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**Author(s):** Näyhä, Annukka

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Transition in the Finnish forest-based sector: Company perspectives on the bioeconomy, circular economy and sustainability

Annukka Näyhä

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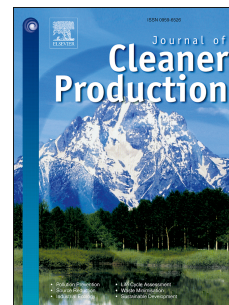
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## Transition in the Finnish forest-based sector: Company perspectives on the bioeconomy, circular economy and sustainability

Corresponding author: Annukka Näyhä<sup>ab</sup>

a. Jyväskylä University School of Business and Economics, P.O. Box 35, FI-40014 University of Jyväskylä, Finland. Email.

annukka.nayha@jyu.fi. Tel. +358 40 8054817

b. University of Jyväskylä, School of Resource Wisdom

### Abstract

The forest-based sector is affected by many profound structural changes and the increasing complexity of the business environment due to, for example, the mature markets of many core products and the aims for bio and circular economies and more sustainable societies. In response to the changing business environment, forest-based sector firms need to restructure their business models and develop new products and services.

From the Finnish perspective, new forest-based businesses are crucial in the transition to successful and sustainable bio and circular economies. Views on the concepts of bioeconomy, circular economy and sustainability vary according to which parties are involved. Developing new forest-based sector businesses requires that different actors have knowledge of how each understands these concepts because this creates a basis for commonly accepted goals. This study aims to shed light on how forest-based sector companies understand the concepts of bioeconomy and circular and their linkages to sustainability when transforming their businesses.

Semi-structured thematic interviews were conducted with 18 company executives and managers from 17 forest-based sector firms and companies from interfacing sectors, all of which have operations in Finland.

The results indicate that there are various understandings of the studied concepts and that they are strongly interlinked. The participating firms often saw themselves as forerunners of circular bioeconomy, highlighting the core role of sustainability and reliance on “reasonable use of wood” and far-reaching, in-depth Finnish expertise in the field. Bioeconomy was usually seen as a response to climate challenge by bio-based, renewable material. The key dichotomy was whether bioeconomy should include traditional, bulk forest-based products or should it be dedicated to new, innovative, higher value-added products only. Another challenge was how to target and guarantee the availability of wood-based biomass for different purposes. Circular economy was characterized by resource efficiency, closed loops, recycling and collaboration. The challenges here was leaning too much on old practices whereas more emphasis should be put on inventing innovative collaborations and products.

The sustainability discussion was focused on raw material sustainability and on the importance of Finnish forests as carbon sequesters and the sustainable volumes of wood-biomass utilized, whereas biodiversity went largely unnoticed.

**Keywords:** Forest-based sector; bioeconomy; circular economy; sustainability; transition; Finnish views

## 1 Introduction

The world around us is changing rapidly. This is true also for the forest-based sector (FBS),<sup>1</sup> which is currently being affected by many profound structural changes. Changing consumer demands and values, mature markets for many core products, the need for new competitive forest products, globalization, the strengthening role of emerging economies, digitalization, climate change, resource scarcity, increasing awareness of sustainability challenges and transition towards the bio- and circular economies<sup>2</sup> are making the current business environment increasingly complex (e.g. UNECE/FAO, 2011; Hansen et al., 2013; Hurmekoski and Hetemäki, 2013; Hetemäki, 2014; Pätäri et al., 2016). Toppinen et al. (2013) describe the development of the forest industry's strategic orientation over time as a four-stage process: forestry orientation, production orientation, market orientation, and sustainability orientation.

The long-term survival and success of firms requires the upgrading of business strategies, models and capabilities along with the changing business environment and strategic goals (Grant, 2010; Teece et al., 1997). In response to the changing business environment, FBS firms are developing new products based on wood biomass, such as bioenergy, raw material for textile industries, nanofibres, biocomposites, biodegradable plastics, polymers, food additives and pharmaceutical products, which can be utilized in different sectors. In addition to large-scale biorefineries, there are many opportunities in smaller scale, decentralized, higher value-added production and service-based businesses. This development is also driving the creation of new companies and business start-ups in the field (e.g. Ollikainen, 2014; Näyhä et al., 2014; Näyhä et al., 2015; Schipfer et al., 2017). Innovations and the development of new product portfolios often require expertise from different fields, cross-sectorial collaboration and the establishment of new type of consortia (Näyhä and Pesonen, 2014; Toppinen et al., 2017a). This means that forest industry companies have become interlinked – and will become in future even more so – with other sectors, and therefore the conventional concept of the “forest sector” can often be replaced by the “forest-based sector” or “forest-based BE” (Hurmekoski and Hetemäki, 2013; Näyhä et al., 2015).

Corporate sustainability is becoming increasingly important. Accordingly, there is an increasing focus on strategy formulation and changing and restructuring business models in line with sustainability principles (Stubbs and Cocolin, 2008; Bocken et al., 2014; Baumgartner and Rauter, 2017). Resource efficiency, social relevance, localization and engagement, longevity, ethical sourcing and work enrichment are seen as key principles in business models for sustainability (Wells, 2016). Environmental, social and economic sustainability

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<sup>1</sup> In this study the term forest-based sector (FBS) companies is understood to include, in addition to companies in the sector, also companies which interface with the FBS or utilize raw material and side streams from FBS.

<sup>2</sup> In this study BE is an abbreviation for bioeconomy and CE refers to circular economy

are also important drivers for the FBS firms in creating new business models (e.g. Li and Toppinen, 2011; Näyhä and Horn, 2012; Pätäri et al., 2016). Forest-based businesses are often seen as sustainable due to wood's status as a renewable natural resource. Nevertheless, industrial use of wood causes changes and leads to adverse impacts on ecosystems. In particular, many stakeholders criticize large-scale harvesting (e.g. for bioenergy production) and the resulting impacts on carbon balance and biodiversity, and therefore they are increasingly voicing criticism of the environmental and social acceptance of using wood (e.g. Näyhä and Horn, 2012; Kleinschmit et al., 2014; de Besi and McCormick, 2015). Furthermore, BE and CE and related businesses are often linked closely to sustainability (Pfau et al., 2014; de Besi and McCormick, 2015, Ghisellini et al., 2016). However, neither a straightforward link between increased sustainability and the use of wood-based material, nor a peremptory connection between sustainability and forest-based BE or CE, should be created (Näyhä and Horn, 2012; Pfau et al., 2014; Seppälä et al., 2015).

Many public and private sector strategies highlight the opportunities offered by a BE both globally and locally (e.g. OECD, 2009; EC, 2012, McCormick and Kautto, 2013; de Besi and McCormick, 2015). The transition to a BE has been named as a strategic goal by the EU (EC, 2012), and it is also identified as an important political aim by the Finnish government (Ministry of Economy and Employment of Finland, 2014). The objective of the Finnish BE Strategy is "to generate new economic growth and new jobs from an increase in the BE business and from high value-added products and services while securing the operating conditions for the nature's ecosystems" (Ministry of Economy and Employment of Finland, 2014, p. 3). Finland has large forest areas and long traditions in utilizing forest-based resources, and it is believed that FBS will have a significant role in the future by producing high-tech and new high value-added products together with traditional forest products and bioenergy (Hetemäki, 2014; Ministry of Economy and Employment of Finland, 2014). Therefore, the Finnish BE Strategy highlights the role of forests and the forest industries in the transition (Ministry of Economy and Employment of Finland, 2014). However, the understandings and definitions of BE vary between regions, organizations and among different stakeholders (McCormick and Kautto, 2013; de Besi and McCormick, 2015). Despite the consensus on the significant role of the BE vision, it is not fully understood how various forest-based actors understand the concept, what the BE means in practice for them, which perspectives they highlight, how sustainability is understood in this context, and what is required for the transition (see e.g. Kleinschmit et al., 2014; Pfau et al., 2014; Pülzl et al., 2014; de Besi and McCormick, 2015).

There has recently been significant interest in CE as a solution to overcoming prevailing production and consumption models, which are based on the increasing use of natural resources and continuous growth (Ghisellini et al., 2016; Winans et al., 2017). The European Commission's CE Package aims to help "European businesses and consumers to make the transition to a stronger and more CE where resources are used in a more sustainable way. The proposed actions will contribute to 'closing the loop' of product lifecycles through greater recycling and re-use, and bring benefits for both the environment and the economy" (EC, 2015, p. 1). In Finland, an important development has been the incorporation of CE in the Strategic Programme of the Finnish Government (Valtioneuvoston kanslia, 2015). Forest-based businesses are often seen as being part of CE (Hagemann et al., 2016), yet the

understanding of the concept and its significance remains unclear both to the surrounding society and the FBS actors.

The above mentioned concepts – namely sustainability, BE and CE – are receiving plenty of attention in the current societal discussion. Likewise, sustainability has been approached in various fields from a variety of perspectives. There are also many academic conceptual studies, which aim to explore and define BE and CE concepts. The relationships as well as differences and similarities of BE and CE to sustainability have also been studied to some extent. Views on these concepts vary according to involved parties and different actors stress different aspects. Yet the overall understanding of these concepts as well as the insights, pathways, potential and challenges connected to these approaches often remain ambiguous. For example, D'Amato et al. (2017) highlights in their comparative analysis that a critical comparison of the potential and limits of CE, BE and green economy is currently lacking. They also emphasize that this kind of evaluation would provide an important basis for guiding, among other things, research and policy implementation. Furthermore, many of the previous reviews done on the evolving BE and CE have not analysed issues from the perspective of the FBS, and according to my knowledge there are only a few conceptual studies on this issue (e.g. Kleinschmit et al., 2014; Ollikainen, 2014; Pülzl et al., 2014; Hurmekoski et al., 2018), and none of these concentrate only on Finland.

### **1.1 Research goals**

While actively seeking new opportunities and creating new business models for FBS, a need for an open discussion between different actors about various ways to realize future BE and CE goals in a sustainable manner is often highlighted. An important starting point for this discussion would be to create an understanding of the key concepts, namely BE and CE, and closely associated sustainability term, which are all strongly connected to the development of novel businesses and the ongoing transition in FBS.

Thus, it is important to analyse how FBS companies understand BE and CE concepts and their linkages to sustainability and various sustainability goals in the context of their businesses when they are transforming their strategies and models. This study concentrates on the perspectives of company executives and managers on these issues, since they are often key actors in sustainability transformation in companies (Rauter et al., 2017). For example, can unanimous views be found in the sector, do companies highlight different goals and aspects, which issues contain the biggest controversies, and what are the related challenges and advantages? In addition, do representatives disclose any other closely connected concepts related to BE and CE? What kind of new perspectives specifically related to FBS can actors bring to the societal discussion? To my knowledge, there are no previous studies concentrating only on company managers' perspectives on these issues. In addition, many previous studies on sustainability strategies and the implementation of CSR in the forest industry have concentrated on large companies despite the recognized potential related to small and medium enterprises in the distributed BE (Kleinschmit et al., 2014). This study includes both large companies and SMEs.

Overall, it is crucial that different actors have knowledge about each other's views and understandings because this creates a basis for commonly accepted goals and views within

society. Knowledge facilitates companies' dialogue with their stakeholders – other companies, customers, authorities and society at large – and also promotes the development of businesses that respond to the stakeholders' values and needs. This purely qualitative study aims to shed light on the views found among FBS actors. Due to the wide variety of FBS actors, it can be expected that this study will find a range of understandings on the issues being examined.

## 2. Conceptual framework

This section introduces the key concepts of this research: BE and CE. The specific aim is to present their relevance to the FBS context. The section also provides an overview on sustainability in FBS within the context of BE and CE. The aim is not, therefore, to give detailed views and definitions of the term *sustainability* in general.

### 2.1 Bioeconomy

The concept of BE has received significant attention during the last decade in both research and policy discussions (e.g. Staffas et al., 2013; de Besi and McCormick, 2015; Bugge et al., 2016). BE as a term emerged first in policy documents and later in scholarly literature in the early 2000s (Pülzl et al., 2014). Over the years, a large portion of BE studies have had an emphasis on natural science and engineering, but more recently there has been increasing interest towards economic and business, policy and social scientific perspectives (Kleinschmit et al., 2014, Pülzl, 2014).

According to de Besi and McCormick (2015, p. 1), a BE can be defined as “an economy based on the sustainable production and conversion of renewable biomass into a range of bio-based products, chemicals and energy.” The use of the BE concept initially started within biotechnology and the life sciences, and it was later extended to include other related concepts, such as biorefineries (EC, 2005; Mc Cormick and Kautto, 2013). Bugge et al. (2016) identified three visions for a BE: biotechnology, bio-resource and bio-ecology. The biotechnology vision highlights biotechnology research, applications and the commercialization of biotechnology in various fields. The bio-resource vision concentrates on research, development and demonstration related to various biological resources, and on how they can be converted and upgraded. The bio-ecology vision focuses on the ecological processes that aim to optimise the use of energy and nutrients and promote biodiversity. This vision also emphasises the potential of regional circular and integrated processes.

The distributed bio-based economy-model introduced by Luoma et al. (2011) highlights the possibilities of local production close to the raw-material reserves while at the same time emphasizes that local actors/hubs operate part of the global market. In addition, D'Amato et al. (2017) found that there is an emerging discussion in the BE literature on local processes, particularly related to biosecurity issues and rural policies. Overall, according to de Besi and McCormick (2015) biomass creates a basis for the BE, and the way in which it is utilized affects the sustainability of the transition. The core issues, which are part of the various BE strategies, are the optimal use of biomass and the effort to obtain the highest

possible value of biomass at each stage of its use. Cascading use and the utilization of waste and residues are essential ways to guarantee the efficient use of biomass in the value chain.

Various biorefinery concepts (with related biofuels and other bio-based products) are an important part of the BE (Näyhä and Pesonen, 2011; McCormick and Kautto, 2013; de Besi and McCormick, 2015) and combine many of the elements presented in Bugge's et al. (2016) visions. In addition to large-scale production, there is an increasing emphasis on value-added production and service-based businesses (Näyhä et al., 2014; Näyhä et al., 2015; Pelli et al., 2017; Toppinen et al., 2017a). BE-related initiatives often have a cross-sectoral focus and many industries with different kinds of value chains and technological abilities are included (Näyhä and Pesonen, 2014; Pfau, 2014; Toppinen et al., 2017a).

Overall, different actors define and understand BE differently, and definitions of BE are constantly developing (e.g. Staffas et al., 2013; de Besi and McCormick, 2015; Kleinschmit et al., 2014; Pülzl, 2014; Bugge et al., 2016). There has also been criticism related to the BE concept claiming that it is only new slogan for old ideas (Pülzl et al. 2014).

Many studies highlight the potential and opportunities offered by BE activities, with its importance for economic output and employment often being highlighted (McCormick and Kautto, 2013; Staffas et al., 2013). On the other hand, several risks and uncertainties related to evolving BE are often presented (McCormick and Kautto, 2013; Pfau et al., 2014; de Besi and McCormick, 2015; Hagemann et al., 2016). One of the most essential concerns connected to BE is a concern related to the use of biomass and competing claims about it (Lewandowski, 2015). Staffas et al. (2013) remark that in the many national strategies and policies the economy of a nation and related new business and employment opportunities are emphasized, whereas the perspectives related to sustainability and resource availability are given much less attention.

Hagemann et al. (2016, p. 2) define wood-based BE as "bio-based CE that uses lignin-containing, and, therefore hard parts of stem, branches and twigs of plants such as trees and scrubs". Accordingly, they highlight that the largest portion of wood comes from forests (round timber, pulp wood, forest residues), but some wood biomass originates from short rotation coppice and landscape residues, while by-products of wood processing and recycled wood are also utilized. Interestingly, in this definition BE and CE are combined.

BE offers many opportunities for FBS and, as mentioned above, various biorefinery concepts and efforts have a key role in new business development (Näyhä and Pesonen 2012; Hetemäki 2014; Toppinen et al. 2017a). Toppinen et al. (2018) indicate that the most evident construction-related new business opportunity in the emerging BE will be wooden multistory construction, encouraged in the future particularly by consumer demand for sustainable living and wood construction as a modern way of living. Pelli et al. (2017) found that in many European-level strategy documents the key message is that FBS is one of the most important sectors that will contribute to development of BE. Forest and FBS are consistently expected to contribute to the development of Finnish BE significantly (Ministry of Economy and Employment, 2014). However, BE also presents many demands and challenges for the sector. There is a lack of information on how climate and energy policies will evolve, and how these will affect forest-based industries (Ollikainen, 2014). Ollikainen



(2014) also points out that the key challenge for FBS is to expand and innovate new value-added products, in the way that high-tech processes and cascading use of raw material is a crucial part of production. The role of FBS services should also be recognized more fully (Näyhä et al., 2015). Accordingly, Kleinschmit et al. (2014) highlight that, in the context of forest-based BE, two cross-disciplinary issues are particularly important: innovation and management of sustainability at all levels of the operational environment. New technologies and products are necessary for forest BE to develop, thus innovations are needed (de Besi and McCormick, 2014; Kleinschmit et al., 2014; Ollikainen, 2014). In turn, collaborative work between different stakeholders and actors is needed to foster innovations. Moreover, a supportive and coherent policy framework that focuses on facilitating collaboration between actors is needed (Kleinschmit, 2014; de Besi and McCormick, 2014). Resource use that is both efficient and sustainable requires integrated forest and environmental management (Kleinschmit et al., 2014). Hagemann et al. (2016) conclude that wood-based BE has the potential to develop further if an adequate policy framework exists and it is supported by voters. Furthermore, as crucial requirements for BE development, they also point to consumers' willingness to pay for wood-based products and firms' willingness to embark on a path towards BE.

## 2.2 Circular economy

The CE concept has lately been receiving increasing attention among policymakers, companies and researchers both locally and globally (e.g. Ghisellini et al., 2016; Ellen MacArthur Foundation, 2017; Geissdoerfer et al., 2017). The CE concept became particularly popular in China during 1990s due to rapid economic growth and increased pressure on natural resources (West et al., 2013; Naustdalslid, 2014; Zhijun and Nailing, 2014). CE is seen as originating mainly from ecological and environmental economics and industrial ecology (e.g. Erkman, 1997; Andersen, 2007; Ghisellini et al., 2016; Winans et al., 2017). Geissdoerfer et al. (2017) highlight that the prevailing understandings and its practical applications have evolved through combining different contributions from various concepts, which all include the idea of closed loops. Blomsma and Brennan (2017) argue that CE can be conceptualized as an umbrella concept (see Levin and Hirsch, 1999 for a definition of the umbrella concept) under which different resource strategies can be grouped. Even though these strategies cannot, on their own, be considered novel, the CE concept brings a new framework to these strategies by emphasizing extended resource life and giving focus to the relationship between these strategies (Blomsma and Brennan, 2017).

One of the most well-known definitions is presented by the Ellen MacArthur Foundation (2015, p. 1): "A CE is restorative and regenerative by design, and aims to keep products, components, and materials at their highest utility and value at all times." Geissdoerfer et al. (2017, p. 766) define CE as "a regenerative system in which resource input and waste, emission and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing and recycling." Many other studies consistently connect the three Rs of "reduction, reuse and recycle" to CE (Ghisellini et al., 2016). In addition to promoting closing-the-loop patterns, CE aims for the overall goal of decoupling of economic growth from resource consumption. CE, in other words, could facilitate the transition to the degrowth path (Kerschner, 2010; Ghisellini et al., 2016). Overall, CE provides a framework

for improving our current business models in a way that enables the transformation of our society into a more sustainable one in which increased wellbeing is obtained with fewer resources (Kerschner, 2010; Ghisellini et al., 2016). Furthermore, service-based businesses are seen as an important part of CE business models (Tukker, 2015; Stahel, 2016).

Globally, there are various policies and economic instruments for CE (Ghisellini et al., 2016). McDovall et al. (2017) compared Chinese and European perspectives on CE, and their study indicated that the Chinese basis for the CE was developed particularly for pollution-related issues and in the context of the country's rapid growth and industrialization. Accordingly, Chinese CE policies are framed as part of a wider response to these environmental challenges. In contrast, understandings of the CE in Europe are based on a narrower environmental scope, focusing on waste and resources. CE policies in Europe emphasize the potential for resource efficiency to increase competitiveness with less attention on scale or place.

Economic benefits and job opportunities related to CE incentives and business models are often highlighted, and they also act as motivational actors for private firms and investors or other stakeholders (Ghisellini, 2017; Ellen MacArthur Foundation, 2017). Several studies have indicated that CE-related initiatives and projects require integrated bottom-up (support and involvement of the industries and stakeholders) and top-down (e.g. subsidies or tax incentives) approaches for successful implementation and evaluation (Winans et al., 2017). In addition, one of the key issues promoting CE business models is to increase awareness of both consumers and producers (Ghisellini et al., 2016). Ghisellini et al. (2016, p. 12) highlight that "sustainability patterns (such as CE) not only require innovative concepts but also innovative actors". Geissdoerfer et al. (2017) also see business model innovations as a key for transformation to CE (as well as for sustainability). However, Leipold and Petit-Boix (2018) noticed that business actors currently relate CE mainly to established practices and to technological business models. Overall, according to Ghisellini et al. (2016), it appears that the implementation of CE practices globally are in the early stages, focusing more on recycling than on reuse. At the company level, the adoption of cleaner production and eco-design are the main strategies for CE.

In the traditional forest industry, closing-the-loop patterns have been part of the production models for a long time. In countries with rich forest resources, such as in Finland, Sweden and Canada, the pulp and paper industries have developed symbiotic operation models for local industry facilities. For example, wood is a raw material for pulp and paper mills whereas wood-based residues and black liquor can be used for heat and energy production. Pulp and paper industries share heat and electricity with municipal power plants. Chemical industry plants, waste management facilities and sewage treatment facilities are also often included in the complexes which emerge around pulp and paper mills. These systems typically operate closely with local communities, providing jobs and district heating as well as waste disposal. Overall, in this symbiotic industrial setting (which clearly follows the CE philosophy) many economic, environmental and social benefits can be found when it is compared to standalone production. Wood raw material can be utilized more resource-efficiently (e.g. Korhonen, 2001; Karlsson and Wolf, 2008; Wolf and Karlsson, 2008; Lehtoranta et al., 2011; Mabee, 2011; Sokka et al., 2011). As a further example, a case study

conducted by Sokka et al. (2011) at a Finnish forest industry mill indicated that GHG emission reductions were achieved within a symbiotic industrial setting.

### **2.3 Sustainability in bio- and circular economies**

The relationship between BE and sustainability is often viewed as a positive one: the BE activities are associated with increased sustainability (Pfau et al., 2014). However, there has lately been increasing attention to sustainability considerations, particularly in the scientific debate on BE, and it is obvious that BE cannot be viewed as inherently sustainable (de Besi and McCormick, 2014; Pfau et al., 2014; Hagemann, 2016). For example, it still appears that the consequences of forest-based activities for climate change and environmental protection are not assessed at an adequate level (Ollikainen, 2014).

In order to support sustainable development, BE need to be designed and implemented intelligently at all levels of society (McCormick and Kautto, 2013; de Besi and McCormick, 2014). Furthermore, open dialogue between different stakeholders (public, industries, government) would be important for the development of sustainable BE, which considers long-term benefits instead of short-term economic profits (McCormick and Kautto, 2013). Pfau et al. (2014) also indicate that the relationship between different actors and sectors participating in BE and joint knowledge production should be examined further because cross-sectoral and interdisciplinary solutions appear to be particularly promising. To date, the emphasis has been on discrepancies between sectors, largely based on resource and land use competition (Pfau et al., 2014). It would also be important to apply different tools, such as life cycle assessments, for evaluating the implications of BE activities (de Besi and McCormick, 2014; see also Näyhä and Horn, 2012). Overall, a holistic understanding of the potential and role of FBS in BE (Kleinschmit et al., 2014), and the integrated analysis of BE value chains is needed (Lewandowski, 2015).

In a review of the conceptual relationship between sustainability and CE, Geissdoerfer et al. (2017, p. 767) conclude that CE is “viewed as a condition for sustainability, a beneficial relation, or a trade-off”. Their study also found that the relationship between sustainability and CE often remains ambiguous in both academic studies and discussions among policy-makers and industry representatives (see also Korhonen et al., 2018). Geissdoerfer et al. (2017) further indicate that sustainability and CE are used in similar contexts but the similarities and differences between these concepts remains unclear in many cases. Although sustainable development is not possible without balanced considerations of different sustainability aspects, economic benefits are oftentimes highlighted and, except for impacts on employment, social perspectives are mainly absent (Geissdoerfer et al., 2017; Ghisellini, 2017; Kirchherr et al., 2017; Murray et al., 2017). Correspondingly, many studies focus on the environmental performance improvements of the CE, but CE is often conceptually simplified to mean resource input, waste and emission output whereas other issues, such as biodiversity or land use, are given less emphasis (Geissdoerfer et al., 2017).

Korhonen et al. (2018) highlight the importance of the CE concept due to its ability to attract both policy-makers and business actors to pay attention to sustainability work, but they also indicate the challenge of lacking scientific research and critical sustainability assessment, which would be needed to guarantee that the actual environmental impacts of CE

contribute sustainability. According to Genovese et al. (2017), integrating CE principles with green supply chain management can provide clear environmental benefits, but at the same time they can cause negative economic effects. Furthermore, they indicate the need for more relevant environmental indicators to compare linear and circular systems.

Leipold and Petit-Boix (2018), in their recent study, analysed the business community's views on the circular economy, focusing particularly on the bio-based sector's perspectives. When exploring the link between CE and BE, they recognized the obvious need to define the cycles which contribute most to a sustainable future economy. Leipold and Petit-Boix (2018) also indicated that strengthening the connection between CE and BE debates could provide an important step towards defining the sustainability of the circular economy. They also believed that exploring the link between BE and CE could contribute to setting a clearer political scope as well as aims for sustainable business practices. Overall, it appears that, neither BE nor CE can be viewed as self-evidently sustainable.

### **3. Materials and methods**

In spring 2017, semi-structured thematic interviews were conducted with 18 company executives and managers from 17 firms representing various forest-based industries and interfacing sectors. The criteria for the company selection were that companies were developing or involved in the development of new products and services as either supplements to their portfolio or as main products and they utilized wood-based raw material. A further requirement for the selection was that the interviewed firms have operations in Finland. The companies were chosen so that as many different types of companies as possible were involved in the study. Thus, the forest-based industry companies and those firms interfacing with them that participated have different business strategies, models, features and products. The companies varied, for example, in maturity, size, growth plans, market orientation and the role of new products versus old products in their portfolio and exchanges (business-to-business/business-to-consumers). The current core products of the studied companies included pulp, paper products, packaging materials, energy, chemicals, health care products, exterior/interior design products and construction materials. In addition to traditional FBS products, there were many new wood-based products and services related to those under strategic planning, research and development, commercialization and/or production. These included biofuels, bioenergy, biochemicals, biocomposites, textile fibres, biomedicines, healthcare products, food industry additives, new types of construction and building materials, interior design products, and packaging materials and solutions. Overall, the companies were chosen so that the scale of the participating firms varied from large, traditional and mature FBS companies transitioning to new businesses to small start-up companies.

The purposive sampling technique was applied because individuals with specific knowledge and positions were needed (see Silverman, 2005). The personnel contacted held leading positions in the firms (e.g. CEO, chief development officer or chief sustainability officer). The interviewees were given the main interview topics beforehand during the initial inquiry, so that they were able to assess if they possessed adequate knowledge about the interview themes or would they recommend some other person to be contacted in the company. As a

whole, the interview questionnaire consisted of three parts: 1) business models and conceptualization; 2) role in the markets, competitiveness and resources; and 3) foreseeing the future. This manuscript is based mainly on the first part, and the interview themes and questions are presented in Appendix 1.

During the interviews, depending on the respondent's knowledge and willingness to elaborate on certain questions or themes, additional questions may have been asked or, respectively, certain questions were left out. In the other words, certain topics and themes were included in the interview structure, and these were discussed with the respondents at the level of detail and in ways that the respondents were able/willing to do so. However, there were plenty of themes and perspectives which were brought up freely and spontaneously by the respondents during the interview, and which the researcher was able to conceive and structure when coding the data.

The data were examined using the thematic analysis (Braun and Clarke, 2006; Guest et al., 2006). One researcher carried out both the interviewing and data analysis. The interviews were transcribed and ATLAS.ti was used as an analysis tool. The analysis loosely followed the step-by-step guide presented by Braun and Clarke (2006). The interviews were first read through in order to obtain an overall understanding of the contents. The next phase was to code preliminary themes in the data that were evaluated as being of central importance in relation to the research goal (i.e. understanding of the theme is similar to the description presented by Braun and Clarke (2006, p. 10): "A theme captures something important about the data in relation to the research question..."). After this, contents and coded themes were re-evaluated and more detailed sub-codes were assigned if needed. Then the codes were re-organized in order to compose broader level main themes. At the end, data and created codes and themes were re-evaluated again, and possible supplementary information was searched for from the data in order to establish a final understanding and develop interpretations.

Overall, the data were approached mainly inductively (see e.g. Patton, 2002, p. 56; Thomas, 2006, "general inductive analysis"), meaning, for example, that the coding was not limited to the predetermined themes. However, it needs to be mentioned in this context that a purely inductive approach is not possible in any research, because it would require that the researcher has no preconceptions on the studied topic (see e.g. Patton, 2002; Eriksson and Kovalainen, 2008). In this study, elements of the deductive approach were included, for example when interview questions were formulated, as previous studies and approaches were explored for finding various angles to approach the studied issues (see also Patton, 2002, p. 56).

In this study, the key aims of striving for the trustworthiness (see also Guba and Lincoln, 1985) of the study is that the approach, sample and interview themes have been chosen, structured and analyzed in a way that there is concordance between them. In this manner, the overall aim is to produce as full an understanding as possible of the studied concepts and issues (see also e.g. "verification strategies" in Morse et al., 2002, p. 18; Fig. 1 in Sousa, 2014), producing reliable findings (see also Silverman, 2005, p. 242). To strengthen the validity of the research, critical thinking during the data analysis (coding) was supported by

the constant comparative method<sup>3</sup> and deviant case analysis<sup>4</sup> (Silverman, 2005). Modifying preliminary classifications (themes and concepts) was part of the process. Data were also interpreted based on various perspectives (see “theoretical triangulation” in Denzin, 1970). In addition, the readers of this study are offered material for evaluating the quality of study, such as a detailed description of the research process and numerous quotes from the interviews. The quotations are indicated by numbers in the Results section, and the quotations corresponding to those numbers can be found in Appendix 2.

## **4. Results**

### **4.1 Company perspectives on forest-based bioeconomy in Finland**

#### **4.1.1 Opportunities**

Most of the companies categorized themselves primarily as BE actors, and many considered themselves as BE as well as CE firms with a growing role for these businesses. According to the respondents, forest-based BE and related businesses are a response to the urgent challenges that society is currently facing: most of all climate change, but also issues such as resource scarcity, need for the utilization of renewable resources, the growing population and urbanization all affect the transition towards BE. For example, along with urbanization, the need for “green” and “healthy” housing was seen as increasing, and the use of wood as a raw material could offer new types of solutions for that area. Overall, BE businesses were believed to bring various benefits to the surrounding society since forest-based BE is based on renewable, non-fossil-based raw materials, and preferably on the utilization of local side-streams aiming at sustainable resource use and value chain management. The versatile use of wood-based resources creating different profitable business opportunities was seen as an ultimate goal. It also emerged that, in comparison with many other sectors, it is more natural for FBS actors to be part of BE.

This study indicates that Finland is viewed as a unique country in the context of forest-based BE businesses in many ways. First, plentiful forest resources and a long tradition and extensive knowledge in utilizing these resources are seen as a basis for forest-based BE. The respondents believed that the role of forest-based BE in Finland is currently more prominent than in most of the other European countries, and Finland was seen to be a key actor in the field in the future as well. Many interviewees highlighted support by the government and Finnish BE strategy as important indicators of that standing. Finnish actors were believed to have a strong understanding of forest management, wood utilization and new BE technologies.

#### ***Quotation 1***

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<sup>3</sup> The constant comparative method refers to the practice that the analysis was started with a small part of the data and by defining preliminary themes and concepts, then it was continued by expanding the analysed data corpus (i.e. by including more interviews).

<sup>4</sup> Deviant case analysis refers to an approach in which anomalous and divergent opinions were also seen to be important in creating a comprehensive understanding.

It was also believed that there is plenty of untapped potential in forest-based BE businesses and utilizing wood-based material, and Finnish actors should be active in technological development and side-stream utilization in the future as well. Furthermore, the role of the start-up companies was seen as important. These firms can bring plenty of new ideas and speed up development in the field, while also encouraging the slower, more mature FBS companies to restructure their business models. In addition, the importance of collaboration between different actors in the FBS network was highlighted. For example, there is plenty of potential in the interfaces between the forest industries and chemical industries, and these opportunities should be explored more carefully.

#### **4.1.2 Different understandings and challenges**

There were different understandings of forest-based BE and related businesses, including varied views on which products, processes and facilities should be categorized under the umbrella of BE, and in which direction the field should develop. Similarly, the scale of the production and related discussion on biomass quantities needed for production occupy an important position. There were differences in perspectives between the countries, and it was often emphasized that in many contexts Finnish perspectives, forest resources and skills – particularly related to management – are not properly known and understood by the stakeholders in other European countries. Many pointed controversies were related to sustainability (see section 4.5.3). On the other hand, it was pointed out that this can also bring some benefits for Finnish firms because they can operate and innovate in the field which is more unfamiliar for other countries. It was also mentioned that it is natural that various sectors apply definitions differently, and there are also distinct understandings among the forest industry actors.

However, it also emerged that even among Finnish FBS companies, there is no unanimous view on the goals, directions and contents of forest-based BE. An essential line of discussion here was whether traditional forest sector companies and their products should be categorised as part of BE or whether BE should be entitled only to new forest-based products. Many respondents emphasized that BE business models should be more than “business as usual”. Oftentimes, representatives from large, mature forest industry companies tended to categorize their businesses as part of BE, but there were also views among them that BE should include new types of products in addition to the traditional core products. Accordingly, it was pointed out that BE businesses are part of the chemical industry as well.

#### **Quotation 2**

This discussion was closely connected to the discourse about raw material utilization and the debate on bulk products versus higher value-added products. For example, it was pointed out that wood-based biofuels are not a reasonable alternative (see more detailed discussion in section 4.4.3). There were worries about the sufficiency and availability of forest-based material, particularly the difficulties to find a certain type material needed for high quality products.

#### **Quotation 3**

**Quotation 4**

On the other hand, many respondents believed that sustainable Finnish forest management practices, use of side-streams and less in-demand parts of the biomass guarantee sufficient biomass availability.

Several respondents also addressed the idea of *intelligent BE*: the highest possible raw material refining before energy production (“cascading use”) and full exploitation of Finnish know-how in creating higher value-added products. The challenges brought up in this context were how to fully take advantage of high-quality Finnish education when developing new products, and also how to guarantee the future availability of skilled employees. For example, in the context of design products the availability of qualified craftsmen (with technical and esthetical skills) are important, so that Finnish products can stand out from the competitors in the future as well.

**Quotation 5****Quotation 6****4.2 Company perspectives on circular economy in Finnish forest-based sector****4.2.1 Potential and requirements**

As in the context of BE, key features associated with CE and related businesses were a smaller carbon footprint, the replacement of renewable or fossil-fuel based products, response to resource scarcity and social acceptance. However, in the context of CE resource efficiency, closed loops, recycling and collaborative networks were more prominent. Utilizing side-streams and waste streams (e.g. sawdust) from other processes, utilizing the maximal potential of raw material, producing less waste and guaranteeing safe disposal were highlighted. It was also mentioned that minor biomass side-streams should be developed into new products (particularly in collaboration with other actors in the network), thus offering business opportunities for various small-scale actors. In addition, utilizing side-streams close to their origin was seen as important.

**Quotation 7**

Many respondents also focused on the historical perspective by pointing to traditional Finnish forest industry production as a model example of CE with a closed-loop ideology and circulating material streams. In this context, the term *industrial ecology* was also brought up. Forest industry side-streams are utilized in, for example, the energy, chemical and cosmetic industries. Likewise, Finland was viewed as a country where the recycling of material in various sectors in addition to the FBS has been an everyday procedure and at the core of the business models for a long time before the CE hype started.

**Quotation 8**



Overall, current Finnish companies were believed to perform well and to have the potential to also be future forerunners in CE businesses, such as in creating closed-loop systems in the textile industry. Being in the front line, however, requires collaboration with other businesses as well as innovativeness and the deployment of new technologies and processes. It was also emphasized that new types of products should be as good as or better than corresponding traditional products in quality, efficiency, safety, durability and other properties. In addition, it would be important to deliver more knowledge to the stakeholders about value chains, and thus motivate them to be more involved in CE activities and development. It was also pointed out that even when practices (particularly those related to recycling) appear to be handled well, there is room for improvement.

Many respondents viewed their companies as both BE and CE actors, and the respondents highlighted that belonging to both types of economy are not exclusive to each other. The *circular BE* concept was also brought up. However, it was mentioned that there appears to be some juxtaposition for BE and CE at the European Union level. Overall, compared to the BE concept, CE is viewed as a broader concept because it also includes inorganic streams.

### **4.3 Criticism of bioeconomy and circular economy concepts**

However, the respondents also saw that both BE and CE were new concepts for old ways of doing things, and they believed that many companies have been BE/CE actors for a long time. Thus, there was plenty of criticism towards the use of BE and CE as trendy, new expressions without considering their actual meaning and content. The use of the concepts was compared to widespread usage of the term *cleantech* a few years earlier. Moreover, some respondents viewed them more as political terms. A need for a more precise categorization and classification was emphasized in order to avoid misuse of these terms and misunderstandings. For example, systematic use of colour codes for different BE types was brought up as a way of clarifying concepts between countries. Clarification of these issues nationally, such as in the Finnish BE strategy, would also be important. On the other hand, a few respondents considered why exact definitions for these concepts are even needed. Instead, there should be a clear emphasis on defining and evaluating business activities against wider environmental goals, particularly against climate goals.

Furthermore, the respondents pointed out that concepts and definitions and their usage in societal discussions per se will not create business potential and cases; there needs to be regulation, taxes and markets, which enable practitioners to create and manage concrete businesses in a profitable manner. Overall, demand and markets guide companies in their decisions about products and their product portfolios. Despite the noticeable “unnecessary hype” related to these concepts, respondents indicated, however, that there exist many new, innovative ways and examples of being a BE/CE actor.

### **4.4 Sustainability considerations**

Many respondents connected BE and CE businesses with increased sustainability. This was indicated by the common abilities, features and descriptions of products and processes that the respondents associated with the BE and CE economies and sustainable businesses. In

this context, the *green economy* concept was also brought up. However, many respondents pointed out that being a CE or BE actor does not guarantee the sustainability of actions.

#### **4.4.1 Sustainability in core of the business**

The results indicate that the ultimate disclosed sustainability goal of FBS actors is mitigating climate change and decreasing CO<sub>2</sub> emissions. Related to this, however, were arguments about the minor role of Finnish actors in affecting global climate issues.

Although managing sustainability related issues is part of image creation and control, as well as of obligatory fulfilment of legal requirements and sustainability criteria – which are set in both national and international instances – many respondents highlighted that sustainability goals and practices are at the very core of their business. They also indicated that sustainability is an essential part of their corporate visions and strategies and they try to respond to current sustainability challenges. This means that new business models, products and services are planned so that sustainability aspects are taken into account at the very beginning of the process.

##### **Quotation 9**

Many respondents further highlighted the economic aspect as a necessary prerequisite (“responsible profit-making”). Overall, the respondents perceived their companies’ practices and codes of conduct to be sustainable in terms of all sustainability dimensions. In addition, the respondents felt it is important that sustainability goals, criteria and their implications are based on scientifically proven information. Likewise, interpretations based on the scientific data should be carefully considered.

##### **Quotation 10**

According to the respondents, there is a long tradition of taking sustainability issues seriously in Finland, and Finnish companies are experienced and advanced in the sustainability management of their value chains. They believed that actors comply with a strict legal framework and sustainability criteria. In addition, various voluntary sustainability systems, often demanded by the customers, have been implemented by the firms. The FBS in particular was viewed as a forerunner in responsibility and sustainability issues, and in general, forest-based value chains in Finland were seen as sustainable. It was also mentioned that forest industry integrators have traditionally had an important role in the local societies. In addition to employment, they also contributed to, for example, hospital and day care facilities. According to the respondents, the social dimension has an increasing importance for the companies in the current society, and a “new era of social responsibility” has started. Increasing employment and local (rural) development, and acceptance from the local communities in general are some of the key issues in this context. Related to this, refining local raw materials close to their origin was seen to be favourable in many contexts. Overall, the respondents indicated that business ideas and models should go hand in hand with societal goals.

Overall, the respondents mostly believed that wood-based businesses are acceptable and justified, and the reasonable use of wood (and related FBS activities) has been, is, and will

be part of Finnish society and the national economy. It was emphasized that products made from wood are replacing products based on fossil fuels and that wood-based products are targeted at “a real need”.

#### ***Quotation 11***

#### **4.4.2 Sustainable raw material, production and products**

Several companies have their focus on wood-based raw material sustainability and availability considerations. The most highlighted issue was sustainable forest management, referring to the fact that total wood biomass volumes are not decreasing, as well as an emphasis on the essential role of Finnish forests as carbon sinks.

#### ***Quotation 12***

It was also pointed out that Finnish forest management practices guarantee suitable resources for various industries. Some of the respondents also felt that managed forests have a better capacity to absorb carbon than unmanaged forests. Considering the sustainability of the whole value chain (including logistics, which is sometimes difficult to manage) was seen as important. It should also be noted that there are many FBS companies and developments with business models that are based on high value-added products, and the required raw material volumes are very low, thus making raw material issue fairly irrelevant.

However, it appears that there is much less emphasis on biodiversity-related issues. Diverse forests and the quality of forest ecosystems were mentioned but the discussions were more focused on sustaining wood volumes and on the role of forest as carbon sinks (see section 4.4.3).

It emerged in this study that, in addition to raw material harvesting, sustainability aspects needs to be considered in the context of production, products and their disposal, thus covering the whole life cycle of different BE and CE activities. Sustainability in terms of production and products were associated and described with the following qualifications presented in the Table 1 (production) and Table 2 (products; see Appendix 3).

The customer perspective was also a regularly discussed topic. A dichotomy in the perspectives on targeting products to markets could be observed. Where some actors highlighted targeting their products to environmentally conscious customers in eco-shops, others emphasized that their customers are not “BE or CE customers” but “normal or standard customers” that require safe and efficient products. Overall, the aim appeared to be to plan, develop and offer new wood-based products, which respond to the market demand and customer needs and fulfil the sustainability and responsibility goals.

#### ***Quotation 13***

#### **4.4.3 Sustainability: Challenges and goals**

It emerged in this study that there are many challenges related to the sustainability of forest-based BE and CE businesses. First, there were different understandings of *forests* per se as well as of *forest management practices*. The *sustainability* of forest management practices especially raised different views. Controversial views were emphasized when Finnish perspectives were compared to the other European countries. Finnish actors pointed out that European actors (with the exception of other forest rich countries) lack the knowledge and understanding that Finland has of forest management and utilization practices. Finnish actors also believed that due to the long history of utilizing forest resources, the FBS in the country has skills which are largely lacking elsewhere. With some frustration, some Finnish actors argued that according to the prevailing European view wood resources should not be utilized at all. Many respondents also found it problematic that at the European level larger countries have the authority over the issues, whereas Finnish views are not fully considered in decision-making and political processes, despite BE's significant role in Finland. Some respondents even argued that the role is bigger in Finland than in any other European country.

**Quotation 14**

**Quotation 15**

Discussion of sustainable forest management also dealt with the *forest-related carbon balance* and acceptable/sustainable biomass volumes gathered for industrial use. In this context, the differences with European Union perspectives were seen particularly prominent. Most of the Finnish actors believed that carbon sinks of Finnish forest are not decreasing, and some respondents felt frustrated about the need to explain their wood utilization at the European or global level. The respondents highlighted the key role of the Finnish forest as Europe's "lungs", emphasizing at the same time that many other European countries have destroyed their forest a long time ago. On the other hand, there were also critical voices among the Finnish practitioners towards the volumes of forest biomass harvested in Finland and carbon neutrality, thus showing an understanding of the concerns over large-scale harvesting indicated in the European Union. Particularly actors whose businesses requires small volumes of biomass and/or who are looking to produce more value-added products criticized those actors producing high volume products with less value (pulp, biofuels).

Furthermore, there were different opinions on how forest-based raw material should be targeted in a sustainable manner. Again, European views were criticized, but the Finnish actors did not have a unanimous view of *the most optimal and sustainable uses of wood biomass* ("Can we afford it?" vs. "Is it sustainable?"). This discourse largely concentrated on the conflict between higher value-added and bulk products.

**Quotation 16**

In particular, the production of wood-based biofuels provoked controversial views. Some respondents noted that biofuels have strict sustainability criteria, their production is based on side-streams (there was an unanimous view that only side-streams should be used for production), and that Finnish actors are seen forerunners in the production of advanced

biofuels. On the other hand, the sustainability of wood-based biofuels and their value chain was questioned, particularly by actors aiming for higher value-added products and requiring smaller volumes of biomass for their production. There were concerns that subsidies direct forest-based raw material to biofuel production instead of towards higher value-added products. It was also pointed out that the efficiency of biofuel production is not good, its effect on carbon balance is negative and that the global biofuel challenge cannot be solved with the Finnish resources alone. Accordingly, some respondents indicated that wood-based bioenergy and biofuel production should not take all the attention from other types of products and value chains (e.g. those in the chemical industries). It was also pointed out that the small actors such as saw mills should, along with large forest industry facilities, be able to sell electricity produced from side-streams to the grid. In any case, a requirement for profitable business is the availability of suitable raw material, and competition over it was seen as a threat.

Overall, it was emphasized that a holistic perspective on the issue is important, where different alternatives for resource use are evaluated by taking into consideration the causes and effects of different choices.

The management of global value chains and operating in the global markets were seen as a challenge. Some of the respondents even indicated that the biggest sustainability problems are outside Finland, meaning that companies are encountering new supplier chains and courses of action related to these global value chains.

#### ***Quotation 17***

Different certification systems can be a challenge and were seen as somewhat irrelevant for small actors using low volumes of biomass. It was noted, however, that such systems are often required by their customers.

The insufficient knowledge of stakeholders and the general public about FBS value chains and related sustainability aspects were often viewed as another challenge. It was believed that businesses could be threatened by political decisions based on poor understanding. It was also mentioned that sustainability is a highly political issue and that lobbying can have a substantial impact. Related to this, it was brought up that FBS is a fragmented sector with variety of products and different stakeholders, and thus is difficult to build a common voice.

Many respondents also highlighted intensified resource scarcity and its related effects on, for example, product prices and availability as well as on regulation and laws, which requires that people need to reconsider their habits regarding consumption. It was also believed that this will affect all sectors of society, including FBS. However, changing ways of thinking will be a challenge.

How can these challenges be addressed and solved? Many respondents emphasized the role of national and international communication. Dialogue is needed among those actors who utilize wood-based biomass as well as between the practitioners and their stakeholders (e.g. customers, politicians). All sustainability dimensions, considerations of the entire value chain (particularly its global scope) and various aspects should be included so that holistic

views of the issues, without unnecessary simplifications, can be formed. The respondents believed that increased dialogue could decrease prejudices related to the sustainability of the FBS and its activities among citizens. Active dialogue and increased understanding about new forest-based businesses would also decrease unintended consequences created by policy-makers.

### **Quotation 18**

## **5 Discussion**

This study explored how Finnish FBS companies understand the concepts of BE and CE and their linkages to sustainability and sustainability goals when they are restructuring their business strategies and models.

The key findings of this study are in many respects in line with other recent studies which explore FBS transformation, forest-based BE, CE and related sustainability aspects. In addition to the studies presented in section 2, the following paragraphs will address some interesting reflections from the other studies, which relate to the main outcomes of this research.

This study found that a commonly accepted definition or understanding for the studied concepts does not exist. In line with this study's findings, D'Amato et al. (2017) observed that various actors are involved in conceptualization processes of CE and BE (as well as of the green economy), a situation which inevitably leads to the great internal diversity of the narratives. Kleinschmit et al. (2014, p.1) also observed that "the agenda of BE comprises different shades of green", meaning that different actors emphasize different perspectives of the concept. The findings of this study also reflect similar aspects and definitions on the forest-based BE found by Hurmekoski et al. (2018, see also Winkel, 2017). In their European-wide study, they identified five categories of definitions, indicating a range of understandings of the forest-based BE. Moreover, the current study also found that many new business models are appearing in the FBS with the versatile utilization of wood for various end uses and intensified cross-sectoral collaboration. Additionally, this study, in line with Hurmekoski et al. (2018), highlights the importance of the innovative use of resources, suggesting the concept of *intelligent BE*. Intelligent BE is seen as having its basis in the high quality of Finnish education, which enables the development of higher-value added products according to the cascading raw material use principle. Thus, it appears that intelligent BE aims to combine technologically smart solutions and/or high-quality design products with resource-efficient, and overall, more sustainable raw material use. However, a recent study on the forest sector CE in Finland (Husgafvel et al. 2018) indicates that the potential for large-scale cascading of solid wood is very limited in Finland without incentives, legislative obligations or demand from customers.

Resource efficiency is another key issue connected to sustainable BE and CE in this study, and it is particularly prominent in the context of CE principles. Pelli et al. (2017) observed in their study on European-level BE and FBS strategies that resource efficiency is often seen as one of the main focuses. Husgafvel et al. (2018) also highlight material and energy efficiency as key issues in forest-based BE and CE development in Finland. Olsson et al. (2017), however, point out that there is currently no consensus view of what resource-efficient use

of wood actually is, and that wood raw material is used for a variety of functions in society. Similarly, the firms of this study utilize wood-based biomass for a variety of purposes, while at the same time indicating resource efficiency of their processes. The results therefore indicate that more precise definitions for resource efficiency would be needed.

Toppinen et al. (2017b) emphasized that it is important to improve the utilisation of by-products from primary production, which have been traditionally utilized in energy production or wood-based panel production. As pointed out earlier (sections 2.2 and 4.2.1), the Finnish FBS has experience with working in symbiotic industrial settings, utilizing side-streams and managing environmental issues. However, when planning new industrial processes and higher value-added products, it is important to take into account that direct support, such as energy subsidies, for one sector can have negative impacts on the competitiveness of other sectors because of the competition over raw material, which in turn affects prices (Toppinen et al. 2017b). This issue was seen as a significant threat also in this study.

Many BE strategies stress that the added value of bio-based products is achieved through renewability, carbon neutrality and overall sustainability (Pelli et al., 2017). These same qualities were linked to the sustainable forest-based BE and CE products and processes in this study as well. Social relevance, localization and engagement longevity and ethical sourcing often determine the business models for sustainability (Wells, 2013). The findings of this study are in line with the sustainability business models' key principles. It is also noteworthy that Finnish BE strategy has a strong regional focus (Ministry of Employment and Economy of Finland, 2014). Overall, when the respondents described BE and CE and evaluated the sustainability and sustainability goals of their own actions, the definitions were interlinked and overlapping.

However, despite how the companies in this study considered their own actions to be mainly sustainable in reference to the various sustainability dimensions, they were aware of different opinions between not only countries but also among the Finnish actors. They indicated a range of challenges related to, for example, sustainable forest management practices, raw material utilization and product portfolio choices. Several other studies indicate similarly that the relationship between sustainability and BE and CE cannot be seen as self-evidently sustainable (see also sections 2.1–2.3).

Wolfslehner et al. (2017) suggests that if sustainability is accepted as a key concept underlying forest-based BE, instruments for assessing the developments are needed. Although the FBS is experienced in using different indicators to address forestry issues, they emphasized that the scope needs to be wider, and a value chain approach should be adopted. Likewise, there should be a more balanced approach towards all three sustainability dimensions. Husgafvel et al. (2018) also stressed that sustainability and life-cycle thinking and assessment have a crucial role in the development of CE in the Finnish forest sector. They suggest that in future it would be important to study, for example, the competitiveness of renewable raw materials and products in a way that key sustainability dimensions are taken into consideration. Assuming a wider view, Pülzl et al. (2014) concluded that BE cannot be subsumed under other already existing meta-discourses such as limits to growth, sustainable development or ecological modernization discourse (see also Arts et al., 2010). According to them, BE represents a so-called mixed source discourse,

and they also highlighted that despite the supposed support in BE for sustainable development, economic perspectives still dominate. Kröger and Railio (2017, p. 14) worried that global BE meta-discourse allows current policies to neglect sustainability challenges, and speculate that without BE discourse it would have been more challenging for the Finnish government “to push through a markedly capitalist forest policy”. They further concluded the following: “The transformation of Finland from a country of forests into a country of tree-based “bioeconomy” and its tree plantations will be a major topic of discussion in the coming years” (Kröger and Railio, 2017, p. 14). Other recent Finnish studies have also noted the sustainability dilemma related to increased wood material use in BE, particularly its harmful effects on biodiversity (e.g. Korhonen et al. 2016; Kotiaho, 2017). In turn, Soimakallio et al. (2016) observed that the trade-off between mitigating emissions through fossil fuel substitution and reduction in forest sequestration ability due to harvesting causes huge challenges for forest management and utilization in terms of climate mitigation targets. The most recent report by the Intergovernmental Panel on Climate Change (IPCC, 2018) concludes that the drastic actions to limit global warming to 1.5 degrees need to be taken immediately. This raised plenty of discussion over the issue also in Finland, particularly related to forest utilization. For example, the head of the Environment Ministry-appointed Finnish Climate Panel has discussed the challenges related to wood-based biofuels by highlighting that their environmental load is four times larger than that of fossil fuels (Sutinen, 2018).

In line with the studies mentioned above, this study presents BE as a many-sided concept closely interlinked with CE, sustainability, innovations, carbon neutrality and profitability. Interestingly, the interviewees in this study frequently brought up the need for holistic sustainability considerations and value chain management covering the whole life cycles of BE and CE activities as key goals of sustainability management. They also pointed out the “new era of social responsibility” in this context. However, what was striking in the findings was that emphasis was still largely on the role of the Finnish forest as a carbon sink, whereas biodiversity was given much less attention. This finding is surprising and conflicting with the coincidental stress by the respondents on holistic management.

The respondents often characterized their companies or Finnish firms in general as forerunners of sustainable and circular BE. However, it appears that in some contexts actors in the field may assume their leading role in sustainable circular BE be too self-evident. Too much emphasis on past merits can prevent constructive developments and dialogue and the willingness to change ways of working. Rather than emphasizing past models it would be advisable to concentrate on new types of industrial ecosystems and develop concepts, innovations, minor raw material streams and (cross-sector) collaboration into novel models while applying balanced and useful tools for sustainability evaluation. These types of systems also create opportunities for new innovative start-up companies, which could be connected to the industrial network. For example, Metsä Group’s Äänekoski mill has taken steps in this direction (Metsä Group, 2018). This study also identified, for example, new types of closed-loop systems related to textile production as a new interesting future opportunity.

## 6. Summary and conclusions



In this study, most of the interviewees characterized their companies as both BE and CE actors, and sustainability in general was seen to be at the core of their business models. A circular BE concept was also suggested in this study. However, there were various understandings of these concepts, which were also strongly interlinked. Furthermore, there were varied business models and perspectives among the actors regarding how to utilize wood-based biomasses and how the sustainability goals can be best achieved. Firms aim to produce various kinds of products and services based on renewable forest-based resources – particularly those based on (minor) side-streams – thereby highlighting closed loops and resource efficiency. The interviewees believe that their companies are responding to urgent societal challenges, primarily those related to climate change, while simultaneously aiming to fulfil various customer needs. Cross-sectorial collaboration and innovations are necessities for intelligent circular BE. Start-ups are important in speeding up development in the field. The overall goal for the FBS actors appears to be conducting sustainable and profitable forest-based businesses.

Finland was seen as a unique country, where a long history and extensive knowledge in forest utilization and sustainable practices, the forest industry's prominent position, plentiful resources, government support and untapped future potential create strong prerequisites to be a leading actor in the sustainable circular BE businesses. The firms often saw themselves as forerunners of circular BE, highlighting the core role of sustainability and reliance on "the reasonable use of wood".

The largest controversies were identified as existing between the European Union and the Finnish perspectives on the various understandings of sustainable forest management practices as well as on what constitutes sustainable volumes of wood biomass utilization and the related carbon sinks. The interviewees pointed out that Finland has no authority when deciding on these issues at the European level. It should be noted, however, that this study found different understandings among the Finnish actors, particularly between companies utilizing large amount of biomass and those needing smaller amounts of raw material. The key dichotomy was whether the definition of BE should include traditional, bulk forest-based products and biofuels or should it be dedicated to new, innovative, higher value-added products only. Further questions addressed where wood-based biomass should be targeted and how to guarantee the availability of raw material for all actors. In addition, the interviewees identified challenges connected with managing global value chains. Although the companies closely linked sustainability to circular BE and reported a range of sustainability perspectives to be at the core of their actions, their focus was largely on the role of the Finnish forest as a carbon sink. Some challenges related to the concepts themselves were also identified: BE and CE were seen by some as new concepts for old ways of doing things; they are mostly political terms; and more precise categorization is needed for their practical use.

Overall, the forest-based circular BE will be a versatile network of different actors with various understandings, raw-material needs, products, services, and sustainability challenges. It is understandable that due to this versatility, expectations and the threats related to different actors and processes will also be different. Recognizing the various perspectives that different actors are looking at the issues through is important to the actors as well as to their stakeholders, which includes NGOs, researchers, politicians and customers. It is obvious that open dialogue and active collaboration between stakeholders

and actors is needed, particularly on how and where to direct wood-based biomass resources in a sustainable manner. Shallow and vague use of the terms BE, CE and sustainability as well as careless bundling of all the actions and processes under the umbrella of the circular, forest-based BE (e.g. at the political level) will inevitably lead to conflicts. In the future, participatory research approaches that engage different stakeholders in the process (such as participatory backcasting, see e.g. Quist et al., 2011) could be beneficial in exploring stakeholders' opinions and future views as well as in facilitating shared understandings. In addition, sustainability cannot be an add-on – companies need to genuinely evaluate the sustainability of their actions, and transparent value chain communication on these issues should be at the core of their activities. The significance of sustainability, especially biodiversity aspects, cannot be highlighted enough. This means that more emphasis needs to be aimed on developing instruments and indicators for assessing sustainability dimensions. In the future, multidisciplinary research approaches and combining knowledge from natural, economic and social sciences will be necessary. Ultimately, the questions here are as follows: What are the sustainable levels/volumes of utilization and, even more fundamentally, what does sustainability mean? The classic saying about “seeing the forest through the trees”, which refers to understanding the big picture and larger entities, is highly relevant to the development of forest-based BE and CE businesses.

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**Highlights**

- Forest-based circular bioeconomy is a network of actors with a range of views
- Bioeconomy is viewed as a response to climate challenges by using renewable material
- Circular economy is defined by resource efficiency, closed loops and collaboration
- The sustainability debate focuses on the role of the Finnish forests as carbon sinks
- The Finnish firms see themselves as forerunners of sustainable, circular bioeconomy
- Directing biomass for various needs (bulk/higher value-added products) is a challenge