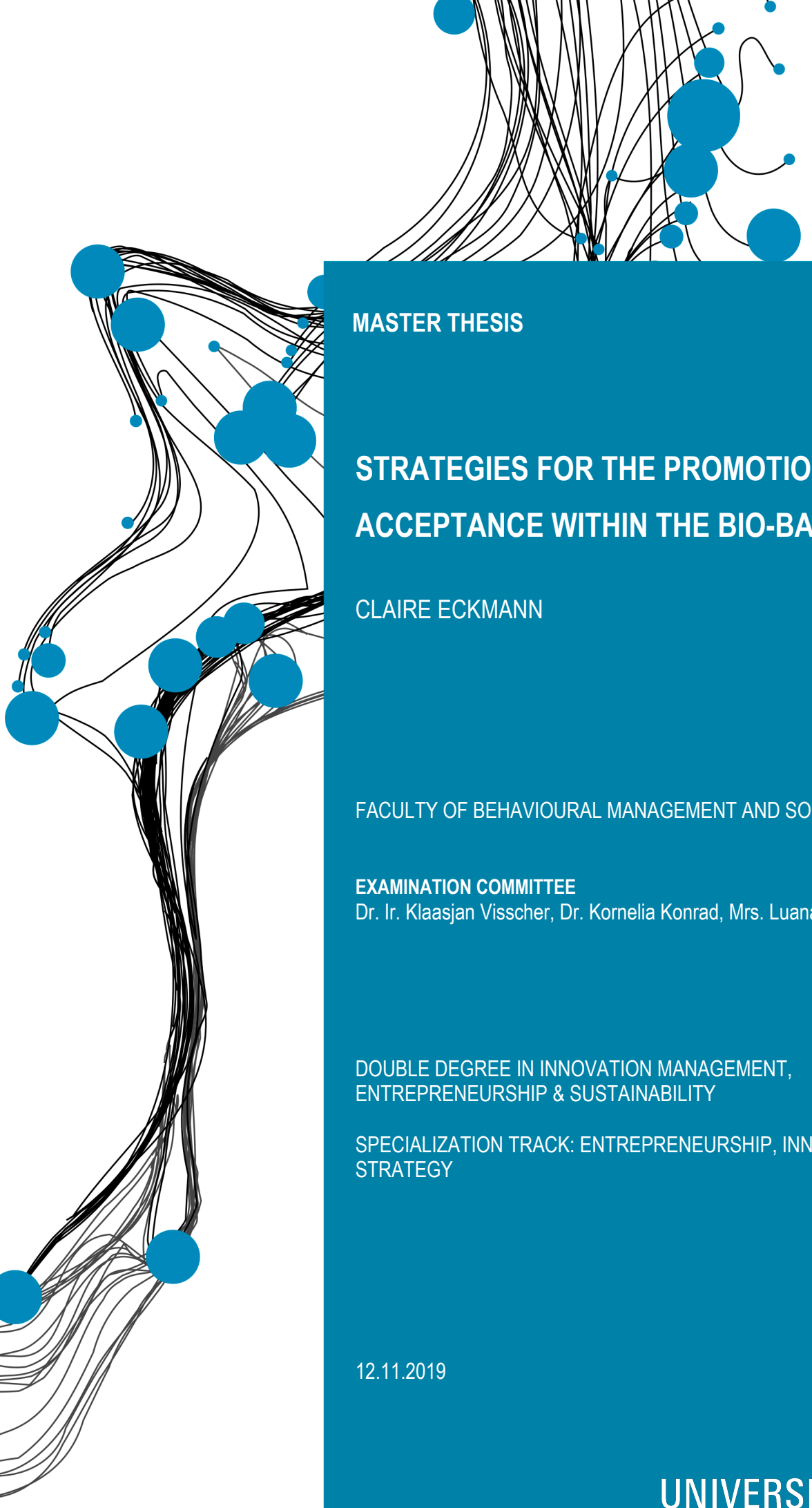

MASTER THESIS

STRATEGIES FOR THE PROMOTION OF CONSUMER ACCEPTANCE WITHIN THE BIO-BASED ECONOMY

CLAIRE ECKMANN

FACULTY OF BEHAVIOURAL MANAGEMENT AND SOCIAL SCIENCES

EXAMINATION COMMITTEE
Dr. Ir. Klaasjan Visscher, Dr. Kornelia Konrad, Mrs. Luana Ladu, M. Sc.

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Supervisors: Dr. Ir. Klaasjan Visscher, Dr. Kornelia Konrad, Mrs. Luana Ladu, M.Sc.

STRATEGIES FOR THE PROMOTION OF CONSUMER ACCEPTANCE WITHIN THE BIO-BASED ECONOMY

HOW TO PROMOTE CONSUMER ACCEPTANCE FOR BIO-BASED PRODUCTS MANUFACTURED FROM SECONDARY BIOMASS FEEDSTOCKS

MASTER THESIS

Submitted for the degree of Master of Science in Business Administration

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Abstract

The transition from a fossil-based to a bio-based economy shows great promise amid current attempts to mitigate climate change - especially if secondary biomass feedstocks can be successfully valorised. However, such a transition will only prove successful if widely embraced by consumers. Whereas consumer acceptance for bio-based products has been empirically researched before, little is known about viable strategies to leverage it. The present research therefore aimed at identifying strategies for the promotion of consumer acceptance regarding bio-based products manufactured from secondary biomass feedstocks. The multi-level perspective (Rip & Kemp, 1998; Geels, 2002; Smith et al., 2010) served as theoretical background to the qualitative inductive study. Cross-sectional empirical data was collected through 18 semi-structured interviews involving niche stakeholders from the bio-based economy - i.e. EU researchers (n=4), frontrunner businesses (n=8), and experts (n=6). The inductive qualitative content analysis revealed that secondary biomass feedstock valorisation could be marketed as an asset. Besides, bio-based products need to offer added value while fulfilling consumers' expectations regarding usual product qualities and attributes. Communicating the bio-based content of products is recommended for fully bio-based products but could backlash for partially bio-based ones. Furthermore, bio-based niche stakeholders are advised to shed light on fossil-based products' externalities, use simple labels and privilege actionable product claims. Also, marketing strategies need to be tailored to B2B and B2C customers. Finally, a transparent and holistic communication combined with innovative business models and co-creation processes is the way forward. The research also shed light on necessary changes at the policy and cultural level. The identified strategies offer opportunities for further experimental studies and will hopefully prove useful to bio-based economy stakeholders.

Keywords: bio-based economy, secondary biomass feedstocks, bio-based products, Strategic Niche Management, multi-level perspective, user preferences and practices, consumer acceptance.

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List of abbreviations & acronyms

B2B	Business-to-business
B2C	Business-to-consumer
BBI JU	Bio-Based Industries Joint Undertaking
BIC	Bio-Based Industries Consortium
BSCI	Business Social Compliance Initiative
COP21	21st Conference of the Parties
CSR	Corporate social responsibility
EU	European Union
FAO	United Nations Food and Agriculture Organization
LCA	Lifecycle assessment
MLP	Multi-level perspective
NAICS	North American Industry Classification System
NGO	Non-governmental organisation
OECD	Organisation for Economic Cooperation and Development
RRI	Responsible Research and Innovation
SCAR	Standing Committee on Agricultural Research
SDGs	Sustainable Development Goals
SIRA	Strategic Innovation and Research Agenda
SNM	Strategic Niche Management
TM	Transition Management
WWF	World Wide Fund for Nature

General Introduction

The detrimental impact of human action on the planet has steadily gained public attention over the past decade. The alarming rate of biodiversity loss and the multiplication of extreme climate events point to the fact that current and past socioeconomic choices are neither sustainable nor realistic. A transition thus needs to take place and is in fact already on its way. The COP21 Paris Agreement, technological innovations such as renewable energies or eco-housing, and the multiplication of global citizen movements such as Fridays for Future or Extinction Rebellion all clearly "signal that the need for change is no longer questioned, and the overall direction away from a fossil-based economy is clear" (Loorbach et al., 2017, p. 602).

In this context, bio-based products manufactured from renewable feedstocks "present the potential for a long-term shift away from fossil-based towards a bio-based economy" (InnProBio, 2019). A number of global brands such as Coca-Cola or H.J. Heinz have already started experimenting with bio-based materials (Reinders et al., 2017), thereby acknowledging the potential of the bio-based niche.

However, for the bio-based economy to successfully transition from niche to mainstream, two essential conditions need to be fulfilled: bio-based products need to be more sustainable than their fossil-based counterparts (from cradle to grave), and consumers have to embrace the change.

The present research addresses both aspects by researching what strategies could contribute to increasing consumer acceptance for bio-based products manufactured from secondary biomass feedstocks. The multi-level perspective (Rip & Kemp, 1998; Geels, 2002; Smith et al., 2010) serves as a theoretical frame to the research. Major barriers and drivers to consumer acceptance for bio-based products are identified at different socio-technical levels. Through a qualitative inductive approach based on semi-structured interviews, insights from bio-based niche stakeholders are collected and analysed against the backdrop of academic research findings to suggest potential strategies that could prove useful to stakeholders seeking to scale the bio-based niche. It is a timely project as "green niches are more likely to diffuse into the mainstream and thereby displace 'socio-technical regimes' if the latter are placed under concerted pressure to become more sustainable" (Smith, 2007, p. 427). This is precisely the trend that is currently occurring worldwide.

I. An introduction to the bio-based economy – opportunities & challenges

I.1. The bio-based economy to address systemic environmental challenges

In 1950, the world population was estimated at around 2.6 billion people. By 2015, it had reached 7.3 billion. According to current projections by the United Nations (2019), it will have increased to 8.5 billion people by 2030 and to a staggering 11.2 billion people by 2100. While Africa and Asia are predicted to be the main contributors to the rapid demographic expansion, China and India will experience the largest growth in middle-class population. The middle-class population is expected to increase worldwide by 2 billion people to reach 5.6 billion by 2030. China and India will concentrate 66% of the global middle-class population and 59% of the middle-class consumption (European Commission, 2019). These two trends will result in "higher consumption and demand for food, manufactured goods, and energy sources" and add further pressure to a strained global economic system and environment (Morone, 2016, p. 370).

Albeit these predictions are challenged by some researchers (e.g. Lutz et al., 2018; Randers, 2012; McKeown, 2019), as of 2019, the anthropogenic impact on the environment is already unsustainable. The Earth Overshoot Day – i.e. the date when our demand for ecological resources exceeds the Earth's regeneration potential in a given year – takes place earlier every year. In 2019, the world population reached its Earth Overshoot Day on 29 July, thereby needing the resources of 1.75 planet (Earth Overshoot Day, 2019). It is therefore urgent to shift from a "society heavily based on mass consumption, uncontrolled waste generation, and heavy fossil fuels exploitation towards one based on resource-efficiency, new production and consumption behaviours, waste reduction, reuse and valorisation" (Morone, 2016, p. 370). In this context, the development of both a resilient bioeconomy and bio-based economy bears great potential. It could contribute to shifting from a take-make-waste to a circular economy (Lokesh et al., 2018).

The bioeconomy is defined as:

> All industrial and economic sectors and their associated services which produce, process or in any way use biological resources (plants, animals, micro-organisms). These sectors include: agriculture and forestry, the food industry, fisheries, aquaculture, parts of the chemical, pharmaceutical, cosmetic, paper and textile industries, as well as the energy industry (Bioökonomierat, 2009, p. 8).

It involves the "production of renewable biological resources and the conversion of these resources and waste streams into value-added products, such as food, feed, bio-based products and bioenergy" (European Commission, 2012, p. 3).

The bioeconomy is to be distinguished from the bio-based economy. While the former includes food and feed chains, the latter only refers to "non-food goods, i.e. bio-based materials, chemicals and medicine/pharma, pulp and paper, wood, textiles and bioenergy" (FAO, 2016, p. 11). The bioeconomy thus encompasses the bio-based economy. The current research focuses on the bio-based economy and more specifically on bio-based products manufactured from secondary biomass feedstocks. Bio-based products are "products wholly or partly derived from biomass, such as plants, trees or animals (the biomass can have undergone physical, chemical or biological treatment)" (CEN, 2019, p. 1).

Both the bioeconomy and the bio-based economy depend on the availability of primary, secondary and tertiary biomass feedstocks from agriculture, forestry, marine environments or waste streams. Currently, biomass is still mainly used for food, feed and increasingly for the production of biofuel and biodiesel. The conversion of biomass into biomaterials – e.g. bioplastics or pharmaceutical products – remains a niche market (Ladu & Quitzow, 2017).

Many low- and middle-income countries have now embraced the bioeconomy as a viable development pathway to meet the Sustainable Development Goals (SDGs) and the Paris Climate Agreement targets. It could further positively contribute to job creation, energy security and trade (FAO, 2018).

Providing accurate facts and figures on the potential of the bio-based economy in different regions of the world remains a challenge - especially for highly innovative sectors such as bio-based chemicals and composites manufacturing. Indeed, these added value bio-based products are still new and statistical classification systems – e.g. the North American Industry Classification System (NAICS) - have not yet developed specific codes for such products.

Nevertheless, different organisations are currently actively involved in the development of projections and future scenarios for the bio-based economy. For example, the Organisation for Economic Cooperation and Development (OECD) monitors progress of the bio-based economy in several countries and develops supporting policies as well as adapted biorefinery models (Parisi & Ronzon, 2016). The United Nations Food and Agriculture Organisation (FAO) has been tasked to coordinate international work on the bioeconomy through the development of Sustainable Bioeconomy Guidelines (FAO, 2019). At European level, the Bio-

Based Industries Joint Undertaking, a public-private partnership between the European Union (EU) and the Bio-Based Industries Consortium, is aimed at supporting and developing "innovative bio-based value chains at the EU level to ensure the establishment of ideal market conditions for the bio-based sector" (Parisi & Ronzon, 2016, p. 9).

On a world-wide scale, the bio-based economy seems to be praised as a panacea for ever-increasing environmental and economic challenges. However, treading that particular path will only bear fruit if carried out thoughtfully and sustainably. As shown by Heimann (2019), if kept as such, the current bio-economy concepts will certainly contribute to improving some SDGs - e.g. through cleaner industrial production. However, they will also be detrimental to other goals - e.g. through increased resource extraction, loss of biodiversity and increased monoculture production leading to job losses. The present research therefore advocates the development of a bio-based economy provided the necessary steps are taken to make this economic development path truly viable. This should be done through adequate "regulations, policies, and investments ensuring sustainability" as suggested by Heimann (2019, p. 43).

I.2. The bio-based economy within the European Union

I.2.1. Key facts & figures

The EU has acknowledged the potential of the bio-based economy in providing an answer to the rapid depletion of fossil resources and the environmental and economic challenges of a linear economy. The EU adopted a first bioeconomy strategy in 2012. At the end of 2018, the European Commission announced a new bioeconomy strategy for Europe which could create a further million green jobs by 2030 (European Commission, 2018). The 2012 bioeconomy strategy was thereby revised to accelerate the "deployment of a sustainable European bioeconomy so as to maximise its contribution towards the 2030 Agenda and its SDGs, as well as the Paris Agreement" (Interreg Europe, 2018, p. 1). The bioeconomy strategy is further aligned with EU-level policies aimed at promoting an innovative, knowledge-based and circular economy within Europe – e.g. the Horizon 2020 EU Research and Innovation programme or the EU Circular Economy Action Plan adopted in 2014 and 2015 respectively (Ladu & Blind, 2017).

Bioeconomy strategies have also been adopted at the national level - e.g. in Germany, the Netherlands, Denmark, Spain, France or Italy – and at the regional level. The specificity of regional strategies is that they are tied to local biomass availability and cluster specialization

(Bell et al., 2018). An example of such bioeconomy clusters is the Toulouse White Biotechnology cluster which benefits from a dense network of research institutes and transfer and support structures (Philp & Winickoff, 2017).

Furthermore, cities are also developing their own bioeconomy strategies. For example, Stockholm, Ljubljana and Porto are considering how to convert municipal bio-waste into high value-added chemicals and products, and Amsterdam wishes to create an urban circular economy through the "high value recycling of all organic residue streams in the city" (Bell et al., 2018, p. 27).

Biomass uses within the EU

Within the EU, the biomass supply comes from three sectors: agriculture, forestry and fishery. While agriculture and forestry respectively provide 65% and 34% of the total supply, fishery accounts for a mere 1% (Gurriá et al., 2017).
As to biomass uses within the EU, out of a total supply of 1.13 billion tonnes of vegetal and forestry biomass, 62% is dedicated to food and feed production, 19% to energy production and a further 19% to the manufacturing of bio-based materials (Ibid., 2017; Appendix A, p. 114).

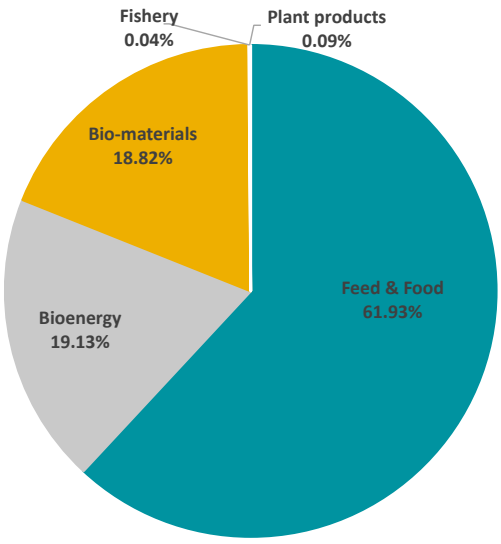

Figure 1: Composition of the EU-28 biomass uses (adapted from Gurriá et al., 2017, p. 25)

With respect to the production of bioenergy and bio-based materials more specifically, most of the biomass originates from forestry products. The share of EU agricultural biomass dedicated to the production of biofuels for example only represents 2% of the total agricultural biomass (Ibid., 2017).

Economic significance of the EU bio-based economy

A study conducted by the German nova-Institute in 2016 shows that the EU bio-based economy has grown in terms of turnover between 2008 and 2016, increasing from 600 billion Euro in 2008 to 700 billion Euro in 2016 (Piotrowski et al., 2019, pp. 6, 8).

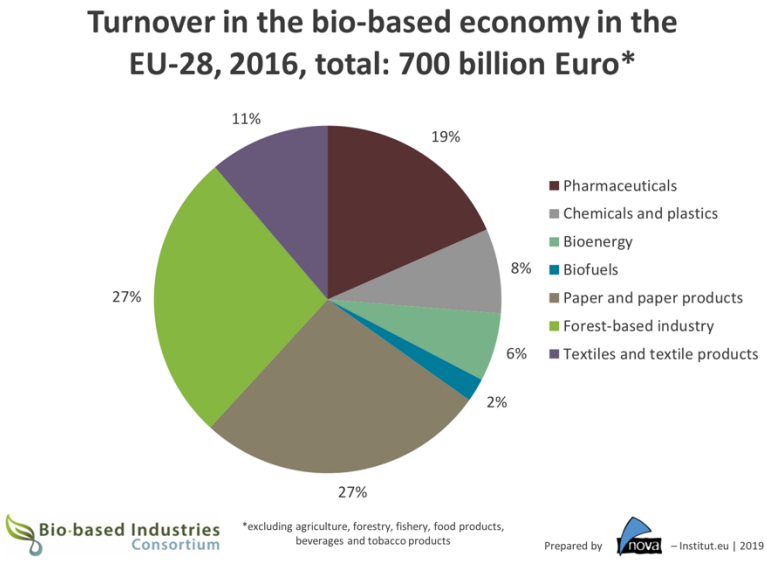

Figure 2: Turnover in the bio-based economy in the EU-28, 2016 (Piotrowski et al., 2019, p. 9)

The EU's future ambitions for the bio-based economy are high. In 2014, it launched the Bio-Based Industries Joint Undertaking (BBI JU) under the EU umbrella programme Horizon 2020. This €3.7 billion public-private partnership between the EU and the Bio-Based Industries Consortium (BIC) aims at leveraging the untapped potential of secondary biomass feedstocks for value-added products (Bio-Based Industries Consortium, 2019). The BBI JU is currently developing a Strategic Innovation and Research Agenda (SIRA) for 2030 which should be ready by the end of 2019. The targets set by SIRA 2030 are, amongst others, to achieve a 20% increase in biomass supply and reach a 25% share of bio-based chemicals and materials by 2030 (against 10% in 2010). As to the valorisation of by-products and waste, the aim is to utilise 25% of unexploited streams by 2030 (Bio-based Industries Consortium, 2017a; 2019).

In spite of these optimistic targets, the current share of bio-based materials remains modest compared to the share of fossil-based counterparts, both worldwide and at EU level. For example, in 2018, the global market share for bio-based polymers accounted for only 2% of the total polymer and plastics market, with almost a third of bio-based polymers dedicated to consumer goods (nova-Institute, 2019). Within the EU chemical industry, the share of bio-based chemicals reached 7% in 2016, increasing by 2% since 2008 (Piotrowski et al., 2019).

I.2.2. Green niches: state-of-the-art & future developments

The bio-based economy is highly cross-sectoral and cross-regional. From a value chain perspective – i.e. from biomass supply over biomass processing to the production of biofuels and bio-based products - it "bring[s] together traditional sectors such as agriculture, forestry and fisheries with innovative research fields such as nanotechnology [and] highly advanced manufacturing systems" (Spatial Foresight et al., 2017, p. 19). Bioeconomy activities usually concentrate at the regional level. These regional bioeconomy ecosystems involve a multiplicity of actors, from traditional cluster stakeholders - i.e. research institutes, private companies and governmental organisations - to more atypical ones – i.e. "producers of biological resources, i.e. farmers and fishermen" (Ibid., p. 9), recycling and waste management organisations, logistics professionals, chemicals and fuels companies (Philp & Winickoff, 2017).

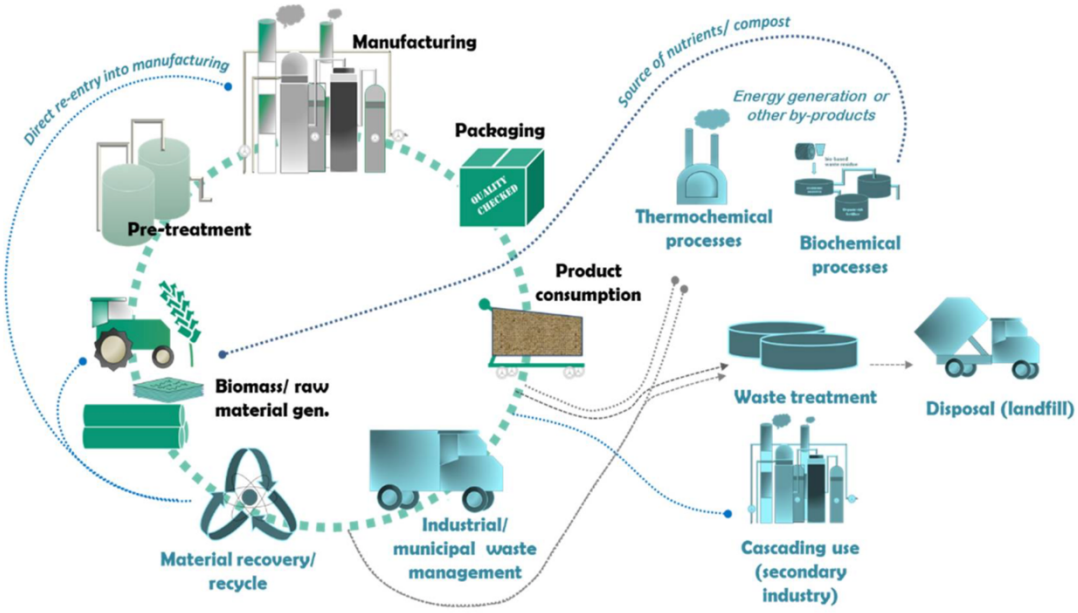

Figure 3: Generalised map of a bio-based value chain (Lokesh et al., 2018, p. 3)

As of now, several bio-based niches of different sizes currently coexist. As most bioeconomy strategies focus on developing biofuels and bioenergy, the biomass allocation is distorted towards the production of energy (Bos et al., 2018). Further prevalent bio-based niches are those able to outcompete their fossil-based counterparts because of a lack of fossil-based alternatives - e.g. enzymes or pharmaceutical compounds or because of unique added value (Pietzsch, 2017). A selective translation of bio-based niche elements into the regime has thus been achieved (Smith, 2007). In the near future however, the aim will be to achieve a better material circularity and cascading and to valorise bio-waste through the creation of multi-regional value chains (Lokesh et al., 2018). This trend is visible in the increase of biomass-

cascading biorefineries throughout Europe – i.e. "integrated production plant[s] using biomass or biomass-derived feedstocks to produce a range of value-added products and energy" (Bio-based Industries Consortium, 2017b, p. 1). Examples of promising value chains in the EU are starch to bioplastics, bio mulch films and frame materials; cellulose to bio-based solvents; and vegetable fats/plant lipids to bio-based lubricants (Lokesh et al., 2018, p. 12).

I.2.3. Circular & cascading principles for an optimised biomass use

Circular and cascading principles are essential for a sustainable bioeconomy as biomass availability is limited. This has been acknowledged by the Standing Committee on Agricultural Research (SCAR) - an advisory committee to the EU on research and innovation policy. In 2015, SCAR introduced five guiding principles to the bioeconomy: 1) food and nutrition security first, 2) sustainable yields with a focus on the regeneration of soils and renewal of stocks, 3) cascading approach with priority given to high-value uses of biomass, 4) circularity of materials, and finally 5) diversity of production methods and scales to improve resilience (Pietzsch, 2017, p. 160; Agricultural and Rural Convention, 2019) .

Circular economy and cascading concepts overlap to a great extent (Lokesh et al., 2018). The circular economy is "a regenerative system in which resource, waste, emission, and energy can be minimized by closing material and energy loops". The bioeconomy cascading use of materials aims at deploying "biomass with as much added value as possible, and for the most appropriate application" (Zabaniotou, 2018, p. 198). In this context, so-called integrated biorefineries will play a decisive role in the coming years. Contrary to single conversion biorefineries, they combine several conversion technologies to smartly process various biomass streams into both high- and low-value products (McCormick & Kautto, 2013).

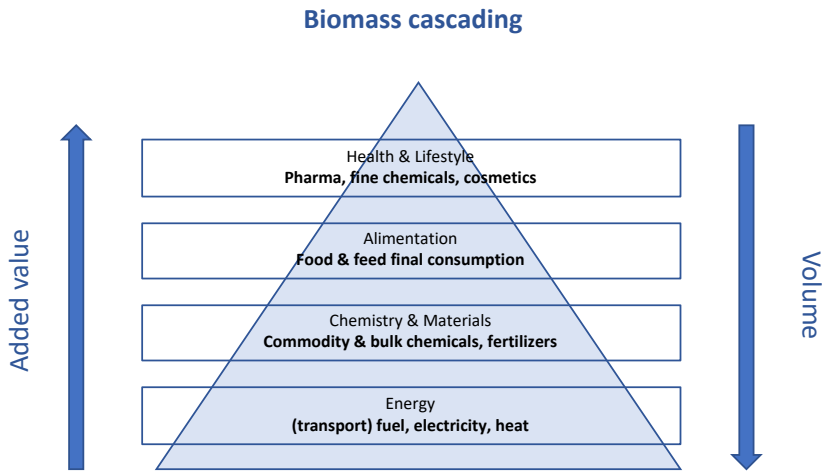

Figure 4: Cascading biomass uses (adapted from van Ree, 2017, p. 4)

The cascading pyramid depicted above represents an optimal value utilization from a bio-refinery perspective – i.e. where high value substances can be isolated to obtain a higher economy value. In reality however, social and environmental added value matters also. Food and feed are thus given priority to ensure food security (Pietzsch, 2017).

I.3. Biomass availability and market acceptance as stepping stones

To successfully transition towards a fully-fledged bio-based economy, decisive hurdles need to be overcome, from technical and legislative challenges to a lack of level-playing field with fossil-based products (Ladu & Quitzow, 2017; Ladu & Clavell, 2019). Pietzsch (2017) mentions specifically raw material availability, production costs, ecological sustainability and societal acceptance as some of the key hurdles (p. 160).

As of today, the well-established fossil-based economy enjoys high market entry barriers and considerable economies of scale. From material extraction to refining and manufacturing, fossil-based value chains benefit from well-developed infrastructures, institutional support and legitimacy at the political and cultural level. Moreover, incentives and regulations are lacking to bear the costs of negative environmental and social externalities linked to the exploitation of fossil resources, whereby "sustainable actions are punished rather than rewarded" (Pacheco et al., 2010, p. 465). Therefore, it is currently difficult for the bio-based industry to compete. Within the bio-based economy itself, there is a lack of level-playing field with regard to the allocation of biomass. As mentioned earlier, the biomass allocation is distorted towards the production of biofuels and bioenergy rather than materials, thereby reducing biomass availability for bio-based products (Bos et al., 2018). Besides, the chemical complexity and composition variability of biomass materials implies that they cannot be standardised as easily as fossil-based materials. A further hurdle are the fluctuations in biomass availability. Biomass availability is indeed greatly determined by seasonal and regional factors. At the moment, only bio-based products for which there are no fossil-based alternative available (e.g. enzymes or pharmaceutical compounds) or that offer superior product functionalities because of their unique properties are able to outcompete their fossil-based counterparts (Pietzsch, 2017).

Within the academic literature, two main hurdles regarding the scaling of the bio-based economy are brought to the fore:

Biomass availability[1]

Relying on agro-food based biomass – i.e. primary feedstocks – undermines the sector's long-term sustainability and puts food security at risk (Ladu & Quitzow, 2017). With the increase in world population and thereby food production needs, the scarcity of available land for dedicated biomass production will increase accordingly. Thus, for the bio-based economy to become a truly viable alternative to our current fossil-based economy, the following strategies can be adopted:

- The valorisation of secondary and tertiary biomass feedstocks. These range from agro-industrial residues and by-products to forestry residues and municipal waste. The valorisation of side streams could thereby help avoid so-called additional land conversion (Lokesh et al., 2018; Girotto et al., 2015);
- The application of cascading principles with regard to the use of biomass feedstocks. This would allow to prioritize the production of high added value bio-based products over that of low added value ones such as biofuels (Girotto et al. 2015; Maina et al., 2017, Ladu & Quitzow, 2017).

Market acceptance for bio-based products[2]

As underlined by Russo et al. (2019), current academic research on closed-loop supply chain models focuses mainly on technical, chemical and engineering aspects (e.g. Dietrich et al., 2017; Dilkes-Hoffman et al., 2018; Brosowski et al., 2016, Girotto et al., 2015). It thereby neglects to address consumers' role. As of now, the "social acceptance and commercialization of bio-based products" are still in their infancy (Ladu & Quitzow, 2017, p. 168). Not only are consumers often unfamiliar with bio-based products, but the bio-based attribute in itself is generally not a sufficient argument to convince people to opt for these products (Sijtsema et al., 2016). It is therefore crucial to better understand and promote market acceptance. Increased market acceptance could attract more investors and facilitate the scaling up of the bio-based economy (Ladu & Quitzow, 2017, p. 168).

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[1] e.g. Imbert et al., 2017; Ladu & Quitzow, 2017; Lokesh et al., 2018; Zabaniotou, 2018.

[2] e.g. Ladu & Quitzow, 2017; Peuckert & Quitzow, 2017; Russo et al., 2019; Sijtsema et al., 2016; Almenar et al., 2010, Herbes et al., 2018.

II. Research Question

II.1. Research question formulation

As mentioned earlier, on a worldwide scale, the bio-based economy still occupies a niche position within the broader socio-technical regimes in place (Ladu & Quitzow, 2017). In order to understand how transitions occur from the niche to the regime, the multi-level perspective (MLP) first developed by Rip & Kemp (1998) and further refined and popularised by Geels (2002) offers a useful tool for analysis.

Indeed, for a niche innovation to scale, a combination of changes at different levels needs to take place. However, as pointed out by Geels (2002), with cutting-edge technological innovations, the focus is more often than not on the scientific and engineering aspects. Geels (2004) therefore pleads to widen the "sectoral systems of innovation" approach within innovation studies to "explicitly incorporate the user side in the analysis" (p. 897). By transitioning from sectoral systems of innovation to socio-technical systems, the author highlights the role of societal functions and underlines that "technical trajectories are not only influenced by engineers, but also by users" (Geels, 2002, p. 1260).

This observation also applies to the scaling up of the bio-based economy. As pointed out earlier, the commercialization of bio-based products is still in its early stages and *market acceptance* for such products needs to be further explored (Ladu & Quitzow, 2017). The socio-technical dimension of *user preferences and practices* (Geels, 2002) can thereby serve as a theoretical lens to better understand the drivers and barriers to *market acceptance* – i.e. "the willingness of [end-consumers, firms, investors and public bodies] to adopt, purchase, and financially support a new technology" (Peuckert & Quitzow, 2017, p. 93). The present research proposes to focus more specifically on *consumer acceptance* by considering end-consumers and firms only. This allows to narrow the scope of the research while also being in line with business and management research. A focus on investors and public procurement stakeholders would rather be relevant in the context of finance and policy research respectively.

Within academic research on the bio-based economy, a number of drivers and barriers to consumer acceptance have been identified so far. Examples of barriers are a lack of level playing field between bio-based and fossil-based products which implies that bio-based products usually come with a price premium and are thus less accessible to consumers; or

greenwashing practices which lead to green scepticism on the part of consumers and thus negatively affect bio-based companies' marketing efforts (e.g. Bosman & Rotmans, 2016; Carus et al., 2014; Sijtsema et al., 2016; Lemke & Luzio, 2014; Goh & Balaji, 2016). However, research on the topic is relatively recent and scarce and little is known about potential strategies to promote consumer acceptance.

Therefore, contrary to past research analysing consumer acceptance by focusing on the user side, the present research proposes to adopt a different perspective on the issue and focus on bio-based stakeholders at the niche level instead. The aim is to identify current drivers and barriers to consumer acceptance and analyse what strategies bio-based stakeholders could adopt to promote consumer acceptance and thereby more easily scale their niche. By using the MLP as an analytical tool, strategies at different levels can be unveiled. Besides, it is also useful to consider niche stakeholders that are situated at different stages along the product innovation journey. Indeed, while researchers are still at the research and development stage, frontrunner businesses have already launched their bio-based products on the market and thus implemented specific strategies. By considering both types of stakeholders, strategies for consumer acceptance can be analysed at different stages along the product development process.

Regarding the type of bio-based products developed by these stakeholders, the focus is laid on those manufactured from secondary biomass feedstocks. Indeed, the valorisation of secondary biomass feedstocks currently holds great potential for a sustainable bio-based economy in the near future. Primary feedstocks are more likely to put food security at risk as mentioned earlier (Ladu & Quitzow, 2017) as they include biomass directly harvested from forest or agricultural land (Cherubini et al., 2009). As for tertiary feedstocks – i.e. post-consumer feedstocks - they have yet to be successfully exploited for the production of value-added bio-based products. Indeed, research is still in the early stages and commercial exploitation virtually non-existent (Sisto et al., 2017; Girotto et al., 2015; Montonori, 2017; Vea et al., 2018). Post-consumer organic waste is indeed "difficult to collect and segregate, but also challenging to valorise given its heterogeneous composition" (Pfaltzgraff et al., 2013, p. 308).

Furthermore, as has been mentioned earlier, the EU currently occupies a leading position in "closing the loop" of product lifecycles and optimizing waste management (cf. pp. 11, 13). Therefore, as the EU plays a preponderant role in developing the potential of secondary biomass feedstocks, the current research proposes to focus on the EU level.

Thus, the following research question arises:

What strategies could EU researchers and frontrunner businesses who valorise secondary biomass feedstocks for the production of bio-based products pursue to promote consumer acceptance?

The research question raises the following sub-questions:

a) How is the concept of *consumer acceptance* defined within the academic literature on sustainability transitions? (answered in chapter III., III.1.4, III.1.5)
b) What are current drivers and barriers to consumer acceptance for bio-based products and more specifically bio-based products manufactured from secondary biomass feedstocks? (answered in chapter III., III.2.2, III.2.3, and chapter V., V.1.)
c) What are current strategies to promote consumer acceptance? (answered in chapter III., III.3 and chapter V., V.2.)
d) Which strategies can be recommended to promote consumer acceptance? (answered in chapter VII., VII.1, VII.2)

II.2. Concept operationalisation & research scope

In the following, the main research concepts are operationalized, and the research scope is defined.

EU researchers & frontrunner businesses

The present research proposes to consider the following bio-based niche stakeholders involved in the valorisation of secondary biomass feedstocks:
1) EU researchers who are members of public-private consortia operating under the BBI JU,
2) EU frontrunner businesses.

EU researchers designate members of public organisations and private companies which have received funding in the context of the BBI JU – i.e. the EU and BIC partnership aimed at leveraging the untapped potential of secondary biomass feedstocks for value-added products mentioned earlier (cf. p. 13).

EU frontrunner businesses designate companies that have launched or are in the process of launching bio-based products manufactured from secondary biomass feedstocks on the market.

The *frontrunner* concept is hereby borrowed from Transition Management literature (e.g. Loorbach & Wijsman, 2013; Jhagroe & Loorbach, 2015; Rauschmayer et al., 2015; Brown et al., 2013; Loorbach, 2010). Frontrunner businesses go beyond mere corporate social responsibility by "positively utiliz[ing] and address[ing] tensions between business and society" (Loorbach & Wijsman, 2013, p. 23) They are "creative minds, strategists, and visionaries" that have "the capacity to generate emergent structures and operate within these deviant structures" (Rotmans & Loorbach, 2009, p. 189).
An example of such frontrunner businesses would be Orange Fiber, an Italian company which produces textiles based on citrus juice by-products (Orange Fiber, 2019), or Bio-Lutions, a German company which develops packaging solutions and disposable tableware based on agricultural residues (Bio-Lutions, 2019).

Secondary biomass feedstocks valorisation & bio-based products

As mentioned earlier, biomass feedstocks can be sourced either from primary, secondary or tertiary raw materials. Secondary and tertiary biomass feedstocks occur at different points of production value chains – i.e. they are sourced respectively at the pre- and post-consumer stages (Cherubini et al., 2009). They can be categorised in five main types: 1) agricultural by-products and residues, 2) residues of forestry and wood industries, 3) municipal waste, 4) industrial residues, and 5) residues from other areas (Brosowski et al., 2016).

As to the terms "by-products" and "residues", the EU makes a distinction with regard to their waste status. A production residue is a "material that is not deliberately produced in a production process but may or may not be waste" depending on its further use within the economy. A by-product "is a production residue that is not waste" (European Commission, 2007, p. 4), i.e. "where the further use of the material [is] not a mere possibility but a certainty, without any further processing prior to reuse and as part of a continuing process of production" (Ibid., p. 7). For example, starch production by-products are currently often used as animal feed and are therefore not classified as waste.

Secondary biomass feedstocks – whether they consist of residues or by-products – can be used for the production of different types of bio-based products. As shown in figures 2 (p. 13) and 4 (p. 15), possible applications are pharmaceuticals, plastics, biofuels, paper products and textiles, whereby the added value of products should be given priority in the context of an optimal cascading of biomass resources.

Strategies for the promotion of consumer acceptance

Strategies can be understood as approaches at different MLP levels susceptible to contribute to consumer acceptance and which might reinforce each other when cleverly combined. Consumer acceptance is thereby defined as the willingness to purchase, pay for, switch to and use green products or technologies on the part of end-consumers (B2C) and firms (B2B) (e.g. Hazen et al., 2017; Russo et al., 2019; Peuckert & Quitzow, 2017; Huijts et al., 2012; Chen & Chang, 2012).

At the niche level, a potential strategy could consist in involving early adopters in the product development process and thereby ensuring a product design which meets consumer expectations. At the regime level, policy-driven strategies such as the development of eco-labels or the use of subsidies (e.g. Bleda & Valente, 2009; Ladu & Blind, 2017; Theinsathid et al., 2011) could reinforce niche-level approaches.

To summarize the proposed research question, the aim is twofold:

First, review the current state of consumer acceptance for bio-based products and more specifically those manufactured from secondary biomass feedstocks. The MLP socio-technical dimension of *user preferences & practices* thereby offers a useful theoretical lens to understand drivers and barriers to consumer acceptance.

Second, unravel what strategies - at different MLP levels - could help bio-based niche stakeholders in addressing the identified drivers and barriers and thus promote increased consumer acceptance for their bio-based products.

III. Literature Review

To answer the research question formulated above, a review of the related academic literature is first conducted. The aim of the literature review is threefold: first, to provide a theoretical underpinning to the research question; second, to review consumer acceptance with regard to bio-based products and more generally sustainable innovations; and three, to offer preliminary answers to reviewed hurdles and opportunities by identifying suggested strategies for the promotion of consumer acceptance.

In the following, the literature review outline is summarised:

- In a first step (chapter III, section III.1), a theoretical background is provided by briefly introducing sustainability transitions research and its main academic streams. This allows to introduce the multi-level perspective (e.g. Rip & Kemp, 1998; Geels, 2002; Smith et al., 2010) and explore more in depth the socio-technical dimension of *user preferences & practices*. As user preferences and practices can either be barriers or drivers to their acceptance for specific products and services, the concepts of *market acceptance* and *consumer acceptance* in relation to the bio-based economy are then explored.

- In a second step (chapter III, section III.2), the aim is to review academic articles analysing consumer acceptance for bio-based products manufactured from secondary biomass feedstocks. However, as research is still relatively modest with respect to this specific type of bio-based products, the review scope is enlarged. The focus is first laid on consumer acceptance for eco-innovations in general (section III.2.1), then on consumer acceptance for bio-based products (section III.2.2), and finally on consumer acceptance for bio-based products manufactured from secondary biomass feedstocks specifically (section III.2.3).

- In a third and final step (chapter III, section III.3), the totality of the identified academic articles is reviewed to identify both suggested and implemented strategies aimed at promoting consumer acceptance. Here again, a differentiation is made between strategies targeted at promoting eco-innovations in general and those targeted at bio-based products more specifically.

III.1. Part I - Theoretical background

III.1.1. Sustainability transitions research

The field of sustainability transitions research is relatively new. It emerged in the 1990s and evolved towards becoming a highly transdisciplinary field focused on the core concept of transition – i.e. "a nonlinear shift from one dynamic equilibrium to another". The concept of sustainability transitions in particular refers to "large-scale societal changes deemed necessary to solve 'grand societal challenges'" (Loorbach et al., 2017, p. 600). The aim of transitions research is to understand transitions but also "explore possibilities to advance and accelerate desired transitions" and thereby address lock-ins and path dependencies (Rotmans et al., 2001). With an initial focus on transitions in socio-technical systems (e.g. energy, mobility), transitions research has since then broadened its scope by also looking at socio-ecological, socio-economic and socio-political systems where notions of power and discourse for example come into play (Ibid.). As sustainability in itself is a public good and is therefore subject to "free-rider problems and prisoner's dilemmas" (Köhler et al., 2019, p. 3), sustainability transitions necessarily have to rely on the intervention of public policy and further intermediaries. Therefore, sustainability transitions research is characterized amongst others by its *normative directionality* – i.e. it seeks to shape trajectories through "normative statements about what transitions seek to achieve" (Ibid., p. 3). *Normative directionality* is essential for sustainable transitions to assert their legitimacy. Thus, by combining "evolutionary theories of socio-technical change with theories of agency and strategic decision-making" (Smith et al., 2010, p. 446), sustainability transitions studies follow a modernist approach where meta-narratives and the pursuit of an objective truth play an essential role in showing the trajectory forward (Gilligan, 2012). It should be underlined however that *directionality* has been acknowledged as a challenging aspect of this research field. Setting a direction is indeed debatable when the systemic effects of innovations are uncertain and a definition of what a "sustainable" trajectory could or should be is subject to interpretation (Smith et al., 2010). Within transition research, some advocate for an "enlightened modernist" approach based on reflexive governance (e.g. Rip, 2006). Rather than silencing alternative narratives, "strategies of reflexive governance promise to engage more openly and directly with the challenges of handling rather than eliminating ambivalent and changing goals" (Walker & Shove, 2007, p. 213).

Sustainability transitions research builds on four founding theoretical frameworks: The *Multi-Level Perspective*, the *Technological Innovation System* approach, *Strategic Niche Management* and *Transition Management*. These approaches all "take a systemic perspective to capture co-evolutionary complexity and key phenomena such as path-dependency, emergence and non-linear dynamics" (Köhler et al., 2019, p. 4).

Two academic literature streams have become predominant within transitions research, namely Transition Management (TM) and Strategic Niche Management (SNM). Both literature streams were developed in the Netherlands as an alternative to approaches on innovation considered too top-down and linear. Even though TM and SNM both aim at promoting alternative sustainable visions to replace existing regimes, they differ in some respects (Loorbach & Van Raak, 2006). On the one hand, SNM emerged from technology and innovation studies and looks at viable technological trajectories for change. It "builds on the Multilevel Perspective (MLP) of socio-technical change" and thereby adopts a "technology centered" perspective (Loorbach & Van Raak, 2006, p. 9). The focus is laid on the technical and economic feasibility of potential technologies as well as their social desirability. *Barriers* and *catalysts* to the technology development are thereby considered (Kemp et al., 1998). On the other hand, TM "takes a societal problem as a starting point and sees a search- and learning-process as the solution". It has thereby rather evolved as a governance theory which relies on complex systems theory to analyse society as a "complex adaptive system" (Loorbach & Van Raak, 2006, pp. 4, 8). As to the last founding theoretical framework -. i.e. Technological Innovation System – it focuses mainly on the emergence phase of innovations and is likely to encompass several niches (Markard & Truffer, 2008). It refers to a "set of network of actors and institutions that jointly interact in a specific technological field and contribute to the generation, diffusion and utilization of variants of a new technology" (Ibid., p. 611).

The SNM approach is particularly pertinent for the current research as its main characteristic is to offer an alternative to "technology-push" approaches by "align[ing] technology and user environment" (Loorbach & Van Raak, 2006, p. 3). Especially the multi-level perspective which SNM builds on underscores the relevance of learning processes and input from different regime actors as explained more in detail in the following.

III.1.2. The multi-level perspective

The present research uses the MLP as an analytical tool. The MLP analyses the evolution of technological trajectories based on a nested hierarchy. According to this hierarchy, micro-level technological niches are embedded within meso-level socio-technical regimes, themselves embedded within larger macro-level landscape developments (e.g. Rip & Kemp, 1998; Geels, 2002; Smith et al., 2010).

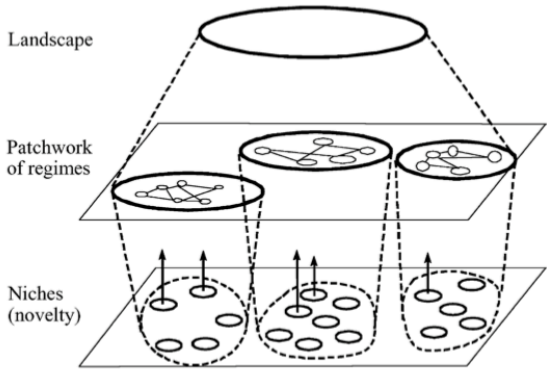

Figure 5: Multiple levels of a nested hierarchy (Geels, 2002, p. 1261)

In his later work on the MLP however, Geels (2011) proposes to abandon the idea of "nested hierarchy", arguing that the micro-, meso- and macro-levels "refer to different degrees of structuration of local practices, which relate to differences in scale and the number of actors that reproduce regimes (and niches)". In that sense, levels refer to "different degrees of stability" and are therefore not necessarily hierarchical (p. 37). In this revised understanding of the MLP, the regime level is considered central as this is where transitions occur, whereas the niche and landscape levels become "derived concepts" (Ibid., p. 26)

The concept of *socio-technical regime* (Hermans, 2018) is derived from the technological regime concept as first developed by the evolutionary economists Nelson and Winter (1977; 1982). They define the technological regime as a cognitive concept related to "technicians' beliefs about what is feasible or at least worth attempting". This implies that what is deemed possible shapes the direction and boundaries of technological progress - "A regime not only defines boundaries, but also trajectories to those boundaries" (Nelson & Winter, 1977, p. 57). As underlined by Geels (2002), when "engineers and firms share similar routines", they "form a *technological regime*" which in turn results in a certain "technological trajectory" as "the community of engineers searches in the same direction" (p. 1259).

Geels (2002) broadens the *technological regime* concept by postulating that "technical trajectories are not only influenced by engineers, but also by users, policy makers, social groups, suppliers, scientists, capital banks, etc" (p. 1260). He thereby widens the "sectoral systems of innovation" approach by "explicitly incorporate[ing] the user side in the analysis" (Geels, 2004, p. 897). He summarizes his reasoning as follows:

> The sectoral systems of innovation approach has a strong focus on the development of knowledge, and pays less attention to the diffusion and use of technology, impacts and societal transformations. Sometimes, the user side is taken for granted or narrowed down to a 'selection environment'. (Ibid., p. 898)

By transitioning from sectoral systems of innovation to socio-technical systems, Geels (2004) underlines the role of societal functions and "indicates that the focus is not just on innovations, but also on use and functionality" (p. 898). Socio-technical regimes can be defined as "complex structure[s] of artefacts, institutions and agents" (Smith, 2007, pp. 427, 428). They further consist of "rules that enable and constrain activities within communities". These regime rules can be "cognitive routines and shared beliefs, capabilities and competences, lifestyles and user practices, favourable institutional arrangements and regulations, and legally binding contracts" (Geels, 2011, p. 27).

A key contribution of the MLP is that it "does away with simple causality in transitions". Transitions cannot be traced back to a single cause, they are rather the result of a so-called "circular causality" where "processes in multiple dimensions and at different levels […] link up with, and reinforce, each other" (Geels, 2011, p. 29). Not only do transitions occur at multiple levels but they also evolve through different phases: *predevelopment*, *take-off*, *acceleration* and *stabilization* (Rotmans et al., 2001, p. 17).

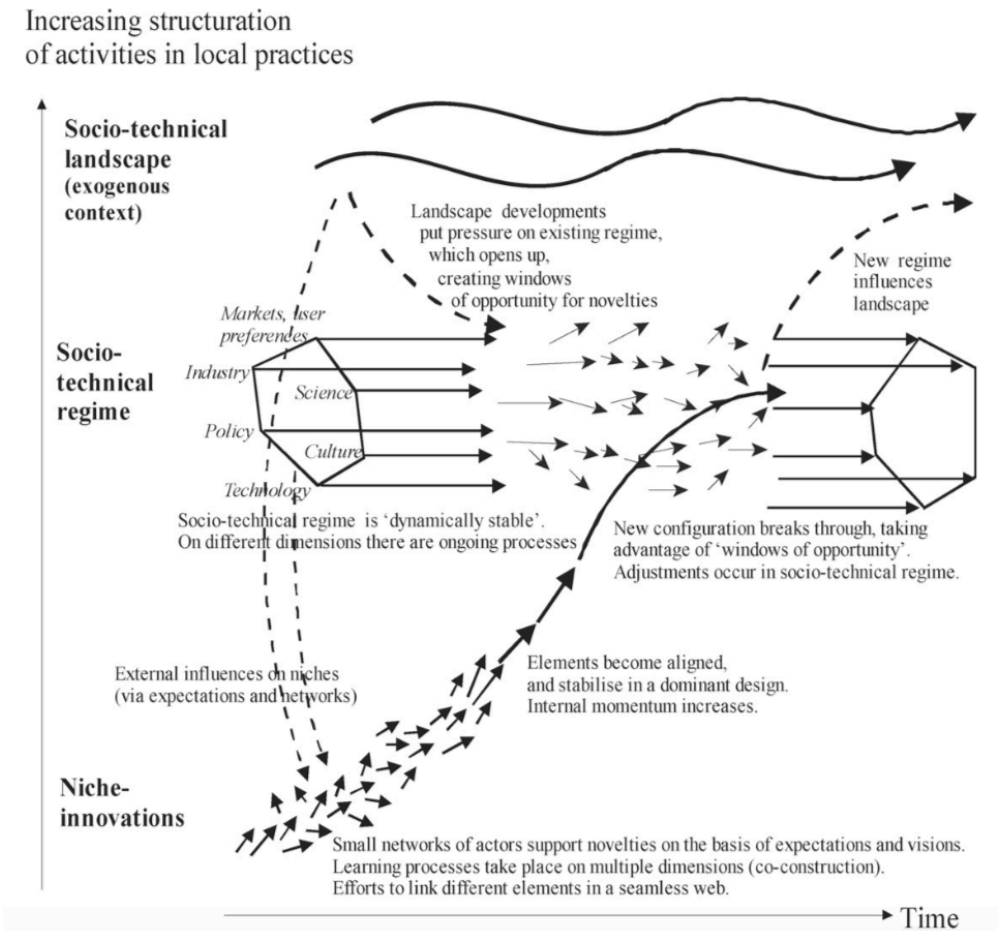

Figure 6: Multi-level perspective on transitions (Geels & Schot, 2007, p. 401)

At the meso-level, socio-technical regimes "constitute the mainstream, and highly institutionalised, way of currently realising societal functions" (Smith et al., 2010, p. 440). As a result of an accumulation and lock-in of knowledge, values, norms, infrastructure and investments amongst others, changes within the regime are mainly path dependent and incremental (Ibid.). These regimes are characterized by seven socio-technical dimensions: 1) *industry structure (industrial networks, strategic games),* 2) *techno-scientific knowledge,* 3) *technology,* 4) *culture and symbolic meaning of technology,* 5) *infrastructure,* 6) *policy (sectoral policy),* and 7) *user preferences & practices, and application domains (markets).* These dimensions interact and form together "dynamically stable" regimes (Geels, 2002, pp. 1262, 1263).

Regimes are influenced both by the macro-level landscape and micro-level niches. The landscape consists of "technology-*external* factors" (Geels, 2002, p. 1260) which prove even more difficult and slow to change. However, when pressures arise at the landscape level, they open up windows of opportunities for niches to destabilize the socio-technical regimes in place.

As to micro-level niches, they are the source of radical innovations as opposed to incremental innovations which occur at the meso-level (Ibid., p. 1260). In the context of sustainability transitions research, niches are conceptualized more specifically as *green niches*, i.e. protected "spaces where networks of actors experiment with […] greener organizational forms and eco-friendly technologies" (Smith, 2007, p. 427). In the context of the present research, the use of secondary biomass feedstocks for the production of bio-based products is considered a *green niche* within the incumbent European socio-technical regime (Ladu & Blind, 2017).

The general overview of the MLP provided above allows to now consider more specifically one of the seven meso-level socio-technical dimensions mentioned earlier, namely *user preferences & practices, and markets* (Geels, 2002; Schot & Geels, 2008).

III.1.3. The user preferences & practices socio-technical dimension

The present research focuses on EU researchers and frontrunner businesses involved in the development and commercialization of bio-based products manufactured from secondary biomass feedstocks. It aims at assessing how these micro-level stakeholders address the meso-level *user preferences & practices, and markets* socio-technical dimension. As the concept of markets is a distinct one within the socio-technical dimension - they are namely defined as "application domain[s]" at the socio-technical regime level and thereby refer to abstract entities rather than concrete users (Geels, 2002, p. 1262) – it is purposefully excluded from the research scope. Indeed, the *markets* concept covers different aspects than the *user preferences & practices* concept and cannot be additionally addressed here due to time and scope constraints.

Within sustainability transitions research in general and Strategic Niche Management literature more specifically, the *user preferences & practices* dimension has been operationalized in different ways. Users are thereby most frequently put on par with economic actors by being referred to as "consumers", "choice agents" or "end users"[3], i.e. "the person or organisation that uses a product or service" (Cambridge Dictionary, 2019). Besides their role as consumers, users have also been addressed in their role as "citizen users", thereby adopting a socio-political perspective on users' influence in the socio-technical regime[4].

Within the MLP, Geels (2002) mentions two user-related dimensions in particular: "user practices" and "preferences". "User practices" refers to consumption patterns and can be

[3] e.g. Geels & Kemp, 2007; Loorbach & van Raak, 2006; Smith et al., 2005; Rauschmayer et al., 2015.
[4] e.g. Schot et al., 2016; Kivimaa et al., 2019; Geels, 2018.

associated to "routines", "lifestyles", "consumption habits"[5]. In the current research, practices understood as "entities that exist across time and space" and are "carried, sustained and transformed by cohorts of practitioners" (Shove, 2014, p. 418) are not a central focus. Indeed, analysing practices goes beyond looking at "drivers and barriers of individual behaviour" as it entails understanding "the dynamics of social practice" (Ibid., p. 426). This is beyond the scope of the current research. What can be said however is that "user practices" are motivated by both their "preferences" and "needs". "User preferences" are linked to their personal choices and wishes. Users will display specific "interests" or "motivations" that explain their preference for specific products or services[6]. "User needs" refers to the traditional economic concept of supply and demand (Smith et al., 2005). Users thereby form "expectations" and want specific "requirements" or "criteria" to be fulfilled when choosing and using products or services[7].

The antecedents to user preferences and needs are "user beliefs" and "user competencies". Users can indeed form certain beliefs regarding specific technologies or cultural phenomena based on "cultural conventions", their personal "values", "assumptions" and "perceptions"[8]. In contrast, users also possess specific "competencies", "skills" and "expertise" rooted in knowledge[9].

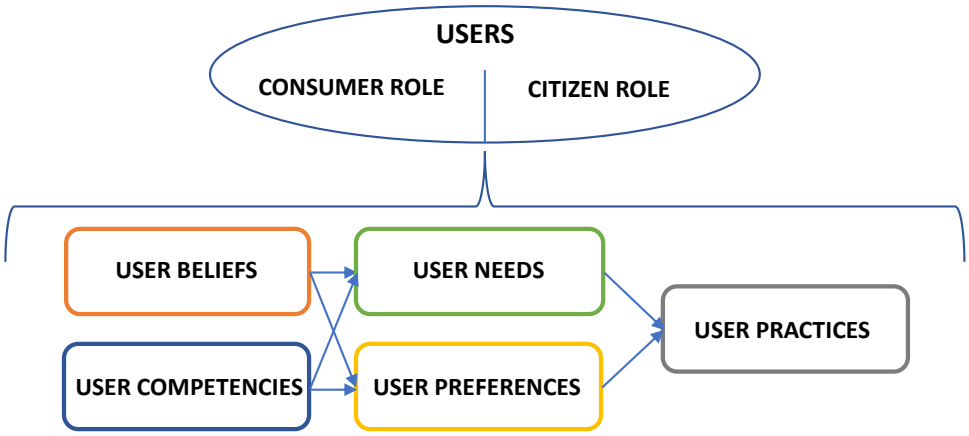

Figure 7: Theoretical representation of the *user preferences & practices* socio-technical dimension

[5] e.g. Geels et al., 2017; Markard et al., 2012; Schot et al., 2016; Roberts & Geels, 2019.
[6] e.g. Geels & Schot, 2007; Naber et al., 2017; Geels, 2005.
[7] e.g. Sovacool et al., 2017; van den Bergh et al., 2011; Markard & Truffer, 2008.
[8] e.g. Loorbach & van Raak, 2006; Caniëls & Romijn, 2008; Geels et al., 2017; Schot et al., 2016.
[9] e.g. Kemp et al., 1998; Geels et al., 2017; Markard et al., 2012.

When users share the same consumption patterns, they are often designated as belonging to a specific "consumer segment". They might then form "associations", "clubs" or "online collectives" to lobby for their preferences and lifestyles, and thereby actively shape the socio-technical regime[10]. Furthermore, users assume different roles, from "active" to "passive consumers", depending on their degree of reflection and engagement with regard to their consumption habits. They can for example display enthusiasm and engagement towards an innovation, show no interest at all, or at the other extreme, display a great level of resistance[11]. Active users can be "lead users" or "user-producers" and thereby actively contribute to designing and developing the innovation at hand[12]. Further, they can advocate the niche innovation by endorsing a broker role in-between the niche and meso-level as "user intermediaries" and "legitimators"[13]. User resistance, on the contrary, implies a voluntary and conscious opposition on the part of users who thereby become "non-adopters" and ultimately "non-users"[14].

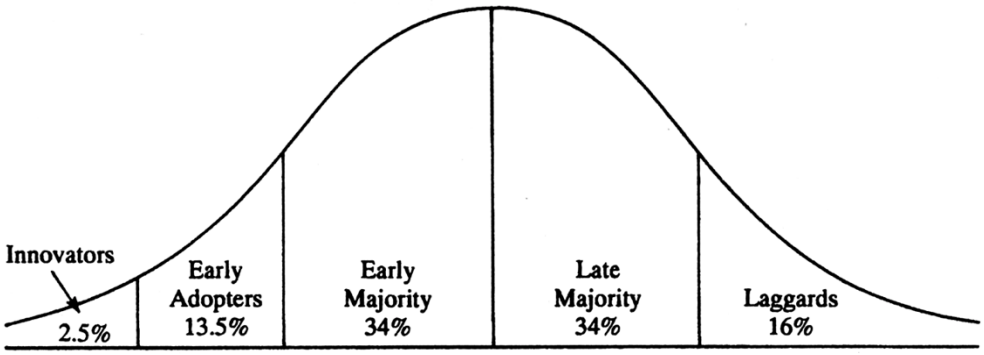

Figure 8: Adopter categorisation on the basis of innovativeness (Rogers, 2003, p. 281)

The different user roles are reminiscent of the diffusion of innovations theory by Rogers (1983). Rogers indeed defines different adopter categories, from "innovators" and "early adopters" to the "late majority" and "laggards". He further identifies "opinion leaders" which act as brokers in a similar way to the "user intermediaries" mentioned above. Interestingly, Kahma & Matschoss (2017) extend Rogers' theory beyond the mere "delayed consumption" by laggards by also considering deliberate non-adoption of innovations (p. 28). Further elements of Roger's diffusion of innovation theory share similarities with the MLP perspective. At the user level, Rogers describes a five-phase decision process where *knowledge* and *persuasion* are

[10] e.g. Geels, 2005; Köhler et al., 2019; Schot et al., 2016.
[11] e.g. Roberts & Geels, 2019; Köhler et al., 2019.
[12] e.g. Markard & Truffer, 2008; Köhler et al., 2019; Fischer & Newig, 2016.
[13] e.g. Kivimaa et al., 2019; Köhler et al., 2019; Schot et al., 2016.
[14] e.g. Köhler et al., 2019; Roberts & Geels, 2019; Kahma & Matschoss, 2017.

preliminary phases to *decision* (consumer acceptability), *implementation* and *confirmation* (consumer acceptance). Thus, the degree of an innovation's fit with users' preferences and practices - depending on its *compatibility*, *complexity*, *relative advantage* (added value), etc. - will play a role in its diffusion rate (Lundblad, 2003, p. 53). Further, Rogers defined diffusion as the "process by which an *innovation* is communicated through certain *channels* over *time* among the members of a *social system*" (Rogers, 2003, p. 11). Not only did Rogers already point to the importance of *opinion leaders* and the influence of different actors within a given *social system* but he also described the diffusion process as going through different phases, from take-off to maturity (Ibid.). His s-shaped diffusion curve is very similar to the different transition phases defined by Rotmans et al. (2001) – i.e. *predevelopment*, *take-off*, *acceleration* and *stabilization* with regard to sustainability transitions in an MLP perspective.

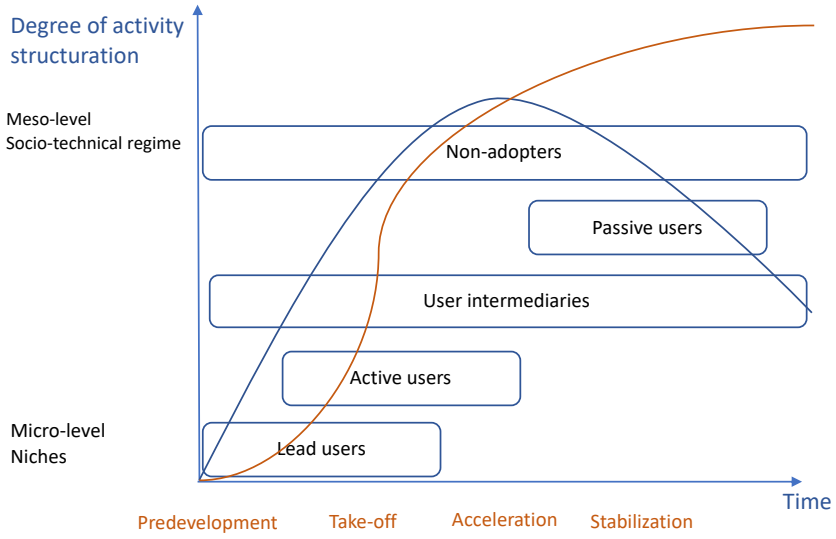

Figure 9: User roles and transition phases at different MLP levels & through time

This brief overview of the different aspects related to the *user preferences & practices* socio-technical dimension underlines that users are complex agents within the MLP. Not only are they characterized by emotional and rational traits, but also by their degree of involvement or resistance with regard to innovative technologies and products and societal dynamics.

The beliefs, competencies, needs, preferences and practices of users play a role in their "willingness […] to adopt, purchase, and financially support a new technology" (Peuckert & Quitzow, 2017, p. 93). They can indeed act as *barriers* or *catalysts* (Kemp et al., 1998) when it comes to market acceptance for innovative technologies and products. This is why the *user preferences & practices* socio-technical dimension introduced here provides a useful theoretical lens to further explore the concept of market acceptance.

III.1.4. Market acceptance concept

As already mentioned earlier, the "social acceptance and commercialization of bio-based products" are still in their infancy (Ladu & Quitzow, 2017, p. 168). Not only are consumers often unfamiliar with bio-based products, but the bio-based attribute in itself is generally not a sufficient argument to convince people to opt for these products (Sijtsema et al., 2016). Wüstenhagen et al. (2007) provide a detailed definition of the *social acceptance* concept borrowed from policy literature. The authors introduce three dimensions pertaining to the umbrella concept of *social acceptance* in the context of renewable energy innovations. *Social acceptance* is thereby understood as *socio-political*, *community*, and *market acceptance*.

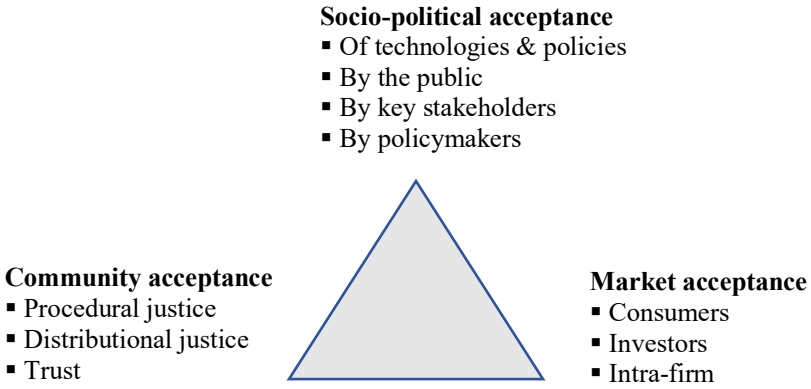

Figure 10: The triangle of social acceptance (adapted from Wüstenhagen et al., 2007, p. 2684)

While *socio-political acceptance* refers to the broadest possible level of acceptance with regard to policies and technologies in general, *community acceptance* focuses on the regional level where local stakeholders play a predominant role. The third dimension, *market acceptance*, is defined as the "process of market adoption of an innovation" (Wüstenhagen et al., 2007, p. 2685), i.e. "the willingness of actors to adopt, purchase, and financially support a new technology" (Peuckert & Quitzow, 2017, p. 93).

The *market acceptance* dimension is also closely linked to the process of market adoption of an innovation as first articulated by the literature on diffusion of innovations (Rogers, 1995). Market acceptance will thereby vary according to the type of users confronted with a specific innovation, from early adopters to laggards or even non-adopters (Kahma & Matschoss, 2017). Potential adopters can be end-consumers, firms or investors (Wüstenhagen et al., 2007). Peuckert and Quitzow (2017) further consider a fourth actor - i.e. public bodies and government agencies – as they can also be a source of demand in the context of public procurement.

As mentioned earlier, the present research focuses on consumer acceptance specifically by considering end-consumers and firms only. This is the reason why the market acceptance concept is narrowed down to that of consumer acceptance explored more in detail below.

III.1.5. Consumer acceptance concept

Within the field of sustainability transitions, the concept of *consumer acceptance* is articulated along four dimensions: consumers' willingness to purchase, pay for, switch to and use green products or technologies (e.g. Hazen et al., 2017; Russo et al., 2019; Peuckert & Quitzow, 2017; Huijts et al., 2012; Chen & Chang, 2012). Huijts et al. (2012) define *consumer acceptance* as opposed to *citizen acceptance.* As consumers, people are given the choice to adopt or not a given innovation whereas in their citizen role, they have less control and decision-power regarding the introduction of the said innovation (p. 526).

It is worth mentioning here that *consumer acceptance* goes beyond mere *consumer acceptability*. Whereas the former refers to behavioural responses – i.e. the purchase and use of innovative products or technologies -, the latter merely refers to actors' supportive attitude towards them (Ibid., p. 526).

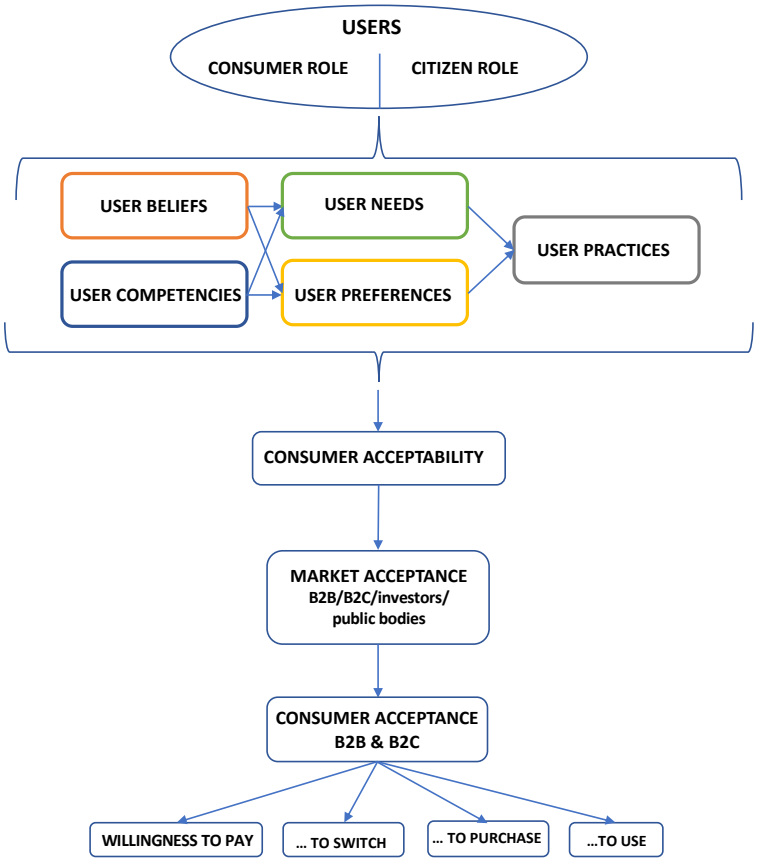

Figure 11: Theoretical representation of the *consumer acceptance* concept through the lens of the *user preferences & practices* socio-technical dimension

By introducing the theoretical background to the research, the first research sub-question (a) has been explored (i.e. *How is the concept of consumer acceptance defined?*). In a second step, consumer acceptance for eco-innovations, bio-based products and bio-based products from secondary biomass feedstocks is reviewed, thereby providing answers to the second research sub-question (b) (i.e. *What are current drivers and barriers to consumer acceptance?*).

A total of 65 articles related to *consumer acceptance* were identified through a key word search on Scopus, ScienceDirect, JSTOR and Google Scholar databases, and through forward and backward snowballing. As expected, there has been little academic focus so far on consumer acceptance for bio-based products manufactured from residues and by-products – i.e. 6 articles only could be identified. The literature scope was thus broadened to include articles on consumer acceptance for bio-based products (22 articles) and eco-innovations (30 articles).

The term eco-innovation is used here to designate what is commonly referred to as green products and technologies. It is to be understood according to the definition provided by Kemp and Pearson (2007, p. 7) – i.e. an "eco-innovation is the production, assimilation or exploitation of a production process, service or management or business method that is novel to the organisation (developing or adopting it) and which results, throughout its lifecycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives".

Finally, 7 further articles within the field of sustainability transitions research were retained albeit not directly linked to *consumer acceptance*. Indeed, the potential strategies they mention are relevant for the current research purpose and ought therefore to be included.

III.2. Part II - Consumer acceptance in sustainability transitions research

III.2.1. Consumer acceptance for eco-innovations

In each of the following sections (III.2.1, III.2.2, III.2.3), the reviewed articles were grouped into sub-categories based on their main focus (product type or core concept). Accordingly, within this first section dedicated to consumer acceptance for eco-innovations (III.2.1), the first sub-category groups articles analysing consumer acceptance for the sustainability concept and eco-innovations in general (III.2.1.1). The second sub-category looks at sustainable packaging (III.2.1.2) and the third one at remanufactured products (III.2.1.3).

III.2.1.1. Consumer acceptance for sustainability & eco-innovations in general

Among the reviewed articles, approximately a third look at consumers' understanding and acceptance of sustainability and sustainable products in general. Hanss and Böhm (2012) define five dimensions pertaining to the sustainability concept. They go beyond the traditional triple bottom line concept of *environmental*, *social* and *economic* dimensions (Elkington, 1998) by adding a *temporal* and *developmental* dimension. They thereby include salient aspects such as considering the needs of both current and future generations (*temporal*) and the technological, lifestyle and political developments needed to achieve sustainability (*developmental*). The authors conducted face-to-face interviews with Norwegian consumers and found that these were most familiar with the environmental, social and developmental sustainability dimensions. They further found that consumers were positive towards sustainability labels they were most familiar with and sensitive to the following sustainable products attributes: "recyclability of the packaging, fair payment of producers, low energy use and low carbon dioxide emissions during production and shipping" (p. 678). Furthermore, a survey conducted by BBMG et al. (2012) among 6,224 respondents in six international markets (Brazil, China, Germany, United Kingdom, United States) revealed that 65% of consumers felt "a sense of responsibility to purchase products that are good for the environment and society" (p. 6).

However, does this sensitivity necessarily translate into green purchase intentions? According to Trudel and Cotte (2009), it does pay indeed for a company to propose ethical products. They found that consumers were willing to pay a premium for ethically produced goods and demanded a lower price for unethical goods (thereby implicitly punishing the unethical companies). Casadesus-Masanell et al. (2009) came to the same conclusion by showing that Patagonia customers in the U.S.A. had accepted to pay a price premium with no incremental benefits in return when the brand introduced organic cotton in all its sportswear in 1996. Furthermore, in a follow-up study to a first study conducted in 1996, Whitson et al. (2014) showed that consumers' willingness to pay a price premium for sustainable products had increased over a 15-year period, thereby perhaps corresponding to a "greening of consumer perceptions and acceptance of higher priced eco-friendly products" (p. 464).

On the contrary, Young et al. (2010) conducted in-depth interviews among self-declared green consumers in the United Kingdom and revealed a "values-action gap" among these consumers. Although they were willing to purchase green products, their willingness often failed to translate into action. The authors found that key drivers for action were consumers' green

values, past purchase experience of green products, having sufficient time to conduct research prior to purchase, having sufficient environmental knowledge and a comfortable financial situation. Besides, the green products should be reasonably available (p. 29). When these drivers become barriers, the "values-action" gap was likely to widen even further.

Chen and Chang (2012) also mention barriers to green purchasing. They argue that consumers will not favour green attributes over other product attributes they consider essential if this implies a trade-off. They found that green purchase intentions among Taiwanese consumers were determined both by green perceived value and green perceived risk. They further suggest that green trust acts as a mediator: increasing green perceived value and decreasing green perceived risk can thus contribute to greater green trust and thus higher green purchase intentions.

Goh and Balaji (2016) also analysed consumer behaviour by submitting self-reported questionnaires to 303 Malaysian retail customers. They specifically focused on the rise in green scepticism - i.e. where "customers doubt or disbelieve environmental claims made by the firms". This green scepticism was found to result from so-called greenwashing where "firms are disseminating false and misleading environmental information to improve their sales and reputation" (p. 629). They found that environmental concern and environmental knowledge fully mediate the relationship between green scepticism and green purchase intentions. This means that the more sceptic consumers are regarding green products, the less likely they are to be concerned about the environment and seek additional information on the topic. This in turn impacts their green purchase intentions negatively. Conversely, they found that customers with environmental knowledge, be it objective or perceived, are more likely to turn towards eco-innovations.

Furthermore, Barbarossa and De Pelsmacker (2016) studied antecedents to the purchasing of eco-friendly products. They submitted questionnaires to both green and non-green consumers in Italy. They found altruistic – i.e. "care for the environmental consequences of purchasing" - and ego-centric – "green self-identity and moral obligations" - antecedents to be the main drivers for the purchasing of eco-friendly products (p. 239). This applied to both green and non-green consumers, albeit to different degrees. The study further revealed that the "personal inconvenience of purchasing eco-friendly products" – a negative ego-centric antecedent - influenced negatively the purchase of eco-friendly products for both green and non-green

consumers. Indeed, the purchase of eco-friendly products was considered by both consumer categories as time-consuming, expensive, stressful and insufficiently accessible (Ibid., p. 242).

It becomes clear from the examples above that consumers' personal preferences and ego-centric motives play a decisive role with regard to consumer acceptance for eco-innovations in general. They can either act as key drivers or key barriers. This has been confirmed by Newman et al. (2014) who show that green enhancements in a product are not necessarily welcomed and can actually lead to a decrease in consumer interest for sustainable products. Their study - conducted among participants recruited through the Amazon platform Mechanical Turk - revealed that consumers believe in a zero-sum allocation of product attributes. They believe that when green enhancements are introduced, then quality or performance attributes for example necessarily have to suffer from it.

Luchs et al. (2010) come to a similar conclusion by introducing the concept of "sustainability liability". They used projective techniques and implicit association tests among undergraduate students in the U.S.A. and found that the sustainability aspect of green products or technologies is not systematically an asset. It can namely lead to a "sustainability liability" – i.e. some attributes that consumers usually associate with a specific product might be incompatible with the sustainability attribute. This is the case for example when strength-related attributes are involved - e.g. in the case of detergents. Consumers will perceive the sustainable alternative as less efficient because they rather tend to associate sustainable attributes with gentleness-related attributes. This negatively impacts consumer preferences for sustainable products.

In a further study conducted among 512 participants in the U.S.A. through a scenario-based behavioural experiment, Petersen and Brockhaus (2017) come to comparable conclusions. They implemented "more sustainable materials" and a "green exterior design" in both a slow-moving (headphones) and fast-moving (garbage bags) consumer good (p. 343). Regarding the product materials, they found that informing consumers about the use of recycled or bio-based plastics instead of fossil-based plastics led them to positively assess the sustainable materials and penalize the fossil-based ones. With respect to the green design, consumers perceived a loss of quality and aesthetics when implemented in the headphones, but not in the garbage bags. Marketing sustainability might thus come at a cost for specific product categories.

These findings are further in line with the main results of the literature review by Liobikiene and Bernatoniene (2017). The authors analysed 80 articles published between 2011 and 2017

on green purchase behaviour. They concluded that each product category should be analysed separately as different factors will influence consumers' purchasing decisions depending on the respective product attributes. The determinants mentioned – e.g. price, social norms, personal health, accessibility – seem to confirm that personal preferences and perceptions play a major role in consumer acceptance. This is corroborated by the survey mentioned earlier by BBMG et al. (2012).The survey shows that a majority of consumers worldwide would purchase more sustainable products provided they "performed as well as, or better than, products they usually buy", were not more expensive and "companies' health and environmental claims were more believable" (p. 6).

Are such behavioural barriers ineluctable then? Wei et al. (2018) offer a way to circumvent them. They analysed how consumers' willingness to pay more for green products could be increased. Through the use of a scenario-based experiment where participants were invited to customize an eco-friendly T-shirt, they found that by involving customers during product design and delivery, their willingness to pay increased. This also held true when consumers had low environmental concern and knowledge.

In their study on consumer attitudes towards green energy brands, Hartmann and Apaolaza-Ibáñez (2012) further suggest that putting forward environmental concern and utilitarian benefits (how consumers can contribute), as well as psychological brand benefits (how they can feel good about it) in advertising campaigns can positively affect purchase intentions.

III.2.1.2. Consumer acceptance for sustainable packaging

Consumer acceptance for sustainable packaging – i.e. packaging with a low environmental impact according to lifecycle assessments (Glavic & Lukman, 2007) – has been analysed extensively, especially in the marketing field. Rokka and Uusitalo (2008) for example tested consumer preferences for functional drinks packaging in Finland. They found that the product attributes that mattered most were an environmental packaging – labelled as such - (34% average relative importance), the product price (35%), the product's convenience of use – i.e. resealable packaging - (17%), and the product brand (15%). Rather than socio-demographic variables, product attribute preferences were better apt at revealing different consumer segments.

The importance of product attributes was further stressed in a study by Martinho et al. (2015). They compared consumers that attached importance to sustainable packaging with consumers

indifferent to it through an online survey among 215 participants in Portugal. The study revealed that the consumers for which a sustainable packaging mattered were characterized by high environmental awareness, concern about societal opinions, a positive attitude towards green purchasing and a perceived control over their actions. For both consumer segments, low prices, high product quality and functionality were the most relevant product attributes. The design of the packaging, however, independently of the type of product, was not considered central.

Regarding sustainable packaging design, Magnier and Schoormans (2015) conducted two between-subject experiments in France and the Netherlands to assess how visual appearance and verbal sustainability claims might influence consumers' purchase intention. They used two different types of products to conduct their study: laundry detergent and mixed nuts. Contrary to Martinho et al. (2015), they found that consumers did care about packaging design. Indeed, for both types of products considered, an attractive packaging design did affect purchasing intention positively. Besides, both environmentally concerned and indifferent consumers valued congruence between visual appearance and verbal claims positively. Incongruence however led to higher scepticism from indifferent consumers whereas environmentally concerned consumers were not sensitive to it.

Steenis et al. (2018) further revealed that not all types of sustainable packaging are equal. Indeed, consumers were found to value circular design strategies (e.g. using biodegradable materials) more than linear ones (e.g. reducing the amount of packaging material). They also found that combining different sustainable design strategies for the same product did not lead to a linear increase in consumers' willingness to purchase.

Finally, both Klaiman et al. (2016) and Steenis et al. (2017) show through their respective studies that consumers' perceived knowledge with respect to sustainable packaging does not necessarily match objective facts about their environmental impact. For example, in the study by Steenis et al. (2017), consumers ranked glass and bio-based packaging as more sustainable than carton whereas, in reality, the opposite is true.

Similarly, Klaiman et al. (2016) found that U.S. consumers' willingness to pay for recyclable materials was mainly based on their perception of the materials' environmental impact. Their beliefs however did not necessarily match reality.

III.2.1.3. Consumer acceptance for remanufactured products

Finally, a relevant topic for the present research is that of consumer acceptance for remanufactured products. Remanufacturing refers to a closed-loop value chain process where products at their end-of-life are disassembled, cleaned and restored to their original state to be then reintroduced on the market for resale (Abbey et al., 2015). Remanufactured products are in that sense similar to bio-based products manufactured from residues and by-products. Both types of products offer the option – where applicable – to close the loop at the end-of-life stage.

Abbey et al. (2015) found that consumers generally had negative perceptions of remanufactured products. Product quality and cleanliness were for example questioned. While offering a reasonable price discount contributed to increasing product attractiveness, using highly valued brands as a proxy for quality and reliability did not have a significant effect on consumers' perception. However, green consumers who perceived the remanufactured products as also being more sustainable found them more attractive. Van Weelden et al. (2016) came to similar conclusions by analysing consumer acceptance of refurbished phones in the Netherlands – i.e. where a company collects and restores used phones to resell them afterwards. The authors found that a lack of awareness towards refurbished products as well as poor image associations (misperceptions) led to low acceptance.

In a similar vein, Hazen et al. (2017) analysed consumers' willingness to switch to remanufactured products by looking at laptop computers. They found that consumers' attitudes towards remanufactured goods acted as a moderator on macro-level factors such as price, government incentives and environmental benefits. For example, when remanufactured products become more attractive, "consumers will view prices of new products as being increasingly unattractive, thus heightening levels of switching" (p. 460).

Finally, Hazen et al. (2012) focused on companies adopting green reverse logistics practices – i.e. reusing, remanufacturing and recycling throughout the supply chain. They concluded that companies should adopt green supply chain management practices that specifically aim at increasing consumer loyalty. Indeed, their research showed that consumer loyalty acted as a positive mediator to the relationship between consumer satisfaction and consumers' willingness to pay.

Now that academic findings on consumer acceptance for eco-innovations in general have been reviewed, articles on consumer acceptance for bio-based products are to be reviewed.

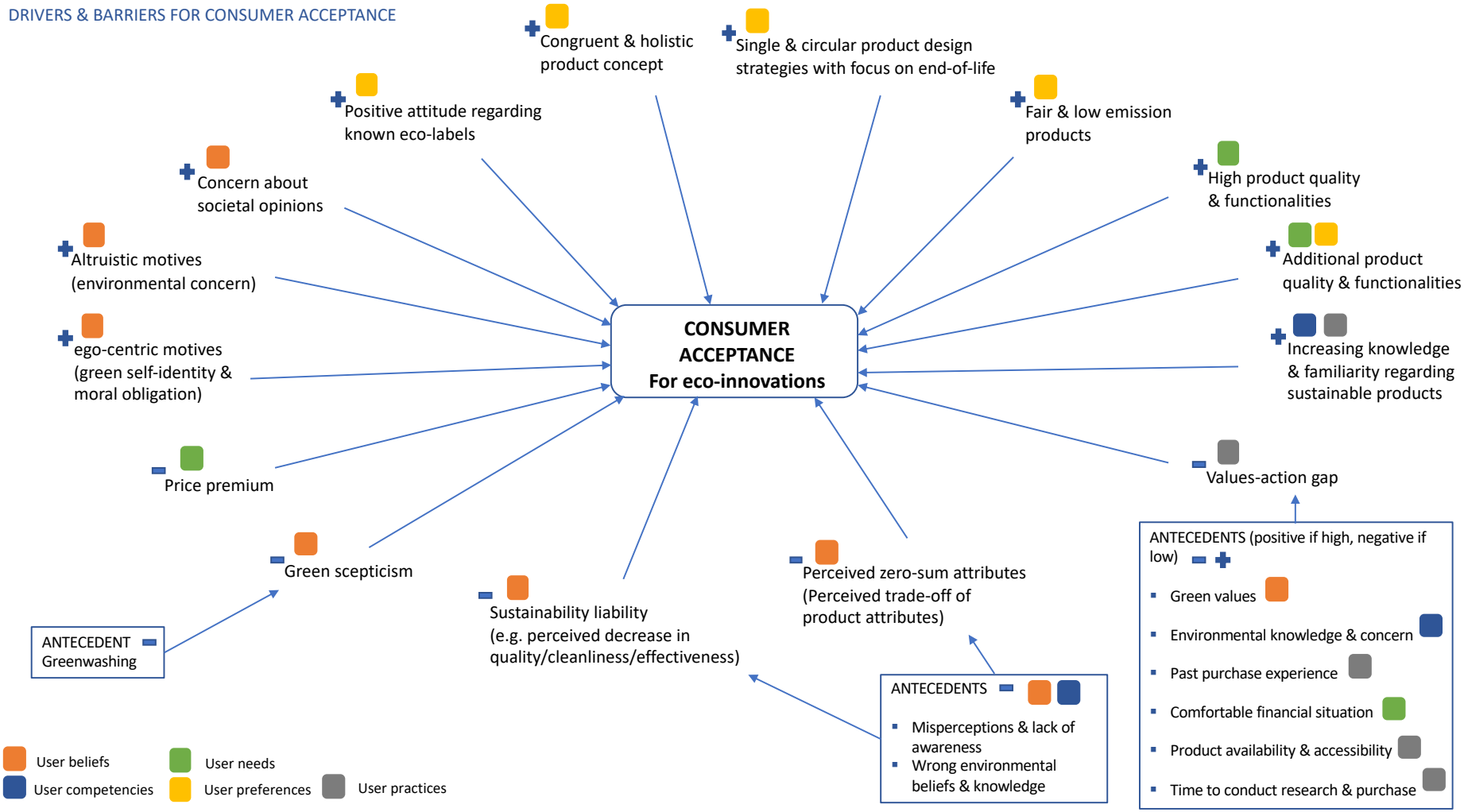

Figure 12: Drivers & barriers for consumer acceptance (academic literature on eco-innovations)

III.2.2. Consumer acceptance for bio-based products

Within this second chapter dedicated to consumer acceptance for bio-based products, a total of four sub-categories could be identified. The first sub-category corresponds to articles analysing consumer acceptance for the bio-based economy in general (III.2.2.1). The second sub-category looks at consumer acceptance for general bio-based products and technologies (III.2.2.2) whereas the third and fourth sub-categories look into bio-based plastics (III.2.2.3) and bio-based packaging (III.2.2.4) respectively.

III.2.2.1. Consumer acceptance for the bio-based economy

"Biotechnological innovations stir a range of frequently conflicting societal responses, as different groups assess risks, benefits, desirability, and necessity of new technologies in disparate ways" (De Witt et al., 2017, p. 70). Through the lens of the Integrative Worldview Framework, De Witt et al. (2017) explain how the public's perception of bio-based innovations is shaped by different competing personal worldviews. Where the modern and technology-oriented view considers the bio-based economy as a viable economic and sustainable solution to current challenges, the postmodern view underlines related scientific and social risks and criticizes the underlying commercial interests.

Stern et al. (2018) also analysed perceptions of the bio-based economy by conducting interviews among Austrian students, employees, farmers and pensioners. They found that two visions dominated: one driven by technology and industry, and a second one driven by regional environmentalism. Overall, respondents (especially students) were positive towards the bio-based economy. Farmers voiced most concerns and fears with regard to feasibility and decrease in jobs and economic growth.

In a similar way, Sleenhoff et al. (2015) attempted to unveil people's social representation and emotional views regarding the bio-based economy by using the Q methodology. They found that a social representation was lacking altogether as people were mostly unaware of the current transition. However, regarding emotional viewpoints elicited through bio-based economy-related pictures, four categories could be identified: 1) compassionate environmentalists - who want change, but also worry about potential adverse effects); 2) principled optimists - who focus on the modes of production and do not wish a bio-based economy at all costs); 3) hopeful motorists - who wish they can keep on using their cars while polluting less); and 4) cynical

environmentalists - who appreciate the idea of independence in regard to non-renewable resources, but distrust bio-economy stakeholders.

In a similar study based on the same Q methodology, Sleenhoff and Osseweijer (2016) find that the public's emotional viewpoints will also influence their perceived contribution to the bio-based economy. Indeed, the way they wish to engage does not necessarily match the expectations of bio-based economy stakeholders. The authors found for example that people who were most willing to "save the world" were also more likely to fight the development of the bio-based economy because the latter was perceived as harmful to nature.

III.2.2.2. Consumer acceptance for bio-based products & technologies

Consumer acceptance for bio-based products currently remains challenging to research and analyse. Indeed, many bio-based products and processes have not been marketed on a large scale yet (Pietzsch, 2017). This can be in part explained by a lack of level-playing field with fossil-based products and fossil fuels which benefit from much lower market prices and thereby remain more competitive (Spatial Foresight et al., 2017). Therefore, these bio-based niche products and technologies are rather unfamiliar to a majority of consumers or even viewed with suspicion - especially when innovative biotechnologies such as gene modification come into play. This is why many studies can only draw hypothetical results regarding consumer acceptance for bio-based products (Pietzsch, 2017). The lack of current awareness and familiarity among customers has been highlighted in many studies (e.g. Sijtsema et al., 2016; Lynch et al., 2017; Meeusen et al., 2015; Reinders et al., 2017; Spatial Foresight et al., 2017).

Among consumers that are aware of the bio-based concept, Sijtsema et al. (2016) found that the concept was either associated with positive perceptions such as environmental friendliness or negative perceptions such as technological and health issues. Through focus groups organized in the Czech Republic, Denmark, Germany, Italy and the Netherlands, the authors found that bio-based attributes in a product are not sufficient for consumers to be willing to purchase or use the said product. Rather, consumers want personal benefits to be fulfilled first, such as price, looks, conformity with a healthy lifestyle, convenience, etc. This was further stressed in a study by Lynch et al. (2017) focusing on Dutch citizens' perception of bio-based innovations. They found that the citizens' degree of acceptability depended on the fulfilment of or threat to their own personal interests. Both as citizens and consumers, trade-offs such as paying a (small) price premium were only deemed acceptable if a direct benefit could be

expected in return. Citizens' point of view on the bio-based economy was also at the heart of several panel discussions organised by van den Berg et al. (2013) in the Netherlands. They assembled a so-called "Microsociety" - representative of Dutch citizens - to understand their attitudes towards bio-based products and technologies from a citizen and consumer perspective. Here again, participants stressed that prices should remain the same (as those of fossil-based equivalents), brands should be trustworthy, product alternatives amply available, and the sustainability advantages clearly explained.

Where Lynch et al. (2017) and van den Berg et al. (2013) analysed consumers' acceptability, Millner et al. (2006) and Cao et al. (2014) tested actual willingness to use and to purchase bio-based products respectively. Millner et al. (2006) conducted a three-month pilot project at an employee cafeteria in the U.S.A. All polystyrene and plastic tableware were replaced by compostable bio-based ware and cafeteria employees received extensive information on the pilot project beforehand. The experiment revealed high levels of consumer acceptance towards the bio-based alternative. Cao et al. (2014) looked at consumers' willingness to purchase bio-based apparel and footwear and came to similar conclusions as Lynch et al. (2017). Wear tests and questionnaire surveys among female college students in the U.S.A. revealed that the bio-based material was appreciated as an additional attribute. However, design and style requirements needed to be met first. Besides, the participants did not show willingness to pay more for the sustainable attribute.

The willingness to pay more for bio-based products has been explored more in depth by Carus et al. (2014). They define green premiums as the additional price paid by market actors for bio-based alternatives with the same technical performance as their conventional counterparts. Their findings reveal that green premiums decrease along the supply chain with end-consumers paying the lowest price premium. Besides, reasons to pay a green premium differ according to the consumer type: while private end consumers are motivated by the emotional performance of the product – i.e. feeling that they are doing the right thing by buying the product -, B2B intermediates are motivated by the strategic performance – i.e. gaining a competitive advantage via a green brand image, diversifying their product offering or avoiding increasing oil price volatility and oil shortages in the near future.

Peuckert and Quitzow (2017) also looked at consumer acceptance for bio-based products in the B2B market specifically. By using the Delphi method, they found a high market acceptability – the antecedent to market acceptance - of bio-based products among firms. The

two main reasons for it were gaining independence from fossil sources and complying with environmental regulations. However, the authors also found key barriers such as high production costs, volatile feedstock prices and a lack of adequate regulation and incentives. Besides, the identified market drivers were not homogenous across different European countries.

Sijtsema et al. (2016) further revealed that end consumers are more likely to accept bio-based products made from 100% bio-based materials rather than partially bio-based ones. This essential aspect is corroborated by Reinders et al. (2017). Through two experimental studies conducted in six European countries, they found that only brands with 100% bio-based attributes witnessed an increase in consumers' willingness to purchase, based on consumers' brand attitude and emotions.

III.2.2.3. Consumer acceptance for bio-based plastics

The increase in plastic pollution on a global scale has led many researchers to focus on the promising alternative of bio-based plastics. The most recent and largest study so far on consumers' willingness to purchase bioplastics was conducted by Klein et al. (2019) among 1,673 German participants. The main findings were that sociodemographic characteristics such as age, gender or education had no significant impact on purchase intentions. Rather, having green consumer values, a positive attitude towards bioplastics, prior product experience and showing interest in information on the topic had the greatest influence. While the overall purchase intention among participants was only 56%, it reached 95% among those with product experience. Besides, having an innovative and altruistic mindset also played a role.

Two further studies on bioplastics also focused on German end consumers in particular (Scherer et al. 2017, 2018). In the first study (2017), the authors analysed the willingness to use and pay for bio-based sand toys among parents of two- to eight-year-old children. They found that price played the greatest role. While eco-sensitive and origin-sensitive consumers were willing to pay a limited price premium, price-sensitive and conventional plastic-preferring consumers were not willing to pay a premium. Besides. two-thirds of the respondents, who correspond to the first two categories, had high expectations towards the bio-based toys. Indeed, the bio-based content should be high and environmentally friendly, and the biomass be cultivated within Europe. In the second study, Scherer et al. (2018) again used a choice-based-conjoint analysis to look at consumer preference and willingness to pay for bio-based sporting

equipment this time. Their findings confirmed those of the first study: the material origin and a high percentage of bio-based material in the final product were key criteria. While respondents showed interest in the products, they once more accepted only a moderate price premium.

Finally, Brockhaus et al. (2016) provide an interesting perspective on the issue of consumer acceptance by focusing on specific B2B customers, i.e. product developers, and on their choice of fossil-based versus bio-based materials when designing new products for the consumer goods market. They found that albeit being intrinsically motivated to experiment with new materials and thereby achieve higher sustainability, product developers were hesitant because of uncertainty with respect to how consumers will react and fear of greenwashing allegations. In that sense, they shared the same beliefs as the general public regarding perceived risks of bio-based materials such as competition for land with food production. The authors thereby underlined behavioural challenges as a major barrier to the willingness to switch to and use bio-based plastics.

III.2.2.4. Consumer acceptance for bio-based packaging

Bio-based packaging has also been addressed within the academic literature, albeit not as extensively as bio-based plastics. Koenig-Lewis et al. (2014) for example analysed Norwegian end consumers' purchase intention with regard to a partially bio-based water bottle. Through semi-structured interviews and the use of a subsequent questionnaire, the authors found that instead of relying on a rational evaluation, participants' purchase intention was rather driven by their positive or negative emotions towards the bio-based bottle. While most reactions were positive (e.g. being proud, happy and enthusiastic), some participants showed "fear about the purity of the materials used, or worry about broader effects on food supply chains" (p. 102). The authors thereby showed that only putting forward rational benefits of bio-based products might not be sufficient – appealing to consumers' emotions was found to be essential as well.

On a broader level, Theinsathid et al. (2011) also evaluated acceptance for bio-based packaging, but from a different point of view. Instead of asking consumers directly, they conducted semi-structured interviews with lead users and experts involved in the bio-based economy (policy, technology, materials and marketing specialists). They thereby analysed the major barriers to the use of innovative anti-microbial bio-based food packaging films for the meat industry in Thailand. The main challenges were the packaging film's high price, lack of

availability and consumers' unawareness of its benefits. Further barriers according to the interviewees were missing incentives and regulation, a lack of consumer demand and a lack of collaboration among stakeholders along the value chain.

Finally, Almenar et al. (2010) indirectly tested consumer preference for bio-based packaging by asking participants to test and rate fresh blueberries in both bio-based and conventional containers. The bio-based container had the advantage of prolonging the fruit's shelf life and was also the container favoured by participants. The study thereby provides a useful indication that consumer acceptance can be high when the bio-based materials offer additional product attributes and therefore additional benefits to consumers.

To conclude this section dedicated to bio-based products, it is useful to mention the main findings from the EU Open Bio report by Meeusen et al. (2015) on market acceptance among end consumers, firms and public procurement officials in six European countries (Germany, the Netherlands, Italy, Slovenia, Denmark and Czech Republic). The results, based on qualitative focus group research and quantitative surveys, mirror well the different points identified so far throughout the review. Overall, the study found that market acceptability for bio-based products was high, albeit the high environmental expectations on the part of consumers might backlash (as also signalled by Scherer et al., 2017). As to end consumers, their lack of familiarity with bio-based products was underlined, sometimes leading to mixed or negative feelings on the topic. Second, personal benefits were found to matter most, with sustainability considered an additional positive element albeit not an essential one. Third, information about recyclability and biodegradability of product materials were highly valued. Regarding acceptance within the business-to-business market, bio-based products were considered positively and seen as a solution to gain independence from fossil fuels and resources. High production costs and a lack of appropriate regulations were found to be the most salient market barriers for B2B customers. Finally, the study found that market drivers differed across countries and product categories (as also shown by Peuckert and Quitzow, 2017).

The academic literature on consumer acceptance for bio-based products is relatively recent. This is even more true in the case of bio-based products manufactured from residues and by-products as shown in the following.

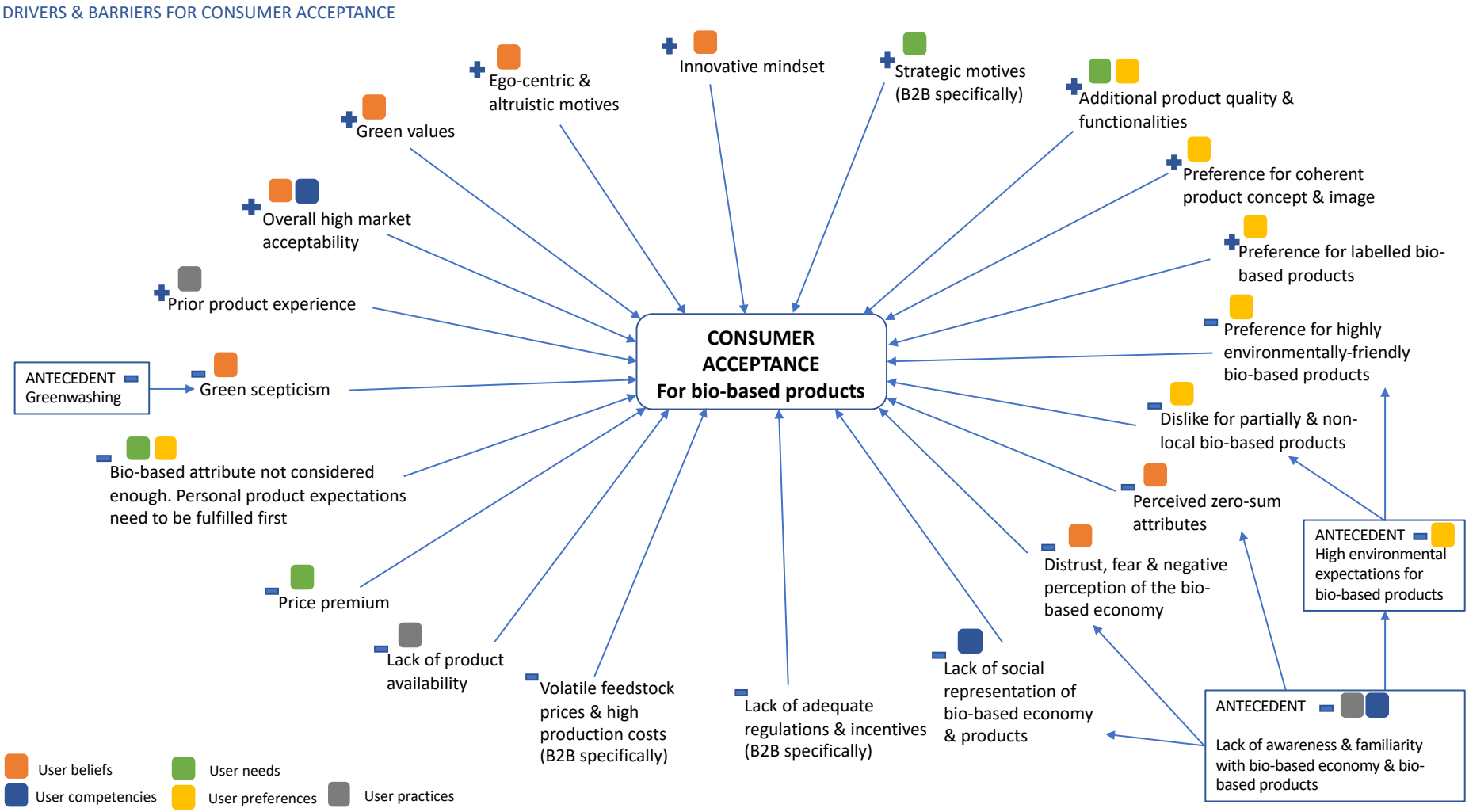

Figure 13: Drivers & barriers for consumer acceptance (academic literature on bio-based products)

III.2.3. Consumer acceptance for bio-based products from secondary biomass feedstocks

Within this third chapter, no sub-categories are provided as done previously because of the modest number of academic articles that were retained (n=6). The articles address different types of bio-based products as described more in detail in the following.

Within the still scarce academic literature on the topic, the study by Russo et al. (2019) analyses consumers' intention to purchase, pay for and switch to bio-based products manufactured from food waste. They specifically looked at UK consumers' response to a new type of biodegradable, multifunctional material produced via conversion processes of urban biowaste. Their experimental study revealed that age and past purchase experience played a role. Namely, "older consumers display[ed] higher willingness-to-pay, and those who already purchased eco-products had higher intentions to purchase and switch to bio-based products, regardless of the number of times they purchased eco-products in the past" (p. 972). Conversely, gender and perceptions of a product category's importance - from inexpensive fast-moving items to luxury ones - did not. Besides, consumers' green self-identity, defined as "an individual's overall perceived identification with the typical green consumer" (Ibid., p. 968), was found to mediate the relationship between consumers' attitude towards bio-based products and their willingness to switch, purchase and pay for these products.

In a further study, Herbes et al. (2018) analysed consumer acceptance for biomethane-based packaging in Germany, France and the U.S.A. They found that, in spite of cultural differences leading to somewhat different results, consumers focused mostly on end-of-life attributes such as biodegradability, reusability and recyclability while ignoring the environmental impact of manufacturing, transport and retail activities upstream in the value chain. For example, "having to choose between a non-biodegradable package based on renewable resources and a biodegradable package based on non-renewable (fossil-fuel) resources, a consumer will in many cases choose the latter" (p. 215). The study thereby also revealed the lack of knowledge and biased perception of the bio-based economy on the part of participants. A further observation was that some consumers perceived biomethane-based packaging as dirty and unhygienic, which corroborates the findings by Abbey et al. (2015) mentioned earlier (cf. p. 41).

In a similar vein, Yue et al. (2010) combined a hypothetical conjoint analysis and non-hypothetical experimental auctions to test U.S. consumers' willingness to pay a premium for different types of biodegradable plant containers respectively made from wheat starch, rice hull and straw – the carbon-saving options -, and conventional plastic plant pots – the carbon-intensive options. When presented with the carbon footprint of all available options, not only were participants willing to pay a premium for the carbon-saving options, but the premium increased with an increase in waste material composition of the pot. Conversely, the carbon-intensive containers were discounted, thereby echoing the findings by Trudel and Cotte (2009) mentioned earlier (cf. p. 36).

A further study by Plazzotta et al. (2018) comes to somewhat different conclusions than Herbes et al. (2018) and Yue et al. (2010). The authors analysed preferences among bread eaters in Italy for bread baked with lettuce waste flour. The use of lettuce waste flour allows to valorise food waste while also enhancing the fibre content of the bread. The findings showed that consumers did not express disgust towards the use of waste in a food product (contrary to conclusions by Herbes et al, 2018 and Abbey et al., 2015). Besides, consumers were not ready to pay a price premium. Quite on the contrary, price was the factor that affected most consumer preference (contrary to findings by Yue et al., 2010). The sustainability claim related to the valorisation of waste led to positive reactions and an increase in consumer preference. This might however be explained by a specific consumer concern regarding food waste, a topic which currently benefits from a broader media coverage than bio-based economy-related topics.

Finally, two studies adopt a different perspective by looking at consumer acceptance among a specific consumer category, namely European farmers. Scaringelli et al. (2017) analyse Italian farmers' willingness to pay for mulch films manufactured from urban and agricultural residues and which display greater strength and durability attributes than conventional plastic-based films. The conducted survey showed that 60% of interviewed farmers were willing to use the mulch films. Among those 60%, a majority had already adopted the mulching technique and used biodegradable materials in the past. The remaining 40% of non-adopters raised concerns about quality and performance. Thus, past product experience played a major role. As regards willingness to pay, among the 60% willing to adopt the mulch films, farmers already using conventional films displayed an even higher willingness to pay a price premium than farmers already using biodegradable materials. They mentioned the promise of additional strength and

durability attributes as decisive factors. Here again, as with other studies mentioned previously, when attributes deemed essential to consumers are present, the latter seem to "show […] no prejudice toward the origin of the materials" (p. 62).

Tur-Cardona et al. (2018) focused on farmers' preferences and willingness to pay for manure-based fertilizer instead of chemical fertilizer. Discrete choice experiments were conducted in seven European countries. Here also, product attributes such as nitrogen content and nutrient concentration played a major role, independently of the sustainability aspect. As bio-based fertilizers are difficult to standardize and transportation costs remain critical, these products are not trusted and the willingness to pay is negative. However, here again, farmers with a positive past experience regarding bio-fertilizers were more likely to choose them over chemical alternatives.

The extensive literature review conducted so far has allowed to gain insights into consumer acceptance for different eco-innovations and bio-based product categories. In the following, a categorization of relevant strategies to promote consumer acceptance is elaborated, thereby addressing the third research sub-question (c) (i.e. *What are current strategies to promote consumer acceptance?*). The strategies are based on the findings and recommendations of the reviewed academic articles.

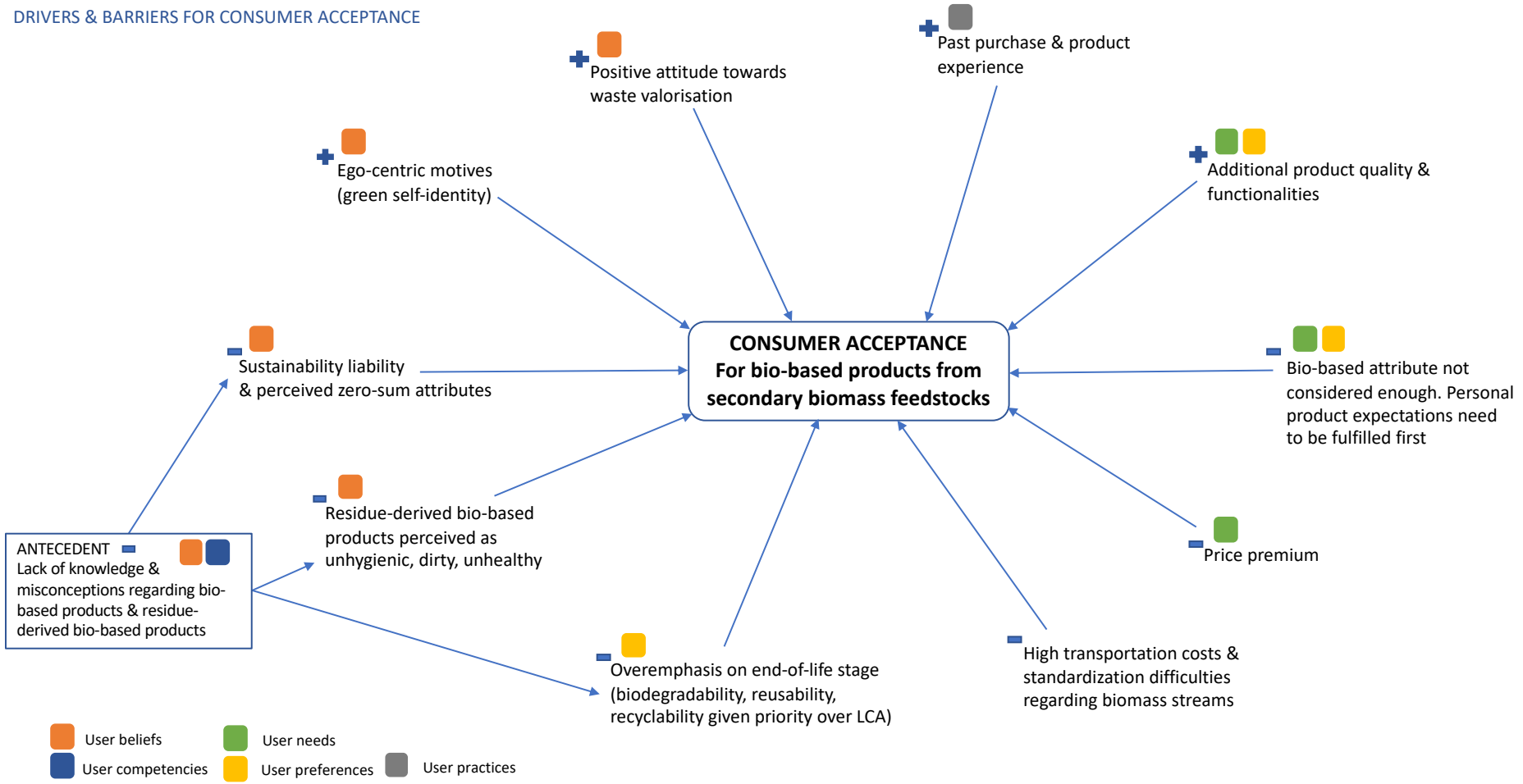

Figure 14: Drivers & barriers for consumer acceptance (academic literature on bio-based products manufactured from secondary biomass feedstocks)

III.3. Part III - Strategies for the promotion of consumer acceptance

The third part of the literature review is dedicated to strategies aimed at promoting consumer acceptance for eco-innovations in general and bio-based products in particular. In order to structure the results, strategies were first identified throughout the 65 reviewed academic articles. Then, they were analysed and grouped according to common themes. A total of ten umbrella strategies could thereby be defined: *Communication focus on products' sustainability* (III.3.1), *Communication focus on products' added value* (III.3.2), *marketing claims & channels* (III.3.3), *product design & packaging* (III.3.4), *eco-labelling & sustainability certification* (III.3.5), *consumer & early adopter involvement* (III.3.6), *user intermediaries* (III.3.7), *business model innovation* (III.3.8), *information & awareness-raising activities* (III.3.9), *government incentives and regulations* (III.3.10). Within each umbrella strategy, findings were again categorized by differentiating between strategies targeted at eco-innovations in general and at bio-based products in particular.

The umbrella strategies were defined to facilitate the analysis and interpretation of the literature review but possible overlaps between categories are not excluded. For example, strategies related to product packaging and design will overlap to a certain extent with marketing recommendations as the commercialization of a product often entails entwined approaches.

III.3.1. Communication focus on products' sustainability

Strategies for eco-innovations in general

Regarding the communication of environmental attributes, these should be tailored to each product category as general sustainability claims are insufficient (Liobikiene & Bernatoniene, 2017; Meeusen et al., 2015; Goh & Balaji, 2016; Rokka & Uusitalo, 2008; Tolionski, 2012). Companies should thereby provide "extensive, transparent and accessible information" as underlined by van Weelden et al. (2016, p. 751) in the context of refurbished products.

Furthermore, as consumers believe that sustainable products must necessarily come with trade-offs, Luchs et al. (2010) recommend providing exhaustive information not only on sustainability attributes, but also on further product attributes. This could be achieved amongst others by using explicit brand names that serve as cues for specific product qualities such as strength, performance, aesthetics, etc. The communication strategy would help counter the

issue of *sustainability liability* (Ibid., 2010) and thereby decrease perceived green risk and increase green trust among consumers (Chen & Chang, 2012).

Goh and Balaji (2016) further recommend the use of two-sided messages to increase the credibility of environmental messages and decrease the risk of greenwashing allegations – e.g. combining a positive and a negative message by promoting sustainable achievements while also pointing to remaining weaknesses.

While sustainability designs should be explicitly communicated to consumers, Steenis et al. (2018) found that communicating multiple sustainable design strategies – e.g. recyclability and reduced material usage - will not lead to an increase in consumer interest. It is thus better to focus on one strong sustainable attribute or improvement rather than communicating many.

Furthermore, the type of environmental information provided should be tailored to the targeted consumers. While highly environmentally involved consumers will be more sensitive to the company's communication on its own sustainability efforts, low environmentally involved consumers are more likely to respond to extrinsic rewards – i.e. they prefer learning about how they will have a positive impact by choosing the product at hand (Cho, 2015).

This has further been confirmed by the BBMG et al. (2012) survey looking at different consumer segments worldwide. The authors identified four distinct consumer segments with regard to sustainable consumption: “from highly committed Advocates (14%) to style and social status-seeking Aspirationals (37%), price and performance-minded Practicals (34%), and less engaged Indifferents (16%)” (p. 7). The report concluded that strategies for consumer acceptance should be tailored not only to different product categories and different countries, but also to the identified consumer segments.

Strategies for bio-based products specifically

With respect to bio-based products specifically, Reinders et al. (2017) suggest that information on bio-based content should be easily accessible and clearly communicated. Targeting environmentally conscious consumers who are more likely to purchase these products could further help promote the products in the short term, thereby possibly leading to a more widespread adoption of bio-based brands in the long term.

Finally, as underlined in many academic articles, the lack of level-playing field between bio-based and fossil-based products remains a main hurdle for the bio-based economy uptake.

Therefore, communicating about the fossil-based content of equivalent materials could contribute to emphasising the benefits of sustainable and bio-based materials. Many articles indeed show that knowledge about the negative impact of fossil-based products leads consumers to discount them and privilege more sustainable alternatives (e.g. Petersen & Brockhaus, 2017; Trudel & Cotte, 2009; Yue et al., 2010).

III.3.2. Communication focus on products' added value

Strategies for eco-innovations in general

Highlighting the sustainable or bio-based features of a product as a key quality might not always be a suitable strategy according to some academic researchers. As underlined by Newman et al. (2014), praising greater product sustainability can lead to perceived losses in product quality on the part of consumers. The authors suggest circumventing the issue by introducing the sustainability enhancements as unintended, i.e. by communicating that the aim was to improve product performance and that the product's environmental impact was thereby inadvertently improved as well. Conversely, when the sustainability benefits are inherent to the product, the authors suggest that companies will need to "go the extra mile in specifying the exact nature of the enhancement and how it came about" (p. 835) to avoid negative perceptions on the part of consumers regarding assumed trade-offs.

Steenis et al. (2017) come to the same conclusion with regard to food packaging. They warn that designing product packaging in a way that signals sustainability can be a double-edged sword as it might signal trade-offs in food quality and taste. The proposed strategy is then to promote sustainable attributes as complementary to other product attributes rather than as the main added value of the product.

Strategies for bio-based products specifically

In the case of bio-based products, some researchers advocate for not promoting the bio-based content altogether. Meeusen et al. (2015) for example advice against communicating bio-based characteristics and focusing on new product features instead to avoid the zero-sum issue on the part of consumers. Along the same lines, Sijtsema et al. (2016) question the congruity of marketing bio-based products as such – especially when products are only partially bio-based - and suggest emphasising other product features instead. A coherent product concept is thereby essential as consumers dislike inconsistencies in a product's image.

III.3.3. Marketing claims & channels

Strategies for eco-innovations in general

If one now turns to specific marketing strategies– i.e. strategies for "reaching people and turning them into customers of the product or service that the business provides" (Barone, 2019, p. 1), providing extensive and reliable product information is a central aspect for companies introducing eco-innovations. According to Hazen et al. (2017), marketing strategies should shape consumer attitudes by, for example, demonstrating a product's reliability or providing an honest and transparent "behind the curtain view" on the company (p. 461). Companies should thereby "seek to build increased consumer loyalty via adoption of green supply chain management practices. This may be accomplished by advertising the organization's commitment to sustainability and the environment" (Hazen et al., 2012, p. 429).

A specific way of advertising this commitment is through the use of social media as suggested by Barbarossa and De Pelsmacker (2016). The authors provide the example of being listed as a firm on Good Guide, an app which informs consumers about the sustainability of their chosen products. Further targeted communication tools are e-mail marketing, social media platforms such as Facebook or further mobile applications focusing specifically on the environmental impact of purchased goods.

Further, Hartmann and Apaolaza-Ibáñez (2012) suggest that advertisers should not only use rational arguments, but also appeal to consumer emotions and thereby underline psychological brand benefits. An example is provided by Tolionski (2012) who argues that socio-psychological cues should be used to appeal to consumers' self-interest. For example, instead of a verbal claim mentioning "renewable resource", a more efficient claim would be "the plastic in this package is based on easy-to-grow sugar cane instead of limited fossil fuels" (p. 17) or "efforts of people like you in recycling this package help preserve our fossil-fuel resources" (p. 19).

Luchs et al. (2010) further mention that the use of appropriate brand names can serve as a positive cue, increasing consumers' trust in the product and reinforcing their positive perceptions of specific non-sustainability related attributes such as quality and performance.

Strategies for bio-based products specifically

The relevance of combining rational marketing claims with emotional ones has also been stressed by Koenig-Lewis et al. (2014) with regard to bio-based products. Such an approach would contribute to alleviating consumers' negative emotions towards bio-based products. With bio-based packaging for example, the authors mention that "fear about the purity of materials used, or worry about broader effects on food supply chains" (p. 102) could be associated with negative emotions. They plead for these negative emotions to be actively addressed by marketers. In the same vein, Reinders et al. (2017) argue that positive emotions regarding the use of bio-based materials should be emphasized.

Conversely, Plazzotta et al. (2018) found that sustainability claims related to the valorisation of waste contributed to an increased consumer acceptance and could therefore be a viable marketing strategy. Even though their study was focused on food waste and therefore cannot be generalized to other types of secondary biomass streams, the strategy is worth mentioning.

Furthermore, appealing to consumers' green values as well as their altruistic and ego-centric motivations could increase their acceptance for bio-based products as these user characteristics were found to be relevant antecedents to consumer acceptance (Klein et al., 2019; Carus et al., 2014).

Besides, as there is still a lack of knowledge and awareness among consumers regarding bio-based products, a possible strategy according to Scherer et al. (2017, 2018) would be to increase consumers' interest in such products by conforming to their current expectations. Based on their research findings, they propose promoting firstly bio-based goods which are environmental-friendly and made from local raw materials. These two product characteristics were indeed found to be essential in the eyes of consumers. This is also the suggested strategy by Herbes et al. (2018). They underline that producers should formulate their environmental claims in accordance with customers' perceptions, for example, by marketing sustainable end-of-life solutions – another product feature that consumers highly value. However, the authors also acknowledge that, on the long term, "it would certainly be beneficial to educate consumers about the differentiated real impact of different packaging options [and bio-based products in general] so that their perceptions gradually get closer to real impact" (p. 214).

Finally, van den Berg et al. (2013) advocate a transparent marketing strategy where brands explain why they ask for a price premium and, additionally, how they position themselves

within the bio-based economy debate (with respect to the food versus fuel question, land grab practices, etc.).

III.3.4. Product design & packaging

Strategies for eco-innovations in general

Coherence and consistency in sustainability communication and marketing also apply with regard to product design and packaging. According to Magnier and Schoormans (2015), a sustainable product's visual appearance and verbal sustainability claims should be consistent. Indeed, consistency was found to increase the positive attitude towards and purchase intention of sustainable products by both high and low environmentally involved consumers.

Petersen and Brockhaus (2017) provide a more nuanced approach by advising a differentiated approach depending on the type of product. They found that for fast-moving consumer goods, consumers are positively influenced by both the use of sustainable materials and a sustainable exterior design. On the contrary, for slow-moving consumer goods, the choice of materials has a positive impact whereas a green design might actually backlash. Indeed, the latter might not necessarily satisfy consumers' design and aesthetics expectations.

Strategies for bio-based products specifically

In the case of bio-based products, identified strategies prove similar to the ones advocated for sustainable products in general. As such, Meeusen et al. (2015) suggest favouring a coherent product concept as their findings have shown that "participants do not like inconsistencies in the product image nor insecurities about quality" (p. 27).

Further, instead of focusing on a bio-based product design, the focus could rather be laid on the product innovativeness as consumers with an innovative mindset were found to be more positively inclined towards bio-based products (Klein et al., 2019; Scherer et al., 2017).

Finally, product designers are strongly advised to develop bio-based products and packaging that are recyclable and/or biodegradable as these two end-of-life characteristics are key considerations for consumers (e.g. Herbes et al., 2018; Meeusen et al. 2015). A further recommendation regarding product design is to develop 100% bio-based products instead of partially bio-based ones (Scherer et al, 2017, 2018).

A final comment which applies to both eco-innovations and bio-based products is that neither sustainable product materials nor a sustainable product design will be considered a sufficient and decisive feature when it comes to consumer acceptance. Products need to offer the qualities and functionalities that consumers usually expect from them and, ideally, offer additional qualities or features linked to their sustainable or bio-based characteristics (e.g. BBMG et al., 2012; Martinho et al., 2015; Sijtsema et al., 2016).

III.3.5. Eco-labelling & sustainability certification

Strategies for eco-innovations in general

As has been discussed previously, sustainability claims - when used appropriately - can increase consumer acceptance for eco-innovations. This is even more true when these claims are associated with an eco-label. Cho (2015) has shown that this combination had the highest impact on consumers' purchase intentions and willingness to pay a price premium for sustainable products. Eco-labels can be defined as "seals of environmental approval – awarded by public or private organisations – which provide information to consumers" (Bleda & Valente, 2009, p. 513). Eco-labels do not only signal sustainability, they can additionally point to further product benefits that matter in the eyes of consumers. For example, a study among U.S. consumers found that they were more willing to pay for refrigerators with a sustainable "ENERGY label" because of expected energy cost savings besides the environmental benefits (Ward et al., 2011). In this sense, eco-labels can be considered an efficient strategy for the promotion of consumer acceptance. However, here also, it is crucial to better understand which type of label proves most effective.

On a general level, Lupiáñez-Villanueva et al. (2018) plead for eco-labels which inform on holistic environmental footprint indicators. This means that labels should reflect more exhaustive and objective environmental impact assessments (such as lifecycle assessments) which encompass the whole value chain environmental impact rather than single point indicators. This would allow to compare products more easily and thus provide better guidance for consumers at the point-of-purchase. Similarly, Hanss and Böhm (2012) propose introducing a standardised sustainability label that covers all sustainability dimensions.

Bleda and Valente (2009) propose a different perspective by claiming that for labels to be fruitful, they should not be conceived as a binary certification system (certified versus non-certified products). Instead, they plead for the introduction of graded eco-labels which would

apply to all products indiscriminately. This would encourage mainstream consumers to increasingly turn towards green products as fossil-based products could thereby be evaluated as well and compared to more sustainable products. According to the authors, binary eco-labels are on the contrary more conducive to maintaining the status quo - where eco-niches coexist along mainstream markets, separated by a minimum threshold of eco-friendliness mirrored by the presence or not of an eco-label.

Strategies for bio-based products specifically

When it comes to bio-based products, Scherer et al. (2017) suggest that - as with eco-innovations in general - the adoption of appropriate labelling and certification schemes could greatly contribute to facilitating consumers' purchasing decisions and increase their trust. This approach is all the more promising as consumers have been found to prefer labelled bio-based products to those bearing no label (Meeusen et al., 2015).

Peuckert and Quitzow (2017) plead for the introduction of a European label for bio-based products that would inform consumers not only on the bio-based content, but also on additional environmental indicators and on the sustainability of the biomass feedstock.

Similarly, Meeusen et al. (2015) claim that when bio-based products are marketed as sustainable goods, they should bear eco-labels which inform on a comprehensive set of environmental and sustainability criteria. Besides, these labels should be adapted to each product category to inform on relevant criteria per product type.

Finally, Majer et al. (2018) introduce the idea of *meta-standard-frameworks* – i.e. the development of individual certification frameworks that would recognise each other under an umbrella meta-standard, itself based on a set of common minimum criteria. They further mention that the design of eco-labels in general should be "simplified, robust, transparent, clear and applicable even if limited data and resources are available" (p. 14).

III.3.6. Consumer & early adopter involvement

Strategies for eco-innovations in general

A further potential strategy is to actively involve consumers in the product design and development. Wei et al. (2018) found that allowing consumers to participate in the product design appealed to their sense of competence and their efficacy beliefs, especially when

consumers displayed low eco-literacy and environmental concern. Providing these consumers with an opportunity to actively contribute increased their willingness to pay for the eco-innovation. Van Weelden et al. (2016) further suggest that early adopters of eco-innovations (in their case refurbished products) could serve as brand ambassadors and thereby promote the products among consumers still unfamiliar with them. This strategy is likely to bear great potential as consumers seem willing to participate. According to the survey by BBMG et al. (2012), 67% of consumers globally would be "interested in sharing their ideas, opinions and experiences with companies to help them develop better products or create new solutions" (p. 6).

Strategies for bio-based products specifically

The involvement of consumers is also mentioned within the academic literature on bio-based products. Theinsathid et al. (2011) for example plead for producers to involve users in the development of bio-based products. This is further underlined by van den Berg et al. (2013) who claim that governments and scientific researchers should actively involve both citizens and consumers in the development of future scenarios for the bio-based economy.

On a more general level, Lynch et al. (2017) mention the Responsible Research and Innovation (RRI) concept in their study aimed at understanding Dutch citizens' perceptions on the bio-based economy. The RRI points to the importance of actively involving the general public and further societal actors in the development of new technologies and innovations to ensure that their expectations and values are accounted for.

III.3.7. User intermediaries

Strategies for eco-innovations in general

A further concept beside that of early adopters are user intermediaries. User intermediaries have been mentioned earlier in the context of the *user preferences & practices* socio-technical dimension (cf. pp. 29, 30). User intermediaries advocate the niche innovation by endorsing a broker role in-between the niche and the dominant socio-technical system. They are "peers, or user support organizations, who connect new niche technologies and practices to citizens and everyday life" (Kivimaa et al., 2019, p. 1071). In that sense, the Good Guide app mentioned by Barbarossa and De Pelsmacker (2016) – cf. p. 57 - could be an example of intermediary platform between companies and consumers.

In the context of user intermediaries for eco-innovations, the survey by BBMG et al. (2012) provides useful indications with regard to potential user intermediaries for consumers worldwide. The survey revealed that consumers in developing markets were four times more likely to trust social media channels as consumers in developed markets. Besides, for all markets considered, traditional company communications through advertisement and website were the least trusted channels as shown in the figure below.

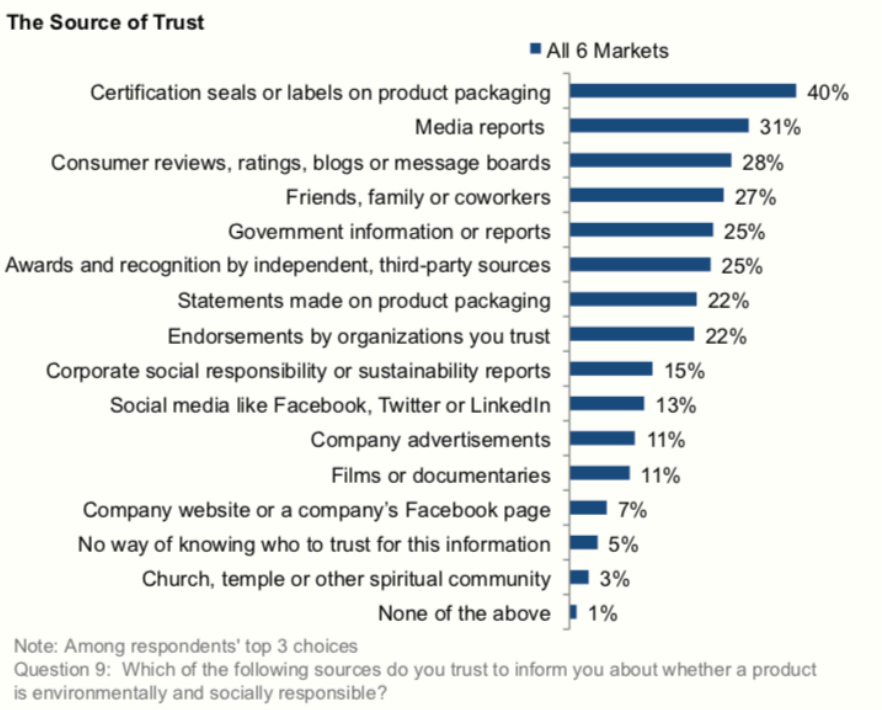

Figure 15: The source of trust (BBMG et al., 2012, p. 16)

The user intermediaries advocated within the academic literature overlap to a great extent with the most trusted sources of information identified in the survey. Goh and Balaji (2016) for example suggest for brands to rely on the support of third-party organisations that can verify and certify their environmental claims and award corresponding eco-labels. Parguel et al. (2011) also mention that sustainability ratings provided by external sources are an efficient strategy to avoid allegations of greenwashing. Partnering with such external intermediaries that enjoy a good reputation and hold credentials allows companies to show consumers that they are sincere about their environmental efforts. A further strategy is to partner with pro-environmental organizations. The co-branded partnership between Kimberly-Clark, a U.S. multinational brand producing consumer goods, and the World Wide Fund for Nature (WWF) allowed the brand to target both environmentally concerned consumers and WWF members more specifically (Vock et al., 2013).

Strategies for bio-based products specifically

The study by Meeusen et al. (2015) on consumer acceptance for bio-based products in Europe partially confirms the findings by BBMG et al. (2012) regarding relevant user intermediaries. Consumer organisations were perceived as most reliable across all countries. Non-governmental organisations (NGOs) and independent certification organisations were also highly ranked. Conversely, "television programs, newspapers, government and manufacturers were less trustworthy" (Meeusen et al., 2015, p. 28).

III.3.8. Business model innovation

Strategies for eco-innovations in general

The implementation of innovative business models to promote consumer acceptance for eco-innovations is seldomly mentioned within academic literature. Pay back guarantees (Chen & Chang, 2012) and innovative warranty options (Hazen et al., 2017; van Weelden et al., 2016) are suggested to increase consumer trust. Besides, van Weelden et al. (2016) suggest that product accessibility should be improved through both online and brick-and-mortar stores and that high-quality service should be offered as a complementary product feature.

Strategies for bio-based products specifically

With regard to bio-based products, the higher potential for product circularity (Lokesh et al., 2018) implies that there might also be an incentive for producers to recover the materials at the end-of-life stage where applicable. Where this is the case, Casajeros et al. (2018) suggest that products should be offered as a service. An example would be to return a bio-based packaging to the store and receive a voucher in exchange to purchase a new product. Along the same lines, Lokesh et al. (2018) mention the usefulness of introducing incentives and loyalty schemes for consumers to bring back their bio-based products at the end-of-life stage. The product materials could thereby be more easily recovered to be used for the manufacturing of further products. The rare examples reviewed above – both for eco-innovations and bio-based products – suggest that the use of innovative business models for increased consumer acceptance might be worth exploring further.

III.3.9. Information & awareness-raising activities

Strategies for eco-innovations in general

The lack of awareness and familiarity with respect to sustainable materials and bio-based products in particular implies that information campaigns targeted at the general public are urgently called for. All the more so because even environmentally concerned consumers may choose the least sustainable options based on (wrong) lay beliefs regarding materials' perceived sustainability (Steenis et al., 2017).

In this sense, Barbarossa and De Pelsmacker (2016) mention that programmes specifically tailored towards green and non-green consumers should be developed. These programmes should appeal to both egocentric and altruistic motivations in consumers as these were found to determine their purchase intention with regard to eco-friendly products. Similarly, Martinho et al. (2015) argue that information campaigns should be specifically developed to increase the pro-environmental behaviour in consumers who are currently indifferent to the issue. In the specific case of remanufactured products, Abbey et al. (2015) claim that educating consumers on the quality of such products would greatly contribute to offsetting existing negative perceptions.

As a concrete example, Schot et al. (2016) mention the use of digital and physical fora that could serve as platforms for consumers to discuss their experiences and share information.

The effectiveness of such outreach and awareness campaigns has been proven successful in a study by Klaiman et al. (2016). The authors demonstrated that, in the case of sustainable packaging materials, targeted information - through a video clip - positively affected consumer preferences for the eco-friendly materials and their overall willingness to pay for packaging recyclability.

Strategies for bio-based products specifically

In the case of bio-based plastics, communication and information activities are also promoted as a viable and efficient strategy (Klein et al., 2019; Theinsathid et al., 2011). Here also, there is a need to inform consumers so that their perceptions of the environmental impact of different bio-based materials gradually get closer to reality (Herbes et al., 2018).

Not only is it relevant to educate about bio-based materials and their properties, but the feasibility of a transition towards a fully-fledged bio-based economy should be underlined as well. Awareness campaigns should thereby point to the future opportunities by adopting a positive discourse and sharing possible future scenarios with citizens and consumers alike (Stern et al., 2018).

In this regard, van den Berg et al. (2013) suggest that governments have role to play. They should implement national information strategies to introduce the bio-based economy. Possible concrete measures could be to develop digital applications and information leaflets targeted at the general public. Creating an e-mail address that citizens could use as contact point to ask questions about the transition is a further possibility. Finally, the authors believe that debates should be organised throughout countries to look at the social, ethical and political implications of the transition.

On a B2B level, Brockhaus et al. (2016) argue that researchers and material suppliers should provide product developers with precise metrics and exhaustive information about the social and environmental benefits of bio-based products – bioplastics in their case. This would allow for product developers to gain confidence in these innovative materials and overcome their current hesitations and mistrust.

III.3.10. Government incentives and regulations

Strategies for eco-innovations in general

A further strategy that was identified for the promotion of consumer acceptance are government incentives and regulations. Albeit this strategy needs to be adopted by governments and can therefore not be directly leveraged by the EU researchers and frontrunner businesses who are the focus of the current research, it is a major driver that deserves to be mentioned.

Policymakers could for example punish greenwashing practices among firms by imposing penalties (Goh & Balaji, 2016).

They could further deliberately pull consumers towards sustainable products such as remanufactured goods through governmental incentives (Hazen et al., 2017). This could contribute to increasing the availability of sustainable products for consumers and thereby help reducing the "values-action gap" (Young et al., 2010) mentioned earlier (cf. p. 36). It would

further address the price premium issue by giving price-sensitive and financially weaker consumers access to more sustainable products.

Economic incentives could also be introduced to promote the adoption of eco-labels. Indeed, barriers to the widespread use of appropriate eco-labels remain as eco-labels do not necessarily translate into expected green premiums for firms. Yenipazarli (2015) found that auditing fees paid per product currently remain high and consumers' willingness to pay a premium limited. The author thereby suggests that governments should provide financial incentives to encourage firms to more widely adopt eco-labels for their products.

Besides financial incentives, sound regulatory frameworks are also crucial. Looking at the United Kingdom, Young et al. (2010) argue that there is a need for "coherent sustainable production and consumption policies across government departments, not just 'green advice'" (p. 30).

Strategies for bio-based products specifically

With respect to bio-products specifically, policymakers should develop standards for the end-of-life stage (Klein et al., 2019) to improve their circular potential. Such standards are currently missing. This also holds true with regard to bio-products manufactured from residues and by-products for which there are currently no homogeneous EU-wide waste management practices and standards (Ladu & Quitzow, 2017). Governments should also adopt environmental regulation specifically aimed at stimulating the circular economy in general (Meeusen et al., 2015).

A final strategy from a governmental perspective would be to lead by example through the prioritization of bio-based materials over fossil-based ones in the context of public procurement (Meeusen et al., 2015). This could contribute to increasing consumer access to such products and thereby lead to an increased familiarity and acceptance for bio-based products.

Part III - Conclusion

To conclude this chapter on potential strategies for consumer acceptance, it should be pointed out that, in a majority of cases, the reviewed strategies are simple suggestions by academic researchers based on their research findings. Therefore, it remains unknown in how far they would be pertinent and effective. Furthermore, some strategies have barely been researched so far and would deserve further academic attention – e.g. business model-related approaches and consumer and early adopter involvement. A summary of both empirically tested and suggested strategies is provided in the appendix (cf. Appendix B., pp. 115-117). The identified strategies were further linked to the drivers and barriers mentioned under part II to offer a visual analysis of the academic literature findings (cf. Appendix C., pp. 118-120).

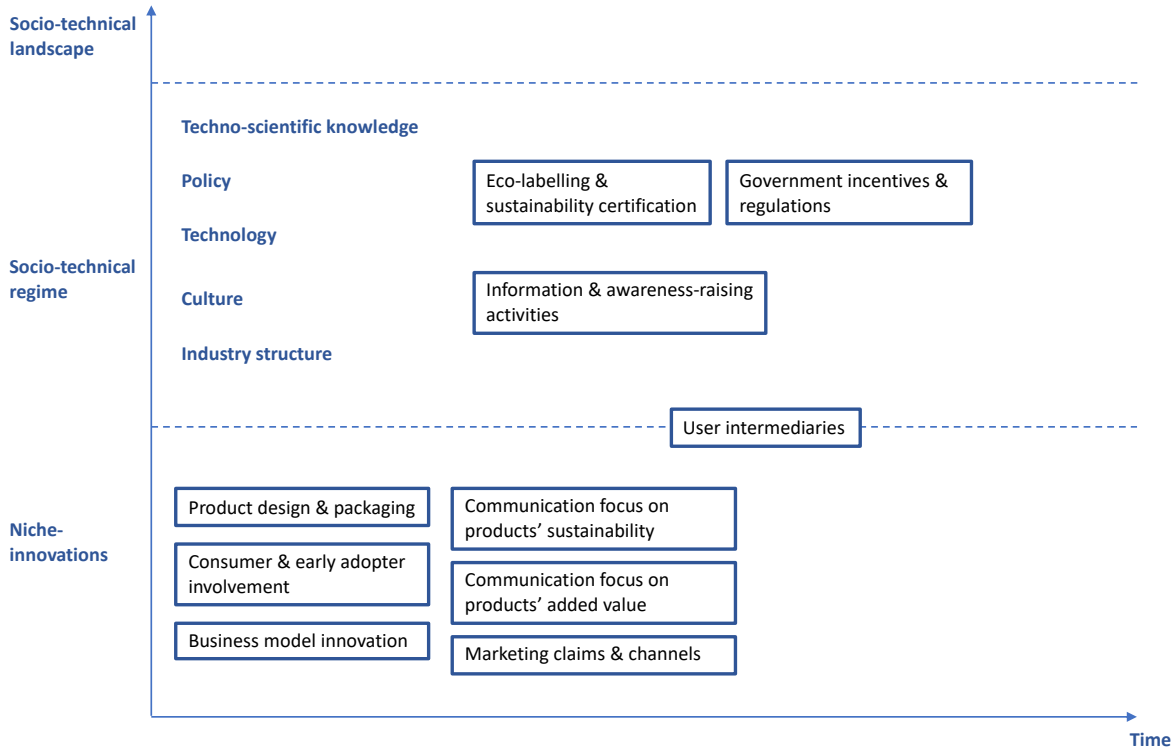

Figure 16: Ten umbrella strategies for consumer acceptance at different MLP levels

III.4. Overall literature review conclusion

A general analysis of the reviewed articles on *consumer acceptance* reveals that for all three domains considered - eco-innovations, bio-based products and bio-based products manufactured from secondary biomass feedstocks - the *willingness to purchase* and *willingness to pay for* dimensions have been researched most extensively. *Willingness to use* was seldom analysed explicitly. Instead, it was most often described as an implicit consequence of users' *willingness to purchase*. *Willingness to switch* was analysed in three articles only (cf. Appendix D., p. 121). This indicates that the dimension could be further explored within academic research. It is especially relevant for bio-based products as a scaling of the bio-based economy to ultimately replace fossil-based products implies consumers will not only have to accept buying bio-based products, but also switching to them for good on the long term.
Interestingly, there were almost no studies looking at *lead users* and *non-users*, two extremes on the adoption curve of innovations. This could be a viable research venue for the future when it comes to better understanding consumer acceptance. Besides, end-consumers (B2C) are the prevalent object of analysis in the reviewed articles. The consumer acceptance of B2B customers was rarely addressed (only 7 articles explicitly focused on B2B customers). It is also useful to mention here that many studies were conducted outside of the EU, either in the U.S.A. or in Asian countries. They were purposely included as they provide valuable data for the current research. However, applying these findings on a one-to-one basis to the European context should be considered with caution. Finally, it is also worth noting that the reviewed articles are recent. For the literature on bio-based products and bio-based products manufactured from residues and by-products, the publication timeframes range respectively from 2006 to 2019 and from 2010 to 2019. This indicates that the field of research is relatively young. It might also explain why so little literature could be found regarding consumer acceptance for bio-based products manufactured from secondary biomass feedstocks.

The current literature review further does not aim to be exhaustive. Indeed, by enlarging the review scope to eco-innovations in general, a selection had to be made and only the most pertinent articles could thereby be discussed both out of time and scope constraints.

Now that a review of the academic literature has been conducted, an empirical data collection and analysis is performed to investigate whether and how identified issues are being addressed in reality. The proposed theoretical framework for this research is depicted below.

III.5. Theoretical framework

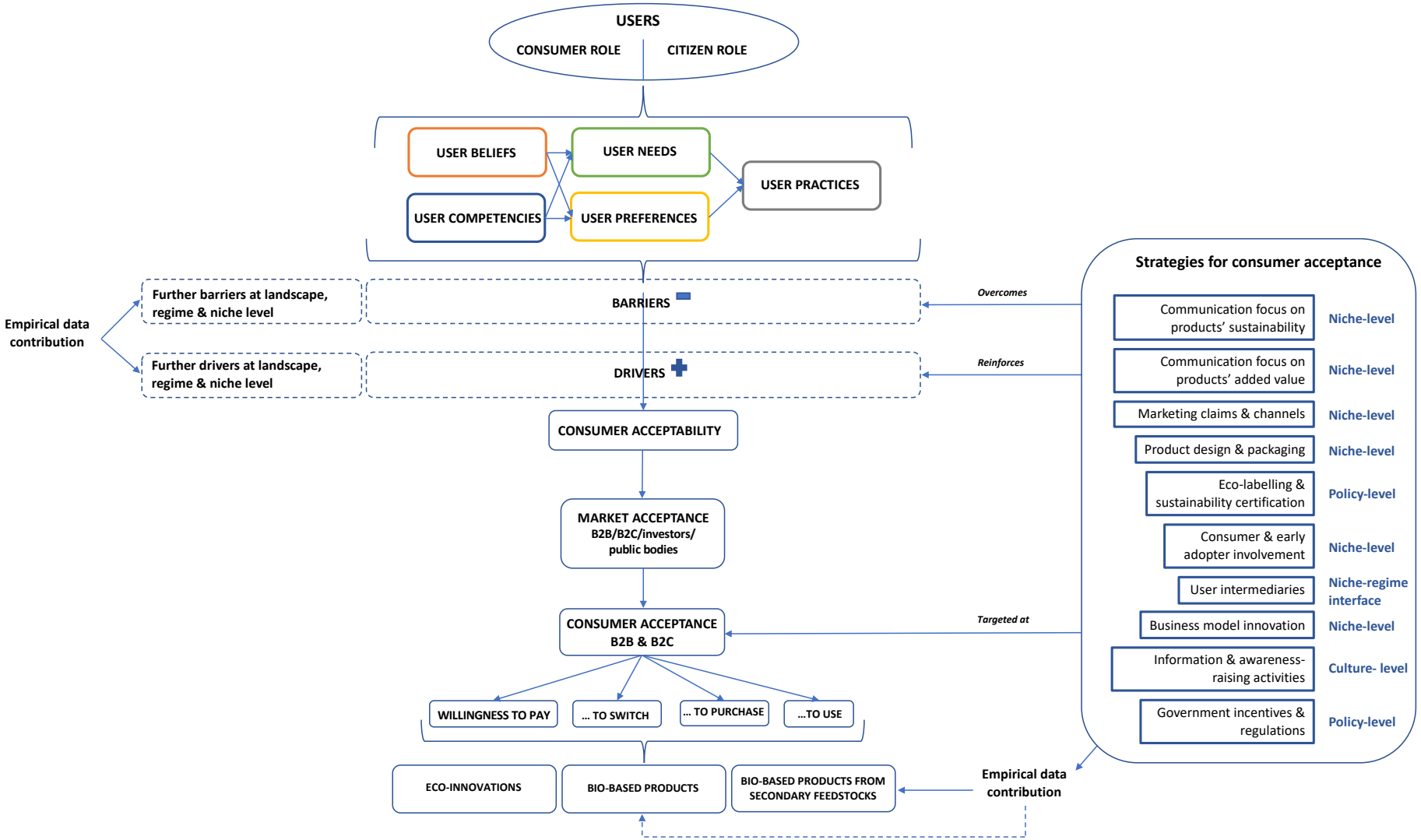

Figure 17: Theoretical framework – key concepts & empirical data contribution

IV. Research Methodology

The explorative nature of the research question calls for a qualitative inductive approach. This is the preferred method when "neither the sites and units of investigation, nor the precise objects of reasoning, circumstances and core problems are really known at the beginning of the endeavour" (Diefenbach, 2009, p. 877). The research methodology chapter consists of four sections. In the first and second sections, the empirical data collection and data analysis methods are introduced respectively. In the third and fourth sections, ethical considerations and validation of the research design are addressed.

IV.1. Empirical data collection

As the research is based on a qualitative inductive approach, semi-structured interviews were chosen to collect empirical cross-sectional data. Interviews in general are a common methodology in qualitative research where researchers are interested in "gaining insights or understandings of opinions, attitudes, experiences, processes, behaviours, or predictions" (Rowley, 2012, p. 261). In the fields of management and business studies in particular, interviewing is a common and appreciated data collection methodology (Ibid., 2012). It allows the researcher to study the "attitudes, beliefs, behaviours or experiences" of the interviewee "as a citizen, user, consumer or employee" (Ibid., p. 260). Semi-structured interviews in particular are useful for "exploring new areas or ones in which the researcher has limited knowledge" (Bryman, 2001, p. 247). The researcher can thereby rely on an interview guide which offers "flexibility in the questions asked, the extent of probing, and question order" (Rowley, 2012, p. 262). As such, semi-structured interviews can be defined as a "managed conversation" (Cachia & Millward, 2011).

For the present research, two rounds of interviews were conducted. The first round involved EU researchers and frontrunner businesses as defined in the research question (cf. pp. 20, 21). The aim of the first round was to collect insights from bio-based niche stakeholders at different product development stages regarding possible and/or implemented strategies for consumer acceptance. A second round of interviews was then conducted with EU experts working in the field of the bio-based economy. The second round was meant to gain a different perspective on the issue as well as complement the information gained in the first round. Indeed, as EU researchers and frontrunner businesses were asked about their product development and commercialisation activities, they might have withheld some information for strategic business

secrecy reasons. The second round also allowed to refine the interview questions based on the information gained in the first round and thus to explore some aspects more in depth.

IV.1.1. Stakeholder identification

The research question is focused on EU researchers and frontrunner businesses who valorise secondary biomass feedstocks for the production of bio-based products. Therefore, the first round of interviews was focused on these two specific stakeholder types.

The EU researchers were identified through the BBI JU official website. Indeed, the programme's official website (www.bbi-europe.eu) lists all the participating public-private consortia that have received funding so far. The projects were selected based on the type of valorised residues and by-products to ensure they would fall within the research scope. For each retained project, a member of the public or private consortium entity in charge of the EU project coordination was then invited for an interview.

The frontrunner businesses were identified through different channels: An initial key word Google search was conducted in different languages - (e.g. "bio-based material" / "startup" / "waste" / "residue" / "award" / "innovat*" / "company" in different combinations). Also, online information portals dedicated to the bio-based economy (e.g. biomarketinsights.com, news.bio-based.eu, allthings.bio, bioplasticsmagazine.com, bioplasticsnews.com, agro-chemistry.com) and the Cradle to Cradle certification organisation's website (c2ccertified.org) were scanned. Potential interview candidates were further identified through newspaper and academic articles as well as based on recommendations from interviewees themselves. Finally, the Bio-based Material of the Year award (bio-based-conference.com) and Sustainability awards (thesustainabilityawards.com) were also useful in identifying frontrunner businesses.

In selecting the above-mentioned stakeholders, the stage of product development and commercialization was taken into account. This allowed to analyse the stakeholders' intended and/or implemented strategies for consumer acceptance at different stages of the product innovation journey. Further selection criteria for both stakeholder types were diversity in the bio-based product categories they specialised in and variety in their country of origin to aim for a more representative picture of the bio-based niche at EU level.

In a second round, EU experts working on topics related to the bio-based economy were asked to participate. They were also identified through a desktop research based on their published

academic articles, their involvement in bio-based related projects and/or their belonging to bio-based related organisations. An example of such EU experts is the Bioökonomierat, an independent consultancy organisation mandated by the German federal government to research and advice on the bioeconomy, or NGOs with a special focus on the bio-based economy such as the WWF.

The aim was to collect a variety of perspectives and insights from different stakeholders. Indeed, "data from different interviewees referring to the same issues will provide a much broader picture" (Diefenbach, 2009, p. 883). Besides, as the research findings should be interpreted qualitatively, there is no need for quantitative representativeness. However, "the site and unit of investigation [should be] suitable" to the issue that is analysed (Ibid., p. 879).

IV.1.2. Interview guide & interview process

To conduct the interviews, two interview guides of open-ended questions (one per interview round) were drafted based on the insights gained from the literature review above (cf. Appendix E., pp. 121-124). The ten umbrella strategies used under chapter III.3 (pp. 54-68) served as a guideline to structure the interview guide and formulate the questions. A more detailed overview of the rationale behind the question formulation is provided in the appendix (cf. Appendix E, pp. 125, 126). The questions were voluntarily kept as general as possible to offer interviewees more latitude in their answers. Besides, interviewees were given the option for the interview to be held in English, German or French. The interview guides were translated accordingly. The conducted interviews were introduced by a briefing providing background information on the purpose and context of the interview. They were followed by a debriefing where interviewees could comment on the interview and ask questions (Brinkmann, 2008). Additionally, probing was used where applicable during the interviews to obtain more detailed answers and build up rapport as recommended by Ayres (2008). The interviews were conducted over the phone and audio-recorded in full. Phone interviews namely allow to include more participants in the absence of geographical barriers (Cachia & Millward, 2011). They are here the favoured option considering the geographical scope of the research. It cannot be denied that face-to-face interviews usually offer more detailed input. They allow researchers to "note characteristics of the respondents or the quality of their interaction with the respondents" (Babbie, 2016, p. 278) such as emotions, reactions, mood, gestures. However, the interviewees being spread throughout the EU, this option had to be excluded because of time and budget constraints. Besides, telephone interviews also offer methodological advantages over face-to-

face interviews. First, the researcher is less likely to affect the respondents' answers. Second, sensitive issues can be more easily addressed as "respondents will be more honest in giving socially disapproved answers if they don't have to look [the researcher] in the eye" (Babbie, 2016, p. 272). Thus, telephone interviews have the potential to avoid biased answers, but the "rapport and richness of the interaction may be lost" (Rowley, 2012, p. 265).

Out of the 43 potential interviewees that were reached out to per e-mail, 18 accepted the invitation. A total of 18 semi-structured qualitative interviews were thus conducted over a period of two months. The first round of interviews was held with EU researchers (n= 4) and EU frontrunner businesses (n= 8) while the second round was held with EU experts (n=6). The interviews' average duration was 45 minutes. While 2 interviews were held in German, all 16 remaining interviews were held in English. As to the country of origin of the interviewed stakeholders, the Netherlands (n=7) and Germany (n=5) were most represented, followed by Italy (n=2), Great Britain (n=2), Denmark (n=1) and Spain (n=1).

With respect to targeted customers and market presence of the interviewed EU researchers and frontrunner businesses, 67% of the interviewees target exclusively B2B customers while 33% target both B2B and B2C. Besides, 67% of the interviewees are present both on national and international markets while 33% are present only on their national market. Regarding the products that the interviewees develop or market, the two most represented categories are bio-based packaging and active ingredients, followed by bio-based fuels, food and beverage, and bio-based plastics (cf. Appendix F., p. 127).

By the end of the second round, insights increasingly overlapped with those from previous interviews and no novel information could be gained, pointing to a certain degree of saturation being reached. Therefore, no further interview invitations were sent out. The next step consisted in analysing the collected data.

IV.2. Data Analysis

IV.2.1. Interview transcription

To analyse the data, the interviews were transcribed into written text "exactly as given" as this allows for subsequent meaning patterns or codes to emerge (Babbie, 2016, p. 269). As many participants expressed the wish for their contribution to not be made public, all transcriptions can be found in a separate appendix (cf. Interview transcriptions). Each transcription is introduced by a brief description of the type of stakeholder interviewed, the organisation's country as well as its main activities. The interviewees' names, titles and positions are not mentioned for confidentiality reasons.

IV.2.2. Inductive qualitative content analysis method

The transcriptions were coded manually with the help of the MAXQDA software, a qualitative data analysis tool. Each transcription was thereby analysed individually. Following the approach by Gioia et al. (2012), a first order coding was performed using "informant-centric terms" (p. 18). Interview segments were coded based on an inductive qualitative content analysis. – i.e. where "coding categories are derived directly from the text data" as opposed to directed or summative approaches (Hsieh & Shannon, 2005, p. 1277). Contrary to qualitative methods such as grounded theory or phenomenology which share a similar analytical approach, conventional content analysis does not "go beyond content analysis to develop theory" (Ibid., p. 1281). This data analysis method is based on an inductive approach where an open coding is performed by reading each transcript and preliminary codes can then be modified or completed based on the remaining transcripts findings. This allows to gain "direct information from study participants without imposing preconceived categories" as opposed to a deductive approach where coding categories are predefined (Ibid., p. 1280).

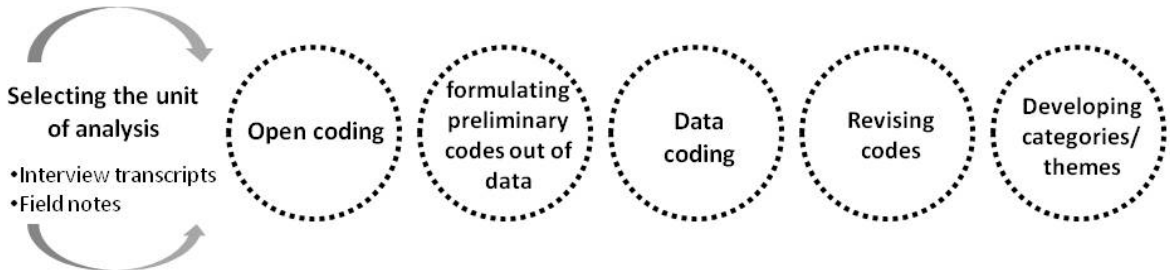

Figure 18: Procedure used in an inductive approach to qualitative content analysis (Cho & Lee, 2014, p. 11)

Inductive qualitative content analysis is particularly suited "for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (Ibid., p. 1278). The identified categories should be exhaustive and mutually exclusive (Cho & Lee, 2014). The method further allows to reduce data and thereby "requires the researcher to focus on […] those aspects that relate to the overall research question" (Schreier, 2012, p. 170).

After the first order coding was completed, a second order coding was performed and aggregate dimensions identified based on the theoretical concepts (MLP levels) and literature review findings (ten umbrella strategies) developed earlier on in the research (cf. figure below). This approach is useful to reconcile empirical insights with theoretical ones and to create a sound data structure for later analysis (Gioia et al., 2012).

Interestingly, albeit the interview guide focused on strategies rather than drivers and barriers related to consumer acceptance, the first order coding revealed a number of drivers and barriers mentioned by the interviewees, not only in terms of consumer acceptance but also more broadly linked to the bio-based economy and to the development and marketing of their own products.

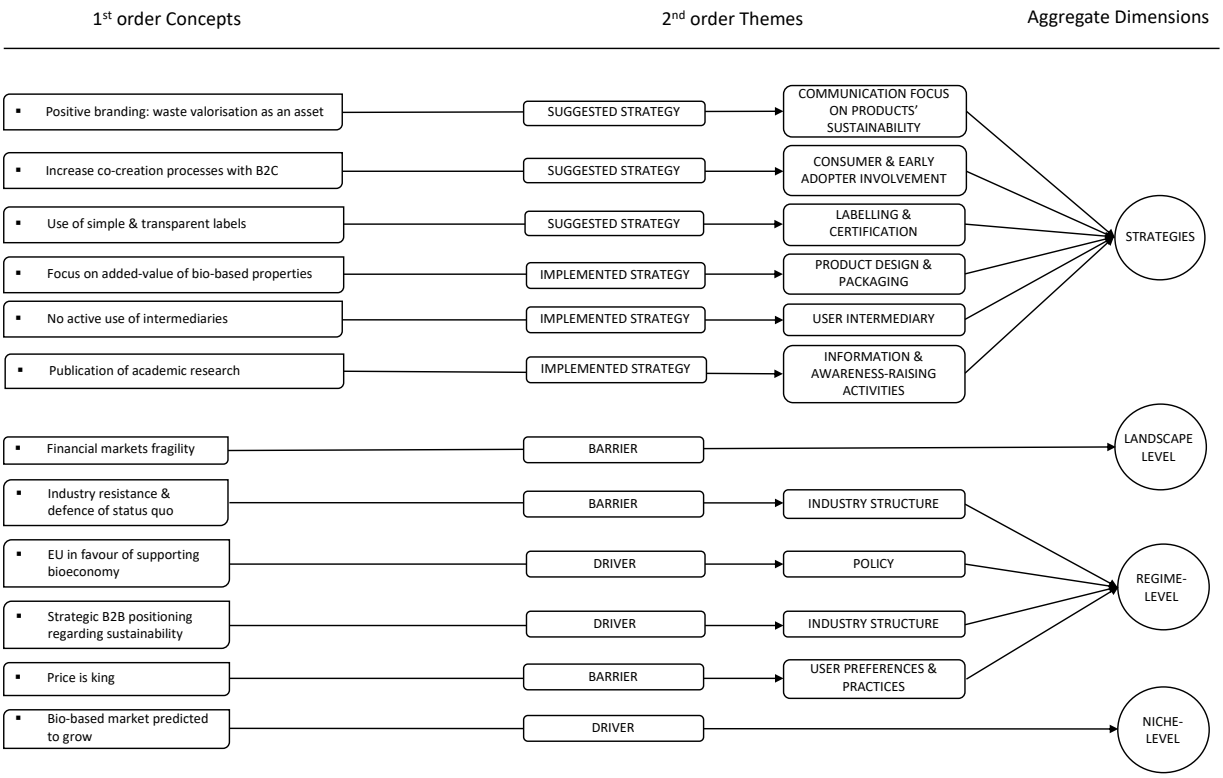

Figure 19: Coding structure (inspired from Gioia et al., 2012)

IV.3. Ethical considerations

As ethical issues need to be taken into account (Brinkmann, 2008), confidentiality and informed consent have been considered with respect to the data collection, analysis and interpretation steps. Both the e-mail invitations sent to identified stakeholders and the interview briefings explicitly informed the participants that their personal data would not be disclosed. Besides, participants were informed beforehand both per e-mail and in the interview briefing that the interview would be audio-recorded and transcribed later on. They were thereby explicitly asked for their informed consent. As many participants expressed the wish for their contribution to not be made public, the transcriptions have been compiled and handed in as a separate document to this report.

IV.4. Validation of the research design

As academic literature on research methodology advises for a pilot study to be conducted before the actual interviews (Rowley, 2012; Babbie, 2016), the questionnaires were submitted to non-participants first. This allowed for questions to be improved and possible misunderstandings and biases to be detected. The interview guides were first reviewed by three different academic researchers working in the bio-based economy field in Berlin, Germany. They were then submitted to two university undergraduates at Technical University Berlin to ensure that non-experts were also able to understand the questions and that the chosen formulations were free of biases.

In the following chapter, the empirical data collection results are presented. Barriers and drivers mentioned by the interviewees are introduced first, followed by strategies classified according to the ten umbrella strategies identified earlier on (*communication focus on products' sustainability/products' added value; marketing claims & channels; product design & packaging; eco-labelling & sustainability certification; consumer & early adopter involvement; user intermediaries; business model innovation; information & awareness-raising activities; government incentives & regulations).* These results provide further insights to answer the sub-questions (b) and (c) respectively (i.e. *What are current drivers and barriers to consumer acceptance; and what are current strategies to promote it?*). As the interview transcriptions are not included in the present document to guarantee the anonymity of interviewees, interview samples are provided for the most frequently identified drivers and barriers (cf. Appendix G., pp. 128-131) as well as strategies (cf. Appendix H., pp. 132-144).

V. Results

V.1. Identified barriers & drivers

V.1.1. Barriers

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
BARRIERS & DRIVERS			
LANDSCAPE LEVEL			
BARRIERS			
Financial markets fragility		1	
SOCIO-TECHNICAL REGIME LEVEL			
CULTURE			
BARRIERS			
PUBLIC MISPERCEPTIONS			
Public's confusion/misperceptions regarding bio-based concept	2	2	5
Public afraid of /repulsed by waste	1	1	1
Politicians' misperceptions regarding bio-based concept	2		
PUBLIC UNAWARENESS			
Public unaware/not interested in products' environmental impact		3	1
Public unaware of bio-based products	1		1
Public unaware of waste valorisation issue			1
TECHNO-SCIENTIFIC KNOWLEDGE			
BARRIERS			
Technical difficulties to reach 100% bio-based	1	2	
Replacement challenge			2
Biomass seasonality		1	
INDUSTRY STRUCTURE			
BARRIERS			
Industry resistance & defence of status quo	1	2	2
Greenwashing practices	1	1	3
INFRASTRUCTURE			
BARRIERS			
Lock-in from existing structures, networks & infrastructures		2	1
USER PRACTICES & MARKETS			
BARRIERS			
Price is king	1	5	2
B2C customers do not recognize/ understand labels		1	3
B2B incapacity to pay bio-based premium		2	
Products' expected properties & qualities have priority		1	1
Insufficient availability of bio-based products			2
B2B hesitations to promote bio-based products		1	1
Difficulty to change people's routines/habits		1	
POLICY			
BARRIERS			
Ill-adapted legislation for cascading use of biomass & residues	2	3	2
Ill-adapted waste legislation & waste management systems	1	4	2
Negative externalities not accounted for & penalized	1	3	1
Lack of adequate labels & certifications		4	
Wrong policy trajectory for sustainability			2
Legislative changes too slow		2	
Lack of material standardisation for bio-based products	1	1	
NICHE-LEVEL			
BARRIERS			
Costs incurred by innovative value chain & lack of scale		4	
Limited marketing capacities of frontrunners		3	
Slow growth of bio-based economy			3
Certification and labelling costs		1	
Dissemination as weak point in EU-funded projects	1		
Difficulty of partnership with large NGOs		1	

Table 1: Barriers at different MLP levels
(individual code occurrences counted only once per interview)

In both interview rounds, interviewees mentioned various barriers occurring at different MLP levels. As shown in the table above, users' misperceptions and misunderstanding of the bio-based concept were mentioned by all interviewee groups. Besides a lack of accurate mental representations of the bio-based concept, a lack of awareness and knowledge regarding the environmental impact of products in general and environmental labels specifically was mentioned. As one EU frontrunner business put it: "Would the end customers know what we know, then they would scream for alternatives. But they don't know. [...] I think consumers don't want to know. It's easier not to know". This lack of knowledge and awareness seems to have direct repercussions at the market level on both B2B and B2C customers' willingness to pay. Indeed, price was highlighted as a major issue by all three interviewee groups. One of the explanations for the fact that consumers will "always just be going for the cheaper product" (EU researcher) was that polluting products are being subsidized and that negative environmental and social externalities are neither being factored in nor penalized.

Besides hurdles at the cultural and market level, inappropriate policies and industry-level resistance were the most cited barriers. Among all interviewee groups, EU frontrunner businesses were the most vocal about ill-adapted legislation with regard to proper cascading of biomass and appropriate waste management systems. As pioneers in the valorisation of residues, they also mentioned a lack of adequate labels for their innovative products. The pressure at industry level to maintain a status quo and the flourishing of greenwashing practices which surf on the current sustainability wave were also denunciated. Greenwashing was mentioned as being practiced not only by manufacturers of conventional products but also by manufacturers of bio-based ones. Finally, costs incurred by EU frontrunner businesses at the niche-level were also mentioned, either with regard to marketing efforts or to the implementation of an innovative value chain as a result of residue valorisation.

V.1.2. Drivers

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
BARRIERS & DRIVERS			
LANDSCAPE LEVEL			
DRIVERS			
Increasing social pressure	1	2	1
Health scandals		1	
SOCIO-TECHNICAL REGIME LEVEL			
CULTURE			
DRIVERS			
Growing awareness of climate change & pollution issues	1	6	3
Growing awareness of health issues			1
INDUSTRY STRUCTURE			
DRIVERS			
Strategic B2B positioning regarding sustainability		1	1
Industry increasingly embraces sustainability topic			2
Financial divestments from fossil-based sectors			1
USER PRACTICES & MARKETS			
DRIVERS			
Consumers appreciate natural/plant-based/sustainable products	2	2	2
Consumers appreciate waste valorization idea		3	3
B2B demand for sustainable products	1	2	
Increasing market pressure on industry		2	1
POLICY			
DRIVERS			
Facilitating legislation		2	2
EU in favour of supporting bioeconomy	2		1
Policy makers pushing the circular economy agenda		1	
NICHE-LEVEL			
DRIVERS			
Bio-based market predicted to grow	3	4	6
Lobbying activities from niche actors		2	

Table 2: Drivers at different MLP levels

Regarding drivers, all interviewee groups underlined that they expect the bio-based economy to grow, albeit at a slower pace than currently predicted according to the interviewed EU experts. Albeit this driver was the most frequently mentioned, it is not necessarily the most significant one. Indeed, this code corresponds to the interviewees' answer to one of the interview questions specifically inquiring about the expected growth of the bio-based market and is thus not a fortuitous insight. Further frequently cited drivers are mostly linked to the *user preferences & practices* dimension. Consumers seem to increasingly appreciate both sustainable and natural products. As one EU expert explained: "there is a strong emerging link in consumers' view between environmental issues and human health issues" and "they seem to be keener towards these kinds of products whenever they see advantages for both, for the environment and for health". Consumers also seem to appreciate the waste valorisation idea. As one EU frontrunner put it, "the reception that we get is generally extremely positive". At the same time, demand for sustainable products is also on the rise among B2B customers who are making sustainability a key element of their strategic positioning on the market and feel an increased market pressure towards more sustainable products. This increased pressure from consumers on industry players is related to two major trends: 1) at the cultural level, there is a

growing awareness with regard to environmental issues and climate change which, 2) at the landscape level, translates into a worldwide social pressure – i.e. "pressure coming from grassroot movements, NGO's, researchers, citizen movements" (EU expert). Finally, regulation and policies were mentioned as relevant drivers. Especially for EU frontrunners, recently adopted legislation was considered a facilitator for their bio-based products. Two interviewees highlighted for example the EU ban on single use plastics which will boost their niche products. Indeed, one offers biodegradable disposable plates while the other specialises in biodegradable and industrially compostable bio-based foam packaging – i.e. environmentally-friendly alternatives to single use plastic solutions. Besides, the fact that the "EU is willing to support the bioeconomy" was also considered as a driver that would "translate into a positive influence on the market" (EU researcher).

Now that the main identified barriers and drivers have been reviewed, strategies for consumer acceptance implemented or suggested by the interviewees are analysed in the following.

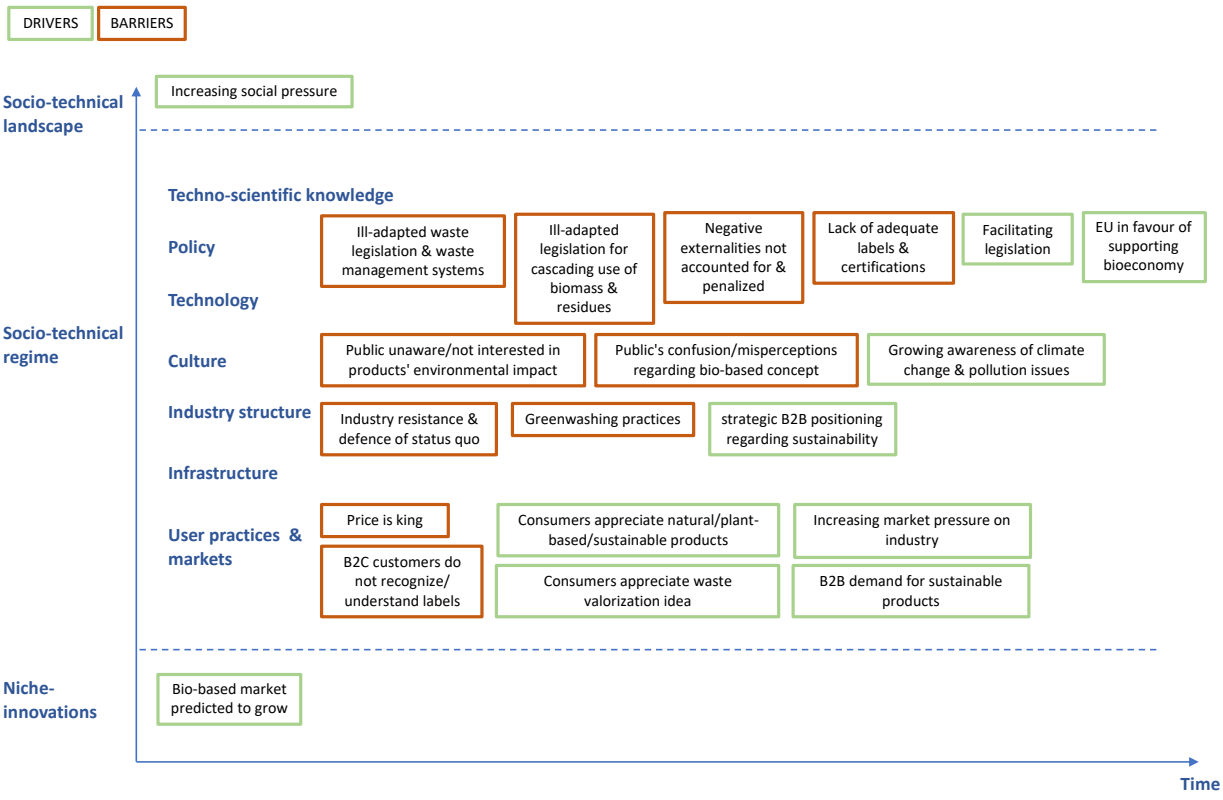

Figure 20: Top 10 empirical barriers & drivers at different MLP levels
(ranked according to code frequency & interviewee type diversity)

V.2. Identified strategies for consumer acceptance

V.2.1. Communication focus / marketing claims & channels

Implemented & suggested strategies

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
COMMUNICATION FOCUS ON PRODUCTS' SUSTAINABILITY			
IMPLEMENTED			
Communication of sustainability & environmental footprint	3	6	
Holistic & coherent communication	1	5	
Communication of bio-based content	2	3	
Communication of waste valorisation		5	
Communication of both expected & bio-based properties	1	3	
Communication of health benefits & naturalness	1		
COMMUNICATION FOCUS ON PRODUCTS' ADDED VALUE			
IMPLEMENTED			
No active communication if partially bio-based	2		
Focus on mainstream customers		2	
Communication of expected & added-value properties	1	1	

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
COMMUNICATION FOCUS ON PRODUCTS' SUSTAINABILITY			
SUGGESTED			
Positive branding: waste valorization as an asset	2	1	4
Provide accurate, easy, holistic & transparent product info	1		5
Communicate bio-based content	1		2
Communicate sustainability performance			3
Communicate on land grab issue	1		1
Communicate on all 3 sustainability pillars			1
Provide guidance on end-of-life options	1		
Communicate health benefits to B2C			1
Detailed environmental & material communication for all products			2
COMMUNICATION FOCUS ON PRODUCTS' ADDED VALUE			
SUGGESTED			
No need for bio-based content communication to B2C	1		3
Detailed B2B communication/ simple B2C communication			3

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
MARKETING CLAIMS & CHANNELS			
IMPLEMENTED			
CLAIMS			
Promotion of positive emotions & associations with waste		2	
Use of labels & logos	1	1	
Appeal to consumers' ego-centric & altruistic motives		1	
Premium marketing of bio-based product		1	
CHANNELS			
Use of media communication/press releases	1	1	
Knowledge transfer activities	1	1	
Seminars, fair & conferences	1		
Company open doors activities		1	

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
MARKETING CLAIMS & CHANNELS			
SUGGESTED			
Avoid general & vague sustainability/bio-based claims	1		3

Table 3: Identified strategies regarding the communication focus and marketing claims & channels (individual code occurrences counted only once per interview)

A striking commonality among interviewed EU frontrunner businesses was their focus on a holistic product concept that echoes their company values. For five out of eight companies, the valorisation of waste was at the heart of their business model. This is also reflected in their implemented communication and marketing strategies. A majority of EU frontrunners underlined that they provide a "behind the curtain view" on their companies. For example, they publish reports about their ethical and environmental commitments, explain the story behind their products and also provide concrete figures about the sustainability of their materials and processes. Different marketing channels were mentioned such as open-door days, knowledge transfer activities or the use of press releases. The waste valorisation aspect was further considered a main asset for consumer acceptance. Not only do consumers appreciate the idea of waste valorisation, but as one interviewee underlined, companies can actively communicate that they do not compete with the food chain. Both EU researchers and frontrunners seemed in favour of actively communicating about the sustainability of their bio-based products, the bio-based content as well as expected and value-added properties. A minority of EU researchers mentioned that the bio-based content was not necessarily communicated to end consumers when the percentage in the final product was very low – i.e. "when it's partly bio-based, we only communicate it when people ask questions about it".

The suggested strategies are very much in line with the implemented ones. Several EU experts confirmed that a detailed and transparent company communication focusing on all sustainability aspects was essential. They saw it as a precious instrument to decrease consumers' unawareness and misunderstandings with regard to bio-based products. However, for the communication to be successful, the claims should be based on evidence and justified in terms of environmental added value. As one EU researcher put it: "very diffuse environmental messages can actually harm the industry far more than not saying anything unfortunately". This comment echoes a general opinion among interviewees that, both within and outside the bio-based industry, companies should avoid greenwashing and vague sustainability statements. As a further EU researcher put it: "You have to make data available to your customers, freely available. You have to use certifications for your claims. You cannot just say this product is sustainable. Ok, sustainable…in what way? You are using bio-based feedstock. Is it from responsible sourcing, from sustainable sourcing? What is the exact percentage of the bio-based feedstock in the product?"

Furthermore, all three interviewee groups insisted on the great potential of marketing waste valorisation as an asset. As one EU researcher put it: "there is this misconception that bioplastics compete with food production. So, I think, in that case, waste sells better".

Many interviewees also insisted on the pertinence of a carefully crafted branding and marketing approach as consumers' negative perception of waste remains a barrier. An EU researcher using secondary biomass feedstocks for active ingredients mentioned that it was crucial to not use the word "waste" but indicate that "it is just another fraction […] of the plant" instead. Besides, an EU frontrunner business using spent coffee grounds as raw material said they "had to consider the language and use the word 'spent' rather than 'waste', even just for the emotional ties, the emotional associations people have with the word waste. People think it's dirty. And so, using the word 'spent' is moving away from that emotional association". The company further encouraged its customers to understand "the sustainability story around that…. extracting the remaining value…basically saying this product is not waste, there is still valuable use in this product".

A further relevant strategy mostly put forward by EU experts was to differentiate between B2B and B2C customers when communicating the bio-based content. Where B2B customers will need to know the exact material composition of the products they buy, B2C customers will care more about the added value and performance of the products. As one EU expert underlined: "in case the bio-based product is realizing…is helping to formulate, to develop a better product, it's not really necessary to say: that's because it's bio-based. It is the better product!"

Another communication criterium put forward was the percentage of bio-based content (also mentioned in the implemented strategies). When too low, B2C customers might perceive the bio-based content communication as greenwashing and the company's marketing efforts might thus backlash. As suggested by an EU expert: "I would say for B2C, you can go for a claim of bio-based content when it's over 40%".

Furthermore, most interviewees agreed that communicating on sustainability only was not sufficient. They did not advocate for promoting sustainable attributes as unintended but rather as equally important to expected and value-added product attributes.

Finally, with regard to marketing claims, two EU frontrunners stressed promoting positive emotions and mental associations with regard to waste in their marketing claims. A third appealed to consumers' ego-centric and altruistic motives: "Waste is not always a very sexy

word for it so that's why we used […] 'you are a hero because you saved 200 g of tomatoes in your soup today'. Se we made them [the claims] more actionable".

V.2.2. Product design & packaging

Implemented & suggested strategies

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
PRODUCT DESIGN & PACKAGING			
IMPLEMENTED			
Focus on added value of bio-based properties	4	3	
Focus on both expected & bio-based properties	2	4	
Optimized cascading: high-value products	4	2	
Sustainable product design	3	3	
Circular product design	1	2	
Focus on expected product properties	1	1	

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
PRODUCT DESIGN & PACKAGING			
SUGGESTED			
Focus on development of value-added bio-based products		1	3
Adapt design to each product category			1
Adapt packaging to consumers' expectations	1		
Focus on recyclability of bio-based products		1	

Table 4: Identified strategies regarding product design & packaging

Regarding the design and development of their bio-based products, EU researchers and frontrunner businesses highlighted that they used bio-based materials not only because of their potentially greater sustainability but also because of their unique properties and value-added functionalities. This insight is not surprising for EU researchers however as their product development efforts specifically aim at an optimized cascading. Indeed, the goal under the EU umbrella programme Horizon 2020 is to leverage secondary biomass feedstocks for the development of value-added products (Bio-Based Industries Consortium, 2019).

Both EU researchers and frontrunner businesses did acknowledge that developing a bio-based product for the sake of its bio-based content only was not sufficient to ensure consumer acceptance. They insisted on the need to offer products with value-added bio-based properties while also ensuring that the usual expected product qualities and functionalities were present.

A further major aspect with reference to the design of their products was to ensure an environmentally sustainable and for some interviewees even completely circular product, especially with regard to end-of-life options. As one EU researcher put it: "the project is of course looking at […] industrial compostability to […] improve the final waste management options because industrial compostability is still a better alternative or solution than landfill for example". When the final product was only partially bio-based (e.g. in the case of active

ingredients), the end-of-life aspect was less of a consideration. For fully bio-based products however, the recyclability or compostability was always given.

Among the suggested strategies, the same focus is laid on offering value-added product attributes and on ensuring the recyclability of bio-based products.

Overall, product packaging was barely mentioned by the interviewees. However, many provided an explanation for it: as they mostly targeted B2B customers, these were the ones developing packaging further down the value chain. Interviewees therefore were not able to provide much information about packaging design and materials.

Albeit not mentioned specifically in the context of product design, interviewees were further conscious about consumers' scepticism with regard to partially bio-based products and all aimed for the highest bio-based content possible where technically feasible.

V.2.3. Eco-labelling & sustainability certification

Implemented & suggested strategies

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
ECO-LABELLING & SUSTAINABILITY CERTIFICATION			
IMPLEMENTED			
PRODUCT CERTIFICATIONS			
Use of industry-related labels/standards compliance	2	5	
End-of-life certifications /compostability & biodegradability	3	4	
Toxicity assessment	1	1	
LCA assessment	3	4	
Impact assessments		1	
CSR CERTIFICATIONS			
BSCI certification		1	
B-Corporation certification		1	

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
ECO-LABELLING & SUSTAINABILITY CERTIFICATION			
SUGGESTED			
Use of simple & transparent labels			3
Introduce LCA label for all products			3
Introduce unique EU-level sustainability label for all products			1
Reliance on industry-related norms & standards	1		1
Reliance on labels to justify sustainable/bio-based claims	1		1
Introduce label for waste valorisation			1
Use of labels for virgin biomass			1

Table 5: Identified strategies regarding eco-labelling & sustainability certification

When asked about labels and certifications for their products, both EU researchers and frontrunner businesses mentioned that product-specific certifications and industry standards compliance were a priority. Not only do they stand for product conformity but as one EU researcher stated: "sometimes the customers ask for it. If you don't have a certain label, you cannot do business with them". More specifically, many interviewees mentioned end-of-life

certifications as part of their standard product labelling. As one EU frontrunner put it: “we have the whole composting labels...things like this we all do…but these are actually rather industry standards…I don’t think anybody would buy because of these labels”. Furthermore, many interviewees mentioned the implementation of lifecycle assessments (LCAs) for their products, which measure the whole value chain environmental impact rather than providing isolated indicators. For EU frontrunners, this approach seems to corroborate their claims with respect to a holistic sustainability communication and company concept. Besides, two EU frontrunners also highlighted their commitment to guaranteeing ethical and fair social conditions through the use of BSCI- and B-Corporation certifications.

If one now turns to suggested strategies, an interesting insight provided by EU experts is that implemented labels should be simple and transparent as consumers currently struggle to recognize and understand them.

A further suggestion would be to introduce a compulsory LCA label for all products – i.e. fossil-based and bio-based alike -, tailored according to each specific product category. One EU expert pushed this idea further by mentioning the necessity of introducing for all products an EU-endorsed “official [sustainability] label rather than having all these homemade labels”.

In general, interviewees agreed that labels were useful to guarantee transparency and quality to consumers but that they needed to provide a more holistic picture, especially with regard to sustainability aspects. Besides, some highlighted that such labels should apply to all products indiscriminately, not only to avoid greenwashing accusations regarding bio-based products but also to potentially “see that the same product that comes from fossil fuels impacts more” (EU expert).

V.2.4. Consumer & early adopter involvement

Implemented & suggested strategies

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
CONSUMER & EARLY ADOPTER INVOLVEMENT			
IMPLEMENTED			
DEVELOPMENT STAGE			
B2B market assessment in development stage	3	4	
B2B involvement in development stage	4		
No B2C market assessment in development stage	3		
MARKET STAGE			
No active feedback seeking	2	2	
Active feedback seeking		2	
Focus on feedback regarding functionalities		2	

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
CONSUMER & EARLY ADOPTER INVOLVEMENT			
SUGGESTED			
Increase co-creation processes with B2C			2
Priority to B2B involvement over B2C			1

Table 6: Identified strategies regarding consumer & early adopter involvement

As 67% of the interviewed EU researchers and frontrunner businesses target the B2B market, it comes as no surprise that many mentioned conducting market assessments at the B2B level rather than at the B2C level. Moreover, as members of an of EU public-private consortium operating under the BBI JU, the EU researchers necessarily collaborate with private B2B consortium partners or are themselves a private stakeholder active both in the development and commercialization of products. This also explains why EU researchers highlighted actively involving (potential future) B2B customers – i.e. their consortium partners – in the product development phase. However, some EU researchers openly admitted that, even though some of the bio-based products they developed would eventually be destined to the end-consumer market, assessing the B2C market at the development stage was "not a direct task". The B2C involvement was foreseen only at a much later stage, when prototypes would be ready for "volunteers to test [them]". The same can be said for EU frontrunners who mostly eluded the question or indicated that they did welcome feedback but had no dedicated structure in place to actively seek it. Two interviewees mentioned a lack of financial capacity as a main reason. Among those actively seeking feedback, the focus was laid primarily on the enhancement of functionalities and on tailoring products to the wishes of larger B2B customers.

Overall, results suggest that an active implementation of co-creation processes with B2C customers to ensure greater consumer acceptance was missing. However, two of the interviewed EU experts insisted on the importance of this strategy. As one of them suggested: "Develop the process together with the consumers, then technical, then consumers again, it has to be an iterative process in which they really help each other in developing a product that is accepted by the consumer […] so please, please, please, take the consumer perceptions as a starting point and don't start…because we do see it every time again…don't start with technical things first and then try to sell it".

V.2.5. User intermediaries

Implemented & suggested strategies

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
USER INTERMEDIARIES			
IMPLEMENTED			
Partnership with NGO's & Non-For-Profits		3	
Partnership with certification organisations	1	1	
Partnership with governmental bodies		1	
Partnership with research consortium members	1		
INDUSTRY PARTNERSHIPS			
Partnership with industry representation organisation		2	
Partnership with CSR company		1	
Partnership with own B2B customers		1	
Partnership with B corporations		1	
No active use of intermediaries	2	1	
Use of intermediaires in early phase only		1	

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
USER INTERMEDIARIES			
SUGGESTED			
Role of businesses		4	3
Importance of alliance among sustainable businesses		1	
Bio-based industry should speak as one voice		1	
Role of media			3
Role of legislation		1	2
ROLE OF PUBLIC FIGURES			
Role of climate activists			1
Role of celebrities		1	
Role of environmental organisations			2
Avoid NGO backlash			1
Role of researchers			1

Table 7: Identified strategies regarding user intermediaries

When asked about potential partnerships with so-called user intermediaries, interviewees provided a great variety of partners they were working with. However, no specific type of user intermediary decisively stood out. Three EU frontrunners worked hand in hand with non-profit and environmental organisations, thereby reinforcing their own credibility while also working towards increasing consumers' awareness for waste valorisation and circular economy topics.

Another EU frontrunner mentioned a close collaboration with his own B2B customers to reach the end customer: "we are too small to bring this material known to all markets. […] So, what we are doing is doing that together with our customers in the specific area where our customers are active".

Further user intermediaries were named at the industry level. Two EU frontrunners partnered with private companies sharing similarities – i.e. other B-Corporations or CSR certified companies - while two others mentioned partnering with branch-specific industry organisations that "are very well aware and have supported where they can".

Furthermore, even though partnering with certification organisations was mentioned by only one EU researcher as a strategy they could "use it in [their] communication", other interviewees indirectly indicated that they relied on certification organisms through their use of labels (cf. V.2.3, p. 86).

Finally, four further interviewees mentioned that they did not explicitly rely on user intermediaries in order to increase the visibility of their niche products. One EU frontrunner highlighted the difficulty as a niche player to collaborate with large environmental organisations that defend the vested interests of their own sponsors. Another highlighted that he had stopped promoting the sustainability of his products through third parties as his company was "actually on the way to enter more and more the mass market".

When it comes to suggested user intermediaries, both EU frontrunners and experts agreed on the key role of "big businesses" and "big retailers". As one EU frontrunner put it: "it's up to business to lead on this because consumers follow business…what business tells them to do". Indeed, some interviewees mentioned that their B2B customers - in this case large retailers – were often too hesitant to act as intermediaries on their behalf even though they supported the products. Besides, one of them highlighted that it was urgent for the bio-based industry itself to "speak with one voice".

Two further suggested intermediaries were the media - which "[could] be much more attentive in connecting problems we face in the world with the way that we consume products and with the way our products are made" (EU expert), and policymakers – who "have to set the trajectory forward" (EU expert). Finally, to a lesser extent, the role of public figures and environmental organisations were cited. One EU expert thereby mentioned that "you have to be aware of the NGOs and take them with you in the process" to avoid any backlash.

V.2.6. Business model innovation

Implemented & suggested strategies

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
BUSINESS MODEL INNOVATION			
IMPLEMENTED			
Waste valorization as core business model		5	
Innovative value chain		3	
Borrowing principle		1	
Bring one, get one		1	
Circularity as core business model		1	
Take back model		2	
Local value chain		2	
Absence of innovative business model	2	2	
Exploitation plan for B2B consortium partners	2		

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
BUSINESS MODEL INNOVATION			
SUGGESTED			
Product as a service/material ownership			1
Increased circularity of value chains			1
Increased triple bottom line integration		1	

Table 8: Identified strategies regarding business model innovation

Regarding the business models described by the interviewees, most reflected either the company's position with regard to sustainability and/or a mechanism to circumvent existing barriers at the socio-technical level. Few were directly targeted at increasing consumer trust and awareness for bio-based products.

First, albeit all interviewed stakeholders used secondary biomass feedstocks for their bio-based products, five EU frontrunners also created their whole business model around the valorisation of waste. As one underlined: "we did it because we thought it's our purpose to make a difference and we have to do that quick". Three of them mentioned having to implement a radically new value chain and logistics infrastructure to circumvent the existing lock-in at the infrastructure and legislative level. For example, a company using spent coffee grounds for the manufacturing of stove pellets entered a partnership with a coffeehouse chain to ensure the raw material would not leave the food chain and thus not be categorized as waste. A further EU frontrunner using bio-waste from food processing plants had to convince the partnering production locations to "separate the waste streams in their supply chains". A third one using grass residues from garden and park waste had to set up a new logistics route with an innovative material processing stage along the way.

Further EU frontrunners mentioned having adopted a circular business model in line with their circular products. The holistic company concept promoted by a majority of interviewees is therefore also present here through their business model. Two EU frontrunners insisted on the

importance of local value chains to ensure a sustainable product circularity. As one of them explained: “We do not export, on principle, because of the carbon emissions involved in that. However, we do operate in other countries, but we do so by brewing with a local brewery, contracting with a local brewery and taking the local bread waste in order to do that”. For two EU frontrunners, the social pillar of sustainability also played a key role in their business model. As one put it: “we focus on wasted food and wasted talents”.

The relevance of adopting business models which embrace all sustainability pillars was also mentioned among the suggested strategies.

With respect to business model innovations directly targeted at increasing consumer trust and awareness, one EU frontrunner mentioned introducing an innovative product incentive scheme. End customers can bring their own compost in exchange for a free bag of the company’s organic fertilizer. A further interviewee mentioned proposing a take back model to their B2B customers: “We take it [the material] back and we can do a number of things. We can recycle it which means that we can make small beads again from it”. The idea of offering products as a service was also part of the interviewees’ suggested strategies. However, as pointed out by some, this approach cannot apply to all types of bio-based products – e.g. biodegradable disposable tableware (the essence of which is to be disposable).

Conversely, four interviewees mentioned that developing an innovative business model for their product was not a priority. For one EU researcher, developing a business model was considered a later step in the project: “the business model, again, it will be up to the companies to decide how they want to put the product in the market”. An EU frontrunner further underlined that it was up to their B2B customers to develop innovative schemes for the end customer.

V.2.7. Information & awareness-raising activities

Implemented & suggested strategies

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
INFORMATION & AWARENESS-RAISING ACTIVITIES			
IMPLEMENTED			
RESEARCH LEVEL OUTREACH MEASURES			
Publication of academic research	2		
INDUSTRY LEVEL OUTREACH MEASURES			
Guidance on end-of-life options	1	1	
B2B information campaign	1		
Consumer awareness campaign		1	

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
INFORMATION & AWARENESS-RAISING ACTIVITIES			
SUGGESTED			
Communication activities as crucial strategy	1	3	2
CONTENT			
Communicate consumption decrease as priority			3
Keep critical view on bio-based economy		1	1
Associate bio-based economy with dematerialization			1
MEDIUM			
Governmental outreach programmes			1
Introduce sustainability curriculum in schools & universities			1
Use of mobile applications			1

Table 9: Identified strategies regarding information & awareness-raising activities

Overall, all interviewees agreed that the lack of consumer awareness and knowledge with regard to bio-based products constituted a major hurdle and that information campaigns were therefore urgently called for. They acknowledged their usefulness in promoting consumer acceptance for more sustainable products. As one EU researcher highlighted: “communication is very important. It should be education and public perception”.

Among the information strategies implemented by interviewees, EU researchers mentioned their own scientific publications and reports, not only “in scientific journals but also in broader journals accessible to the general public”. Further interviewees mentioned outreach measures at the industry level - i.e. providing general guidance on end-of-life options for bio-based products, detailed product information and awareness-raising campaigns regarding waste sorting specifically targeted at B2C customers.

As to suggested strategies, all interview groups confirmed that communication on the bio-based economy and sustainability was essential. Be it through governmental programs, school education or the use of digital applications, “people will have to read, and people will have to learn” as one EU frontrunner underlined.

However, interviewees also provided a more nuanced approach when it comes to promoting the bio-based economy. Three EU experts warned that awareness programs should first and foremost sensitize the public to the issue of overconsumption. As one of them explained: “we also have to reduce the amount of things that we are consuming. This is the first thing that we need to do. This is the first thing we need to communicate to consumers of tomorrow”. Furthermore, two interviewees questioned whether the bio-based economy should be pushed at all costs. As such, sustainability should be communicated on a holistic level and not exclusively through the bio-based lens. As one EU expert underlined: “there are different ways [……] Bio-based is just one of several”.

V.2.8. Government incentives & regulations

Implemented & suggested strategies

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
GOVERNMENT INCENTIVES & REGULATIONS			
IMPLEMENTED			
Supportive legislation as facilitator	1	2	

Code System	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
STRATEGIES			
GOVERNMENT INCENTIVES & REGULATIONS			
SUGGESTED			
Regulation as key strategy		2	2
FOCUS ON SUSTAINABILITY			
Promotion of sustainable goals	1		3
Penalize polluting & non-renewable products/pay the true price	1	3	2
CO2 tax			1
Introduce residual value for all products			1
Tax rebates for companies meeting triple bottom line		1	
Promotion of circular & cascading use of materials	1		2
Extended producer responsability			1
FOCUS ON BIO-BASED			
Importance of adequate end-of-life legislation		2	3
Importance of adequate legislation for bio-based products	2	2	
Promote bio-based products through incentives		1	2
Public procurement as accelerator			2

Table 10: Identified strategies regarding government incentives & regulations

A majority of interviewees highlighted the key role of policymakers in adopting appropriate legislation and removing existing regulatory hurdles. As clearly visible in the code tables above, suggestions were many whereas implemented facilitating legislation was rather the exception. Some interviewees did mention indeed that, both at national and EU level, supportive legislation was on its way, facilitating the penetration of bio-based products on the market. As one EU frontrunner described: "we also did have difficulties at the beginning to sell the product but now that there is also regulation coming that also supports this…that is good for us". However, especially EU frontrunners and experts underlined that current policies were ill-adapted and that "the ball [was] in the field of politics" when it comes to changing the current status quo and allowing for more sustainable alternatives to flourish on the market. Discussing the lock-in by dominant corporate interests, an EU frontrunner underlined: "I think the main point is really regulation. They only change because of regulation. They will never change a running system in which they are positioned very well".

Two main patterns emerged from the interviews:

First, the need for governments to have overall sustainable goals in mind when drafting legislation, e.g. by promoting sustainable bio-based products as one among several sustainability strategies. As one EU expert pointed out: "I would be reluctant in rules or laws,

directives to use a certain amount of bio-based. The government should aim to have less energy use, less climate change", thereby implying that the overall sustainability score of a bio-based product should be given priority over the exact percentage of its bio-based content. One of the most cited tools to do so was to penalize polluting and non-renewable products to allow for the true cost of goods to become visible to consumers. As summarized by one EU frontrunner: "at the end of the day, we have to provide consumers with honest choices" with regard to both conventional and bio-based products.

Second, interviewees agreed on the urgent need to update and improve EU-wide legislation on end-of-life options but also on the cascading use of biomass In this context, they also pleaded for adequate legislation regarding their innovative bio-based products and the usefulness of incentives to give them the necessary first push on a market characterized by a lack of level-playing field. As mentioned by an EU researcher: "If you have a regulatory framework for these kinds of products made out of bio-based feedstocks, automatically you will have a stronger presence in the market".

Finally, two interviewees highlighted the role of public procurement in increasing the presence of bio-based products on the market. By privileging such products in the purchase of goods for public procurement projects, their market availability increases, and they thus gain in legitimacy and visibility in the eyes of consumers. "Governments have a responsibility. They can send market signals through public procurement." (EU expert).

Now that the empirical data collection results have been analysed for each umbrella strategy, results are discussed in the light of the literature review insights and final recommendations are made.

VI. Discussion

From a Strategic Niche Management perspective, unveiling the barriers and drivers to the development of a specific technology is a necessary step before strategies can be developed to respectively overcome and reinforce them (Kemp et al., 1998). The literature review conducted here revealed a number of barriers and drivers to consumer acceptance for eco-innovations, bio-based products, and bio-based products manufactured from secondary biomass feedstocks in particular. The empirical data gained through semi- structured interviews confirmed the majority of them, and unveiled additional ones at the niche, regime- and landscape-level. It thereby expanded the literature review insights further.

Regarding barriers and drivers at the niche level, the EU's support of the bioeconomy represents a major driver, especially at the product development stage. EU researchers currently benefit from "protected spaces" where "protection can be afforded through subsidised projects for research demonstration and learning" (Smith et al., 2010, p. 440). The BBI JU project –a public-private partnership - is an example of such an endeavour to create a protected space as articulated within SNM literature. At the same time however, EU researchers face technical difficulties and shortcomings with regard to the dissemination of their work among consumers. As to EU frontrunner businesses, while they benefit from an increased demand for sustainable products from both B2B and B2C customers, they still face major resistance at different MLP levels, from cultural misconceptions with regard to bio-based products to mainstream market players' resistance and ill-adapted or lacking legislation.

When it comes to barriers beyond the niche, the research results indicate that, at the user level, consumers have little knowledge and understanding of bio-based products and their related labels. The bio-based concept itself seems to be met with a certain degree of confusion and misconceptions. On a cultural level, the bio-based economy is not part of a social imaginary yet. As Sleenhoff et al. (2015) highlighted, consumers remain unaware of the bio-based transition because they don't have a mental representation of it. However, a perceived sustainability liability (Luchs et al., 2010) or perceived zero-sum attributes with regard to bio-based products and sustainable products in general (Steenis et al., 2017; Newman et al. 2014; Petersen & Brockhaus, 2017) could not be confirmed as interviewees made no allusion to it. The lack of familiarity with bio-based alternatives is reinforced by a lack of adequate labels and certifications at the policy level, the prevalent opacity with regard to the environmental impact of equivalent fossil-based products at the market level, and the flourishing of greenwashing

practices at the industry level. Consumers' uncertainty combined with the abundant availability of cheap conventional alternatives implies that there is no willingness to privilege bio-based products over others and thus to pay a potential premium. Furthermore, there are considerable regulatory hurdles with regard to an adequate cascading use of biomass and to end-of-life options. More specifically, there is an urgent need to revise the waste status of materials and end-of-waste specifications – i.e. "when waste ceases to be waste" (Ladu & Clavell, 2019, p. 23). These regulatory hurdles currently limit the market availability of bio-based products, especially those manufactured from secondary biomass feedstocks. This is problematic as prior product experience greatly facilitate consumers' willingness to purchase (Klein et al., 2019). The values-action gap amongst consumers as put forward by Young et al. (2010) thus remains large.

If one now turns to drivers beyond the niche, pressure at the landscape level is likely to increase in the future. With the multiplication of extreme climate events, the growing volatility of financial markets and social movements gaining momentum worldwide, windows of opportunity are opening up. This is reinforced by current trends at the regime level: consumers' interest for more sustainable and healthier products is steadily increasing at the market level; B2B customers are strategically re-positioning themselves to reduce their dependence from fossil-based resources at the industry level, and governments are timidly stepping in to facilitate the transition at the policy level.

In the light of these barriers and drivers, different strategies are needed at the niche level. These need to be complemented and reinforced by additional strategies at other MLP levels. In the following, strategies are discussed all along the product value chain, starting from the product development stage to its commercialization. Some will be more relevant to EU researchers or frontrunner businesses while others will be useful to both types of niche stakeholders.

With regard to the design and development of bio-based products, insights from the academic literature review and empirical data collection overlap. In the early product development stages, EU researchers should develop products which combine expected product attributes with value-added bio-based qualities (Martinho et al., 2015; Sijtsema et al., 2016). Besides, providing sustainable end-of-life options for their products (Herbes et al., 2018; Meeusen et al., 2015) and aiming for the highest possible bio-based content (Scherer et al., 2017, 2018) is recommended. As the empirical data did not provide any conclusive insights with regard to packaging designs or materials, further research is needed here to verify whether an attractive and sustainable

packaging design is indeed likely to positively affect consumers' purchasing intentions (e.g. Magnier & Schoormans, 2015) and to determine what sustainable design strategies can be most effective (e.g. Steenis et al., 2018).

A further strategy at the product development stage is to actively involve the end users of the product through co-creation processes. The findings suggest that EU researchers involve consumers late in the product development process – namely when testing their products. This approach seems to be still embedded in a traditional technology-push philosophy where users' feedback is only asked for after the pilot phase or product launch. However, as "users increasingly seek out those products […] that fit their personal and situational needs", adopting a user-driven approach to product design and development might be a better strategy (De Moor et al., 2010, pp. 51, 52). Moreover, research on sustainable products has shown that involving consumers much earlier on could increase their willingness to pay for these products later on (Wei et al., 2018). On top of that, consumers themselves are very willing to share their ideas with companies when it comes to sustainable product design (BBMG et al., 2012). Involving consumers and in particular early adopters – i.e. users with an innovative mindset who are likely to show greater receptivity to bio-based products (Klein et al., 2019) – is thus relevant at all product development stages. This could be done for example through iterative prototyping workshops or brainstorming sessions where learning processes and feedback loops can flourish. A "continuous and adequate involvement of the user" (De Moor et al., 2010, p. 54) also applies to EU frontrunners further down the value chain. They could do more than merely collecting sporadic feedback from their customers as seems to be currently the case. Here also, developing dedicated communication channels and formats for feedback could contribute to improving bio-based products while raising awareness and interest among consumers. Such co-creation processes are further in line with the learning and experimenting philosophy at the heart of Strategic Niche Management (Loorbach & van Raak, 2006).

Besides co-creation processes, EU researchers could also find ways to communicate on their work and on the advantages of bio-based products and thereby engage more directly with the broader public. To some extent, the scientific community within the EU has started developing such awareness-raising initiatives as advocated amongst others by Schot et al., (2016), Klaiman et al. (2016) and Herbes et al. (2018). The Bioways project has launched an e-library for bio-based research and projects and uses gamification to sensitize EU citizens (e.g. the Bio Challenge, an online quiz on bio-based products). The AllThings.Bio project is a further

example where playful infotainment videos are posted online. It could be worthwhile however to go beyond passive information and explore gamification techniques even further. Furthermore, digital and physical fora could be created where discussions between scientists and citizens can take place (Schot et al., 2016). This also holds true at other MLP levels. Educational curricula and governmental programmes could bring citizens to reflect and learn more on current consumption patterns and more sustainable alternatives; especially against the background of a possible rebound effect with regard to bio-based alternatives. A gain in eco-efficiency might indeed be counterbalanced by an increase in consumption (Urban et al., 2018). Consumers thus need to be informed on all aspects of sustainability. For EU frontrunner businesses further down in the value chain, raising awareness is especially relevant when it comes to shedding light on the advantages of valorising secondary biomass feedstocks and no longer considering it waste. In that regard, one EU frontrunner business mentioned for example partnering with an association called "Samen tegen Voedselverspilling" (Together against food waste) and thereby informing its customers on wider topics than only the qualities and attributes of its own products.

For EU frontrunners in particular, the research results clearly indicate that a well-designed and honest communication strategy plays a key role in promoting consumer acceptance for their products. Albeit academic research remains scarce on the pros and cons of putting the valorisation of residues and by-products in the limelight, all interviewee groups agreed that a positive branding of waste could contribute to promoting bio-based products. As some consumers are concerned with possible land grab issues when it comes to bio-based goods, positioning oneself clearly with regard to a sustainable use of biomass could indeed be the way forward as advocated by van den Berg et al. (2013). This being said, focusing a company's communication on sustainability only is likely to be insufficient. As expected product properties are of paramount importance, sustainability attributes are best communicated as complementary (Steenis et al., 2017) or equally important to expected and value-added product attributes. The bio-based content of products also plays a decisive role here. Indeed, as pointed out by some interviewees and also mentioned in the academic literature (Meeusen et al., 2015; Sijtsema et al., 2016), when products are only partially bio-based, the focus should be less on the sustainability attributes of the bio-based content but rather on its added value in terms of product properties. The empirical data results further confirmed the relevance of a holistic, detailed and transparent company communication (van Weelden et al., 2016; Reinders et al., 2017). The need for a tailored communication per customer segment and product category as mentioned

by Cho (2015) and BBMG et al. (2012) was not brought to the fore in the interviews. Nevertheless, two EU frontrunner businesses did indicate that they changed their communication strategy when attempting to reach new customer segments. They intentionally moved away from a sustainability-oriented discourse to focus more on added value and uniqueness of their products to reach mainstream consumers more easily. In that sense, they confirm the recommendations by Newman et al. (2014) and Steenis et al. (2017) but not with the same finality in mind. Where the latter wish to circumvent the sustainability liability issue, the EU frontrunners' objective is to broaden their customer base.

As to marketing claims and channels, they need to be differentiated depending on whether the targeted customers are B2B or B2C. For B2B customers higher up in the product value chain, detailed information on products' qualities is essential. This is where knowledge transfer activities, technical reports and professional fairs can be particularly useful to EU researchers. To reach end customers at the end of the value chain however, using emotional and actionable marketing claims seems to be the way forward. Two EU frontrunners mentioned eliciting positive emotions in consumers with regard to waste valorisation through their marketing claims as also suggested by Hartmann and Apaolaza-Ibáñez (2012) and Koenig-Lewis et al. (2014). A third mentioned using actionable claims to give consumers the feeling they could make a change through their purchasing choice – a strategy successfully tested by Tolionski (2012). Overall, results regarding market strategies are rather inconclusive as the latter were not discussed in depth by interviewees and thereby leave room for debate.

A further area where results were meagre and therefore no compelling evidence can be provided concerns business model innovation. Some EU frontrunner businesses opted for a holistic circular and sustainable concept where the sustainability of their business model aligns with that of their product. To a certain extent, the chosen business model thus increases their legitimacy and promotes trust among consumers. For a majority of interviewees however, the chosen business model for their product was not designed with an explicit purpose to elicit increased consumer acceptance. Only one EU frontrunner mentioned introducing an incentive scheme directly targeted at B2C customers as put forward by Lokesh et al. (2018). Especially EU researchers upstream in the value chain did not consider business model innovation as a complementary building block to their product. However, in the specific context of bio-based products, there is a high potential for circularity (Lokesh et al., 2018). Therefore, business models where products are offered as a service (Casajeros et al., 2018; Lokesh et al., 2018)

deserve greater attention from the early product development stages onwards. Indeed, this would allow for materials to be retrieved later on - provided this makes sense for the product category considered. Such innovative business models would send a powerful signal to consumers that a different way of doing business and conceiving products is feasible. At the moment, research efforts in the context of BBI JU-financed projects seem to be mostly directed at replacing fossil-based products with more sustainable bio-based ones. The transition path behind it seems to follow a *fit and conform* logic rather than a *stretch and transform* one (Smith & Raven, 2012). Reflecting on the business model that accompanies innovative products comes down to reflecting on the type of transition bio-based stakeholders wish to follow. Will they opt for a transition where the niche innovation becomes competitive within "a relatively unchanged selection environment" - *fit and conform* - or one where "the niche is empowered by enabling it to change its selection environment rather than be subordinated by it" - *stretch and transform* (Ibid., p. 1030)? Albeit inconclusive results, business model innovation should not be neglected as "the same technology commercialized in two different ways will yield two different returns" (Chesbrough, 2010, p. 354). Business model innovation could be a powerful ally in *stretch and transform* efforts by bringing about changes in user practices.

Regarding the use of labels and certifications, the research results offer compelling evidence that they are a powerful marketing and legitimatization tool for bio-based products. From the product design to the commercialization stage, labels and certifications are useful to both EU researchers and frontrunner businesses by signalling specific product properties and qualities to both B2B and B2C customers. Labels are especially relevant in the context of a communication strategy where sustainable bio-based attributes are put forward. Indeed, certifications and labels on product packaging rank first as a source of trust among consumers when it comes to evaluating the environmental and social sustainability of products (BBMG et al., 2012). Both the empirical data and literature review results highlight the importance of holistic labels that reflect the impact of a product from an LCA perspective (Lupiáñez-Villanueva et al., 2018; Hanns & Böhm, 2012). An even more important insight in that regard is the role legislation could play in introducing compulsory eco-labels for all products. The idea of a graded eco-label (Bleda & Valente, 2009) which would be tailored to the specifics of different product categories and apply to all products within each category is a promising concept. In the case of bio-based products, the label could mention the origin and sustainability of biomass feedstocks to ensure greater transparency (Peuckert and Quitzow; 2017). The

research results also point to the importance of aiming for mandatory sustainability requirements that target all sustainability aspects, - i.e. economic, social and environmental.

Policy intervention is a crucial strategy that goes beyond introducing adequate product certification – and financially supporting their adoption among market players (Yenipazarli, 2015). A regime push needs to apply at all stages of the product value chain if the bio-based niche is to successfully scale. As the current infrastructure with regard to logistical routes and waste management systems is inadequate for a proper valorisation of secondary biomass feedstocks, innovative legislation on end-of-life options and a cascading use of materials is required. Both interviewees and academic research agree on the need for revised legislation coupled with regulatory incentives (e.g. Klein et al., 2019; Ladu & Quitzow, 2017). Public procurement targeted at bio-based products specifically and policies targeted at channelling consumers towards more sustainable choices (Young et al., 2010; Meeusen et al., 2015) are the way forward. This would increase the visibility of bio-based products and facilitate consumer acceptance for waste valorisation. From an MLP perspective, the legislative dimension can facilitate a *stretch and transform* empowerment for niche stakeholders through such "'control policies' […] which incline (regime) actors more favourably towards investment in niche solutions" (Smith & Raven, 2012, p. 1031).

Finally, in-between the niche and the regime, the role of user intermediaries cannot be stressed enough. Intermediaries are a cornerstone of the MLP and SNM literature. They act as *key catalysts* that can purposefully or incidentally "speed up change towards more sustainable socio-technical systems" (Kivimaa et al., 2019, p. 1062). This differentiation between a *purposeful* and *incidental* endorsement of niches is reflected in the research results. According to academic research (e.g. Meeusen et al., 2015), both EU researchers and frontrunner businesses could benefit from a purposeful endorsement by consumer and certification organisations as well as NGOs. Such intermediaries are considered more trustworthy in consumers' eyes than the ones suggested by interviewees themselves - i.e. industrial partners, policymakers and the media. However, it should be noted that, in their answers, most interviewees broadened the definition of user intermediary. They not only addressed the stakeholders' role as promoters for their niche products but also highlighted their responsibility in pushing for action and communicating on environmental issues in general. In that sense, current regime stakeholders can indeed also incidentally support the bio-based niche by shaping societal opinion with regard to sustainability issues in general. This is all the more pertinent as societal opinions matter to users and can thus shape their choices (Martinho et al., 2015).

Opinion leaders can act as powerful role models and contribute to changing consumers' minds at all levels of society, from Pope Francis and his encyclical on ecology to The Guardian newspaper pledging to report on climate change or the renowned scientist Tim Jackson questioning current economic growth models. Thus, spokespersons can contribute to "articulat[ing] acceptability interactively" (Rip, 1995, p. 422) by endorsing the bio-based niche, be it purposefully or incidentally.

In the light of the strategies discussed so far, it is useful to take a step back and reflect on their inherent limitations. As Rip (2006) points out, "steering from within" (p. 88) necessarily implies that actors of transition cannot adopt an outsider position when developing strategies. They are part of the system they wish to transform and therefore will by definition never be quite able to see the wood for the trees. Besides, implemented strategies might not have the desired impact. As mentioned earlier, the SNM literature recognizes that "the effects of deliberate intervention [are] inherently unpredictable" (Shove & Walker, 2007, p. 769) as socio-technical systems are dynamic and thus in constant evolution. As the world does not stand still, strategies must permanently be revised and adapted accordingly. This also applies to *user preferences and practices*. Albeit the present research did not focus on user practices per se, it is worth reflecting how changes in production and consumption patterns both at the B2B and B2C consumer level might impact the bio-based niche evolution. As of now, some bio-based products fulfil mainly a replacement function for fossil-based alternatives. As such, they do not radically impact current user practices. But what if these practices were to change? For example, one EU frontrunner introduced biodegradable disposable plates to address the issue of single-use plastics. Single-use cutlery is only one element of a wider socio-cultural practice of fast food and take away, which itself has become ritualized in the broader context of busy modern lifestyles. The underlying script is one which dictates that being busy equals being performant and thus successful. The use of single-use cutlery relies on "recurrent reproduction" (Shove & Walker, 2007) to be kept alive. If norms for attractive lifestyles were to change however, the practices they are built on would change accordingly. In the case of disposable plates, if slow food should become more attractive than fast food, the niche alternative would probably no longer make sense and disappear along with its fossil-based alternative. On the contrary, some external factors can indirectly contribute to reinforcing the niche. For example, as one interviewee mentioned, farmers currently privilege chemical over bio-based fertilizers as their stable composition makes it easier to fulfil their legal obligation of statistically reporting on

them. Should legislation be loosened up however, this practice might change as farmers would probably more readily turn towards bio-based fertilizers which are less detrimental to their soils.

These examples underline the unpredictability of agency efforts. However, the more bio-based niches will *stretch and transform* rather than simply *fit and conform* (Smith & Raven, 2012), the more likely they are to drastically reshape regime elements, from waste management systems to agricultural production, logistics routes and refinery technologies. In this sense, the strategies suggested hereafter are an invitation to "recognis[e] the value […] of an 'illusion of agency' and […] that a difference can be made in the face of so much evidence to the contrary" (Shove & Walker, 2007, p. 768).

The proposed strategies are meant as recommendations for both EU researchers and frontrunner businesses. The best practices and recommendations described hereafter are an answer to the final research sub-question (d) (*i.e. Which strategies can be recommended to promote consumer acceptance?)* and thereby also the overall research question: **What strategies could EU researchers and frontrunner businesses who valorise secondary biomass feedstocks for the production of bio-based products pursue to promote consumer acceptance?**

VII.1. Best practices & recommendations

To answer the research question, EU researchers and frontrunners involved in the valorisation of secondary biomass feedstocks are advised to pursue the strategies described below to promote consumer acceptance for their bio-based products.

- The valorisation of secondary biomass feedstocks could be marketed as an asset. Indeed, consumers are increasingly sensitive to the issue of waste. Therefore, both EU researchers and frontrunner businesses are advised to communicate openly and clearly about waste valorisation. A positive branding with regard to the use of residues might indeed lead to increased consumer acceptance. When a clear link is established between the use of residues and its positive impact in terms of sustainability, consumers are prone to finding such products more attractive (Abbey et al., 2015). Besides, this offers niche stakeholders the opportunity to position themselves with regard to the land grab issue and thereby dissipate possible misconceptions on the part of consumers. The promotion of waste valorisation could further help consumers develop positive mental representations of bio-based products and the bio-based economy in general.

- The valorisation of secondary biomass feedstocks is not enough however to ensure consumer acceptance, nor is the promise of a bio-based or more sustainable product. The first quality of such products should be to ensure that all the expected product properties and attributes are present. Otherwise, it will not be possible to reach mainstream consumers. As shown by Liobikiene and Bernatoniene (2017), the consumer acceptance factors for each product category have to be taken into account – i.e. product attributes have priority (Cao et al., 2014) and will vary for each product category. Besides, ensuring a high-quality product that meets consumers' expectations will also contribute to decreasing the product's sustainability liability (Luchs et al., 2010). With respect to bio-based products specifically, they should offer an added value compared to their fossil-based counterparts, especially when the bio-based content is to be promoted. Indeed, promoting a bio-based product for the sake of being bio-based will not do the trick. Bio-based products needs to convince through additional qualities such as an improved environmental impact, a higher material safety, improved product properties, etc. This also implies that they should offer better end-of-life options than their conventional fossil-based counterparts and ideally reach a 100% bio-based content. Indeed, consumers usually associate bio-based products with biodegradability and

recyclability (Steenis et al., 2018; Meeusen et al., 2015). Therefore, end-of-life options need to be explained very transparently to avoid any greenwashing allegations. The same applies to the percentage of bio-based content which matters to consumers (Sijtsema et al., 2016; Reinders et al., 2017). The reasons behind the products' bio-based share should be clearly explained to consumers when EU researchers and frontrunner businesses decide to communicate about it.

- A coherent, holistic, and transparent communication is crucial. Both the empirical data and literature review results point to the relevance of adopting a "behind the curtain" communication. EU frontrunner businesses that valorise secondary biomass feedstocks could thus not only communicate on their products but also on the company values, the sustainability of the value chain, the end-of-life options for their products, etc. Simple and transparent labels which reflect the whole lifecycle of a product or combine multiple sustainability factors are a powerful communication tool in that regard. Besides, marketing strategies should be tailored to the targeted customers: where B2C customers want to know how their choices can contribute to increased sustainability for example and how they can feel good about it (Hartmann & Apaolaza-Ibáñez, 2012), B2B customers are rather motivated by strategic performance (Carus et al., 2014). Niche stakeholders are advised to make their product claims more actionable (Koenig-Lewis et al., 2014) and offer a coherent product concept (Magnier & Schoormans, 2015). A further communication strategy is to inform consumers about the fossil-based content of equivalent materials to highlight the benefits of sustainable and bio-based materials. Indeed, knowledge about the negative impact of fossil-based products leads consumers to discount them and privilege more sustainable alternatives (e.g. Petersen & Brockhaus, 2017; Trudel & Cotte, 2009). In the case of products with a low bio-based content however – e.g. active bio-based ingredients with better properties than synthetic equivalents – the additional product qualities should be put forward rather than the bio-based content. Communicating on the bio-based content could indeed backlash and be perceived by consumers as greenwashing.

- Involving consumers more actively in the product development could contribute to raising awareness among consumers and ensuring that products meet their expectations. This also holds true when it comes to developing future scenarios for the bio-based economy. Both governments and scientific researchers could actively involve citizens so that they feel listened to and can co-shape the transition (van den Berg et al., 2013). Business models can further play a role here. For example, embracing extended producer responsibility and

offering customers the possibility to return bio-based materials at the end-of-life stage – that is, where feasible – would signal to consumers that the undertaken sustainability efforts are sincere and thus increase trust.

- User intermediaries can also be a useful bridge between the niche and the regime level. Frontrunner businesses are advised to collaborate with consumer organisations, NGOs and certification organisations that can act as platforms for their products and their message. The bio-based industry should thereby ensure to speak as one voice and take NGOs with them. Providing detailed information to these intermediaries can contribute to the emergence of a more coherent and visible discourse. However, niche stakeholders can only do so much, and further user intermediaries should jump in. Especially governmental bodies can set the trajectory forward through public procurement, and public figures can act as role models by promoting social desirability for bio-based products and new social norms through peer pressure.

The niche-level strategies mentioned above will not be sufficient however without major regime changes, especially at the policy and cultural level.

- There cannot be consumer acceptance as long as consumers are not offered a real choice and products are not marketed at their true cost. This implies that the negative externalities of all products – both fossil-based and bio-based – should become visible to consumers and factored into the final price. This could be achieved through graded eco-labels that are compulsory for all products, by legally penalizing greenwashing practices, and by providing incentives to niche businesses that have embraced all sustainability pillars. Furthermore, for the regime infrastructure to change and innovative value chains to flourish, there is a need for EU-wide legislation on end-of-life options and the cascading use of materials. Product sustainability needs to become the legislative trajectory to aim for.

- At the cultural level, it is crucial for consumers to develop symbolic meanings and social norms with regard to the bio-based concept and the valorisation of so-called “waste”. Information is thereby essential and could be relayed by various regime actors: educational curricula and media reports could discuss environmental issues much more and provide science-based information. Businesses also have their role to play by increasing transparency along the whole value chain. Finally, governments could develop outreach programmes to emulate a broader debate on the correlation between our production and consumption modes and our anthropogenic impact on the planet.

VII.2. Overview of recommended strategies for consumer acceptance

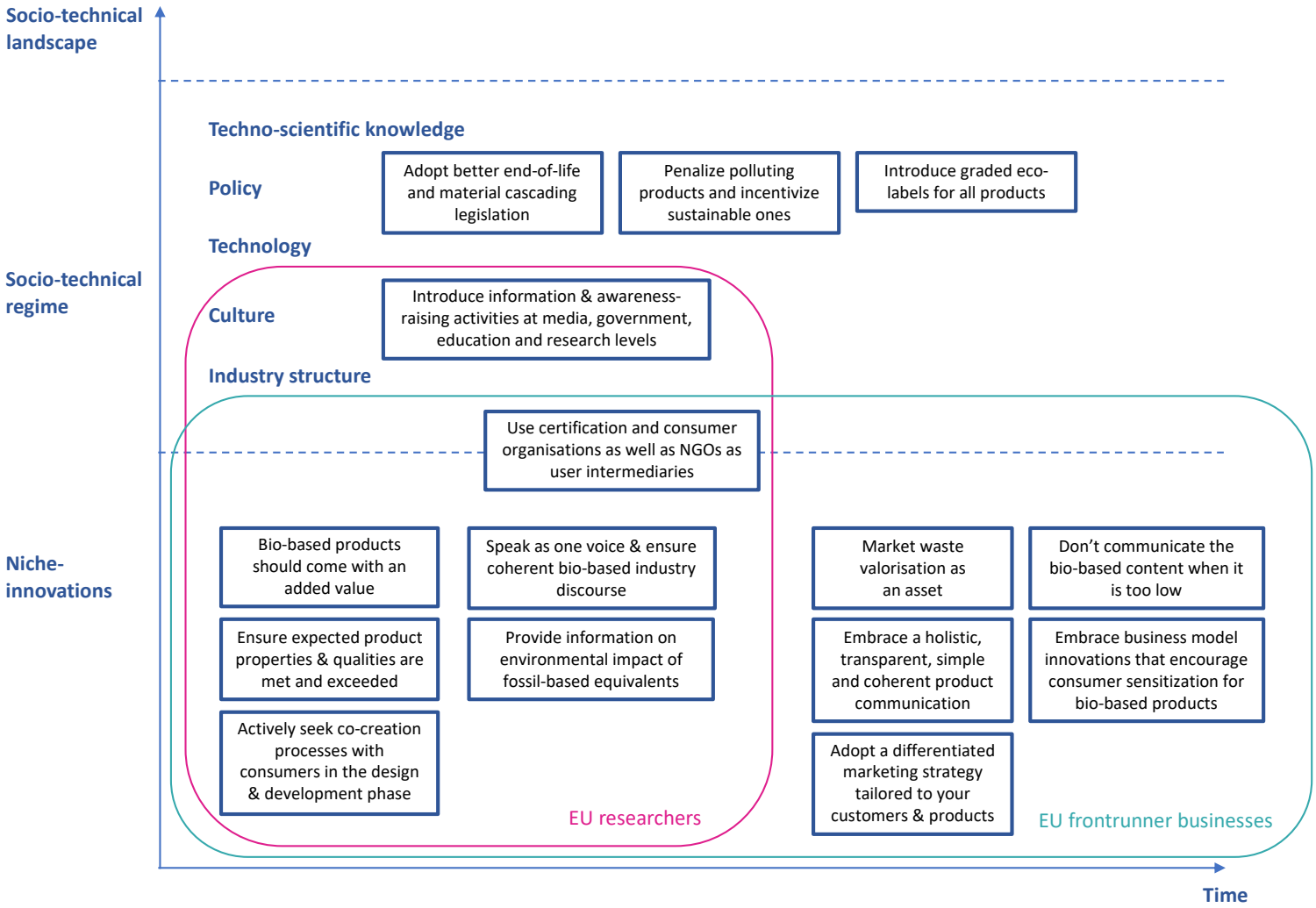

Figure 21: Recommended strategies at different MLP levels for EU researchers and frontrunner businesses

VII.3. Limitations & future research

As with the majority of studies, the findings of this study have to be considered in the light of some limitations. The first limitation concerns the chosen methodology. As there is still very limited academic research on consumer acceptance with regard to bio-based products derived from secondary biomass feedstocks, the literature review had to be extended to further bio-based products and eco-innovations in general. The interview guide was then drafted based on these insights. This implies that the questions submitted to interviewees might not have covered correctly or completely all relevant aspects linked to the specific product type studied here. A second limitation lies in the interviewee selection. First, by asking EU researchers and frontrunner businesses to share their strategies for consumer acceptance, there is a non-negligible risk that confidentiality policies and strategic business secrecy might have led interviewees to not disclose relevant information for this research. The findings might therefore be incomplete. Second, among the final sample of interviewees who agreed to participate, stakeholders from the Netherlands and Germany are overrepresented. Furthermore, a majority target B2B customers while only a few focus on B2C customers. In the literature review however, most articles focused on B2C customers. Also, EU frontrunner businesses were more numerous than EU researchers to accept an interview. These factors might have biased the empirical data collection results. A third limitation concerns the data analysis through the coding process. The elaboration of codes was performed by the author of this research only. Involving a second researcher to code the interview transcriptions in parallel and then comparing and discussing results would certainly lead to a more accurate result interpretation. A further limitation lies in the scope of the research: as strategies were researched from the multi-level perspective, they could not be refined to the product category level.

In the light of the limitations mentioned above, future studies could for example adopt a different methodological approach. Instead of semi-structured interviews, unstructured interviews might be a fruitful approach to ensure that no previously defined topics limit or bias the interviewees' input. A further option could be to complement the current approach with one or several case studies. The researcher could thereby compare the results of the case study investigation with the interview results to compensate for possible information shortcomings. The case study approach could also offer researchers the opportunity to compare and evaluate the effectiveness of different implemented strategies. However, this approach might prove slightly premature as the marketing of bio-based products valorising secondary biomass feedstocks is still in its infancy.

In order to provide more detailed insights, future studies could also focus on consumer acceptance for a specific product category derived from secondary biomass feedstocks. This would allow for more tailored strategies to be proposed and subsequently tested.

The present study could further be repeated in a different setting – e.g. on the U.S. market where the bio-based economy is also growing (Scarlat et al., 2015). This would allow to compare and critically discuss the present results.

Finally, studies that focus on the effectiveness of specific strategies among those presented here could also prove fruitful. For example, consumer involvement could be tested through an experiment where both lead users and laggards are invited to participate in the development of bio-based products aimed at waste valorisation. A further study could consist of testing the impact of different outreach programme formats or channels to identify the most effective ones.

Now that the study limitations have been addressed, it is useful to also mention how it contributes to both theory and practice.

VII.4. Contribution to theory & practice

VII.4.1. Theoretical contribution

Within the field of sustainability transitions, academic literature on consumer acceptance has paid little attention so far to consumer acceptance for bio-based products manufactured from secondary biomass feedstocks. The literature review carried out in the context of this research has shed light on the urgent need to fill this gap. The dearth of data might be linked to the way research on consumer acceptance has usually been conducted until now. Indeed, when it comes to consumer acceptance for bio-based products and eco-innovations, research has focused predominantly on asking consumers directly about their perceptions and experiences (e.g. Hanss & Böhm, 2012; Steenis et al., 2018; Sijtsema et al., 2016; Almenar et al., 2010). This approach becomes problematic however when it comes to highly innovative products that are still at an early development stage and for which market availability remains modest – as is the case with bio-based products valorising "waste". The present research has attempted to overcome this issue. First, the literature review was expanded and insights on consumer acceptance for eco-innovations and bio-based products in general were used as proxies to bridge the information gap. Second, niche stakeholders were asked directly about how to promote consumer acceptance for their products, whereby related barriers and drivers could be unveiled. The research could thus serve as an inspiration for future research on consumer

acceptance. Indeed, besides asking consumers directly about their willingness to purchase, pay for, switch to or use green products or technologies (Peuckert & Quitzow, 2017), insights from other stakeholders along the value chain could be collected. Albeit the current research did not analyse *consumer acceptance* per se but rather strategies to promote it, the empirical data collection did allow to gain interesting insights from niche stakeholders on consumer acceptance for their products.

Furthermore, the research focused on strategies for consumer acceptance with regard to both firms (B2B customers) and end-consumers (B2C customers). It thereby contributes to a still scarce stream of literature focusing on B2B consumer acceptance for eco-innovations and bio-based products. Indeed, as the literature review has shown, the majority of research efforts are directed towards understanding consumer acceptance among end-consumers.

When it comes to sustainability transitions studies in general and more specifically the socio-technical approach to transitions research, the research departs from a traditional descriptive approach to embrace a more forward-looking and prescriptive one. It thereby inscribes itself in an emerging stream of literature which aims at using the MLP lens for prescriptive research rather than merely descriptive purposes (Köhler et al., 2019). The MLP has indeed first served as an analytical lens to understand and reconstruct past transitions. Selected sociotechnical systems and regimes have been analysed retrospectively – e.g. the transition from sail to steam ships, or from coal to gas (Geels, 2002; Correlje and Verbong, 2004). This is problematic as pointed out by Shove and Walker (2007, p. 764): "One consequence is that studies of systems in transition are typically distanced, even voyeuristic, making few claims about how individuals and organisations can, might, or should act to affect the processes in question or to steer trajectories towards predefined, normative goals". The present research acknowledges this critique and provides an example of a forward-looking approach where the MLP is "used to assess the potential of emerging and desired technologies against the background of incumbent structures and technologies" (Loorbach et al., 2017, p. 610). By focusing on the nascent niche of bio-based products manufactured from secondary biomass feedstocks, the research thereby focuses on the early phase of a possible sustainability transition.

The research further stresses the relevance of user intermediaries in shaping and promoting sustainability transitions. It thereby builds on a recent stream of literature focusing specifically on the role of intermediaries in the context of niche-regime interactions (e.g. Diaz et al., 2013; Kivimaa, 2014; Smink et al., 2015).

VII.4.2. Practical contribution

For innovative researchers and entrepreneurs who wish to successfully develop and scale their niche products, a sound understanding of what drives or hinders consumer acceptance for their products is primordial. This in turn allows them to develop targeted strategies to address identified issues. In the specific context of the bio-based economy, the issue of consumer acceptance remains a thorn in the side of many bio-based niche stakeholders. Indeed, bio-based products are still relatively unknown and poorly understood by the broader public, especially when it comes to bio-based products manufactured from secondary biomass feedstocks (e.g. Fytili & Zabaniotou, 2017; Sijtsema et al., 2016; Meeusen et al., 2015; Herbes et al., 2018). The current research contributes to supporting these niche stakeholders by providing practical recommendations at different stages of the product value chain. Besides, by suggesting strategies at the regime level, it provides useful insights for regime stakeholders also. EU policymakers in particular can benefit from the research results. The results indeed point to the importance of a regulatory framework that will guide consumers' choices and practices and facilitate the development and commercialization of innovative and circular bio-based products. As the valorisation of secondary biomass feedstocks for bio-based products is still in its early stages, different niche and regime stakeholders who wish to advocate such a trajectory can use the research results as a compass when strategically directing their efforts towards increased consumer acceptance. Indeed, designing innovative products manufactured from residues and by-products might be to no avail should the *consumer acceptance* dimension not be considered and addressed in a timely manner. It also points to the crucial role of pivotal stakeholders such as EU researchers, frontrunner businesses, policymakers and high-profile intermediaries while also allowing these stakeholders to gain a more holistic perspective on the issue.

General Conclusion

In the light of growing unsustainable consumption patterns worldwide and the ensuing depletion of resources and deterioration of ecosystems, the bio-based economy could offer a viable alternative. However, as both the bioeconomy and bio-based economy depend on the availability of biomass feedstocks, optimal circularity and cascading of materials are required to ensure both a successful and sustainable transition from fossil-based to bio-based resources. With increased food production needs and thus growing land scarcity, the reliance on primary feedstocks cannot be the privileged strategy on the long-term. This is where the valorisation of secondary and tertiary feedstocks offers a promising alternative.

Nevertheless, a shift in the design and manufacturing of products can only succeed if it is embraced by the majority and enters collective consciousness. This is where market acceptance plays a decisive role and consumers become kingmakers. Through the theoretical lens of the multi-level perspective, the present research has aimed at identifying strategies which, at different socio-economic levels, could promote consumer acceptance and thereby help bio-based economy stakeholders to transform their niche into a new socio-technical regime.

As the research has pointed out, efforts at the niche level will not suffice because, as with most sustainable transitions, environmental innovations suffer from the fact that "sustainability is a collective good" (Geels, 2011, p. 25). Without "changes in economic frame conditions" (Ibid., p. 25), the current status quo and vested interests are likely to prevail. For change to happen, regime stakeholders need to play their part, from policy interventions to the action of powerful regime actors endorsing an intermediary role.

In fact, on a larger scale, both niche and regime stakeholders will need to reflect on the underlying rationale for their actions for a viable trajectory forward to emerge. Indeed, for truly sustainable transitions to occur worldwide, humanity will need to redefine the premises of its actions. Here, questions of power, responsibility and rights come into play. There is an unquestioned assumption that citizens in affluent societies have rights to a […] carbon intensive lifestyle and to continuous growth" (Newell et al., 2015, p. 538). This however happens at the expense of poorer communities who bear the brunt. The bio-based economy therefore needs to be part of a larger debate where essential human needs are given priority and the notions of well-being and human progress are redefined. "If we view the Earth as a commodity to be bought and sold, our responses will be different than if we recognise the Earth as an interactive system in which we are an intrinsic part" (Gilligan, 2012, p. 466).

Appendices

A. EU-28 net trade in biomass

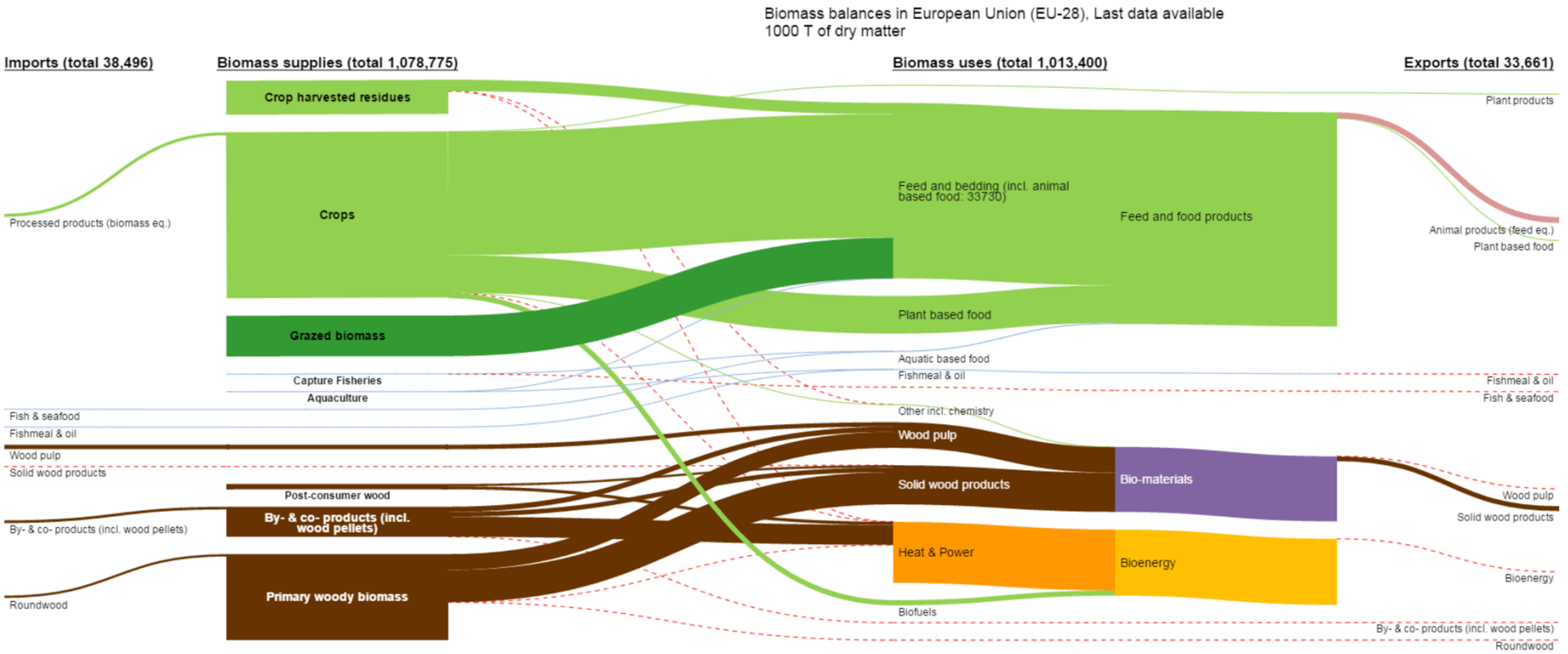

Figure 22: Sankey biomass diagram depicting net trade in biomass for the EU-28 (European Commission, 2017, p. 1)

B. Strategies for consumer acceptance – Literature review summary

Empirically tested strategies

Communication focus on products' sustainability

Eco-innovations	Bio-based products
▪ Differentiation of sustainability communication according to product category **CSE1**	▪ Communication about material content & impact of fossil-based equivalents **CSB1**
▪ Provision of information & cues on product main attributes & qualities besides sustainability attributes **CSE2**	▪ Provision of clear & accessible information on bio-based content **CSB2**
▪ Provision of transparent & extensive sustainability communication (ex. two-sided messages) **CSE3**	▪ Targeting environmentally-conscious consumer segment first in communication efforts **CSB3**
▪ Focus on communicating single strong sustainable strategy per product **CSE4**	▪ Developing tailored communication strategies according to different customer segments and product categories **CSB4**
▪ Differentiation of sustainability communication according to targeted consumers (green vs. non-green consumers) **CSE5**	▪ Emphasis on positive emotions linked to use of bio-based materials **CSB5**

Communication focus on products' added value

Eco-innovations	Bio-based products
▪ Communication of sustainability attributes as unintended enhancements **CAE1**	▪ Avoidance of promoting the bio-based content altogether & focus on new product features instead, especially for partially bio-based products **CAB1**
▪ Communication of sustainability attributes as complementary rather than key attributes **CAE2**	▪ Ensuring coherent product concept if bio-based content is communicated **CAB2**

Marketing claims & channels

Eco-innovations	Bio-based products
▪ Providing honest, exhaustive & transparent "behind the curtain" view on company & marketed products **MSE1**	▪ Combining rational & emotional claims to promote bio-based products **MSB1**
▪ Use of social media, mobile applications & further communication tools with specific environmental focus to market products **MSE2**	▪ Formulation of environmental claims & development of bio-based products in accordance with consumers' current expectations towards bio-based products (short-term strategy) **MSB2**
▪ Appeal to consumers' green values, ego-centric & altruistic motives through targeted verbal claims & brand cues (put forward environmental concern, utilitarian benefits & psychological brand benefits) **MSE3**	▪ Informing consumers about real environmental impact of both fossil-based and bio-products (long-term strategy) **MSB3**
	▪ Adoption of transparent marketing strategy explaining price premium & company's stance on the bio-based economy **MSB4**
	▪ Appeal to consumers' green values, ego-centric & altruistic motives **MSB5**
	▪ Highlight the waste valorisation aspect (only researched for food waste) **MSB6**

Product design & packaging

Eco-innovations

- Ensuring consistency between visual and verbal sustainability claims **PDE1**
- Adoption of a differentiated approach per product category when creating a sustainable exterior design and packaging **PDE2**
- Offer high quality & expected product attributes besides sustainability attributes **PDE3**
- Offer additional product attributes & benefits linked to sustainable features **PDE4**

Bio-based products

- Ensuring consistency in the product concept & image **PDB1**
- Focus on innovativeness of bio-product instead of its design **PDB2**
- Design of bio-based products in accordance with consumers' current expectations: 100% bio-based product/packaging that is recyclable/biodegradable **PDB3**
- Offer high quality & expected product attributes besides the bio-based attributes **PDB4**
- Offer additional product attributes & benefits **PDB5**

Eco-labelling & sustainability certification

Eco-innovations

- Use of eco-labels in combination with sustainability claims **ELE1**
- Use of eco-labels which inform on total environmental impact (LCA) rather than single-point indicators **ELE2**
- Introduction of graded eco-labels which would apply to all products (sustainable & non-sustainable) **ELE3**

Bio-based products

- Use of a European-level holistic bio-based label informing consumers on bio-based content, environmental indicators & sustainability of biomass feedstock **ELB1**
- Use of differentiated labels per product category informing on comprehensive sustainability and environmental criteria **ELB2**
- Use of meta-standard frameworks to facilitate cross-recognition of individual labels **ELB3**
- Use of simplified, clear, transparent eco- & bio-based labels **ELB4**

Consumer & early adopter involvement

Eco-innovations

- Involve both green & non-green consumers & lead users in design & development of eco-innovations **CIE1**
- Use early adopters of eco-innovations as brand ambassadors **CIE2**

Bio-based products

- Involve consumers in the development of bio-based products **CIB1**
- Involve citizens and consumers in scientific research and governmental activities for the elaboration of future scenarios for the bio-based economy **CIB2**

User intermediaries

Eco-innovations

- Use of third-party certification organisations for verification & certification of a company's environmental claims **UIE1**
- Partnerships with external intermediaries such as environmental organisations, support organisations, peers **UIE2**
- Use of sustainability ratings & third party reporting **UIE3**

Bio-based products

- Partnerships with consumer organisations, NGOs and independent certification organisations to promote environmental and social benefits of bio-based products **UIB1**

Business model innovation

Eco-innovations	Bio-based products
▪ Increase product accessibility through both online & brick-and-mortar stores **BME1**	▪ Offer products as a service (where applicable) **BMB1**
▪ Offer additional services as complementary product feature **BME2**	▪ Offer loyalty schemes & incentives to customers so as to close the product loop at the end-of-life stage **BMB2**
▪ Increase consumer trust for sustainable products through pay back guarantees, innovative warranty option, etc. **BME3**	▪ Recover bio-based materials at end-of-life stage for remanufacturing purposes (where applicable) **BMB3**

Information & awareness-raising activities

Eco-innovations	Bio-based products
▪ Develop information programmes on sustainable eco-innovations which appeal to consumers' egocentric and altruistic motivations (targeted at both green & non-green consumers) **OPE1**	▪ Develop information programmes on bio-based targeted at increasing consumers' understanding for bio-based materials, their properties & recycling options **OPB1**
▪ Develop information campaigns aimed at increasing the pro-environmental behaviour of consumers and educating them on sustainability and remanufacturing issues **OPE2**	▪ Develop information campaigns to highlight the feasibility of a bio-based economy transition through a positive discourse & possible future scenarios **OPB2**
▪ Use digital & physical fora as communication platforms **OPE3**	▪ Implementation of governmental information strategies on national level through digital applications, information leaflets, e-mail address for inquiries, debates **OPB3**
	▪ Provision of extensive information material and metrics within B2B sector on social & environmental benefits of bio-based products **OPB4**

Government incentives & regulations

Eco-innovations	Bio-based products
▪ Punish greenwashing practices by imposing penalties **GIE1**	▪ Development of standards for bio-based products' end-of-life stage **GIB1**
▪ Pull consumers towards eco-innovations through governmental incentives (ex. towards remanufactured products) **GIE2**	▪ Develop homogeneous EU-wide waste management practices and standards **GIB2**
▪ Provide incentives to facilitate adoption of eco-labels **GIE3**	▪ Adopt environmental regulation targeted at promoting circularity in product design, development and along the supply chain **GIB3**
▪ Adopt more coherent regulatory frameworks regarding sustainable production & consumption **GIE4**	▪ Privilege bio-based products over fossil-based equivalents through public procurement **GIB4**

Table 11: Strategies for consumer acceptance (literature review summary)

C. Strategies for consumer acceptance targeted at drivers & barriers - Literature review summary

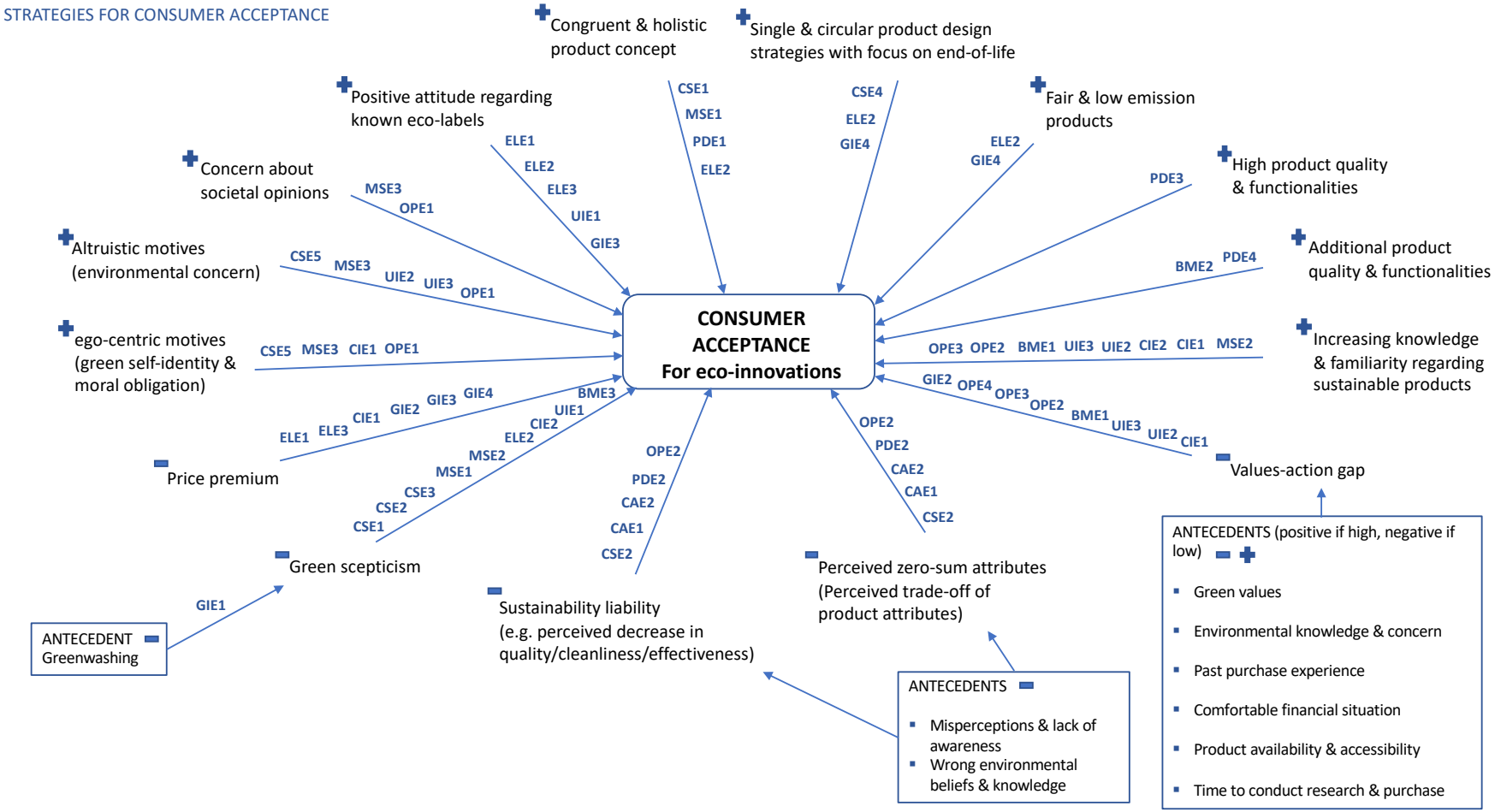

Figure 23: Strategies for consumer acceptance (academic literature on eco-innovations) – cf. Appendix B., pp. 115-117

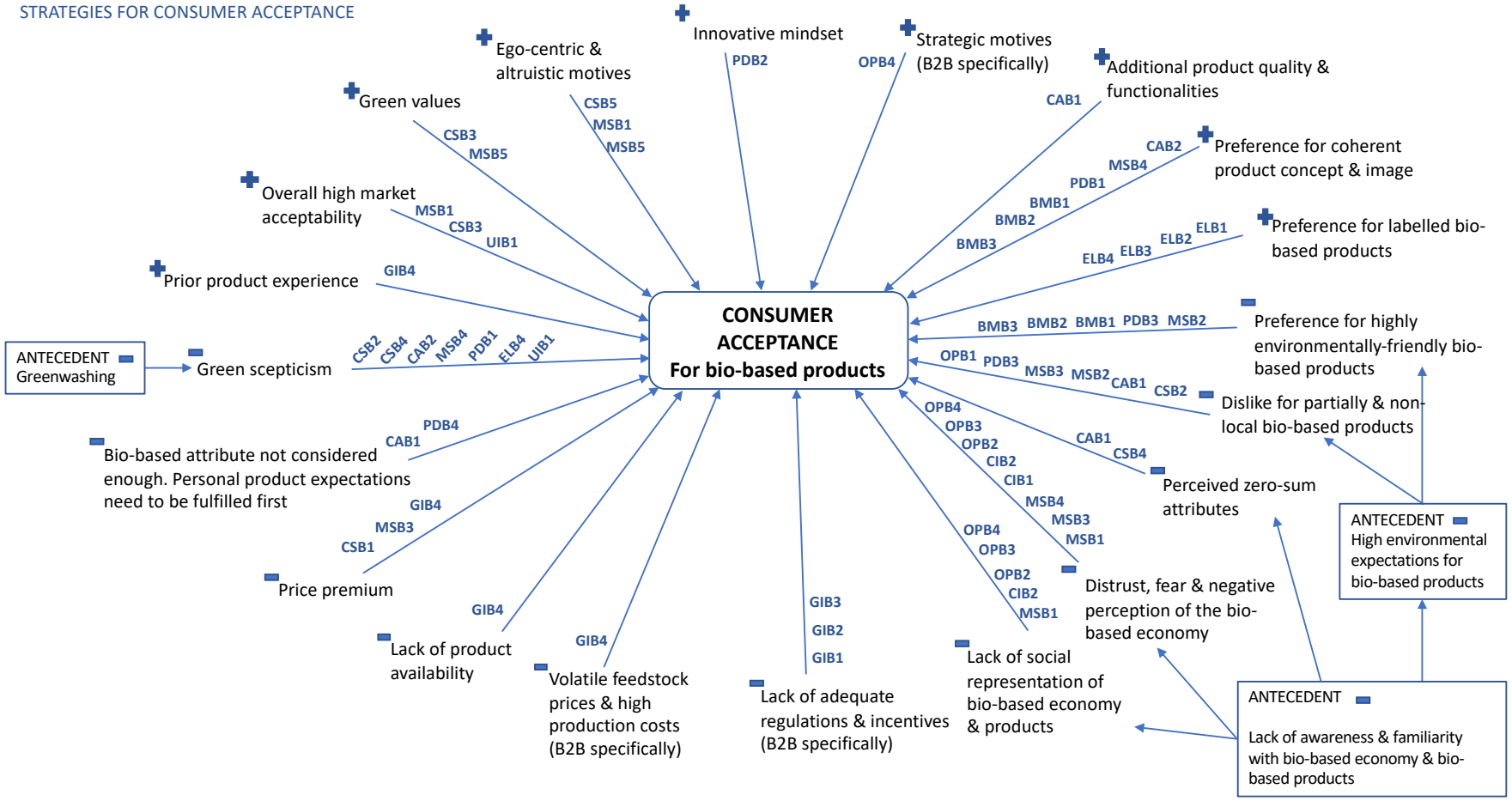

Figure 24: Strategies for consumer acceptance (academic literature on bio-based products) – cf. Appendix B., pp. 115-117

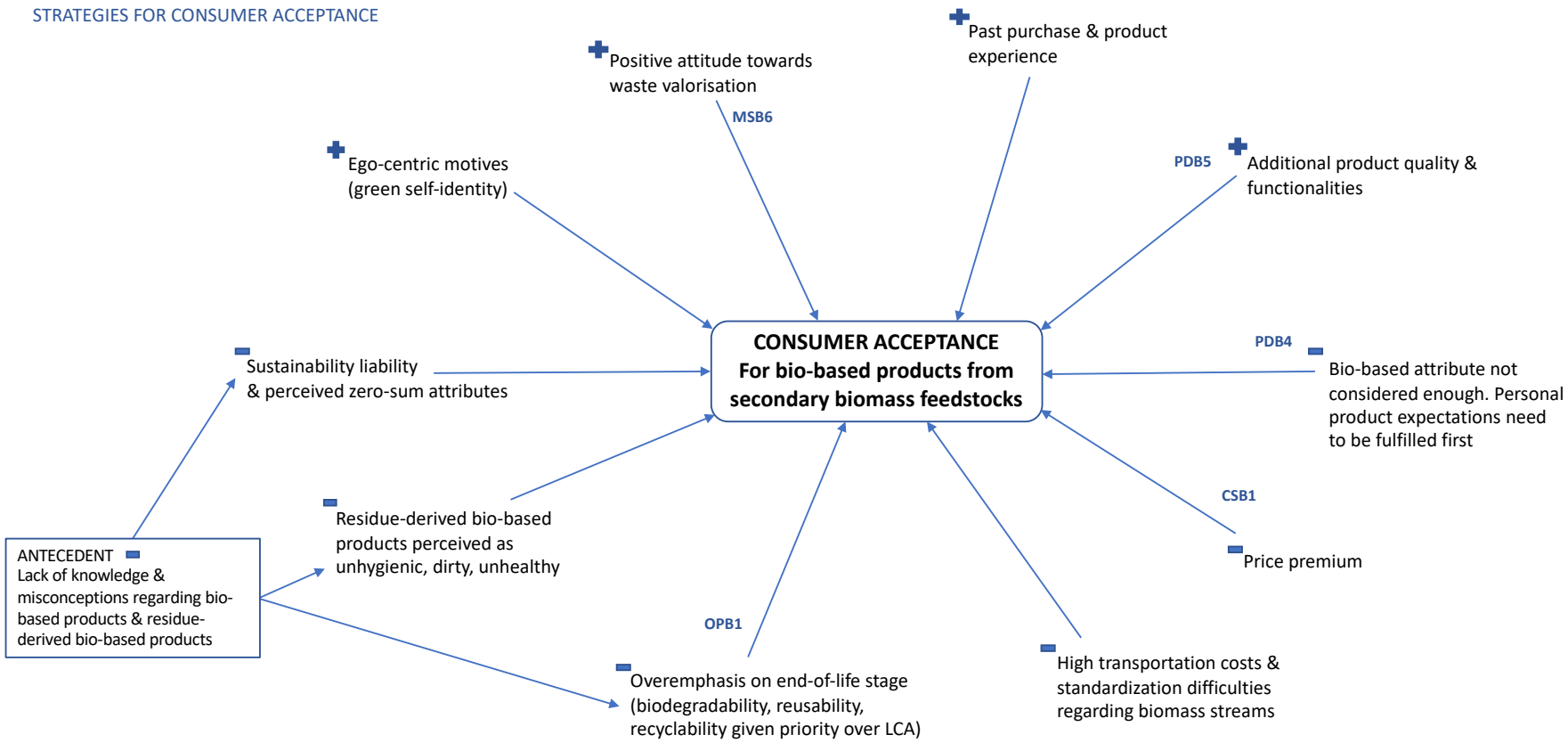

Figure 25: Strategies for consumer acceptance (academic literature on bio-based products from secondary biomass feedstocks) – cf. Appendix B., pp. 115-117

D. Consumer acceptance dimensions – Literature review summary

CONSUMER ACCEPTANCE	ECO-INNOVATIONS	BIO-BASED PRODUCTS	BIO-BASED PRODUCTS FROM SECONDARY BIOMASS FEEDSTOCKS
WILLINGNESS TO SWITCH	Hazen et al., 2017	Millner et al., 2006; Brockhaus et al., 2017	Russo et al., 2019
WILLINGNESS TO PURCHASE	Steenis et al., 2018; Bleda & Valente, 2009; Chen & Chang, 2012; Rokka & Uusitalo, 2008; Martinho et al., 2015; Hartmann et al., 2012; Young et al., 2010; Van Weelden et al., 2016; Tolionski, 2012; Newman et al., 2014; Liobkiene et al., 2017; Magnier & Schoormans, 2015; Cho, 2015; Goh & Balaji, 2016; Barbarossa & De Pelsmacker, 2016; BBMG, GlobaScan, & SustainAbility, 2012	Sijtsema et al., 2016; Almenar et al., 2010; Reinders et al., 2017; Meeusen et al., 2015; Koenig-Lewis et al., 2014; Cao et al., 2014; Klein et al., 2019	Russo et al., 2019; Herbes et al., 2018
WILLINGNESS TO USE	Steenis et al., 2018; Bleda & Valente, 2009; Rokka & Uusitalo, 2008; Martinho et al., 2015; Hartmann et al., 2012; Van Weelden et al., 2016; Tolionski, 2012; Liobkiene et al., 2017	Sijtsema et al., 2016; Almenar et al., 2010; Meeusen et al., 2015; Sleenhoff & Osseweijer, 2016; Sleenhoff et al., 2015; Cao et al., 2014; Millner et al., 2006; Brockhaus et al., 2017; Scherer et al., 2017; Scherer et al., 2018	Scaringelli et al., 2017, Tur-Cardona et al., 2018
WILLINGNESS TO PAY FOR	Klaiman et al., 2016; Whitson et al., 2014; Hazen et al., 2018; ; Ward et al., 2011; Trudel & Cotte, 2009; Martinho et al., 2015; Yenipazarli, 2015; Cho, 2015; Casadesus-Masanell et al., 2009; BBMG, GlobaScan, & SustainAbility, 2012	Theinsathid et al., 2011; Peuckert & Quitzow, 2017; Meeusen et al., 2015; Carus et al., 2014; Cao et al., 2014; Wei et al., 2018; Scherer et al., 2017; Scherer et al., 2012	Russo et al., 2019; Scaringelli et al., 2017; Tur-Cardona et al., 2018; Yue et al., 2010

Table 12: Consumer acceptance dimensions (literature review summary)

E. Interview guides

FIRST INTERVIEW ROUND – EU RESEARCHERS & FRONTUNNER BUSINESSES

BRIEFING

Thank you for accepting to participate in this academic research. I would like to first give you a quick briefing with regard to the interview.

As announced in my invitation e-mail, the current research aims at analysing what strategies can contribute to promoting consumer acceptance with regard to bio-based products. The focus is laid on bio-based products derived from secondary biomass feedstocks as these products have the potential to valorise residues and academic research on the topic is still relatively scarce.

I will ask you 16 questions and the interview will take around 30 minutes. Please feel free to ask me any clarifications or add any information that you believe could be useful or interesting and that is not addressed by my questions.

Regarding your personal data, your name and any further personal information will remain confidential. The interview will be audio-recorded so that your answers can be transcribed later on. If you do not agree to the audio-recording of this interview, you are free to withdraw your permission at any time.

Do you have any questions before we start?

QUESTIONS

General product-related questions

1. What products do you produce / intend to produce? From which residues or by-products?

2. Are the (potential) target customers for your product B2B or B2C customers?

3. Do you / will you market your product on a national or international level?

4. Is your product 100% bio-based or only partially made from bio-based materials? What is the % of side streams? And why?

Communication focus/ Marketing claims & channels

5. Did you / do you intend to use sustainability assessment schemes for your product?

6. Do you communicate / intend to communicate the environmental footprint of your product to customers? And if so, how?

7. Do you communicate or intend to communicate the bio-based content of your product to customers? And if so, how?

Product design & packaging / eco-labelling & sustainability certification

8. Regarding the design of your product, do you / did you consider customers' preferences and practices when designing the product? If so, which ones? And why?

9. What visual and / or verbal claims do you use or intend to use to communicate the functional features / the sustainability features of your product? I am referring here to product packaging, eco-labels or sustainability certification for example.

Consumer & early adopter involvement/ User intermediaries

10. Have you / will you actively involve your customers in the design of the product? And if so, how? How did / will you select the customers involved?

11. Do you / will you collect feedback from your customers with regard to the design and/or sustainability features of your product?

12. Do you / will you partner with third parties such as environmental organisations, media partners, consumer organisations or independent certification organisations as a platform- to inform consumers about your product?

Business model innovation

13. Did you or do you intend to introduce an innovative business model with regard to your product? For example, offering customers the possibility to return the product at the end-of-life stage.

Information & awareness-raising activities / government incentives & regulations

14. Customers are not very familiar yet with bio-based products and even less so with bio-based products derived from residues or by-products. Do you believe this is / will be an important

barrier for your product? If so, what measures in your opinion could contribute to solving this issue?

15. In general, are there any other strategies that you believe would be most efficient in promoting consumer acceptance for your product? For example, governmental support, incentives, awareness programmes, etc.

16. How do you see the market for bio-based products evolve in the coming five to ten years? And why?

DEBRIEFING

We are now finished with the interview. Do you have any questions or additional comments you would like to make? Do you have any additional points you would like to talk about?

I would like to thank you for your time. If you wish, a copy of the final publication can be sent to you once the academic project has been finalized.

SECOND INTERVIEW ROUND – EU EXPERTS

BRIEFING

Thank you for accepting to participate in this academic research. I would like to first give you a quick briefing with regard to the interview.

As announced in my invitation e-mail, the current research aims at analysing what strategies can contribute to promoting consumer acceptance with regard to bio-based products. The focus is laid on bio-based products derived from by-products and residues. I have already conducted interviews with EU researchers currently developing bio-based products manufactured from residues or by-products as well as with EU businesses that have already launched such products on the market.

In a second step, I am conducting more informal interviews with bio-based economy experts within the EU. I would like to hear your opinion on the topic of consumer acceptance with regard to bio-based products in general and bio-based products manufactured from residues more specifically.

I will ask you 11 questions on the topic and the interview will take around 30 minutes. Please feel free to ask me any clarifications or add any information that you believe could be useful or interesting and that is not addressed by my questions.

Regarding your personal data, your name and any further personal information will remain confidential. The interview will be audio-recorded so that your answers can be transcribed later on. If you do not agree to the audio-recording of this interview, you are free to withdraw your permission at any time.
Do you have any questions before we start?

QUESTIONS

General introductory question

1. Could you tell me a bit more about your current work / research with regard to the bio-based economy?

Drivers & barriers to consumer acceptance / waste valorisation

2. Consumers are not very familiar yet with bio-based products. Do you believe this is currently a challenge to the further development of the bio-based economy? If so, what measures in your opinion could contribute to solving this issue?
3. Consumers are even less familiar with bio-based products manufactured from residues or by-products. Do you believe that the use of secondary biomass feedstocks will represent an additional hurdle, or could it rather be considered an asset?

4. Do you believe there is a difference in consumer acceptance between B2B and B2C customers?

Communication focus

5. Do you believe companies should communicate about the environmental footprint / the bio-based content of their products? If so, also when their products are only partially bio-based?

Product design & packaging / eco-labelling & sustainability certification

6. What influence can product design and packaging, eco-labels, Life-Cycle-Assessments and further sustainability certifications/assessments have regarding the promotion of bio-based products? And regarding bio-based products derived from residues and by-products?

Consumer & early adopter involvement/ User intermediaries

7. What actors in your opinion should be at the forefront of promoting the bio-based economy? Should it for example rather be the responsibility of governments, of businesses? How about third parties such as environmental organisations, media partners, consumer organisations, independent certification organisations?

8. Do you believe that actively involving customers in the design of bio-based products and seeking their feedback could contribute to improving their awareness of and acceptance for bio-based products? And in the case of bio-based products derived from residues and by-products?

Business model innovation

9. Do you believe innovative business models could play a role in the development of the bio-based economy?

Information & awareness-raising activities / government incentives & regulations

10. What specific tools or measures do you believe to be most effective in promoting consumer knowledge and acceptance for the bio-based economy (e.g. governmental support, incentives, awareness programmes, etc.)?

Future trends

11. How do you see the bio-based market evolve in the coming five to ten years? And why?

DEBRIEFING

We are now finished with the interview. Do you have any questions or additional comments you would like to make? Do you have any additional points you would like to talk about?

I would like to thank you for your time. If you wish, a copy of the final publication can be sent to you once the academic project has been finalized.

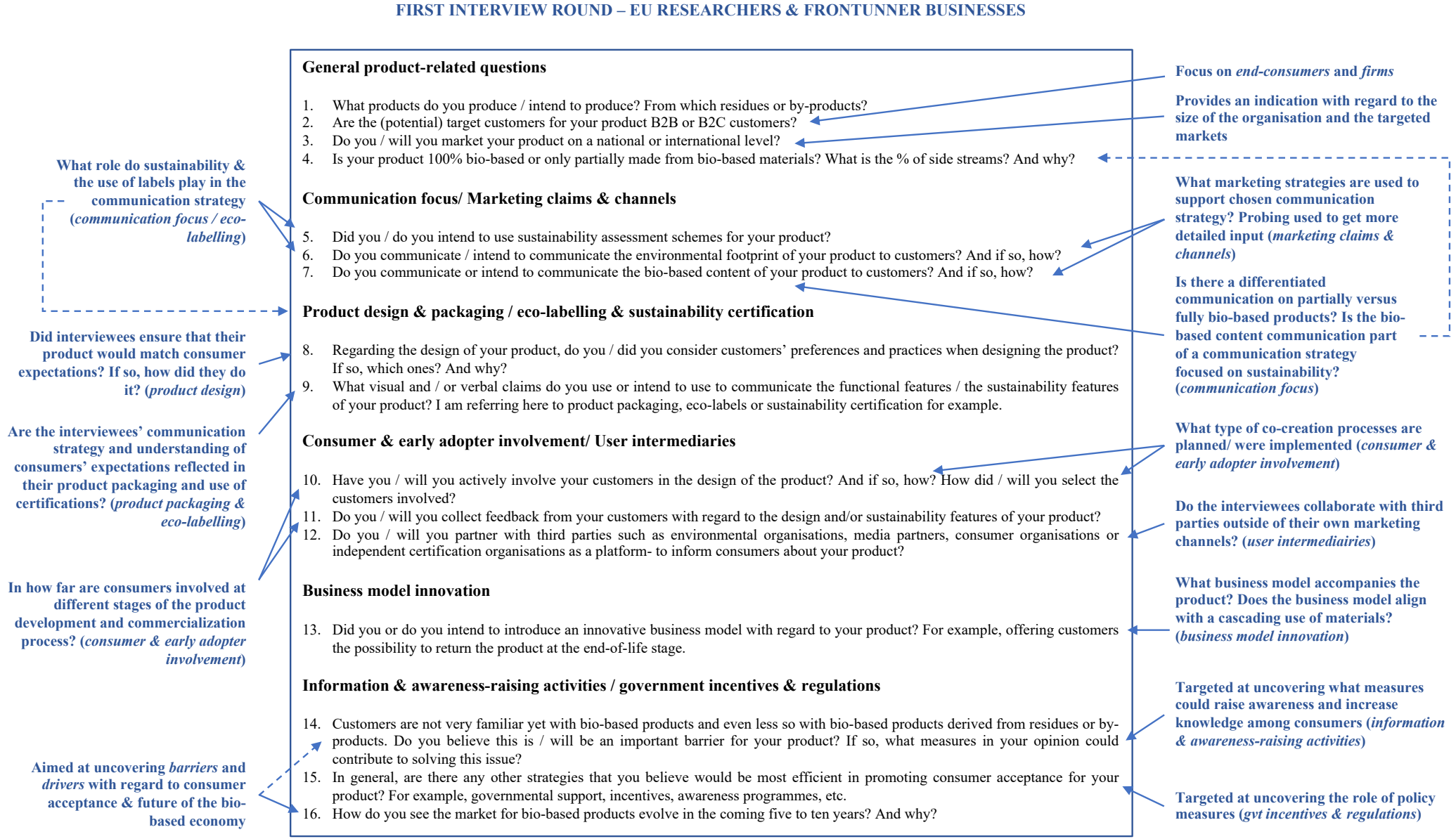

Figure 26: Interview guide logic & structuration - first interview round

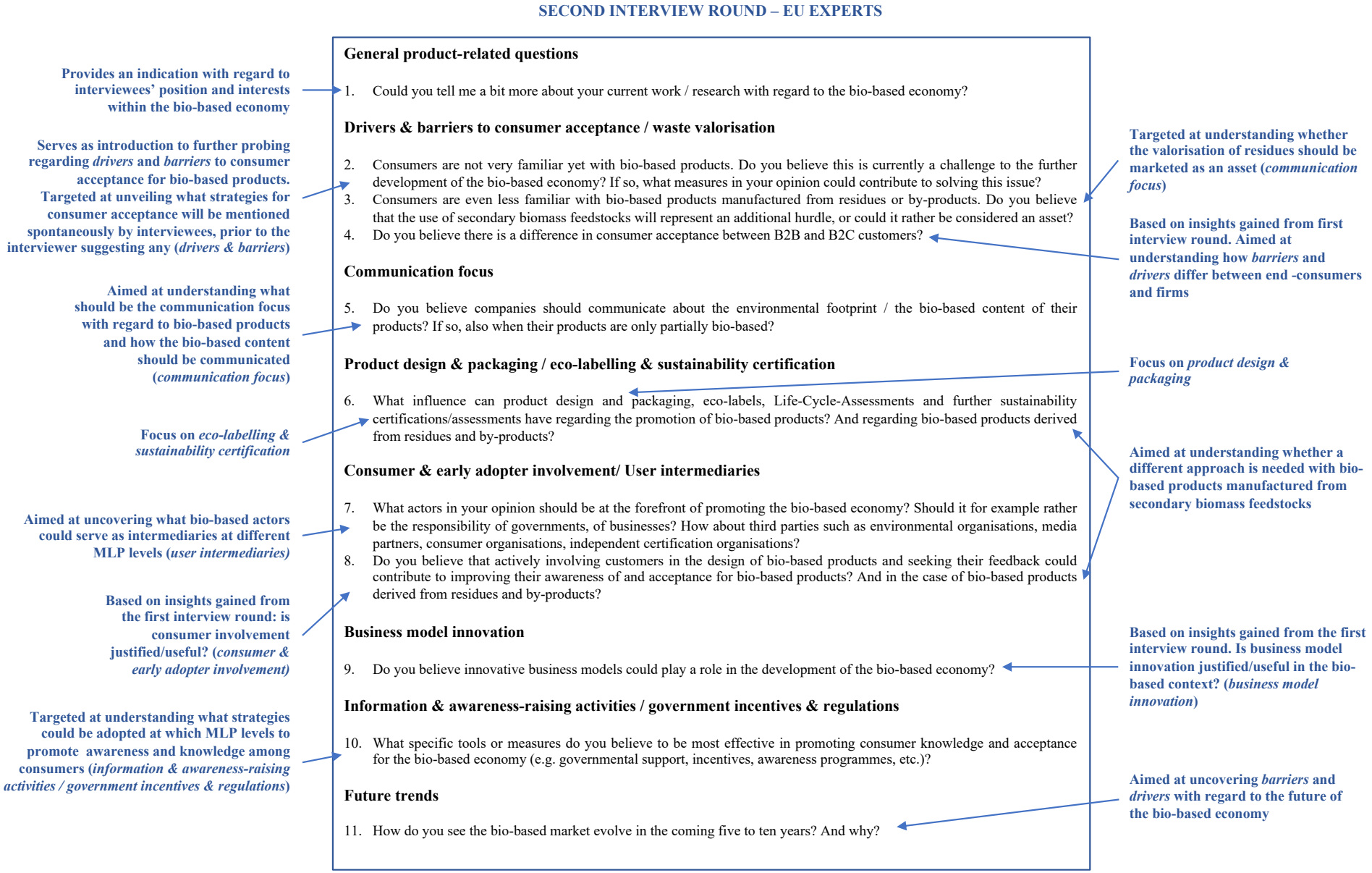

Figure 27: Interview guide logic & structuration - second interview round

F. Interviewee analysis

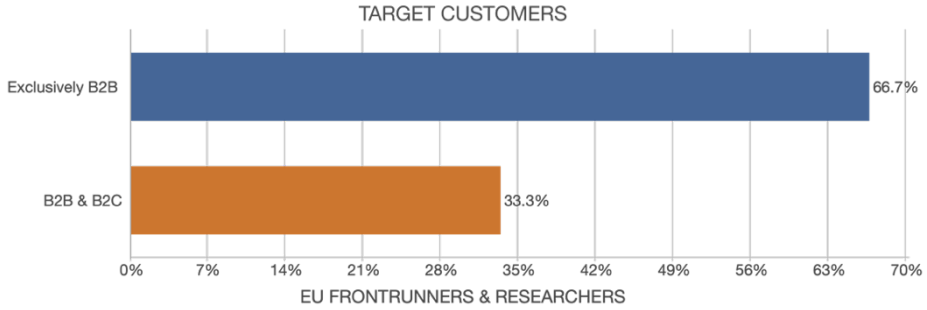

Figure 28: Target customers of EU frontrunners & researchers

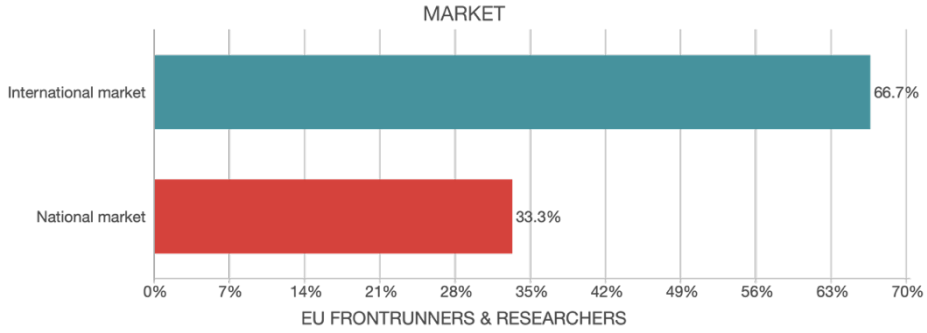

Figure 29: Market presence of EU frontrunners & researchers

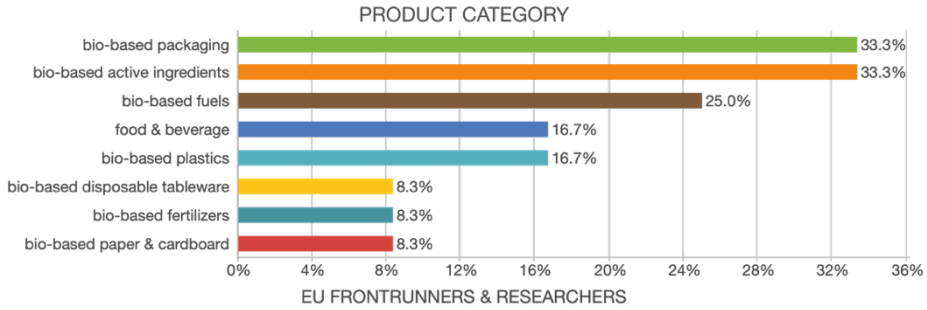

Figure 30: Products marketed/developed by EU frontrunners & researchers

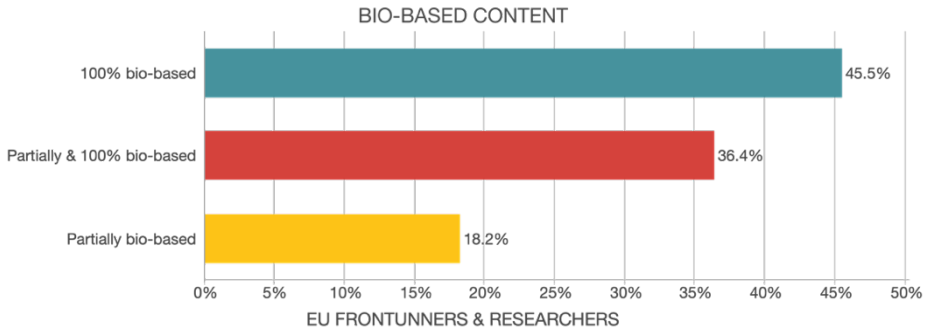

Figure 31: Bio-based content of products marketed/developed by EU frontrunners & researchers

G. Interview samples – identified barriers & drivers

DRIVERS & BARRIERS		INTERVIEW SAMPLES		
TOP 10 BARRIERS	CODES	EU RESEARCHERS	EU FRONTRUNNERS	EU EXPERTS
1	Public's confusion/ misperceptions regarding bio-based concept	"And it seems like consumers are confused by the word bio-based"	"And I think that's where the consumers are getting confused, certainly with regard to plastics versus bioplastics. A lot of people think bioplastics are excellent but there are also a lot of bioplastics which you cannot recycle."	"I mean, I think that there is a big confusion amongst consumers about bio-based products. From what we have been studying, the impression that I have got is that consumers are generally aware of the need to stop using fossil sources, specifically oil, and that something has to change, but I think that there is still a lot of confusion on the idea of bio-plastics…what they really are, what is the real content of bio-based materials, waste-based feedstocks and all these kinds of more technical issues."
2	Price is king	"I think they will always just be going for the cheaper product."	"So, consumers generally, you know, I don't mean to be harsh, but we are lazy and I don't make the best choices all the time either because…yeah, we are all operational…If I buy the cheaper one, then I'll save money for X-thing. It's a short-term thinking"	"From a B2B point of view, in order of importance, they are looking for, first, understanding the return on investments, understanding the time to recover money to switch, second, understanding the quality, feasibility of the products."
3	Ill-adapted legislation for cascading use of biomass & residues	"there are all kinds of regulations which limit the usage of food products for non-food applications"	"how will a product be classified? If it's paper, it's paper. But how is the product classified when there is grass inside? Is that still paper or is it not paper? So, processing grass in countries or transporting grass in countries where grass is considered a bio-waste, and then use it as a raw material…these things are ahead of what a traditional thinking or a traditional legislation is about…so they come across a lot of challenges to make everything happen."	"So, the products…there are a lot of different types of wastes and residues which could be used in a certain way and a lot of pathways are blocked with contradictory policy frameworks"
4	Ill-adapted waste legislation & waste management systems	"Even if here it might be a bit more…regulation might be a bit more reluctant to accept these products in the waste management system"	"So, we have come with different materials…like ours…on the market, and the whole waste management situation has to adapt. For example, at the moment, you have a funny thing that you have a regulation… that is the DIN 13432 that you have to fulfil to be compostable. This implies a 90-day composting period. This is the time that the recycling companies are supposed to run their plant because everybody is working with this standard. But at the end of the day, at the moment, they are not really doing so, running it in a shorter time to make more money. So even the waste management companies have to adapt "	"And this is related to problems with the end-of-waste regulation, and this is one of the core issue that we are discussing in Italy with the minister of environment but there is also a big discussion going on at European level. You should look at the waste directive."
5	Greenwashing practices	"we see a lot of examples of greenwashing out there. I always say…probably companies doing that think that greenwashing will help them to sell more products but in the long term, that's killing their reputation and their credibility but it's also affecting negatively the whole industry. And companies doing the right thing are paying the consequences for some greenwashing out there."	"They don't really think about using their power to achieve this change. They rather think "How can we greenwash ourselves as cheaply as possible". They haven't really…in some ways, it feels like they haven't really gotten the message that it's also their planet."	"As a parallel, I am using the label "made in Italy". So, "made in Italy" is a very important brand for us. But "made in Italy", if you want to investigate, it means for example that some parts are made in China, but the final part of the product was made in Italy. So, I mean, I'm thinking there is always…it's a good tentative but I think that behind that, there will be several tricks to say that it's bio-based but it's not a 100% bio-based. "

DRIVERS & BARRIERS		INTERVIEW SAMPLES		
TOP 10 BARRIERS	**CODES**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
6	Industry resistance & defence of status quo	"It was done by companies like Unilever who uses oil for soap, which is also a non-food application, and they complained about the price level of let's say, palm oil, and they said it was because of subsidiary programmes for bio-diesel, which was based on facts and figures actually not true, but they said that was the reason, food versus fuel…that has led to high prices of food products…but that was completely nonsense."	"And the major companies who are in touch with the customers don't want to communicate about it."	"and there is simply a lobby from the big concrete industry that has a big saying in the NEN against changing these norms. So that kind of power play should be played out."
7	Negative externalities not accounted for & penalized	"And one way or another, society has to pay for it. There is a stupid discussion going on in the Netherlands about CO2 reduction, and the left-wing political parties say you cannot make civilians pay for it, the industry should pay for it. The right-wing politicians say you cannot put the bill too much on the industry. But one way or another, people are going to pay for it. And it will always be the society that has to pay."	"The biggest problem we have in the sustainable production industry is that the classical products are mostly subsidized. […] So, all these costs are not in the plate. The whole costs and money aspect of the plate begins at the producer and ends at the consumer. The whole raw material process and the recycling are not priced. If you would put all these costs into the final plastic plate, it would cost the very same as our plates."	"Es gehört dann dazu, dass alle schlussendlich gesellschaftlichen Bereichen, industriellen Bereichen auch führen, dass was mit konsumieren verbunden ist, dafür den realen Preis zahlen. Das heißt aus nicht nachwachsenden Rohstoffe hergestellten Produkten müssen teurer werden oder ich muss ganz bewusst den biobasierten Produkten fördern. Und das gilt auch für CO2 in der gesamten Diskussion, denn das belastet uns auch." (translation: "This also implies that, in the end, all sectors of society, all industrial sectors that are linked to consumption pay the real price for it. This means that either products manufactured from non-renewable raw materials have to become more expensive or I have to deliberately subsidise bio-based products. And this also applies to CO2 within the whole debate, as this also burdens us.")
8	B2C customers do not recognize/ understand labels		"Don't put two or three logos on it because customers won't know what to do with it. Logos are not well-known among end customers and consumers."	"The problem now is that there are a lot, but consumers are kind of confused by all this labelling"
9	Public unaware/not interested in products' environmental impact		"Would the end customers know what we know, then they would scream for alternatives. But they don't know. […] I think consumers don't want to know. It's easier not to know."	"So, I think that if we investigate and ask people: "Do you think that sun cream creates problems for the environment?" People will say: "No, I don't think so. Why? I'm trying to protect myself." But it's not true because when you are going to have a swim and you have a cream, you create a problem with the sea because some pieces of the cream are based on fossils."
10	Lack of adequate labels & certifications		"The challenge that we have as a company is that the standard, let's call it legislation, is FSC, that's what they use for paperboard. And that's of course stupid because we don't say that paper from trees is bad…of course not…it's not bad at all. But it excludes all the others. So, by selling a standard that is based on trees, you are actually excluding alternatives, and therewith also innovation."	
			"So, in the UK, there is not sort of a label that suits or fits coffee logs. It's a new product and they are kind of a disruptor in this category. In the UK, there is a wood fuel scheme, and on fuel bags, if you are categorised appropriately and you fit within the scheme, you can get this label on your bag that says "ready to burn". We cannot get that because we are not wood (laughter)."	

DRIVERS & BARRIERS		INTERVIEW SAMPLES		
TOP 10 DRIVERS	**CODES**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
1	Bio-based market predicted to grow	"I think we will see a higher representation of bio-based products in the market.[…] We have seen a growth of almost 25% of in general bio-plastics, not only bio-based, also biodegradable, not bio-based. But we have also seen an increase in the bio-based."	"And what I also wanted to say is that the number of projects we are working on, the number of requests, is really growing daily. It's unbelievable what is happening in this industry in this moment. […] I think…I'm always confident that it will explode in the coming years because…and it will also of course depend on what will happen with the worldwide economy… […] I think at this moment… which part of the industry is bio-based, it's maybe 5%. But I think in 5 to 10 years, it will certainly be a third or maybe half. So, I think it will expand enormously."	"I think it will be growing quite fast. Maybe it will take more than 5 to 10 years, but I think it will be growing more and more. […] I think that… the signal is that large companies are taking steps in this direction and this is kind of suggesting that they see there is no other way forward. So, since they want to keep their market leadership, they are adjusting their production lines in this direction, in order to be ready when the transition will will not just affect 2% of production but will be 20%, 30, 40 or 50%.
2	Growing awareness of climate change & pollution issues	"but I would think that there has been awareness raising about plastic pollution since probably last summer, and consumers are looking more into alternatives and how to reduce the plastic footprint."	"I think because sustainability is at the forefront of the agenda for consumers, for businesses, for governments and it's especially a huge topic right now because of climate change, because of the fact that we are…if we don't change drastically, basically we're screwed, pretty much…"	"Wir merken es ja momentan mit dem Bürger…er scheint sich sehr viel deutlicher für das Thema Nachhaltigkeit zu engagieren und zu interessieren…[…] Ja, ich merke das ja auch in meinem privaten Umfeld, dass es so ist und, dass Umweltthemen an Stellenwert gewonnen haben, was in den letzten Jahrzenten noch nicht so stark der Fall war." (translation: "We notice it at the moment with citizens…they seem to have clearly become more interested and engaged in the sustainability topic…[…] Yes, I also notice it in my private life, that it is like that, and that environmental issues have gained importance, which was not yet as much the case in the past decades.")
3	Consumers appreciate waste valorization idea		"but what I can tell you is that the reception that we get is generally extremely positive because once you tell people the facts surrounding food waste, basically anyone who shops in a supermarket or something like that is kind of aware of the general issues surrounding the amount of food that gets thrown away in one sense or another"	"No, the consumers are ready to accept it now…so it's also where the whole NGO sector is pushing to use waste and residues, go for a circular economy. I think the consumers are not the problem on this topic."
4	Consumers appreciate natural/plant-based/sustainable products	"But natural or plant-based is something which they do understand. And have the perception that it's sustainable."	"And they like that it is a sustainable alternative. They like the fact that they want to light a fire because they want to have a glass of wine with friends or loved ones, be cosy, but they are not hurting the environment more than they would…it's giving them a different option."	"…that they like the idea of a circular economy or bio-based economy, and that they have the feeling that it is environmental friendly."
5	Facilitating legislation		"Actually, there is one island in Italy that has completely banned all of the plastic materials in its fish industry. They all switched to bio-based materials, also for the fish markets…for the fish from the harbour to the shops, but also from the shops to the end customers."	"There is now a guideline about labelling for bio-based content, so a lot of tools and instruments are now in place which can help to have a much more clear, differentiated and transparent picture of bio-based products."

DRIVERS & BARRIERS		INTERVIEW SAMPLES		
TOP 10 DRIVERS	**CODES**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
6	Increasing social pressure	"I think that the pressure from society on politicians will grow and grow and grow and that will lead to legislation in all kinds of areas and that can really help promoting the bio-based economy."	"Man sieht es überall an Demonstrationen gegen Kohle, Fridays For Future…also das wir nicht immer mehr nur Konsum, Konsum, Konsum von reine Gütern sondern das war wir haben wiedernutzen können" (translation:"We see it everywhere with demonstrations against coal, Fridays For Future…that is, that it is no longer only always more consumption, consumption, consumption of virgin goods, but that we can re-use what we have.")	"policy makers are also under pressure coming from grassroot movements, NGO's, researchers, citizen movements."
7	B2B demand for sustainable products	"We are receiving questions about renewable carbon content, carbon content, that's important."	"Another question that came from our customers was: "Is your material compostable"? Like coffee cups or other kinds of packaging, is it compostable? And we started with industrial compostable. Because with a lot of products like coffee cups, there is a coating so the maximum you can do is industrial composting, but we have also customers in the UK who asked us: "Is it also home compostable"? So, I don't know! We didn't try. And just recently, last week, before the weekend, we received the test reports for three of our products that we have tested and all three have passed the tests. So, we will apply for certification for home composting also."	
8	EU in favour of supporting bioeconomy	"Yeah, I think that, again, the European Union is willing to support the bioeconomy and that will also translate into a positive influence on the market."		"Yes, yes, obviously the European Commission is putting a lot of money to investigate this issue so maybe…the impact will be very high"
9	Increasing market pressure on industry		"Well, when they come, for us it's always B2B, but at the end, when I'm realistic, it comes from the market. Because the market now indicates we want to replace plastic, we want to save our trees, so actually it's more the public opinion that pushes our customers and we give our customers the tools to meet the requirements of the end customers."	"so, there, there is this public awareness going on and companies start feeling this, and start taking this seriously."
10	strategic B2B positioning regarding sustainability		"This is one of the things that they are doing, reducing their company-wide CO2 emissions. So, that's one of the main reasons B2B customers are doing this - as a kind of promotion but also as a kind of strategy- but also, they want to place themselves as one of the leaders in the green technologies because they are skipping all kinds of plastic materials that are derived from fossil materials and they are looking for bio-based materials…so, it's a company strategy."	"Yes, of course there are greenwashing activities as well but it's not just that…I think it's a business strategy…they are getting ready for the transition of the market."

H. Interview samples – identified strategies for consumer acceptance

COMMUNICATION FOCUS/ MARKETING CLAIMS & CHANNELS		INTERVIEW SAMPLES		
IMPLEMENTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Holistic & coherent communication		"so that's why we communicate very openly and transparently and then they can see what we do and how we do it "	
			" at the end of the day, you need more as a selling point than just the sustainability of course. But it is one of the main aspects of it…and from our side, product-wise, you don't have to communicate too much because the product kind of speaks for itself…in terms of business, we communicate it also through like our conduct, how we produce, how the material is in comparison to other materials."	
	sustainability & environmental footprint	"We actively communicate that it's non-toxic, biodegradable, things like that. That's what we do"	"the sustainability is one of the main selling points of the product"	
		"And this will be used of course as a base for our environmental claims"	"That's at the core of our brand statement"	
	Communication of bio-based content	"When it's completely natural, we use that of course in our communication."	"Of course, yes! What I can do is…I have a kind of document where all the information is stated…in which you can see all the certificates that we have … all the properties of the material compared with the standard materials in the market."	
			"But slowly we are also targeting other markets because we have done a lot on marketing, on making this material known, so we have got a lot of requests from all over the world, not only from Europe but worldwide"	
	Communication of waste valorisation		"Oh absolutely! I mean, that's our USP. We are in the business of turning coffee waste into…you know, basically extracting the remaining value from this material that would otherwise be considered waste."	
			"What we encourage them to understand and to share and to communicate is the sustainability story…using something that would otherwise be tossed away, that would otherwise be forgotten and harm the environment by being wasted."	
			"So, we focus on wasted food and wasted talents"	
	Communication of both expected & bio-based properties	"I think the glue end user is definitely going for both…of course quality but also saying we have a bio-based glue"	"so we are communicating the functions of it…that it's a solid fuel for wood burner…for domestic use… and that it burns hotter and longer, that it's made of coffee"	

COMMUNICATION FOCUS/ MARKETING CLAIMS & CHANNELS		INTERVIEW SAMPLES		
SUGGESTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Positive branding: waste valorization as an asset	"And I think, being a university, it's probably also just a matter of branding. Now we are using waste for food…saying that this is just another fraction or just another part of the plant is important…so that people know they are kind of using everything and it's not something that is waste…because waste is disgusting…it's just so negative (laughter). People don't want to eat waste, but they definitely want to eat just a fraction of whatever…I think it's definitely a matter of wording and branding."	"For our product, it's very simple because it's paper. You can only tell that it is made of agricultural waste or agricultural residue because that's…when you talk about waste, some people can think….oh waste, beurk…it's waste…but if you talk about agricultural residue, it's already less of a challenge. And it does not come from the green bin or whatever, it is not collected food waste. It's a clean fibre. But you have to be careful on how you communicate."	"I think it depends on the context. For example, there is a very nice design company here in Utrecht that creates […] products for the consumer market based on processing metal wastes and he has a marketing strategy for this…so he calls it raw metals…he makes sure that the raw elements…like people like raw wooden elements, right? A floor or a table made of used scaffolding wood…it has this raw image… or old industrial lamps. That's a design strategy and there is a market for it, so he makes sure that this story…that these are all metals from waste streams put together and crushed into different products. This type of marketing strategy, I think that is a good strategy"
	Provide accurate, easy, holistic & transparent product info	"the end consumers going to the supermarket and buying diapers, they don't understand LCA. You cannot expect regular people who have nothing to do with science to understand what an LCA means. So, you have to always provide the information in a very comprehensive, easy, transparent way because you have to make their life easier basically, not more complicated"		"In our scenario that we used for our work, we tried to explain to the consumer the potential savings in terms of resources, less environmental impact, CO2 and so on. So maybe it could be useful to understand for the consumer that those products are better for the environment, but not better for the environment because I am saying this, but better because there are numbers behind that"
		"What we always say is that every claim a company makes about a product has to be of course accurate and truthful. You have to make data available to your customers, freely available. You have to use certifications for your claims. "		"Transparency and communication! To have a very clear and transparent communication about what it means"
	Avoid general & vague sustainability/bio-based statements	"Things that I already told you…don't make big claims…like oh, that's super sustainable…you have to say what does it mean"		"It's not helpful if you say, ok, make a big claim about a bio-based product and then the bio-based content is only 30%"
	No need for bio-based content communication to B2C	"For the external packaging, I think it's not a big problem because at the end, you lose traceability of the material in the end"		"I don't think it is necessary to be that familiar with the context of bio-based because you are not obliged…or it's not always the best route to communicate that with the consumers. When the bio-based product results in a better performance of products, a better quality or it's longer-lasting or the colour of bio-based products is better, or whatever you can think about, when the quality is better, you are not obliged to say it's bio-based. You can just say it's a better product"
				"Yes, absolutely! So, I would say for B2C, you can go for a claim of bio-based content when it's over 40%"

PRODUCT DESIGN & PACKAGING		INTERVIEW SAMPLES		
IMPLEMENTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Focus on added-value of bio-based properties	"And the idea is to improve the skin contact properties and the antiseptic properties"	"So, they found our material and now we are placing several fields with bio-based beads as an infill material. And that's of course 100% bio-friendly. And the health aspect plays of course a role. And what is also very important…normally, with the old infill material, with the shredded car tyres, if you put it on the soccer fields and there is a lot of rain, it will get into the ground water and you get microplastics in nature. And with this material, it's not a microplastic. So, if it reaches sea water, in about three to four years' time, and also if fish are eating it, it's not harmful. So, the material would disappear within the fish, it's not a microplastic."	
		"The European Commission has included all kinds of bio-based fertilizers because it is not only interesting for the efficient use of resources but also because it is richer in nutrients, micro-elements, hummus…we want to improve the soil and the environmental impact of the fertilizers"	"Die sind aber bekannt und der Vorteil ist halt am Kompost…im Gegensatz zum chemischen Dünger…es verbessert den Boden… es verbessert die Bodenstruktur" (translation: "But they are known and the advantage of compost…contrary to chemical fertiliser…it improves the soil…it improves the soil structure")	
	Focus on both expected & bio-based properties	"we know then which molecules or which technological functionalities we have to develop…in combination with other drivers like more sustainable, more natural, more plant-based, things like that…"	"Yes, it has the same properties. It's also in the document I will send to you. For example, regarding the insulation of the material, it's comparable, regarding shock-absorption, it's comparable. "	
		"In the end, it's equally important because the project was funded to create sustainable alternatives but that they are also functional. I think consumers nowadays, they are very demanding on what they are buying, and you just cannot make products that are not working and then expect them to succeed. If you want a sustainable product to successfully penetrate the market, you need to make products that work."	"I would say both! What I have always done in all of my jobs…when it comes to raising your products, consumers love an eco-message but there are (inaudible)… one is price and one is experience. If it's an eco-product but you have a horrible user experience, you're not going to like that product. It has to offer a good positive experience in order to have good positive emotional associations with that."	
	Optimized cascading: high-value products	"And what we do is we try to use low value side streams and convert them to high-value products"	"we are extracting the remaining compounds of the spent coffee grounds to develop products that have application as fragrance and flavour ingredients for use in food, beverages and cosmetics"	
	Sustainable product design	"the project is of course looking at improving the carbon footprint - that's why we are using bio-based feedstocks – but also industrial compostability to reduce the final….to improve the final waste management options because industrial compostability is still a better alternative or solution than landfill for example. And in the case of diapers, there are so many discarded every day. We are talking about tons!"	"we came more from the need that we see in the market…at the time when we started, it was rather the need of the planet than of the people…it's kind of obvious if you like…for example think about all the meals from the Vietnamese place around the corner. After you've finished your meal, you're just sitting in front of a table full of packaging materials. It all takes between 100 and 1000 years to disintegrate. So, this is something that is obviously going towards a wall because you can only order so and so much until the planet is full of plastic. So, we started out of this difficulty we see in the market"	
SUGGESTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Focus on development of value-added bio-based products		"Yes, it's a combination of certain properties that you have to look for and not only focus on bio-based."	"For us, that's the main requirement for using bio-based materials. We always say it doesn't make sense if it's only a substitution of materials, then it doesn't make sense at all. What we have to do is to reduce our resource use. It makes sense to use bio-based materials if there is an added value."
				"And another thing that is interesting is: don't waste time to investigate on how to replace a bottle of water, or other very cheap plastic products"

ECO-LABELLING & SUSTAINABILITY CERTIFICATION		INTERVIEW SAMPLES		
IMPLEMENTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Use of industry-related labels/standards compliance	"Yes, we have a lot of registrations, certifications related to this…eco-labels, INCOSE…I forgot a few. But yes, we try to get those labels as well for our ingredients because it helps our customers as well and sometimes the customers ask for it. If you don't have a certain label, you cannot do business with them."	"Yes, our factory has all the certificates in hygiene or to collect the food waste because we also have to deliver to retail, so everything has to be ok"	
	End-of-life certifications/ compostability & biodegradability	"I think it's also very important to get certification for industrial compostability according to a relevant standard. In this case, it would be the European standard. And I think those are the main aspects because an LCA is good for a scientific base, but people don't understand LCA."	"Most of the eco-labels…we have the whole composting labels…things like this we all do…"	
		"biodegradability tests made by a partner company"	"As I said, there is a compostable logo on the product itself. It's a different one depending on the country so that people can know where they can throw it away."	
	LCA assessment	"We will have the LCAs and the LCCs results in that part of the project where the consumers will see…well, this is environmental impact, and this is the product, and this is the business case, and this is kind of how all of this will look like."	"Yes, of course! Sure! We made those calculations. Of course, considering how difficult they are because you are in a start-up phase… so it's sometimes very hard to factor in all the elements which create a contribution to the LCA. But yes, we have done these calculations as well."	
		"Yes, there is an LCA planned"	"Yeah, well what we do now is we have performed an LCA, a Life-Cycle-Assessment, so we can compare our environmental impact over the complete chain of growing the plant until the paper is in our warehouse. We hired a company that did the LCA for us and we compared it with data that is available on the market of certified FSC paper made in Europe and recycled FSC paper made in Europe."	

ECO-LABELLING & SUSTAINABILITY CERTIFICATION		INTERVIEW SAMPLES		
SUGGESTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Use of simple & transparent labels			"So, we need clear frames, clear claims and clear labels, and a lot of communication around it."
				"I think we need to get to a point where we have less labels but more agreed upon and better-known ones. The problem now is that there are a lot, but consumers are kind of confused by all this labelling"
	Introduce LCA label for all products			"That's why we need LCAs along the whole value chain, we need sound studies in order to tell us which option is better."
				"So "numbers" means to measure the life-cycle-assessment for example, and see that the same product that comes from fossil fuels impacts more "
	Reliance on industry-related norms & standards	"This is also something that you can also probably sell with good certification because if you are using for example wound healing products, you know a hospital is not going to buy something that is not hygienic or that could create infections. You have to pass a lot of tests for these kinds of products"		"norms are very important for this. For example, I know a bit more about the construction sector and there are norms there that prescribe…so in the Netherlands, we have the Dutch organisation for norms, the NEN…and there are all kinds of norms that prescribe and define how construction materials should look like and also in terms of material composition. So, if you deviate from that norm, there will be no market acceptance because any builder will say "ok, this might be a nice material, but this is too risky"
	Reliance on labels to justify sustainable/bio-based claims	"Yeah, I think that certifications right now is the best tool we have to help the consumer understand the properties, yes."		"Yes, they really do. I think labels can help them. Especially in cases of…yes, of course, only when they are sustainable, when they have high scores regarding sustainability criteria, then of course, a label can help because the label suggests that the product is quite…that experts have already looked into it, they have assessed all those kinds of things and have said yes, this is ok! So that gives people sort of trust. And I do think that helps!"

CONSUMER & EARLY ADOPTER INVOLVEMENT		INTERVIEW SAMPLES		
IMPLEMENTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	B2B market assessment in development stage	"Yes, so there is a market assessment. For example, one of the partners for the most delicate market: bio-based plastics for cosmetics…we have a partner that is an international natural cosmetics company. We also work with a big company in Spain regarding the waste bags."	"of course we did analyse what there was on the market and tried to create competing products…like similar products that fulfil the same function"	
	B2B involvement in development stage	"business-developing seminar sessions along the way where we will invite businesses and consumers and have them thinking about how these components could be developed into a new product, and how the whole business will be in terms of making it a viable production, in terms of economic and technical feasibility…"		
		"As I said, within the consortium we also have companies, not only research institutions. And so, they are of course directly involved in the design of the product"		
	No B2C market assessment in development stage	"Yeah, and at this point, I'm not sure if they will do interviews. We haven't planned so. It's not a direct task but if they see that that's something they would need in order to fulfil their deliverables, maybe that's something they'll consider but not at this point."		
		"Not yet. What is foreseen, for example for the face masks, universities will have a group of volunteers to test it. And for the rest, we didn't make tests on volunteers, but these companies involved in the development of the prototypes, they are in direct contact with customers. So, they have this know-how available."		
	No active feedback seeking	"We love to receive a lot of feedback from our customer on how his product is perceived in the market and sometimes we get feedback but sometimes it's not shared actively with us. Because it's their let's say trade secrets. If they shared it with us, it ends at the competitor. But sometimes indeed we get feedback."	"Yes, we get a lot of positive feedback about the taste and also about the story, but we do not investigate it with a research…we don't have capacity I guess to make that step for now. We are focussing more on making it bigger and bigger but not so much on research, no…"	

CONSUMER & EARLY ADOPTER INVOLVEMENT		INTERVIEW SAMPLES		
SUGGESTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Increase co-creation processes with B2C			"So please, please, please, take the consumer perceptions as a starting point and don't start…because we do see it every time again…don't start with technical things first and then try to sell it. Please, start with the consumer…what do they think, what kind of pictures or ideas they have…which images, associations do they have, and try to build on that to meet expectations of the consumers as a starting point. That's what we always say!"/ "It has to be much earlier in the process! Develop the process together with the consumers, then technical, then consumers again, it has to be an iterative process in which they really help each other in developing a product that is accepted by the consumer."
				"Well, we have projects […] in the energy renovation of social housing for example, where the social housing corporation but also architects try to involve the residents […] and that really enhances the acceptance and the mutual trust. And of course, they have different goals […] But via these co-creation processes, they also come into contact with sustainability ideas […] So, I could imagine the same thing for products, but you have to really think about how to organize the process in this co-creation and what you want from consumers. Most consumers, at the start of such a process, wouldn't really care probably or wouldn't really want to be bothered with how products are made, but more what kind of functions does it have, what's the price? But they might become interested in how products are made and the choices and the consequences of this in the process of co-creation. These kinds of co-creation processes really enhance consumer acceptance based on my experience in the social housing project. I am confident of this."

USER INTERMEDIARIES		INTERVIEW SAMPLES		
IMPLEMENTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Partnership with NGOs & Non-For-Profits		"we are connected with “Samen tegen voedselverspilling” and that’s a big platform and community focused on reducing the waste in the Netherlands. And Wageningen University is the leader of it. So that’s the right community where in the Netherlands all the big companies are connected to."	
			"Nebenbei arbeiten wir auch mit Instituten oder Umweltverbände…da gibt es immer wieder Austausch oder Kontakt, um die Sensibilisierung der Bürger zu erhöhen, was das Thema Kreislaufführung von Rohstoffen angeht." (translation: "we also work with institutes or environmental organisations…we are frequently in touch or exchange on how to best increase citizens' awareness with regard to the issue of raw material circularity.")	
	Partnership with certification organisations	"We use certification organisations to get a certificate. Because it is required by our customer or we can use it in our communication."	"I know you already have the Cradle-to-Cradle certificate so that’s already a certification organisation you are partnering with"	
	Partnership with industry representation organisation		"we are member of several organisations. One is the stove industry association."	
			"I think packaging organisations we have been working with or awards, these kinds of things…on the paper side, for promoting the products and alternatives to paper-made products…these organisations are very well aware and have supported where they can, and we have cooperated on that."	
	No active use of intermediaries	"No, we don’t…well of course we have the homepage, but we don’t have a third party involved. Actually, when I read the question I thought: oh, that’s a good idea! (*laughter*) No we don’t!"	Interviewer: "Ok, and in that regard, can I ask you whether you partner with any third parties to promote your products…or inform your customers about bio-based products? For example, environmental organisations or media partners, consumer organisations?" Interviewee: "No. no…"	

USER INTERMEDIARIES		INTERVIEW SAMPLES		
SUGGESTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Role of businesses		"So big retailers have a lot of possibilities to make a different kind of environment for the consumers, or big retailers can demand on their suppliers to make changes or have another communication..."	"Ansonsten sind aber schlussendlich die Aufgaben eher in der gesamten Lieferkette zu sehen, von den Rohstoffanbietern, Produzenten, Endproduzenten über den Handel bis zu den Konsumenten. Und da ist die ganze Lieferkette eigentlich in der Verantwortung das auch umzusetzen. Die Politik kann das ja nicht selber umsetzen." (translation: "Apart from that, it is rather up to the whole supply chain in the end to take action, from the raw material suppliers, producers and end-producers to the retailers and consumers. And the responsability actually lies in the whole supply chain to also implement it. Political actors cannot implement it themselves.")
			"So, it's up to business to lead on this because consumers follow business...what business tells them to do. Consumers follow marketing, so businesses take the lead on this by introducing these kinds of products. They are easing consumers into the idea and getting them to accept it. It's messaging. It's just tweaking the wording, understanding consumer behaviour. It's behaviour change right? It's behaviour change and so big businesses have to manage that behaviour change. They have to lead on creating that behaviour change. And if they do it, governments will have to follow and then I think consumers will also follow."	"Yes, like I said before...it's from public procurement to big retailers, big businesses, society, ..."
	Role of media			"Media can be much more attentive to...general public media, newspapers, national television...they can be much more attentive in connecting problems we face in the world with the way that we consume products and with the way our products are made. These things are really interconnected and there is really little attention of journalists to this. For example, the circular economy which is all about these kinds of questions, is a very big topic among all kinds of governmental institutions, among businesses, but media hardly writes about this. So, journalists can write more about materials and should feel a responsibility to investigate how these things hang together. And that would help public awareness of these things. […] So yes, I think journalists have a responsibility there."
				"And the media have their role to play, and we have our role to play."
	Role of legislation		"Interviewer: Do you think it should be an effort on the part of governments or on the part of businesses, or both? Interviewee: Both, entirely both! I would say in general that there is no one responsible party and in terms of combatting waste, environmental impact and everything, this is an entirely global issue, and everyone has a responsibility, just as a human being."	"Yes, the policy makers have to set the trajectory forward...but policy makers are also under pressure coming from grassroot movements, NGO's, researchers, citizen movements. So, policy makers are not isolated islands. They take decisions based on what is the development within the society and they should reflect these developments. But at some point they also have to adopt a long-term vision and bring it forward."
	Role of environmental organisations			"So, the role of environmental organisations can be valuable in terms of putting pressure on policy makers in order to accelerate the change. This is the way I see it."
				"and that's also something we are doing...we have a cooperation with a small company making sunglasses out of ocean plastic waste. So, we are really trying to support such ideas and such business models." (interviewee talking about own role as environmental organisation)

BUSINESS MODEL INNOVATION		INTERVIEW SAMPLES		
IMPLEMENTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Waste valorization as core business model		"so we are basically taking a material that would be otherwise considered waste and transferring it, processing it, and renewing it into sustainable products that can be put back into the economy."	
			"Yes, so we were searching for where in the food chain is the most waste, and we saw that it was especially at the production locations that make slices for big fast food companies for example. So, for the tomatoes, they make slices for the fast food companies and then the heads and the cunts, they are left-overs. And so, there was a lot of waste in the Netherlands in the food chain, almost 2.5 billion euro a year. So, we started a factory…well, it's bigger than a kitchen but if Unilever is visiting us, it's a kitchen again (laughter). But it's a small factory and we can make…I think it's a scale-up model. And we receive a lot of waste streams and we make soups or sauces of it".	
	Innovative value chain		"And that logistic company, when they drop off the beans, they pick up the bags with the wet coffee grounds and backtroll it to the central location and it comes to us. So that's sort of a unique innovative logistic model that we created with Costa.[…] It's the innovation around…the logistical model and around, in our factory, processing and drying the coffee. It's massive! It was such a huge learning curve because no one had ever done it before. […] we have to work with waste associations and DEFRA to kind of recategorize what we are doing and make sure that the coffee grounds stay within the food chain […] and then therefore can be considered not a waste"	
			"Yes, and the supply chain is very new because the production locations have to separate the waste streams in their supply chains. So, that's also new for them most of the time"	
	Absence of innovative business model	"So , it's not our top priority at the moment."	"Yes, exactly, so we have looked at that, but we have not seen any possibilities to do that."	
		"No, because that's also not part of the project."	"We would love to! We would love to have [company name] recycling, but we are way too small for that. You need huge volumes for that. And let's be honest, most paper in Europe is already collected. It works perfectly. Because [company products] can be collected with regular paper. It's also clean fibres, it's virgin fibres. You can recycle it 5, 6 times. No problem at all."	

BUSINESS MODEL INNOVATION		INTERVIEW SAMPLES		
SUGGESTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Product as a service/material ownershíp			"Now one way to solve it is if you retain ownership. That's what we do in the construction, if you retain ownership of the materials, in doesn't count as waste by law. So, then you don't have to bother with waste legislation because it doesn't enter the waste stream. You are still the owner. It's not waste, it's just a resource that you retrieve and turn into something else like fertilizer or something like that.[…] But one of the problems for bio-based compared to other circular business models is that you have to diversify your production chain into new kinds of products."
	Increased circularity of value chains			"Yeah, yes, I do think that it's necessary! Because we don't have linear chains anymore. And we use the by-products and the waste products from other activities and then you have other dependencies. So, it has to play a role in a new business model, yes, I think so!"
	Increased triple bottom line integration		"but also I hope that more and more companies will look differently at their business models, not only in numbers or money, so not only in an economic way but also in a human and social way, and a combination of that."	

INFORMATION & AWARENESS-RAISING ACTIVITIES		INTERVIEW SAMPLES		
IMPLEMENTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Publication of academic research	"We will also publish… some of the reports will be public, in scientific journals but also in broader journals accessible to the general public."		
		"And dissemination activities meaning scientific publications."		
	Guidance on end-of-life options	"You also have to provide customers with the right guidance for waste collection because of course customers don't know exactly what bioplastics are. So where should they throw them away? In which bin? The yellow one, the brown one? So that's what we always put an effort on […] we will provide this kind of information to the companies interested."	"And together with our customers, we are discussing: "how can we communicate the message of the material?" Because that's one of the big disadvantages of this material: you can hardly see the difference with normal EPS. So, if a customer sees this material, he thinks: oh, it's plastic. And he throws it away in the waste bin. And that's of course…it's possible…you can throw it away…but that's of course a sin for the material itself. So, together with the companies, with our customers, we are discussing what can we do to communicate the message to their customers. And there are several ways. You can do it on the packaging itself…sometimes there are labels, you can put logos also on the material where you can state clearly how it can be thrown away… sometimes they are using other networks, other messages to put this message towards the customer, newsletters, e-mail newsletters, etc., etc."	

INFORMATION & AWARENESS-RAISING ACTIVITIES		INTERVIEW SAMPLES		
SUGGESTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Communication activities as crucial strategy	"No, well yes of course, communication is very important. It should be education and public perception."	"I think that's part of communication and I think that already starts to change now with all the focus we see in the media, etc., …that people will have to read, and people will have to learn. You can't force people to read so it's more the frequency and the repetition you do on that to create that know-how and knowledge into people so that finally they will learn it."	"Zumindest wenn die Verbraucher oder die Konsumenten mit dem Nachhaltigkeitsthema an sich vertraut sind und damit was anfangen können. Es muss vernünftig erklärt sein. Ja, das macht auf jeden Fall Sinn." (translation: At least when the users or consumers are familiar with the sustainability topic and understand it. It has to be explained in a sound way. Yes, that certainly makes sense.")
	Communicate consumption decrease as priority			"That's true…that's why we also have to reduce the amount of things that we are consuming. This is the first thing that we need to do. This is the first thing we need to communicate to consumers of tomorrow. Even more than…whether it's fully bio-based or partially bio-based…we have to communicate that the mass consumption model is simply unsustainable for so many reasons and we have to change our consumption habits…"
				"What we have to do is to reduce our resource use"
	Keep critical view on bio-based economy		"on the other hand, are we also sure about what are the right solutions? And whether bio-based is always the right solutions? And that's also what I said, if you have bio-based plastics, you might still be making plastics that are non-compostable, non-degradable. So that's probably not the right way to go."	"These companies are asking themselves: how can we replace that? Maybe we don't need a bio-based product there, we need paper for example. And this is enough. Or another material that I have no clue. And linked with your question, this is not something that is linked with bio-based products. So, it means this is not an advantage for them. So, I mean, there are different ways, if we want to concentrate on the issue of plastics, there are different ways to reduce, replace plastic. Bio-based is just one of several"

GOVERNMENT INCENTIVES & REGULATIONS		INTERVIEW SAMPLES		
IMPLEMENTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Supportive legislation as facilitator	"For fertilizers I can tell you, we will use the new fertilizer regulation which was approved this year in June."	"we also did have difficulties at the beginning to sell the product but now that there is also regulation coming that also supports this…that is good for us."	
			"And it's the same of course with the European Union who stops with some of the plastics for throw-away things. And I think this will be the first step and other products will follow."	

GOVERNMENT INCENTIVES & REGULATIONS		INTERVIEW SAMPLES		
SUGGESTED STRATEGIES	**CODES (MOST FREQUENT ONES)**	**EU RESEARCHERS**	**EU FRONTRUNNERS**	**EU EXPERTS**
	Regulation as key strategy		"I think the main point is really regulation. They only change because of regulation. They will never change a running system in which they are positioned very well."	"Bio-based…use of recycled materials, that has to be the norm so I'm pushing for the political part of it, to make a clear regulation and to make some…or pushing companies…"
			"but I think if you really want to stop the problem, then you cannot rely on 10, 20 or maybe 30% of the people who are willing to do more. You have to do something in the regulation."	"Third, what is really important is the role of the European Commission. Because law is an important driver as usual. The single use ban is coming from the European Union. I don't think that without that, companies will change. Companies will change because the European Union said that, from 2020, the rules of the game are changing. So this is another important driving element for companies."
	Promotion of sustainable goals	"But you should not aim for a bio-based economy where energy is the most important outlet. Solar and wind should be the most important sources for energy and fuel. And materials should become more and more based on renewable sources. But without legislation it's really a struggle."		"I would be reluctant. I would say we have aims and objectives and we don't want any climate change anymore. And the measures that we take to realize that, that's up to you…so the one can take measures by using more bio-products, another one can implement some sort of technology, whatever, so I would be reluctant in rules or laws, directives to use a certain amount of bio-based. The government should aim to have less energy use, less climate change…"
	Penalize polluting & non-renewable products/pay the true price	"You ask an amateur football club to play against Barcelona and Barcelona is requesting for a level-playing field. So, they are allowed to put into the field Messi and Suarez, etc. Who is going to win? Barcelona I think. Level-playing field is only benefiting those companies that are in power now. It cannot be a level-playing field. You cannot expect the bio-based industry to win from the fossil-based industry in a level-playing field. And therefore, you need legislation. You need to forbid certain products."	"I would agree with you but if you're talking about increasing taxes on for example…based on the carbon footprint of a product, you know, I think that's a reasonably sensible idea…that's one thing governments could be doing…"	"Why doesn't the policy maker impose the burden of these external costs on producers? They have been exploiting…Producers and the society of course have been disregarding these external costs and now is the time for realizing that these external costs have to be integrated into companies' costs in such a way that they can modify the cost structure of producers."
	Promotion of circular & cascading use of materials	"As I said, if a farmer cannot make money with food crops, he will grow something or start a camp site or put solar panels on his agricultural land…and that would be a waste of agricultural land I think. And nobody is complaining that we grow cotton on agricultural land which is also a non-food application. It's all about effective land use. And that should be the policy: how can we produce as much as possible of food, non-food, fuel, energy, whatever…based on the acres of land we have available."		"I think that policy makers should take important steps into this direction…promoting a circular bio-based economy is a way out of the linear fossil-based economy. It's an urgent and called for policy intervention."
	Importance of adequate end-of-life legislation		"And the crucial part will be…you can develop bio-based products, etc. but I think the whole thing around it is to re-arrange proper end-of-life systems, structures supporting bio-based or more bio-based packaging products."	"so for this reason we need a very stringent and binding regulation on end of waste"
	Importance of adequate legislation for bio-based products	"Well, policy and regulation are the first step. If you have a regulatory framework for these kinds of products made out of bio-based feedstocks, automatically you will have a stronger presence in the market. "	"We are talking to government legislators, regulators, trade bodies and organisations. And trying to really push the agenda of removing obstacles around waste regulations to make it easier for other companies to do it as well. There is so much regulation, and it's pretty heavy and pretty outdated really. We need governments to think out of the box. Which is what we have done…which is what other companies are trying to do as well. And we need the government to follow in order to make it."	
	Promote bio-based products through incentives		"Governments should try to support this kind of initiatives rather than what I have seen in the last four, five years with this product."	"Das heißt dann natürlich auch, dass man biobasierte Produkte wie Verpackungen fördern könnte." (translation: this of course also means that bio-based products such as packaging could be subsidised.")

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