la construction de filière à une approche métabolique de flux. Le cas de la Métropole de Lyon ", *Revue d'Economie Régionale et Urbaine*.

Berdier C., Girault M. et Maillefert M., 2024, *Du métabolisme territorial des biodéchets ménagers à leur valorisation en compost pour l'agriculture. Le cas de l'aire métropolitaine lyonnaise*, Colloque de l'ASRDLF, Session SS8 " Transition en territoires de l'alimentation, l'agriculture et l'environnement : vers de nouvelles dynamiques d'innovation ? ", Strasbourg, juin 2024.

Boyer N. et *alii.* (Brullot S, Buclet N, François C, Genuit N, Gobert J, Lavoisy P, Maillefert M, Sarran A), 2016, *Premier pas vers une écologie industrielle et territoriale à la hauteur des enjeux de durabilité, projet ELIPSE*, OREE.

Dumain A. et Rocher L., 2017, " Des pratiques citoyennes en régime industriel : les courts-circuits du compost ", *Flux*, vol. 2, n○ 108, pp. 22-34.

Lehec G., 2019, " Vers un service composite de gestion du métabolisme urbain. Ce que compostage industriel et compostage en pied d'immeuble ont en partage ", *Flux*, vol. 2-3, n○ 116-117, pp. 95-111.

Maillefert M et Robert I, 2020, Dossier "L'économie circulaire: modes de gouvernance et développement territorial" – Nouveaux modèles économiques et construction de la durabilité territoriale. Illustrations à partir d'une analyse de l'action collective. *Natures Sciences Sociétés* 28, 2, 101-107.

Maillefert M., 2024, Vers une réflexion sur la dimension transformative de la société servicielle : autour des notions d'activité et de fonctionnalités, *colloque du RIODD*, Bruxelles, 26-28 septembre.
Zimmermann J.-B., 2005, " Entreprises et territoires : entre nomadisme et ancrage territorial ", *Revue de l'IRESS,* n○47, vol. 1, pp. 21-35.

Keywords: biowaste, territorial anchoring, recycling system

Territorial Anchoring and Ecological Transition: A Winning Combination for Agri-Food SMEs?

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In October 2024, the Fédération des Entreprises et des Entrepreneurs de France (FEEF) raised concerns about the increasing number of small and medium-sized enterprises (SMEs) and mid-sized businesses (ETIs) operating at a loss, with figures rising from 19% in 2018 to 33% in 2023 in France. While commercial negotiations have been identified as the primary cause of these financial difficulties, other structural challenges and uncertainties further exacerbate this instability. The COVID-19 pandemic, the war in Ukraine, and the resulting disruptions to supply chains, as well as the return of Donald Trump to power and the geopolitical uncertainties associated with his administration, have profoundly impacted these businesses. This context reinforces pre-existing concerns regarding SMEs, which are widely recognized as essential drivers of economic growth in France but remain highly vulnerable. Their small size and limited cash flow, particularly in the case of family-owned enterprises, further accentuate their fragility, especially during financial crises.
Faced with this climate of uncertainty, SMEs are seeking strategic levers to ensure their sustainability and adapt to a more stable economic environment. Simultaneously, they must respond to the imperatives of the ecological transition, which requires investments to comply with increasingly stringent regulatory frameworks and to meet evolving consumer expectations. To navigate these constraints, SMEs may adopt various approaches, including resource efficiency, local sourcing, biodiversity conservation, product innovation, recycling, and carbon footprint reduction. The latter, in particular, has been widely acknowledged as a major challenge within the industrial sector. However, the transition from financial planning to concrete implementation presents significant obstacles, as the associated costs are often prohibitive. In addition to their constrained financial resources, SMEs frequently lack both the institutional support and human capital necessary to secure funding and operationalize transition-related initiatives. As a result, ecological transition constitutes not only an economic challenge but also a structural one.

Within this framework, territorial anchoring emerges as a potential lever for SMEs to facilitate their transition towards more sustainable practices. This study aims to examine the relationship between the territorial embeddedness of agri-food SMEs and their capacity to engage in ecological transition. The case of the agri-food sector is particularly relevant due to the complex and multifaceted relationship these businesses maintain with their local environments. While some business leaders perceive their territorial anchoring as merely the geographic location of their facilities, others actively integrate into their regional economic and social fabric. Many

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entrepreneurs develop personal ties with the territories in which their businesses operate, shaping the modalities of their territorial engagement. This anchoring can provide access to both tangible and intangible resources, as well as foster diverse forms of interaction with local stakeholders, ranging from simple collaborations to complex partnerships. Strengthened territorial anchoring may, therefore, enable SMEs to access financial support, specialized expertise, and institutional networks that facilitate ecological transition.

Nevertheless, in the context of globalization, the relationship between businesses and their territories is undergoing profound transformations. In the agri-food sector, the extent to which territorial proximity is leveraged varies significantly. For some SMEs, territorial resources are not automatically perceived as strategic assets. The increasing uncertainties and regulatory pressures surrounding ecological transition highlight the importance of explicit recognition of these resources by business leaders. Furthermore, SMEs exhibit considerable heterogeneity in terms of size, revenue, governance models, and geographic location. While the majority are autonomous entities owned by a single investor, others function as subsidiaries of larger corporations. While some businesses successfully mobilize financial resources to support their ecological transition, independent SMEs often struggle to do so, particularly when operating in isolation. However, territorial anchoring does not always represent the most straightforward or universally beneficial pathway to ecological transition. In some cases, it introduces additional regulatory constraints or even acts as a barrier to the expansion of certain agri-food SMEs. Consequently, while ecological transition is acknowledged as a strategic priority by a growing number of firms, others continue to view it as secondary to their immediate economic concerns.

Keywords: Territorial Anchoring, Ecological Transition, Agri, Food SMEs, company executives

1.E : Using quantitative analysis in a different way: checking the robustness of scenarios based on the narrative of bioeconomy with quantitative storytelling (QST)

Reconciling urban food metabolic pattern with its environment – a "mission impossible"?

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Existing trends of changes in both world population and global diet, are associated with a growing environmental impact, meaning that food consumption is a major concern for environmental sustainability. In relation to this point, in 2022, Greater Geneva committed to a sustainable transition, setting several legitimate, albeit very ambitious objectives for 2050: (i) preserving and regenerating local biodiversity, (ii) reducing environmental pressures generated by society (locally and abroad), (iii) ensuring good health, equity and inclusion of all its inhabitants, and (iv) contributing to the improvement of world population's well-being.
In this paper we check the plausibility of this integrated set of pledges by adopting an integrative analysis capable of addressing all these concerns simultaneously. For this purpose, we adopt the MuSIASEM accounting approach (Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism) to run "what if" scenarios for the Greater Geneva region and Geneva Canton. In particular, we use an approach called "quantitative storytelling" to check the plausibility of two targets – (1) food self-sufficiency; and (2) preserve biodiversity by protecting 30% of territory – while analyzing the trade-offs over the different targets. In relation to the first exercise of quantitative storytelling, results show that when adopting the current Swiss diet, Greater Geneva would require much more agricultural land and agricultural workers than those currently available to achieve total food security (i.e. not depending on imports). Assuming a shift to a more plant-oriented diet, environmental and social pressures of food production would be markedly reduced, but still food sufficiency would remain problematic. In relation to the set aside of land for ecological infrastructure, when considering Greater Geneva region as a reference political boundary, we identify the factors that will make this solution problematic. This study shows the potential of MuSIASEM approach in characterizing a regional food metabolic pattern, especially considering that the same type of metabolic analysis can be extended to other domains and other urban areas to assess the sustainability of energy or water metabolisms.

Keywords: Metabolism, Sustainability, Nexus, Food, Water, Biodiversity

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Using quantitative analysis in a different way: checking the robustness of scenarios based on the narrative of bioeconomy with quantitative storytelling (QST)

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This session illustrates an innovative approach pursuing a high quality of the process of producing and using scientific information in the field of science for governance. Rather than relying on the conventional approach using models to identify 'optimal' solutions and generate relative road maps, quantitative storytelling (QST) explores the robustness of the narratives and storylines used to select deterministic models. QST uses relational analysis to explore the impredicative causal relations typical of complex adaptive systems-'we do what we want to do' (downward causation) and 'what we can do defines what we do' (upward causation). This approach requires applying different representations of the metabolism of social-economic systems characterizing (1) how the system budgets its internal resources over different functional compartments (integration of social practices), and (2) how the individual functional compartments interact with the context to produce the resources used by society.
'What-if?' scenarios are checked by contrasting the compatibility of changes in the internal budgeting determined by the effect of a suggested policy and the existence of biophysical constraints that would prevent the achievement of these changes in the functional compartments.

QST does not claim to reveal a univocal truth, nor to predict or forecast what will happen. Rather it flags the existence of serious doubts about the credibility of policies and scenarios that simply 'cannot happen' (via negativa). In this way different stakeholders can focus their attention and double-check the assumptions, including numerical information, found to be problematic.
The session consists of three presentations covering (1) the importance of checking the robustness of the narratives used in the discussion of bioeconomy policies by mixing quantitative analysis and participatory processes, (2) examples of 'grammars' used for the analysis of the congruence

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over the impredicative relations exhibited by data spanning non-equivalent models, and (3) an application of the method to check scenarios associated with proposed bioeconomy policies in the Grand Geneva region.

Keywords: Quantitative storytelling, Science for governance, Bioeconomy narratives, Futures studies

Addressing bioeconomy policy challenges: the need for more systemic integrated assessment tools

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In the European Commission, bioeconomy policy intersects with a range of policy areas and relates to many different sustainability objectives. Significant trade-offs, related to significant challenges and opportunities, exist. Conventional models and tools often fail to span the option space considered by decision-makers, or to allow capturing of the full spectrum of relevant concerns. This presentation explores from a policymaking perspective the limitations of typical scientific inputs and discusses the need for novel tools better suited to handling the complexity and interconnectedness inherent to the bioeconomy. The presentation sets the stage for the introduction of new approaches and relates to the European Commission's Integrated Bioeconomy Land Use Assessment project(1).
Current practices managing or using biomass are often criticized for perpetuating unsustainable land and biomass use, a reality which highlights the urgent need for new approaches. Alternative practices for supplying, processing, and using biomass have been developed, and more will need to be developed, however they haven't yet been able to reconcile conflicting objectives and deliver the societal and environmental outcomes desired by many. There is a growing need to explore increasingly divergent, alternative pathways, and to understand how to respond to multiple interconnected challenges for the benefit of all. In this context, bioeconomy is seen as both a means and an end for systemic transformation.

Scientific tools are required to support policy making and provide insights on 'better' and 'worse' pathways in relation to agreed (e.g., in the European Green Deal) or individual preferences. However, such support will be exceedingly difficult to realize under a simple continuation of siloed inputs from conventional scientific efforts. A few of the reasons **conventional efforts fall short** include (1) they **tend to have a limited scope**, focusing on limited set of environmental, economic or social outcomes, and-more importantly-a limited set of (policy) drivers, making it difficult to explore the full range of possible bioeconomy futures and neglecting other relevant dimensions of sustainability, (2) they **tend to not adequately assess the impacts of system reconfigurations** on the range of stakeholders, failing further to integrate consideration of diverse values and knowledges, and (3) they **often rely on unrealistic or vague technicalities**, such as equilibrium assumptions or the choice to express model parameters all

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in monetary terms, the latter point leading to biophysical ambiguities.

To overcome these limitations, a **new class of 'whole-of-bioeconomy' tools** are essential. These tools must be capable of (1) **identifying and quantifying trade-offs** between different sustainability objectives, considering not only quantities of resources but also their functional requirements and end-uses, acknowledging that different resources serve different purposes, typically multiple purposes simultaneously, (2) **relating trade-offs to diverse preference profiles**, enabling through social multi-criteria evaluation (or similar) an understanding of how different stakeholders are affected by various policy choices and opening the possibility of adding some automatization to an important aspect of the decision-making process, or alternatively to elicit and integrate different preference profiles as emerging from bottom-up participatory activities, and (3) **illustrating possible future system configurations that can claim to minimize in certain ways deviations from the set of objectives**, a point which does require a systemic perspective and robust consideration of the many interdependencies exhibited by the bioeconomy.

(1) https://knowledge4policy.ec.europa.eu/projects-activities/integrated-bioeconomy-land-use-assessment_en

Keywords: Bioeconomy policy, Sustainability trade offs, Whole of bioeconomy tools, Integrated assessment

Integrated assessment of bioeconomy sustainability through an accounting system for societal metabolism: quantitative storytelling (QST) for robust policymaking

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This presentation demonstrates a novel approach to generating and assessing the robustness of bioeconomy policy scenarios using a **quantitative storytelling** platform and accounting framework based on insights from **societal and ecosystem metabolism**. The work is developed within the European Commission's Integrated Bioeconomy Land Use Assessment project(1), which aims to develop a deliberation support system for more informed discussions on bioeconomy futures.
The presentation starts off with a detailing of the **'diagnostic setup'** of the platform, commenting on theoreticalities and practicalities of the setup. The diagnosis involves a **biophysical approach to scientific accounting**, emphasizing the importance of understanding the **state-pressure relation** expressed by the bioeconomy. It applies a **flow-fund accounting logic**, distinguishing between transient flows of materials and energy and the stable elements (funds) of the system. The framework considers not just the quantity of resources, but also their functional requirements, acknowledging that different resources serve different functional purposes and therefore cannot be reductively aggregated simply because they share a common unit of accounting. We apply this framework to evaluate the metabolic patterns of some distinct bioeconomy configurations expressed across Member States of the European Union.

We further present, as part of the diagnostic setup, the concept of **metabolic processor**, a key component of the platform. Metabolic processors are agents of change, in their formal implementation they express an archetypical profile of inputs and outputs. Libraries of such processors, dutifully organized in a well-structured data warehouse, cover the representation of a wide variety of activities (past, current, future) within the bioeconomy, covering both social-economic and ecosystem aspects.

Following the diagnostic setup the presentation then demonstrates how the platform can be

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deployed in relation to a set of **bioeconomy storylines**. These storylines represent different visions, or social-technical imaginaries, of the future. By rearranging the set of metabolic processors describing the bioeconomy system under assessment, the storylines are given quantitative referent. The platform allows users to explore various 'what-if?' hypotheses, assessing their feasibility, viability, and desirability, in this way moving beyond a focus on siloed economic or environmental impacts to consider the wider implications of bioeconomy futures. With the help of a **social multi-criteria evaluation module**, the platform allows for tighter integration of the concerns, values, and preferences of persons involved in the deliberation process, highlighting challenges and opportunities in relation to coalition formation.

Ultimately, the platform offers a relatively transparent and modular approach, allowing for easy modification and expansion as new data become available. It offers the opportunity for wider involvement in the co-creation of knowledge related to bioeconomy decision-making. Considering more broadly, the quantitative storytelling platform may provide a robust foundation for advancing deliberative methodologies in sustainability policy, supporting decision-makers in navigating the range of complexities related to bioeconomy transformation, hopefully leading to quality-gains in policy interventions.

(1) https://knowledge4policy.ec.europa.eu/projects-activities/integrated-bioeconomy-land-use-assessment_en

Keywords: Societal metabolism accounting, Policy assessment, Deliberation support, Quantitative storytelling

2.A: Agricultural Methanization in France and Europe: Issues, Tensions, and Prospects

Is there a "European model" for agricultural anaerobic digestion? A state of the art based on the international social science literature

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Based on a review of the international social science literature, this paper asks the question of whether there is such a thing as a "European model" for agricultural anaerobic digestion. The corpus, compiled between February and March 2024, initially included 113 papers written in English and French, selected among the 28,973 results from 13 databases (Cairn, Érudit, Gallica, HAL, Jstor, OpenEdition, Persée, Sage, ScienceDirect, SocIndex, SpringerLink, WebOf-Science, Wiley). An advanced keyword research (using the keyword "méthanisation agricole" for French-language databases and "agricultural biogas" or "agricultural anaerobic digestion" for English-language databases) was used to find the most relevant papers dealing with on-farm anaerobic digestion in Europe from a social science perspective. After reading them, we selected 38 papers in English and 35 papers in French and studied them using a detailed thematic analysis grid, from which six main research questions emerged, which we will explore in this paper. To look beyond the general expressions of support for renewable energies in European public opinion, it is interesting to explore: (i) On the one hand, the social acceptability of agricultural biogas plants, which depends on the diverse interests of the stakeholders involved and their divergent internalized perceptions and values. The acceptability of biogas plants needs to be studied first in relation to localised issues and interconnected social and spatial factors. (ii) On the other hand, controversies have especially arisen over the production of energy crops (instead of food crops?), reflecting the priority given to the energy transition over the ecological transition.

Given that most anaerobic digestion plants are small-scale on-farm installations, it is crucial to pay attention to the farms' territorial location and to the interactions between the stakeholders involved. Two main issues thus need to be studied: (iii) the position of farmers in the face of industrial developments in the biogas sector, and (iv) the relation between on-farm anaerobic digestion and local rural development.

These first two series of questions invite reflection on a third point: the development of agricultural anaerobic digestion is part of ongoing processes, showing that these technologies are

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embedded in society and dependent on political and economic regulations (v) which can act either as levers or barriers (see the role of public subsidies and the (poor?) economic performance of anaerobic digestion for farmers).

This will lead us to conclude by addressing (vi) the sustainability issues related to anaerobic digestion, which have not been considered to the same degree in future studies, from which no clear blueprint can thus be derived.
Agricultural anaerobic digestion thus appears to be a boundary object, situated at different – global/local, European/national/regional - levels of understanding and action, and involving different social players and sectors (energy, food, farming, local development, etc.) working together to face sustainability challenges.

Keywords: Agricultural anaerobic digestion, renewable energy, biogas, sustainable agriculture, rural development, viability, social sciences review, Europe

The methanization sector through its instruments. Understanding the multi-scale articulation of sectoral public policies

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Since the mid-2010s, we've seen the imposition of a new sectoral frame of reference (Jobert & Muller, 1987) at national level for the methanization field. The dynamic of units injecting biomethane into networks, supported by both private stakeholders (agricultural worlds, gas network managers) and public stakeholders (central, territorial administrations) has in fact resulted in the imposition of a new chaining in the public policy statements in circulation (Zittoun, 2013). This new chain presents methanization as a solution to the energy and climate problem of decarbonization, leaving aside other chains more focused on agro-ecological issues. Reduced in this way and placed in the category of renewable energy sectors, anaerobic digestion is governed by the instruments traditionally used in national public energy policies: feed-in tariffs, evaluation in terms of cost per MWh produced, 5- and 10-year planning, assignment of quantified production targets, *and so on.* However, the local deployment of units and the investment of local authorities and administrations are leading to the implementation of a reference framework for methanization, which is still sector-specific but territorialized. Other instruments are used locally - at regional and/or departmental level - to reorientate, adapt and tinker with the reference framework established at national level. In particular, these instruments aim to link methanization to other local problems: local economic and industrial development, local circulation of the economic value produced, stemming rural and agricultural desertification.

Keywords: Methanization, Biogas, Public policy, Sector, Energy, Agriculture, Multi, scale, Territorialization

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How do biogas models coexist ? Understanding the interactions between agricultural actors and energy developers in the deployment of methanisation in two departments of the Nouvelle-Aquitaine region

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To achieve its biomethane production and injection targets, the Nouvelle-Aquitaine region, with its Together for 100% Green Gas in 2050 strategy, is declaring its support for all types of methanisation models. Already studied in the academic literature, mainly from an economic and geographical point of view (Carrosio, 2013; Berthe et al., 2020; Berthe et al., 2022; Valve et al., 2021), this diversity of methanisation units is also highlighted within the region by the institutions and observatories supporting biogas production (AREC, 2021; OREGES, 2022). While many guidance notes, reports and scientific articles propose different types of unit (agricultural, industrial, territorial ; cogeneration, injection), depending on various variables (type of input, recovery method, traceability of financial resources allocated to the project, network of players), little is known about the interactions between the different types of project within a given area. Drawing on work in sociology and political science that highlights the dynamics of expropriation within farming sector (Hervieu & Purseigle, 2013; Smith & Ansaloni, 2021), and following a framing in terms of 'energy justice' (Jenkins et al., 2016; Yenneti et al., 2016), this paper explores the effects of the arrival of industrial biogas players on agricultural worlds and pre-existing forms of on-farm methanisation. Field visits to biogas plants (n = 4) and semi-structured interviews (n = 20) with farmers and representatives of the Chambers of Agriculture and CUMA federations in Corrèze and Pyrénées-Atlantiques enabled us to identify the ways in which contrasting 'biogas models' coexist at local level, illustrating what the neighbouring installation of an energy company means for farmers. While acknowledging the diversity of biogas production methods at the local level, this paper aims to show how the strategies of dominant players in the energy sector who are invested in biogas production can be deployed to the detriment of smaller, initial players. It answers 3 questions:

1) *Landing* : How do multi-energy companies become biomethane producers? From a descriptive point of view, we are highlighting the way in which agricultural players are approached by energy companies, through various canvassing practices.

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2) *Distribution* : How does 'industrial' methanisation affect the surrounding agricultural world? Through supply and deposit contracts, the industrial units link up with farms to operate their units and redistribute the digestate, sometimes altering the farms' agronomic plans. At the same time, certain methanisable resources previously destined for agricultural units, such as bio-waste, are sometimes captured by new industrial units.
3) *Recognition* : What boundary-work is at stake ? As a " objet-frontière ", methanisation – and the legitimacy of producting biogas – is claimed by actors from different professional backgrounds, drawing on competing forms of expertise.

Keywords: biogas models, industrial roll, out, energy justice, plantationocene

2.B : Policies, Sustainability and System Constraints

Sustainable Products: Exploring Consumer Decision Making in Bioplastics

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A promising approach to mitigating the environmental impact of plastic production involves replacing crude oil with biomass in plastic products, maintaining their functional advantages while enhancing sustainability. Bioplastics offer a viable alternative to conventional plastics, but understanding the factors driving consumer acceptance is critical for a successful transition. This knowledge is essential for marketers, policymakers, and product developers. Despite the importance of this shift, research on consumer decision-making regarding bioplastic products remains limited, particularly in addressing broader issues like the attitude-behaviour gap. To bridge these gaps, this study employs an extended integrative framework (CBDM-BBP), which combines the Theory of Planned Behaviour (TPB) and Norm Activation Theory (NAT), alongside Partial Least Squares Structural Equation Modelling (PLS-SEM) for an in-depth multivariate analysis of consumer decision-making on bioplastic applications, including packaging and apparel. Drawing on data from a survey of 525 consumers in the Republic of Ireland, a recognised test market with strong government commitment to the bioeconomy and abundant natural resources, the findings underscore the intricate nature of consumer decision-making regarding bioplastic products. The results indicate that consumers demonstrate a sequential progression in their behavioural determinants, moving from interest to intention, willingness to pay, and ultimately to use behaviour. While they often exhibit a linear progression from interest to actual use behaviour, various factors can influence the process at each stage, leading to potential non-linear transitions. In the early stages of decision-making, self-interest values, norms, trust, and beliefs are key influences. However, as consumers progress to later stages, the role of self-interest, trust, and beliefs declines, with norms, particularly ethical values, gaining importance.

Keywords: consumer decision, making, consumer acceptance, behavioural determinants, bioplastics, bioeconomy, sustainability.

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Energetic Limits and Existential Risk on Long-Term Economic Growth

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In the aftermath of the COVID pandemic and the 2022 energy crisis, urban Western elites have been forced to confront the biophysical realities underpinning their financialized economies. These crises have revealed that, despite claims of dematerialization, post-industrial economies still depend on intensive natural resource extraction, environmental stability, and ecosystems services to process their waste. Indeed, wealth creation is accompanied by severe sustainability challenges: a global socio-ecological system breaching planetary boundaries and becoming increasingly fragile, prone to tipping points that could lead to systemic collapse.
In response, Green Growth advocates propose a rapid transition to a net-zero economy, driven by investments in renewable energy. However, this strategy ignores the biophysical limitations of green technologies and relies on overly simplistic techno-economic models. Meanwhile, environmental detractors (usually conservatives) exploit waning support for green investments by pushing to return the political discourse to the familiar framework of "business as usual," under the pretext of addressing economic underperformance while disregarding sustainability concerns. Hence, a green light for unlimited fossil fuel extraction. Degrowth offers an alternative path forward, but it risks underestimating the deeply entrenched materialistic values of contemporary Western societies. Furthermore, it risks falling into a trap of "social optimism" – assuming that humans can successfully orchestrate and manage a prosperous way down. These competing narratives fail to address the existential risks associated with ecological overshoot caused by unsustainable resource demands**.** So, how can we escape this impasse?

In this paper I offer a novel perspective on resource-side sustainability by examining critical fragilities in global oil metabolism and the internal societal constraints tied to human time allocation. I argue that recognizing the energetic limits of post-industrial societies is critical to mitigating existential risks and unlocking their full adaptive potential. Specifically, instead of focusing on environmental stewardship and detailed net-zero roadmaps projected 30 years into the future, we need a framework capable of capturing the systemic socio-ecological fragility of modern societies as they exist today.

I suggest the adoption of a transformative strategy which aims to preserve biophysical resources and capital (i.e., humans, vital energy systems, and industrial infrastructure) while gradually deconstructing and reorganizing societal metabolism to enhance system stability in an increasingly inhospitable environment. By confronting the "tragedy of change" and deciding which functions to relinquish for long-term survival, modern societies can navigate their developmental path without succumbing to collapse. Remaining on a trajectory of unchecked growth is no longer-and has never been-a viable option.

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References

Hickel & Kallis, 2019, Is Green Growth Possible?, New Political Economy, https://doi:10.1080/13563467.2019.15

Kallis et al., 2012, The economics of Degrowth, Ecological Economics, https://doi.org/10.1016/j.ecolecon.2012.0
Manfroni et al. 2021, The profile of time allocation in the metabolic pattern of society: An internal biophysical limit to economic growth, *Ecological Economics,* https://doi.org/10.1016/j.ecolecon.2021.107183

Keywords: Existential risk, biophysical limits, Societal Metabolism, energy, human time nexus, decision making under uncertainty

Framing EU biomass supply and uses into a social-ecological context for policy support

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Ten years ago, a mandate was given to the Joint Research Centre (JRC), by twelve European Commission (EC) services to provide long-term data, analysis, and forward-looking modelling on biomass supply and demand within the European Union (EU) and in the global context. The JRC was, at the time, tasked with assessing biomass flows between supply and demand as a basis to understand the competition and synergies between different sectors for biomass resources, with the objective of assisting the policy-making process to implement policy measures, evaluate policy options and provide elements relevant for future impact assessments. This effort was named The JRC Biomass Mandate.

The scope of the EC's scientific arm included creating a comprehensive knowledge base on biomass, developing tools for assessing biomass flows and availability and evaluating impacts of biomass extraction and use, in the present and in forward looking exercises. The research covers all sources of biomass: agricultural, forest, marine and freshwater, and waste; and includes an assessment of the competition and the synergies between sectors for biomass resources.

Throughout this decadal work, the JRC's findings have been updated in quantitative terms, and the overall findings are constant: there is a steady increase in use of biomass, both recycled and newly sourced. Indeed, what motivated the initial inception of the JRC Biomass Mandate is that there is little doubt that our current overall use of biomass is unsustainable, this had already been acknowledged ten years ago and is still true today.

We explore how framing the issues around biomass, and natural resource management in general, is key to improving scientific support for bioeconomy-related policy. We argue that two basic premises must be upheld for scientific support to be legitimately used as evidence for policymaking: contextualisation and deliberation.

Contextualisation is the broadest concept presented here because it spans both the scientific and ethical aspects of scientific support to policy. Research for policy support for natural resource management and use requires adequate framing, linking the natural resources to their sources (e.g. the ecosystems, or in the case of waste, the social systems). Thus, reporting on biomass quantities for bio-based branches of the economy should be accompanied by both the environmental and social or human context. This approach is an acknowledgement that continuous interaction between nature and society shapes the form and function of social-ecological systems, knowing that social (which includes economic) and ecological subsystems are coupled

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and all the processes within social-ecological systems have a double nature: an ecological (material) one and a social (economic and historic) one – an implication often neglected in studies on natural resources.

Also related to contextualisation is ensuring that the scientific support is able to give a system's level assessment of the biomass demands, availability, extraction etc., also considering its future availability. We argue that researchers should help renew focus on those urgent questions that are most relevant to broad, system-level assessment, to support cross-policy coherence. As society pursues increasingly ambitious goals in such existential domains as sustainability and bioeconomy, adopting systems thinking in foundational research is becoming more and more essential.

The interconnectedness between natural ecosystems and human activities means that any policy affecting biomass can have far-reaching consequences-from impacts on food, housing and energy up to biodiversity and soil health to those on climate regulation, social equity, human health or economic stability. Systems thinking provides a structured way of assessing how changes in biomass lifecycles influence these diverse phenomena, helping policymakers understand the broader implications of their efforts and to navigate complicated decisions. It is an approach that gives focus on the interconnections between components, rather than on components in and of themselves, adding nuance and breadth of understanding to observed phenomena. In the context of biomass and its management, a systems approach means first and perhaps foremost acknowledging that the many processes of biomass extraction, transformation, use, and disposal are tangled up with broader social-ecological dynamics.

The points elaborated above relate to another aspect of contextualisation: the ethical implications of providing scientific support to policy. As researchers are normally human beings, there is an inevitable personal and emotional element to our work, thus scientific findings are the result of a series of choices: which problem to tackle, which method to apply and based on which assumptions, which data to present, and how to interpret. What constitute a relevant fact, or a relevant set of data is conditioned by the larger social and historical context. Scientific endeavours are embedded in society-thus reflecting prevailing social and historical conditions. Reflection and transparency about normative assumptions, the preanalytical vision, the limitations of the analysis and uncertainty of the results, will make our support to policymakers more effective, qualifying our results in a context. Possibly, offering a set of options, or an option space, linked to varying normative assumptions and visions, and the contextualised implications of decisions, can provide the basis for evidence-based decision making.

This brings us to the second element we have identified as critical to scientific support for policy: Deliberation. With a set of options presented to the policymaker, there is no clear course of action and deliberation is needed to decide the best way forward for the collective good. Deliberation is needed early on in the process, in the problem framing phase, in the identification of boundaries of the 'option space' and question how one option can be judged 'better' or 'worse' than the other. This is even a sign of reflexive governance. Deliberation allows decision-makers to remain agile in times of change, and to come to agreeance on sets of responsible actions to be taken towards the management of wicked problems, after acknowledging the implications of uncertainty in the available analysis. This is especially fundamental in complexity, such as bioeconomy futures. Here, depending on who you are talking to, both the problem definition and solution set are multi-faceted across areas that cannot be simply 'aggregated' or 'combined' as they concern challenges and problems of very different nature (e.g. environmental degradation versus human rights). Different representations of the system of interest can be expected to be both equally legitimate and necessary. Decisions will therefore unavoidably 'disappoint' a part of the community. The role of scientists must there include to provide the instruments

and means to ensure transparent and credible decision-making process, which can be accepted by all concerned communities. Stakes are high as the ultimate price of failure is an ecological and societal collapse. Novel decisions are urgent as current solutions are limited, ineffective, unsustainable and contested.

In summary, the experience of a decadal partnership between science and policy on the specific topic of biomass leads us to conclude that reporting on numbers, e.g. biomass supply and uses) is not, while being a necessary precondition in itself, enough to support policy and cannot, in itself, lead to policy coherence. A proper contextualisation and framing of scientific evidence is required, which leads to an increase in the quality of deliberation and hence more inclusive and coherent policy making.

Keywords: Biomass, policy support, social, ecological system, system, modelling, uncertainty, post, normal, European Commission

2.C : Between Circularity and Bioeconomy: Biomass Valorization Pathways

Exploiting blue byproducts and managing the tension between transition and transitory economy. A comparison between green seaweeds in Brittany and shrimp fishery byproducts in Quebec.

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The problematic relationship between the production-based economy, both on land and at sea, and the marine environment is regularly singled out for criticism. Both environmental pollution and overexploitation of stocks are cited as factors in the degradation of natural marine capital. However, this problematic situation is giving rise to economic activities at the crossroads between the circular economy, which promotes the treatment and reuse of waste, and the blue bioeconomy, which seeks to maximize the added value derived from biomass by generating new (co)products (Laperche et al., 2024). The requalification of residual material or excreta from industrial activity into a stock of marine (bio)resources is at the root of new value chains and economic projects (such as a French company which, since 2020, has been incorporating oyster shell powder into wetsuits to limit the use of neoprene). There is an underlying tension running through them. The claim to build a viable "transitional" blue economy echoes well the conventional narratives of the bioeconomy that aim to drive economic investment in these emerging industries (Giampetro, 2019). However, the medium-term viability of these new activities is hampered by the uncertainties surrounding their supply of blue by-products as feedstocks. Proactive environmental policies aimed at eradicating marine pollution generated by land-based industrial activities, or at preserving natural marine resources by restricting marine extractive industries, confer a potentially "transitory" character on economic projects based on the exploitation of "blue by-products".
This article looks at the socio-economic construction of these blue by-product value chains, based on a bottom-up territorial approach. How do operators in blue by-product value chains take advantage of the tensions and complementarities between waste management policies (local, national, international), incentive policies for the economic valorization of blue by-products and environmental policies for the protection of the marine environment? What material and symbolic resources do these policies provide? How do these value chains fit into their respective territorial configurations, and what affiliative strategies are industry operators deploying towards the dominant land-based and sea-based sectors? Do new activities help to green the linear productivist model? Are they limited circular extensions of this model, or are they undergoing a process of autonomization driven by economic logics that, for example, encourage the import of exogenous by-products to supply their activities? How are operators attempting

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to resolve the tension between transitional and transitory economies that the ambiguous status of blue by-products poses for the viability of their economic activity? Does the debate over the status of the material (polluting excreta, by-product, waste, etc.) constitute an argument likely to have an impact in a rivalry between emerging activities?

To answer these questions, this article is based on a qualitative investigation of two case studies concerning value chains for green seaweedd in Brittany (France) and shrimp residues from fishing in Québec maritime (Canada). The material consists of semi-directive interviews with stakeholders (economic operators, scientists, professional representatives, local players) and a documentary analysis of public reports, press articles and corporate communication materials. The case of green seaweeds is set against a backdrop of environmental controversy surrounding the origin and responsibility of the "green tide"1 phenomenon. The explosion of nitrate levels in soils and their run-off into coastal waters are fuelling the proliferation of green algae (Ulva sp.), which constitute a drifting biological mass whose rapid putrefaction following their stranding on shores is proving toxic (Menesguen, 2021). The campaign against green tides, through the regulation of nitrate effluents via local plans2, is seen as a public objective weighing on pig farming, an important sector of the regional agro-industrial complex. Meanwhile, the sustainability of the shrimp fishery, which over the past twenty years has become one of the key resources of the Quebec fishing industry, is threatened by the instability of wild stocks3. Encouraged by proactive economic policies, the food processing sector has made major R&D efforts to add value to shrimp residues, seeking to overcome the sector's weaknesses in a region facing recurring regional development problems. Against this backdrop, a number of players are basing their economic activity on the collection, processing and valorization of these blue by-products. Since the mid-2000s, we have seen the emergence of a Breton value chain involving companies affiliated with the regional agro-industrial sector, deploying non-energy valorization for the animal and plant health markets. In Quebec, following on from scientific studies, shrimp processing plants are equipping themselves to ensure the valorization of shrimp by-products for the agri-food, human and animal industries, as well as diverse applications in various sector.

These case studies enable us to compare the forms of territorial hybridization between circular economy and blue bioeconomy projects, as well as the political and economic uses of these two motifs. The first set of results concerns the tensions between the creation of a new economic model that is autonomous in its supply and the maintenance of a dependence, linked to the availability of the resource, on threatened or changing historical sectors. Are operators developing blue by-products seeking to emancipate themselves by linking up with other sectors offering them opportunities? Do territorialized value chains present particular limitations in this respect? A second set of results concerns the political limits of the blue by-products economy in regional contexts of uncertainty. Do we observe differentiated strategies for adapting to uncertainty? Do the repertoires of the circular economy and the blue bioeconomy constitute repertoires that operators mobilize to legitimize their value chain? Are the difficulties of building a territorial brand around blue by-products, such as Breton green seaweeds, compensated for by integration into projects claiming to be part of the blue economy?

Bourblanc, M. (2016). Définir des indicateurs en milieu controversé: Retour sur l'expertise scientifique "Algues vertes" en France. VertigO: la revue électronique en sciences de l'environnement, 16(2). https://www.erudit.org/fr/revues/vertigo/2016-v16-n2-vertigo02855/1038175ar/

Brun, A., & Haghe, J.-P. (2016). Les médias, les algues vertes et le modèle agricole breton. L'Espace géographique, Tome 45(2), 142-156.

Giampietro, M. (2019). On the Circular Bioeconomy and Decoupling: Implications for Sustainable Growth. Ecological Economics, 162, 143-156. https://doi.org/10.1016/j.ecolecon.2019.05.001

Laperche, B., de Rouffignac, A., Pawlicki-Jullian, N. (2024) Les filières de production. Nouvelles analyses au prisme de la bioéconomie. Technologie et innovation, Les filières de production dans la bioéconomie, 9 (1), 1-13. ⟨10.21494/ISTE.OP.2024.1057⟩. ⟨hal-04394672⟩

Le Chêne, M. (2012). Algues vertes, terrain glissant. Ethnologie française, 42(4), 657-665. https://doi.org/10.3917/ethn.124.0657

Levain, A. (2020). Faire face aux "marées vertes", penser les crises du vivant. ethnographiques.org, 27. http://www.ethnographiques.org/2013/Levain
Ménesguen, A. (2021). "Marées vertes", une conséquence dérangeante de nos déchets azotés. Raison présente, 220(4), 49-56. https://doi.org/10.3917/rpre.220.0049

Keywords: blue byproducts, blue bioeconomy, circular economy, regional value chains, Quebec, Brittany

Biochar and circular agricultural systems: an application to Viticulture production system

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Biochar is a carbon-rich product resulting from the pyrolysis combustion of biomass, which has the ability of both trapping soil carbon and improving its properties, mainly by preventing erosion and water draining. It has also the ability to restore essential organic matter lost with the removal of biomass from agricultural systems. Biochar has been experienced from a long time by Amazonian communities, allowing to preserve their soil by the " terra preta " ancestral practices. Moreover, as it can be produced by burning biomass wastes, it can contribute to the promote circular agroeconomic systems. It can also give another source of income to the agricultural sector by providing a supplementary energy source and soil amendment through its production of heat and of bio-oil by- products.

Biochar techniques have been experienced in various contexts, using different pyrolysis techniques and biomass inputs (mainly, waste and agricultural residues), on different soils and in different agricultural contexts. The aim of this paper is (i) to evaluate the economic feasibility of Biochar and its different advantages, which go far beyond its direct valuation through current techno-economic

analysis, (ii) to assess its ability to promote circular economy at different farm levels (iii) to present a project, the REVIVFI project, launched in the French Centre Val de Loire region, which proposes to implement Biochar production and use in vineyard, in order to remediate long term soil pollution by the Bordeaux mixture.

- A literature survey on Biochar exhibits a huge diversity of results, related to the production technique of biochar, the nature of the soils on which it is used, and the different technical configurations implemented, slow pyrolysis being the most widely used.

For the use of Biochar as an agricultural soil improver, its benefits are highly dependent on the nature of the soils concerned: while Biochar's ability to improve the soil's capacity to retain moisture and nutrients is undeniable, this capacity mainly concerns degraded soils.

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The benefits of adopting Biochar as a soil amendment go farther than its only direct agricultural gains. They have to be calculated over a long-term scale, as its ability to sequester carbon in the soil persists over a long time. This property allows it to be considered as a powerful Carbon Dioxid Removal (CDR) technique. Another benefit lies in its ability to prevent water erosion, pollutant infiltration (mainly, Nitrogen) and fertilizer persistence in the soil. Biochar appears as a powerful tool to improve soil quality at a low cost, jointly with improved seed varieties and SWC (Soil and Water Conservation) techniques.,All these benefits are difficult to evaluate, but are necessary to realize a comprehensive cost/benefits analysis of biochar.

(ii)The economic and environmental benefits of Biochar are mainly depending on whether it is produced locally, on a scale that can vary, or purchased from external suppliers. Their economic valuation needs also to take account of its contribution to a circular economy scheme, at various scale, from farm small production units to large-scale industrial units using urban wastes. The economic balance of different projects depends highly on their ability to be included in local circular economy networks. A large number of studies are devoted to various configurations where biochar is produced locally, mainly from agricultural waste, in units of varying size, with recovery of the heat produced by combustion to meet the needs of the farm, and optimization of the fertilizers and biochar composition. More specific uses for biochar have also to be considered, notably for the polluted or degraded land remediation as the REVIVIFI case study. Then considering a circular economy approach improves the cost/benefit balance of biochar and will make it a decisive factor in the search for new agro-ecological practices. (iii)The REVIVIFI regional project lies in a case study on the implementation of biochar production using vineyard wastes (vine shoots, grape marc, other wastes). Biochar will be incorporated in the soil and then will fix copper residues incorporated in the soil after years of Bordeaux mixture use. Moreover, the biochar pyrolysis burning produces bio-oil by-products, which can be used as soil amendment, improving its ability to fix copper. The REVIVFI Project will assess the gains linked to the use of Biochar use in vineyard, in different soils and landscape contexts, from an agronomic and an economic point of view.

Keywords: Biochar Agroecology Viticulture Soil remediation

Territory and Governance of Circular Bioeconomy Projects – The Case of Pomegranate Juice By-product Valorization in Southern France

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The quest for independence from fossil resources entails, notably, an increased reliance on biomass, in other words, expanding its non-food uses, which in turn intensifies competition with its food uses (Bobulescu, 2015). Overcoming this tension between intensification and the competition of food and non-food uses seems to involve implementing cascading valorization, particularly of waste and organic by-products from agricultural and agro-industrial activities. The realization of this technical "solution," which allows for the superimposition of multiple complementary valorizations, requires reorganizations of the productive system, particularly by linking the agricultural and agro-industrial sectors with a new diversity of industries (Colonna et al., 2020; Girard, 2022). From one territory to another, the reorganizations induced by cascading valorization vary and locally produce new productive systems with characteristic governance and performance (Benoit, 2021; Donner et al., 2020). While this diversity is well-studied, it remains to understand what has produced it in the territories, particularly the material and immaterial resources necessary for its emergence.

Based on Torre's work on territorial development (Torre, 2023), this article explores the connections between proximity relations, stakeholder behaviors according to Hirschman's model (Exit, Loyalty, Voice) (Hirschman, 1970), and their consequences on the shaping of cascading valorization projects. These projects are conceived here as organizational and territorial innovations. As such, these circular bioeconomy projects result from a system of heterogeneous stakeholders with situated rationality, whose confrontation of interests allows for the emergence of new governance of production at the territorial level. To account for these stakeholders, their interests, and their strategies, we focused on the case study of valorizing by-products from the pomegranate sector in southern France. We conducted semi-structured interviews with the stakeholders involved in this emerging production system. We analyzed the norms, regulations, and contracts that govern their interactions. To simulate the confrontation of represented interests, our fieldwork culminated in a participatory workshop bringing together the interviewed actors.

Our analyses reveal the dynamics at play in the formation of a new circular bioeconomy value chain, centered on the valorization of organic waste. This process involves a complex interplay between farmers, agri-food industries, energy industries, other non-food industries (cosmetics, pharmaceuticals, etc.), and institutional actors (local authorities, research institutes, etc.). The discussions that shape this emergence focus on the distribution of responsibilities, investments,

*Speaker

and value. Each stakeholder asserts their position based on their resources and the asymmetry of their relationships with other system participants. The emergence of such a value chain has the potential to disrupt the existing organization of production, creating conflicts and confrontations that are resolved differently depending on the territory. For example, it could alter upstream-downstream relationships between agri-food industries and farmers by introducing new interlocutors for the latter, giving them the opportunity to escape asymmetric relationships prevalent in certain food systems.
Keywords: circular bioeconomy, territory, productive system, governance

Benoit, S. (2021). Bioéconomie et diversité des ancrages territoriaux. *http://journals.openedition.org/economi* *Avril-Juin*(376), 77-91. https://doi.org/10.4000/economierurale.8944

Bobulescu, R. (2015). From Lotka's biophysics to Georgescu-Roegen's bioeconomics. *Ecological Economics*, *120*, 194-202. https://doi.org/10.1016/j.ecolecon.2015.10.016

Colonna, P., et al (2020). New issues to meet bioeconomy challenges and opportunities. *Natures Sciences Societes*, *27*(4), 433-437. https://doi.org/10.1051/NSS/2020003

Donner, M., Gohier, R. et de Vries, H. (2020). A new circular business model typology for creating value from agro-waste. *Science of the Total Environment*, *716*, 137065. https://doi.org/10.1016/j.scitotenv.2020.137065

Girard, G. (2022). Does circular bioeconomy contain singular social science research questions, especially regarding agriculture – industry nexus? *Cleaner and Circular Bioeconomy*, *3*, 100030. https://doi.org/10.1016/j.clcb.2022.100030

Hirschman, A. O. (1970). *Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations, and States* (edited by Harvard University Press).
Torre, A. (2023). Contribution to the theory of territorial development: a territorial innovations approach. *Regional Studies*, 18. https://doi.org/10.1080/00343404.2023.2193218

Keywords: Circular bioeconomy, territory, productive system, governance, innovation, Territorial Development

2.D : Approaching Bioeconomy in Japanese Regional Economic Research – Exploring Territorial Dynamics

Toward a Local Circular Economy: Visualization of Transaction Structures and Business Networks of Resource-Upcycling Companies in Rural Japan

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The development of a circular economy (CE) that aims to balance environmental sustainability and economic growth has become an urgent global issue. In Europe, supported by EU policies, CE principles have been institutionally integrated into regional strategies and are being steadily implemented across both urban and rural areas. In Japan, initiatives such as the Ministry of Economy, Trade and Industry's Circular Economy Vision 2020 and the Ministry of the Environment's Regional Circulating and Ecological Sphere have promoted the use of local waste and underutilized resources to advance CE practices. As a result, resource-upcycling companies have garnered increasing attention as key actors in this process.

However, while these companies are expected to enhance resource efficiency and generate business and employment opportunities within local economies, there remains a lack of empirical studies examining the actual structures of resource and economic circulation and their impacts on regional economies (Ghisellini et al., 2016). Furthermore, there is a shortage of data and analytical methods necessary for quantitatively assessing micro-level economic circulation within regions (Fujimoto & Ikejima, 2022; Ikejima, 2022). To fully understand the potential of CE, it is essential not only to evaluate the economic efficiency of resource-upcycling companies but also to visualize how their activities are embedded in local economic structures-such as the formation of supply chains and networks-and what kinds of economic effects they generate.

This paper focuses on resource-upcycling companies in rural areas of Japan that are engaged in the reuse and upcycling of food waste and unused agricultural products. It aims to analyze the structures of both resource and economic circulation within these regions. Specifically, the research clarifies the business models of the target companies, identifies their transactional structures with Tier 1 and Tier 2 partners, examines the geographical distribution of these relationships, and visualizes money flow within transaction networks.

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Keywords: Circular Economy, Environmental sustainabilityand economic growth, Transaction structures, local economies

Development and Challenges of Alternative Regional Economic Studies

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Since the 1990s, globalization has led to corporate concentration and population inflow in Japan's urban areas, while rural regions have experienced depopulation and economic decline. One factor behind this disparity is the externally driven development model, such as attracting branch plants or implementing large-scale public projects. In response, Japanese regional economic studies have explored alternative development approaches influenced by endogenous development theory. These approaches focus on local reinvestment and expanding intra-regional trade to build regional economic circulation. Researchers have investigated whether such circulation can improve local income and money inflow, analyzing network structures and their spatial characteristics.

At the same time, the world faces pressing environmental challenges, including global warming, marine pollution, and biodiversity loss. Balancing economic growth with environmental protection has become a major global issue. A transition is needed from the traditional linear economy-based on mass production, consumption, and disposal-to a circular economy, which aims to reuse resources and reduce environmental impact. In Japan, pollution-related health problems emerged during the rapid economic growth of the 1960s, prompting early environmental action. However, inspired by Europe's framing of the circular economy as economic policy, Japan is now shifting its focus from purely environmental measures to integrated economic strategies.

This paper aims to explore alternative regional development policies that balance local economic growth and environmental sustainability. By reviewing research on the circular economy as an economic policy tool that promotes resource reuse and regeneration, the study highlights how creating resource and economic loops within specific regions can contribute to local revitalization. The concept of "circulation"-both of materials and economy-within regional boundaries is presented as a key factor in addressing the dual challenges of regional decline and environmental sustainability.

Keywords: Endogenous development theory, Local reinvestment, Economic circulation, Circular economy

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2.E : Modelling Approaches for a Sustainable Bioeconomy

Modelling approaches for a sustainable bioeconomy

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The transition toward a sustainable bioeconomy presents both an opportunity and a challenge. While the bioeconomy offers a pathway to reduce dependence on fossil resources, promote circularity, and enhance ecosystem services, its implementation raises critical questions about land use, biodiversity, socio-economic equity, and long-term viability. In this context, modeling approaches are essential tools for supporting decision-making, informing policy design, and exploring the systemic implications of bioeconomy strategies.
This special session will explore how modeling approaches can contribute to understanding and shaping sustainable bioeconomy trajectories. The session will highlight both methodological advances and applied case studies, with a focus on how models capture the complexity of interactions among environmental, economic, and social systems.

We aim to foster dialogue between disciplines and between academic and non-academic actors. By bringing together researchers with diverse modeling perspectives and empirical focuses, this session will illustrate how models are used to address key questions in the design and governance of the bioeconomy: What are the sustainability trade-offs and synergies involved in bio-based transformations? How do spatial and temporal scales affect modeling outcomes? How can stakeholders be involved in co-producing models that are both robust and relevant?

The session will feature four contributions, each reflecting a different modeling approach and application context. Together, they will offer a comparative lens on the strengths, limits, and complementarities of current modeling efforts.

Presenters and Proposed Contributions:

- MAELIA: an integrated modelling and assessment platform to support a sustainable bioeconomy.
  Therond O., Delattre H., Villerd J., Lenoir A.

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- Quantitative assessment of bioeconomy systems' sustainability: strengths, limits and research agenda.
  Wohlfahrt, J., Therond, O., Gerbel, S.

- Simulating Biomass Chains for Agricultural and Bioeconomy Transitions: An Agent-Based Modelling Approach.
  Delattre H., Therond O.

This session aligns closely with three of the themes of the conference by addressing the methodological foundations and practical applications of modeling in bioeconomy research and governance. It also aims to initiate a broader conversation on how models can be more effectively mobilized to support sustainability transitions in diverse contexts.

Keywords: Agroecology, bioeconomy, Integrated Assessment and Modelling, modelling platform, social, ecological system, territorial scale

MAELIA: an integrated modelling and assessment platform to support a sustainable bioeconomy

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Achieving carbon neutrality by 2050 and broader sustainability goals requires transformative approaches that reconcile food and non-food biomass production with the conservation and regeneration of natural resources. Local to regional bioeconomy projects allow combining diverse strategies, including agroecological systems, optimized biomass-chains and resource use, collective action, and virtuous circles of interactions (e.g. circular economies, stronger rural-urban links).
The design of a sustainable territorial bioeconomy system requires a multi-criteria, and multi-level *ex-ante* assessment approach to identify the trade-offs to be manage and the possible synergies of transition scenarios (Wohlfahrt et al., 2019). Integrated Assessment and Modelling (IAM) approaches offer a powerful framework designed to address complex sustainability issues and support both assessment and decision-making purposes (Hamilton et al. 2015). By enabling the integration of diverse knowledge systems (general multidisciplinary and empirical knowledge), IAM provide stakeholders with actionable information on the environmental, social, and economic impacts of potential future scenarios of structure and dynamics of social-ecological systems, such as bioeconomy systems.

MAELIA is a multi-agent platform for IAM of agricultural and bioeconomy systems at local to regional level. MAELIA simulates, on a daily time step, the interactions between biomass production system, biomass value-chains (processing chains and cascade), recycling activities. Regarding agricultural systems it simulates interactions between agricultural practices, biogeochemical cycles (water, N and C), crop growth and farm's socioeconomic performances, taking into account climate and agricultural price variability. Crop management strategies involving vegetal cover management (annual and perennial crops and cover crop), mineral and organic fertilization (e.g., organic inputs), irrigation and crop residue management are explicitly simulated on a field scale. Developments carried out have enabled MAELIA to incorporate an explicit representation of the structure and dynamics of organic waste chains, as well as a dynamic version of the SYS-METHA model of biogas plants that simulates the production of energy, digestate (quantity and quality) and associated N2O and NH3 emissions.

MAELIA enables assessment of a wide range of performances over a multi-year period, from plot level to territorial level, via socioeconomic indicators (gross margin, working time, production, etc.), agro-environmental indicators (yield, nitrate leaching, ammonia emissions, TFI, GHG emissions, etc.) and ecosystem services (nitrogen supply, water quality regulation, C storage, soil

*Speaker

quality, etc.). These indicators can be analyzed dynamically to assess the resilience/vulnerability of performances to climate (past or future) and/or price variabilities.

MAELIA is modular and, by activating various models and modeling options, is used to define a modeling solution tailored to the issues to be addressed in a given territory. MAELIA has been applied in a variety of French territories to address issues relating to water management, crop-livestock systems, organic wastes management and the development of agro-ecological systems.
The SLAM-B project (FairCarboN PEPR, C6.5m, 2023-2028) aims to expand MAELIA's functionalities to make it an operational and generic IAM tool for supporting stakeholders in designing a circular green bioeconomy. MAELIA will be applied in 7 contrasted living-labs situated in France (metropolitan and overseas departments) and Senegal and will integrate models of biorefineries, livestock farming, forest growth and management, urban metabolism and socio-economic indicators of biomass value-chains. This project will also structure the MAELIA platform for application on a French and European scale, providing decision-makers with a large-scale planning tool dedicated to agriculture and the bioeconomy. SLAM-B therefore aims to significantly increase MAELIA's genericity with regard to territorial bioeconomy issues, positioning this platform as a key tool in this field, in France and internationally. To meet the growing demand for use of the platform, which was no longer a concern of the academic sphere, the start-up MAELAB (https://www.maelab.fr/) was created in July 2021. MAELAB is responsible for deploying MAELIA in the economic sphere.

Keywords: Integrated Assessment and Modelling (IAM), Territorial scale, Agent, based modelling, MAELIA plateform, Circular bioeconomy, Social, ecological system

Quantitative assessment of bioeconomy systems' sustainability: strengths, limits and research agenda

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Introduction

The bioeconomy aims to replace fossil-based products with bio-based alternatives to ensure the continued provision of food and non-food goods to society, while preserving natural resources and drastically reducing GHG emissions. However, the development of the bioeconomy may lead to significant negative impacts due to increased biomass withdrawals and the expansion of processing and transport activities. Therefore, quantitatively assessing the performance of bioeconomy systems is crucial to ensure that the bioeconomy fulfills its promises of sustainability. Sustainability assessments of bioeconomy systems must consider key processes and dimensions (Wohlfahrt et al., 2019):

(i) the entire bio-based value chain, including biomass production, transport, processing, distribution, consumption, and recycling;

(ii) the bioeconomy as a socio-ecological system shaped by natural and socio-industrial processes that are spatially and temporally structured;

(iii) a multi-criteria perspective, as the bioeconomy must address multiple challenges such as food and non-food provision, GHG mitigation, natural resource and biodiversity preservation, and economic development.

To our knowledge, no comprehensive review has yet provided a detailed analysis of studies dealing with the sustainability of bioeconomy systems. This study aims to fill this gap by reviewing the existing literature on sustainability assessment approaches applied to bioeconomy systems. Specifically, we aimed to describe: (i) the types of value chains studied; (ii) the models and methods used; and (iii) the performance criteria employed.

Materials and Methods

To identify relevant articles, we developed a search query and ran it on the Web of Science Core Collection (WoS CC). The query was built around four dimensions of the bioeconomy and associated keywords:

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- "Biomass", to target articles addressing biomass-related activities. We chose this term over "bioeconomy" to focus on bioeconomic activities that inherently involve biomass use.
- "System", to select articles considering bioeconomy systems rather than isolated activities.
- "Circular," "environment," "sustainability," "GHG," "carbon," and "greenhouse gases", based on the assumption that bioeconomy studies frequently address climate-related issues.
- "Evaluation," "assessment," "model," "indicator," and "LCA", to identify studies applying assessment methodologies.

The query initially returned 5204 articles. After screening for relevance and accessibility, we narrowed the selection to 93 articles.

Results and Discussion

Our findings show that most studies focus on agricultural feedstocks and bioenergy production. No study addressed all stages of bio-based value chains. Most research targets the upstream segment of the value chain-namely biomass production, transport, and transformation-with transformation being the most frequently studied activity (89% of articles). This highlights a prevailing biotechnological vision in bioeconomy research, centered on biomass conversion processes.

The concept of biomass cascading-central to the circular bioeconomy and involving the sequential use of biomass for maximum value-is addressed in only 5 studies. The predominance of bioenergy-focused studies likely contributes to this neglect. Additionally, the limited analysis of multi-product/multi-process value chains may reflect the complexity involved in studying, modeling, and assessing such systems. The vast diversity of potential biomass uses and the proliferation of emerging bio-based products complicate the selection and assessment of cascading pathways. In line with Wohlfahrt et al. (2019), we call on the bioeconomy research community to document existing complex chains and develop frameworks capable of capturing their structure and sustainability implications.

Regarding assessment methods, Life Cycle Assessment (LCA) dominates, used in 83% of studies. Fewer than 10% apply simulation models to represent dynamic biophysical or logistical processes, despite these models being well-suited for simulating and assessing bioeconomy systems. Likewise, few studies are spatially and/or temporally explicit. Only 22 studies (less than one-quarter) account for interactions between soil-climate conditions and land use practices. Although simulation models can effectively capture dynamics, they typically address only one activity-e.g., crop models for biomass production-and do not encompass the full biomass-to-bioproduct cycle. Conversely, LCA addresses entire value chains but lacks the capacity to account for biophysical and sociotechnical specificities and dynamic changes. To overcome the limitations of each of these two assessment approaches, some innovative studies have combined them. For instance, Cirone et al. (2025) coupled the MAELIA platform (Misslin et al., 2019), which simulates agricultural system dynamics at the landscape scale, with LCA to perform a Territorial LCA of local food systems that reflects biophysical and agricultural specificities.

We identified 92 different indicators used to assess bioeconomy system sustainability. The most frequently used were GHG emissions and energy efficiency. Overall, sustainability assessments remain heavily focused on environmental indicators. This reflects the dominant perception of the bioeconomy as a climate change mitigation strategy, primarily through the substitution of fossil resources. However, this focus results in a partial sustainability assessment, overlooking social and economic dimensions. A more balanced, multi-criteria approach is needed to fully

assess bioeconomy sustainability.

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Keywords: biobased chain, production, transformation, transport, bioproduct, LCA, model

Simulating Biomass Chains for Agricultural and Bioeconomy Transitions: the agent-based model, BioChains

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The agent-based model BioChains aimed at modelling and simulating the biomass flows between production and processing plants to support the design of sustainable territorial bioeconomic systems (Wohlfahrt et al. 2019).
Starting from concepts and formalisms of the existing UPUTUC model (Soulié et al. 2017), biomasses are represented as " pools ", defined by their volume and type, transiting through multiple production, processing and consumption "units". In addition to their type (e.g: Faba beans, corn silage, pig slurry etc), each biomass pool is characterised by its age and physical characteristics (e.g.: dry matter, nitrogen content, phosphorus content etc), which may vary on a daily basis, due to phenomena such as degradation within storage units.

BioChains has been designed to represent five layers of phenomena regarding the prospects of biomass pools in a territory;

- Wells and sources of biomass: where are produced and consumed biomass pools? And at which rate?

- Storage: what are the maximum capacities and storage conditions offered by the units of the territory? How do the physical characteristics of biomass pools change between the time they are stored and the time they are retrieved?

- Transportation: how are biomass pools moved from one unit to another? How can exchanges between units be assured, depending on the characteristics of freight companies' fleets?

- Processing of biomass: What biomass pools are needed and processed by biomass processing plants of the territory?

- Performances: how much greenhouse gases are emitted by composting or degradation during storage of a given quantity of biomass? How much bioproducts (e.g.: biogas, biomaterials) are produced through the different processing plants? How the transportation traffic in increase due to the development of the bioeconomy?

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BioChains allows integrating multiple coarse- or fine-grained bioprocess models. The bioprocesses currently implemented are anaerobic digestion (through the SysMetha model) and household composting. An industrial composting platform model and a bioplastic production plant model are also underway. In a more general manner, the BioChains model has been designed as a framework into which new bioprocesses can easily be described and communicate between each other through generic interfaces.

The BioChains module provide its users with building blocks allowing to model and simulate multiple scenarios of biomass chain organisations, like linear vs. cascading and circular ones, thus making it possible to assess their respective environmental and economic performances.

Being powered by the GAMA platform, the BioChains module is designed to be pluggable into the MAELIA platform (Misslin et al., 2021) to simulate interactions between agricultural, hydrological and biomass pools dynamics. BioChains is capable to interact with MAELIA agents as well as to function as a " standalone " model. This coupling possibility adds the ability to test bioeconomy scenarios to MAELIA's Integrated Assessment Modelling approach (for example; which feasibility for a specific transformation unit layout on a territory? What scaling for the logistics around the upcycling of a given organic waste product?).

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References

Misslin R., Clivot H., Levavasseur F., Villerd J., Soulié J.-C., Houot S., Therond O., 2022. Integrated assessment and modeling of regional recycling of organic waste. Journal of Cleaner Production, 369. https://doi.org/10.1016/j.jclepro.2022.134725

Wohlfahrt J., Frechaud F., Gabrielle B., Godard C., Kurek B., Loyce C., Therond O., 2019. Characteristics of bioeconomy systems and sustainability issues at the territorial scale. A review. Journal of Cleaner Production. https://doi: 10.1016/j.jclepro.2019.05.385

Soulie Jean-Christophe, Wassenaar Tom. 2017. Modelling the integrated management of organic waste at a territory scale. In : MODSIM2017 Managing cumulative risks through model-based processes. Abstracts. Syme G. (ed.), Hatton MacDonald D. (ed.), Fulton B. (ed.), Piantadosi J. (ed.). Hobart : Modelling and Simulation Society of Australia and New Zealand, Résumé, p. 75. ISBN 978-0-9872143-6-2 International Congress on Modelling and Simulation (MODSIM2017). 22, Hobart, Australie, 3 Décembre 2017/8 Décembre 2017.

Keywords: biobased chain, production, transformation, transport, bioproduct

3.A : Promises and Socio-Economic/Ecological Challenges of Agricultural Methanization in the Grand Est Region (France)

Anaerobic digestion, Innovation and Localization: the Cross-Border Circulation of References from Germany to France in the Grand Est Region (France)

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Based on on-site observations and more than 70 sociological interviews with farmers in the Grand Est region conducted from November 2022, this paper explores the ambivalent perception of the "German model" of anaerobic digestion, which is both held up as an example due to its earlier implementation and criticized for encouraging agricultural intensification. Analysis of the development of biogas plant manufacturers – mostly German companies – reveals the cross-border circulation of references from Germany to France and sheds light on the role played by these go-betweens and visits to biogas plants on the dissemination of technologies to the Grand Est region. The paper, then, offers a sociological reflection on the processes of local and professional adaptation and appropriation of anaerobic digestion models, which makes it possible to go beyond the simplistic opposition between farmers and energy providers. This study ultimately draws attention to the tension, both in Germany and France, between the two goals of decarbonizing the economy and achieving environmental sustainability – in other words, between energy and ecological transition – revealing complex spatio-temporal dynamics in the development of the on-farm anaerobic digestion sector and providing for a better understanding of current and future challenges.

Keywords: Agricultural anaerobic digestion, renewable energy, biogas plant manufacturers, circulation of references, sociological interviews, Germany/France, Grand Est region

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Towards a Diversity of Agricultural Bioeconomy in the Grand Est Region (France): A Socio-Ecological Analysis of On-Farm Biogas Production

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The ecological bioeconomy, conceptualized by Nicholas Georgescu-Roegen in the 1970s, proposes a fundamental rethinking of the relationship between the economic system and the biophysical limits of the planet (Debref, Vivien, 2021; Georgescu-Roegen, 1975, 1984). His work called for a shift toward resource cycles based on organic materials, an idea that continues to fuel debates in social-ecological economics. Recent research highlights the persistence of competing and complementary visions of the bioeconomy, shaping diverse innovation dynamics and influencing the resilience of agricultural models (Grouiez *et al.*, 2023; Vivien *et al.*, 2019). This diversity extends to agricultural systems, which play a central role in supporting these various trajectories. Among these models, the rise of *energy farming model*-where biomass is cultivated for green energy production. This approach is largely driven by anaerobic digestion technology, known as agricultural methanization, which has become a strategic investment for farms. By adopting this model, farmers navigate the intersection of two socio-technical regimes: agriculture and energy. Agricultural methanization stands out therefore as a transformative mechanism, positioning farmers not only as food producers but also as key players in renewable energy production, in alignment with French public policy objectives (Berthe *et al.*, 2022). However, the extent to which this model accounts for the biophysical limits of the biosphere remains a subject of debate (Dziebowski *et al.*, 2023).
Our research explores the *energy farming* model, its issues, and its dissemination in the Grand Est region, recognized as a leader in France. Using a combination of heterogeneous data collected from this territory and an exploratory study based on both quantitative and qualitative methods, we adopt an evolutionary approach inspired by the social ecological economics to analyse the diffusion of agricultural methanization from the early 2000s to the present.

Our findings reveal that the *energy farming* model has given rise to three distinct business models along a broad spectrum. At one end, a highly productivist approach is characterized by the externalization of transformation processes, while at the other, more integrated models align with the biophysical limits of the biosphere. We demonstrate how the expansion of agricultural

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methanization reflects diverse business strategies, shaped by farmers' relationship with biomass, its uses, and their perception of renewable energy production in agriculture. These contrasting models highlight different ways of integrating environmental constraints and redefining the relationship between agriculture and nature, contributing to either an ecological or a non-ecological bioeconomy.

References

BERTHE, A., GROUIEZ, P., FAUTRAS, M., (2022), Heterogeneity of Agricultural Biogas Plants in France: A Sectoral System of Innovation Perspective, Journal of Innovation Economics Management, Im-24.

DEBREF, R., VIVIEN, F.-D., (2021), Quelle bioéconomie? Les enseignements d'une controverse en France à la fin des années 1970, Economie rurale, (n○ 376), 19-35.

DZIEBOWSKI, A., GUILLON, E., HAMMAN, P., (2023), Idées reçues sur la méthanisation agricole, CAVALIER BLEU.

GEORGESCU-ROEGEN, N., (1975), Energy and Economic Myths, Southern Economic Journal, 41(3), 347.

GEORGESCU-ROEGEN, N., (1984), Feasible Recipes and Viable Technologies, Atlantic Economics Journal, 12, 21-31.

GROUIEZ, P., DEBREF, R., VIVIEN, F.-D., BEFORT, N., (2023), The complex relationships between non-food agriculture and the sustainable bioeconomy: The French case, Ecological Economics, 214, 107974.

VIVIEN, F.-D., NIEDDU, M., BEFORT, N., DEBREF, R., GIAMPIETRO, M., (2019), The Hijacking of the Bioeconomy, Ecological Economics, 159, 189-197.

Keywords: Agriculture, Biogas Production

The metabolic approach for a better understanding of the socio-ecological issues associated with the development of agricultural methanisation

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Today's agricultural and food systems face a variety of constraints (environmental, economic, regulatory and social), encouraging rapid changes. These include diversification into non-agricultural activities and biomass energy recovery, including agricultural methanisation. The Grand Est region has the largest methanisation capacity in France, and is aiming for 264 units by 2030, in line with the French law on green growth. Marty et al (2021) have shown that the expansion of anaerobic digestion in northern Aube is creating major competition for biomass of agricultural origin, a resource whose management is at the interface of different national and local strategies (agri-food and energy), and for which decision-makers lack the systemic tools for appropriate planning. Territorial metabolism is an interesting way of analyzing the circulation and circularity of agricultural biomass flows, identifying interactions and competition phenomena between agricultural methanization and other sectors such as sugar beet, alfalfa and livestock farming, and grasping the issues relating to biogeochemical cycles thanks to a metabolic approach focusing on nitrogen and carbon and decarbon energy flows.

Keywords: Territorial metabolism, agricultural methanization

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Perspectives of the biomethane production growth by 2030 and 2050: what are the scenarios and impacts for the agricultural sectors?

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The recent announcements made by french gas operators to achieve 49 TWh of biomethane from methanisation by 2030 and more than 130 TWh by 2050. Compared with the current production of 13 TWh at the end of 2024, these figures raise questions about the ability to achieve these targets, both in terms of operational reality (time taken to process applications, local ownership and construction of units) and the potential impact on the agricultural sector, particularly in terms of competition over the use of biomass. While for some players '*With regard to the sustainability of biomass (...) this is more than 140 TWh of first-generation biomass, where there are no conflicts of use*', for others, the proposed dynamic could have an impact on the agricultural and livestock sectors in particular.

Several more or less systemic reports (Solagro, INRAe, FranceAgrimer, etc.) have been published in recent months to analyse both the potential competition for uses and the underlying assumptions for achieving the announced targets. All of these studies, reports and scenarios agree that the production of 140 TWh of biomethane by 2050 cannot be achieved without major impacts on the agricultural industry (particularly the decline in cattle numbers). In particular, it implies far-reaching systemic changes to our agricultural model (Solagro scenario in particular), which raises questions about the possible realities. For the time being, the scenarios do not seem to have incorporated these trade-offs into their forecasts, preferring to focus on decarbonisation strategies that use technological levers without reducing production volumes in either the animal or plant sectors.

Beyond this, it also seems necessary to ensure that biomass production is in line with the principles of agro-ecology (soil fertility conservation in particular), while preserving biodiversity and water quality and improving the capacity to store carbon in agricultural soils.

Keywords: Biomass, Scenarios, Transition, Competition, Sustainable.

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3.B : Approaching Bioeconomy in Japanese Regional Economic Research – Biomass, Co-Products, and Opportunities

Utilization of local resources in sake brewing and their potential

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This paper focuses on Japanese Sake production. Japanese Sake is made using rice and rice malt as the main ingredients, and undergoes a unique fermentation process known as multiple parallel fermentation, which is unique among brewed alcoholic beverages. Nicolas Baumert (2011) has introduced this as something unique to Japan.
As domestic consumption of sake has fallen sharply, small and medium-sized sake breweries in particular have been taking on new initiatives to survive. For example, there has been a shift to producing high-quality sake. This is shown in the production of "Special Designation Sake". In addition to being particular about the rice used as the raw material, they are pursuing measures such as increasing the rice polishing rate to reduce unpleasant flavors. In recent years, exports of this high-quality sake have also been progressing.
The rice used in sake brewing is called sake-brewing rice. There are about 120 varieties throughout Japan, which have been developed mainly by public testing and research institutes. Unlike wine grapes, rice can be stored for long periods and transported long distances. For these reasons, "Yamada-Nishiki", the most suitable variety for sake production, is used as an industrial ingredient in sake breweries all over the country. On the other hand, there are also many initiatives that emphasize locality, such as using locally grown rice to make high-quality sake. This is similar to terroir in wine, and also extends to maintaining Japan's rural landscape and revitalizing local communities.
In addition, the reuse of rice bran and sake lees generated during sake production, that is, upcycling, is also progressing. Originally, rice bran was used as fertilizer and animal feed, as well as an ingredient in sweets. Sake lees were also used in traditional Japanese meals. However, as lifestyles change and these values are being lost, new value is being added through product development. We will consider the implications that these new trends bring to regional values and the circular economy.

Keywords: Japanese Sake, revitalizing local communities, local values, circular economy

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Valuation of Local Forest Resources in Furniture Production Society in Japan

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Our research has two important problematics in the economy of Capitalism, the societal relationships with nature on the one hand and the decline of local industry and economy on the other hand. We consider the relationships with nature in local society as a fundamental space to rebuild the relationships with nature in our global society. In this context, we therefore place the local economic society as territory of daily life on the heart of our analysis to rebuild the relationships between nature and human beings. In more detail, we pay attention on the role played by products of local industry utilizing local natural ressources in order to reconstruct the local society in where nature, local industry(economy) and our daily life are complementary connected via local industry's product. In this general framework of our research problematic, we will more concretely study the local furniture industry and also the role of furniture products made by local forest trees. The object of this article is therefore to examine values of the utilization of local forest trees and its furniture products. We will introduce some cases of major production areas of furniture in Japan. Through these case studies, we will propose possibilities of local tree's furniture to recreate a local society of furniture production, which will permit to complementary connect forest, our living and local furniture industry. On the one hand, the utilization of local trees could connect different players of furniture manufacturing toward a collective community. On the other hand, the furniture of local trees could give an opportunity to concern the local forest to citizens thourough the relationships with consumers. Thus, while the utilization of local trees in the manufacturing of furnitures create the economic value on the trees, we would like to insisit more social values created by local forest trees to reconstruct our local society and also our global society. Values are not given, but could be created and recreated.

Keywords: Forest resources, Local trees, Local Furniture industry, Valuation, Watershed society

*Speaker

3.C : Social Anchoring and Territorial Dynamics in the Bioeconomy

Bioeconomy is local and requires tailor-made performance indicators for informed decision making: a review of existing indicators and insights from stakeholders consultations

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Life Cycle Assessment (LCA) has been widely adopted and has proved its relevance for informing on potential environmental impacts (eLCA) of products, services and/or massive investments. This is particularity true for decisions to be taken with regards to bioeconomy investments, confronted with the challenge of sustainably mobilizing additional biomass and eventually energy resources for products and services demanded in the economy. However, LCA extension to Life Cycle Sustainability Assessment (LCSA), which integrates economic (Life Cycle Cost) and social (Social Life Cycle Assessment) aspects, has yet to gain equally widespread acceptance. Mobilizing eLCA alone then limits the possibilities of correctly reporting on the three dimensions of sustainable development with the aim of supporting relevant bioeconomy policy making. Moreover, due to a lack of understanding of some LCA indicators, decision makers and stakeholders in the bioeconomy sometimes find it difficult to exploit the results of these assessments. This is a shortcoming to overcome in order to ensure and accelerate the investments needed to launch a strong and sustainable bioeconomy in Europe.
The research presented herein aims to overcome this limitation. It builds on the premise that bioeconomy, unlike petro-economy, is local and happens on territories with different realities across Europe. The aim is twofold: (i) establishing a conceptual framework providing bioeconomy stakeholders with key performance indicators (KPI) that they understand, need and that are operational, for informed decision-making towards sustainable and resilient bioeconomy and (ii) enabling stakeholders to play an active role in selecting and developing these KPI.

This work is part of an ongoing study, of which the 3 first phases are performed; the results of these will be presented herein. First, we reviewed the literature reporting indicators for the wide sectors covered by the bioeconomy concept, relying in particular on the work of the European Union(1) and the Food and Agriculture Organization (FAO) of the United Nations(2).

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It led to a set of more than 700 indicators, that we assembled and organized within a common, flexible referential framework, making it possible to account for economic, environmental and social effects, but also sectoral particularities (agricultural, forestry, fishery, food and agroindustry, bio-based construction material and furniture, pulp and paper, bio-based textiles, bio-based chemicals and polymers, healthcare and bio-pharmaceutical and bioenergy).

Second, 27 interviews were conducted with selected European experts in the field of bioeconomy, agronomy, social and economics sciences, prospective, agriculture and multi-criteria. These were 1-hour semi directive online interview, the purpose of which was, among other things, to capture the concerns of various stakeholders in the bioeconomy; to identify relevant indicators, methodologies or conceptual frameworks with regards to bioeconomy decision-making; and to confront our initial working hypotheses with the opinions of experts.

These interviews and the initial set of 700 indicators were used to propose and conduct a collective intelligence workshop. During this workshop, the participants first established the specific characteristics of the territory under study. These characteristics were organized around the triptych of vulnerability, opportunity, and territorial/political objectives, which was then used to define a limited list of tailor-made indicators that were ranked by the stakeholders.

(1) https://knowledge4policy.ec.europa.eu/bioeconomy/monitoring_en

(2) https://openknowledge.fao.org/server/api/core/bitstreams/95937318-a0be-40d5-82b2-2277dd98add5/conte

Keywords: Indicators, circular bioeconomy, territoire

The Non-take-up of French Farm Holders, from social rights to CAP

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The Non-take-up of French Farm Holders, from social rights to CAP

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Communication proposal to

Towards an Ecological Bioeconomy: Integrating Concepts and Practices from the Human and the Social Sciences congress.

Through their production, farmers are at the heart of the emerging and promising bioeconomy, which relies on renewable resources (European commission 2018). However, frustration is growing among French farmers, who are still awaiting European subsidies. Protests and road blockages have been taking place across rural areas and major cities. In some cases, farmers have even taken control of municipal buildings, as seen in the department of Indre, France (France Info, 2024). Paradoxically, while the agricultural population feels increasingly marginalized-expressing their frustration through demonstrations and even tragic cases of suicide-the promises of the bioeconomy have never been more celebrated as a model of success.

Since the bioeconomy impacts society as a whole, it is essential to focus more on farmers' incomes, particularly as they are undergoing changes. As their profession evolves, farmers are now required to manage biomass for both food and non-food purposes, a shift that can directly affect their revenue streams (Grouiez et al, 2023). This situation calls for a mechanism that addresses both social inequalities and economic objectives. A dual approach like this could

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be reflected in a social protection system that ensures social justice-a fundamental pillar of an ecological bioeconomy which its essential as without such mechanisms, the bioeconomy risks being "*hijacked*" by market-driven interests, undermining social equity and long-term ecological sustainability (Vivien and al, 2019).

One of this important agriculture social protection forms is a European political tool established as early as 1962, the Common Agricultural Policy (CAP). With its social and economic objectives, it has had a significant positive impact on the European Union's exports (OECD, 2018). It has also influenced land use, as well as the income and production of most agricultural activities (OECD, 2011, CAPRI model). Meanwhile, its objectives include not only improving the competitiveness of the agricultural sector, but also inclusivity and solidarity towards farmers (European Commission, 2023), along with elements characteristic of social protection. Despite of its importance there has been a notable decline in the producer support estimate, a key component of the CAP that measures transfers to farmers, both direct and indirect, particularly after 2013 (OECD, 2023). Meanwhile it is not clear that this decreasing trend is due to the agriculture holder's rejection of such tools and non-take up may exist or not. Thus, this article seeks to explore *whether farmers are not accessing important social and economic tools such as the CAP and who are the non-takers?*

Despite the challenges faced by some agricultural holders and their precarious incomes (Magnan, 2022), a non-take-up of social rights is observed among people insured through the Mutualité Sociale Agricole, the social insurance for farmers and other agricultural workers. For example, the non-take-up rate for family allowances among MSA insured was estimated between 7.5% and 8.2% in 2018 (MSA, 2021). This phenomenon also exists in the rest of the population, who is affiliated with a different social security system (the general social security regime), witch includes various social insurances funds depending on the sort of risk (there exist a find dedicated to pensions, another to healthcare, etc). The non-take-up of social rights phenomenon is mainly explained by individual reasons, such as rejection of stigma associated with poverty, and concerns that taking benefits may impact self-esteem and personal autonomy in adapting to the economy (Deville, 2015; Warin, 2014). Thus, literature gives evidence that a part of the agricultural population non takes-up to social rights, which question the existence or not of a non-take-up phenomenon to CAP.

Therefore, to better understand the income of a major contributor to the bio-economy system, the farmers, the article is organized as follows. First part will present a detailed analysis of the origin of farmers' income, particularly through the agricultural operations they manage (Magnant, 2022; Laurent, Magnant, 2023). Part 2 focuses on the literature on non-take-up of social assistance, highlighting the reasons of non-take-up (Van Oorschot, 1996; Warin, 2014; Warin, 2016; Deville, 2015; Meinzel, 2022). Part 3 aims to present the CAP as a form of social protection and test the hypothesis of the existence of non-take-up of such important social protection tool and its relation to the agriculture holders' revenues. The analysis will be based on data from the RICA survey (Réseau d'Information Comptable Agricole), an annual survey conducted by the French Ministry of Agriculture and Food Sovereignty under the direction of the European Union. The project will use data from the 2022 survey, which covers a sample of 7,322 agricultural holding and indicates the CAP benefits received by these holders, as well as elements allowing the determination of eligibility. Part 4 discuss these results regarding the highlights of the literature about non-take-up. Part 5 briefly concludes.

This research proposal is part of a PHD work which aims to study the non-take-up of social rights within the agricultural population. Although the policies adopted by the European Union primarily have economic objectives, particularly after 2008, the CAP remains both an economic and social policy, and more recently, an ecological one. By drawing a parallel with

benefit systems directly linked to social protection, which have already been the subject of numerous in-depth studies, it is possible to consider the non-take-up of the CAP.

References

Boyer, R. (2002). Aux origines de la théorie de la régulation. In *Théorie de la régulation, l'état des savoirs* (Vol. 2, pp. 19-30). La Découverte.

Deville, C. (2015). Le non-recours au RSA des exploitants agricoles. L'intégration professionnelle comme support de l'accès aux droits. Revue des politiques sociales et familiales, 119(1), 41 50.

European Commission, (2018), A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment: updated bioeconomy strategy.

European Commission, Key policy objectives of the CAP 2023-27

Finger, R., Fabry, A., Kammer, M., Candel, J., Dalhaus, T., & Meemken, E. M. (2024). Farmer Protests in Europe 2023–2024. EuroChoices, 23(3), 59-63.

Grouiez, P., Debref, R., Vivien, F.-D., Befort, N., (2023), The complex relationships between non-food agriculture and the sustainable bioeconomy: The French case, Ecological Economics, 214, 107974.

Magnan A. (2022) Le développement du salariat précaire dans l'agriculture française : une approche d'économie institutionnelle. Thèse d'économie, Université Paris-Saclay.

Magnan, A., & Laurent, C. (2023). Chapitre 51. Changement institutionnel et rapport social d'activité dans l'agriculture. In Théorie de la régulation, un nouvel état des savoirs (pp.419-427). Dunod.

Meinzel, P. (2022). Le non-recours au minimum vieillesse des personnes seules. Dossier de la

Drees, 97, 299.

Michel, S. (2023). Le retour du rapport salarial? Une enquête régulationniste. *Théorie de la régulation, un nouvel état des savoirs.*

MSA. (2021). La MSA lance sa campagne sur le non-recours aux droits pour accompagner ses adhérents les plus exposés à la crise.

OCDE, (2011), Agricultural Policy Monitoring and Evaluation 2011.

OCDE, (2018), Agricultural Policy Monitoring and Evaluation2018.

OCDE, (2023), Agricultural Policy Monitoring and Evaluation 2023: Adapting Agriculture to Climate Change.

Représentation Permanente de la France auprès de l'Union Européenne. (2023). La Politique Commune (PAC). La France dans l'UE.

Vivien, F.-D., Nieddu, M., Befort, N., Debref, R., Giampietro, M., (2019), The Hijacking of the Bioeconomy, Ecological Economics, 159, 189-197

Warin, P. (2014). Le non-recours aux prestations sociales : quelle critique du ciblage?. Les sociales, (2), 12-23.

Warin, P., & Catrice-Lorey, A. (2016). Le non-recours aux politiques sociales (Vol. 35). Grenoble : Presses universitaires de Grenoble.

Keywords: Wage, labor nexus, social protection of agricultural workers, non, take, up of social rights, The common agricultural policy (CAP), sector, based regulation, French Agricultural Social Insurance (Mutualité sociale Agricole).

Developing a Territorial Transition Model Based on a Cooperative Bioeconomy for Hemp

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The European Hemp Pole bets on cooperation as the driving force behind the growth of the hemp-based bioeconomy. To achieve the goal of developing a plant with multiple potential uses that can benefit the territories that choose to cultivate it, the implementation of structured, strategic initiatives-tailored to the strengths and weaknesses of those territories-is essential. Without such initiatives, no real transition is possible.
These structuring projects and strategies cannot succeed without considering the hemp plant's full ecological and economic potential-recognizing its value as a whole. This multi-valorization of hemp necessarily requires ecosystem-based cooperation involving multiple stakeholders and markets.

However, today, value creation is primarily framed in terms of bioeconomy, not cooperation. The concept of **cooperative bioeconomy** acknowledges that value arises not only through the transformation of biomass into new applications, but also through a new way of organizing economic actors. This involves effective cooperation within a multi-stakeholder, multi-market ecosystem-from upstream agriculture to all downstream valorization chains-based on three shared principles: open-ended cooperation, fair value distribution, and an ecosystem-based approach that includes territories, markets, value chains, and actor typologies.
This new approach aims to foster the long-term, stable development of a socio-economic ecosystem within a given territory.

Keywords: Bioéconomie coopérative, innovation organisationnelle, coopération, chanvre

*Speaker

3.D : Traffic Jam Around Nature-Based Solutions. Contradictions and Complementarity Over Land Regulations for Environmental Welfare

Ecological neutrality as a frame for environmental policies A socio-historical approach

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Environmental public action is often based on the notion of ecological neutrality, as expressed in legal objectives and principles such as Carbon Neutrality, No-Net Loss of Biodiversity, Zero Pollution, Net Zero Plastic, etc., or in institutional programs such as the UN's "Race to Zero". This accounting approach to environmental problems, which consists in balancing impacts with beneficial actions (production of environmental goods, services and credits), is the fruit of a compromise between economic development and the management of nuisances, with one allowing the other to continue without fundamentally challenging growth trajectories. How can we explain the success of the net in environmental policies, and what consequences does this have for the way we deal with environmental problems? To answer these questions, I trace the socio-history of this category, to show that its growing appropriation goes along with an evolution in its definition, becoming more open and fuzzier. Through a literature review, the presentation highlights three main conceptualizations of ecological neutrality, ranging from a regulatory operation that allows firms to comply with environmental regulations, to voluntary arrangements embedded in supply-chain certification, and to market mechanisms included in decarbonation pathways. The historical trajectory of the category shows a progressive evolution where equivalence of impacts and gains is becoming more open and flexible, allowing for the participation of a broader range of actors and therefore complicating the regulation of related policies.

Keywords: ecological neutrality, no, net loss, socio, history

*Speaker

The triple climatic promise of soil organic carbon: mitigation, neo-classicization and bioeconomization

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Theme : Climate requalification in the language and thinking of the bioeconomy, particularly with a view to sustainably managing biomass production (Juerges and Hansjürgens, 2018), is one of several ways of conditioning soil organic carbon. However, these bioeconomic recharacterisations of soil carbon are not yet routine in France. For example, a recent book on the bioeconomy (Gohier et al., 2023), published by the Coopération agricole (the umbrella organisation for French agricultural cooperatives), contains no paragraph on soil organic carbon. Despite this, some actors in the bioeconomy are taking up the issue and incorporating it into their strategies, particularly in the Grand-Est region. We are seeking to better specify this nascent bio-economic requalification and what it has helped to produce in recent years in France, in particular an experiment in carbon credits from field crops, to be sold on voluntary carbon markets.
Theoretical approach : Using the theoretical approach of the economics of techno-scientific promises (Joly, 2013, p221-235), we propose to analyse the climate control of organic carbon by distinguishing three major promises, seen as a continuum: 1) that of a carbon sink making it possible to reduce atmospheric CO2, supported by carbon cycle sciences (which we call 'mitigation'), already studied in part by King et al. (2018); 2) that of additional remuneration for farmers, through a monetary incentive, supported by neoclassical economists (of the climate and agriculture) (which we call 'neo-classization'); 3) that of a new brick in the bioeconomy, supported by economic players (cooperatives, innovation groups, etc.) exploiting agricultural biomass for non-food uses (which we call 'bioeconomicization').

Our distinction of three promises is supported by a distinction of three 'thinking-styles' in the sense of Ludwik Fleck (Zittel, 2012), including a language specific to scientific communities and their ways of formulating metaphors, images and 'pre-ideas(1)'. As in an artistic style, the 'thinking-styles' also induces a hierarchy of values for certain features, objects or attributes. For example, we would say that the promoters of the bioeconomy value the object of the biorefinery and the co-products with a view to optimising the uses of biomass. These values and representations influence the choice of research funding in a given field, and the way in which groups are cemented together. This distinction between thinking-styles helps us to characterise each promise and what it produces, so that we can then better demonstrate their reciprocal influences, and finally, the strength of their alliance in the construction of a carbon credit. The same stakeholder or collective can have several styles.

*Speaker

From a conceptual point of view, promises are distinct from scientific statements: 'promises are by definition speculative' (Joly, 2013, p221-235), whereas scientific statements refer to results based on codified and rigorous scientific methods and evidence systems. The promise aims to mobilise funding for research and development and to convince a wide range of stakeholders of its validity. It has at least two ingredients: i) it is presented as a solution to a given problem: 'the more urgent and widely recognised the problem, the more attractive the promise, and the more legitimate the measures taken' (*ibid*); ii) it must be credible, not only with scientists, but also with a wide range of stakeholders: government agencies, private companies, banks, etc. (*ibid*). Each of these three promises thus generates scientific statements, which mobilise communities of actors that we are trying to distinguish. Nevertheless, when they are articulated or brought together, they mobilise a wide range of arguments and players, giving them a force of conviction and action.

Qualitative method: we are analysing qualitative data collected during our thesis between 2019 and 2023, using two methods. The first uses documents produced by the players: scientific and legal texts, reports, speeches at conferences, press files, etc. The second uses semi-structured interviews with the actors (here anonymised). The second consists of semi-structured interviews with the players (here anonymised), focusing on three main aspects: i) their professional missions related to decarbonisation in arable farming and the reasons that lead them to account for organic carbon ii) the choice in favour of the 'Arable Farming' carbon credit in the 'Low Carbon Label' scheme iii) the interviewee's relations with other actors in order to understand the distribution of roles and the influences of some on others. In addition, informal interviews at agricultural trade fairs and conferences provided additional information on chronological elements, technical tools and strategies.

Plan : First, we want to distinguish between each promise concerning soil organic carbon (mitigation, neo-classization, bioeconomicization), in terms of speculative ideas, scientific statements and the actors who make them. This will enable us to better show how they form a continuum by articulating and mutually reinforcing each other. Secondly, we will focus on a case study, seen as a result of this self-reinforcement: the collective construction of a carbon credit for field crops initially intended for voluntary carbon markets, as part of the "Label Bas Carbone". We will look at the actual alliance between the different styles/actors and the concessions made between them. We will also look at the way in which each promise is put to the test in the implementation of this scheme. In conclusion, we wish to make the disappointments and renunciations explicit, by characterising the gaps between the promises, the scientific statements and the implementation of a credit system in the field.

(1) For Fleck, these 'pre-ideas' are vague ideas, lacking in precision, attached to representations and prejudices, which influence the production of scientific facts (Zittel, 2012). For example, syphilis was linked to the idea of lust in nineteenth-century medical research.

Keywords: Soil organic carbon, economics of techno, scientific promises, thinking, style

How could bioeconomy projects fit into local political agendas on climate and environment? Reflections in light of a study on the territorialization of climate policy

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The development of the bioeconomy requires a territorial approach, as numerous studies have shown (Benoit, 2021). The establishment of production systems based on the principles of the bioeconomy must necessarily be part of a local reflection involving economic and political actors in the territories concerned. The collection, transport and use of biomass are embedded in territorial ecosystems (Girard, 2023).
In this communication, I propose to focus on the integration of the bioeconomy into local environmental and climate policies. In particular, I would like to open a discussion on the capacity of bioeconomy projects to challenge local frameworks for environmental and climate issues.

In France, policies to combat global warming are increasingly territorialised. Public institutions for intermunicipal cooperation (EPCI) have gradually been recognised by the public authorities as legitimate actors in the fight against global warming. Since 2015, EPCIs with more than 20,000 inhabitants have been required to adopt and implement territorial climate-air-energy plans (PCAETs), which are "the operational tool for coordinating the energy transition in the territory" (Bertrand and Richard, 2014). Initial research has attempted to analyse this process of territorialisation of climate action (Mazeaud et al., 2022). These works are critical of the specific effects of these dynamics. They show that the appropriation of the fight against global warming as a "public problem" by local government actors (both technical staff and elected officials) remains limited, despite government mandates and the proliferation of dedicated instruments.

As a postdoctoral researcher, I participated in a collective political science study on the implementation of these climate plans in Nouvelle-Aquitaine and Occitanie(1). As part of this study, we identified a factor that had been neglected in the literature on local climate policies: the specific effects of environmental and climate assessments, which are nevertheless an essential component of these territorialisation instruments. The climate plans imposed on EPCIs are systematically based on the production of such assessements, which are an inventory of the "environmental and climate performance" of the territory covered by the local authority. This assessment is often the first objective representation of the territories' involvement in climate issues. These assessments are the "stable statistical objects" (Desrosières, 1989) from which local

*Speaker

climate action is envisaged, debated and sometimes politicised. Given that numerous studies at other levels have shown how useful it is to study public action and the objective representations on which it is based (Edwards, 2010; Aykut and Dahan, 2015), the lack of interest in these objects is all the more regrettable.

By studying these assessments in detail, we have been able to show that they contribute to the low priority given to climate issues at the local level. On the one hand, the concrete conditions under which these assessments are produced prevent the politicisation of the climate issue at the local level: they typically involve a very small number of local actors. On the other hand, they impose a very specific framing of the climate issue, which in most cases prevents climate injunctions from being translated into local action. These assessments are based primarily on the mobilisation and compilation of quantitative data on sectoral carbon emissions, energy production and consumption, and carbon sequestration potential. This carbon/energy framework may seem legitimate as it reproduces a stable definition of climate issues at the local level. However, it is clear that this framing contributes to the low level of local politicisation of climate issues. The assessments produce a representation of the territory that appears to have little mobilising power compared to other framings for climate and environmental issues. For example, the assessments neglect landscape issues: they do not establish a link between climate and landscape change. They also neglect biodiversity and natural heritage issues: they do not take into account local geophysical and ecological specificities or more sensitive relationships with the territory. The study of the assessments reveals a gap between the local history of environmental policies and the instruments of territorialisation.

In this communication, I would like to use the presentation of these results to open and facilitate a discussion on the integration of bioeconomy projects into local climate policies. What our analysis reveals is the diversity of local framings for environmental and climate issues, as well as the heterogeneous levels of support and politicisation that these framings generate. The widespread adoption of the bioeconomy will necessarily involve local political actors and will be part of the territorialisation of climate and environmental policies. It therefore seems necessary to ask how bioeconomy projects can be integrated into local framings for environmental and climate issues. The study of the difficult implementation of local climate policies can provide rich lessons and questions in this regard. How can bioeconomy projects be integrated locally? According to which frameworks? How can the development of these projects be linked to the political mobilisation of the territory? How can these projects be used to revitalise the territorialisation of public action on climate and environmental issues?

(1) Apclimter (2020-2022), financed by the Nouvelle-Aquitaine Region; Pecaplo (2022-2024), financed by Ademe.

Bibliographic references

Aykut S.C., Dahan A., 2015, *Gouverner le climat? Vingt ans de négociations internationales*, Presses de Sciences Po, 752 p. https://doi.org/10.3917/scpo.aykut.2015.01

Benoit S., 2021, " Bioéconomie et diversité des ancrages territoriaux ", *Économie rurale*, *376*, 2, p. 77-91. https://doi.org/10.4000/economierurale.8944

Bertrand F., Richard E., 2014, " L'action des collectivités territoriales face au "problème climat" en France : une caractérisation par les politiques environnementales ", *Natures Sciences Sociétés*, *22*, 3, p. 195-203. https://doi.org/10.1051/nss/2014036

Desrosières A., 1989, " Comment faire des choses qui tiennent: histoire sociale et statistique

", *Histoire & Mesure*, *4*, 3, p. 225-242. https://doi.org/10.3406/hism.1989.1358

Edwards P.N., 2010, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming*, Cambridge, MA, USA, MIT Press (Infrastructures), 552 p.

Girard G., 2023, *La bioéconomie circulaire et les territoires: Emergence d'un système productif territorial de valorisation en cascade de coproduits issus de l'agriculture et de l'agro-alimentaire*, These de doctorat, Toulouse, INPT.

Mazeaud A., Aulagnier A., Smith A., Compagnon D., 2022, " La territorialisation de l'action climatique ", *Pôle Sud*, *57*, 2, p. 5-20. https://doi.org/10.3917/psud.057.0005

Keywords: local climate policy, climate policy, territorialisation

4.A : Between Circularity and Bioeconomy: Innovation Ecosystems & Cluster Governance

Deploying the bioeconomy through bioclusters: Between European policy imaginary and conflicting territorial appropriation. A French case study

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To address 21st century challenges such as climate change, food security, and the depletion of natural resources, European institutions have placed the bioeconomy at the core of their public policies. Promoted as a development model that tackles these challenges while fostering economic growth, the bioeconomy is being implemented across EU member states, with a strong emphasis on creating bioclusters. If bioclusters have such a crucial role to play in the deployment of the bioeconomy, key questions arise : How do they form and structure themselves within specific regions? Can existing models be replicated elsewhere? And what about their sustainability?
This study addresses the conditions for the emergence of bioclusters through two main lenses. First, it examines the European Smart Specialization Strategy, a key policy framework supporting the deployment of the bioeconomy across European regions. Second, it analyzes an ongoing initiative to establish an industrial hemp biocluster in the French department of Aube.

By integrating proximity and heritage economics and through a narrative approach, the study reveals that bioclusters emerge as a result of an imaginary according to which the deployment of the bioeconomy requires the formation of bioeconomy clusters. This imaginary, based on the myth of the omnipotence of geographical proximity, shapes European public policies that promote the bioeconomy. It also has a performative effect on territorial actors involved in the valorization of non-food biomass.

The study also shows that this imaginary, by targeting territorial heritage, can lead to ecological contradictions. In fact, by focusing on dominant value chains and dominant players in territories in order to build bioclusters, this imaginary can lead to lock-ins, leaving unexploited the rich diversity of bioeconomy models, which is nevertheless invaluable for the ecological transition of territories.

Bibliography

Benner, M. (2020). Six additional questions about smart specialization: implications for regional innovation policy 4.0. *European Planning Studies*, *28*(8), 1667-1684. https://doi.org/10.1080/09654313.2020.17

*Speaker
†Corresponding author: adebo-jean-daniel.houeto1@univ-reims.fr

Benoit, S. (2021). Bioéconomie et diversité des ancrages territoriaux. *Économie rurale*, *376*(2), 77-91. https://doi.org/10.4000/economierurale.8944

Foray, D. (2015). *Smart Specialisation: Opportunities and Challenges for Regional Innovation Policy*. Routledge. https://doi.org/https://doi.org/10.4324/9781315773063

Foray, D., David, P. A., & Hall, B. H. (2011). *Smart specialisation from academic idea to political instrument, the surprising career of a concept and the difficulties involved in its implementation.*

Grouiez, P., Debref, R., Vivien, F.-D., & Befort, N. (2023). The complex relationships between non-food agriculture and the sustainable bioeconomy: The French case. *Ecological Economics*, *214*, 107974. https://doi.org/https://doi.org/10.1016/j.ecolecon.2023.107974

Haarich, S. (2017). *Bioeconomy Development in EU Regions: Mapping of EU Member States'/regions' Research and Innovation Plans & Strategies for Smart Specialisation (RIS3) on Bioeconomy* (9279680110). https://data.europa.eu/doi/10.2777/84684

Haarich, S., & Kirchmayr-Novak, S. (2022). *Bioeconomy strategy development in EU regions* (9276500405). O. d. p. d. l. U. européenne. https://data.europa.eu/doi/10.2760/065902

Hassink, R., & Gong, H. (2019). Six critical questions about smart specialization. *European Planning Studies*, *27*(10), 2049-2065. https://doi.org/10.1080/09654313.2019.1650898

Hermans, F. (2021). Bioclusters and Sustainable Regional Development. In (pp. 81-91).

Houeto, A. J.-D. (2023). *Une analyse economique des conditions d'emergence des bioclusters. Le cas de la bioeconomie du chanvre industriel dans l'Aube* (Doctoral dissertation, University of Reims Champagne-Ardenne). Reims.

Ketels, C. C. H., J ; Lubicka, B ; Lindqvist, G ; Nauwelaers, C ; Peck, F. (2013). *The role of clusters in smart specialisation strategies.*

Martin, R., & Sunley, P. (2003). Deconstructing clusters: chaotic concept or policy panacea? *Journal of Economic Geography*, *3*(1), 5-35.

Mazzucato, M. (2018). Mission-oriented innovation policies: challenges and opportunities. *Industrial and Corporate Change*, *27*(5), 803-815.

Nieddu, M., Garnier, E., & Bliard, C. (2014). Patrimoines productifs collectifs versus exploration/exploitation. Le cas de la bioraffinerie. Revue économique, 65(6), 957-987.

Porter, M. E. (1998). *Clusters and the new economics of competition* (Vol. 76). Harvard Business Review Boston.

Vivien, F. D., Nieddu, M., Befort, N., Debref, R., & Giampietro, M. (2019). The Hijacking of the Bioeconomy. EcolEcological Economics, 159, 189-197.
Torre, A., & Rallet, A. (2005). Proximity and Localization. *Regional Studies*, *39*(1), 47-59. https://doi.org/10.1080/0034340052000320842

Keywords: Bioeconomy, bioclusters, proximities, collective productive heritages, imaginaries, smart specialisation

How do Innovation Ecosystems facilitate Circular Economy through reuse as a material? System dynamic drivers in the European Textile

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How Innovation Ecosystems Facilitate Circular Economy Implementation through Reuse as a Material in the European Textile Sector

Summary

Circular Economy (CE) is understood as the regenerative system approached through a systems perspective (Kirchherr, Reike, and Hekkert 2017). This study focuses on the European textile and apparel sector, a dynamic example of CE transitions triggered by evolving EU regulations. These regulations emphasize recycling, sustainable design, and industrial symbiosis, particularly for polycotton, a blend of cotton and synthetic fibers. Traditional supply chain frameworks struggle to address the complexities of CE transitions, leading to the adoption of innovation ecosystem theories. This approach facilitates inter-supply chain connectivity, systemic interactions, and stakeholder engagement, including consumers.

Key research questions are: 1. What are the key drivers in the circular innovation ecosystem for textiles? And 2. To what extent can identifying innovation drivers for "reuse as a material" inform strategies for polycotton circularity?

The CE concept has gained momentum in Europe, supported by initiatives such as the French Anti-Waste Law (2022) and Extended Producer Responsibility (EPR) policies. These regulations encourage businesses to rethink textile reuse across three streams: post-industrial, pre-consumer, and post-consumer waste. Each stream presents unique challenges and opportunities for maximizing value through circular strategies.

While supply chain management frameworks have historically supported resource optimization, they face limitations in addressing CE complexities. Challenges include insufficient stakeholder integration, limited macro-environmental considerations, and a lack of dynamic feedback loops. Emerging concepts, such as green supply chains (Plaza-Úbeda et al. 2020) and sustainable supply chain management (Centobelli et al. 2022), partially address these gaps but fail to offer holistic solutions.

Innovation ecosystems (Tolstykh, Shmeleva, and Gamidullaeva 2020)provide a robust framework for CE transitions. By fostering systemic interdependence, dynamic interactions, and

*Speaker

stakeholder diversity, this approach overcomes the limitations of linear supply chains. Key mechanisms include biochemical recycling, circular design, and industrial symbiosis, which collectively enhance material reuse and resource efficiency. For example, industrial symbiosis promotes inter-supply chain collaboration, transforming waste into valuable inputs for other industries.

Our present study entails a hybrid research protocol design including the use of qualitative and quantitative analysis methods, to provide an alternative analytical tool able to handle the complexity, inter- supply chain connection, macro-environmental impact and consumers influence that the available supply chain Planning, Logistics management and Inventory management tools do not offer. The presented protocol represents an original and novel design to be highlighted as one of the main outcomes of the study. The raison of using a hybrid research methodology that integrates a comprehensive literature review, expert opinions, and quantitative analysis offers is supported by the comprehensive understanding offered by the integration of a literature review, that provides a strong theoretical foundation, and the practical relevance gathered from the diverse insights obtained from the 10 experts across different roles, organizations and origins. The panel of experts is composed by scholars affiliated to the Kauno Waste Management Centre, Ministry of Economy and Innovation of the Republic of Lithuania, Circular Economy Forum in Austria, Technical University of Crete, Deutsche Bundesstiftung Umwelt, ECOPAL, Université de Lorraine, Universidad de Almeria, University of Graz, and University of Pisa from seven European countries (Lithuania, Austria, Germany, Greece, Italy, Spain and France) that help us to improve our understanding of the causal relationships among drivers of the European Textile Ecosystem.

The research protocol design emerges as the first part of the protocol followed by the research methods implementation applied to the group of 10 experts in business and academic contexts, such as environmental transition, sustainable development, digital transformation, innovation ecosystems, supply chain management, and/or circular economy in Europe. This expert group's diversity ensures a variety of viewpoints, reduces bias, and incorporates region-specific insights into circularity drivers. Including practitioners alongside scholars and researchers ensures that the research findings are not just theoretical but are also relevant and applicable to real-world practices.

The quantitative analysis of the Causality matrix, network analysis, and Causal Systems Diagram, provides an objective way to validate the qualitative insights from experts, strengthening the credibility and reliability of the findings and facilitating a systematic understanding of interdependencies and causal relationships among circularity drivers. This helps prioritize the most influential factors for targeted interventions. The combination of qualitative and quantitative methods ensures a nuanced understanding that can better inform decision-making processes, policies, and strategies for circularity initiatives. The methods triangulation (literature review, expert opinions, and quantitative analysis) particularly suited for complex, multi-faceted topics like circularity, ensures the study is both deep and robust, minimizing the limitations inherent in using a single methodology. The methodology emphasizes stakeholder diversity and systemic approaches, enabling a comprehensive understanding of CE drivers in the European Textile Ecosystem.

The results are empirically validated through the textile and apparel case study, proposing a systemic and dynamic tool to analyze the CIE while identifying the major challenges and the forthcoming avenues of research and investment in the system. The author decided to limit the ecosystem boundaries of the textile and apparel sector analysis to Europe because the European Commission is developing a comprehensive set of new stringent regulations associated with the EU strategy for sustainable and circular textiles. A comprehensive analysis of the way textiles and apparels are sorted, recycled, designed, manufactured, and handled at the end of their life

promoting the identification of the key-drivers used as innovative leverages to accelerate the circularity transition in Europe.

This study provides solid evidence about the advantages of studying circular innovations transitions in the textile and apparel sector in Europe through the lenses of system dynamics and ecosystems approach. This comprehensive perspective affords the complexity of dealing simultaneously with 1) systemic interdependence; 2) dynamic interaction; 3) global macro-environment integration and 4) consumer orientation that a supply chain management theory cannot offer to the analysis of textile and apparel sector in Europe. Herein we display the causality matrix in Table 1 analyzing the previously identified 11 drivers that shape the circular transition.

The INN-SCO entry is symbolized as X, meaning Innovation (INN) and Education and Competencies (SCO) cause each other, in green color meaning the coincidence in the direction of the causal relationship represent more than 83% among the experts. Besides recommending a few minor corrections to the labelling, experts confirmed the overall structure and inclusiveness of the drivers. Herein, we define each one of the 11 variables as the main factors that positively impact or hinder the implementation of circular practices in the textile and apparel sector, displaying the highest causality effect and network connectivity corroborated by the experts.

The System Dynamics (SD) representation of causal drivers offers a deeper understanding of the interconnected forces that compete for the same resources displaying some trade-offs in the behavior. To display causal relationships, CLD makes use of causal loops, arrows that can be either positive (reinforcing behavior) or negative (balancing behavior). A reinforcing behavior, known in SD as reinforcing feedback, implies that if variable X is connected to variable Y, they move in the same direction (an increase in X will lead to an increase in Y, and a decrease in X will lead to a decrease in Y). A balancing relationship, also known as balancing feedback, suggests that one variable is influenced by another in opposite direction (e.g. an increase in X will lead to a decrease in Y, and a decrease in X will lead to an increase in Y).
Without surprise and validating the insights borrowed from the innovation and ecosystems literature, we recognize the advantages of approaching the textile and apparel sector with a systemic cause-effect perspective. The results of our study shed light on the relevance of macro-environmental integration (Cricelli, Greco, and Grimaldi 2021), systemic interdependence, dynamic interactions (Kaplinsky 2015; Konietzko, Bocken, and Hultink 2020) and the consumer orientation (Nuojua, Pahl, and Thompson 2024; Polyportis, Magnier, and Mugge 2023; Ghisellini, Cialani, and Ulgiati 2016; Pakarinen et al. 2010) enabling CIE (Bjørnbet et al. 2021) transitions in textile and apparel production, waste management, biochemical recycling and other side-related supply chains.

Keywords: innovation ecosystems, circular economy, industrial symbiosis, reuse as a material, textiles, Europe

Building Innovation Ecosystems for Biobased Value Chains: Higher Education and Research in the Chicory Sector of Hauts-de-France

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Despite the multiple and sometimes contradictory interpretations of the term *bioeconomy (Vivien et al., 2019)*, one of the most widely accepted definitions refers to the production of renewable biological resources and their conversion into various products and bioenergy (Bugge et al., 2016). Aiming to replace fossil-based carbon with renewable carbon, the bioeconomy is structured around the creation or restructuring of biobased value chains.
The analysis of value chains has a long-standing tradition, from the French industrial economics approach of the 1980s, which introduced a *mesoeconomic* analysis through the concept of *filière*, to the extensive body of work on global value chains (De Marchi et al., 2020). However, in the context of the bioeconomy, the study of value chains at the territorial/local level is being renewed and deepened (Laperche et al., 2024).

Biobased value chains, built around biomass, encompass cultivation and harvesting stages, specific transformation processes, and the reintegration of waste and co-products-both upstream at the agricultural level and downstream in the production of high-value-added goods. To analyze their structure and economic (as well as environmental) impacts, traditional input-output analysis methods can be employed, incorporating sustainability aspects. However, to fully understand how these value chains emerge and function, it is crucial to examine more qualitative dimensions.

According to us (Laperche et al., 2024), a value chain can therefore be conceptualized as an *innovation ecosystem* (Granstrand & Holgersson, 2020; Baldwin et al., 2024), where a network of actors-drawing on shared or complementary knowledge and technologies-interacts to innovate, i.e., to design, produce, and commercialize a set of goods and services within a given territory, generating value at both individual and collective levels. These actors include producers (farmers, processors, manufacturers), public institutions, and researchers.

The key economic players in the transition towards the bioeconomy and the development of new value chains are often identified as companies providing technological solutions and public authorities that drive change through regulations and incentives (Gottinger et al., 2020; Pyka et

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al., 2021). However, the role of Higher Education and Research (HER) remains underexplored, despite its potentially crucial contribution to fostering territorial innovation, in conjunction with businesses, local authorities, and other stakeholders involved in the development of biobased value chains.

Objective and Methods

This paper examines the role of HER in the emergence of biobased value chains and, more broadly, in the territorial transition towards the bioeconomy. Numerous studies in the economics and geography of innovation have highlighted the concept of *entrepreneurial universities* as pillars of economic growth, particularly within the framework of collaboration between academia, businesses, and public institutions-often referred to as the *triple (or multi) helix model* (Etzkowitz & Kloften, 2005). Additionally, the need for sustainability transitions to be guided by *mission-oriented policies* and *responsible innovations* (Prochaska & Schiller, 2021; Barlatier et al., 2024; Liotard & Revest, 2024) reinforces the importance of HER's involvement in these transformations (Mobhe & Uzunidis, 2022).

Based on this premise, our research seeks to answer the following question: **How can Higher Education and Research contribute to the formation of an innovation ecosystem within biobased value chains?** To address this, we adopt a **qualitative approach** and a **reflexive perspective** (Attia & Edge, 2017). Our case study focuses on the **FermEndive project (2022-2025)**, which brings together researchers from various universities and a growers' association in the Hauts-de-France region. This project aims to valorize co-products from chicory production through a circular economy approach. Specifically, its objectives are: 1/**Developing a biobased plastic food packaging** from molecules extracted, produced (via fermentation), or modified (through enzymatic biocatalysis) from chicory co-products (field leaves, root sorting waste, peelings, rootlets). 2/**Creating a high-health-value food product** derived from the lactic fermentation of downgraded chicory.

Our methodology includes: an **analysis of grey and academic literature** on the evolution of this value chain and its need for transformation; a r**eview of literature** addressing the role of researchers in sustainable projects at the territorial level; **Interviews with FermEndive researchers** specializing in food and packaging sciences; **Discussions with other stakeholders** involved in chicory-related projects in the Hauts-de-France region.

Expected Results and Paper Content

This study provides a **review of the role of HER in innovation ecosystems linked to biobased value chains**, as outlined in the existing literature. By analyzing the components of an innovation ecosystem-including actors, coordination and governance structures, and the types of innovation developed-we examine the potential contributions of HER in shaping biobased value chains. These contributions can be categorized as follows:

- **Scientific and technological contributions**: Multidisciplinary research teams identify the chemical and physical properties of plant co-products and assess their potential for valorization in biobased products.
- **Networking and coordination**: HER plays a key role in mapping and connecting actors along the value chain, from agricultural production to the development of finished goods-considering the value chain as an innovation ecosystem.

- **Innovation and sustainability-driven research**: Researchers contribute to the design of formulations and innovations that facilitate the creation or restructuring of sustainable local value chains (de Rouffignac et al., 2024).

Our study demonstrates that **universities play a decisive role upstream of value chain restructuring and innovations based on biobased co-products**. Initially considered waste, these co-products gain value through in-depth chemical analysis, which serves as a foundation for product innovation.

Furthermore, as leaders of research projects, university consortia also act as **mediators and facilitators**, fostering the development of territorial innovation ecosystems. Their work is not limited to scientific advancements but extends to the structuring of stakeholder networks and coordination mechanisms.

Finally, the trajectory of regional biobased value chains is **deeply influenced by the choices made by research teams**, including their capacity to establish collaborative networks and to align their experimentation processes with sustainability criteria-criteria that are often neither predefined nor objective but rather shaped by researchers' perspectives and methodological frameworks.

Ultimately, the sustainability of biobased sectors **depends on the ability of HER to create synergies among stakeholders and to guide the restructuring of innovation ecosystems towards the construction of a truly sustainable regional bioeconomy**.

Bibliography

ATTIA, M & EDGE J. (2017) Be(com)ing a reflexive researcher: a developmental approach to research methodology, Open Review of Educational Research, 4:1, 33-45, DOI: 10.1080/23265507.2017.1300068.BA
WIN, C. Y., BOGERS, M. L., KAPOOR, R., & WEST, J. (2024). Focusing the ecosystem lens on innovation studies. *Research Policy*, *53*(3), 104949.

BARLATIER, P., GEORGET, V., PÉNIN, J., RAYNA, T. AND RAYNA, T. (2024) . The Origin, Robustness, and Future of Responsible Innovation. Journal of Innovation Economics & Management, No 43(1), 1-38. https://doi.org/10.3917/jie.043.0001.

BUGGE, M., HANSEN, T., & KLITKOU, A. (2016). What Is the Bioeconomy? A Review of the Literature. Sustainability, 8(7), 691.

DE MARCHI V., DI MARIA E., GOLONI R., PERI A. (2020), Nurturing International Business research through Global Value Chains literature: A review and discussion of future research opportunities, International Business Review, Volume 29, Issue 5, October 2020, 101708

DE ROUFFIGNAC, A., GAST, S., LAPERCHE, B., VERNIER, M.F., (2024) " La durabilité de la bioéconomie et des filières biosourcées : outils et enjeux "*, Technologie et Innovation, Vol .9 https://www.openscience.fr/La-durabilite-de-la-bioeconomie-et-des-filieres-biosourcees-outils-et-enjeux*

ETZKOWITZ H., KLOFSTEN- M., The innovating region: toward a theory of knowledge-based regional development, R&D Management, 243-255.

LAPERCHE, B., DE ROUFFIGNAC, A., JULLIAN, N., (2024) " Les filières de production. Nouvelles analyses au prisme de la bioéconomie ", *Technologie et Innovation, Vol 9,* https://www.openscience.fr/Les-filieres-de-production-Nouvelles-analyses-au-prisme-de-la-bioeconomie

LAPERCHE, B., LIMA, M., SEUILLET, E., TROUSSE, B (2019) *Ecosystèmes d'innovation : regards croisés des acteurs clé*s, LHarmattan, Paris.

LIOTARD, I., REVEST, V. (2024) . Grands Challenges et politiques publiques d'innovation : un état des lieux. Innovations, N○ 74(2), 5-25. https://doi.org/10.3917/inno.074.0005.

UZUNIDIS D., MOBHE BOKOKO D. (2022), La recherche responsable : contexte, enjeux, dispositifs, Technologie et Innovation, vol.7, https://www.openscience.fr/La-recherche-responsable-contexte-enjeux-dispositifs

GRANSTRAND O, HOLGERSSON M., (2020), Innovation ecosystems: A conceptual review and a new definition, Technovation, Volumes 90–91.

GOTTINGER A., LADU L., QUITZOW R. (2020), Studying the Transition towards a Circular Bioeconomy-A Systematic Literature Review on Transition Studies and Existing Barriers, Sustainability, 12, 8990

PYKA A., ARIE E., ALVA-FERRARI A., URMETZER S., (2021), The Bioeconomy Transition Process – Sailing through Storms and Doldrums in Unknown Waters, Journal of Innovation economics and Management,

PROCHASKA, L., & SCHILLER, D. (2021). An evolutionary perspective on the emergence and implementation of mission-oriented innovation policy: the example of the change of the leitmotif from biotechnology to bioeconomy. Review of Evolutionary Political Economy, 2(1), 141–249.

VIVIEN F-D, NIEDDU M., BEFORT N., DEBREF R., GIAMPIETRO M. (2019), The Hijacking of the Bioeconomy, Ecological Economics, Volume 159, 189-197, https://doi.org/10.1016/j.ecolecon.2019.01.

Keywords: chicory value chain, by, products valorization, Bioplastics, Novel food, Sustainability, Innovation Ecosystems, HER (higher education and research)

4.B : Deployment and Pilot Projects of BECCS for Carbon Storage

Towards a BECCS Pilot in France? The Long Road of the CO2-DISSOLVED Project

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Highlights

- BioEnergy with Carbon Capture and Storage (BECCS) can remove CO2 from biorefineries.
- This technology, marked by high costs and controversies, faces significant deployment challenges.
- Actor-Network Theory (ANT) is applied to study a pilot project in France.
- ANT reveals the construction of the BECCS actor network.
- The initial project evolves under the influence of actor demands and CCS controversies.

Keywords: BECCS, Actor-Network Theory, controversy, Innovation

Long Abstract

In the early 2000s, the concept of a technological innovation known as BECCS (BioEnergy with Carbon Capture and Storage) emerged (Laude, 2020). This approach involves integrating CO2 capture technology into facilities producing bioenergy (e.g., biofuels, electricity, heat, hydrogen). The novelty does not lie in CCS itself, which has existed since the 1970s, but rather in its application to a new sector of activity.

This is not an incremental innovation, as it raises hopes for an additional Carbon Dioxide Removal (CDR) technology capable of removing CO2 from the atmosphere. This is achieved through the growth of plants, which absorb atmospheric CO2 via photosynthesis. From an economic perspective, this represents a "win-win" situation, legitimizing the use of bioenergy while combating climate change. From a technical standpoint, however, BECCS entails specific challenges, such as the composition of gases emitted by bioenergy plants, which affects capture efficiency. Yet, the primary technical challenge stems from the smaller scale of these emitters compared to fossil-based sources, such as coal power plants. This limited scale leads to reduced economies of scale and, consequently, lower profitability. From an environmental perspective,

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BECCS is highly controversial. Concerns revolve around the bioenergy aspect (risks of deforestation, soil depletion, and biodiversity loss), the capture process (which is highly water- and energy-intensive), and storage (with fears of leakage).

Twenty-five years later, **few industrial-scale BECCS pilots have been implemented worldwide**. However, there is currently renewed interest in this innovation, particularly observable in the USA, Sweden, Finland and the United Kingdom (Smith et al., 2024).

The barriers to BECCS development are similar to those facing CCS. Some of these obstacles are well-documented in the scientific literature: i) the high cost of the technology, making it risky for private investors; ii) consequently, inadequate and poorly calibrated economic incentives and regulatory frameworks; iii) a lack of political will; iv) the risk of public rejection of the technology (social acceptability).

This article does not challenge these explanations. Instead, it **seeks to understand how, in this context, BECCS proponents are attempting to adapt their technology and persuade other actors of the validity of their solution, with the goal of building one or more industrial-scale pilot projects**.

To this end, **a case study will be conducted on the "CO2-DISSOLVED" research project**, led by the BRGM (French Geological and Mining Research Bureau) from 2007 to the present (Laude et al, 2011). This project has three main objectives: i) to assess the techno-economic feasibility of CO2 storage in a specific type of geological formation known as "saline aquifers"; ii) to investigate a variant of CCS with heat recovery through geothermal energy; iii) to develop an industrial-scale pilot project.

Figure 1 : CO2-DISSOLVED – geothermal energy and CCS (BRGM)

Actor-Network Theory (ANT) is particularly well-equipped to track the evolution of technological innovation (Akrich, Callon & Latour, 2006). This constructivist approach to the science-society relationship stands out by considering non-human actors (e.g., objects, technologies, contracts, devices, places) in relation to human actors (e.g., employees, business partners, public authorities). Indeed, ANT has critiqued from the outset the tendency to treat the evolution of science and technology separately from that of society. There is co-evolution: the social can influence the development of technologies, innovations, and science, but these, in turn, can shape social relations. But no animism here: ANT attributes characteristics to these "non-human actors" that constrain human behavior or, conversely, open up opportunities. For instance, the Highway Code and traffic lights can be seen as "non-human actors" that regulate the behavior of drivers, with these artifacts being embedded within the sociotechnical regime associated with cars.

BECCS is a modular technology: each step of the technical process must be integrated with the others and has its own specific characteristics. **As a result, there are several non-human actors to align**. These include the gas flow exiting the plant, which requires qualification of its composition, quantity, and production rate. Additionally, the capture technology, which may vary in terms of efficiency and speed, and the storage site, referred to as the 'injection site,' are key components. **The injection site stands out as a key non-human actor**. Its geological characteristics are partly unknown, and its features determine the feasibility (in terms of implementation) and desirability (profitability and potential undesirable side effects) of the project. Represented as a non-human actor, the site may accept the addition of CO2. It can also be more or less productive in terms of heat generation. Although it is not living, **it can be assigned an objective: "to maintain its integrity."** This is a sine qua

non condition imposed by geologists, which means that modifications to the injection site must not lead to deformation or weakening of either the storage site or the adjacent geological layers. For example, the creation of cracks could lead to CO2 leakage. **Among other key non-human actors, one should consider the research contracts that strongly govern actions** (e.g., the obligation to secure private funding, international partnerships, and, of course, the amount of subsidies).

Another characteristic of **ANT** is that **it does not view innovation as fixed or linear**. Instead, it results from interactions between various actors, each with distinct objectives and specific demands. **These adaptations result from 'translations' of the interests of different parties.** They converge towards a common solution, even if this requires significant changes to the initial project. There is a constant trade-off between the need for adaptation and the necessity to stay close to the initial project. Without adaptation, the innovation will not diffuse, but straying too far from the initial project risks losing its purpose. he translation process follows several stages of development that may overlap: i) problematization; ii) enrollment; iii) interestment; iv) the mobilization of allies (Callon, 1986).

During the problematization phase, actors aim to define a common objective that accounts for everyone's positions. They then formulate an 'Obligatory Passage Point' (OPP). During the enrollment phase, actors aim to recruit new allies by 'translating' the benefits of their solution. These allies may, in turn, influence the evolution of the project. During the enrollment and mobilization phases, actors are assigned roles and begin to take action. Spokespersons emerge and are essential to coordinate actions and translate the interests of all parties.

Returning to the CO2-DISSOLVED technology, it developed through a succession of research projects, with the BRGM always serving as the initiator and coordinator. The BRGM thus constitutes the focal organization for this study. The article illustrates how the first project helped to problematize the technology by introducing an initial "Obligatory Passage Point" (OPP): "*the necessity of establishing an industrial pilot to test the technology*". From this point onward, the translation process with bioenergy companies emerges, particularly through the constraint of initial investment costs. At the same time, a controversy arises regarding the energy balance of CO2 capture, which is rather poor. In fact, this is a characteristic of general CCS that is "duplicated" at the local level of the project.

It becomes apparent that some characteristics of CCS and BECCS generate controversies, which can be traced within the CO2-DISSOLVED project, as it attempts to bypass or mitigate them. For example, the controversy surrounding the energy balance is mitigated by combining CCS with geothermal energy, the latter enabling the simultaneous production of non-fossil energies. This leads to a second OPP: "*geothermal energy must be combined with CCS to decarbonize small CO2 emitters.*" Geothermal energy could at times take precedence over CO2 capture, as it seems feasible that CO2 capture could become a mere supplementary income. Other controversies will cross the project's path, echoing those within the broader CCS and BECCS field, such as the choice between CO2 storage or industrial valorization. Conversely, the fieldwork conducted by the team reveals tensions that had not been identified yet within this research field due to the often top-down and model-based perspective of BECCS. An example of this is the competition between BECCS and other decarbonization technologies within the concerned plants (natural gas boilers, electrification).

This article will therefore demonstrate how the general controversies interfered with the project. It will also show how the **project has brought to light new controversies that BECCS must address to develop**. It will also show the translations it had to integrate, **demonstrating resilience**. However, it has not yet fully succeeded – for now? – in entering the phases of

enrollment and mobilization.

References

Akrich M., Callon M., Latour B. (2006), Sociologie de la traduction. Textes fondateurs, Paris, Presses des Mines de Paris

Laude, A., Ricci, O., Bureau, G., Royer-Adnot, J., Fabbri, A. 2011. CO2 capture and storage from a bioethanol plant: Carbon footprint and Economic Assessment. International Journal of Greenhouse Gas Control, 5 (5), 1220-1231.

Laude, A. 2020. Bioenergy with carbon capture and storage: are short-term issues set aside? Mitigation and Adaptation Strategies for Global Change. 25, 2, 185-203. https://doi.org/10.1007/s11027-019-09856-7.
Smith, S., Arcusa, S., Bellamy, R., Cowie, A., ..., Vaughan, N., & (Eds.). (2024). The State of Carbon Dioxide Removal, 2nd Edition. doi:10.17605/OSF.IO/F85QJ.

Keywords: BECCS, Actor, Network Theory, controversy, Innovation, Negative emissions

Optimal Deployment of BECCS and DACCS around the North Sea

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The Intergovernmental Panel on Climate Change (IPCC) emphasizes that reaching the 1.5∘C climate target requires large-scale deployment of Carbon Dioxide Removal (CDR) technologies. Among engineered options, Bioenergy with Carbon Capture and Storage (BECCS) and Direct Air Carbon Capture and Storage (DACCS) are considered essential to offset residual emissions from hard-to-abate sectors and to achieve net-negative emissions trajectories. However, significant uncertainties persist regarding the cost-effective pathways for their deployment, particularly at the regional level. This study addresses this gap by developing a dynamic, spatially explicit, cost-optimization model that examines how, where, and when BECCS and DACCS should be deployed across seven European countries and regions bordering the North Sea: France, the United Kingdom, Germany, Benelux, Denmark, Sweden, and Norway, from 2025 to 2050.
The model minimizes the discounted cost per ton of net CO removed while accounting for techno-economic parameters, infrastructure constraints, learning-by-doing effects, and the evolving decarbonization of electricity grids. It integrates lifecycle emissions, three-year construction delays, national capacity limits, and differentiated costs for transport and storage based on proximity to North Sea infrastructure projects such as Northern Lights. The model adopts earning rates and uses country-specific biogenic CO potentials and electricity decarbonization pathways.

The results reveal a two-phase deployment strategy. In the early period (2025–2040), BECCS dominates due to its relative cost advantage and integration with existing biomass infrastructures. Countries such as the UK and Sweden lead the deployment, leveraging biomass availability and early access to transport and storage facilities. However, as biomass constraints become binding and electricity grids increasingly decarbonize, DACCS emerges as the dominant removal technology after 2040. Early DACCS investments occur in Norway due to its near-zero carbon electricity, followed by France and the UK as capital costs decline. By 2050, DACCS overtakes BECCS in terms of annual removals.

Economic results show an average removal cost of approximately €270 per ton of CO, though substantial geographical disparities exist. Countries such as the UK and Sweden bear the highest cumulative costs, while Denmark and the Benelux region incur lower burdens due to size constraints and limited biomass availability. When costs are expressed relative to national GDP, Sweden and Norway appear particularly exposed, raising important questions of fairness and the need for coordinated burden-sharing mechanisms.

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The study highlights three critical enabling factors for successful CDR deployment: (i) sustainable biomass supply, (ii) access to low-carbon electricity, and (iii) proximity to CO transport and storage infrastructure. It emphasizes the need for targeted European policies, including regulatory support for sustainable biomass, accelerated grid decarbonization, and investment in shared cross-border CO infrastructure.

Keywords: CDR, BECCS, DACCS, Spatial model, Europe

Towards a BECCS Pilot in France? The Long Road of the CO2-DISSOLVED Project

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BECCS (BioEnergy with Carbon Capture and Storage) aims to integrate CO2 capture technology into facilities producing bioenergy (e.g., biofuels, electricity, heat, hydrogen). It raises hopes for a Carbon Dioxide Removal (CDR) technology capable of removing CO2 from the atmosphere. BECCS is highly controversial, with concerns about the bioenergy aspect (risks of deforestation, soil depletion, and biodiversity loss), the capture process (which is very water and energy intensive), and storage (with fears of leakage). In addition, BECCS is very expensive. To date, only a few industrial-scale BECCS pilots have been implemented worldwide. Using the Actor-Network Theory (ANT), this article seeks to understand how BECCS proponents attempt to adapt their technology and persuade other actors of the validity of their solution, with the goal of building one or more industrial-scale pilots.

To this end, a case study will be carried out on the "CO2-DISSOLVED" research project, led by the BRGM (French Geological and Mining Research Bureau) from 2007 to the present. This project has three main objectives: i) to assess the techno-economic feasibility of CO2 storage in a specific type of geological formation known as "saline aquifers"; ii) to investigate a variant of CCS with heat recovery through geothermal energy; iii) to develop an industrial-scale pilot project.

This article will therefore demonstrate how the general controversies on BECCS interfered with the project. It will also show how the project has brought to light new controversies that BECCS must address to develop, regarding the competition between decarbonation technologies at the plant scale. It will also show the translations it had to integrate, demonstrating resilience. However, it has not yet fully succeeded – for now? – in moving into the enrolment and mobilisation phases.

Keywords: BECCS, Actor, Network Theory, controversy, Innovation

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4.C : Relationship between Agriculture and Ecological Bioeconomy : Agricultural Innovation

Barriers to Circular bioeconomy transitions in the agri-food waste system

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Barriers to Circular bioeconomy transitions in the agri-food waste system The case of Reunion island

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1- Introduction

Circular bioeconomy (CBE) is attracting increasing attention from public authorities and private stakeholders as a way to drive sustainable transitions in agri-food-waste systems (AFWS). Previous studies have identified various barriers to the development of a CBE including technological, cultural, political and organizational(Kirchherr et al., 2018).These barriers have primarily been studied at the scale of industrial sectors valorizing bio-based products (Chrispim et al., 2024; Neves and Marques, 2022). However, very few studies have examined the mechanisms of barriers and lock-ins underlying transitions through a CBE in AFWS (Chhetri et al., 2010; Magrini et al., 2016; Meynard et al., 2018). To address this gap, we sought to identify the barriers encountered in the development of CBE initiatives within the AFWS of Reunion Island.

2- Methods

To this end, a comprehensive approach was employed to identify barriers hindering the development of CBE initiatives. A stakeholder mapping exercise, 44 semi-structured interviews, and a participatory workshop involving 30 AFWS stakeholders were conducted. For each initiative, barriers were identified and then grouped into different categories commonly found in the literature: technical, environmental, economic or organizational commonly found in the literature.

3- Results

Among the 38 identified CBE initiatives, organizational barriers related with governance issues

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emerge as the primary challenge, surpassing technical, environmental, or economic barriers. The most frequently cited barriers include: i) a low degree of participation in collective actions (e.g., consumer awareness campaigns); ii) administrative burden; iii) tensions in actor dialogues; iv) inadequate regulations (e.g., ICPE(1) standards); v) difficulties in accessing financing; and vi) an increased workload associated with innovation development.

Initiatives requiring strong coordination among stakeholders, such as the development of fodder banks, composting platforms, or anaerobic digestion units, face significant challenges in fostering collective action. These difficulties are often rooted in a lack of trust between stakeholders, fueled by historical tensions or constraints associated with transitioning to new organizational models. Tensions are particularly pronounced in innovations aimed at substituting imported materials, such as peat alternatives, which place additional pressure on access to local biomass. Furthermore, projects using biomass frequently encounter regulatory constraints like in the composting initiatives. The absence of an institutional framework for certain innovative processes also results in additional administrative burdens, prolonging implementation timelines by several years and sometimes leading to project abandonment. Finally, the development of certain innovations imposes additional workloads, particularly on farmers. This includes the time required to manage the logistics of collective composting platforms or oversized projects relative to available human resources, such as those in territorial food projects.

4- Discussion and Conclusion

The study conducted by Mehmood et al. (2021) identified several barriers to the development of a CBE in agriculture, echoing our findings by highlighting a marked prevalence of institutional barriers. These include both the rigidity of regulatory frameworks, which hinder the adoption of new practices, and a lack of institutional support for project leaders driving innovation. Such institutional constraints reflect the inability of current systems to adapt swiftly to the specific needs of circular initiatives, often discouraging initiative leaders. Economic constraints identified by these authors are also reflected in our observations, particularly the high initial investment costs, which remain a significant barrier given the uncertainty surrounding their profitability and long-term payback. This underscores the need for improved access to tailored financing and economic support mechanisms to facilitate the transition. Michel et al. (2022), on their study about market gardening systems in Provence, also highlights similar challenges, emphasizing the central role of collective dynamics. These systems, while potentially rich in innovation, are often hindered by a lack of coordination among stakeholders and interpersonal tensions. Such tensions, whether arising from historical conflicts or divergent interests, undermine the ability of actors to collaborate effectively and achieve shared objectives. Similarly, Meynard et al. (2013) demonstrated that initiatives aimed at diversifying agricultural crops in France face comparable barriers. Inadequate public policies and the absence of suitable regulatory frameworks are recurring barriers that limit the implementation of CBE innovations, as corroborated by Martínez-Moreno et al. (2024).

These convergences between our findings and existing studies reinforce the relevance of our analysis by showing that the barriers identified are not specific to a particular context. Instead, they reveal common challenges deeply rooted in institutional, economic, and social structures that hinder the transition to circular agricultural practices. This highlights the critical need for structural reforms, including adapted regulatory frameworks, incentivizing public policies, and robust financing mechanisms, to enable CBE practices to establish themselves sustainably within AFWSs.

References

Chhetri, N.B., Easterling, W.E., Terando, A., Mearns, L., 2010. Modeling path dependence in agricultural adaptation to climate variability and change. Annals of the Association of American Geographers 100, 894–907. https://doi.org/10.1080/00045608.2010.500547

Chrispim, M.C., Mattsson, M., Ulvenblad, P., 2024. Perception and awareness of circular economy within water-intensive and bio-based sectors: Understanding, benefits and barriers. Journal of Cleaner Production 464, 142725. https://doi.org/10.1016/j.jclepro.2024.142725

Kirchherr, J., Piscicelli, L., Bour, R., Kostense-Smit, E., Muller, J., Huibrechtse-Truijens, A., Hekkert, M., 2018. Barriers to the Circular Economy: Evidence From the European Union (EU). Ecological Economics 150, 264–272. https://doi.org/10.1016/j.ecolecon.2018.04.028

Magrini, M.-B., Anton, M., Cholez, C., Corre-Hellou, G., Duc, G., Jeuffroy, M.-H., Meynard, J.-M., Pelzer, E., Voisin, A.-S., Walrand, S., 2016. Why are grain-legumes rarely present in cropping systems despite their environmental and nutritional benefits? Analyzing lock-in in the French agrifood system. Ecological Economics 126, 152–162. https://doi.org/10.1016/j.ecolecon.2016.03.024

Martínez-Moreno, M.M., Buitrago, E.M., Yñiguez, R., Puig-Cabrera, M., 2024. Circular economy and agriculture: Mapping circular practices, drivers, and barriers for traditional table-olive groves. Sustainable Production and Consumption 46, 430–441. https://doi.org/10.1016/j.spc.2024.02.036

Mehmood, A., Ahmed, S., Viza, E., Bogush, A., Ayyub, R.M., 2021. Drivers and barriers towards circular economy in agri-food supply chain: A review. Business Strategy & Development 4, 465–481. https://doi.org/10.1002/bsd2.171

Meynard, J.-M., Charrier, F., Fares, M., Le Bail, M., Magrini, M.-B., Charlier, A., Messéan, A., 2018. Socio-technical lock-in hinders crop diversification in France. Agron. Sustain. Dev. 38, 54. https://doi.org/10.1007/s13593-018-0535-1

Meynard, J.-M., Messéan, A., Charlier, A., Charrier, F., Fares, M., Le Bail, M., Magrini, M.-B., Savini, I., 2013. Freins et leviers à la diversification des cultures: étude au niveau des exploitations agricoles et des filières. OCL 20, D403. https://doi.org/10.1051/ocl/2013007

Michel, E., Dufils, A., Navarrete, M., 2022. Analyse sociotechnique des systèmes maraîchers en Provence.

Ministère de la transition écologique, 2019. Tout savoir sur les ICPE (WWW Document). URL https://www.ecologie.gouv.fr/politiques-publiques/savoir-icpe-nomenclature-gestion-declaration (accessed 10.25.24).

Neves, S.A., Marques, A.C., 2022. Drivers and barriers in the transition from a linear economy to a circular economy. Journal of Cleaner Production 341, 130865. https://doi.org/10.1016/j.jclepro.2022.130865

Rey-Valette, H., Mathé, S., 2012. L'évaluation de la gouvernance territoriale. Enjeux et propositions méthodologiques. Revue d'Économie Régionale & Urbaine décembre, 783–804. https://doi.org/10.3917/reru.125.0783

Vermunt, D.A., Negro, S.O., Verweij, P.A., Kuppens, D.V., Hekkert, M.P., 2019. Exploring barriers to implementing different circular business models. Journal of Cleaner Production 222, 891–902. https://doi.org/10.1016/j.jclepro.2019.03.052

(1) Installations Classified for Environmental Protection (*Ministère de la transition écologique,* 2019)

Keywords: Barriers, innovations, circular bioeconomy, transition, agri, food waste system, Island, territory

The Ecologization of Hedgerows in the Grand Est Region: A Perspective

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Hedgerows are often presented as an ecological 'Tower of Babel' (OFB, 2021) of biodiversity (refuge, reproduction, food, mobility for multiple species), or as a 'Swiss army knife' of ecology (Magnin, 2024) because of the multiple 'ecosystem services' they provide (OFB, 2022): water quality, climate regulation, pest control, etc. However, the national hedgerow line shows a loss of 23,571 km/year between 2017 and 2021, against 3,000 km of replanting per year during the same period (CGAER, 2023).
Multiscalar agro-ecological, energy and bio-economic policies (Dassot et al., 2022) are attempting to reverse the trend. At European level, the CAP makes subsidies conditional on the maintenance of hedgerows (GAEC system) and pays a "hedgerow bonus", in addition to funding for agroforestry under the EAFRD (European Agricultural Fund for Rural Development). At French level, the 'hedge pact', launched in 2023, provides for €110 million in subsidies to plant 50,000 km of linear hedges by 2030. At regional level, the Grand-Est region has set itself the target of planting 4,000 km of hedgerows by 2030, enabling local initiatives to get under way. In addition to subsidies, carbon credits under the Low Carbon Label, supported by the public authorities, are attracting private funding for farmers, by offsetting industrial CO2e emissions by storing carbon in wood and agricultural soils.

We propose to put this policy into perspective on the basis of observations and lessons learned from the Tétra'haies research programme, co-funded by INRAE and the Grand-Est region, and conducted in partnership with the CIVAM Oasis. To do this, we will draw on social science research that helps us to understand the (re)mobilisation of stakeholders in favour of hedgerows and the greening of hedgerows (Magnin, 2024). Stéphane Sachet (2020) has shown how wide range stakeholders mobilisation (scientists, associations, GIEEs, etc.) since the 1970s has converged with the desire of the Ministry of Agriculture to move away from co-management with the FNSEA and develop an agro-ecology that can be appropriated by all actors. In his thesis, Léo Magnin (2021) documented the major role played by a network of stakeholders within the Afac association (renamed 'Réseau Haies' on 1 January 2025) in ensuring that hedgerows were taken into account in the 2015 CAP. It also describes how the mapped inventory of hedgerow lines ('graphical parcel register') was developed in response to the European 'fine' of 2013 (€1 billion at stake, see p.163 and p.214).

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This work highlights, sometimes in great detail, the fact that hedgerows are first and foremost objects in the workings of negotiations that take place on multiple political, spatial and temporal scales: from the supranational space in which European and French regulations clash, to the agricultural plot where the technical adviser of a chamber of agriculture adjusts his recommendations to the expectations of the farmer (or groups of farmers). As we know, the period 2023-2024 was marked by a large-scale protest movement by the farming profession, led by various unions and groups. These protests focused on standards and economic instruments for greening agriculture. In this debate, hedgerows replanting appears to be a major component. These difficulties provide an opportunity to put the hedgerow support networks in the Grand Est region to the test.

On the basis of an analysis of the interplay of actors, a documentary study with some historical depth (Guilman et al., 2023), and our field observations since the start of the Tétra'haies project in 2023, we propose to give an account of the various political, social and economic negotiations that hedgerows are currently the subject of in the Grand Est region, which is not a traditional bocage area.

Bibliography

Afac. (2024, octobre 17). *Réduction de 72% du budget du Pacte en faveur de la haie: Il faut accélérer, pas reculer!* https://afac-agroforesteries.fr/72-de-budget-pour-le-pacte-en-faveur-de-la-haie-alertons-nos-parlementaires/

CGAER (2023), La haie, levier de la planification écologique

https://agriculture.gouv.fr/la-haie-levier-de-la-planification-ecologique

Coq, J. F. L., Pesche, D., Legrand, T., Froger, G., & Segura, F. S. (2012). La mise en politique des services environnementaux: la genèse du Programme de paiements pour services environnementaux au Costa Rica. *VertigO-la revue électronique en sciences de l'environnement*, *12*(3).

Dassot M., Commagnac L., Letouze F., Colin A. (2022). Stocks de bois et de carbone dans les haies bocagères françaises. 66 pages.

https://librairie.ademe.fr/ged/6883/rapport-etude-bocage-bois-carbone-ign-2022.pdf

Guilman, E., & Dugua, B. (2023). Mutations du paysage agraire et enjeux autour de la mise en œuvre d'une trame fonctionnelle de haies en Champagne crayeuse. *Pour*, *247*(3), 143-155.

Magnin, L. (2021). *La haie requalifiée : enquête sur un dispositif d'écologisation de la Politique agricole commune (2014-2019)* (Doctoral dissertation, Université Paris-Est).

https://theses.hal.science/tel-03558953/document

Magnin, L., 2024, La vie sociale des haies. Enquête sur l'écologisation des mœurs, Éditions La Découverte, 224 p

Ministère de l'Agriculture (2024), Retrouvez tous les dispositifs d'aide de la Planification écologique pour l'année 2024

https://agriculture.gouv.fr/retrouvez-tous-les-dispositifs-daide-de-la-planification-ecologique-pour-lannee-2024

OFB (2021), Journée d'échange technique, Haies bocagères, Rôle des haies sur la biodiversité et les services écosystémiques. 6 et 7 octobre 2021 à Caen

https://www.genieecologique.fr/sites/default/files/1_francoise_burel_ofb.pdf

OFB (2022), Services écosystémiques : la haie

https://biodiversite.educagri.fr/files/ServicesEcosustemiquesLaHaie_fichier_2022.01.12-services-ecosys-haie-fiches.pdf

Preux, T (2019). De l'agrandissement des exploitations agricoles à la transformation des paysages de bocage : analyse comparative des recompositions foncières et paysagères en Normandie. Géographie. Normandie Université

Sachet, S. (2020). La mise en politique de l'agroforesterie : des interdépendances sociales défiant le corporatisme sectoriel en France ? *Économie rurale*, 372, pp. 119-135.

Keywords: Bioéconomie écologique, écologisation des politiques agricoles, haies

Agroforestry in viticulture: reducing pesticides and pests while enhancing productivity and profitability?

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Agroforestry is increasingly considered as a sustainable alternative to pesticide use for managing vineyard pests while providing multiple ecosystem services. However, few economic studies have assessed the actual benefits of these services in viticulture. This research aims to analyse the extent to which natural regulation induced by agroforestry practices can mitigate pest-related losses and enhance vineyard profitability. To this end, we studied 40 vineyard plots, both conventional and organic, located in the Nouvelle-Aquitaine region of France. Data were collected between 2018 and 2023 as part of the Bacchus Territorial Innovation Laboratory (LIT). Our methodology integrates a spatial econometric approach applied to panel data, combined with Geographic Information Systems (GIS) to map agroforestry practices around vineyard plots,

*Speaker
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including hedgerows, grasslands, shrubs, and woodlands. The objective is to assess their impact on grape yield, pesticide expenditures, and the time spent managing pests. Preliminary results indicate that pests have a non-significant effect on grape production, whereas the interaction between agroforestry practices and pest pressure, as well as the interaction between the insecticide treatment frequency index and pests, has a positive and significant effect on yield. These results indicate that agroforestry practices can provide pest regulation services comparable to those of pesticides, reinforcing their potential as an environmentally friendly pest control strategy. They call for support for agroforestry as a means of reducing pesticide use, despite policies that limit its funding, such as budget cuts for hedgerows. However, we have observed a continuous decline in yields over the years, with this decrease being more pronounced in organic farming than in conventional farming. The yield level in organic farming is 26.5% lower than that of conventional farming, highlighting the climatic and sanitary challenges faced by viticulture and the need to rethink the agricultural system.

Keywords: Agroforestry, natural pest regulation, economic value, damage function, viticulture, spatial econometrics, GIS.

4.E : Integrative Future-Oriented Approaches for Transformative Change in Agricultural and Bioeconomy Systems

Thriving future cropscapes: stakeholder-informed models for agrifood transition

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Climate change will alter the yields and resultant cultivation geographies of many major crops. Evaluating how climate interacts with human activity to shape cultivation possibilities for farmers is vital to understanding the impacts of climate change on agricultural systems. This talk will describe a new multi-institution project integrating predictive modeling, expert insights, and farmer feedback to distill *possible* future cultivation geographies in the three U.S. states. Our team is working iteratively with experts to quantify the impacts of biophysical, technological, and political-economic shifts on cultivation geographies in each region over the next 30-40 years. Within this suite of co-produced *possible* futures, we will articulate futures deemed *desirable* by diverse stakeholders and identify leverage points to move agricultural systems in each region towards these futures.

Keywords: US, agriculture, data science, modeling

*Speaker

Anticipating bioeconomy transitions: An integrative systems approach for exploring uncertain futures

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This paper addresses the contested nature of Europe's bioeconomy transition by developing an innovative methodological framework that integrates qualitative stakeholder insights with quantitative System Dynamics modeling. The bioeconomy, defined as the use of renewable biological resources to produce food, materials, and energy, has become central in European policy discourse as essential for achieving circular and low-carbon economies. However, this transition reveals fundamental tensions between competing visions, including industrial biotechnology focused on growth and global competitiveness, regional circularity emphasizing local development, and ecological sufficiency prioritizing reduced consumption and social justice.

Current future-oriented approaches to understanding these transitions show significant gaps - quantitative models typically emphasize technological change and economic growth while overlooking critical political dynamics, ecological sufficiency policies, and questions of social justice. Conversely, qualitative foresight approaches such as scenario workshops often lack explicit clarity on system interactions and internal consistency, limiting their ability to generate robust insights.

The integrative approach developed here employs a four-step iterative cycle: (1) Uncovering competing visions through literature review and analysis of eight position papers and blueprints recently published in relation to the upcoming update of the EU Bioeconomy Strategy; (2) Mapping system interactions via causal loop diagrams that make feedback loops visible; (3) Anticipating system behaviors through System Dynamics simulation modeling to explore nonlinearities and unintended consequences; and (4) Enabling transformation through multi-level stakeholder co-design processes that ensure outcomes are practical, legitimate, and actionable.

This methodology extends Blumberga et al.'s (2018) "biotechonomy" modular model by explicitly incorporating ecological sufficiency dynamics and industrial resistance feedback loops. The approach illuminates potential pathways toward an ecological bioeconomy while simultaneously highlighting systemic resistances that may emerge. By modeling how policies like consumption caps on resource-intensive bio-products can trigger counteracting responses from industrial stakeholders, it reveals the complex dynamics that may shift trajectories away from sustainability, enabling more robust transition strategies.

Through empirical application involving stakeholders from European NGOs, we demonstrate how this approach clarifies critical trade-offs, identifies leverage points, anticipates resistance,

*Speaker

and develops actionable pathways toward ecological sufficiency and social justice. The research contributes both methodological innovation for sustainability transitions research and practical insights for policymakers navigating the complex socio-ecological challenges of bioeconomy transitions.

Keywords: Bioeconomy transition, system dynamics, stakeholder engagement, ecological sufficiency, futures thinking, causal loop diagrams, policy pathways, contested visions, transformative change

Quantifying Irrigation Influence on Crop Likelihood in the Central and Eastern US

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Meeting the rising demand for food, feed, fiber, and fuel is a key challenge this century, especially as climate change, biodiversity loss, and food insecurity threaten ecosystems. Irrigation plays a vital role in enhancing crop production and shaping farmers' choices by ensuring water availability during critical growth stages. It also interacts with environmental and farming factors to influence which crops suit a region. In this study, we used explainable artificial intelligence to explore how irrigation affects crop choices in the eastern and central United States. Our findings show that irrigation's impact varies by crop and region. Moreover, the complete collapse of irrigation significantly reduces the likelihood across all major crop-producing areas.

Keywords: cropping systems, food security, irrigation expansion, explainable AI

*Speaker

4.D : Energizing Territories through Innovative Bioeconomy

Stimulating Territorial Development through Environmental Innovation in Bioeconomy

Caroline Viault * [1]

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- Introducing the University Innovation Program 'InnoRem' and speakers (10 min)
- Presentation of scientific work by 2 Reims based start-ups working on themes linked to environment (15 min each):

- Elidreo : created from the results of a Reims University lab led over 10 year research (SEBIO), the SU offers a standardized field bioassay based on the zebra mussel (*Dreissena polymorpha*), a bivalve mollusc representative of freshwater bodies, for the chemical and microbiological biomonitoring of water, improving water quality assessment by concentrating bioavailable contaminants present at low concentrations and integrating temporal variations.
- Origins. Earth: this SU proposes "MeteoCarbone" a technology able to measure city's CO2 concentrations in real time to provide accurate knowledge of anthropogenic sectorial emissions, providing cities and with a tool to monitor territorial emissions in real time, identify main emission sources and hotspots. The company opened a new branch in Reims thanks to the InnoGes[2] project, which is leaded by Origins.earth in a consortium with a Reims University lab (AEROLAB – GSMA) and a local innovative company, Eloneo.

- Testimonies and discussion around challenges linked to innovating in Bioeconomy (35 min): measure reliability, translating research results, making research and legislation match, selecting a territory and positioning environmental innovation projects on Bioeconomy in the Grand-Est region, bridging the gap between research and business development, etc. ; local territorial impact: environmental, economic, technological, academic...

- Followed by a Q&A (15 min)

Speakers:

- Elidreo: Dr. Audrey Catteau and Dr. Mélissa Palos-Ladeiro

*Speaker

- Origins. Earth: Giulio Magi (Business Developer), Hervé Utard (CTO), Guillaume Brifoteaux (Scientific Software Engineer)

- Quest for Bioeconomy: Charles de Bohan (Start-up Manager)
- Communauté Urbaine du Grand Reims: Franck Mode (Bioeconomy and research project manager)

Keywords: bioeconomy, environment, innovation, collaboration, research, expertise, testimonies, startup, sustainability

5.A : Behavioural Drivers of Sustainability: Food Choices, Investment Decisions, and Bioeconomy Transitions

The impact of food labels on consumers' choices: the case of Eco-score and Nutri-score

Annarita Colasante * [1], Piergiuseppe Morone [1], Francesca Frieri [2], Alberto Russo [3]

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A third of the environmental impact of European households is caused by the production and consumption of food, making it an important sector from an environmental standpoint (Guinée et al., 2006b; European Environment Agency, 2015). Reducing the environmental impacts of diets is therefore one of the key points to be addressed, even if persuading people to change their food choices is considered to be very challenging (Nestle et al., 1998). One of the possible approaches to encourage these changes is the "knowledge-deficit" approach, which assumes that people will be influenced by information that increase their awareness on the products they consider buying (Abrahamse, 2020). A change in the presentation of products, which incorporates information, can therefore influence consumers' choices without decreasing option or changing economic conditions (Sunstein and Thaler, 2008)." (Slapø e Karevold, 2019, p. 2). One possible way to present information in a simplified way is through labels, which are considered a type of nudge by some scholars as they "provide additional information at the point of choice" (Ölander and Thøgersen, 2014).
This study explores how environmental and health information on food products provided as labels (Eco-score and Nutri-score) affects consumer decision-making, with a particular focus on identifying which type of information-nutritional or environmental-holds greater sway over consumer choices. Understanding this distinction can shed light on the kinds of labels that may be most effective in guiding consumers toward healthier or more sustainable choices. Moreover, this study examines participants' willingness to engage with additional information about a product's score, by the means of a button that they can choose to click or not to get this additional information: when given the opportunity to explore further details, do consumers demonstrate a readiness to seek out and interpret this information, even if it requires additional effort? Lastly, the experiment probes whether a comprehensive indicator of the grocery total health or sustainability rating influences consumers to adjust their choices. This question explores if a simplified, overarching score might encourage shifts in behaviour, especially when there's a gap between consumers' perceptions of their choices and the actual score received.

To answer these questions, we ran a Basket Based Experiment in which participants were asked to choose 8 over 30 products they would typically buy and/or consume. The experimental consisted in four treatments: Treatment 1 in which participants only see basic product information (i.e., price per kilogram, quantity, and an image of the product); **Treatment 2** (eco-score

*Speaker

treatment) where, besides the basic information, an Eco-score which rates each product's environmental impact was added; **Treatment 3** (Nutri-score treatment) is similar to treatment 2 but instead of the Eco-score, a Nutri-score reflecting the product's health impact was provided; **Treatment 4** included both Eco-score and Nutri-score labels allowing participants to evaluate both dimensions simultaneously.

The same set of products, anonymized and stylized, is shown across all treatments to control for brand bias. The product assortment was carefully curated to include equal representation across eco and nutri-score categories (from A to E) and a balanced number of items where either the eco-score or the nutri-score was higher. Products covered six categories- breakfast products, animal products, animal derivatives, sauces, legumes and their derivatives, and pasta and cereals-to cover a diverse range of food types. For each product, a button was available that revealed additional information about the features contributing to the product's score (based on the treatment) and participants were free to press it or not, with no cost involved other than their time and effort. The button aimed to replicate the action of seeking more in-depth information and further examining a simplified score.

In all but Treatment 1, after selecting their products, the average score relative to the products in their basket was shown to the participants . They were asked if they were satisfied, willing to change, and wanted to modify their choices. Those who opted to change could adjust their selections. At the end of each experimental session, participants completed a questionnaire aimed at gaining some relevant information

The experiment was designed to elicit authentic preferences through an incentive mechanism which consists in informing participants that they have a one-in-five chance of having their selected items delivered to their home (purchased from a supermarket's online store). Moreover, each subject received 5€ participation fee.

A Generalized Ordered Logistic Model was employed to examine factors influencing Eco-score and Nutri-score categories, with an incremental model evaluation approach to optimize fit, while an additional Ordered Logit Model ensured robustness; a t-test compared the mean scores, and pairwise correlation analysis explored relationships between information-seeking behaviour and score outcomes.

Our results confirm the efficacy of labels on consumer purchases. Indeed, participants exposed to eco- and nutri-score selected products with better scores compared to the control group, supporting previous research on the effectiveness of simplified labels in guiding consumer behaviour (Lehner et al., 2016; Slapø and Karevold, 2019; Thaler and Sunstein, 2008). The research hypothesis based on the higher weight assigned to nutritional information was partially confirmed by the results: even though both Nutri- and Eco-score significantly impacted purchasing decisions, Eco-score had a a stronger effect in baskets composition. The stronger influence of Eco-score may be attributed to consumers' greater familiarity with nutritional information, making the added value of Nutri-score less pronounced. The questionnaire findings support this, as participants reported regularly checking nutritional labels. In contrast, the environmental impact of food choices is less commonly considered, meaning that Eco-score provided novel and useful information.

Interestingly, participants exposed to Eco-score were more likely to express interest in seeing Nutri-score as well, but the reverse was not observed. This suggests that nutritional information is perceived as essential, while environmental information is viewed as supplementary. While participants acknowledged the link between environmental and personal health, this connection seemed less salient during grocery shopping, where immediate and controllable benefits to per-

sonal health are prioritized. The environmental impact of food choices, being more dependent on collective action, may feel less tangible, contributing to an intention-behaviour gap.

A key finding of the study was the role of the feedback mechanisms. Participants received an overall score evaluation for their basket and this feedback demonstrated a greater willingness in reconsidering their choices. In total, 43% of respondents revised their choices after seeing their overall score. The highest rates of revision occurred in the Eco-score treatment, where 58% changed their choices. This reinforces the idea that consumers are less aware of the environmental impact of food choices and are more open to adjusting their behaviour when provided with relevant information. However, when both Nutri-score and Eco-score were displayed together, participants were less likely to revise their choices, likely due to information overload. Furthermore, when changes were made in Treatment 4, participants primarily improved their Nutri-score, strengthening the importance of nutritional aspects in consumer food purchasing.

Additional information seeking, on average, did not strongly correlate with better choices. The only exception is observed in Treatment 4 where both scores are presented. This suggests that seeking information does not always lead to healthier or more sustainable decisions.
Overall, this study demonstrates that simplified labels, particularly Eco-score, can effectively nudge consumers toward healthier and more sustainable food choices. However, it also highlights the complexity of consumer decision-making, the challenges of integrating environmental considerations into purchasing habits, and the need for further research on strategies to enhance the effectiveness of food labelling systems.

Keywords: food choice, experiment, labels

Circular Bioeconomy: A Review of Empirical Practices Across Implementation Scales

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The paper reviews empirical research on monitoring and modelling the bioeconomy, focusing on its transition towards sustainability. The paper addresses the complexity of this transition, including environmental and social risks. It highlights the need for decision support tools at macro (national-global), meso (regional-citizen) and micro (product-firm) scales. The research identifies major shortcomings, such as the uneven distribution of sustainability indicators and the lack of standardised monitoring frameworks and proposes a comprehensive agenda to improve the life-cycle perspective, visualise trade-offs and monetise externalities. Behavioural insights play a crucial role in addressing these challenges, particularly in understanding consumer perceptions, designing effective incentives and promoting transparency through certification schemes.

Keywords: Bioeconomy, Circular economy, Sustainable transition, Bioeconomy indicators, Life cycle management

*Speaker

Cognitive Dissonance and Information Avoidance in Sustainable Investment Decisions

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In recent years, sustainable investments have become increasingly central in global financial markets. This is not only due to the growing environmental and social awareness of economic actors, but also to the emergence of more forward-looking risk management strategies. These strategies can deal with regulatory, reputational and market uncertainties (Lewis et al., 2016; Park & Oh, 2022). Integrating environmental, social and governance (ESG) criteria into investors' decision-making processes is now widely recognised as a strategic lever, capable of combining financial performance and ethical responsibility (Mervelskemper et al., 2014). Nevertheless, an increase in the focus on sustainable finance does not guarantee investment behaviour consistent with sustainability principles, particularly among retail investors. While the availability of ESG data has increased, significant obstacles persist related to the fragmented, opaque or expensive nature of such information (Billio et al., 2021). In this context, the psychological mechanisms of cognitive dissonance, information avoidance and selective exposure can profoundly influence individuals' choices, making an effective transition towards more informed and sustainable investment decisions difficult (Pröllochs et al., 2018; Huck et al., 2015).
The present study aims to investigate how the psychological and informational factors mentioned above influence individual investors' decision-making processes in the presence of conflicting, uncertain or costly sustainability information. The study will examine the interaction between the accessibility, reliability and cost of sustainability information and the propensity of individuals to make choices consistent with their pro-social and pro-environmental orientations (Caferra et al., 2021; Whitmarsh & O'Neill, 2010). Following the extant literature on information avoidance and cognitive dissonance, it was hypothesised that the presence of economic costs or uncertainty in accessing ESG data would reduce the propensity to inquire and, consequently, the frequency of making sustainable choices. It was also predicted that the conflict between economic performance and environmental impact would favour selfish behaviour, especially in the absence of clear and reliable information, while individuals with strong pro-environmental orientations would show greater value coherence, but only under favourable information conditions.

To address these hypotheses, an online behavioural experiment was conducted based on a Stated Choice Experiment (SCE), drawing inspiration from the model developed by Momsen and Ohndorf (2022) for green consumption, with adaptations made to the context of sustainable financial investments. The experiment involved a sample of 136 university students, recruited from UnitelmaSapienza University, who participated remotely via the z-Tree unleashed platform (Duch et al., 2020). The experiment was carried out individually and remotely, with participants always

*Speaker

connected and video cameras active to ensure compliance with the established protocol and prevent any communication between them. Adherence to the experimental protocol was ensured by real-time monitoring, and a virtual room on Google Meet was utilised for clarification without compromising the experimental integrity.

The experiment consisted of two phases. In the first phase, participants completed a preliminary questionnaire assessing socio-demographic characteristics and behavioural attitudes, including pro-social orientation, pro-environmental identity and risk attitudes (Caferra et al., 2021; Eckel & Grossman, 2002; Whitmarsh & O'Neill, 2010). The collected data were aggregated into synthetic indices that allowed for the categorisation of subjects according to the degree of inclination towards altruistic, ecological and risk-averse behaviour. In the second phase of the experiment, participants were presented with 24 investment decisions, each between two options (G1 and G2) characterised by different financial returns and probability of carbon offsets. The experimental conditions were designed to simulate realistic scenarios in which sustainability information could be fully available, partial, uncertain or associated with a cost. The distinction between the investment options was based on the presence or absence of a conflict between economic return and sustainable impact. Investment choices were divided into two categories: 'aligned interest' situations (where the most profitable investment was also the most sustainable) and 'conflicting interest' situations (where the most sustainable investment offered the lowest return). The analysis was primarily oriented towards the latter, as they constitute a suitable context for the emergence of cognitive dissonance.

The experimental conditions were divided into five treatments: a control group with full and free access to information and four experimental groups in which access to sustainability information was subject to limitations in terms of cost, uncertainty or both. In the control group, participants received both the financial return and the probability that the investment would contribute to the sustainable fund, thus being able to make fully informed decisions. In the experimental groups, on the other hand, only returns were initially shown, while information on sustainability could be requested via two separate buttons: one for 'good news' and one for 'bad news', each with a 50% probability of revealing whether the most or least profitable option was also the most sustainable. nn certain conditions, no financial cost was incurred for requesting information, while in others, each click on the buttons resulted in a slight reduction in the return on the selected investment. In a further variant, the information provided could be inaccurate: every time the participant requested information, there was a 25% probability that it was incorrect. Finally, in the most restrictive condition, economic limitations and uncertainty combined, access to information entailed a cost and, at the same time, the content provided could be unreliable. This design enabled the observation of how variations in cognitive and economic costs influenced both the propensity to inform and the final investment choices.

The results support the theoretical hypotheses formulated. Participants in the control group, who had full access to information, made a higher percentage of sustainable choices. This finding indicates that the accessibility and clarity of information are crucial factors in the adoption of responsible investment behaviour. Conversely, the introduction of a modest economic cost or a margin of uncertainty has a substantial impact on the demand for information, leading to a corresponding decline in the frequency of sustainable choices. It is also interesting to note that subjects tend to avoid information completely or to request it only when they are certain of its reliability, confirming the hypothesis that uncertainty acts as a cognitive barrier that promotes avoidance. Another central element concerns the role of differences in performance between options. The analysis demonstrates that as the difference in return between the sustainable and non-sustainable options increases, the propensity to choose the sustainable option decreases significantly. This supports the idea that high economic incentives reduce the effectiveness of value orientations and that professed preferences for sustainability do not always translate into

actual behaviour when they imply a perceived cost. However, individuals with a high pro-environmental orientation demonstrate greater resistance to this dynamic, maintaining a higher propensity to make sustainable choices, but only under conditions of clear and reliable access to information. Conversely, when information is uncertain or costly, these individuals also tend to adopt more selfish behaviour, highlighting the fragility of ethical motivations in contexts of imperfect information. Concerning information behaviour, it has been demonstrated that the propensity to avoid information increases significantly in those treatments that involve a cost for its acquisition. Concurrently, the perceived reliability of the information has been identified as a key factor. Participants tend to avoid information when there is a risk that the information is incorrect or has the potential to be inaccurate or misleading. The findings of this study imply that if sustainability-related information is not perceived as credible and easily accessible, it is not only ignored but may also reinforce rationalisation mechanisms that lead to the justification of less sustainable choices. In summary, the study demonstrates that the clarity of ESG transparency policies is a crucial factor in their effectiveness and that the presence of cognitive or economic barriers to information can hinder regulatory and market efforts to promote responsible finance.

This study makes a significant contribution to the ongoing discourse on sustainable finance by offering experimental evidence on the role of cognitive bias in decision-making processes. Specifically, it demonstrates that cognitive dissonance is not merely a theoretical construct but a tangible factor influencing economic choices, particularly in contexts of information uncertainty. The findings underscore the notion that information, despite its theoretical availability, is not utilized efficiently if it incurs a cost, is associated with uncertainty, or engenders potential psychological distress. Consequently, public policies and market strategies that are oriented towards the promotion of ESG investments must consider these factors and go beyond the mere disclosure of data. It is essential to also focus on how this information is presented, perceived and integrated into individuals' decision-making processes. The findings of this study are of relevance to the field of regulation. To encourage sustainable investment among retail investors, it is essential to develop tools that reduce costs, enhance the reliability of sources, and ensure the accessibility and comprehensibility of ESG information. Addressing the fragmentation and absence of standards in ESG ratings is crucial, as this contributes to uncertainty and investor cognitive dissonance. The implementation of more harmonised and transparent rating methodologies will serve to limit avoidance strategies and thereby foster investor confidence. The study demonstrates that the influence of cognitive bias cannot be ignored, even among investors with strong environmental motivations. To promote truly sustainable finance, it is therefore necessary to act on the psychological and behavioural mechanisms that govern the use of information. Key steps to be taken to make sustainability policies more effective and to bring financial markets closer to the long-term goals of sustainable development are as follows: reducing uncertainty, simplifying access to and improving the reliability of ESG information.

Keywords: Sustainable Finance, Cognitive Dissonance, Information Avoidance, ESG Transparency, Investment Decision, Making

5.B : Navigating European Research Funding: Opportunities in Bioeconomy

Navigating European Research Funding: Opportunities in Bioeconomy

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, Camille Compain *

, Daryna Pypko *

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European funding has become a cornerstone for advancing research across numerous disciplines, including bioeconomy. This session aims to provide researchers with a detailed understanding of available European funding opportunities.
It will begin with an in-depth presentation of the Horizon Europe program, focusing on its four foundational pillars:
• **Excellent Science**: Supporting groundbreaking research and fostering global talent through initiatives like the European Research Council (ERC) and Marie Sklodowska-Curie Actions (MSCA), the European Union's reference program for doctoral education and postdoctoral training.
• **Global Challenges and European Industrial Competitiveness**: Addressing critical societal issues while strengthening industrial leadership in strategic sectors, including the ecological, digital, and energy transitions.
• **Innovative Europe**: Boosting innovative ecosystems and accelerating the adoption of innovative solutions.
• **Widening participation and spreading excellence**: building research and innovation capacity for countries where successful transnational research is still developing.
This first part will also highlight the role of **European partnerships**, which create synergies between the public and private sectors, co-funding projects aimed at addressing pressing societal and technological challenges, particularly in the field of bioeconomy. **A focus will be addressed on the Circular Bio-based Europe Joint Undertaking (CBE JU), a partnership designed to accelerate the transition to a sustainable bioeconomy by promoting innovation in bio-based industries. This initiative fosters the development of circular and renewable resources while supporting research, innovation, and market deployment of bio-based solutions across Europe, in the context of the European "green deal".**
The second part will focus on **COST Actions** (European Cooperation in Science and Technology). These collaborative networks provide a foundation for researchers to exchange knowledge and form consortia, paving the way for successful participation in larger European programs. COST is particularly useful for interdisciplinary and international research initiatives.

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In the final section, participants will be guided through **the process of preparing and submitting competitive applications to Horizon Europe**. Key evaluation criteria, such as excellence, impact, and implementation, will be explored. Practical advice will be shared to help researchers align their proposals with Horizon Europe's strategic goals, supported by concrete examples and best practices.
Lastly, the session will discuss how researchers can leverage **URCA's Project Engineering Office**, which offers tailored support to streamline the application process, enhance project quality, and maximize chances of success. It will be a unique opportunity for researchers and PhD candidates to ask the Project Engineering team their questions.
By the end of this session, participants will have a clearer understanding of European funding frameworks, actionable strategies for proposal preparation, and insight into institutional support mechanisms. This knowledge will empower them to navigate the complexities of EU funding with confidence.

Keywords: Bioeconomy, COST Actions, ERC, European funding, European partnerships, Horizon Europe, MSCA, Research Opportunities

5.C : Bioeconomy, Innovations and Territories in the Southern Hemisphere

The future of biorefineries: a strategic vision, challenges and opportunities of biorefining in Brazil

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This article's main contribution is the proposal of an analytical framework to guide the study of biomass from a perspective that considers the future of biorefineries. The article is the result of a study carried out in 2024 on biorefining in Brazil. In addition, it presents illustrations of the situation and challenges of biorefining in Brazil.
Over the last twenty years, interest in biorefineries and biorefining has grown significantly. According to the Scopus database, to date, 18,025 documents have included the terms biorefinery or biorefining in their titles, abstracts, or keywords. Of this total, only 3 were registered in 2000. In 2010, 338 documents were published; in 2023, the annual number of documents reached 2,084.

However, except for biofuels in a few countries, generally restricted to first-generation biofuels, the sustainable valorization of biomass has made little progress. If we consider the ambition of 25 years ago, the results of new bioproducts and biomaterials launched are certainly not exciting (1, 2).

However, this scenario is set to change. The intensification of climate change pressures in the last 10 years could open up a new space for biorefining as a contribution to reducing the use of fossil resources and valorizing renewable carbon. In addition, a new way of producing and using biomass can be seen as an opportunity for sustainable development in many regions.

How should biorefining be viewed when building biorefineries in the future? What conceptual vision of biorefining should be constructed to develop sustainable businesses that effectively meet the economic, environmental, and social dimensions? What attributes should biorefineries strive for? These are the questions the article aims to address.

In the study of biomass, in addition to bibliographical research, interviews were conducted with 46 players (industry, government, and research centers), and case studies were drawn up exploring selected biomass with experience or potential for exploitation in Brazil.

A systemic view of biorefining is proposed as a starting point. This vision considers that biorefining involves not only the industrial units for treating and converting biomass, i.e., the biorefineries themselves but also the production chains and the production and innovation ecosystem.

*Speaker

The production chain includes the supply of biomass, processing, industrialization, and marketing.

The importance of a systemic view of biorefining was emphatically emphasized in the study Innovation Ecosystems in the Bioeconomy (3). The construction of industrial units - biorefineries - is seen as the most straightforward element in developing new businesses in the bioeconomy. The most critical challenges lie in creating ecosystems of companies and organizations and value chains capable of supporting the activities of biorefineries.

In addition to a systemic vision, the ideal of biorefining is to look for a set of strategic attributes for achieving biomass's sustainable valorization. Based on the literature, mainly reports and strategic plans for the bioeconomy, four main attributes stand out: product diversification, full biomass utilization, circularity, and regional/territorial insertion.

Based on the systemic vision of biorefining and its strategic attributes, an analytical framework is proposed that can be used to diagnose the current situation of biorefineries. The analytical framework can be presented in a matrix on two axes considering the structuring of supply and biomass valorization. The horizontal axis positions the resource in terms of the supply model and structure, considering supply derived from extraction or cultivation, mastery of cultivation and harvesting technologies, and levels of utilization of the waste generated (low, high, full). The vertical axis considers the different levels of product diversification (lack of diversification with the extraction of only one main product, diversification of products with low added value, and diversification of products with high added value).

Each biomass of interest can be positioned in the diagnostic matrix. This diagnosis guides the study of a given biomass and makes it possible to identify the challenges for the development of biorefining in each case.

In addition to the systemic level, policies and programs must be able to consider the challenge of structuring businesses. Biorefining businesses are often emerging without a defined structure and require innovation. The different levels of structuring can be identified and characterized in an analytical framework that considers four key dimensions in co-evolution: raw materials/resources, technologies, products, and business models (4, 5).

The study of these dimensions and how they are articulated allows for a characterization of biorefineries, distinguishing the different levels of structuring. The policies and strategies implemented for the development of biorefining must consider the challenges involved in each of the dimensions.

As an illustration of the proposed methodology, a brief discussion of the Brazilian case is presented. Six biomasses representative of the variety of resources available in Brazil are explored, including biomasses from Brazilian biodiversity (açaí, macaúba, babassu) and from agro-industrial chains (sugarcane, planted forests, coffee). The analysis allows us to identify the challenges these biomasses face in their evolution from the perspective of the future of biorefining. Policy and strategy recommendations can be derived from the analysis of these challenges.

References

1 - de Jong et al., **Bio-based Chemicals, Value Added Products from Biorefineries,** IEA Bioenergy Task 42, available at www.ieabioenergy.com, 2020.

2 - Teixeira, L.V.; Bomtempo, J.V.; Oroski, F.d.A.; Coutinho, P.L.d.A., **The Diffusion of**

Bioplastics: What Can We Learn from Poly(Lactic Acid)? Sustainability, 2023, 15, 4699.https://doi.org/10.3390/su15064699

3 - OECD. Innovation Ecosystems in The Bioeconomy. OECD Science, Technology and Industry Policy Papers. No. 76, september 2019.

4 - BOMTEMPO, J. V., *Nota técnica do sistema produtivo Química e foco setorial Bioeconomia*, para o projeto Indústria 2027 – Riscos e Oportunidades para o Brasil diante de Inovações Disruptivas, CNI/IEL, 2017.

5 - BOMTEMPO, J. V., ALVES F., Innovation Dynamics in the Biobased Industry, **Chemical and Biological Technologies in Agriculture**, **1**:19 doi:10.1186/s40538-014-0019-8, 2014.

Keywords: biorefining, biomass, Brazil

Governance of circular bioeconomy transitions in the agri-food waste system: Perceptions and Strategies

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Governance of circular bioeconomy transitions in the agri-food waste system: Perceptions and Strategies
The case of Reunion island

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1- Introduction

Circular economy (CE) is a concept that is gaining an increasingly important place in public policies at the European (e.g. The Europe Action Plan for the Circular Economy as part of the European Green Deal, 2020) and national levels (eg. In France Loi Garot, 2016). Even if the evidence remains vague (Giampietro and Funtowicz, 2020), the promise of reducing environmental impacts and contributing to economic development through circularity seems to appeal agri-food waste system stakeholders' attention (Leipold et al., 2021). Consequently, we observe collective and individual initiatives emerging at different scales (suppliers, farmers, local authorities, etc.). Faced with these major changes, we conducted a study to explore stakeholders' perceptions of the circular bioeconomy (CBE- circular economy applied to the agri-food waste system *via* biomass uses) and to characterize the strategies underlying CBE innovation initiatives.

2- Methods

To this end, a comprehensive approach combining the Multi-Level Perspective (MLP) framework (Geels, 2020) with territorial governance (Pachoud, 2022) analysis was used to address CBE ideal, material, and institutional dimensions. Both stakeholder perceptions of the CBE concept associated to the 9R principles in Kirchherr et al. (2017) framework and the limitations of its operationalization were analyzed. Together with the diversity of CBE innovation initiatives that have emerged and the role of public stakeholders in their promotion. A stakeholder

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mapping, 44 semi-structured interviews, and a participatory workshop gathering 30 agri-food waste system stakeholders were conducted.

3- Results

Analysis of the ideal dimension revealed that the reference framework surrounding the concept of CBE remains ambiguous, particularly its implementation at territorial scale. All the stakeholders surveyed said that they had heard of the concept of circular economy or CBE, although they did not necessarily associate them with each other. Six of the 9R principles in Kirchherr et al. (2017) framework about the role of CBE were mentioned by the stakeholders. Rethink" was the most frequently mentioned. The principles of "Reuse," "Recycle," and "Recondition" were the least frequently mentioned. The analysis of the stakeholders' representations also revealed very few explicit mentions of the term biomass in their definitions.

Analysis of the material dimension revealed 40 innovation initiatives, grouped in three main strategies representing the main pathways of transition: (i) replacing imported materials by local or more renewable alternatives; (ii) increasing the consumption of local food; and (iii) enhancing circularity through the expansion of organic matter recycling. Strategy (i) focuses on innovation initiatives supported by both public and private stakeholders. Agricultural cooperatives are exploring alternatives to imported materials, such as establishing a 'fodder bank' to store locally produced fodder for dry-season use. Renewable wood pellets have replaced coal for electricity generation, and horticultural practices are shifting towards local compost as a substitute for imported peat. Innovation initiatives in strategy (ii) aims to change consumers' eating habits by promoting the consumption of local products. These initiatives, often led by public stakeholders, include awareness-raising actions such as school and community gardens, waste sorting, and tasting of traditional Creole vegetables. Territorial food projects, organized by local authorities, also encourage the use of local produce in school. Private stakeholders contribute by creating local outlets for direct meat sales, reducing intermediaries, transport, and packaging. Additionally, a label has been introduced to promote locally produced meat. Finally, strategy (iii) focuses on enhancing territorial circularity by valorizing local organic matter through anaerobic digestion and composting units. Key stakeholders, including livestock cooperatives and waste treatment sectors, drive innovations to manage livestock effluents, such as composting and separating pig slurry phases.

Analysis of the institutional dimension highlighted the role of public action in supporting the emergence of CBE innovation initiatives. The State, through the Regional Environmental, Planning, and Housing Agency (DREAL Reunion), coordinated the creation of a 'Roadmap for a Circular Economy,' with 50 measures to reduce resource consumption and waste by 2030. Regional and local authorities manage European and national funds, financing innovation initiatives and supporting research to build locally adapted knowledge. Local public stakeholders also promote consumer behavior change and create regulatory frameworks that encourage recycling and alternative solutions for managing livestock effluents. Starting in 2024, a new requirement for source separation of organic waste will further push stakeholders to adopt circular bioeconomy solutions

4- Discussion and Conclusion

Firstly, findings provide a perspective that contrasts with studies emphasizing the significant role of niches in innovation processes (e.g., (Geels, 2020)). In fact, in the agri-food waste system of Reunion Island, transitions through a CBE are primarily driven by stakeholders embedded in dominant sociotechnical regimes rather than niche innovations. These stakeholders leverage well-established networks and oligopolistic market structures on the island to rapidly secure and establish innovations (Hermet & Rochoux, 2014). Moreover, inter-professional plant and live-

stock organizations play a pivotal role by supporting innovation initiatives, mediating between public and private sector needs, and providing technical solutions and funding. Niche stakeholders outside these networks often face delays or abandon projects due to limited access to resources and support. These findings highlight the importance of networks in enabling innovation and align with transition geography studies that emphasize their role in stabilizing niche innovations.

Secondly, in the literature, initiatives of CBE have generally been identified at the sectoral level, but rarely or not at territorial scale (Kalmykova et al., 2018). The originality of the territorial approach allowed us to trace the pathways of transition through the CBE by integrating the specificities of Reunion Island. Then, as highlighted in the work of Allain et al. (2022), stakeholders recognize circular bioeconomy as a useful concept for rethinking the territory. However, the contours of its operationalization to collectively engage the transitions of agri-food waste systems remain unclear. Thus, the main challenge faced by transitions through CBE in agri-food waste systems is the co-construction of a territorial governance that will enable greater coherence among the various components of the regimes.

References

Allain, S., Ruault, J.-F., Moraine, M., Madelrieux, S., 2022. The 'bioeconomics vs bioeconomy' debate: Beyond criticism, advancing research fronts. Environmental Innovation and Societal Transitions 42, 58–73. https://doi.org/10.1016/j.eist.2021.11.004

Decree No. 2016-1134 of August 19 (2016). Stratégie Nationale de Mobilisation de la Biomasse.

DEAL Réunion (2021). Feuille de Route EC (FREC) de La Réunion. https://www.reunion.developpementdural
gouv.fr/feuille-de-route-economie-circulaire-frec-de-la-a1023.html (accessed 4.20.23).

Geels, F.W., 2020. Micro-foundations of the multi-level perspective on socio-technical transitions: Developing a multi-dimensional model of agency through crossovers between social constructivism, evolutionary economics and neo-institutional theory. Technological Forecasting and Social Change 152, 119894. https://doi.org/10.1016/j.techfore.2019.119894

Giampietro, M., Funtowicz, S.O., 2020. From elite folk science to the policy legend of the circular economy. Environmental Science & Policy 109, 64–72. https://doi.org/10.1016/j.envsci.2020.04.012

Hermet, F., Rochoux, J.-Y., 2014. Vie chère et pauvreté à La Réunion. Informations sociales 186, 90–97. https://doi.org/10.3917/inso.186.0090

Kalmykova, Y., Sadagopan, M., Rosado, L., 2018. Circular economy – From review of theories and practices to development of implementation tools. Resources, Conservation and Recycling 135, 190–201. https://doi.org/10.1016/j.resconrec.2017.10.034

Kirchherr, J., Reike, D., Hekkert, M., 2017. Conceptualizing the circular economy: An analysis of 114 definitions. Resources, Conservation and Recycling 127, 221–232. https://doi.org/10.1016/j.resconrec.20
Leipold, S., Petit-Boix, A., Luo, A., Helander, H., Simoens, M., Ashton, W., Babbitt, C., Bala, A., Bening, C., Birkved, M., Blomsma, F., Boks, C., Boldrin, A., Deutz, P., Domenech, T., Ferronato, N., Gallego Schmid, A., Giurco, D., Hobson, K., Xue, B., 2021. Lessons, narratives and research directions for a sustainable circular economy. https://doi.org/10.21203/rs.3.rs-429660/v1

Keywords: Perceptions, innovations, circular bioeconomy, strategies, transition, agri, food waste system, Island, territory

Trajectoires d'innovations sur les bioproduits à base de micro-organismes une contextualisation par l'agriculture tropicale.

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Introduction

L'utilisation des micro-organismes comme ressources constitutives de l'agriculture est historiquement ancrée dans les pratiques agricoles (compostage, lactofermentation.) des sociétés rurales depuis des siècles. La caractérisation de ces micro-organismes (virus, champignons, bactéries) par leur fonctionnalité pour restaurer la fertilité des sols, réduire l'usage de pesticides mobilise elle depuis une trentaine d'années les organisations de la société civile, entreprises, organisations professionnelles agricoles et la recherche agronomique principalement dans les pays du sud. L'augmentation, la multiplication des situations exploratoires de développement ou productives est cependant en croissance en liens par la science qui explore les conditions d'exploitation de ces ressources invisibles. Pour la recherche agronomique elles sont la promesse d'une révolution agronomique majeure qui permettra de s'affranchir des externalités négatives des intrants chimiques, mais aussi répondre à des enjeux économiques dont les couts reliés à ceux de l'énergie sont en croissance dans l'agriculture et l'alimentation. Le marché des bioproduits connaît ainsi depuis une dizaine d'année une croissance spectaculaire.

Ces nouveaux intrants peuvent être différenciés en deux catégories : les produits de lutte biologique au sens large (y compris les biopesticides) et les biofertilisants (y compris les biostimulants). Ils peuvent être autoproduit par les agriculteurs et les petites entreprises à partir de ressources locales ou faire l'objet d'un production industrielle ce qui structure potentiellement deux trajectoires technologiques qui s'affirment à l'échelle mondiale. Cette communication

*Speaker

référence l'historicité de ces trajectoires est documente par des recherches participatives situées en quoi l'autoproduction de biofertilisants est une opportunité d'intensification socio-écologique de l'agriculture ou une nouvelle " promesse " pour solidifier l'intensification industrielle et chimique mondialisée de l'agriculture ?

Méthodologie

La démarche mobilise deux phases d'enquêtes participatives. La première structurée par différents projets explore avec un même canevas méthodologique les situations expérimentales d'autoproduction de bio-intrants à partir micro-organismes dans des pays du sud (Côte ivoire, Cambodge, Cameroun..). Chacun des contexte faisant l'objet de publications spécifiques. La deuxième conduit partant de ces situations à organisé un forum transdisciplinaire(1) qui a confronté un état de lieux des recherches dans les instituons agronomiques (inrae, cirad, ird) au regard des expériences mis en œuvre par le réseau d'acteur impliqué par des projets dans l'agriculture tropicale en Amérique latine (Équateur), Afrique (Côte d'Ivoire), Asie (Cambodge), Europe (France). Ce forum avait plusieurs objectifs : créer un échange coopératif entre les acteurs identifiés, réduire les asymétries d'informations et de connaissances, et contribuer à la capitalisation d'expériences issues de différents contextes. D'abord pour 'informer les institutions de recherche agricole, les acteurs publics et les bailleurs sur l'état des connaissances. Ensuite pour caractériser la nature des verrous et leviers à l'affirmation d'une trajectoire technologique d'autoproduction de biofertilisants à partir de ressources locales.

Résultats

Les résultats différencient deux trajectoires technologiques respectivement d'autoproduction et d'industrialisation des microorganismes dans la production de biofertilisants, puis analysent les freins à la mise en œuvre d'une trajectoire d'autoproduction de biofertilisants basée sur les ressources locales.

Une trajectoire agricole d'autoproduction de bioproduits à base de micro-organismes

L'activation des micro-organismes pour produire des intrants, conditionnés, transportés et utilisés en dehors de lieux d'existence est apparue dans les années 70 dans le développement des techniques de fermentation anaérobie des déchets organiques dans l'agriculture biologique japonaise. La participation d'ingénieurs japonais à la vulgarisation de ces pratiques en Amérique latine a initié des situations expérimentales pour la production de Bokashi. Au début des années 2000 cette expérimentation a été reprise à Cuba et structuré des investissements productif nationaux.

Dans les années 1980, les réseaux d'agriculteurs expérimentaux émergents en Amérique latine se sont diversifiés : au Costa Rica, puis à Cuba et en République dominicaine (Restrepo et Rivera 1996, 2001) puis dans différents pays (Équateur, Pérou, Colombie, Mexique, etc.). Elle documente l'émergence d'investissements par différentes catégories d'agriculteurs à l'origine de la multiplication petites unités de production qualifiés de biofrabriques par les travaux en cours (Goulet 2024). Ces situations ont généré des lieux de formation, d'échange d'expériences à l'origine de l'autoformation d'ingénieurs d'ONG francophones activent l'expansion des processus d'expérimentation en liens par les instituts de recherche agricole tropicale (CIRAD-IRD) dans l'agriculture européenne (Belgique, France, Pays-Bas, etc.), en Afrique, principalement au Sénégal et au Burkina Faso (respectivement 2017 et 2016), en Côte d'Ivoire (2020), en Guinée Bissau (2024) et en Asie (Cambodge, Vietnam).

Une trajectoire d'industrialisation de la production de micro-organismes

La deuxième trajectoire est le résultat de recherches universitaires japonaises qui ont conduit au développement standardisé de micro-organismes à base de bactéries (Teruo Higa de l'Université Ryukyus d'Okinawa) dans les années 1980. Cette recherche a structuré la création de la société EMRO qui, après avoir breveté son procédé, licencie l'utilisation de micro-organismes efficaces pour différents usages comme la production de Bokashi dans le circuit de distribution des jardineries en Europe. La mondialisation de la firme EMRO par la marque EM Efficace active une industrialisation de la production et un réseau de distributeurs à l'échelle mondiale : filiales en Europe depuis 1991 (création du groupe Agriton) et en Afrique ou Asie. Cette trajectoire est densifié en Europe par les investissement des firmes de l'agrofourniture des engrais et un nombre croissant de Startups. En Amérique latine, cette trajectoire d'industrialisation de la production de micro-organismes est au centre des investissements soutenus par le gouvernement en lien avec le secteur agro-industriel de la production de soja. Elle reste principalement polarisée par les produits de biocontrôle..

Ces deux trajectoires s'hybrident de manière complémentaire par différentes interdépendances portées par les acteurs (entreprises, instituts de recherche) qui se mobilisent dans l'amélioration des connaissance ou les expérimentations dans le système productif. Ces trajectoires sont aussi en compétitions. Les acteurs centraux qui les portent : les agriculteurs, les industries de l'agrofourniture mondialisée, les politiques publiques n'ont pas les mêmes objectifs au sein des chaines de valeur ou des territoires.

Caractérisation du potentiel et des obstacles à l'autoproduction de bioproduits

La comparaison des relations concurrentielles et complémentaires entre les trajectoires d'autoproduction des bioproduits et d'industrialisation qualifient les principaux freins à la mise en place d'une trajectoire d'autoproduction de biofertilisants à partir de micro-organismes locaux. Ces verrous dans une analyse matricielle (cf. tableau) peuvent être caractérisés selon deux niveaux. Le premier différencie en termes de blocages intrinsèques aux processus lui-même (faiblesse) ou à des menaces externes, c'est-à-dire à des variables externes (macro-institutionnelles, économiques) qui peuvent provoquer un changement d'échelle dans l'expansion des conditions de production et d'utilisation de ces bioproduits. Le second séquence ces bocages internes ou externes selon leur dimension : économique, écologique, technique, socio-écologique.

Keywords: Bio, intrants, Agriculture tropicale, Trajectoires technologique, innovation

Biological Inputs in Argentina: Perspectives of Producers and Companies Facing the Competition of Agrochemicals

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In Argentina, the development and production of agricultural biological inputs (biopesticides and biofertilizers) have been known for several decades. However, in the past decade, there has been a growing interest in these products from the State, scientific and technological organizations, companies in the sector, and certain agricultural organizations.
The rising interest in biological inputs occurs within a broader context of increasing demand for reducing the environmental footprint of agricultural production. In this scenario, the bioeconomy emerges as a new development strategy for the country, given Argentina's abundant and diverse availability of biomass.

In the last ten years, biological inputs have begun to appear on government agendas (Goulet et al., 2020), leading to the creation of programs and institutions regulating their use, such as the Advisory Committee on Biological Inputs for Agricultural Use (CABUA).

Scientific and technological organizations, including the National Institute of Agricultural Technology (INTA), the National Scientific and Technical Research Council (CONICET), and National Universities, have also intensified their research efforts in developing biological inputs. These institutions currently boast more than 55 developments at various stages of progress (Starobinsky et al., 2024).

In the private sector, a growing number of companies have added biological inputs to their product portfolios, especially large national or multinational suppliers of agricultural inputs. Additionally, small and medium-sized enterprises specifically targeting the biological input market have emerged, many of which are organized under the Argentine Chamber of Biological Inputs. On the demand side, the use of biological inputs is increasingly discussed in forums held by producer organizations, such as the Argentine Association of Direct Sowing Producers and interprofessional crop organizations for soybeans, rice, and maize, among others.

In summary, there is a growing presence of biological inputs in Argentina, mirroring global trends.

However, most of Argentina's agricultural production, particularly extensive crops such as soybeans, maize, wheat, sunflower, sorghum, and rice-which form the backbone of the country's export structure-is conducted under a technological model that relies heavily on chemical inputs.

*Speaker

This reliance is evident in the increased use of pesticides and chemical fertilizers per hectare, within a context of lax regulation and oversight.

Thus, while advances in regulating and promoting the use of biological inputs in agriculture are evident, no corresponding efforts to reduce the use of chemical inputs have been identified (Goulet & Hubert, 2022). Consequently, the biological input industry in Argentina appears to be subject to competition based on price and efficacy against chemical alternatives, which have the advantage of being well-established and widely adopted by farmers. This dynamic is reflected in the lower market penetration and participation of biological inputs in Argentine production, even when compared to other countries in the region, such as Brazil and Chile (Starobinsky et al., 2024).

In this context, this study offers an exploratory analysis of the perspectives of biological input companies and agricultural producers who use or might potentially use these products. Specifically, it aims to examine the trajectory of industrial investments in the development of biological inputs in Argentina (Temple & Fernandes, 2024). On the one hand, the study seeks to identify the strategies employed by these companies to strengthen their presence in the local market and their perspectives on competition with chemical inputs. On the other hand, it aims to understand the viewpoints of agricultural producers engaged in extensive cropping systems regarding their experiences and expectations with biological inputs.

The study is based on an analysis of specialized press sources, particularly two periodicals targeting the sector: *AgrofyNews* and *Bichos de Campo.* Additionally, it draws on a series of exploratory interviews with companies, producer organizations, and agricultural producers, as well as participant observation in forums and meetings of sector stakeholders, such as the National Meetings on the Production of Extensive Crops with Biological Inputs and Sustainable Strategies (EnBio).

Bibliography

Goulet, F., Aulagnier, A., & Hubert, M. (2020). Del reemplazo tecnológico al desplazamiento de fronteras.Las alterna*vas a los agroquímicos en Argen*na, Brasil y Francia. En *Naturaleza y conocimientos en tensión. Aportes al debate ambiental desde las ciencias sociales.* Teseo.

Goulet, F., & Hubert, M. (2022, noviembre 22). *Los bioinsumos de uso agropecuario en Argentina: Las políticas públicas para acompañar las transiciones hacia una agricultura sostenible.* Blog del IICA. https://blog.iica.int/blog/los-bioinsumos-uso-agropecuario-en-argentina-las-politicas-publicas-para-acompanar-las

Starobinsky, G., Mozón, J., Broggi, E. D. M., & Braude, H. (2024). El desarrollo de bioinsumos como camino hacia una especialización sustentable: Capacidades, oportunidades y recomendaciones de políticas para Argentina. *Pymes, Innovación y Desarrollo*, *12*(2), Article 2. https://doi.org/10.70453/2344.9195.v12.n2.46458

Temple, L., & Fernandes, P. (2024). Innovaciones de bioproductos basados en microorganismos para la reducción de plaguicidas: Potencialidades y riesgos en la agricultura tropical. *Memorias de la VII Convención Internacional Agrodesarrollo 2024.* https://agritrop.cirad.fr/611432/7/611432.pdf

Keywords: Agricultural bioinputs, Argentina, Actors'perspective, Crop production

5.D : Workshop GTT3 – "Biomass, Bioeconomy, and Biorefinery within TETRAE (Closed Session)

Projet de recherche BICCOC Valorisation des co-produits des filières agricoles, agro-alimentaires, sylvicoles et marines

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Résumé du projet de recherche

Le projet de recherche BICCOC (Bioclusters Circulaires en Occitanie) initié dans un programme porté par l'INRAE et la région Occitanie s'intéresse à la **valorisation des bioressources** en région et aux transitions sociotechniques, écologiques et agricoles dans les territoires ruraux. L'objectif est d'étudier comment cette valorisation conduit à la **transformation des filières agricoles, agro-alimentaires, forestières et des produits de la mer et à leur territoire.** Cette transformation nécessite généralement des **innovations** portées par divers acteurs cherchant à **valoriser en cascade les co-produits de l'agriculture, l'agro-alimentaire, la sylviculture et la pêche**. La **bioéconomie circulaire (BEC)** est le nom donné à cette valorisation alimentaire ou non alimentaire des co-produits à des fins de substitution des énergies fossiles et aux arbitrages nécessaires qui en découlent entre les usages des bioressources.

L'objectif du projet BICCOC est de **comprendre les freins et les leviers à l'émergence des initiatives dans le domaine de la BEC** et de **questionner la mise en œuvre de ces transformations avec les acteurs de ces filières**. L'objectif complémentaire de BICCOC est d'en dégager une **démarche d'accompagnement adaptée à ces projets territoriaux**.

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Proposition thématique SESSION SPECIALE TABLE RONDE

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- Cas du bois de châtaignier dépérissant des Cévennes et son projet de création d'une bioraffinerie

Retour sur le projet MODESTINE : ce projet porte sur la valorisation des taillis dépérissants de châtaignier en Cévennes par la création d'une filière de chimie verte (bioraffinerie) locale. Dans ce cadre, une étude a été réalisée pour déterminer les conditions sociales d'émergence de cette filière sur le territoire cévenol. L'approche consiste à mettre en lumière les attentes et préoccupations des acteurs locaux à prendre en compte dans ce projet. En parallèle, un procédé d'extraction des tanins est étudié : l'extrusion bi-vis. La composition et la valorisation de ces extraits sont étudiées.

- Cas du gemmage du pin maritime des Cévennes et son projet d'atelier distillerie.

Les Chartes forestières du Pays des Cévennes et du PETR Sud Lozère travaillent sur la mise en place d'une filière de gemmage du pin maritime. Plusieurs sessions de gemmages ont été organisées ces dernières années en s'appuyant sur la méthodologie employée dans les Landes. Grace à un partenariat avec une entreprise locale, l'huile essentielle de térébethine récoltée a permis la conception d'une douche térébenthinée qui sera utilisée dans une station thermale située en Cévennes.

Pour ces deux cas pilotes, les scénarios qui permettront leur mise en place devront être élaborés (identification des acteurs, dimensionnement, étude économique et environnementale, structure de gouvernance,...)

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Keywords: Bioéconomie, filière, forêt, territoire, Cévennes, ressource, Bioclusters

5.E : Economic and Governance Challenges of BECCS for Carbon Storage

What economic incentives for Bioenergy with Carbon Capture and Storage? An overview of pricing mechanisms for Carbon Dioxide Removal (CDR)

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Carbon Dioxide Removal (CDR) technologies, including Bioenergy with Carbon Capture and Storage (BECCS), have evolved from being met with skepticism to being recognized as essential for achieving net-zero emissions targets globally (IPCC, 2022). Integrated Assessment Models (IAM) have incorporated BECCS since the late 2000s (van Vuuren et al., 2013), and mitigation pathways compatible with the Paris Agreement objectives are increasingly relying on BECCS.
In that context, the rationales for considering CDR in public policy are multifaceted: balancing residual emissions from hard-to-decarbonize sectors, enabling net-zero emissions targets, and even moral obligations for historical emitters to drive down CDR costs for others (Honegger et al., 2021). However, despite its critical role, CDR is characterized by a public goods dilemma, where few actors bear the costs, but the benefits are global, necessitating systematic long-term public intervention.

This paper provides a comprehensive overview of existing and proposed economic incentives aimed at fostering the deployment of BECCS to meet national Net-Zero objectives. We examine a range of mechanisms, including carbon crediting mechanisms (Schenuit et al., 2023), voluntary carbon markets (Fuss et al., 2024), UNFCCC carbon markets (UNFCCC, 2021), taxes, and Emissions Trading Systems (ETS) (Kalkuhl et al., 2022; Rickels et al., 2022, 2021), to understand how they can be designed and implemented to promote the uptake of BECCS.

By synthesizing the current state of knowledge in the economics literature, this study aims to inform policymakers and stakeholders on the most effective strategies to overcome the economic barriers to CDR deployment, ultimately supporting the transition to a net-zero economy.

References

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Fuss, S., Johnstone, I., Hoglund, R., Walsh, N., 2024. Chapter 4: The Voluntary Carbon Market, The State of Carbon Dioxide Removal - 2nd Edition. https://doi.org/10.17605/OSF.IO/MG3CY

Honegger, M., Poralla, M., Michaelowa, A., Ahonen, H.-M., 2021. Who is paying for carbon dioxide removal? Designing policy instruments for mobilizing negative emissions technologies. Frontiers in climate 3, 672996–672996.

IPCC, 2022. Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, NY, USA. https://doi.org/10.1017/9781009157926

Kalkuhl, M., Franks, M., Gruner, F., Lessmann, K., Edenhofer, O., 2022. Pigou's Advice and Sisyphus' Warning: Carbon Pricing with Non-Permanent Carbon-Dioxide Removal. SSRN Journal. https://doi.org/10.2139/ssrn.4315996

Rickels, W., Proelß, A., Geden, O., Burhenne, J., Fridahl, M., 2021. Integrating Carbon Dioxide Removal Into European Emissions Trading. Frontiers in Climate 3, 1–10. https://doi.org/10.3389/fclim.2021.69

Rickels, W., Rothenstein, R., Schenuit, F., Fridahl, M., 2022. Procure, Bank, Release: Carbon Removal Certificate Reserves to Manage Carbon Prices on the Path to Net-Zero. Energy Research & Social Science 94, 102858–102858. https://doi.org/10.1016/j.erss.2022.102858

Schenuit, F., Gidden, M.J., Boettcher, M., Brutschin, E., Fyson, C., Gasser, T., Geden, O., Lamb, W.F., Mace, M., Minx, J., 2023. Secure robust carbon dioxide removal policy through credible certification. Communications Earth & Environment 4, 349.

UNFCCC, 2021. Decision -/CMA.3 Guidance on cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement.

van Vuuren, D.P., Deetman, S., van Vliet, J., van den Berg, M., van Ruijven, B.J., Koelbl, B., 2013. The role of negative CO 2 emissions for reaching 2 C-insights from integrated assessment modelling. Climatic Change 118, 15–27.

Keywords: BECCS (Bioenergy with Carbon Capture and Storage), economic incentives, carbon dioxide removal, negative emissions, carbon markets

Will be CCS/BECCS lost in energy transition?

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In the energy transition, carbon capture and storage (CCS) techniques have an ambiguous status: they are seen as an instrument for minimizing the overall cost of the energy transition by decarbonizing sectors that cannot do without fossil fuels in the short/medium term. As a result, they enjoy the support of producers in these sectors, and are seen by their detractors as techniques that contribute to the "carbon lock-in" of our economies. We might add that their large-scale deployment would generate additional demand for energy, and hence greater reliance on fossil fuels. On the other hand, CCS associated with the energetic use of biomass, BECCS, has the ability to achieve negative emissions, enabling it to be considered a Carbon Dioxid Removal (CDR) technique. This means that these technologies should continue to be used *after* the energy transition. BECCS, which initially appeared as a *complement* to CCS, should eventually become its *substitute*, as the decarbonization of fossil fuel-using industries progresses.
To be more precise, the development of BECCS as a source of negative emissions is increasingly being promoted both in academic work and by international institutions (IPCC, IEA) as an indispensable means of achieving the objective of limiting global warming to 1.5○. This situation is all the more paradoxical given that the deployment of both CCS and BECCS remains very slow, despite the fact that this recourse seems increasingly necessary in view of the difficulty our economies have in decarbonizing. In other words, the more difficult it becomes to reach our decarbonization targets, the more legitimate the call for these technologies becomes... on a horizon harder and harder to reach.

In other words, using BECCS as a CDR means recognizing the difficulty we have in reducing our CO2 emissions *today*, and promoting a technology that will enable us to extract it from the atmosphere *tomorrow*. In this way, the development of BECCS could help to legitimize the development of CCS, which initially originated in the oil and gas industries.

The first objective of this article is to examine this paradoxical configuration, which sees CCS both as an instrument for perpetuating the "carbon lock in", and as an integral part of a new carbon-neutral energy mix. It will then provide an initial assessment of the state of progress of all CCS/BECCS techniques.

As far as BECCS is concerned, the figures provided by both the IEA through the Global CCS Institute (GCCSI 2022) and the IPCC (IPCC, 2005) point to negative emissions volumes (or CDR) of the order of 333 to over 1,200 Gt of CO2 in 2100, of which 226 to 900 Gt for BECCS,

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the remainder being provided by direct air capture technologies (DACS) whose status is still uncertain and whose costs are high. Modeling carried out by Imperial College using the MONET (Modelling and Optimization of Negative Emissions Technologies) model produces the same orders of magnitude (Chiquier et al, 2023), without taking into account DACS techniques, but with that of Afforestation/reforestation. Finally, the work of Rickels et al (2022), provides an assessment of the various available sources of negative emissions, including sources of still very uncertain status (Direct Air Capture, DACS). They show that BECCS has a potential close to that of reforestation or land management change, with a much stronger permanence of storage.

In the second part of the paper, we'll look at the chances of success of this paradoxical configuration, and in particular at the limits that could be imposed on a large-scale deployment of BECCS.

First of all, while BECCS uses techniques close to those of CCS, and will therefore benefit from advances in these techniques, its energy production units are much smaller, and the sources of CO2 from biomass are much more diffuse than those used by fossil fuel CCS. So adapting CCS infrastructures to BECCS will be costly, and will undoubtedly require large-scale developments.

Another limitation relates to the financing of negative emissions: even if a legal framework already exists, the question of how to price these emissions remains open, especially if BECCS deployment becomes widespread - which we hope it will.

A final limitation to the large-scale deployment of BECCS is the land-use change it could lead to. BECCS will not be able to use agricultural waste alone. As a result, deployment could increase pressure to produce biomass for energy purposes, to the detriment of food production. This problem of land-use change is not specific to BCCS, and immediately concerns the use of biomass for energy purposes, particularly agrofuels, but it should not be overlooked. Modeling carried out at global level does take these various constraints into account and leads to the definition of optimal solutions, enabling us to limit these changes in land use, but it is to be feared that the operation of real economies will lead to results that are far removed from them.

Finally, the question raised by the BECCS, and all the work on negative emissions, raises the question of the viability of a strategy that consists in pinning our hopes of limiting climate change on the future deployment of a technology that is struggling to establish itself today.

Keywords: Carbon Dioxid Removal, Carbon Capture storage on Bioenergy, Climate Change Mitigation

5.F : Narratives and Vision of the Futur of Bioeconomy

Visions, hopes and contradictions of the bioeconomy: a critical analysis of EU Policy Narratives and stakeholder responses

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The bioeconomy is a central part of the European Union's strategy to transition away from fossil-based economies, promising solutions that balance economic growth, environmental protection, and energy independence. However, the concept remains contested, encompassing diverse and sometimes conflicting visions. This study conducts a narrative analysis of the EU's bioeconomy in the European Bioeconomy Strategy (2018) and its Progress Report (2022). The analysis is complemented by 27 semi-structured interviews and a deliberation workshop with EU policymakers, researchers, and other stakeholders, which offer additional insider-insights into the promises and tensions of these narratives.
The analysis identifies nine distinct narratives about the bioeconomy. Some focus on the shift from fossil fuels to bio-based alternatives, emphasizing technological innovation, bioenergy, and circularity. Others stress ecological boundaries and the need to align economic activities with nature's limits. While these narratives collectively promote the bioeconomy as a solution to climate change and energy dependence, they also reveal underlying conflicts. For example, narratives advocating technological fixes for fossil fuel substitution often clash with those prioritizing agroecology or planetary boundaries, highlighting trade-offs between economic expansion and ecological sustainability.

This research underscores how win-win narratives-offering solutions that promise environmental and economic benefits without trade-offs-dominate EU discourse on the bioeconomy. However, such narratives risk oversimplifying complex policy challenges. For instance, reliance on bioenergy as a fossil fuel substitute raises concerns about land-use conflicts, resource depletion, and environmental integrity. Similarly, the assumption that innovation alone can drive decarbonization often overlooks the systemic changes needed to achieve sustainability within planetary limits.
By analyzing these narratives and integrating stakeholder perspectives, this study sheds light on the discursive dimensions of the EU bioeconomy and their implications for climate and energy policies. It calls for a more nuanced and critical approach to bioeconomy strategies, one that openly addresses trade-offs and prioritizes coherence between environmental, social, and economic goals. This is essential to ensure that the bioeconomy contributes meaningfully to decarbonizing fossil fuel economies and advancing a just and sustainable transition.

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Keywords: bioeconomy, narrative analysis, policy

Towards more just and responsible innovation in the bioeconomy? A multiple-case study on German bioeconomy innovations

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We contribute to the integration of dimensions of responsible (research and) innovation (RRI) with dimensions of justice (following recent literature on just sustainability transitions) at the organization level to better account for and potentially govern responsible bioeconomic innovations for transitions towards more ecologically sustainable and just innovation systems.
The "bioeconomy" remains a contested concept. Depending on the underlying worldview (e.g., see De Witt et al., 2017; Schlaile et al., 2022), it still holds the promise of facilitating an innovation system transformation contributing to the overall shift towards regenerative, resilient, and sustainable social-ecological systems, while its notion also becomes blurred and diluted by the prevalence of conventional mechanistic innovation paradigms with their overemphasis on technological solutionism and ecomodernist narratives (e.g., Biber-Freudenberger et al., 2020; Blok, 2021, 2023; Bogner & Dahlke, 2022; Friedrich et al., 2021; Schlaile et al., 2017, 2022, 2024; Veraart et al., 2023; Vivien et al., 2019). In the same vein, despite advances in the literature on responsible (research and) innovation (RRI) (e.g., Stilgoe et al., 2013) – also in the particular context of innovation processes in and for the (circular) bioeconomy (e.g., Inigo & Blok, 2019; Sonck et al., 2019) – the following assessment still holds: "The bioeconomy is on the rise as it is, but whether it will guide us the way towards an equitable, environmentally sound, and future-proof economy, heavily depends on the normative guardrails imposed by science, society, and business" (Urmetzer et al., 2022, p. 1).

Ranging from perpetuating existing inequalities (e.g., with regard to non-inclusive value chains and the unfair distribution of burdens and benefits) to aggravating land use conflicts, the transition towards a bioeconomy involves multiple (potential) moral issues that raise questions of (in)justice – be it distributive, procedural, recognitional, epistemic, spatial, or temporal – and connected questions of responsibility (e.g., Bastos Lima, 2022; Blok, 2023; Schlaile et al., 2017, 2024; Veraart & Blok, 2021). Against the backdrop of the urgency of these normative questions, innovation types in and for the bioeconomy (e.g., Bröring et al., 2020) appear to require

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even more integration with normative frameworks such as RRI (e.g., Rosemann & Molyneux-Hodgson, 2020, on a related note) in order to better capture and systematically integrate their (potentially transformative) social-ecological impact (Friedrich et al., 2021).

Hence, there is a gap in the research on the normative dimension of innovation systems, especially from a bioeconomy perspective: (Design) principles for more just and responsible innovation processes seem to be insufficiently considered and integrated (by both researchers and practitioners). Our study aims to address this gap and uses a qualitative multiple-case study design to explore the question: *How are issues of (in)justice and dimensions of responsible (research and) innovation perceived, discussed, acknowledged, and embraced/implemented in bioeconomy innovation projects in Germany?* Preliminary results from 16 expert interviews (e.g., with winners of bioeconomy innovation awards and other innovators in "flagship" projects) suggest limited to no explicit implementation of RRI in practice, although some dimensions (e.g., anticipation and inclusion/deliberation) are discussed more prominently. Moreover, both explicitly and implicitly, potential conflicts and injustices (e.g., resource conflicts, land use conflicts, exploitation) are addressed but also reveal the need for more support from policymakers and intermediary organizations for the polycentric governance of transitions towards more just and responsible innovation systems.

The following example quotes illustrates the different, often competing, normative guardrails found in our interviews:

1) Example quote concerning the trade-off between sustainability and profitability "... if I now produce a shoe that is partly made from bio-based materials, but which is still produced in overproduction and with unfair production methods and not even regionally, but is still based on the exploitation of ... people living in other countries, I don't really see the progress that the bioeconomy should bring us." (BioInno16)

2) Example quote for how distributive justice is addressed: "Now I'm talking about the fashion industry. ... We have a big sustainability problem because there is way too much product produced. ... It's very hard to recycle. It puts a big strain on the resources and on the people that make them and ... the systems that need to take care of these after use. (But) ... if we're looking at production and fast fashion ... it has a lot of problems, but it also enables people ... that don't really have the access ... to dress up well. It makes it easier for people to access, for example, environments where they otherwise wouldn't really be able to come in. I think this is a positive aspect of affordable fashion that ... shouldn't be disregarded." (BioInno07)

3) Example quote for the RRI dimension of "anticipation": "... for our product, ... we have certain regulatory consultants that we consult. But ... It's not like a general purpose AI that's gonna launch some nuclear missiles or something." (BioInno01)

4) Example quote for the RRI dimension of "inclusion/deliberation": "Well, as far as our core processes ... are concerned, that's in-house. In other words, we really only do this here. As far as further downstream processing is concerned, we also work a lot with partners. That has also proved effective." (BioInno02)

5) Example quote for the RRI dimension of "reflexivity": "Erm ... Values ... That's also a difficult word. ... I can't really think of anything off the top of my head." (BioInno06)

6) Example quote for the RRI dimension of "responsiveness": "That will only ever happen step by step, and I believe that there will still be enough opportunities to adapt things. Right now, it is simply important that we optimize and improve our research in this respect." (BioInno04)

7) Example quote for the RRI dimension of "transparency": "As far as the actual technology is concerned, we are not so transparent, simply because as a young company with limited resources, you are not in a position to secure all aspects of innovation with patents at the beginning ..." (BioInno02)

In summary, our (preliminary) results offer a new integrative perspective on the interconnections between justice and responsibility in the transition towards an ecologically sustainable bioeconomy.

References

Bastos Lima, M. G. (2022). Just transition towards a bioeconomy: Four dimensions in Brazil, India and Indonesia. *Forest Policy and Economics, 136,* 102684.

Biber-Freudenberger, L., Ergeneman, C., Förster, J. J., Dietz, T., & Börner, J. (2020). Bioeconomy futures: Expectation patterns of scientists and practitioners on the sustainability of bio-based transformation. *Sustainable Development*, *28*(5), 1220–1235.

Blok, V. (2021). What Is Innovation?: Laying the Ground for a Philosophy of Innovation. *Techné: Research in Philosophy and Technology*, *25*(1), 72–96.

Blok, V. (2023). The Normative and Social Dimensions of the Transition towards a Responsible, Circular Bio-Based Economy. In S. Lamalle & P. Stoett (Eds.), *Representations and Rights of the Environment* (pp. 334–352). Cambridge University Press.

Bogner, K., & Dahlke, J. (2022). Born to transform? German bioeconomy policy and research projects for transformations towards sustainability. *Ecological Economics*, *195*, 107366.

Bröring, S., Laibach, N., & Wustmans, M. (2020). Innovation types in the bioeconomy. *Journal of Cleaner Production*, *266*, 121939.

De Witt, A., Osseweijer, P., & Pierce, R. (2017). Understanding public perceptions of biotechnology through the "Integrative Worldview Framework." *Public Understanding of Science*, *26*(1), 70–88.

Friedrich, J., Bunker, I., Uthes, S., & Zscheischler, J. (2021). The Potential of Bioeconomic Innovations to Contribute to a Social-Ecological Transformation: A Case Study in the Livestock System. *Journal of Agricultural and Environmental Ethics*, *34*(4), 24.

Friedrich, J., Holz, J., Koch, P., Pungas, L., Eversberg, D., & Zscheischler, J. (2023). Rural bioeconomies in Europe: Socio-ecological conflicts, marginalized people and practices. GAIA - Ecological Perspectives for Science and Society, 32(2), 219–224.

Inigo, E. A., & Blok, V. (2019). Strengthening the socio-ethical foundations of the circular economy: Lessons from responsible research and innovation. *Journal of Cleaner Production*, *233*, 280–291.

Schlaile, M. P., Urmetzer, S., Blok, V., Andersen, A., Timmermans, J., Mueller, M., Fagerberg, J., & Pyka, A. (2017). Innovation Systems for Transformations towards Sustainability? Taking the Normative Dimension Seriously. *Sustainability*, *9*(12), 2253.

Schlaile, M. P., Kask, J., Brewer, J., Bogner, K., Urmetzer, S., & De Witt, A. (2022). Proposing a cultural evolutionary perspective for dedicated innovation systems: Bioeconomy transitions and beyond. *Journal of Innovation Economics & Management*, *38*(2), 93–118.

Schlaile, M.P., Friedrich, J., & Zscheischler, J. (2024). Rethinking regional embeddedness and innovation systems for transitions towards just, responsible, and circular bioeconomies. *Journal of Circular Economy, 2*(1).

Sonck, M., Asveld, L., & Osseweijer, P. (2019). Meta-Responsibility in Corporate Research and Innovation: A Bioeconomic Case Study. *Sustainability*, *12*(1), 38.

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy, 42*(9), 1568–1580.

Urmetzer, S., Schlaile, M. P., Blok, V., & Pyka, A. (2022). Quo Vadis, Bioeconomy? The Necessity of Normative Considerations in the Transition. *Journal of Agricultural and Environmental Ethics*, *35*(1), 1.

Veraart, R., & Blok, V. (2021). Towards a Philosophy of a Bio-Based Economy: A Levinassian Perspective on the Relations Between Economic and Ecological Systems. *Environmental Values*, *30*(2), 169–192.

Veraart, R., Blok, V., & Lemmens, P. (2023). Ecomodernism and the Libidinal Economy: Towards a Critical Conception of Technology in the Bio-Based Economy. *Philosophy & Technology*, *36*(2), 18.

Vivien, F.-D., Nieddu, M., Befort, N., Debref, R., & Giampietro, M. (2019). The Hijacking of the Bioeconomy. *Ecological Economics*, *159*, 189–197.

Keywords: Responsible Research and Innovation, Bioeconomy, Just Sustainability Transitions, Innovation Systems

The Transformative Bioeconomy and other archetypical narratives in the Bioeconomy Discourse

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The bioeconomy is a major concept in both academic and policy debates, but what it actually means remains diverse across contexts. In a qualitative analysis of the discourse on the bioeconomy, my literature review identifies three archetypical bioeconomy narratives: the "neoliberal bioeconomy", the "ecological bioeconomy", and the "transformative bioeconomy". Each narrative follows a particular rational of viewing the world, leading to different implementation pathways for the global bioeconomy. While biobased resources play an important role in all narratives, they differ significantly in their sustainability concept, their inherent goal of economic activity, their views on which role society plays in an economy, their approach to science and knowledge-management within society and economy, and they differ in terms of their onto-epistemological positions.
While there are two narratives that, although clearly distinct in their epistemological approach, are quite similar in framing the socio-ecological transformation as a process that can be catalyzed through a bioeconomy (the two "Sustainable Bioeconomy Narratives"), the main argument of my proposition lies in distinguishing these two narratives from the unsustainable narrative of the currently dominant "Neoliberal Bioeconomy" (NeoBE).

The NeoBE is based on a flat ontology that reduces the multifaceted reality of entities to abstract numerical exchange values and therefore assumes that individual utility maximization (estimated as profit-oriented cost-benefit-optimum) ultimately leads to greatest benefit for overall society. This is represented by the currently mainstreamed set of techno-economic paradigms for biobased resources that rely on a liberally governed free-market economy of growth and competition that has however not produced sustainable results so far. This also represents a discursive lock-in, in the sense that intentions of sustainability end up their opposite because underlying paradigms inevitably lead to unsustainable practice.

The Sustainable Bioeconomy Narratives (SustBE) on the other hand regard entities (and thus humans) als uniquely constituted by their environment. The economic goal is set to minimize the entropic degradation of resources and aid the natural reproductive capacities of ecosystems in order to enable a globally cooperative, fair and just "good life for all" within planetary boundaries. Consequently, co-creation of science-based policies in locally embedded actualities through bottom-up approaches takes precedence over top-down strategy development, though both approaches can be found in SustBE. Overall, the development of human nature is guided

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through transformative scientific approaches to consistently integrate with non-human nature's imperative.

Upon closer examination, the SustBE-narratives can further be distinguished between an ecocentric approach that primarily argues for a socio-ecological transformation based on the functional principles of varied ecologies in non-human nature in order to maintain our basis of existence (the "Ecological Bioeconomy", EcolBE), and a sociocentric approach that argues for the same socio-ecological transformation, but is primarily exploring the sociocultural structures that would organize our civilization as a convivial species (the "Transformative Bioeconomy", TrafoBE). TrafoBE is thus more engaged with philosophical questions and regards the bioeconomy as an ethic which debates the socio-cultural issues of life, whereas EcolBE is more concerned about the biophysical and material aspects. Both narratives can be said to emerge from a process-relational school of thought, however EcolBE assumes discrete systems (i.e. "the economy") that can be *transitioned* between relatively stable states by reconfiguring the arrangement of their (similarly discrete) system elements (i.e. "society" or "technology"), whereas TrafoBE assumes temporarily stabilized patterns of relations (instead of systems or elements) that are *transformed* by inclusion or exclusion of constituting patterns.

Setting the finer epistemological points aside, EcolBE and TrafoBE can be both regarded as narratives of the socio-ecological transformation. NeoBE, on the other hand, can be understood as the branch of Neoliberalism that is associated with organic matter, an evolutionary step in the development of liberal governmentality that has by now depoliticized most decisions by entrusting them to techno-economic paradigms that are falsely assumed "objective" or "independent". The stories that the NeoBE-narrative produces, are mostly focussed on the development of products and their relation to technology and measurements. EcolBE-stories, on the other hand, also include the resources that are necessary to produce them, and most importantly, the limits (to growth) that arise from these resources. TrafoBE-stories, finally, see products merely as means to an end. The end being a societally negotiable "quality of life". The TrafoBE-narrative thus is a way of explicitely communicating sustainability as broader societal discussions about values and norms.

For example, knowledge-dissemination happens in the NeoBE through commodification and intellectual property rights, and market rationality and deregulation in governance are supposed to spur these innovation cycles. In SustBE, knowledge-dissemination triggers societal development through transformative and transdisciplinary science, and participative co-creation in highly embedded localities develops robust governance structures.
As all narratives of the Bioeconomy claim to increase overall wellbeing for humanity, but demand radically different implementations, a closer examination of their functional principles was necessary. The results indicate that these functional principles concern philosophical foundations and cultural dynamics, and are intricately related to individual preferences and norms. The Bioeconomy thus represents a value system, and discussions about it need to be engaged through ethics. With this perspective, I hope to enrichen the necessary broader societal debate on the implementation of the bioeconomy, and add to the understanding of the bioeconomy as an holistic concept.

Keywords: socio ecological transformation, relational turn, process philosophy, ethics, political economy

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