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Actors and Politics in Finland's Forest-Based Bioeconomy Network

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Abstract: To foster innovativeness for supporting (forest-based) bioeconomy development, participation in decision-making and interaction between diverse actors become a necessary precondition for designing and implementing transition policies. However, who forms the emerging policy networks, and which policy beliefs are promoted? Based on data from a national online survey, we performed a quantitative social network analysis to investigate emerging social structures and policy beliefs in the context of the Finnish forest-based bioeconomy. Our explorative analysis shows that research, governmental, and industrial organizations mainly constitute the Finnish forest-based bioeconomy network. Actors primarily exchange information, and most key organizations report high levels of trust among each other. However, the network structure is rather closed. This raises concerns about equal benefit sharing and the inclusiveness of concerned actors. We discuss the implication of this network structure for enabling new innovations. Finally, we present the key aspects and drivers of "business as usual", and suggest an option for or a more transformative change in the Finnish forest-based bioeconomy.

Keywords: bioeconomy; forest-based; policy coalition; social network analysis; innovation

1. Introduction

One of the main aims of advancing bioeconomy (BE) in the European Union (EU) is to replace fossil-based products with renewable bio-based materials. This can be achieved by generating new knowledge and innovative technologies [1]. However, the pathways of change for realizing these aims may be underlined by various priorities and conflicts [2]. To date, there is no consensus of what a transition to BE entails and how it should be implemented [3–5]. To enable a sustainable BE transition, participation in decision-making, interaction between diverse actors, and a cultural shift enforcing societal transformation are needed [5,6].

Compared to other European countries, the Finnish BE strategy emerged early, in 2014 and identifying the forest sector as "the foundation of the Finnish bioeconomy" [6]. The Finnish BE strategy encourages collaboration between the forest sector and other sectors in the quest to develop knowledge, technologies, and innovative products [5]. In addition, Finland was also the first country to publish a "Circular economy roadmap", highlighting forest-based and sustainable food systems as key focuses, whilst pursuing the position of global forerunner for the circular economy (CE) by 2025 [7]. Meanwhile, due to their similarities, the two concepts have been married under the label of "circular- bioeconomy" [8]. The need to foster innovations is highlighted by BE and CE strategies, referring to a process of knowledge-transfer within societal networks [9] or, for example, to a new (or

improved) product, process, or business model [10]. Furthermore, innovation can be new and "radical" when it has a significant impact on the market, or "incremental" when attributes of already existing products or services are enhanced [10].

To date, however, BE developments in Europe have mainly revolved around incremental innovations that tend to maintain the industry structure and positions of incumbent firms [3,6]. For example, in the biorefinery context, the forest industry is generally seen more as a raw material supplier rather than an industry generating higher added value for customers [11]. Finnish BE strategy has emphasized bioenergy compared to higher value-added production more than, e.g., in Sweden [4]. This somewhat contradicts the expectations that more than 40% of the turnover of the European pulp and paper industry would come from totally novel higher-value products by 2030 [12]. Although a plethora of bio-based innovation projects and experiments are implemented in Finland, they often lack interconnectivity and coherence [13]. In addition, recent developments point to a direction where established (forest-based) companies are in the process of developing "business ecosystems" around themselves, thus maintaining the status quo, and holding key policy collaboration parameters stable and unchanged [14].

However, the inclusion of a broader range of actors (e.g., entrepreneurs, brokers, resource providers, consumers, citizens, etc.) from outside these established industries may be crucial for enabling industry diversification and development towards higher value production [14,15]. A better understanding of relevant actors, their interests, beliefs and power as well as their role in innovation processes, innovation network strategy, and in facilitating innovation is the foundation for innovation success [14,16]. However, who participates in shaping Finland's BE and what beliefs and interests these actors share remains unclear.

Golembiewski et al. [16] argued that differing terminologies and various approaches towards innovation within the BE are typical barriers obstructing collaborative research and technology development required for large-scale societal transition. Actors' perceptions and the choice of approaches may be shaped by their own interests, beliefs, and the networks they operate in [17,18]. Forming powerful policy coalitions to realize interests is a common strategy in emerging policy domains [19]. Policy coalitions within the BE can be formed based on shared beliefs with the intention to influence policy outcomes in favor of their interests [20]. In an evolving domain, these coalitions affect its direction. Power struggles can be expected in the relatively young BE arena [21]. In fact, politics and policy change are an integral part of socio-technical transitions [22]. Recent studies in Finland indicate that a growing divide is already forming between key coalitions around the pathways towards a sustainable (forest-based) BE [2,15]. Given the high stakes and national importance of the BE transition, the emergence of diverse cross-sectoral actor networks driving this process and spanning diverse interests could be expected. Thus far, however, such new networks appear to have slowly emerged, and research on actor partnerships and forms of cooperation in the context of Finnish BE is scant [16,22,23].

Socio-Technical Transition Networks

A growing number of BE-related studies are based on a socio-technical systems perspective, and analyze the concept with various theoretical frameworks [24–27]. A socio-technical transition is commonly understood through the systems that adapt to changes in their internal and external environments [28]. Socio-technical systems, e.g., BE, are required to provide new technologies, but also changes in markets, user preferences, policy, politics, and cultural meanings to tackle global challenges such as climate change, biodiversity and resource depletion [25]. Policy (change) involves the implementation, adaptation, and discontinuation of specific public policies. Given the fundamental uncertainties that characterize transitions, the formulation of policy problems, goals, strategies, and expected outcomes are highly ambiguous and contested [22]. On the other hand, politics refers to the process of policymaking, with a variety of state and non-state actors negotiating and interacting with each other [22].

Both actor networks and policy beliefs are important when accounting for both the systemic and ideational elements of the BE as a socio-technical transition. Following the seminal work by Markard et al. [22], our study used both systems approaches to socio-technical change and the advocacy coalitions framework (ACF) [29]. The underlying rationale is that policy changes are a central element in socio-technical transitions and that socio-technical change may trigger policy change. In this view, socio-technical systems and policy subsystems overlap and are linked through resource flows and (certain) actors [22]. These two systems are tightly interwoven, as they co-constitute each other.

Networks of participating actors reflect opportunities for informal interaction, engagement in social activities, and the potential for bridging relationships across disparate groups [29,30]. Network structure is influenced by policy beliefs, which in turn may exhibit advocacy coalitions consisting of actors with similar belief systems [9]. Besides allowing organizations to share resources, information, and expertise, coalitions within networks are also formed to address a specific set of policy objectives [27]. Beliefs can thus be regarded as key network variables crucial for understanding how actor groups mobilize resources and form coalitions around policy issues [31,32].

The ACF by Sabatier [29] asserts that the appropriate unit of analysis to investigate a policy process and coalition formation is within a so-called "policy subsystem". Although we did not apply this framework in its entirety, we built on its insights about policy beliefs. "Core" beliefs can be particularly relevant to policy issues. Policy core beliefs are understood as the "glue" holding coalitions together, representing basic normative and empirical commitments related to an entire policy subsystem. They are not set in stone and are most likely to change over time [32–34].

Several empirically-based theoretical contributions to ACF through the application of a social network analysis (SNA) [32,35,36] agree that stable policy core beliefs are an important indicator of the advocacy present within a given network [37]. Henry et al. [38], for example, hypothesized that policy core beliefs should produce the strongest belief "homophily" effect [30] because they are both salient and stable. Other types of policy beliefs can have a smaller, but nevertheless positive, effect on belief homophily [38]. Similarly, Ingold [35] suggested that actors within a network show substantial consensus on issues related to the policy core. This in turn can be indicative of emerging coalitions within the network.

Such assertions become particularly interesting when investigating a (forest-based) BE as a socio-technical system. Here, this implies that the presence of certain policy preferences are a strong determinant of the BE policy domain, its future evolution, and the extent to which larger transformative change will actually occur. In the case of Finland, recent studies point to a growing divide between key actor coalitions in the BE policy, along with the exclusion of certain actors [2,16]. In addition, a top-down governance strategy, focusing on shorter-term economic opportunities and incremental innovation is argued to keep the overall structure of existing industries intact [13]. Therefore, we postulated that such less inclusive and conflicting structures can ultimately hamper innovation, especially in the long term [15].

The main objective of our empirical study was to provide better understanding of the actors involved in the BE development, their interests, and what the emerging policy coalitions in Finland's forest-based BE policy arena look like. We aimed to analyze how effective these structures are for promoting innovations, also through the inclusion of new actors. From the theory viewpoint, our study used both socio-technical transition studies and the advocacy coalitions literature, with particular focus on actor network structure and policy core beliefs [31]. It complements the growing literature on the politics of transitions [24,27] and actor networks in BE transition [22,23,38,39]. We posed the following research questions:

- What type of organizations are involved in Finland's forest-based BE networks?
- What policy beliefs does the network structure promote?
- Has the network structure potential to promote more innovations?

Our article proceeds as follows: Section 2 presents the materials and methods we employed, followed by Section 3, which presents and discusses the main results. Section 4 presents the main lessons learned from this analysis along with suggestions for the way forward, and points out the limitations of our study.

2. Materials and Methods

2.1. Literature Review, Actor Identification, and Network Survey

In the first step, we conducted an extended desktop review between September and December 2017. The review included scientific publications and policy documents, along with gray literature and webpages. All analyzed documents focused on the Finnish BE in general, and on the forest-based BE in particular. The final sample comprised 21 documents and is presented in Appendix A. In this first phase, the focus was on identifying actors that are part of the national BE development. "Actors" here represent organizations with one or more individual experts formally acting as representatives of these organizations. Sampled organizations included universities, industry, networking organizations (such as industry associations), other interest organizations (e.g., non-governmental organizations (NGOs) or consultancies), and governmental bodies. The main criteria for actor selection were:

- That actors are (or had recently been) active within the forest-based sector, or other related sectors working closely with the forest-based sector and/or using wood-based raw materials, products, and services, i.e., various industries (e.g., chemical or pharmaceutical industries), policy bodies, consultancy or other networking organizations, consultancies, etc.
- That actors are (or had recently been) publicly and unambiguously associated in some way with the BE. This could include public statements, public outreach (e.g., lectures, conference proceedings, statements, press releases, organizational position papers, scientific publications, etc.). Other criteria were considered for individual experts, i.e., job title or job description, and membership in BE committees, working groups, or technology clusters.

As a result, we compiled a preliminary list of 40 organizational actors (Appendix B). We used BE-related webpages and BE and circular economy events and participant lists as a source for identifying the most relevant individuals in these organizations. The list of actors was consulted and validated by several experts and senior researchers. We assumed that the Finnish forest-based BE shares similar objectives with CE regardless of the diversity of topics and current political buzz embedded in them [4,6]. Both concepts are joined by the common ideal to reconcile economic, environmental and social goals. Both are resource-focused. However, BE and CE strategies have a different angle at the operationalization level, and their relevance to different operational scales and different types of industries has varied over time. In the scientific literature, BE research tends to focus on aspects related to the substitution of industrial inputs with renewable biological resources, while the core idea of CE is to "close the loops" by maximizing material and energy efficiency and recycling [34].

In a second step, we sent an email to each actor identified during the first phase and asked them to fill out an online questionnaire developed with the web-based survey program Unipark (https://www.unipark.com). We asked the participants to forward the survey to organizations with whom they cooperate on BE. This resulted in 17 additional participants. The participants were also able to name relevant contacts without forwarding the survey themselves. Probing was performed in two rounds: in December 2017 and January–March 2018. In the end, the survey reached 57 participants, 23 of whom responded, giving a final return rate of 40%.

The online survey contained 15 closed and open-ended questions and had a mean processing time of 25 min. The first set of questions collected participant information, such as organization name, position within the organization, affiliation, and category (research, industry, policy, NGO, and other), along with an anonymity request question. The next set of questions focused on identifying contacts. Actors were shown a roster of relevant organizations identified in step one, and were asked to select as

many influential contacts as possible. Additionally, with the help of "name generators", participants were asked to add organizations that they considered a part of the network but that had not been originally listed [40]. This added another 10 organizations to the network list, but these were not asked to participate.

Based on these insights, the following questions measured ties resting on the frequency of contacts (i.e., daily; weekly; monthly; few times a year) along with the level of trust (low; rather low; average; rather high; very high). Based on literature measuring types of ties [22,40,41], actors were asked to indicate the type of contact by selecting among: providing or receiving monetary support or other types of income; research and development; knowledge and information exchange; strategic planning and organizational management; material and product exchange; policy advice; investment advice and/or service; private reasons; and other reasons. This set of questions was repeated for each of the previously selected and/or generated contacts.

To elicit information on the position of organizations and their underlying beliefs and policy preferences regarding key BE policy issues, we formulated a set of position statements to facilitate a response in either agreement or disagreement, measured on a Likert scale [19]. The statements were drawn from the desktop analysis undertaken in phase one and covered key issues debated on in national and international BE policy such as key issues of the revision of the Finnish Forestry Act (2010–2013), major themes presented in the national and EU BE strategies [1,5], along with major themes related to circular BE [4,7]. These statements were later used to identify shared beliefs and policy preferences. Additionally, respondents were asked to name and/or rank products/service groups that ought to be prioritized under forest-based BE. Finally, respondents were asked to name their participation in various policy decision panels or events.

2.2. Network Analysis

Quantitative social network analysis techniques were used to investigate emerging social structures [42,43]. Two levels of network analysis were employed: (i) on overall structural features of a network; and (ii) on actor-level measures detailing the positions and roles of specific actors within a network [44–46].

(i) Network-level measures included cohesion, density, or centralization, which can be used to characterize the network as a whole. For example, Coleman [47] argued that network density reflects social capital, as redundant ties reinforce trust, cooperative behavior, and facilitate mobilization of network resources [38]. "Network closure", or the existence of dense networks where everyone is connected, was considered by Burt [48] to affect access to information and facilitate agreements that make it less risky for network agents to trust each other [44,46]. Highly centralized networks may facilitate coordination, but are also likely to be highly exclusive, marginalizing certain actors [44]. Networks with low cohesion, on the other hand, are indicative of disconnected subgroups and segregation, which ultimately may pose obstacles to collective action [45].

(ii) Actor-level measures, such as "betweenness" and "degree centrality", focus on the roles of individual nodes in the network. "Degree centrality" refers to the number of nodes that an organization is connected to. This measure considers both out-degree (the number of connections going to other nodes) and in-degree (the number of incoming edges). Organizations with a high degree of centrality can be considered "well connected". They are important players for mobilizing action and bringing other organizations together [45,48,49]. "Betweenness centrality" of a node measures the extent to which it can play the part of a "broker" that brings together disconnected segments of a network [46]. For example, Sabatier [50] suggested that policy brokers can even act as conflict mediators between various policy coalitions. Other network concepts, such as "the strength of weak ties" [45], can be used to understand such brokerage opportunities [48]. Particularly interesting for this analysis are so-called "policy brokers" that can either play a "neutral facilitator" role or play an "advocacy" role by promoting their own policy preferences [49].

The data were organized in the NodeXL Excel Template (https://nodexl.codeplex.com/) and further analyzed and visualized with the open source and free visualization and exploration software Gephi 0.9.2 (https://gephi.org/).

3. Results and Discussion

3.1. Participating Organizations

According to the respondents of our study, the Finnish forest-based BE policy network structure mapped in Figure 1 is composed of 67 organizations and 359 edges (connections). Our sample is research-dominated, with 36% of participating organizations being identified from research, 12% from government, 22% from industry, 10% from non-industrialized special interest (NIS) groups, 5% from environmental non-governmental organizations (ENGOs), and the remaining 15% represented by other types of organizations (e.g., consultancies, industry association, or networking organizations).

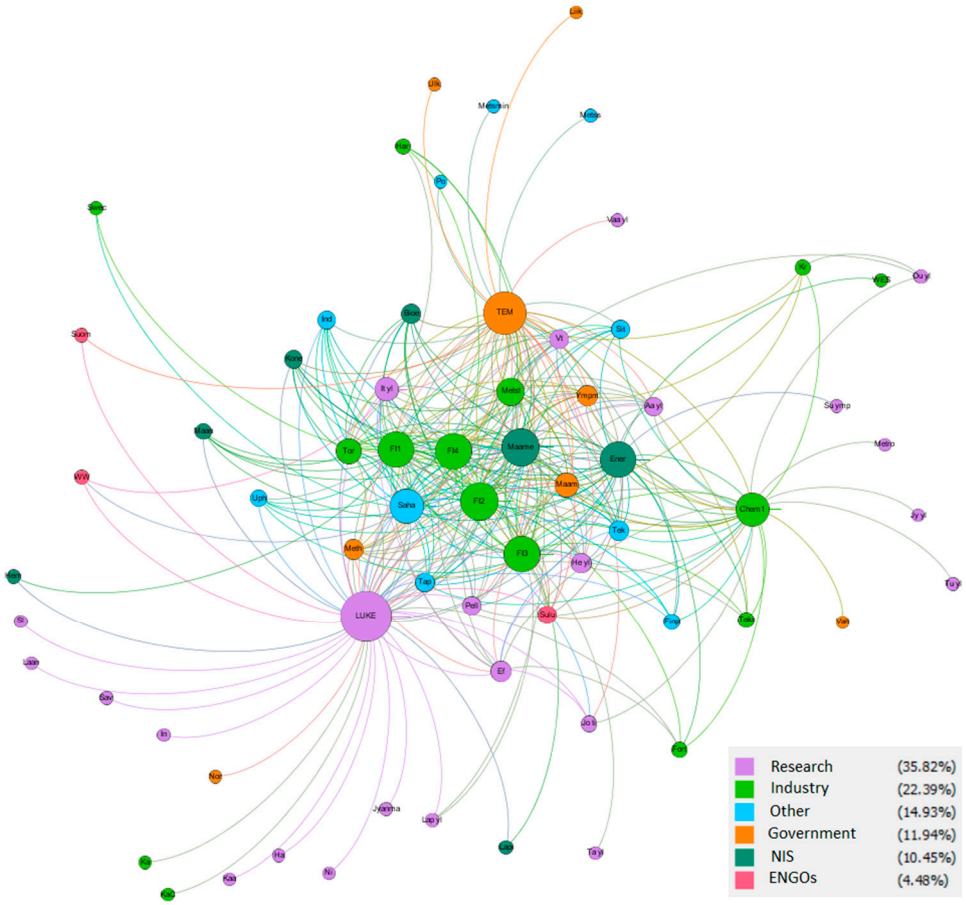

Figure 1. The forest-based BE network in Finland based on the survey (N = 67). The various colors represent different actor groups (research, government, industry, NIS, ENGOs, and other). The larger the node, the more contacts it has. With few exceptions, all organizational abbreviations have been purposely anonymized.

Most research organizations included in our study are universities (e.g., University of Helsinki, University of Eastern Finland, and Lappeenranta University of Technology) or national research institutes (e.g., Natural Resources Institute Finland LUKE), with broad areas of BE expertise ranging from bio-based products and business to energy and food production (represented as purple nodes in Figure 1). Governmental actors included the Ministry of Economic Affairs and Employment of Finland and the Ministry of the Environment (represented as orange nodes in Figure 1). Industry is represented by internationally well-known forest industry companies as well as those in product and

material development (represented as light green nodes in Figure 1), along with industrial associations that connect various organizational actors.

A mix of various non-governmental organizations make up a NIS group (represented by blue nodes in Figure 1). The group includes organizations that can represent a diverse set of economic and social interests of farmers or forest owners, associated with the BE (e.g., The Central Union of Agricultural Producers and Forest Owners). Only few national and international ENGOs are present (represented by pink nodes). Responses from organizations included in the NIS and ENGO groups are combined under NIS later in the manuscript due to the small sample size (see limitations in Section 4). Other types of organizations include networking organizations along with various international consultancies and industrial associations (represented by orange nodes in Figure 1).

In Figure 1, the size of the nodes is associated with its "degree centrality"—the number of nodes that an organization is connected to, considering both out-going and incoming edges [49]. The central part of the network is dominated by a sequence of industry representatives, NIS representatives, and consultancies, all densely connected. The top 10 most central actors in the network are listed and briefly described in Table 1.

Table 1. The top most central organizations in the BE network.

Label	Description	Group	Betweenness Centrality	Degree Centrality
Chem1	Chemical industry group	Industry	86.26	33
Ener	Energy group	NIS	51.05	37
FI1	Forest Industry Group	Industry	24.87	37
FI2	Forest Industry Group	Industry	15.77	40
FI3	Forest Industry Group	Industry	45.2	37
LUKE	National research institute for natural resources and bioeconomy	Research	250.26	61
Maame	Central Union of Agricultural Producers and Forest Owners	NIS	62.41	39
FI4	Forest Industry group	Industry	70.23	38
TEM	Ministry of Economic Affairs and Employment of Finland	Government	183.27	48
Saha	The Finnish Sawmills Association	Other	17.65	34

Three main "brokers" surround the densely connected central area of the network, according to the "betweenness centrality" measurement (the extent to which a particular node lies on the shortest paths between the various other nodes in Figure 1 [46]). These three organizations form a "brokerage triangle" bordering the central nodes described above. These three brokers are represented by the Chemical Industry Federation of Finland (light green node in Figure 1 labeled as Chem 1, with betweenness centrality: 86.26), the Ministry of Economic Affairs and Employment of Finland (orange node in Figure 1 labeled as TEM, with betweenness centrality: 183.27), and a national research organization focusing on BE development (purple node in Figure 1 labeled as LUKE, with betweenness centrality: 250.26). Each of these brokers connects the central part of the network with smaller-sized organizations (mostly dominated by research and NIS representatives), situated more at the periphery of the BE network.

Based on our results, the Finnish forest-based BE network mainly consists of research, and governmental and industrial actors. Large industrial companies are the most central organizations, while other players are situated more at the periphery of the network, including national research organizations, NIS, ENGOs, and a few other organizations (i.e., consultancies, specific lobbying groups). This structural setup indicates that the three broker organizations use their network positions to build ties among other actors and play the role of network integrators. The important position of the Ministry of Economic Affairs and Employment of Finland on the one hand, and the chemical industry on the other, may indicate their roles as policy facilitators.

The central role of one ministry as one of the main network integrators is typical for government-steered transitions [25]. As Bosman and Rotmans [13] observed, the Finnish government appears to act more as a "director" of the transition. However, this may lead to maintaining the status quo rather than opening a sector for larger change away from business as usual. Considering ambitions to increase the value and synergies of existing forest-based supply chains, ties and collaboration between the forest and chemical industry are likely to increase in the future [51]. However, smaller organizations and SMEs are less visible in the network. These are usually perceived to be less influential, both politically and economically [25]. However, this may also be partly due to the small sample of our present study.

3.2. Types of Contact, Frequency, and the Level of Trust

Regarding the nature of contacts, the present analysis measured ties resting on the type of connection, frequency of communication, and trust between the various participating actors. Central actors communicate frequently, most respondents reportedly being in contact with each other either regularly/very often (33%) or occasionally (33%). Forty two percent of respondents reported being in contact rarely. The information in Figure 2 was filtered to only depict the organizations that are most frequently in contact with each other (regularly/very often). In addition to filtering, a modularity analysis was performed. The modularity algorithm searches for the nodes that are more densely connected together than to the rest of the network. It highlights the strength of division of a network into modules (also called groups, clusters, or communities) [52]. Hence, 57 organizations and 116 edges are tightly connected. Two major groups emerge: a research–NIS–ENGO group (depicted in red in Figure 2) and an industry–government–other types group. The highest frequency of communication exists mainly between research, NIS, and ENGOs, whereas actors in the other, larger group are slightly less frequently in contact with each other.

Based on our analysis, the type of communication exchanged between network actors varies considerably, mostly involving some form of information and knowledge exchange (43% of contacts). Other forms of contact indicated by participants included policy advice (8%); receiving money, resources, or income (5%); or research and development (3%). Less frequent types of contacts are divided among material and product exchange (1%); provision of money, resources, and income (2%); or other types of contacts (3%). As the two groups that form the BE network mainly exchange information and knowledge, we assume these two groups also share similar policy preferences.

Most organizations reported a high level of trust with one another. More specifically, 27% reported very high levels of trust, 32% of respondents reported rather high levels of trust, and 26% moderate levels. The level of trust was not indicated in 15% of the answers. No respondents reported rather low or low trust with their network partners. Similar to the frequency of communication, the highest level of trust was reported among the most central organizations and brokers in the network. This is another indicator of network closure, present in dense networks in which everyone is connected, and ultimately facilitates agreements that make it less risky for network agents to trust each other [46,47].

Besides reinforcing trust, this network structure facilitates cooperative behavior, and can aid in mobilizing various network resources (both material and agential) [38]. Research and NIS organizations tended to be in contact more often and share information, indicating strong ties among these actors. Given the peripheral position of certain actors, their strong ties are instrumental for building coalitions and for synchronizing collective action. However, such strong ties that are built over time may also limit the diffusion of new information into the network if communication runs through stakeholders that already tend to have the same information [53].

Industry organizations on the other hand tended to be slightly less frequently in contact with each other. This is not surprising, given the fierce market competition among some of these players on the one hand and rules set by the EU and national competition authorities to restrict collusive behavior on the other. These organizations are, however, all connected to the three main brokers, particularly to the governmental organization (TEM). In fact, weak ties may provide these organizations, and the entire

network, with access to diverse pools of information and resources [53], ultimately proving highly valuable for the establishment of new BE products and services. However, finding organizations weakly connected may also be an indication for lack of trust and understanding needed for more in-depth dialogue and collective action [47,52]. However, as mentioned above, many organizations reported moderate to high levels of trust among each other. Particularly, the three main brokers were among the most trusted organizations in the network, indicating that participants entrust these players to lead the BE transition.

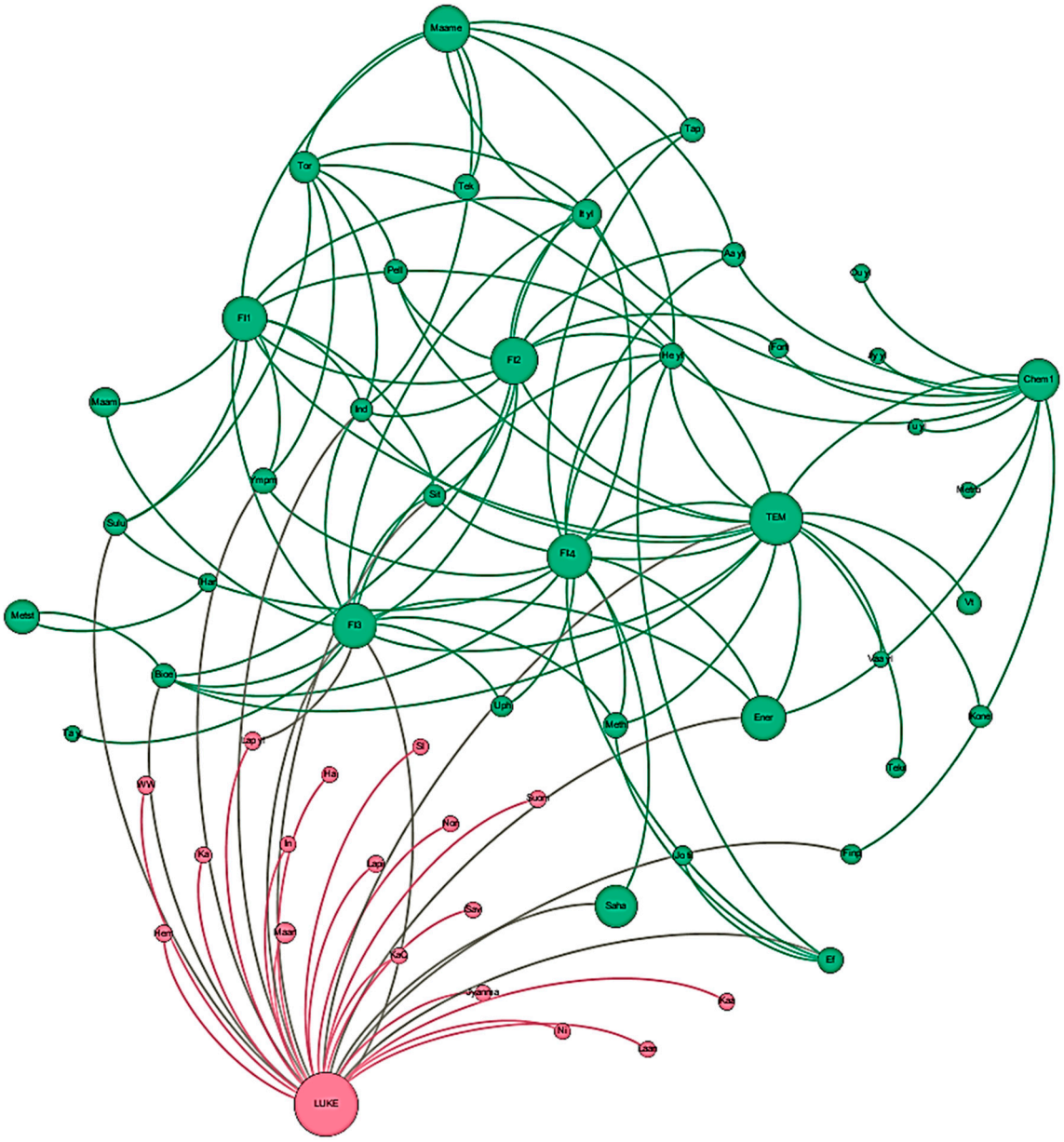

Figure 2. The forest-BE network in Finland connected through the strongest frequency of communication ties (N = 57). Two major groups emerge: a research–NIS–ENGO group (red) and an industry–government–other group (green).

3.3. What Should BE Policies Emphasize?

Respondents evaluated the role of new technology development and economic competitiveness as important aspects of the Finnish BE strategy that should be further developed. Governmental and research representatives tended to emphasize the role of new technology more than the other

groups (Figure 3). Unsurprisingly, the forest industry and its closest contacts mostly ranked the importance of integrating the forest-based sector in wider BE policies. In line with earlier studies analyzing BE policies [2,53–55], responsibility for minimizing environmental impacts as a primary goal of the BE strategy was systematically placed behind technological and many economic aspects. However, providing new employment also ranked low. The importance of integrating forests and forest utilization in the BE policies were also stated as important aspects of the BE, which is only natural considering who our respondents were.

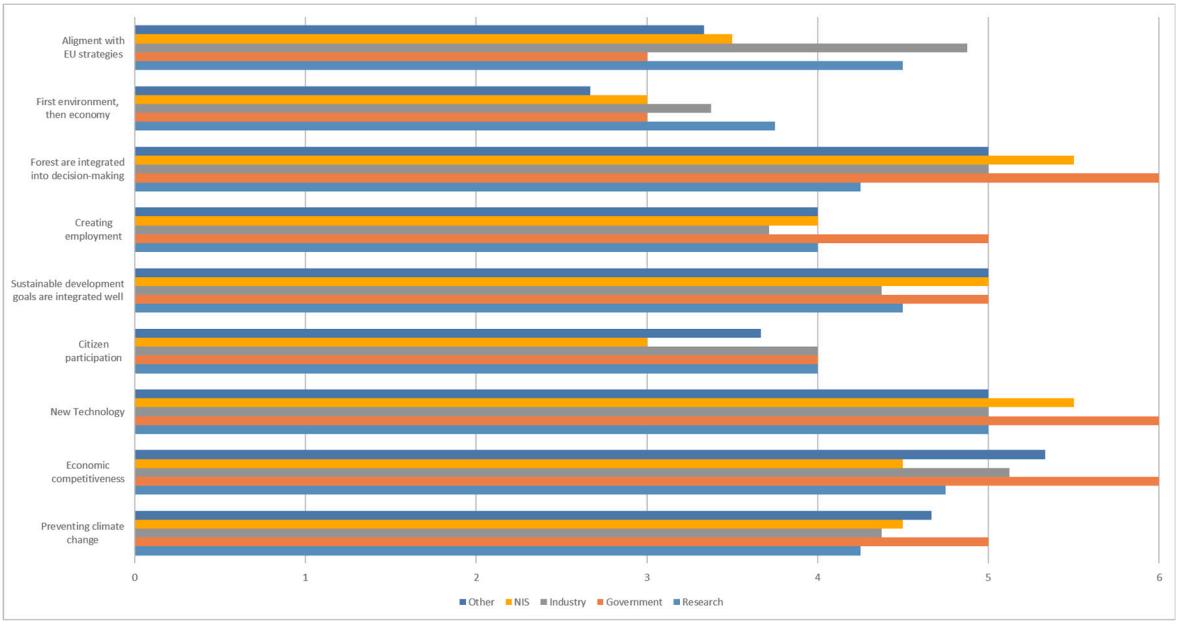

Figure 3. The response breakdown of key BE emphasis topics from the Finnish BE strategy among respondents, 1 = very low importance to 6 = very high importance.

Regarding the views concerning the European perspective of the BE that are particularly relevant for forest-based BE, respondents prioritized promoting business development, expanding businesses, and supporting the competitiveness of wood-based materials (Figure 4). Government representatives foresaw very high potential in developing cross-sectorial business models using digital technologies. Unsurprisingly, the business-as-usual scenario, with a strong focus on existing production pathways, was less prioritized by respondents. However, a number of respondents still considered it important (e.g., industry and research actors). NIS representatives in particular ranked the priority of the existing large-scale production at a lower level. The role of forests as carbon sinks or business development based on a wide-range of ecosystem services (such as berries, fungi, and recreation) were given lower priority compared to developing new forest industrial business opportunities.

Regarding ecosystem services provided by forests, carbon sequestration and forests as carbon sinks were not highly prioritized even though many respondents reported being engaged with climate policies at the EU level. This may be due to the timing of the survey (2017–2018), conducted during the same period as the LULUCF (land use, land use change and forests) negotiations [56], a debate that emerged as a bone of contention between the European Commission and the Finnish forest industry [57]. Again, these policy preferences are indicative of the important advocacy role the industrial forest-based sector plays in the BE network and the important advocacy level it plays at the EU level.

Furthermore, respondents were asked to evaluate the importance of key topics for the forest-based BE that are highlighted in the Finnish circular economy roadmap [7]. Respondents commonly believed that providing support for demonstration plants and trials that reduce the business risks embedded in the commercialization of new circular economy products and services is highly important (Figure 5).

Other important themes were related to creating incentives for shifting the focus on bio-based products with longer lifespan (such as wood used in construction). Education was also highlighted in the context of circular BE development, especially by the government and NIS. The development of a service-centered circular BE, and maximization of the total value of production instead of maximizing wood use was emphasized least. Overall, the government group, NIS, and the others group reported systematically higher rates for the different aspects compared to industry or research.

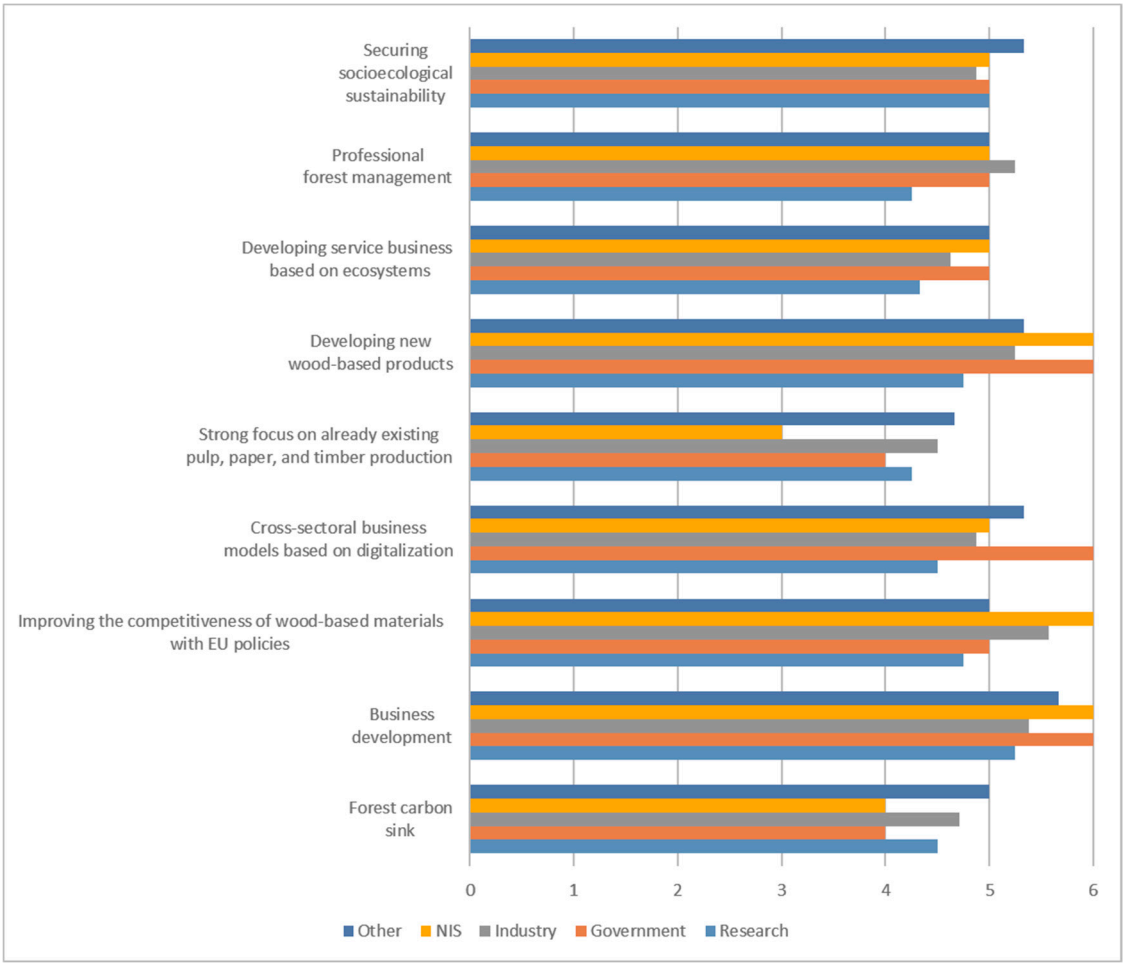

Figure 4. Importance of different themes highlighted at the European-level BE policy, 1 = very low importance to 6 = very high importance.

Regarding the prioritization of products, services and related activities (such as marketing or education) for the forest-based BE in Finland, sawn wood and pulp and paper products were surprisingly seen as the most promising ones (Figure 6). The high score for sawn wood reflects the perceptions on the positive outlook of wooden housing and the importance for forest owners in bringing stumpage earnings. Marketing, services and smart packaging solutions also scored high. Marketing was ranked as the most important aspect among industry actors. Governmental actors particularly emphasized the importance of new products, while industry was more inclined to favor established products. The government highlighted cosmetics and medicine. Education was not the top priority of any participant. In addition, forest-based services were systematically ranked lower than product- and technology-related aspects. Governmental actors ranked the services targeted at forest owners relatively low compared to the other respondents.

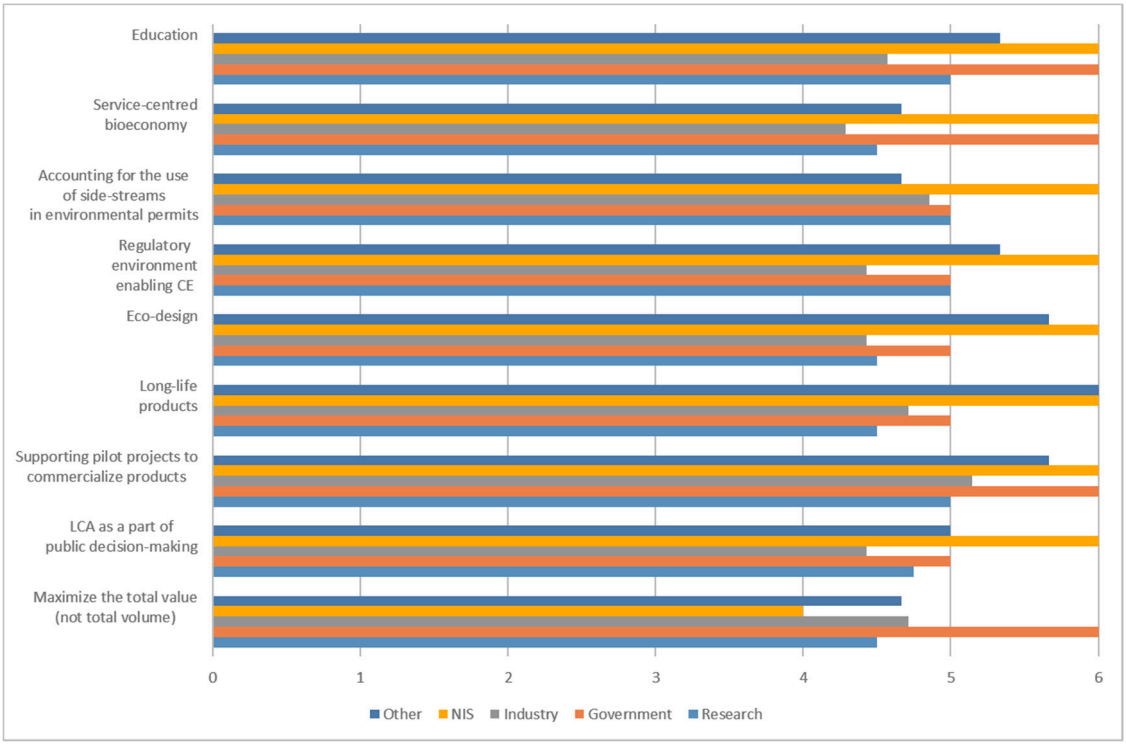

Figure 5. The most important products and services in circular BE based on the average within different representative groups, 1 = very low importance to 6 = very high importance.

Besides policy advocacy for traditional forest sector products, the circular BE agenda serves as a venue for discussion concerning "more transformational change" of the forest-based BE, at least from the industrial development viewpoint [8]. Better commercialization opportunities for circular products and services were emphasized along with longer lifespan products. In the forest-based sector, this emphasizes the strategic importance of, e.g., wooden construction [21], but also other areas such as textiles, construction, bioplastics, chemicals, and intelligent packaging [8]. Although education scored relatively low among forest-based BE themes, it was identified as one key aspect of a circular BE. The need for education may be related to the uncertainties regarding the practical implementation of the "3R" principle (reduce, reuse, recycle) beyond its strategic implications. As certain cascading supply chains may be associated with environmental or human health challenges [58], a circular economy transition needs to go beyond technical fixes and emphasize local value chains along with transformative change in the current consumption habits [59].

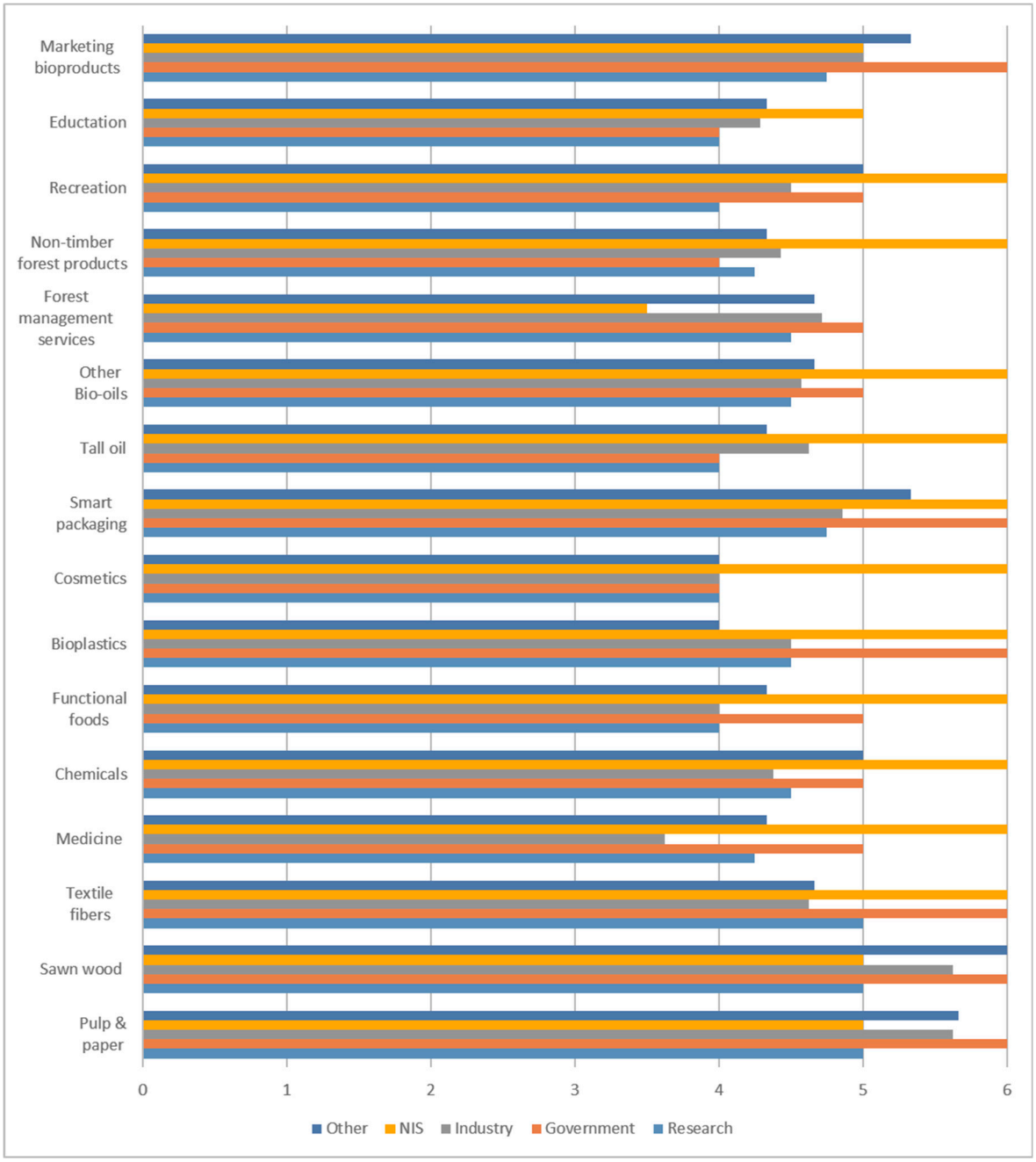

Figure 6. The most important products, services and related other activities in forest-based BE, 1 = very low importance to 6 = very high importance.

3.4. Implications on the Direction of Innovation

How effective is the BE network structure for promoting innovations? The high level of trust between established players and the communication frequency indicates that the BE network was rather closed at the time of the interviews. In other words, established industrial players make up the main bulk of the cooperation network, whereas other (smaller) actors are either at the periphery of the network or absent. Two groups make up this network. On the one hand, a smaller group was made up of research organizations, NIS, and ENGOs. On the other hand, we have a larger group made up of industry and governmental representatives, along with other organizations such as consultancies and networking organizations. Indeed, the network appears to be centrally steered in a top-down manner by government agencies and industrial brokers advocating their own policy interests [13]. Whereas

this network structure may facilitate strong ties and frequent cooperation in the short term, it may be detrimental to long-term innovativeness, especially from the viewpoint of inclusive knowledge transfer within the BE network.

Based on a series of polarizing statements ranked by respondents, we were able to identify certain underlying beliefs and policy preferences for BE transition as promoted by the different actors in the policy domain. However, the small sample size did not differentiate the actor groups, and made it difficult to delineate clear-cut coalitions within the network. Besides the "classical" disagreements between NIS agents and forest industry representatives (e.g., disagreements regarding large-scale forest harvesting and production, and EU BE strategies) [2], the network showed remarkable consensus on some of the policy issues and priority areas for the BE. The minority group within the network showed more preference for environmental aspects and citizen participation. However, these were weighted low in comparison to technological and economic aspects preferred by the larger industry-government group.

This current network structure, centered around governmental bodies and traditional forest-based industries, with less participation of other actors and stakeholders, could hamper knowledge transfer in the networks. The literature suggests that the transition toward BE requires breaking up the silos of the forest-based industry and stimulating hybrid collaboration [13,15]. Our results suggest that technological innovations dominated in the Finnish forest-based BE at the time of the survey. Ideally, opening up network boundaries to include diverse stakeholders (entrepreneurs, forest owners, citizens, etc.) and organizations in a more non-linear and flexible way would increase the quality and social acceptance of dominantly technological innovations [9,14].

4. Conclusions

Our pioneering study provides the first overview of the forest-based BE policy network and various policy beliefs emerging from this network. Identifying the key actors in this network along with their policy preferences is useful for understanding—and informing—the future development of the Finnish forest-based BE. Hence, results offer interesting insights into the different actors' normative struggles over the direction of Finland's BE transition. Three well-known organizations (i.e., a national research institute, the Ministry of Economic Affairs and Employment of Finland, and a chemical industry association) comprise a "brokerage triangle" encompassing a number of central, well-connected organizations. Two main sub-groups constitute this network: a research–NIS–ENGO group and a larger industry–government–consultancy group.

Based on our analysis, key aspects and drivers support two alternative paths in the Finnish forest-based BE: "business-as-usual" development (BAU) or a more radical change ("transformative"). The business-as-usual development pathway is steered by a strong industrial and governmental coalition. A high level of trust among the actors and the "bulk" product- dominated production strategies increase help to maintain the current industry structure intact. This pathway resonates on the one hand with the high global demand for long-fiber pulp produced in boreal regions, and on the other hand with relatively low emphasis on knowledge development in the context of the Finnish bioeconomy strategy. Furthermore, the closed-network structure increases the risk of further segregation in an emerging BE network hampering the knowledge transfer between diverse actors. Based on a more transformative and strategic path, forest sector businesses will diversify the network structure and open new opportunities for smaller scale "niche" businesses. It is likely that various organizations will position themselves differently in the value chain, but based on our results it is too early to say who will be coordinating the change. There are prime examples on how forest and chemical industrial actors support deepening collaboration, and new knowledge can diffuse into the network through education, as also highlighted in the results concerning the CE agenda. Results are also indicate that collaboration with the construction sector will carry on strengthening, as climate policies give support for longer timespan products, such as sawn wood and engineered wood products used as construction material.

The network analysis presented here is far from exhaustive, and the limited response rate was one of the limitations, although it is a common problem in online surveys. Organizations on the consumer side were underrepresented due to the difficulty in identifying and engaging them in the survey. Likewise, ENGOs and civil society actors were underrepresented in the sample. Nevertheless, the analysis managed to include central organizations considered to be among the most influential for BE development (Table 1). Another common challenge in network analysis is formulating the network boundaries, and in our case a wider range of organizations (especially new SMEs) were not initially captured. Including their views would have enriched this discussion. In response to these issues, only a limited number of analytical tools were available and our results should be interpreted as indicative concerning policy preferences among the actors who participated in our survey. Rather than viewing this analysis as exhaustive, readers should understand it as a first attempt to map an emerging network, where policy beliefs and network structure are still in flux. Given the limited sample, our study does not do justice to the empirical and theoretical depth that the coalitions framework requires. In-depth interviews could be added to the current survey with pre-formulated opinion statements to provide a more nuanced understanding of actors' core beliefs and contentious issues in the still unfolding policy domain.

It is beyond the scope of this study to provide policy or network management recommendations. However, our insights can be used by policy makers in future attempts to diversify, broaden and even strengthen certain areas of the Finnish BE network. For example, policy incentives could focus on strengthening responsible research and innovation (RRI) by opening the network for diverse societal actors (e.g., researchers, citizens, policy makers, business, NGOs, etc.). This implies there is co-production during the whole research and innovation process with a wider sense of societal actors to better align both the process and its outcomes with the values, needs and expectations of BE stakeholders.

For the near future, the forest-based BE will likely follow the current industrial logic, where new innovation and servitization processes are built on already existing products. However, given the high level of social capital and sophisticated industrial infrastructure, the BE network appears well positioned to capitalize and further develop these products. The power of this path supporting the promised transformation toward inclusive and more sustainable bioeconomy can also be questioned. The long-term success in building up a resilient society requires a strong strategic role for implementing sustainability commitments at the national, industrial, and company levels. Based on our results, there is room for further understanding of the actors and policy beliefs influencing the development of the BE and circular BE in Finland. This should be done beyond the "traditional" boundaries of sectors, and by increasing understanding concerning the role of niche-level actors, cultural influencers, and communications in the ongoing development to help align strategic visions and grass-root level practices.

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Appendix A. Desktop Analysis

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Appendix B. Organizational Roster List

- Aalto-yliopisto
- Apila Group Oy Ab
- Bioenergia ry
- Energiateollisuus ry
- Finpro
- Fortum
- Helsingin yliopisto
- Hämeen ELY-keskus, Maaseutuosasto
- Indufor
- Itä-Suomen yliopisto
- Joensuun tiedepuisto
- Jyväskylän ammattikorkeakoulu
- Kemianteollisuus ry
- Koneyrittäjien liitto
- Lapin liitto
- Luonnonvarakeskus
- Maa- ja metsätalousministeriö
- Maa- ja metsätaloustuottajain Keskusliitto
- Maanmittauslaitos
- Metsägroup
- Metsähallitus
- Metsäteollisuus ry
- Nordregio
- Pellervon taloustutkimus PTT ry
- Sahateollisuus ry
- Sitra
- Stora Enso
- Suomen luonnonsuojeluliitto ry
- Suomen yliopistot UNIFI ry
- Sweco Industry
- Tapio Oy
- Tapio Silva OY
- Tekes–Teknologian ja innovaatioiden kehittämiskeskus
- Teknologian tutkimuskeskus VTT Oy

- Teknologiateollisuus ry
- Työ-ja elinkeinoministeriö
- UPM
- Uusi puu-hanke
- Wärtsilä Energy Solutions
- Ympäristöministeriö

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