

Changing the market for a sustainable innovation

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ABSTRACT

The development and diffusion of sustainable innovations are of interest to various public and private sector actors. The diffusion of sustainable innovations into value networks facilitates and is facilitated by the change of markets towards sustainability; however, this interaction needs further investigation. We examine how combinations of value network actors' intentions and activities affect market change for a sustainable innovation. We empirically explore market change related to introducing bioplastics into plastic food packaging value networks. We increase the understanding of market change for a sustainable innovation by showing how not only the actors with direct intentions to support the innovation but actors and activities indirectly related to the sustainable innovation contribute to market change. Such indirectly supportive activities focus on broader sustainability aims and can, for example, change market representations, practices, and norms in favor of the sustainable innovation. We propose sustainability layers to understand the diverse sustainability focuses of actors and their relation to the market change in question. Specifically, we contribute to market change literature by broadening the examination scope beyond the most active actors driving market change for an innovation.

1. Introduction

Sustainable development and the need to protect the possibilities of the present and future generations to meet their needs have created a great societal interest in supporting the development and diffusion of sustainable innovations. Such innovations, including products, services, processes, and organizational and marketing methods, seek remarkable sustainability impacts (Aka, 2019). Sustainable innovations are complex and uncertain due to their systemic and multipurpose nature (Pellegrini, Annunziata, Rizzi, & Frey, 2019), and they engage different stakeholders (Longoni & Cagliano, 2018). Even though involving such stakeholders is seen as essential to promote sustainable innovations (Ayuso, Rodriguez, Garcia-Castro, & Ariño, 2011), these actors may have differing views and interests regarding value created through the innovation, as well as on the division of risks and responsibilities (Vleter, Bitzer, Bocken, & Kemp, 2020).

Therefore, despite the constant development of new technologies that mitigate or resolve sustainability challenges, the diffusion of sustainable innovations into the market remains problematic (Planko, Cramer, Chappin, & Hekkert, 2016). Such new technologies must compete with established technologies supported by existing markets (Geels, 2002; Kemp, Schot, & Hoogma, 1998; Köhler et al., 2019), even

preventing actors from adopting more sustainable solutions (Gliedt, Hoicka, & Jackson, 2018; Kivimaa & Kern, 2016). To understand how sustainable innovations are brought to the market, more research is required about processes and mechanisms that can change related markets and value networks (Smith, Voss, & Grin, 2010). In order to enable the diffusion of sustainable innovations, it is suggested that actors need to create and modify the existing structures, including the creation or reconfiguration of value networks and the creation of a supportive environment for an emerging technology (Musioli, Markard, & Hekkert, 2012; Planko et al., 2016). In particular, network collaboration has been identified to be integral in shaping such an environment (Planko et al., 2016). The diffusion of sustainable innovations cannot rest on a single actors' shaping efforts, as the novel solutions typically hold value for longer-term sustainable development and may lag behind when compared to the existing solution from a present value perspective. Thus, the diffusion of sustainable innovations requires understanding of the broader framework of market actors, their activities, and how they affect market change. Currently, limited attention has been paid to the interdependent interplay between heterogeneous market actors when markets change or are changed (Baker, Storbacka, & Brodie, 2019). Extant research has focused either on micro-level practices or macro-level market systems, and more research is

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needed on the market shaping practices at the *meso* level (i.e., network) (Baker & Nenonen, 2020). Also, empirical research on market shaping has been limited so far (Humphreys & Carpenter, 2018), especially in the sustainable innovation context.

Within marketing, research on markets as socio-technical-material constructs consisting of actors and institutions (Araujo, Kjellberg, & Spencer, 2008; Kjellberg & Helgesson, 2007; Nenonen, Storbacka, & Windahl, 2019a), market dynamics (Baker et al., 2019; Kindström, Ottosson, & Carlberg, 2018), and, especially, the purposive efforts by actors to shape markets (e.g., Nenonen, Fehrer, & Brodie, 2021) has provided insights into the different processes and factors affecting broader market systems and their change. Furthermore, markets are increasingly viewed as malleable and complex adaptive systems encompassing a wide array of market actors (Flaig, Kindström, & Ottosson, 2021) that can influence markets through various activities (Kjellberg, Azimont, & Reid, 2015; Ottosson, Magnusson, & Andersson, 2020). To capture the changing nature of markets, the extant literature employs a variety of concepts (Sprong, Driessen, Hillebrand, & Molner, 2021), including “market creation” (Aarikka-Stenroos & Lehtimäki, 2014), “market driving” (Humphreys & Carpenter, 2018), “market innovation” (Kjellberg et al., 2015) and “market shaping” (Nenonen et al., 2019a). Despite some differences in their emphasis, all of them highlight some form of purposive actions of involved market stakeholders, either individually or collectively, to influence market formation and transformation to bring in new offerings or processes (Sprong et al., 2021). As Hawa, Baker, and Plewa (2020) point out, understanding actors' intentions and actions is key to advancing market-shaping knowledge. Thus, to understand market change, the focus needs to be placed on market actors and their diverse behaviors, making it essential to identify whose activities (e.g., interest groups, customers, suppliers, and their advisors) and which kind of activities shape the markets (Kjellberg et al., 2012). In this study, we focus on market change resulting from combinations of market actors' intentions and activities, also examining those actors who are not so purposive in their actions. In our definition of a market, we agree with Nenonen et al. (2019a, p. 252). They characterize, relying on various studies, markets as systemic, complex adaptive socio-technical-material systems, consisting of institutions, actors, practices, and discourses that organize particular economized exchanges. Market change is widely understood here as a combination of changes to the existing market structures, introducing new market devices, altering market behavior, and reconstituting market agents (Kjellberg et al., 2015).

To summarize, the present study examines the market change for a sustainable innovation with a focus on a multitude of actors within an existing value network and their diverse intentions and activities connected to the market change. The research question is: *How do value network actors' intentions and activities affect the market change for a sustainable innovation?* This question is first addressed by examining the combinations of value network actors, their intentions, and activities, then analyzing the activities and the market changes they bring about. To gain theoretical understanding, literature on the intentions of market shapers (e.g., Flaig et al., 2021; Hawa et al., 2020), sustainable innovation (e.g., Varadarajan, 2017), and market change (e.g., Nenonen et al., 2019a) are employed. Qualitative methods are used to examine a plastic food packaging value network, where bioplastic packaging is examined as an example of a sustainable innovation which wider diffusion requires market changes. Bioplastic food packaging provides a rich case to examine the market change for a sustainable innovation as it represents an example of a sustainable innovation pushed by legislation, consumer demand, and public innovation mechanisms, as many sustainable innovations are. It provides market value network actors with a way to act more sustainably. This enables the examination of the activities related to the sustainable innovation itself and their relation to the broader sustainable development activities of the market actors. The packaging sector is bioplastics' most important application area, capturing nearly half the yearly production capacity (European

Bioplastics, 2022a). However, conventional plastics play a key role in the network as a limited number of large-scale firms provide bioplastics, and many bioplastic materials have higher prices and inferior properties in food packaging use compared to conventional plastics. In addition, established actors (e.g., petrochemical companies and packaging suppliers) have made significant investments in machinery, manufacturing know-how, processes, and relationships related to conventional plastics, decreasing interest in new investments in bioplastics. Hence, the case potentially offers a varied set of intentions affecting the market change.

The study contributes to the literature on sustainable innovation (Ottosson et al., 2020; Varadarajan, 2017) and market change (Fehrer et al., 2020; Nenonen et al., 2019a) by showing how the market change results from the diversity of value network actors' intentions and activities. We especially, explicate the importance of actors and activities who only indirectly support the sustainable innovation, as they mold the market towards sustainability and, in that way, indirectly support the market change for the sustainable innovation. We present sustainability layers as a way to distinguish between such directly and indirectly supportive actors and activities. Our findings provide implications for firms developing and commercializing sustainable innovations to existing value networks where diverse actors' intentions collide. Finally, we present further research avenues for examining market change for sustainable innovations.

2. Conceptual background

In the following, we discuss the market actors and the basis of their behaviors in the market as key determinants in understanding the market change for sustainable innovation. This is followed by a discussion on the nature of the activities performed by various market actors that affect market change and a discussion on the role of value network level examination. We conclude by presenting our study approach to understanding market change for a sustainable innovation.

2.1. Actors' roles and intentions in market change

Sustainable innovations refer to new products, services, processes, and organizational and marketing methods that seek significant sustainability impacts (Aka, 2019) and to broader processes where sustainability considerations (environmental, social, and financial) are integrated into company systems from idea generation through R&D and commercialization (Boons, Montalvo, Quist, & Wagner, 2013). Such innovations are ongoing society-level processes, spanning organizational boundaries, engaging different stakeholders, from suppliers and customers to regulators and nongovernmental actors, and changing their behaviors in the market (Longoni & Cagliano, 2018).

The existing literature focusing on market change (e.g., Kjellberg et al., 2015; Storbacka & Nenonen, 2011) depicts how market actors can influence markets to achieve their aims, rather than taking the markets as given and adapting to their constraints. Markets are seen as continuously changing due to the activities performed by actors operating in the market (Baker et al., 2019). This emphasizes actors' behaviors constituting markets (Araujo et al., 2008; Storbacka & Nenonen, 2011) and provides a perspective to understand market change (Araujo, Finch, & Kjellberg, 2010).

In addition to individual market actors, changing the market or market shaping has also been seen as a collective action (Fehrer et al., 2020), and agency can be distributed among several actors (e.g., Doganova & Karnøe, 2015). Hence, a market may be changed or shaped by an individual market actor, e.g., a firm, and it can also be seen as a collective action by a set of actors that share a common end goal (Jaworski, Kohli, & Sarin, 2020; Maciel & Fischer, 2020). In sustainable innovations, various actors involved in the market may have differing views and interests on the value created through the innovation, as well as on divisions of risks and responsibilities (Vleter et al., 2020), yet involving different stakeholders is essential in providing a mechanism to

promote sustainable innovations (Ayuso et al., 2011).

By combining extant research on intentions and agency, Hawa et al. (2020) suggest a framework concerning intentions in market-shaping that includes present- and future-oriented intentions and individual and shared dimensions. Future-oriented intentions reflect, e.g., the goals, the plans needed to achieve these goals and the coordination of individual actions. In contrast, present-oriented intentions are more means-oriented and reveal how the action unfolds in real time. This is essential for sustainable innovations driven by future-oriented sustainable development needs and more present-oriented entrepreneurial opportunities, in accordance to triple-bottom-line thinking (Reficco, Gutiérrez, Jaén, & Auletta, 2018). According to Hawa et al. (2020), actors at an individual level, based on individual intentions, participate in market-shaping by implementing different strategies and mobilizing different activities than those pursued by collectives that strive to transform markets jointly and in accordance with shared intentions. Furthermore, intentions are dynamic, meaning that market actors can swap one form of intention for another. Membership dynamicity means transitions between individual and shared intentions, and temporal dynamicity occurs between questioning current routinized practices, expectations, and market rules and legitimizing and stabilizing new ones (Hawa et al., 2020).

According to Hawa et al. (2020), *intentions at an individual level in the present time* imply routinized participation by individual firms, customers, or other stakeholders in a market. In terms of sustainable innovation, such activities may be connected to seeing the innovation merely in the context of existing solutions and markets and comparing them. When taking the view of the *individual level with future orientation*, the actions are driven by a focal actor's self-interest and ambition to gain an advantage. For example, an actor might pursue diffusing a sustainable innovation due to a business opportunity perspective and sustainable development causes. Being seen as legitimate among stakeholders, the purposeful actor draws on individual future-oriented intentions to coordinate action mobilization and displacement of the status quo with new market understandings. Alternatively, future-oriented intentions may drive individual actors to maintain (or stabilize) the market to protect their position of power (Fligstein & McAdam, 2011).

When considering intentionality at the collective level, Hawa et al. (2020) found that when looking at *collective intentions in the present time*, shared present-oriented intentions are reflected in routinized market network dynamics among embedded actors that change participation, roles, and social positions. Here, an example of behaviors could be the collaborations within the existing industry value network to adopt and diffuse a sustainable innovation. Market actors frequently negotiate the content and distribution of market tasks and coordinate and synchronize their actions in relation to one another (Hawa et al., 2020). Finally, a *joint agency driven by shared future-oriented intentions* means that members identify with their group and rationalize their market situation according to group reasoning. Advancing sustainable innovations through such behaviors is based on a shared view of measures needed for sustainable development in the long run.

Thus, the activity aimed at changing markets is driven by a complex and evolving web of intentions, featuring any combination of present-oriented or future-oriented, individual or collective intentions. In the context of sustainable innovation, the change-creating behaviors, both individual and collective, and with present and future orientations, are relevant to consider when aiming to understand the related market change. The level of intentionality, and whether the activity is individual or collective, plays an essential role as actors can be oriented in their own interests and goals or more towards collective aims, such as sustainable development.

2.2. Market change activities

The diversity of actors and their intentions results in various activities performed, affecting the market change for a sustainable

innovation. Although much of the existing research considers actors as intentionally changing or shaping the market (see Hawa et al., 2020; Nenonen et al., 2019a), we recognize that not all actors are active or intentional but are still advancing the market change with their behaviors. Regardless of the nature of intentionality, all actors conduct three types of practices: exchange practices that realize economic exchanges, normalizing practices that seek to establish normative objectives for the markets, and representational practices aiming at depicting markets and how they work (Kjellberg & Helgesson, 2007). In the context of sustainable innovation, Ottosson et al. (2020) explored how public and private actors have engaged in a multitude of activities that have built up the market-shaping processes in biogas market development. Those activities can be summarized through enabling exchange practices, proving the system, and constructing a supportive narrative for the new technology. Their study highlights that the key actors must repeatedly respond to tensions rising from growth and growth aspirations and consider the relationships with established systems when developing and implementing new technologies. Thus, the intentions and activities of various market actors interact constantly, producing market change.

Market change for a sustainable innovation is often heavily affected by macro-level drivers such as policies and regulations advancing sustainable development (Ottosson et al., 2020; Pellegrini et al., 2019). The market change can be hinged upon the composition of a complex network of actors with diverse interests, where the initial push may come from legislation, and diverse market devices are important, as they overarch the normalizing, representational, and exchange practices that build the market (Doganova & Karnøe, 2015). Market mechanisms intend to trigger a virtuous cycle of demand, supply, and technological innovation, supporting each other and constructing the market (Doganova & Karnøe, 2015). Collaboration among scientists, firms, and users is critical in measuring the benefits and costs of new technologies (Doganova & Karnøe, 2015), improving the system, and building a supportive narrative for a sustainable innovation (Ottosson et al., 2020).

Focusing on market actors' purposeful actions to change the market, Nenonen et al. (2019b) have used the concept of market work and, to assess its effectiveness, developed a composite index of market change, including six elements of market change (see Table 1 for a simplified presentation). Accordingly, markets can be changed by changes in products and prices, customers and use, channels, supply-side networks, representations, or norms. For each element of market change, there are more detailed indicators. For example, in terms of changes in products and prices, the offerings themselves, how they are combined, or their pricing strategies or price levels can change. Changes in customers and use can include changes in how customers use existing products or what customers want in a product, for instance. Changes in norms can refer to changes in regulations, standards, or what is acceptable regarding products, services, or activities. These categories provide a framework to examine market change in an organized way and offer the possibility to link specific activities with specific market changes compared to more ambiguous definitions and frameworks for market change.

2.3. Value networks

Actors, intentions, and activities come together in a value network. In order to diffuse sustainable innovations to diffuse, broader network effects and changes at the whole value network level have been reported as essential (Keränen, Komulainen, Lehtimäki, & Ulkuniemi, 2020). This is because sustainable innovations are complex and uncertain due to their systemic and multipurpose nature (Pellegrini et al., 2019), requiring extensive cross-sector collaboration (Longoni & Cagliano, 2018) and often restructuring existing value networks (Keränen et al., 2020). Actors in the value network have different roles in value creation or positions in the production system (Johanson & Mattsson, 1992). The roles of the diverse actors within the network vary, with some being more active and some less active in advancing the innovation's diffusion.

Table 1
Market change elements and indicators (Nenonen et al., 2019b).

Element	Indicators
Products & price	Radical changes in products and/or services Changes in how products/services are combined into offerings Changes in pricing structures of products/services Considerable changes in price levels of the products/services
Customers & use	Changes in the way or the purpose for which the product/service is used Changes in the kinds of customers who buy the product/service Changes in what customers want in products/services Changes in the options customers have regarding full-service vs. self-service Changes in the physical or technological infrastructure for using products/services
Channels	New or different channels that the industry uses to find/service customers New or different channels that customers are using to find/contact potential service providers
Supply-side network	Changes in the number of competitors Changes in how competitors interact and cooperate Changes in the number of suppliers/partners to cooperate with Working with new kinds of suppliers/partners Changes in how work is outsourced to suppliers/partners Changes in ways to interact and cooperate with suppliers/partners
Representations	Changes in the terminology commonly used Changes in the language/descriptions that media use to report on the industry Changes in the categories used by official statistics/research agencies to report on the industry Changes in the focus of key events/awards related to the industry Changes in the focus of industry associations
Norms	Changes in the industry's standards Changes in government regulations Changes in what is perceived as generally acceptable in terms of types of products, services, or activities

There may be a lack of active market actors pursuing such market-shaping behaviors for sustainable innovations, especially when innovations are generated in research-based innovation systems rather than through entrepreneurial opportunity recognition. Market change is required for sustainable innovations to diffuse, especially within traditional industries with established industry value networks and well-performing solutions. In relation to this, Flaig et al. (2021) suggest that focal market actors attempt to direct the market-shaping process in their own favor, either by inducing a market change or trying to prevent emerging change. In other words, offensive market actors attempt to assert their own market configuration and claim the market. At the same time, defensive firms aim to protect their market from undesired changes that might threaten their value-capturing potential. This supports our aim to focus on different kinds of actors in the market, not only those who intentionally aim to change the market but also those who change it indirectly or even aim to slow down or hinder the change. So, in the context of this study, some actors' intentions can support a certain sustainable innovation or sustainability in general. In contrast, some may intend to maintain the current market state by stagnating the change.

In the present study, we explore a sustainable innovation (i.e., bioplastic food packaging) that involves various value network actors with diverse roles (i.e., actors relevant for developing, using, and disposing of/recycling the bioplastic food packaging) varying from material producers to retailers, consumers, research organizations and regulators. Here a value network includes actors from diverse industries (such as plastics, packaging, food, and retail) involved in the sustainable innovation explored and where value is jointly created (see e.g., Peppard & Rylander, 2006). However, as actors such as regulators primarily affect value creation and interact with such industry actors, we include them in our concept of the value network. The concept of innovation (instead of

invention) is used because the sustainable innovation in question is, from the beginning, being developed for a commercial purpose (see Schumpeter, 1934). Also, it was already introduced to the market, and the business around it is growing (e.g., Garcia & Calantone, 2002). We view the diffusion of a sustainable innovation as a process where value network actors' activities change the market for a sustainable innovation and look at those activities as perceived at a certain point in time to analyze what the actors do to advance their own intentions (i.e., goals) that further drive the market change.

2.4. Value network actors' intentions and activities changing the market change for a sustainable innovation: Study approach

Market change for sustainable innovations can result from a variety of value network actors and their intentions and activities coming together. We aim to understand this complex phenomenon by building a combined understanding of combinations of those actors, their intentions, and activities in a value network and analyzing their effect on the market change related to the diffusion of the sustainable innovation.

Value network actors can have offensive or defensive intentions regarding the market change for the sustainable innovation, and they may be focused on collective or individual perspectives. In addition, actors' intentions can be understood as being present- or future-oriented. Therefore, companies of existing value networks may take an active role in seeking current entrepreneurial opportunities for themselves related to the sustainable innovation or a more-future-oriented approach to seize, together with other actors, opportunities supported by forthcoming regulatory developments related to the sustainable innovation. Market change can be affected by the activities of various actors in the market. In addition to active shapers of the current market, we also seek to identify less active actors, still affecting the change through their activities. Because of their systemic nature, sustainable innovations call for understanding the whole value network and the related activities of diverse actors. Present in the same value network, it is assumed that diverse activities and intentions interact, affecting the market change. Fig. 1 describes our study approach: how the combinations of value network actors' intentions and activities affect continuous market change for a sustainable innovation.

3. Methodology

Qualitative methods are applied to examine how value network actors' intentions and activities affect the market change for a sustainable innovation. In the empirical context of the study, bioplastic food packaging is the sustainable innovation, and the value network refers to actors related to the development, production, use, and disposal of plastic food packaging. Qualitative methods emphasize the qualities of the entities (Denzin & Lincoln, 2008), enabling a detailed and holistic understanding of the human interactions, meanings, and processes, forming organizational settings (Gephart, 2004), such as business networks and markets. Qualitative methods are further useful in describing the network and market change as they allow the examination of situational details (Gephart, 2004), such as contextual specificities of activities affecting market change.

There is an ongoing change in the plastic food packaging market towards more sustainable packaging materials. There is a growing demand for more sustainable materials across sectors, and that demand is answered, for example, by replacing fossil-based plastics with bioplastics (biobased and/or biodegradable plastics (European Bioplastics, 2022b)). In terms of sustainability, bioplastics are not without problems (e.g., Iles & Martin, 2013; Kakadellis & Harris, 2020; Sitaloppi & Jähi, 2021), but bioplastics can offer a renewable feedstock and biodegradable materials instead of fossil-based material that does not degrade (Kishna, Niesten, Negro, & Hekkert, 2017). The sustainability of bioplastics is affected, in practice, by where it is used and how its life cycle is managed. There are numerous biobased biodegradable polymers, but

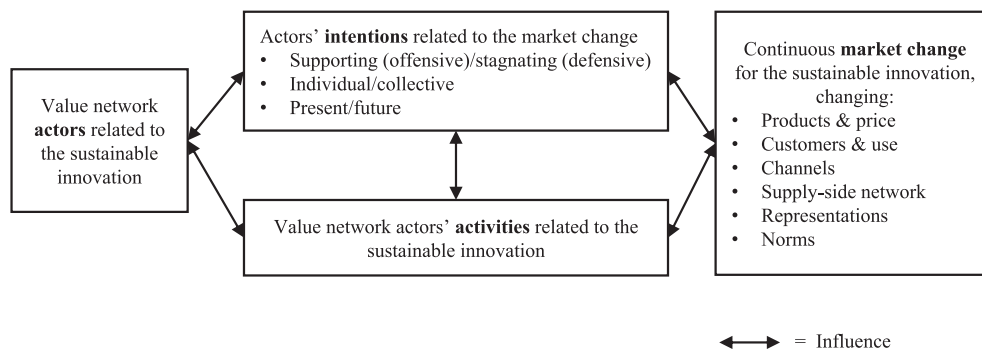


Fig. 1. Market change for a sustainable innovation: study approach.

in this study, we discuss them as one innovation. This approach is in line with the value network actors we interviewed—they discussed bioplastics as one material group or made clearer distinctions between “biobased” and “biodegradable” bioplastics. However, many interviewees did not discuss biodegradable fossil-based plastics as bioplastics. Therefore, in this paper, bioplastics refer to biobased plastics that are or are not biodegradable.

The large-scale production and dissemination of bioplastic food packaging to existing plastic food packaging networks require changes in the raw materials used, their processing technologies, and procedures. Therefore, we examined the whole value network for plastic food packaging and did not focus on any single firm, project, or bioplastic type. The primary data includes 31 thematic interviews of experts that were either directly involved in (such as packaging suppliers or research organizations) or highly influential concerning (such as policy-makers) the development, production, use, or disposal of bioplastics in food packaging (Table 2). The interviewee selection aimed to cover all value network actors. The interviewees represent organizations of different sizes and ages, as such factors might affect how the market change is perceived in the organization.

The interviews were conducted between 2018 and 2020 and they included single and group interviews with participants across Europe (e.g., Belgium, Finland, Italy, Netherlands, Spain, and Switzerland). Most of the interviews were conducted via online video conference applications. Thematic interviews were suitable as they facilitated the interaction between the interviewer(s) and interviewee(s) and permitted the researchers to emphasize different themes depending on the interviewee's expertise and ask follow-up questions. Hence, questions for a technology development manager of a brand owner firm were different in detail than questions for a negotiating official working in a ministry. However, all interviews discussed bioplastics in food packaging and included questions regarding 1) the events, developments, and actors of the value network linked to the development, production, and use of bioplastics in food packaging, 2) the actors' activities related to bioplastic food packaging, 3) the barriers of broader diffusion of the sustainable innovation, and 4) the factors promoting its diffusion.

Four online workshops were organized to elaborate on the challenges of introducing bioplastic food packaging into existing plastic food packaging value networks (Table 3). Some workshop participants were interviewed earlier but some were new, as we sought to acquire complementary insight, for example, from publicly funded R&D projects working on bioplastic packaging and associations. Notes from the workshops were analyzed similarly to interview data.

The interview and workshop data were triangulated by secondary data that includes public plastic and bioplastic industry-related reports and webpages (examples of these include reports and web pages of European Bioplastics, Plastics Europe, EU, and EU funded projects, and the nova-Institute), providing a general understanding of the bioplastics, plastic food packaging market, and the characteristics of plastic food packaging value networks. Thus, we have not utilized the secondary

data directly in the analysis, but it has supported the researchers' understanding of the empirical context.

During the preliminary analysis, it became evident that the data was saturated, as it covered viewpoints from all major actors in the examined value network and new interviews did not seem to provide any new information. One researcher was primarily responsible for further analysis, while all researchers repeatedly compared and discussed drafts. The analysis was revisited to find a consensus in case of conflicting views.

First, the analysis identified relevant actors and their activities related to the market change, which were inductively categorized by the type of activity. After several iterations, ten third-order activity categories were formed, covering 28 second-order categories, comprising 65 first-order categories. After this, we analyzed the intentions (based on Flaig et al. (2021) and Hawa et al. (2020)) linked to actors and their first-order activities. Then, we analyzed the market changes (according to Nenonen et al. (2019a)) linked to activities, starting from the first-order activities, and proceeding to summarize market changes for third-order activity categories. We created various tables, of which the most insightful ones were the one that presented the analysis items (intentions, activities, and market changes) per each actor and another that presented them per each third-order activity category (intentions, actors, and market change). Then, we drew figures based on the tables and looked for patterns in how actors, intentions, activities, and market changes are linked. The final step in the analysis was to examine, based on the tables and figures, the intentions, activities, and market changes as a whole, to form the answer to the “how” research question in terms of the major intentions and activities of each actor, linking individual/collective and present/future intentions with major activities and, finally, connecting activities with market changes.

4. Empirical analysis

4.1. The identified value network actors and major activity categories

We identified the following key actors related to plastic food packaging development, production, use, and disposal. *Petrochemical firms* and *bioplastic providers* act in plastic food packaging value networks as material suppliers, offering *packaging suppliers* (and other plastic processors) conventional and bioplastics for producing preforms and final forms of packaging. Packaging is often designed with and for *brand owners* (such as food companies), and then sold by *retailers* (such as supermarket chains) to *consumers*. Finally, the packaging is handled by diverse *end-of-life service providers* (such as waste management facilities or recycling communities managing flows of recyclable packaging). However, beyond these somewhat linearly connected actors, there are important actors whose activities connect to and affect the plastic food packaging market. These include public and private *research organizations*, *consulting firms*, *NGOs*, *consumer and industry associations*, and *regulators*.

Table 2
Interview data.

Interviewees	Interviewees' organization type	Interview details
R&D Engineer I	Packaging supplier I	14.8.2018, 90 min
R&D Director and two Product Technicians	Brand owner I	4.9.2018, 30 min
Senior Sustainability Consultant	Consulting	12.9.2018, 55 min
Innovation Manager	Brand owner II	8.10.2018, 60 min
Sustainability Manager and Project Manager	Retailer and brand owner I	5.11.2018, 70 min
R&D Engineer II	Packaging supplier I	10.4.2019, 50 min
European Project Manager	Agricultural business consulting	16.4.2019, 30 min
Technology Development Manager	Brand owner III	8.5.2019, 80 min
Director of Bioprocesses Area, Researcher, and Project Manager	Research and innovation center	2.5.2019, 50 min
R&D Project Manager and Researcher	Innovation center for plastics	6.5.2019, 55 min
Process Engineer and Team Leader	Scaling-up laboratory	20.6.2019, 50 min
Senior Scientist	Research institute II	28.8.2019, 90 min
CEO	Waste management facility	24.9.2019, 40 min
Associate Professor	University II	22.10.2019, 35 min
Project Manager	Technology center for agriculture	30.10.2019, 50 min
Researcher	University IV	18.8.2020, 90 min
Head of Packaging Development	Brand owner IV	20.8.2020, 40 min
Researcher	University I	25.8.2020, 45 min
Development Manager	Biogas producer	27.8.2020, 45 min
Key Account Director	Packaging supplier II	1.9.2020, 60 min
Professor	University V	1.9.2020, 70 min
Principal Scientist	Research institute III	2.9.2020, 60 min
Chief Sales and Marketing Officer	Packaging supplier III	14.9.2020, 60 min
Commercial Director and Public Affairs Manager	Bioplastics producer	22.9.2020, 60 min
Negotiating Official	Ministry of Economic Affairs and Employment	2.10.2020, 65 min
Company Owner	Bioplastics provider and importer	16.10.2020, 55 min
Director and Ministerial Adviser	Ministry of the Environment	4.11.2020, 65 min
Sustainability Manager	Retailer and brand owner II	11.11.2020, 40 min
Plastics recycling community	CEO	15.4.2021, 50 min
Potato trade and processing association	Regulatory Affairs Manager	26.4.2021, 40 min
PHA Association	Founder/Consultant	27.4.2021, 75 min

To clarify, by an actor, we refer to a particular position, role, and key activities, in the value network—not to any single organization. In the value network in question, one organization can handle either a specific part of the activities or operate broadly. For example, some large retail chains are also brand owners as they have private labels and design their own packaging for these brands. In packaging suppliers, we also include other plastic processors who, for example, blend masterbatches for various purposes or blow film or bottle preform for the company that

Table 3
Workshop data.

Workshop number	Organization type	Informant(s)	Workshop details
1	Scaling-up laboratory	Business Development Manager Professor Sustainability Consultant I	10.2.2021, 1 h 25 min
	University II Sustainable development consulting Technology center for agriculture Technology center for agriculture	Project Manager I R&D Project Manager I Project Manager II	
2	Research and innovation center Sustainable development consulting Packaging manufacturer I Innovation center for plastics Innovation center for plastics	Sustainability Consultant II Project Manager III R&D Project Manager II Researcher	23.2.2021, 1 h 50 min
3	Biomaterial innovation center Packaging association Plastics industry association	Project Manager IV CEO I CEO II	12.4.2021, 1 h 25 min
4	Bioplastics association Research project I Research project I Research project II/ university Environmental association	Environmental Affairs Manager Project Coordinator Scientific Coordinator Project Coordinator Coordinator	29.4.2021, 1 h 15 min

finalizes the packaging. Sometimes, all these activities are performed by a single firm. Bioplastic providers include large-scale bioplastic producers, piloting facilities doing experimental and small-scale production, and importers of bioplastics. Also, based on our data, we excluded some actors that appeared unimportant for understanding the market change, such as providers of colors and additives and machinery and equipment suppliers.

The major activity categories of market change that we identified from our data are 1) changing operations inside and between organizations to be more sustainable, 2) changing offerings to be more sustainable, 3) educating, 4) collaborative pressuring (for sustainability), 5) collaborative R&D (developing new materials and packaging), 6) regulative push (towards sustainability), 7) lobbying/influencing regulations, 8) supporting adoption/use, 9) collaborative system building for circularity in plastics, and 10) increasing bioplastics production. These activities are explained further in the following sections.

4.2. Linking value network actors, intentions, and activities

4.2.1. Actors' offensive/defensive intentions and their main activities

The plastic food packaging value network combines actors from the plastics, food, and retail sectors. Accordingly, our data reveals differing intentions related to the market change, affecting their activities in the value network. However, these actors' intentions are not clear-cut.

For starters, it is difficult to determine whether an actor's major intentions are mainly supporting (offensive) or stagnating (defensive) the market change for the sustainable innovation, as none of the actors can be said to be defensive *only*. Even petrochemical firms, packaging suppliers, end-of-life service providers and regulators, whose current intentions can be seen to stagnate market change, have activities that

support the change, too. That reflects the ongoing nature of the market change among these actors. Conventional plastics still have a solid position in the value network, especially in petrochemical companies' and packaging suppliers' businesses. Conventional plastics are affordable, available in many qualities and on a large scale, and have superior properties (barrier properties, flexibility, durability, recyclability, etc.) for many food packaging applications. Also, petrochemical companies have strong, established positions and extensive resources to support their business's continuance, compared to the fragmented packaging market. Hence, the effect is that it is easy for brand owners and packaging suppliers to continue using conventional plastic packaging.

"This is what we are dealing with, a lot, with environmentally friendly packaging. They have their price tag. And business units want them. Then they are told that it costs this much and cuts our profit, or the [food producers'] profit, then they think 'we don't want them after all'." (Head of Packaging Development, Brand owner IV).

"In flexible packaging, there is an interesting difference compared to many other domains; this is a market with numerous small and medium-sized companies, and it is not consolidated. So, the raw material provider side around us is enormous, those oil/plastic companies." (Chief Sales and Marketing Officer, Packaging supplier III).

On the other hand, petrochemical firms and packaging suppliers also feel pressure towards more sustainable packaging from regulations and consumers. Many such firms offer "green" product lines, often utilizing biobased plastics or recycled materials. Packaging suppliers also collaborate with various actors to build recycling systems for plastics (also for bioplastics) and develop sustainable packaging. They showcase new materials, especially with brand owners and retailers.

Currently, end-of-life service providers, such as organizations recycling plastics or composting facilities, are primarily perceived to stagnate the market change if looking at their current activities. Many regions in Europe lack recycling infrastructures for many bioplastics and biodegradable plastics are not accepted in composting facilities, as they may hamper the process (especially decomposition), or they are rejected along the sorting process like all plastics. However, end-of-life service providers have intentions and activities supporting the market change. For example, they collaborate with bioplastic providers and brand owners to develop such infrastructure and recycling technologies as the flows of bioplastic materials are expected to grow.

"Even if they [plastics] are certified (...) that they can be composted, the facilities do not have time to verify that, and they do not want to take any risk. (...) So, it means that even if you have on the market some compostable bioplastics, they are not composted." (Senior Sustainability Consultant, Consulting).

"What we do is to work closely with the composters, not only to keep them aware of how our material works in their specific technology, but also to help them find the solutions to increase the composting infrastructure and make better composting infrastructure because you also need technology." (Public Affairs Manager, Bioplastics producer).

Regulators' intentions and activities provide support for the market change but, at the same time, create uncertainty among business actors, stagnating the change. Diverse policy instruments on the EU level (e.g., EU Circular Economy Action Plan and its plastics strategy, Waste Framework Directive, Directive on single-use plastics, Packaging and Packaging Waste Directive) and their implementation on a national level support renewable raw materials, but many interviewees mentioned that the simultaneous push for recyclable materials is making business actors hesitant to invest in or to adopt new low-volume materials based on renewable feedstock as the recycling infrastructure for them is not in place yet (such as for many bioplastics). This regulatory unclarity affects bioplastic providers and packaging suppliers when they consider new investments in production capacity and R&D, develop their offerings, and guide their customers in choices of materials. Also, many brand owners developing their packaging are pondering choices between biodegradable and recyclable materials because of the perceived unclarity on how diverse materials are positioned in regulations. So far,

that reflection has been more harmful to bioplastics than helping.

"Our standpoint is, clearly, regarding materials, two-folded. It is recycling and using recycled materials and then the renewable raw material base. (...) I still can't evaluate clearly, for example, by some clear measures, whether it is reasonable to have biodegradable [materials] or not. Is it good or bad (...) in our market, the northern region of Europe? And I think that is essential and something to think about." (Chief Sales and Marketing Officer, Packaging supplier III).

"We have decided for now that we are not using biodegradable packaging that has various challenges, starting from when you put a liquid product into a biodegradable packaging or even a solid, there is migration, and we do not know how the new components affect food quality and if something occurs there that we do not want. But maybe the biggest [problem] is that the infrastructure for biodegradable packaging is broken." (Head of Packaging Development, Brand owner IV).

The EU's Directive on single-use plastics was another frequently mentioned example of uncertainty about whether bioplastics are treated as conventional plastics. This may lead actors to choose other strategies for sustainable packaging than bioplastics. These regulation-related challenges may be partly due to the wide variety of bioplastic materials and differences in how they degrade or can be recycled, making it harder to form an informed opinion. However, it is suggested that each material's benefits in diverse applications should be evaluated instead of comparing materials in general. That is why bioplastic producers and consulting companies, for instance, direct and guide their customers using such materials.

"In any case, the benefits, I would say, that are related [to biodegradable bioplastics] depend on the purpose of your product and are mainly related to the end-of-life option. So, it makes sense sometimes to have compostable plastics rather than non-compostable." (Senior Sustainability Consultant, Consulting).

Only a few actors, bioplastic material providers, research organizations, and consulting firms have major direct intentions to support the market change for bioplastic food packaging. Understandably, bioplastic providers intent to advance the use of bioplastics in diverse applications, of which packaging represents the most important sector. Especially directing the use of bioplastics in diverse applications is considered essential by bioplastic providers.

"When I say we work with the value chain, it is that we, and it's not so typical for a plastics company, we also work downstream, with our customers' customers, until the very end customer. And the reason is to provide guidance on where it makes sense to use such materials, both from a performance point of view and a product positioning point of view." (Commercial Director, Bioplastics producer).

In addition, bioplastic providers seem to be taking an essential step in increasing the production of bioplastics and answering the increasing demand for them. So far, the limited number of providers of large-scale bioplastics has been limiting the availability and possibilities of adopting bioplastic food packaging. For example, in our data only three large-scale bioplastic providers were mentioned by name. Especially this limitation is felt by large brand owners and retailers and, finally, by packaging suppliers.

"The annual capacity [for a specific promising biobased biodegradable plastic material] is limited. So, our [supplier of bioplastic material] will not, they can't produce 1,500 tons a year. That's close to nothing if you compare it to your annual plastics consumption. So right now, the material is used a lot for research to develop new ideas. To find alternative material solutions to have solutions ready in the future when you can scale up the production." (Company owner, Bioplastic provider and importer).

There are research organizations and consulting companies that directly support bioplastics and bioplastic packaging through collaborative R&D. In addition, consulting companies direct and support the use of bioplastics in customers' applications, and researchers produce and share knowledge of bioplastics and partake in general discussion

and education about sustainable packaging, supporting the market change indirectly.

The intentions and activities of NGOs, industry and consumer associations, and brand owners both directly and indirectly support the market change for bioplastic food packaging, also collaboratively. Some industry associations and organizations provide direct support for bioplastics (such as European Bioplastics, Global Organization for PHA, or New Plastics Center in Finland). Also, certification and standardization organizations for bioplastics support the development and adoption of bioplastics and make them more understandable for end users. Providing indirect support for the market change in question, industry associations for plastic packaging, retail, and the food industry have collaborative activities to advance sustainability in supply chains, for example. At the same time, they are lobbying and influencing regulations related to packaging, for instance. Brand owners are collectively pressuring their suppliers of packaging and machinery to provide more sustainable packaging and equipment to process those, for example. Also, brand owners are collaborating with various value network actors to develop a system for recycling plastic packaging, also made of bioplastics. Even though there are brand owners who are adopting and supporting bioplastics, brand owners' intentions often relate to sustainable packaging in general, supporting their broader sustainability goals.

"What we are aiming at, to minimize food waste, to decrease the amount of packaging waste, so we do not over pack, we optimize the packaging. Then, we want to move away from fossil-based raw materials, that is, use plant-based [materials]. (...) and then, absolutely, circular economy and that our packaging is recyclable and fits into the recycling and collection systems." (Head of Packaging Development, Brand owner IV).

"We have been reducing, making our foils thinner and optimizing the product's weight to the size of our packaging. We have been able to kind of drive this sustainability effort." (Technology Development Manager, Brand owner III).

In our analysis, retailers and consumers appeared as actors who often did not have direct intentions related to bioplastics. Consumers are demanding sustainable packaging, indirectly supporting the market change for bioplastic food packaging. Retailers, especially, are answering to the sustainability demands coming from regulations and consumers, and they indirectly support the market change for bioplastic food packaging.

"[Based on] what we know and what consumers are asking from us is that consumers are really interested in packages and their environmental impact" (Sustainability Manager, Retailer and brand owner II).

Both retailers and consumers put pressure on the supply-side actors, and regulators, creating demand for sustainable packaging, and supporting the market change for bioplastics and bioplastic food packaging. In addition, retailers have broad collaborations to advance their sustainability goals. For example, they work with brand owners, packaging suppliers, and newly, with material providers to develop sustainable plastics and packaging, and the system for circular packaging. Specific to retailers is that it seems that they have taken a societal role, also driving their business interests, educating not only their own suppliers and personnel but informing consumers about sustainability and sustainable packaging in collaboration with other actors, such as research organizations and associations.

"Interviewee 1: ...They [WWF] educate our personnel, and then we have those [projects], where we have clear collaboration (...).

Interviewee 2: Yes, we cannot solve many sustainability problems by thinking about something alone and working on them alone, but through collaboration in the value chain. It is extremely important. (...) When we are solving problems and creating new practices, there can be several industries involved, not only retail but the food industry, environmental service providers, and some chemical company. That is the entity. Then some associations guide and advise consumers and like that." (Sustainability Manager (1) and Project Manager (2), Retailer and

brand owner).

Hence, when looking at actors and their major intentions and activities, we noticed offensive intentions that directly or indirectly support the market change for the sustainable innovation, in addition to defensive intentions that stagnate the market change. Fig. 2 depicts the identified activities that directly and indirectly support the market change and activities stagnating it. From this examination, we learned that *not many actors have major direct intentions to support the market change for the sustainable innovation. Still, there are other actors that provide important indirect support for it.*

In relation to this, analyzing actors' major intentions led us to identify *layers of sustainability* that capture the types of sustainability focus of actors and of their activities. Fig. 3 presents the sustainability layers relevant to our case, starting with the most specific sustainability focus as the core and having broader sustainability focuses organized around it. The first two layers (bioplastic food packaging and bioplastics) were considered to provide *direct support* for the innovation and the related market change. In contrast, the others provide *indirect support* (sustainable packaging, plastics, and operations). These sustainability layers depend on the empirical context, but their identification can help to understand the intentions and activities of the related value network actors. There is a mutual positive influence between the direct and indirect supportive layers.

4.2.2. Linking present/future and individual/collective intentions to activities

When looking at actors' individual/collective and present/future intentions, most actors seem to have both individual and collective (except petrochemical firms that appeared to act rather individually) and present and future-oriented intentions and activities. Hence, there are varied intentions and activities in this sense per actor. However, when examining the intentions that the major activity categories represent, there exist differences between the activities (Fig. 4).

Almost all major activities directly supporting the market change in question represent collective and future intentions. Such activities support bioplastic food packaging or bioplastics. Especially system building for circularity in plastics, including the building of infrastructure and developing the technologies for recycling bioplastics, appears as an ongoing collective activity among a great variety of actors, aiming to change the market to be more supportive of bioplastic packaging in the future. For this purpose, bioplastic providers, packaging suppliers, retailers, brand owners, and plastics recycling communities cooperate with diverse partners, such as research organizations. Lobbying/influencing regulations, educating, and collaborative pressuring are other collective activities with future intentions where the expected results are not immediate. For example, a bioplastic material association aimed, together with industry actors, to influence how bioplastics are treated in a single-use plastics directive, and an environmental organization informs and educates consumers about sustainability in plastics.

Regulative push, referring to policy instruments driving recyclable packaging materials, reduction of single-use plastics, and renewable raw materials, for instance, affects business actors already when being prepared and first implemented. Still, the intentions of such instruments can be considered more future than present-oriented. Collaborative R&D and supporting adoption and use (related to bioplastic food packaging, bioplastics, sustainable packaging, and/or plastics) are also primarily collective and future-oriented efforts. Still, individual actors, especially bioplastic providers, conduct R&D and direct the use of their materials and products.

In comparison, efforts to increase bioplastic production largely depend on the decisions and resources of individual companies, as well as changing offerings to be more sustainable. In many cases, such activities are responding to the present market situation. However, changing operations inside and between companies to be more sustainable requires collective efforts in supply chains, such as joint projects and policy-driven initiatives, even though there are also internal

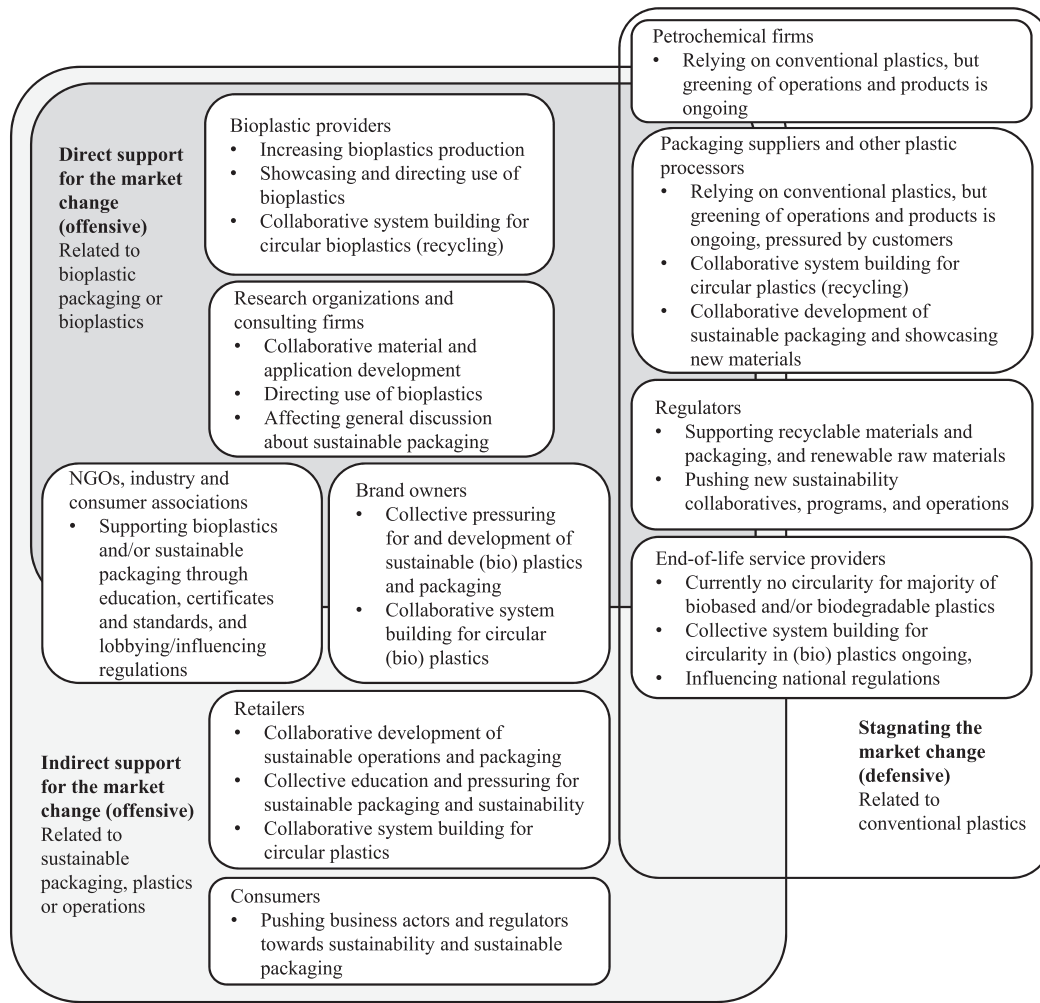


Fig. 2. Actors' major intentions and activities.

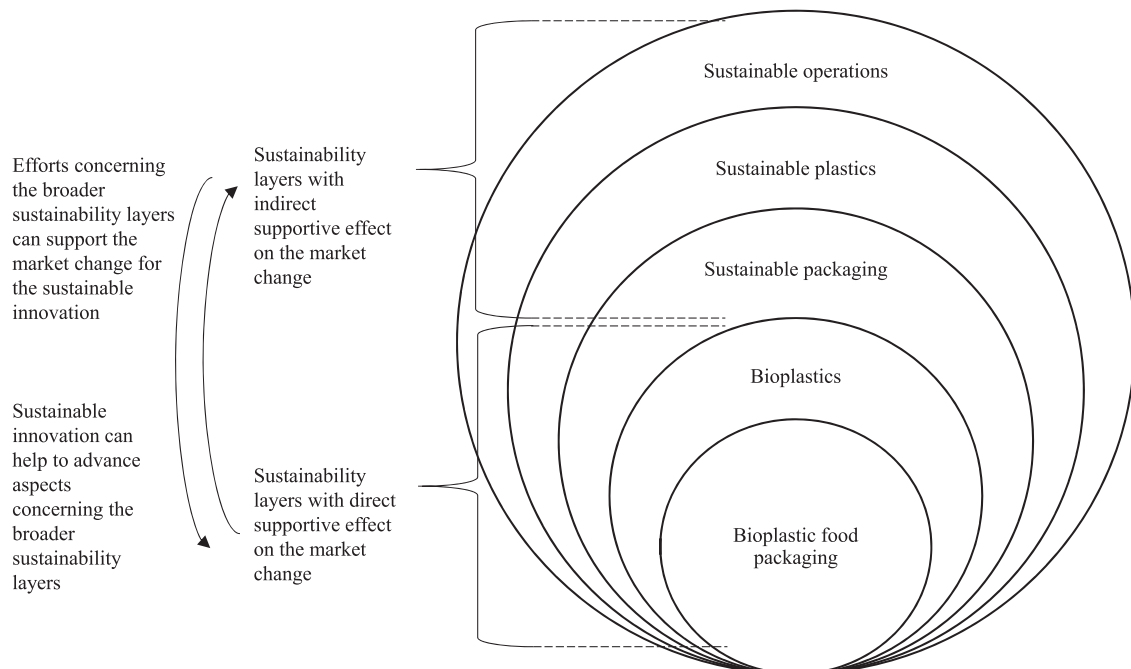


Fig. 3. Sustainability layers relevant to the study.

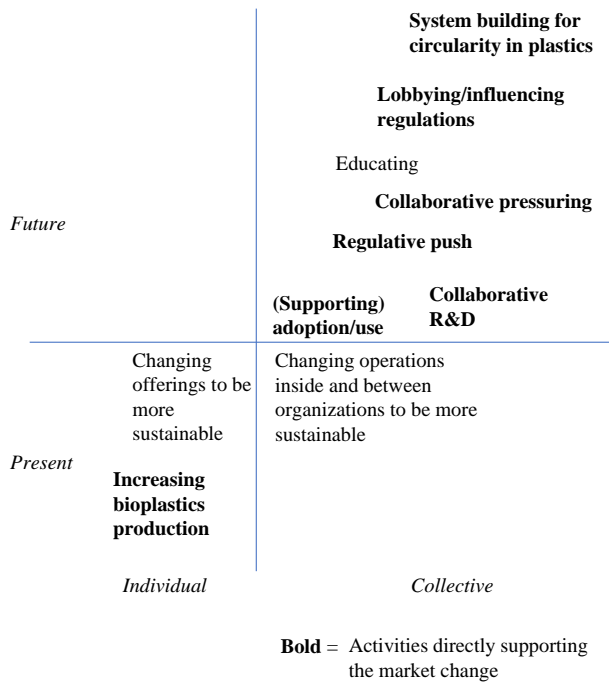


Fig. 4. Linking major activities to individual/collective and present/future intentions.

efforts in companies to change their operations. Especially, retailers we interviewed discussed their general sustainability aims and how they collaborate with their suppliers and customers to achieve them.

“Related to sustainable consumption, this kind of traditional circular economy, or not traditional, but true circular economy thinking, we would want closed loops for the raw materials. We have an example of such a loop, a collaboration with [supplier of cleaning products]. We have utilized the plastic material that we collect from our stores in the supplier's processes so that they can produce cleaning products made of that.” (Sustainability Manager, Retailer and brand owner II).

4.3. Market changes resulting from the identified activities

4.3.1. Modifications to the market change categorization

When we analyzed the market changes starting from the first-order activities, then summarized them to the second and to the third-order activity categories, we soon noted that we needed to modify the categorization of market changes by [Nenonen et al. \(2019b\)](#) to capture our data fully.

First, instead of using a category of supply-side network changes, we refer to (supply-side) network. This minor modification was done to represent the role of important actors, such as research organizations (for collaborative R&D, for instance), industry associations (for lobbying and system building for circular plastics), and regulators (e.g., ministries that participate and manage industry related policy-driven programs), whose market changing activities were strongly present in the data and who collaborate with brand owners, packaging suppliers and bioplastics providers, for instance. Second, we added “supply volumes” as a subcategory to (supply-side) network changes, which was an important identified market change. Still, it did not fall directly under the existing categories. Third, we added “practices” as a new category, even though we first considered labeling it under norms and what is acceptable in terms of activities. However, we wanted to emphasize the actual change of activities continuously performed by organizations, inside and between them, and by consumers, to highlight the behavior change and not only in acceptance of certain kinds of behavior. For instance, many interviewees reported that their organizations are developing more

sustainable practices perforating all their operations, starting from the type and amount of electricity used, guidelines for procurement, or organization of logistics systems. This kind of change in practices supports the market change, creating a pull for the sustainable innovation, as it may help to fulfill some of these broader sustainability aims. Also, bioplastics as a packaging material need specific conditions and maneuvers in packaging production and, from there to the customer, affecting the practices of the involved actors.

“I also know that sometimes if you decide to implement bioplastic in your production line instead of, let's say, polypropylene; you cannot always use the same production process.” (Senior Sustainability Consultant, Consulting).

We did not identify significant market changes related to channels, but partly because we categorized packaging suppliers reaching for new suppliers, bioplastics providers, under changes in the (supply-side) network. There appeared to be a mindset that new solutions are sought with current partners/suppliers rather than seeking new packaging suppliers. The collaboration in the plastic food packaging value network is characterized as linear, long-term, and well-established, influencing the market entry of new actors. The relationships between material providers, packaging suppliers, brand owners, and retailers were described as relatively solid, especially in cases of customized packaging, and sometimes for contractual reasons. Hence, business customers are not largely changing their channels to find or contact potential suppliers, and the innovation does not typically change channels from the consumers' viewpoint.

“We, who are always testing new things, we are not loyal, we test any material, any new material, and if it does not work, we go to another one, [but] if you are producing a specific packaging, and that is your product, you have to stay loyal because [otherwise] your product will change.” (R&D Engineer II, Packaging supplier I).

“We are not exclusive food producers of [name of a customer], but they want to have one single supplier for their foils. So, sometimes we are contractually bound to purchase from a specific supplier.” (Technology Development Manager, Brand owner III).

In addition, many subcategories of the market changes ([Nenonen et al., 2019b](#)) were not identified. For example, changes in the pricing structure of products, options regarding the customers' possibility to choose between full-service and self-service, or changes of focus of key events or awards did not come up in our data. It does not mean that these changes do not happen because of the introduction of bioplastic food packaging, but at least they do not appear to play a significant role.

4.3.2. Linking market changes to activities

We analyzed the market changes related to each identified activity to understand the role of diverse activities in the market change. Changes in the product and prices, (supply-side) network, and customers and use were strongly represented in our data. These are rooted in the material change for food packaging. However, changes in representations and norms were also highly present, reflecting the new terminology related to bioplastics and the broader change of norms related to sustainable development, affecting the market.

Furthermore, we categorized the market changes for activities that directly support the market change (by supporting bioplastic food packaging or bioplastics), do it indirectly (by supporting sustainable packaging, plastics, or operations), or stagnate the market change for the sustainable innovation. In our data, most major activity categories include directly and indirectly supportive activities regarding the market change ([Fig. 5](#)). However, three major activities mainly provide indirect support for the change: changing offerings to be more sustainable (including change of packaging or product materials), changing operations to be more sustainable (including changes in materials), and educating (e.g., for sustainable packaging and materials). Specifically, *these indirectly supportive activities are changing practices and norms* (regarding what is acceptable) and changing the market to be more responsive to activities that directly drive the market change for

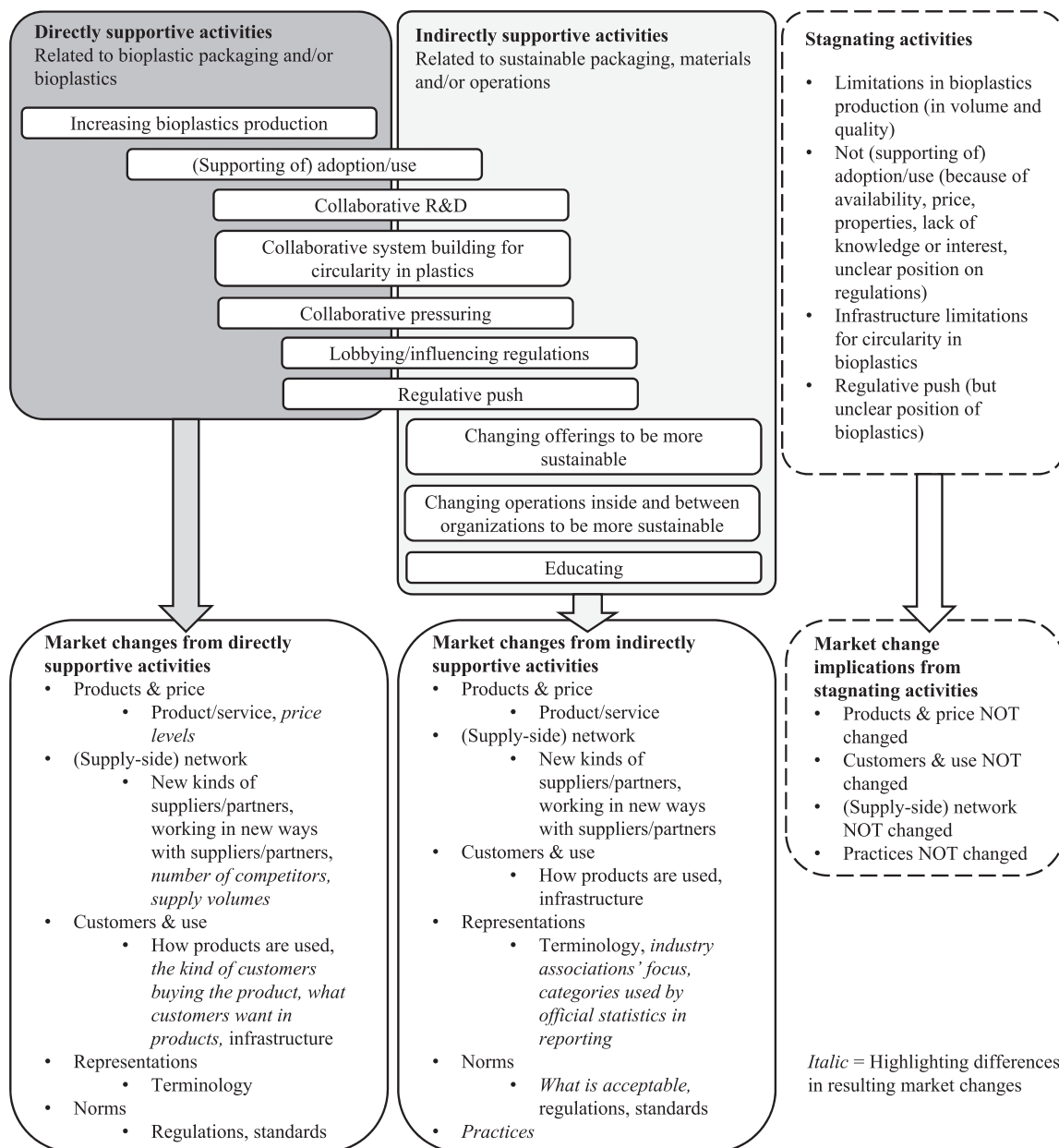


Fig. 5. Market changes linked to major activity categories (grouped by their support of the market change).

bioplastic food packaging.

Importantly, we noted that *the indirectly supportive activities could impose a very similar set of market changes to the activities providing direct support for the market change*, pointing out the importance of such indirectly supportive activities for the market change. Both directly and indirectly, supportive activities produce five such market changes. First, changes to the product (mainly referring to the change in the food packaging material to be more sustainable or a change in packaging design because of this) are supported by all other major activities than education. Second, changes to the (supply-side) network resulted from all but two major activities (lobbying/influencing regulations, supporting adoption/use): we identified several new partnerships and new ways to work with current partners/suppliers, especially to advance diverse sustainability aims, because of the change in the material or the regulative push. For example, retailers who have collaborated with packaging suppliers, the food industry, and diverse associations now also collaborate with each other to have more sustainable packaging, packaging suppliers are collaborating with new R&D partners for

sustainable material development, and ministries and industry associations make voluntary commitments to achieve sustainability goals for which individual firms can join through their associations.

Third, customers and use are changing because of the changes in products. Especially the way products are used (product design, processing, use, disposal) and the infrastructure (technologies and systems for the end-of-life) development, as mentioned, are related market changes. Fourth, representations, in terms of terminology, are changing. The terminology related to bioplastics is often considered confusing among business actors and consumers. For instance, in our data, bio-based, biodegradable and bioplastics were mentioned as examples of such ambiguous concepts. Fifth, norms are changing, as there are efforts to change and influence regulations and create standards regarding food packaging and the use of bioplastics.

Another finding (see Fig. 5) is that even though there are activities and non-activity of a defensive nature that stagnate the market change, such as choosing not to adopt bioplastic food packaging, the largely missing infrastructure for recycling such packaging, and perceived

regulations-based unclarity, *it seems that the stagnating effect may be limited*. We acknowledge that due to our focus on bioplastics, our data might give an overly optimistic stance about this matter. However, our data also indicates that the actors feel the broad sustainability pressure experienced in the value network and society. Hence, even though the change in products and prices, customers and use, (supply-side) network and practices may be slowed down, it is likely that the representations and norms are changing nevertheless, supporting the market change for the sustainable innovation. Related to this, even the actors with defensive intentions may partly be supporting the market change (Fig. 2).

5. Conclusions

5.1. Theoretical contributions

The present study has examined how the value network actors' intentions and activities affect the market change for a sustainable innovation. To answer the research question, the study first identified the relevant actors, their primary intentions (offensive or defensive) regarding the market change, and ten major activities contributing to the market change. It was analyzed whether the activities are driven by individual or collective, and present or future intentions. Then, the market changes resulting from those activities were presented.

This study offers three significant contributions to the existing literature. First, the study contributes to research on market change (Baker et al., 2019; Flaig et al., 2021; Kindström et al., 2018; Kjellberg et al., 2015; Nenonen et al., 2021; Ottosson et al., 2020) by revealing the importance of actors and activities that only indirectly support the market change for the sustainable innovation. The present study identified that there might not be many actors in the value network whose primary intention is to directly support the market change for a particular sustainable innovation. However, many actors indirectly support the market change by focusing on broader sustainability aspects than those represented by the specific innovation. This supports our study's basic assumption that it is important to look beyond the "active shapers" with a direct link to the innovation. Also, the study revealed that indirectly supportive activities create various kinds of market changes, quite similar to changes created by directly supportive activities. The set of only indirectly supportive activities is small (educating and changing offerings and operations to be more sustainable) but crucial for changing the market in favor of the sustainable innovation. Especially we identified these indirectly supportive activities to change practices, norms, and representations towards sustainability, thus also supporting the market change for the sustainable innovation. It has been noted that networks of varied actors and activities can contribute to the commercialization of innovations (Aarikka-Stenroos, Sandberg, & Lehtimäki, 2014). We extend that examination to the sustainable innovation context and look at market change.

Second, related to the first contribution, we add to the knowledge of understanding market change for sustainable innovations by presenting layers of sustainability that support the market change for sustainable innovation either directly or indirectly. These layers represent value network actors' diverse sustainability focuses and activities, and the actual layers depend on the empirical context. In addition to identifying those sustainability focus areas that are directly supporting the sustainable innovation (in our case, bioplastic food packaging and bioplastics), there are likely to be actors with broader sustainability efforts going on (in our study, related to sustainable packaging, plastics, or operations), potentially molding the market to be receptive of the sustainable innovation. Occasionally, the sustainability layers concept has been used for diverse purposes (e.g., Bogren & Sörensson, 2021; O'Dochartaigh & Maughan, 2017). Here, we introduce sustainability layers for the purpose to analyze the market change for a sustainable innovation.

Third, the present study sheds light on understanding market change for sustainable innovations by showing how defensive actors and

activities may have only a limited stagnating effect on the market change toward sustainability. Stagnating activities may slow down the changes in products, customers, use, networks, and practices, but norms and representations keep changing due to extensive social sustainability pressure, affecting business actors. This is in line with Flaig et al. (2021), who suggest that there are both offensive and defensive market actors who have intentions to either change the market or protect the current situation. Furthermore, we suggest that it would be beneficial to analyze what kind of market changes those stagnating activities impose on the market in question, to understand their force.

Besides the three major contributions, our study connects to and adds to the present research on market change and sustainable innovations in the following ways. By utilizing the categorization of intentions by Hawa et al. (2020), our results reveal how major activities that provide direct support for the sustainable innovation and drive the market change share collective future intentions. Our findings support previous research on sustainable innovations noting that they require collective effort and future orientation (Longoni & Cagliano, 2018). Still, we also show which activities are collectively and future-oriented and individually and present-oriented. In addition, this is in line with previous research that has continuously pointed out the need for a future-oriented mindset (Varadarajan, 2017) and collaborative and networked activities for advancing sustainability (Ayuso et al., 2011; Planko et al., 2016).

Furthermore, our analysis complements existing categorizations of market-shaping activities (Baker et al., 2019; Flaig et al., 2021), also drawn from sustainable innovation contexts (e.g., Ottosson et al., 2020), indicating that even though there are similarities between different studies and empirical contexts, the activities appear to be context-dependent. Hence, market-shaping literature has addressed diverse intentions and activities and examined market-shaping activities for sustainable innovation. Still, our study investigates intentions and activities related to the market change for a sustainable innovation.

The present study has demonstrated how the identified activities connect to market changes. Here, the focus has been on the value network instead of looking at the supply network or customers as separate groups of actors. The examined value network includes various kinds of partners beyond exchange relationships. In the analysis, we used the elements of market change proposed by Nenonen et al. (2019b). We add that a broadened view of the network element is necessary to capture the value network perspective, and especially, this seems relevant when looking at sustainable innovations. In addition, we identified that a change in supply volumes was a relevant network change, affecting the market change for such an emerging innovation. Also, we added practices as an essential market change element. We argue that in market change towards sustainability, change in practices of business actors and consumers, indeed, is an important additional element of identifiable market change. Also, it often requires collaborative efforts between firms, such as when thinking of achieving carbon neutrality in a retail chain, triggering changes in the network, too.

5.2. Managerial implications, limitations of the study, and avenues for future research

The study provides insights for firms seeking to create and diffuse sustainable innovations or that want to support such innovations. First, the layers of sustainability highlight that for the actors that have direct intentions to drive the market change for a sustainable innovation, it would be important to acknowledge the activities and actors that are indirectly linked to the sustainable innovation. Identifying an actor's sustainability focus reveals whether and how the actor is linked to the innovation in question, indicating how to present the innovation to the actor. Such indirectly supportive actors can change the market in favor of the innovation in question or become directly interested in it if they find or are shown how the sustainable innovation can contribute to their sustainability focus. For example, based on our data, brand owners and retailers are potential adopters of bioplastic food packaging because of

their strong interest in adopting sustainable packaging. However, they should be educated and informed about the sustainability and properties of bioplastics in food packaging applications and supported in their adoption efforts and packaging redesign. Also, the indirectly related actors can create a market for the sustainable innovation by educating other actors and changing offerings and operations to be more sustainable. The actors driving the market change for the sustainable innovation could aim to build collaborative relationships with well-networked indirectly supportive actors to foster such activities.

Second, our data indicated challenges for the broader diffusion of bioplastic food packaging related to perceived discrepancies in regulations and the growing demand for bioplastics being held back by the strong position of conventional plastics and the limited supply of large-scale bioplastics. These challenges are stagnating the market change. On the other hand, they offer opportunities for business actors, such as developing the performance and properties or improving the availability of bioplastics for food packaging applications.

Third, as with any innovations, identifying innovator customers, who are willing to adopt new sustainable innovations despite the potential problems in performance or supply, is essential. Such firms typically have a strong sustainability orientation, having sustainability as their order-winning strategy (e.g., Ciccullo, Pero, Gosling, Caridi, & Purvis, 2020). In addition, actors who have broad sustainability collaboratives are important to identify for firms bringing sustainable innovations to markets. Our data suggests that smaller plastic packaging suppliers, who act on a project basis and develop new solutions with their customers, could play an important role in bioplastics. In addition, brand owners and retailers are active in sustainability collaborations and could be necessary for advancing the sustainable innovation in question.

The present study's data focuses on the diffusion of bioplastics in the plastic food packaging value network. However, we propose the findings to provide value to other, similar kinds of value networks, where several industry sectors come together, creating a mix of diverse activities and interests that are moving towards more sustainable solutions. Still, the findings need to be assessed through the study's limitations. First, we do not claim that the list of identified market changes is exhaustive. Still, it represents the changes identified in our data, focusing on the actors relevant to the sustainable innovation. Also, the analyzed intentions and market changes need to be considered as researchers' interpretations, even though primary and secondary data support them. Furthermore, the data represents the state of the market change from the perspective of value network actors at the moment of data collection. That inhibited us from examining the market change as a longitudinal process, which would have better-revealed shifts in intentions and activities. Furthermore, the interview data is not focused on specific branded material or companies. That allowed us to have a broad perspective on the phenomenon and to grasp the activities of firms operating under a similar position in the value network. On the other hand, we might have lost some detail describing the market change. Also, each actor has their own view of what a market is, but we guided the interviews to focus on bioplastics in food packaging use.

Our findings offer possibilities for future research. Firstly, our data provided insights into the market change during the emergence of bioplastics in plastic food packaging applications. However, further studies are needed to understand the market change for a sustainable innovation as a longitudinal process, where stabilization also starts to appear (Kjellberg et al., 2015), and actors may adopt different strategies for affecting the market change (e.g., Flaig et al., 2021). For example, how does an emerging market evolve towards stabilization in the case of sustainable innovations, what are the critical activities and processes, and is it even possible to stabilize such markets? Secondly, the data indicates that the established use of conventional plastics has slowed down the broader adoption of bioplastic food packaging. Does broader diffusion of bioplastic food packaging require a decline in the conventional plastics market, or could both packaging solutions exist in

parallel, and how? What kind of tensions arise between new and old solutions, and what are their effects? These questions apply to several industries and existing value networks, where more sustainable offerings challenge conventional solutions. Thirdly, our study suggests that the interaction between parallel offensive and defensive intentions and diverse sustainability focuses deserves further examination to advance our understanding of market change for sustainable innovations.

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Declaration of Competing Interest

None.

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