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Food waste and social acceptance of a circular bioeconomy: the role of stakeholders

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To be socially accepted widely, the emerging circular bioeconomy needs to rely increasingly on residual bio-based feedstock and waste, hence reducing its dependency on crops which are in competition with agriculture/food markets. Food waste represents a valuable option as it allows for the production of a wide range of bio-based products ranging from biofuels to bioplastics. First successful experiences have shown that the involvement of stakeholders with different behaviours, values and backgrounds is a key enabler of the process. In particular, it acts as a key precondition for an increase in the social acceptability of the facilities by informing citizens and civil society organizations and, at the same time, it improves the feedstosck availability by increasing coordination between actors dealing with waste management.

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Introduction

It can be stated that the circular economy defined 'as a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops'[28]; p.759) has been enriched by the contribution of the bioeconomy sector, given that a sustainable bioeconomy represents the renewable 'segment' of the circular economy [24].

Notably, the transition towards a truly sustainable circular bioeconomy needs a stronger strategic orientation towards the implementation of alternative renewable source of biomass, that is, non−food crop−based biomass, not directly affecting food prices and land use change [30]. These alternative bio-based feedstocks can include a broad variety of residues, wastes and algae [5,10,31] and, in this respect, the food supply chain wastes represent a valuable example [13]. Remarkably, there is evidence that new technologies developed within the most modern biorefineries are able to exploit parts of municipal waste. Specifically, food waste (including waste cooking oils)[1] can be used for producing biofuels, bulk chemicals and higher-added-value products [41,21,32]; Dahiya et al., 2018; [11, 12,44,60,63], with positive results in terms of potential profits for companies [3].

Meanwhile, in recent years, there has been growing recognition of the escalating environmental and socio-economic damages occurring from food waste generation [58,2] and, at the same time, the use of wastes as a resource to be reintroduced into the production process has become a shared goal by most advanced economies increasingly engaged in pursuing the waste hierarchy [47,53]. In particular, whether the amount of waste is not reduced at source, that is, through prevention activities which represent the most preferred action, the goal is to boost waste reuse, recycling and recovery and increasingly reduce landfill practice [32,52].

The literature has outlined that the implementation of food waste utilization as feedstocks in biorefineries relies, to a great extent, also on a higher involvement of stakeholders. Indeed, first examples of successful experiences suggest that cooperation and coordination between key stakeholders, such as public authorities, practitioners from industry and industry associations, local administrations and waste management organizations, as well as consumers and civil society organizations are essential to ensuring that the industry can take advantage of wastes generated locally, minimizing any form of resistance associated with 'not in my back yard' and "locally unwanted land use" behaviours.

In view of these considerations, this article aims at deepening our understanding on the role of stakeholders in boosting the use of food waste as a feedstock for creating a circular bio-based economy.

Stakeholder engagement and sustainable innovations

In its seminal contribution, Freeman [27]; p. 46) defines stakeholders as 'any group or individuals who can affect or is affected by the achievement of the organization's

[1] Waste Framework Directive. Available at https://ec.europa.eu/environment/waste/framework/list.htm (accessed 12/12/2019).

objectives'. Another two important definitions, reflecting views from different perspectives, refer to stakeholders as 'individuals, groups, or organizations that can affect or are affected by an evaluation process and/or its findings'[7]; p.1) and 'people or small groups with the power to respond to, negotiate with, and change the strategic future of the organization' [22]; p.117). Indeed, the former definition brings to the fore the role of stakeholders in evaluation processes, whilst the latter focuses attention on the consideration of questions of power. It is worth noting, however, that different conceptualisations of stakeholders are in place and there is not one accepted definition as it remains 'an essentially contested concept [49].

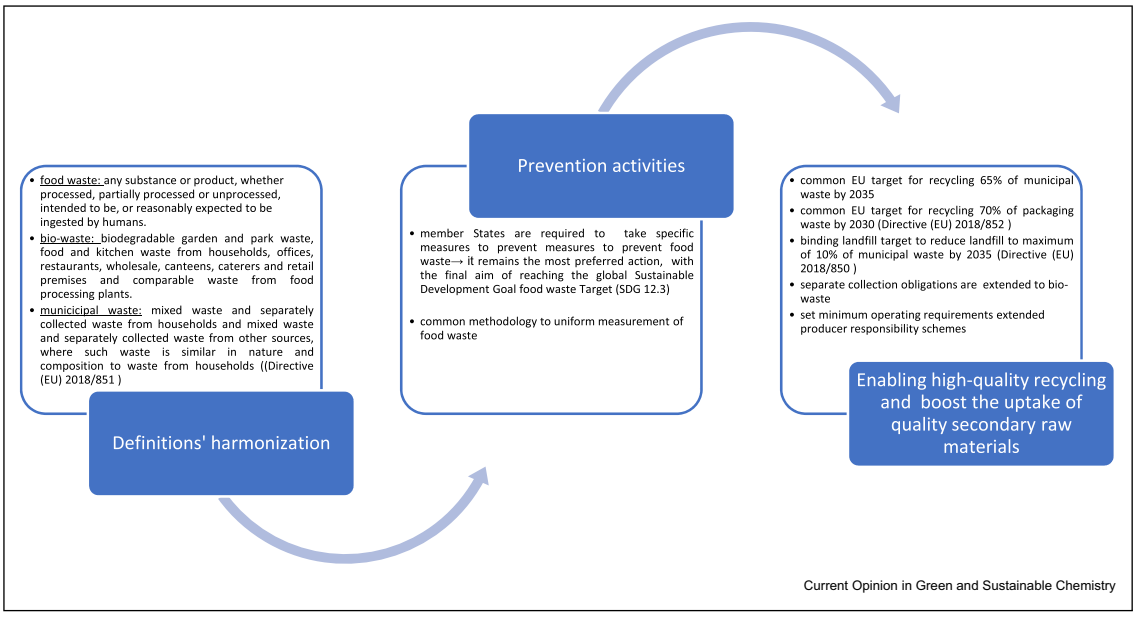
Stakeholder involvement has been increasingly used in different fields of research [55]. However, because the number of stakeholders that may be involved in each analysis/field under investigation is most often very high, it has been suggested that they can be grouped, for convenience, under five broad categories, that is, governmental authorities, the private sector, academia, civil society and other stakeholders [9]. Bryson [8] reviews the techniques that can be used for identifying and analyzing stakeholders that can be involved and whose views should be considered with regard to a specific topic/case of interest. In this respect, stakeholders can be classified into four main groups (i) players, that is, stakeholders who have high power and interest, (ii) subjects, that is, stakeholders who have high interest but relatively low power, (iii) context setters, that is, stakeholders who have power but low level of direct interest and (iv) crowd, that is, stakeholders who have low interest and power [7].

In the management literature, the involvement of stakeholders in innovation processes is described as a well-established practice. In this regard, it has been reported by Kazadi et al. [36] that firms engage a multitude of stakeholders (e.g. policy makers, academics and consumers) to enrich and boost their innovation processes and increase consumer acceptance, though outlining, at the same time, the potential risks associated with the practice of involving different actors with diverse and potentially opposing interests and objectives. Notably, it has been argued that stakeholders' involvement, and its interlinked challenge related to the exhibition of different values and potentially opposing views to the innovation itself, becomes even more important when responsible and sustainable innovation is pursued [42,59,6]. In particular, it has been outlined that to ensure the legitimacy and increased social acceptability of new concepts intertwined with sustainability, such as the bioeconomy, the perceptions and involvement of a broad variety of stakeholders should be considered [18,48,57]. More precisely, different perspectives coming from different categories of stakeholder with different characteristics and conflicting interests strongly contribute to highlight the range of critical issues that deserve to be considered. The relevance of this approach has been outlined by Leipold and Petit-Boix [40] that stressed the presence of several obstacles and debated issues surrounding the circular bioeconomy. For example, whether it is better to recycle organic materials (thereby reintroducing materials into the productive cycle) or to biodegrade them into the land (biogeochemical cycles), remains a debated issue. Furthermore, when it comes to studies specifically relating to biorefineries using food wastes as a feedstock, the relevance of engaging stakeholders was stressed as a major contributing factor towards ensuring a successful implementation of the process [26,38,56].

In reiterating that biorefineries using food waste as a feedstock are still at an early stage of development, Cristóbal et al. [17] emphasized that one of the main elements to be considered, especially with reference to the biorefinery economic viability, is the available quantity and quality of food waste streams and related transportation costs. This makes the location of the facilities and the integration into the local context key factors [62]. In this respect, the involvement of affected stakeholders can drastically improve social acceptance with positive effects on facilities installation times and costs, addressing the not in my back yard and locally unwanted land use syndromes [38]. It should be noted, in fact, that when considering waste biorefineries, odour issues, potential risks to health and to decreased property values of the local community's homes are critical elements that should be considered [50,38]. Moreover, stakeholder involvement would also facilitate synergies and coordination among all actors specifically dealing with waste management, that is, waste processors, waste generators and public authorities [33], enabling an increased availability of this resource.

The Porto Marghera biorefinery located in Italy, where alongside first-generation feedstocks (i.e. palm oil) also secondary feedstocks such as used cooking oils generated by households and commercial activities are increasingly used to obtain high-quality biofuels, provides an interesting case in point [43,19]. Stakeholders, especially at the local level, have been frequently informed and involved in the industrial project. Indeed, according to data presented by the owner of the plant, that is, the ENI (the Italian largest multinational oil and gas company), the gainful employment of used cooking oils has been achieved through actions aimed at

Figure 1



The revised legislative framework on waste and the development of circular bio-based products. Source: Own elaboration.

increasing social acceptance and coordination among diverse stakeholders. These actions included awareness campaigns targeted at students, citizens and civil society organizations and collaborations established with national consortium dealing with vegetable and animal oils and fats and local actors dealing with waste management.[2]

EU policy measures and regulations

Most of the literature reviewed in the above paragraphs suggests that to boost a further development of a circular bioeconomy and reduce failure risks, actions related to regulation and to stakeholders' involvement should be implemented. These actions are closely intertwined as goals will not be achieved without an adequate social involvement [57]. From a European perspective, over the last years, significant progress has been made in regulation related to waste management,[3] especially thanks to the proactive role played by the European Commission.

Bell et al [4] associated potential increased investments to ensure a better use of biowaste, including food waste, to the 2015 proposed changes to the European waste legislation that included the requirement to separate the collection of biowaste [23]. [25] It is worth mentioning that the revision of the European waste legislation took a long time and has involved a great variety of actors, reflecting the view that review processes, in general, need to be shaped also through the involvement of different stakeholders [54]. Indeed, with the support of diverse stakeholders, four directives on waste were recently adopted by the European Parliament.[4] The 2018 revised legislative framework on waste includes a number of points, depicted in Figure 1, deserving particular attention in the context of bio-based products made from food waste.

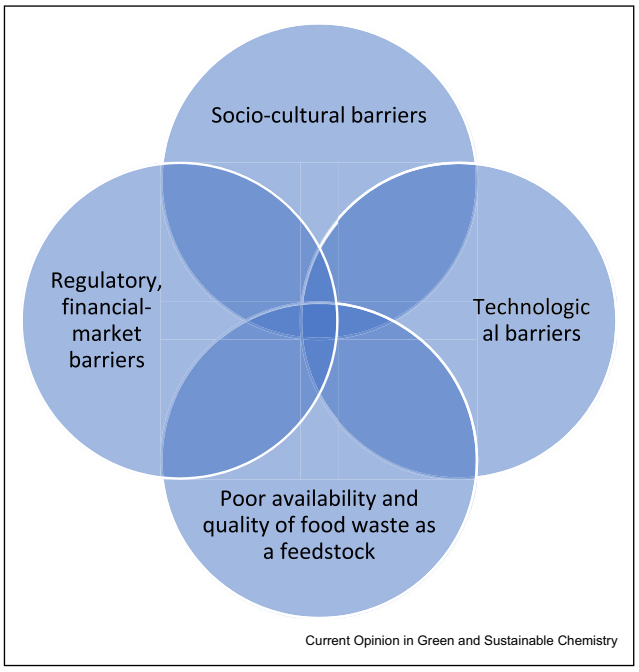
Along with the harmonization of several definitions interlinked with food waste, it has been established that a methodology to uniform the measurement of food waste among European countries should be developed [20] (Directive (EU) 2018/851). Indeed, an efficient monitoring is the basis for prevention activities but also of reuse and recycling activities [16]. The common EU

[2] See https://www.eni.com/en_IT/media/2019/02/deal-between-eni-and-renoils-to-boost-collection-of-used-food-oil-and-oil-used-for-frying.

[3] In particular in the increased share of recycling rates.

[4] i) Directive (EU) 2018/849 of the European Parliament and of the Council of 30 May 2018 amending Directives 2000/53/EC on end-of-life vehicles, 2006/66/EC on batteries and accumulators and waste batteries and accumulators, and 2012/19/EU on waste electrical and electronic equipment; ii) Directive (EU) 2018/850 of the European Parliament and of the Council of 30 May 2018 amending Directive 1999/31/EC on the landfill of waste; iii) Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste; iv) Directive (EU) 2018/852 of the European Parliament and of the Council of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste. See https://www.consilium.europa.eu/register/en/content/out?typ=SET&i=ADV&&RESULTSET=1&&DOC_TITLE=waste&+directive&&CONTENTS=&&DOC_ID=&&DOS_INTERINST=&&DOC_SUBJECT=&&DOC_SUBTYPE=&&DOC_DATE=&&document_date_from_date=&&document_date_from_date_submit=&&document_date_to_date=&&document_date_to_date_submit=&&MEET_DATE=&&meeting_date_from_date=&&meeting_date_from_date_submit=&&meeting_date_to_date=&&meeting_date_to_date_submit=&&DOC_LANCD=EN&&ROWSPP=25&&NRROWS=500&&ORDERBY=DOC_DATE&+DESC.

Figure 2



Main obstacles hampering food waste industrial use in biorefineries. Source: Own elaboration.

methodology, entered into force in October 2019, enables to determine the amount relating to different stages of the food supply chain and whenever possible the composition of the food waste [15]. Another important point of the revised EU waste legislation, as mentioned previously, is that separate collection obligations are extended to biowaste by the end of 2023, to facilitate high-quality recycling and spur the market for secondary raw materials (Directive (EU) 2018/851). Finally, it has been recommended that Member States shall enact a frequent dialogue between relevant stakeholders involved in the implementation of extended producer responsibility schemes, including producers and distributors, private or public waste operators, local authorities, civil society organizations and, where applicable, social economy actors, reuse and repair networks and preparing for reuse operators (Directive (EU) 2018/851).

Yet, this positive general trend masks great differences across Member States due to different domestic waste management systems and technological developments [46,45]. In this respect, regulatory uncertainty and fragmentation of laws specifically concerning food waste, occurring especially at national and local levels, has been emphasized [39].

Conclusions

Despite the approach and targets set by the EU represent a pivotal step, with important implications for the industrial use in biorefineries of food waste, the true impact is related to how and when Members States will transpose the changes under their national legal order. Moreover, a number of challenges related to regulation and policies still remain. First of all, the higher prices of bio-based products are a consequence of fossil fuel subsidies [14,51] and of the exclusion of negative externalities in conventional fossil counterparts [34]. The perception from consumers of higher prices contributes to the crystallization of sociocultural barriers. Interestingly, Kirchherr et al. [37] stressed that despite the academic literature mostly highlighted the relevance of technological obstacles in hampering the circular economy implementation, by conducting a large-Nstudy involving European policy makers and businesses they found that cultural barriers are perceived as the most pressing (particularly, 'lacking consumer interest and awareness' and 'hesitant company culture'). Moreover, the authors argued that cultural barriers are driven by several market barriers such as low price of virgin materials due to existing subsidies and, even though policy interventions are recommended, it was stressed that there is no absolute certainty that improved regulation can lead to a complete overcoming of cultural barriers. The insights provided by this article are all the more important considering the aforementioned additional specific sociocultural barriers jeopardizing food waste employment as a feedstock.

Accordingly, despite there are still a number of obstacles, represented in Figure 2, contributing to the slowdown in the utilization of food waste as a feedstock, the sociocultural barriers appear to play a key role compared with all the others.

Following from this, the categories of stakeholders directly affecting sociocultural perceptions, mainly represented by public authorities and civil society organizations, should therefore be actively involved in the implementation of awareness raising activities addressed to local communities and consumers. This approach also includes the development of educational and teaching activities related to sustainability issues in schools and universities [35,1]. Finally, consultation processes should be undertaken to maximise input from producer associations and civil society organizations for improving regulation to address existing market barriers.

Conflict of interest statement

Nothing declared.

References

Papers of particular interest, published within the period of review, have been highlighted as:

* of special interest
** of outstanding interest

1. Aleixo AM, Leal S, Azeiteiro UM: **Conceptualization of sustainable higher education institutions, roles, barriers, and challenges for sustainability: an exploratory study in Portugal**. *J Clean Prod* 2018, **172**:1664–1673.

2. Aschemann-Witzel J, De Hooge I, Amani P, Bech-Larsen T, Oostindjer M: **Consumer-related food waste: causes and potential for action**. *Sustainability* 2015, **7**:6457–6477.

3. * Bastidas-Oyanedel JR, Schmidt J: **Increasing profits in food waste biorefinery—a techno-economic analysis**. *Energies* 2018, **11**:1551.
Investigates the creation of economic value from complex organic wastes as food waste, by anaerobic digestion processes. The techno-economic analysis show that the profitability of food waste conversion to bulk chemicals, as for example lactic acid or butyric acid, can be increased 5 to 16 times when compared to the production of biomethane, suggesting to concentrate more efforts to the production bulk chemicals instead of too much focusing on biofuels

4. * Bell J, Paula L, Dodd T, Nemeth S, Nanou C, Mega V, Campos P: **EU ambition to build the world's leading bioeconomy—uncertain times demand innovative and sustainable solutions**. *New Biotechnol* 2018, **40**:25–30.
The authors frame the EU Bioeconomy Strategy within the EU regulatory framework, with particular attention to the waste legislation and potentialities for an increased use of biowaste (including food waste) as a feedstock.

5. Bibi R, Ahmad Z, Imran M, Hussain S, Ditta A, Mahmood S, Khalid A: **Algal bioethanol production technology: a trend towards sustainable development**. *Renew Sustain Energy Rev* 2017, **71**:976–985.

6. Boons F, Montalvo C, Quist J, Wagner M: **Sustainable innovation, business models and economic performance: an overview**. *J Clean Prod* 2013, **45**:1–8.

7. Bryson JM, Patton MQ, Bowman RA: **Working with evaluation stakeholders: a rationale, step-wise approach and toolkit**. *Eval Progr Plann* 2011, **34**:1–12.

8. Bryson JM: **What to do when stakeholders matter: stakeholder identification and analysis techniques**. *Publ Manag Rev* 2004, **6**:21–53.

9. Caniato M, Vaccari M, Visvanathan C, Zurbrügg C: **Using social network and stakeholder analysis to help evaluate infectious waste management: a step towards a holistic assessment**. *Waste Manag* 2014, **34**:938–951.

10. Capodaglio AG, Callegari A: **Feedstock and process influence on biodiesel produced from waste sewage sludge**. *J Environ Manag* 2018, **216**:176–182.

11. Carmona-Cabello M, Sáez-Bastante J, Pinzi S, Dorado MP: **Optimization of solid food waste oil biodiesel by ultrasound-assisted transesterification**. *Fuel* 2019, **255**:115817.

12. Clark JH: **From waste to wealth using green chemistry: the way to long term stability**. *Curr Opin Green Sustain Chem* 2017, **8**:10–13.

13. Clark JH, Farmer TJ, Herrero-Davila L, Sherwood J: **Circular economy design considerations for research and process development in the chemical sciences**. *Green Chem* 2016, **18**:3914–3934.

14. Coady D, Parry I, Sears L, Shang B: **How large are global fossil fuel subsidies?** *World Dev* 2017, **91**:11–27.

15. *Commission Delegated Decision (Eu)…/… Supplementing Directive 2008/98/EC of the European Parliament and of the Council as regards a common methodology and minimum quality requirements for the uniform measurement of levels of food waste. C/2019/3211 final*. 2019:3211. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI_COM:C.

16. Corrado S, Caldeira C, Eriksson M, Hanssen OJ, Hauser HE, van Holsteijn F, Stenmarck Å: **Food waste accounting methodologies: challenges, opportunities, and further advancements**. *Global Food Secur* 2019, **20**:93–100.

17. * Cristóbal J, Caldeira C, Corrado S, Sala S: **Techno-economic and profitability analysis of food waste biorefineries at European level**. *Bioresour Technol* 2018, **259**:244–252.
By performing a techno-economic and profitability analysis of biorefineries using wastes from tomato, potato, orange, and olive processing as a feedstock, estimating their potential available quantity in Europe, the authors demonstrate the importance of market analysis since they found great differences in terms of profitability and that the most profitable options are those related to economies of scale.

18. ** D'Amato D, Korhonen J, Toppinen A: **Circular, green, and bio economy: how do companies in land-use intensive sectors align with sustainability concepts?** *Ecol Econ* 2019, **158**:116–133.
By means of a content analysis on the use of the Circular economy, Green economy and Bioeconomy concepts by the private sector, the authors found that the bioeconomy concept is still under-represented, even though connection between the circular economy and the bioeconomy appeared to be very strong. In this context the importance of involving stakeholders is shown.

19. Demichelis F, Piovano F, Fiore S: **Biowaste management in Italy: challenges and perspectives**. *Sustainability* 2019, **11**:4213.

20. *Directive (Eu)2018/851 of the European parliament and of the Council of 30 may 2018 amending directive 2008/98/EC on waste (text with EEA relevance)*. 2018:109–140. Orkesterjournalen L150, 14.16.

21. Dugmore T: **Food waste: a new biorefinery feedstock**. *Food Sci Technol* 2014, **28**:22–24.

22. Eden C, Ackermann F: *Making Strategy: the journey of strategic management*. London: Sage Publications; 1998.

23. European Commission: *Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2008/98/EC on waste, COM(2015) 595 final*. 2015.

24. European Commission: *A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment*. Updated Bioeconomy Strategy; 2018.

25. European Commission. *Closing the Loop - an EU action plan for the circular economy, Communication from the commission to the european parliament, the council, the european economic and social committee and the committee of the regions*, vol. 614; 2015.

26. Fava F, Totaro G, Diels L, Reis M, Duarte J, Carioca OB, Ferreira BS: **Biowaste biorefinery in Europe: opportunities and research & development needs**. *New Biotechnol* 2015, **32**:100–108.

27. Freeman RE: *Strategic management: astakeholder approach*. Boston, MA, USA: Pitman; 1984.

28. Geissdoerfer M, Savaget P, Bocken NM, Hultink EJ: **The Circular Economy–A new sustainability paradigm?** *J Clean Prod* 2017, **143**:757–768.

30. Hassan SS, Williams GA, Jaiswal AK: **Moving towards the second generation of lignocellulosic biorefineries in the EU: drivers, challenges, and opportunities**. *Renew Sustain Energy Rev* 2019, **101**:590–599.

31. Hu Y, Du C, Leu SY, Jing H, Li X, Lin CSK: **Valorisation of textile waste by fungal solid state fermentation: an example of circular waste-based biorefinery**. *Resour Conserv Recycl* 2018, **129**:27–35.

32. Imbert E: **Food waste valorization options: opportunities from the bioeconomy**. *Open Agric* 2017, **2**:195–204.

33. Joseph K: **Stakeholder participation for sustainable waste management**. *Habitat Int* 2006, **30**:863–871.

34. Karan H, Funk C, Grabert M, Oey M, Hankamer B: **Green bioplastics as part of a circular bioeconomy**. *Trends Plant Sci* 2019, **24**:237–249.

35. Kardos M, Gabor MR, Cristache N: **Green marketing's roles in sustainability and ecopreneurship. Case study: green packaging's impact on Romanian young consumers'environmental responsibility**. *Sustainability* 2019, **11**:873.

36. Kazadi K, Lievens A, Mahr D: **Stakeholder co-creation during the innovation process: identifying capabilities for**

knowledge creation among multiple stakeholders. *J Bus Res* 2016, **69**:525–540.

37. ** Kirchherr J, Piscicelli L, Bour R, Kostense-Smit E, Muller J, Huibrechtse-Truijens A, Hekkert M: **Barriers to the circular economy: evidence from the European Union (EU)**. *Ecol Econ* 2018, **150**:264–272.

By conducting the first large-N-study on the existing barriers to the circular economy in the European Union, the authors found that despite academic literature mostly highlighted the relevance of technological, cultural barriers are perceived as the most pressing category of barriers for two categories of stakeholders, i.e. policy makers and business. The link between market barriers and cultural barriers was also investigated.

38. * Kokkinos K, Lakioti E, Papageorgiou E, Moustakas K, Karayannis V: **FCM-based modeling of social acceptance to overcome uncertainties in establishing waste biorefinery facilities**. *Front Energy Res* 2018, **6**:112.

By utilizing Fuzzy Cognitive Mapping, the authors identify the most relevant aspects that affect the social acceptance of biorefineries utilizing waste as a feedstock. The analysis is strongly based on local society stakeholder perceptions, opinions, attitudes and expectations.

39. Ladu L, Quitzow R: **Bio-based economy: policy framework and foresight thinking**. In *Food waste reduction and valorisation*. Cham: Springer; 2017:167–195.

40. Leipold S, Petit-Boix A: **The circular economy and the bio-based sector-Perspectives of European and German stakeholders**. *J Clean Prod* 2018, **201**:1125–1137.

41. Lin CSK, Pfaltzgraff LA, Herrero-Davila L, Mubofu EB, Abderrahim S, Clark JH, Thankappan S: **Food waste as a valuable resource for the production of chemicals, materials and fuels. Current situation and global perspective**. *Energy Environ Sci* 2013, **6**:426–464.

42. Lubberink R, Blok V, Van Ophem J, Omta O: **Lessons for responsible innovation in the business context: a systematic literature review of responsible, social and sustainable innovation practices**. *Sustainability* 2017, **9**:721.

43. Maina S, Kachrimanidou V, Koutinas A: **A roadmap towards a circular and sustainable bioeconomy through waste valorization**. *Curr Opin Green Sustain Chem* 2017, **8**:18–23.

44. Mannu A, Vlahopoulou G, Urgeghe P, Ferro M, Del Caro A, Taras A, Petretto GL: **Variation of the chemical composition of waste cooking oils upon bentonite filtration**. *Resources* 2019, **8**:108.

45. Marin Giovanni, Nicolli Francesco, Zoboli Roberto: **Catching-up in waste management. Evidence from the EU**. *J Environ Plann Manag* 2018, **61**:1861–1882.

46. Mazzanti Massimiliano: **Eco-innovation and sustainability: dynamic trends, geography and policies**. *J Environ Plann Manag* 2018, **61**:1851–1860.

47. McCarthy A, Helf M, Börkey P: *Business models for the circular economy–opportunities and challenges from a policy perspective*. OECD Environment Working Papers. Paris: OECD Publishing; 2018. https://doi.org/10.1787/19970900.

48. Meyer R: **Bioeconomy strategies: contexts, visions, guiding implementation principles and resulting debates**. *Sustainability* 2017, **9**:1031.

49. Miles S: **Stakeholder theory classification: a theoretical and empirical evaluation of definitions**. *J Bus Ethics* 2017, **142**:437–459.

50. * Mohan SV, Dahiya S, Amulya K, Katakojwala R, Vanitha TK: **Can circular bioeconomy be fueled by waste biorefineries—a closer look**. *Bioresour Technol Rep* 2019, **7**:100277.

It shows how biorefineries utilizing food waste as a feedstock connect the circular economy with the bioeconomy concept, focusing on several aspects and critical issues that however need to be considered for ensuring the development of sustainable biorefineries utilizing wastes, including food waste.

51. ** Monasterolo I, Raberto M: **The impact of phasing out fossil fuel subsidies on the low-carbon transition**. *Energy Pol* 2019, **124**:355–370.

By applying an expanded version of the EIRIN SFC behavioral model, the authors found that through a gradual phasing out of fossil fuels subsidiesin high-income countries, positive socio-economic outcomes can be achieved, accelerating the transition towards a low-carbon transition.

52. Morone P, Falcone PM, Imbert E, Morone A: **Does food sharing lead to food waste reduction? An experimental analysis to assess challenges and opportunities of a new consumption model**. *J Clean Prod* 2018, **185**:749–760.

53. Neligan A: *Moving towards a circular economy: Europe between ambitions and reality (No. 9/2016*. 2016 [IW Policy Paper].

54. OECD: *Better regulation practices across the European union*. Paris: OECD Publishing; 2019. https://doi.org/10.1787/9789264311732-en.

55. Raum S: **A framework for integrating systematic stakeholder analysis in ecosystem services research: stakeholder mapping for forest ecosystem services in the UK**. *Ecosyst Serv* 2018, **29**:170–184.

56. Rehan M, Nizami AS, Rashid U, Naqvi MR: **Waste biorefineries: future energy, green products and waste treatment**. *Front Energy Res* 2019, **7**:55.

57. ** Sanz-Hernández A, Esteban E, Garrido P: **Transition to a bioeconomy: perspectives from social sciences**. *J Clean Prod* 2019.

By conducting a systematic review of academic contributions to the field of bioeconomy from a social science perspective, the authors found that there is a need to increase studies focused on socio-economic implications of the bioeconomy.

58. Schanes K, Dobernig K, Gözet B: **Food waste matters-A systematic review of household food waste practices and their policy implications**. *J Clean Prod* 2018, **182**:978–991.

59. Stilgoe J, Owen R, Macnaghten P: **Developing a framework for responsible innovation**. *Res Pol* 2013, **42**:1568–1580.

60. Tsai WT: **Mandatory recycling of waste cooking oil from residential and commercial sectors in Taiwan**. *Resources* 2019, **8**:38.

62. Zabaniotou A, Kamaterou P: **Food waste valorization advocating Circular Bioeconomy-A critical review of potentialities and perspectives of spent coffee grounds biorefinery**. *J Clean Prod* 2019, **211**:1553–1566.

63. Dahiya S, Kumar AN, Sravan JS, Chatterjee S, Sarkar O, Mohan SV: **Food waste biorefinery: Sustainable strategy for circular bioeconomy**. *Biores Technol* 2018, **248**:2–12.