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Transition Governance towards a Bioeconomy: A Comparison of Finland and The Netherlands

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Abstract: In both Finland and The Netherlands strategies are being developed to switch from fossil to green resources in order to tackle the challenges of climate change and resource dependencies and to tap into the economic opportunities that arise. We investigated the similarities and differences in the transition process and governance strategies with respect to the transition towards a bioeconomy in both countries, using transition management as an evaluative lens. The research method involved comparative qualitative case study analysis through action research. We found that the governance approach in The Netherlands focusses on co-creating a long-term vision that informs for short-term action, on facilitating bottom-up regional clusters and promoting radical innovation through cooperation between vested players and frontrunners. Finland adopts a more traditional, top-down governance strategy, focussing on the shorter-term economic opportunities and incremental innovation that keep the overall structure of existing industries intact. We conclude that the Dutch government acts as a facilitator, while the Finnish government acts more as a director of the transition. We recommend that Finland's governance for the bioeconomy be improved by applying insights from transition management, while the Dutch approach runs the risk of being captured by vested interests.

Keywords: bioeconomy; biobased economy; Finland; The Netherlands; transition management

1. Introduction

The 'bioeconomy', as it is called in Finland, or 'biobased economy', which the Dutch prefer, is based on the idea that for an economy to be truly sustainable, it should source its inputs from renewable resources instead of fossil resources. The bioeconomy gains increasing attention across the globe in the face of geopolitical tensions and environmental pollution, climate change and loss of biodiversity [1–4] and because of the potential economic opportunities presented in developing biotechnology [5]. This has spurred several countries, including Finland and The Netherlands, to develop activities and strategies to accelerate the transition towards a bioeconomy [6,7]. These two countries are quite distinct, in terms of their geography, natural resources and economies, which influences how they approach the bioeconomy. In Finland, availability of biobased resources in the form of forests plays a key role, while in The Netherlands such resources are largely absent. In this country product development and the (chemical) processing industry play a larger role in driving the transition. Although their starting points are rather different, both countries have developed ambitious goals for the bioeconomy. The Finnish Bioeconomy Strategy aims for growth of the bioeconomy from about €60 billion at present to €100 billion in 2025, creating 100,000 new jobs in the process. It defines the bioeconomy as follows:

"An economy that relies on renewable natural resources to produce food, energy, products and services. The bioeconomy will reduce our dependence on fossil natural resources, prevent

biodiversity loss and create new economic growth and jobs in line with the principles of sustainable development" [8].

The Dutch Businessplan Biobased Economy aims for The Netherlands to be amongst the top three countries involved in the bioeconomy in 2050 and emphasises that:

"A highly developed [bioeconomy] uses green resources firstly in the production of food and feed and only afterwards (or simultaneously in the case of waste products) for chemicals, materials and energy" [9]. This refers to the cascading principle depicted by the biomass value pyramid (Figure 1), which lies at the heart of the biobased economy discourse in The Netherlands, but is largely absent in Finland. The pyramid indicates where biomass could have the highest value added. Applications such as pharmaceuticals or fine chemicals are generally where one would want to use biomass first. The residues from such processes could be used lower in the pyramid. However, the higher in the pyramid the more radical the innovation involved, requiring different kinds of skills and knowledge. Generally, it is easier to start at the base of the biomass pyramid, but more rewarding to aim at the top.

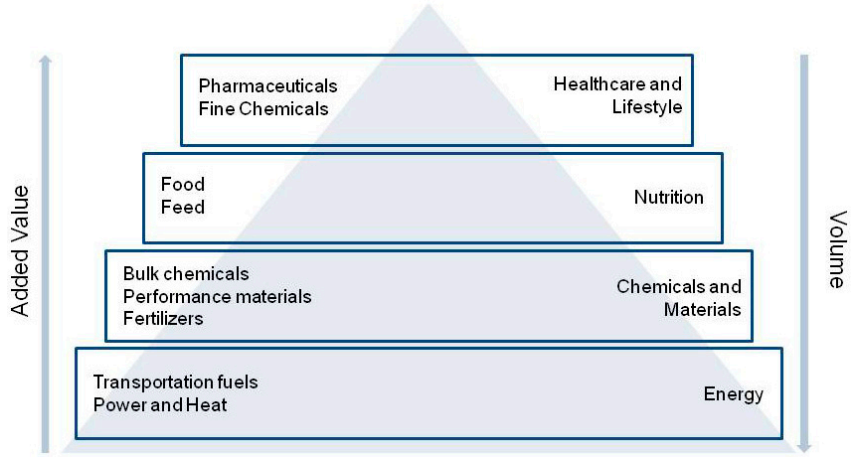

Figure 1. Biomass value pyramid (Adapted from: Businessplan Biobased Economy [9]).

From a transition perspective we understand the transition to a bioeconomy as a complex process [10] that is the result of a co-evolution of economic, technological, institutional, cultural and ecological developments at different scale levels [11].

Such transformative changes generally take decades and require both radical and incremental innovation [11,12]. Incremental innovation is about doing things more efficiently, whereas radical innovation is about doing things entirely differently. Radical innovations are about system innovations and thus transitions. However, transitions are deeply contested societal processes, involving multiple possible visions and transition pathways [12,13]. This is also the case in the bioeconomy [14–16]. Transitions often involve challenging the status quo and thus face fierce resistance from vested interests in the energy, petro-chemical, agriculture and forestry sectors [17,18]. Our aim here is not to problematise the bioeconomy itself [5,19], rather, we aim to provide insights into how two different countries with high bio-ambitions but different starting points understand, shape and govern the transition towards the bioeconomy. Based on the transition perspective [12,20], we want to address the following research questions: how does the transition toward a bioeconomy take shape in Finland and The Netherlands, and what role does transition governance play in this process?

We address this question by looking at the Finnish and Dutch bioeconomy from a transition perspective and analyse the governance strategies employed in both countries in terms of strengths and weaknesses. We conclude with an integrated assessment of the biobased transition and the way it is governed in both countries, and the lessons to be learned from both approaches.

2. Transition Perspective on the Bioeconomy

Research on sustainability transitions is an emerging academic field rooted in multiple disciplines, including innovation studies, evolutionary economics, institutional theory and complexity theory, that addresses questions of fundamental societal change in the face of sustainability challenges [20]. A transition is conceptualised as a fundamental change in the structure, culture and practices of a societal (sub)system that is the result of a co-evolution of economic, technological, institutional, cultural and ecological developments at different scale levels [11]. Transitions are long term (25–50 years), highly complex and involve a variety of domains and stakeholders [12]. Contemporary transitions are often related to sustainability goals in order to resolve a number of persistent problems confronting modern societies.

The envisaged shift and growing societal efforts to move away from fossil fuels and resources and use renewable natural resources, as subsumed under the bioeconomy, fit neatly to the conceptualisation of a sustainability transition as outlined above. The case for the bioeconomy is made by claiming that it could contribute to tackling persistent problems of food security, climate change and resource dependencies [14], but it is also clear that a number of supporters see the potential for exploiting the economic opportunities of biotechnology [21]. The transition towards a bioeconomy is complex, involving several sub-transitions including: untwining the agricultural sector from the fossil sector; untwining the chemical sector from the fossil sector; converting the chemical sector into a food-health sector; and shifting the focus in the forestry sector from bulk to high-end specialty products. Such fundamental change processes tend to be highly contested [22–26], involve a great number of actors across different domains and will probably take decades to reach a new dynamically stable equilibrium. As such, we propose that the concepts and insights developed in the field of sustainability transitions have much to offer in order to understand the change processes involved in the transition towards a biobased economy.

Within the literature on transitions, a distinction is made between understanding transition processes, referred to as transition dynamics, and understanding how actors (aim to) influence transition processes. Research into the possibility of influencing or steering transition processes is referred to as transition governance or transition management [10,27,28]. In practice the distinction is not that clear since trying to influence transitions requires a sound understanding of transition dynamics.

When analysing transition dynamics, different levels in time and functional or geographical aggregation can be distinguished. These have resulted in the 'multi-phase' and 'multi-level' frameworks, which have been extensively described in the literature relating to transitions [11]. The multi-phase concept [29,30], focusses on the direction, speed and size of transitions and describes a transition through time as an S-shaped curve that goes through four phases (see Figures 2 and 3):

(1) Pre-development: small changes are going on in a system but in the background and are not (yet) visible;
(2) Take-off: in this phase structural changes gain momentum, it is the ignition of a transition;
(3) Acceleration: structural changes gain speed and become visible;
(4) Stabilisation: in this phase a new state of dynamic equilibrium is reached.

Distinguishing these four phases in a stylised S-curve gives the impression of a smooth and clearly delineated process. Quite the opposite is true: transitions are characterised by alternating periods of fast and slow change, together forming a strongly non-linear process [11,29,30]. Furthermore, it is not a given that a transition will be successful, with success being defined as the system reaching a new sustainable equilibrium.

The multi-level perspective introduces the idea that socio-technical systems can be studied by differentiating between three levels: the niche-level at which innovative practices are developed, the regime-level which provides structure and stability to a system, and the landscape level which comprises long-term trends and exogenous events that might put pressure on the regime. Transitions can occur when developments at these three levels align [11,31].

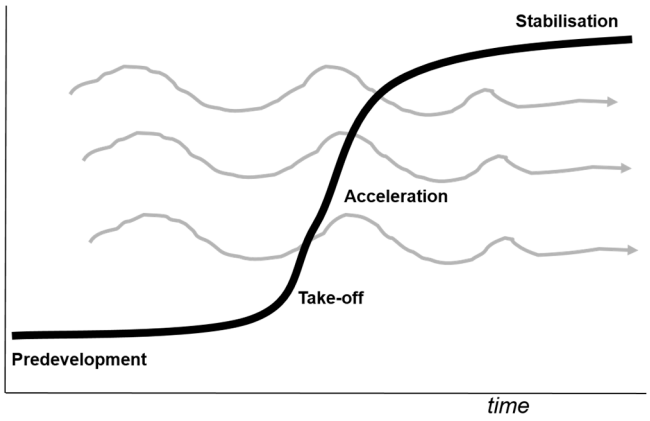

Figure 2. Multi-phase framework (Adapted from: Rotmans, 2005 [29]).

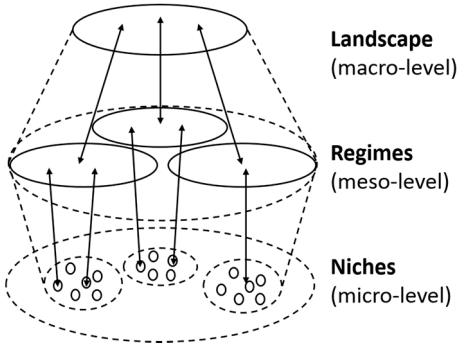

Figure 3. Multi-level framework (Geels, 2002 [31]).

In this study we use the multi-phase and multi-level concepts in order to analyse the direction and speed of the transition to a bioeconomy in Finland and The Netherlands.

In addition to the above analytical concepts, we use insights from transition management to evaluate the transition governance efforts in both countries. Transition management provides a framework within which to analyse and influence transitions in terms of direction and pace. This does not refer to the illusion of commanding and controlling transitions but implies adjusting, adapting and influencing a societal (sub)system in a subtle manner [27,28]. Transition management aims to stimulate radical innovation using principles from complex systems theory. It promotes long-term thinking (at least 25 years) in order to inform for short-term action and policies. It proposes to create space for niches with a focus on frontrunners to promote radical innovation. It argues that actors at a certain distance from the regime can effectively create alternatives to the regime in a protected environment to permit investment of sufficient time, energy, and resources. Furthermore, it promotes (social) learning about different actor perspectives and a variety of options (requiring a wide playing field) as a necessary precondition for change. This requires participation in decision-making and interaction between stakeholders in order to develop support for policies and to engage actors in reframing problems and solutions through social learning. Moreover, transition management asserts that transitions come about through radical innovation in incremental steps, making anticipation and adaptation part and parcel of the governance approach while taking into account that there is no blueprint for a transition [11]. Transition management can be used both as a prescriptive and descriptive framework [32,33], in this study we use it in a descriptive manner.

The transition concepts described above have their pros and cons and are criticised in the literature [11]. In view of their limitations, these transition concepts have already demonstrated their usefulness in numerous case studies, a major reason for their use in assessing developments and ambitions relating to the bioeconomy in both Finland and The Netherlands.

3. Research Methodology

Our research focusses on the bioeconomy in Finland and The Netherlands. We chose to compare these countries, since they both have set ambitious goals for the bioeconomy at the national level, but have very different starting points and driving forces. The bioeconomy is understood and pursued differently in both countries, and the industries and activities involved are different. As such, a straightforward comparison of both countries is difficult. Rather, we provide a qualitative assessment of the ongoing developments contributing to the bioeconomy and the governance efforts aimed at steering the transition in the preferred direction with sensitivity with respect to the specifics of the respective contexts.

In order to address our research question we conducted an integrated transition analysis, which was a combination of: (1) literature review and document analysis; and (2) action research [34]. From 2011–2015 we undertook a series of activities to collect a variety of empirical data: field notes, interview reports, and a selection of case-related documents, including both official publications, as well as internal documents and minutes of meetings. These have been discussed and analysed with Dutch and Finnish contact persons. Next, we did a series of in-depth interviews in both Finland and The Netherlands with high-level representatives from government and business and visited companies, industry associations, ministries and non-governmental organisations. Secondly, we organised group meetings in both countries (although more in Finland than in The Netherlands) with representatives from both the government and private sector; and finally we attended high-level meetings and conferences, particularly in The Netherlands. In-depth individual and group interviews were conducted where we interrogated actors who were carefully selected based on their involvement in the bioeconomy and strategic position within their organization. In most cases they were functioning at the board level (in the private sector) or director level (in the public sector). We selected both actors related to the regime (incumbents often acting upon maintaining the status quo) and niches (entrepreneurs who work on radical innovations), aiming at creating a balance between the two types of actors.

In The Netherlands our focal point was the Ministry of Economic Affairs, which has been active in the Dutch biobased transition for several years and has built up a huge network around this. In Finland our guide in selecting representative actors was TEKES, the Finnish Funding Agency for Innovation. Overall, we are confident to have involved a representative sample of key actors contributing to the biobased economy in both Finland and The Netherlands. See Appendixes A and B for all activities in terms of meetings and interviews performed in both countries: Appendix A for The Netherlands and Appendix B for Finland.

The action research component signifies that we were actively engaged in preparing and organizing the meetings, as well as the normative-oriented debates on the biobased economy in both countries. We also gave lectures as part of the meetings in order to present our findings and insights, ask for feedback, and present the next steps in the transition assessment. Actually, it was a co-production between our Finnish (TEKES) and Dutch (Ministry of Economic Affairs) counterparts and ourselves. Together we drafted the agenda for the research process, and prepared the next steps over a period of four years. This evolutionary approach was far from a blueprint, but was based on what we learned in the previous steps [34,35]. The focus was slightly different in the two countries. In Finland we started from scratch and needed more basic information on the bioeconomy activities, the prominent actors engaged, and the governance involved, while in The Netherlands we were more familiar with those aspects, having followed (and partly engaged in) that transition process from a close distance. That implies that the action component in Finland was higher, where we organised more and different meetings, with an emphasis on group meetings and interviews. In The Netherlands, however, many meetings and conferences were already organised, we participated in quite a few, while others we organised ourselves.

The analysis was carried out in three steps. The first step was the characterisation of context relevant for the transitions towards a bioeconomy, including identifying important sectors and general

economic structure. The second step involved characterisation of the transition towards a bioeconomy, using the multi-phase and multi-level concepts described above. At the micro-level we assessed the emergence of biobased experiments and entrepreneurship, whether these were connected or operating in isolation. At the meso-level we characterised the regime, including sector structure, sense of urgency for transformative change and ownership of the problem. At the macro-level we mapped which exogenous trends and developments influenced the transition towards a bioeconomy. At all levels, we found forces both driving and hampering the transition. This analysis helped us to identify in which stage the biobased transition is at the moment and what major barriers and challenges are in the respective countries. The third step was the assessment of the governance efforts to promote the transition towards a bioeconomy. In this third step we used the principles of transition management as an evaluative lens for the governance efforts towards the bioeconomy. What was the specific governance approach used in each country to stimulate the biobased transition and how could we compare these in terms of transition governance? After having discussed both governance approaches separately, we compared the approaches in both countries, followed by lessons learned.

4. Bioeconomy Transition in Finland

Finland has a highly industrialised, coordinated market economy, which is highly dependent on (imported) fossil fuels. Exports have accounted for over one third of GDP in recent years. The main strengths of the economy lie in manufacturing—predominantly wood, metals, engineering, telecommunications, and electronics. Finland has a highly educated workforce and strong entrepreneurial spirit. The country excels in high-tech exports, as well as promotion of start-ups in gaming, cleantech, and biotechnology sectors. The information technology sector continues to be a significant economic factor, although its role is changing due to the declining importance of Nokia in the Finnish economy. Finland largely depends on imports of raw materials, fossil energy, and components for manufactured goods, except for timber and several minerals that are sourced within the country. Nordic climate conditions mean that agricultural development is limited to maintaining self-sufficiency in basic products. Forestry is the country's second most important export industry, (see Figure 4) and provides a secondary occupation for the rural population.

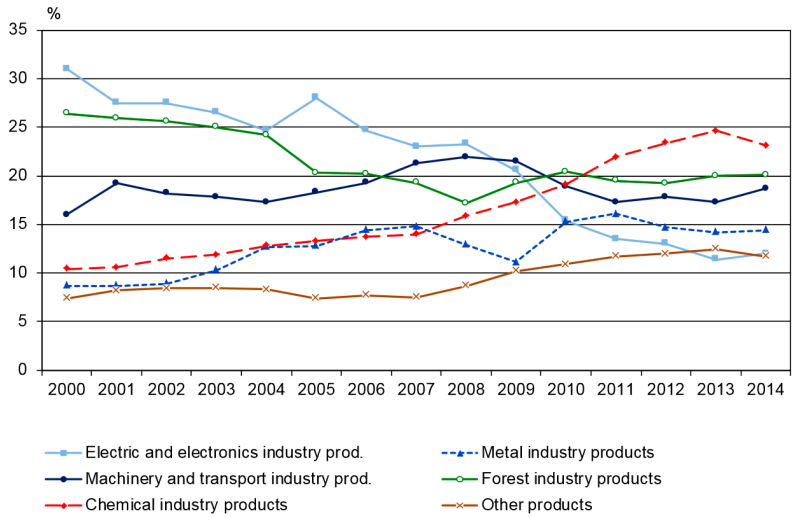

Figure 4. Finnish exports per industry 2000–2014 in % of total exports (Finnish Board of Customs, 2015 [36]).

Finland had been one of the best performing economies within the EU until the financial-economic crisis hit Finland hard and deep. At present, Finland is among the worst performing economies in the Eurozone, and was still in recession in 2015 [37]. Unfavourable conditions for Finland include the crisis

in neighbouring country Russia (an important export market for Finland) falling commodity prices, and decreasing demand for paper. Zooming in on the bioeconomy, we find that Finland's starting position is excellent. An obvious strength is its ample supply of biomass since 60% of the country is covered by forest. This has led to the strong presence of forestry and related industries. Currently, four out of the top ten Finnish export products are related to this industry. Its share to total exports is 20% and total value was around €11 billion euros in 2012. The Finnish Bioeconomy Strategy estimates that already 16% of Finnish GDP is related to the bioeconomy [8]. Furthermore, its highly educated work force, strong cooperation between business and research sectors and innovative capacity form a strong foundation for the transition.

Based on the ample supply of biomass, Finland has built up a strong forestry and pulp and paper industry, leading to a large part of Finnish exports being related to paper. However, since global demand for paper is in decline due to digitalisation, the industry is under pressure to develop new products and tap into new markets. There are strong links between the forestry and energy industry [38], with the former producing almost 70% of Finland's renewable energy, although often in the form of traditional biomass—burning wood logs in a stove for heating purposes. Another sector that evolved alongside Finland's biomass base is the chemical industry, which evolved out of refining side streams of the distributed pulp and paper industry. However, when the pulp and paper industry became more centralised in the 1970s the diversified upcycling of side streams went into decline and many of the businesses involved were sold off to foreign companies.

The agriculture and food sectors play a smaller role in Finland than in The Netherlands. Due to its geographical location, most of the agriculture is located in the South and West of the country. The region of Seinajöki is presenting itself as a leading hub for food-related innovations. A sector of growing importance for the Finnish economy is the ICT (and gaming) sector. This sector develops based on the knowledge and competencies built up around Nokia, and also has links to the bioeconomy, e.g., GPS systems for efficient timber harvesting. Interestingly, the pharmaceutical and construction industries do not seem to play an important role in the Finnish bioeconomy discourse at the moment.

4.1. Transition Analysis of the Finnish Bioeconomy

In our transition analysis, we paid specific attention to the transition dynamics and roles of different actors in the process. Although there seems a broad consensus in Finland on the need for and opportunities of a transition to a bioeconomy [39], the sense of urgency varies significantly among stakeholders. Some stakeholders argue that Finland is already well on its way to having a bioeconomy, while others argue that there are still many barriers to overcome. The crucial difference here is the focus on incremental innovation (by those who believe Finland is well on its way) versus on radical innovation (by those who believe that the bio-economic structure needs to be radically transformed). Furthermore, there seems to be a lack of ownership of the bioeconomy transition. The Ministry of Economics and Employment seems to claim some ownership, however, that is not recognised by other private and public partners. In any case, the Ministry plays a central, pivotal role with little active input from the industry and societal partners. The major cause is that various parties have a different understanding of what the bioeconomy is and in what ways it can or should be stimulated. However, without a major role of the industry and societal partners the bioeconomy transition is doomed to fail.

The Finnish economy and governance structure are organised along the axis of strict silos, which are quite powerful. This silo structure is a typical characteristic of the old economy. The new bioeconomy cuts across this silo structure, because it deals with energy, chemistry, transport, agrifood and forestry in an integral and coherent manner. This implies that the silo structure needs to be (partly) broken down and a new, horizontal, cross-sectoral economic structure needs to be built up to further the transition towards a bioeconomy. Industry, in particular forestry, plays a pivotal role in the Finnish economy in general and in the bioeconomy in particular. The Forestry regime is characterised as quite conservative by most of the interviewees. According to one of the respondents, there are basically three integrated forestry and pulp companies that dominate the market, and these are considered as the

gatekeepers of the bioeconomy. Where most stakeholders look at the forestry industry as the potential leader of the transition towards a bioeconomy, that leading role does not seem to have been taken up yet. This sector has been focussing predominantly on high-efficiency, low-cost bulk products, such as paper, or biomass co-firing for energy production, while the highest value added in the bioeconomy comes from high quality specialty products. The same holds for the agricultural sector that seems to be lagging behind in the biobased transition. A more promising sector that could take the lead in the bioeconomy transition seems to be the chemical industry, which has a potentially important role that is generally underestimated.

The foregoing leads to a provisional assessment of the stage which the Finnish bioeconomy transition is in, and the dynamics at multiple scales that either reinforce or hamper the transition. We have assessed that the Finnish bioeconomy transition is at the end of the pre-development phase (see Figure 5). Although there are ample bottom-up developments, the transition has not yet reached the take-off phase due to a lack of urgency, common understanding and ownership. In the take-off phase there is more turbulence, chaos and increasing conflicts between the old and new order. Analysing the dynamics of the transition at various scales, we assess that most stimulating driving forces are at the micro-level. The most hampering forces are at the meso-level, in particular the silo structure, and the dominance of the forestry regime is a major barrier. Figure 6 summarises the findings of the multi-level analysis.

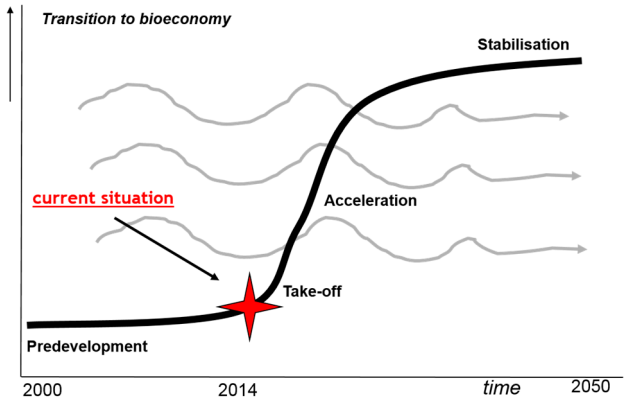

Figure 5. Assessment of phase of the Finnish bioeconomy transition.

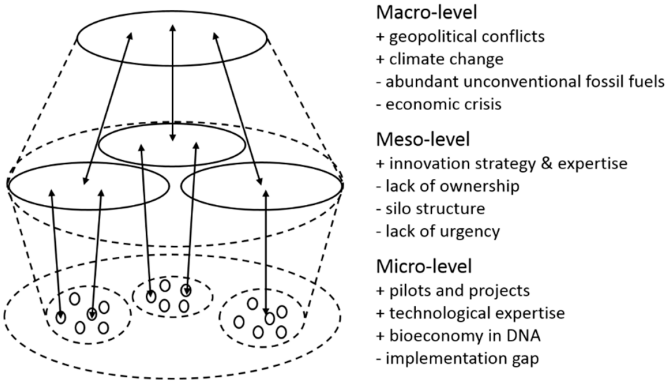

Figure 6. Multi-level dynamics of the Finnish bioeconomy transition.

4.2. Evaluation of Governance of the Finnish Bioeconomy Transition

The main governance efforts of the bioeconomy in Finland are set out within "The Finnish Bioeconomy Strategy: Sustainable Growth from Bioeconomy", published early 2014. The strategy was drafted by the Ministry of Employment and the Economy in close cooperation with the Prime Minister's

Office, the Ministry of Agriculture and Forestry, the Ministry of the Environment, the Ministry of Education and Culture, the Ministry of Social Affairs and Health, the Ministry of Finance, as well as VTT Technical Research Centre of Finland and the Finnish Innovation Fund Sitra. The ultimate goal of the strategy is growth of the bioeconomy from about 60 million at present to 100 billion in 2025, creating 100,000 new jobs, focussing on high added value bioproducts while securing nature's ecosystems. Underlying this objective is the creation of a competitive environment and a strong competence base for the bioeconomy [8].

The vision and goals are clear, integral, appealing and ambitious, developed in cooperation between different Ministries providing a systemic perspective that transcends longstanding silo boundaries and presenting the bioeconomy as an interesting opportunity for Finland. At the same time, this positive framing focussed on business opportunities obscures the barriers and resistances and the underlying persistent problems. One of the biggest barriers is the tendency towards business-as-usual, because the bioeconomy is in the Finnish genes. Forestry plays a key role in Finnish history and contemporary economy, which almost naturally creates a path dependency towards incremental innovation (bulk biomass production). As such, the transition game is played largely with traditional players instead of new players, while the most radical innovation comes from niches. So the Finnish governance strategy could be more explicit in how vested and new players in the biobased field could be mobilised to contribute to the transition strategy and build up counterweight for the vested players with an interest in maintaining the status quo.

Secondly, the focus of the Finnish governance strategy is more on the 'what' than on the 'how'. According to most interviewees, Finland is good at developing visions and strategies (paperwork), but not so good in implementing strategies and ideas. This is referred to as the implementation gap. At the same time, we find a plethora of bottom-up pilots and innovations, which are often still small-scale and fragmented. Somehow, these bottom-up innovations and top-down vision developments need to be connected to drive the transition forward. What is missing is a process design for how to govern the transition (not in a top-down command and control mode), in a smart and subtle manner. A transition strategy requires a subtle, consistent, long-term plan for searching, learning and experimenting in the domains and scales covering the bioeconomy. The strategy should not be a blueprint but comprise a multitude of transition pathways, with no fixed outcomes but a portfolio of transition experiments that provide the seeds of radical change.

And finally, there is the participation issue. During our fact-finding mission we could not really find the owner of the Finnish biobased transition, other than the government. One of our key findings is that those players that are expected to implement the strategy do not feel involved in the process and feel little responsibility for the strategy as proposed by the government. This active engagement of private and public partners is, however, crucial for making the transition a success. Otherwise, the risk is that the Finnish bioeconomy strategy remains a dream on paper. Actor selection for the implementation strategy is crucial and should be done with great care. This does not only include the usual suspects from traditional industry and vested interests, but also frontrunners and new players from niches, sectors that could play a key role in the future bioeconomy, e.g., cleantech, food, health, and service sectors.

5. Bioeconomy Transition in The Netherlands

The Netherlands is the sixth-largest economy in the euro-zone. Its industrial activity is concentrated around food processing, chemicals, petroleum refining, and electrical machinery. The country is home to a highly mechanised agricultural sector that employs only 2% of the labour force but provides large surpluses for the food-processing industry and for exports [40]. However, in terms of the emergence of the green, low-carbon economy, The Netherlands is a laggard rather than a frontrunner in Europe. This is also due to huge vested fossil fuel interests present in the country [41]

Although The Netherlands is not at the forefront of the green economy, the structure and strengths of its economy lend itself well for the transition to a bioeconomy. Like Finland its population is

well-educated. Its large harbours and strong transport and logistics sector make it possible to import and transport biomass and bioproducts efficiently across the globe. Furthermore, it is home to a strong and well-advanced chemical industry with leading players in high quality specialty products such as DSM and Akzo Nobel. Increasingly, these players are looking towards biobased instead of petroleum-based input in order to hedge against rising fossil fuel prices. Another asset in the bioeconomy is its highly developed agro- and food industry, which makes up almost 10% of GDP [42]. In addition, the country's competencies in the energy domain are strong, although it remains mostly fossil fuel-oriented. Another disadvantage with respect to the bioeconomy is that The Netherlands does not have huge biomass potential. In particular, it has no forestry biomass; the only potential available domestically is agricultural biomass, meaning that a large share of biomass will need to be imported [43].

5.1. Transition Analysis of the Dutch Biobased Economy

In The Netherlands, we observe a relatively strong sense of urgency for the biobased economy, driven by the fact that the country is running out of natural gas (current gas supply will be exhausted in about 15 years) and recent calamities in the northern part due to earthquakes caused by intensive gas production. This sense of urgency is also due to the fact that The Netherlands is a laggard in terms of sustainable energy production, with a share of only 5.6% in 2014 [44]. A recent lawsuit filed by Urgenda against the government was surprisingly won by the NGO, forcing the government to reduce CO_2-emissions by 25% in 2020 [30]. That relatively strong sense of urgency is shared, thanks to the common vision on the bioeconomy (see below). This vision was developed together with industrial partners, which also created ownership amongst the parties involved. This means that the government is no longer the only responsible party for protecting common goods, as that responsibility becomes shared with industrial and societal partners. It is also broadly acknowledged that the focus should be on radical innovation, by promoting transition experiments. This because the dominant fossil energy infrastructure needs to be radically transformed.

There is evident ownership, as the chemical industry leads this process together with the Ministry of Economic Affairs. In addition, the agro-food sector and the harbours are actively promoting and stimulating the bioeconomy. Also, knowledge institutes, in particular universities, are engaged in building up a new knowledge and competence bases [45].

The Dutch bioeconomy is made up of the economic topsectors (chemisty, energy, water, agro-food, etc.) that work together with the Dutch government on strengthening the already strong positions. These topsectors actually function as silos, acting from their vested interests, on the one hand promoting the bioeconomy, and on the other protecting their own position and focussing on incremental innovation rather than radical innovation. An exception is the chemistry sector, which is ambitious and innovative, and leads the bioeconomy process, partly forced by the strong global competition and cheap (shale oil and gas) energy in the United States. Other sectors such as the energy, transport and agro-food are much more conservative and fossil-fuel dominated [18,46]. The bioeconomy cuts across these vertical silos of energy, chemistry, transport and agro-food. Thus, a successful biobased transition will ultimately challenge and change the industrial topsector infrastructure.

Our impression is that the biobased economy transition is gaining pace in The Netherlands, although the economic crisis caused stagnation. At the moment it is largely determined by bio-energy instead of high-level specialised bioproducts. Although chemical company DSM is strongly pushing forward high-level biobased products such as bio-medicines, in the Port of Rotterdam the focus is still mostly on biofuels. So there is the risk of a lock-in, where biomass is used to supplement the fossil fuel regime, e.g., to 'green' coal-fired power plants. This leads to the assessment that the Dutch bioeconomy transition is in the pre-development phase (see Figure 7). It is growing fast but is still fragile, and there is a need for more biobased projects that could be scaled up relatively soon. Figure 8 shows the results from the multi-level analysis. Most stimulating drivers are at the micro-level and the most hampering

forces at the meso-level. But the macro-dynamics are favourable, especially with regard to the Russia crisis, the climate change lawsuit and the shrinking gas reserves with earthquakes in its wake.

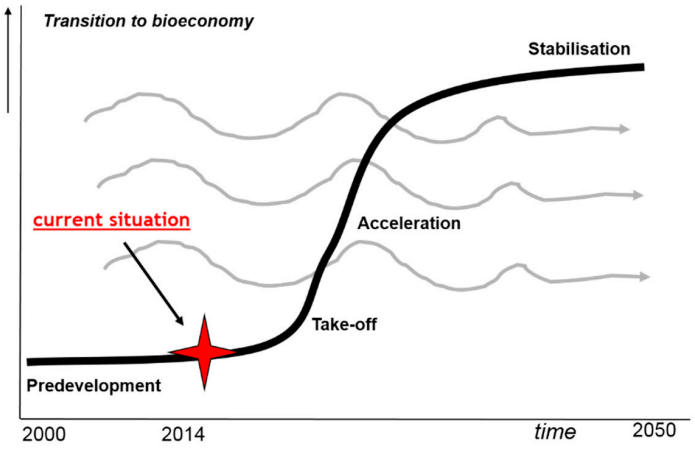

Figure 7. Assessment of phase of the Dutch biobased economy transition.

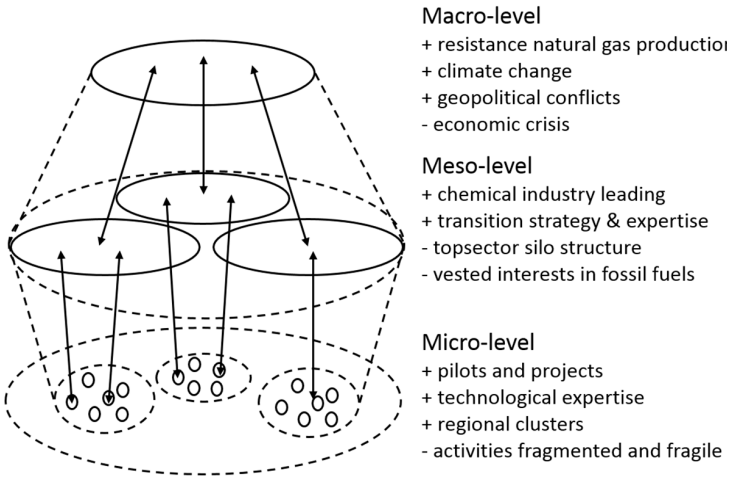

Figure 8. Multi-level dynamics of the Dutch biobased economy transition.

5.2. Evaluation of Governance of the Dutch Biobased Economy Transition

The bioeconomy governance approach starts with a vision and high ambition level. This vision has been developed by the Dutch Topsector, in co-creation between industrial partners and the Dutch government, in particular the Ministry of Economic Affairs [47]. The ambition for 2050 is to become the worldwide leader of the bioeconomy and to be a part of the top three global producers of smart biomaterials. By 2040, 40% of the resources used should be green, and by 2030 one out of three technical students should work in the bioeconomy, with CO_2-emissions cut 11.6 Mton and energy use reduced by 171 PJ. The Ministry of Economic Affairs has a leading role in the biobased transition and has developed a strategy that is based on network development and co-creation. It is actually a combination of a top-down and bottom-up approach, using the principles of transition management. The aim is to bring diverse parties together, both from vested interests and emerging interests, to actively work on co-creation with these partners, and to strive for excellence and ambition (high up in the biomass pyramid), stimulating regional clusters. A key part is searching, learning and experimenting, so the parties involved developed six transition pathways in co-creation, providing the possibilities for aligning them with their own specific goals and ambitions. These six pathways are [48]: (1) biobased

materials; (2) bioenergy and biochemicals; (3) integrated biorefining; (4) plant cultivation and biomass production; (5) recycling water, nutrients, and soil; (6) economy, policy and sustainability.

These pathways give direction in the transition process, new coalitions are formed around them and concrete projects (transition experiments) are developed in order to create the pathways. The coalitions are promoted through a network approach, bringing together diverse parties, both those with vested interests and new and emerging players. Along the way parties experiment with potential solutions, learn about the challenges and adapt their goals accordingly. An interesting example in this respect is the Green Chemistry Campus, which was created by and is located at the premises of petrochemical giant SABIC. This company opened its laboratories for biotech entrepreneurs, which use its facilities to experiment with and develop radical biobased innovations such as biopolymers, biobased building materials and biobased colour pigments. This hybrid cooperation is profitable for both SABIC, for learning alongside the entrepreneurs and trying to scale up their innovative ideas, and for the bio-entrepreneurs, creating the opportunity for making use of world class facilities and of large demand in the case of successful experimenting.

The network approach does not aim for broad coalitions, but aims to bring together a select number of parties that find each other in their high ambitions and together strive for excellence. Figure 9 gives an overview of the different coalitions and platforms that have emerged meanwhile in the Dutch bioeconomy.

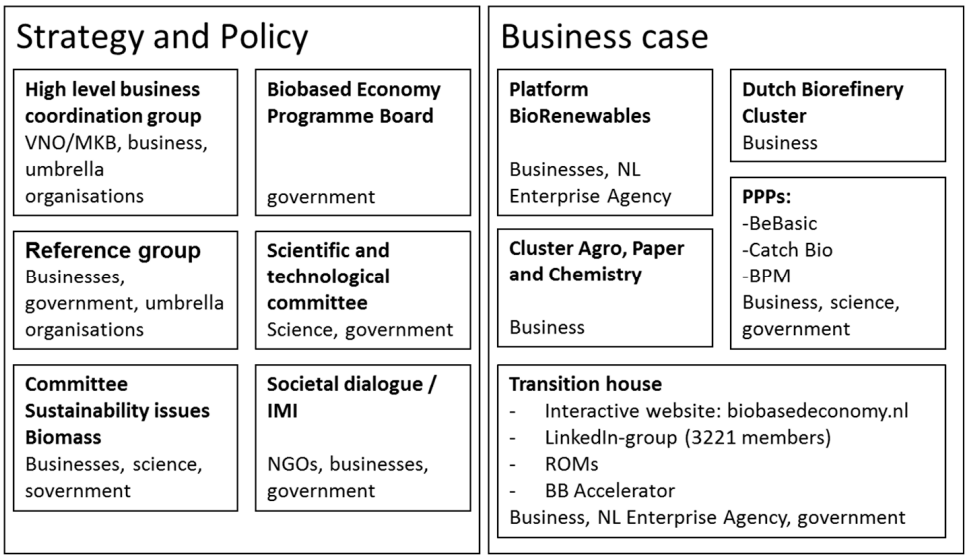

Figure 9. Dutch biobased economy transition networks.

Overall, the government has a facilitating rather than a directing role, e.g., facilitating the development of regional clusters with their own specific strengths in the bioeconomy. This has led to six different clusters, each with their own priorities and functioning quite autonomously, supported by the Ministry of Economic Affairs. Another example of the facilitating role of the government is the mapping of barriers to the bioeconomy [49]. Through a survey amongst business companies active in the bioeconomy, 69 unique barriers have been identified and categorised as operational, structural, fundamental and conflicting. Operational barriers could mostly be resolved by clarifying interpretation of policies and legislation. An example of a structural barrier is that Dutch law considers residual streams as waste, which makes it difficult to reuse (parts of) these streams. Fundamental barriers play out at a higher level of aggregation, such as the lack of a level playing field for bioproducts compared to fossil resources. In order to resolve structural and fundamental barriers changes in law are necessary, which are being discussed at the moment. Conflicting barriers can hardly be resolved since they arise from targeted and equally important societal goals that conflict with the goal of the bioeconomy.

An example is the REACH-regulation, which requires new chemical substances to be registered and validated before they are allowed in the European market. Although this regulation hampers the bioeconomy transition, it was developed with an eye on preventing the spread of dangerous chemicals and safeguarding public health and therefore is not likely to be lifted in the near future.

6. Comparing Finnish and Dutch Bioeconomy Transition Governance

In this section we compare the Finnish bioeconomy and Dutch bioeconomy transitions and their governance approaches. Since the transition contexts, drivers, actors and strategies are very different in both countries, the aim here is not to judge whether one strategy is better than the other, the comparison is rather aimed at teasing out the differences and identifying areas that require further attention in order to accelerate the transition to a biobased economy. Table 1 below summarises the main insights from comparing the Dutch and Finnish transitions and governance approaches and we elaborate further on this below.

Table 1. Comparing Dutch Biobased Economy and Finnish Bioeconomy Transitions.

	Dutch Biobased Economy	**Finnish Bioeconomy**
Transition	Fossil to biobased	Bulk to specialty
Drivers	Chemistry sector/government	Bioeconomy and innovation in genes
Urgency	Rather high	Average
Phase	Pre-development	Just before take-off
Regime	Economic topsectors	Powerful silo structure
Niches	Systematic experimentation	Many unconnected pilots
Vision	Co-created vision for 2050	Government-led vision for 2025
Governance	Transition governance	Traditional top-down
Scale	Regional	National
Approach	Conceptual, network-based	Practical, sector-based
Focus	Radical innovation	Incremental innovation
Government	Facilitator	Director

If we look at the characteristics of the transitions we signal that in The Netherlands it is mainly about breaking away from fossil resources and moving towards biobased resources. In Finland the focus of the transition lies more on the shift from bulk dominated production to high value added specialty products, because of its already high share of bioproducts in the overall economy. The main drivers for the transition in The Netherlands are the chemistry sector and the government. In Finland the process is embedded in the generic structure of the nation. The forests play a key role in Finnish society, which is illustrated by the large number of private forest owners. In The Netherlands we observe a rather strong sense of urgency for the bioeconomy, while in Finland this is average. Paradoxically, this has to do with the fact that natural resources already play such a large role in the country and therefore the urge for real change is less strong.

If we consider the phases of transition we assess that The Netherlands is in the predevelopment phase, still widely experimenting with promising solutions but not really taking off yet, as the overall mass and volume is still small. Finland is estimated just to be before take-off, pressures are increasing, the country's competencies in the area are very rich and promising pilots are numerous, although still scattered. In The Netherlands the regime is made up of the economic topsectors that work together with the Dutch government on strengthening their already strong positions. In Finland the regime is characterised by a powerful silo structure that hampers innovations that cut across these silos, such as in the bioeconomy. The niches, alternatives to the regime, are connected in The Netherlands through regional clusters, a coherent vision, and transition pathway development. This provides coherence and a shared goal. In Finland the pilots seem to be numerous but disconnected, with various experiments going on at many different places, often without being aware of each other. Finland also lacks a

coherent long-term vision, the current vision is government-led and has 2025 as its target year, which in transition terms is a relatively short time frame.

With regard to the governance of the transition we find that The Netherlands applies aspects of transition governance, focussing on co-creation, and searching, learning and experimenting based on a shared understanding of the persistent problems and a long-term vision that informs for short term action. Finland adopts a more traditional, shorter-term, top-down governance strategy, focussing mostly on the economic possibilities of new solutions. Regarding the scale and approach, we observe that The Netherlands adopts a more bottom-up and regional approach based on a networking and facilitating approach. Finland's strategy is more top-down, sector-based and practical. Where in The Netherlands the focus lies on promoting radical innovation through cooperation between change–oriented vested players and smaller frontrunners, the innovation in Finland is more aimed at incremental change that keeps the overall structure of existing industries intact. The Dutch government acts as a facilitator, doing a lot of networking behind the scenes, while the Finnish government acts more as a director in a top-down manner.

7. Conclusions and Recommendations

From our analysis it becomes clear that the characteristics of the biobased economy transitions are different in both countries. While in The Netherlands the process is driven mostly by the chemical industry looking for new feedstock to replace its fossil inputs in the face of climate change, in Finland, which is already quite forestry focused, the transition lies in a shift from bulk dominated production to high value added specialty products. We find that the governance approach in The Netherlands focusses on co-creating a long-term vision that informs for short-term action, on facilitating bottom-up, regional clusters and on promoting radical innovation through cooperation between vested players and frontrunners. Finland adopts a more traditional, top-down governance strategy, focussing on the shorter-term economic opportunities and incremental innovation that keeps the overall structure of existing industries intact. We conclude that the Dutch government acts as a facilitator, while the Finnish government acts more as a director of the transition.

Both countries can learn from each other, in terms of strategy and approach. Where Finland might be too modest and needs a more courageous, entrepreneurial spirit and risk-taking strategy, The Netherlands tends to overestimate itself, being over-pretentious in aiming to become a world leader without having much (forestry) biomass itself other than agricultural biomass. In Finland only a handful of pioneers are driving the transition and more (foreign) entrepreneurs are needed to accelerate the transition.

7.1. Lessons for Finland

Given Finland's biobased genes and its strong position in different biobased-related sectors, it has the potential to take a leading role in the global transition towards a bioeconomy. However, in order to get a leading position worldwide, a more advanced and sophisticated governance strategy is needed. The current Finnish governance approach is fairly traditional and top-down and needs to be supplemented with bottom-up, strategic and network elements of a more transition based governance approach.

In Finland there is a plethora of biobased innovation projects and experiments going on, but they lack interconnectivity and coherence. In order to stimulate systemic change to strengthen the coherence and interconnectivity it might be helpful to create several transition pathways. These pathways are not blueprints for a sustainable future but give direction in the transition process. They are co-created with stakeholders involved, both partners from the vested interests and emerging players. Around these coalitions and networks concrete radical innovation projects are set up (transition experiments) to create the pathways. On top of already chosen areas for the Finnish Bioeconomy Strategy, we have identified four different pathways that seem worthwhile for exploring further based on the competencies of the Finnish economy and the position in the biomass value pyramid:

- Biofibers (textile, biopolymers, -plastics, -packaging)
- Bio-ICT (bioinformatics, bio-3Dprinting)
- Bio-built environment (wooden buildings, construction material)
- Bio-health (food supplements, pharmaceuticals)

These transition pathways could be further explored by systematically experimenting with radical innovative experiments based on an overall long-term vision. Setting up breeding grounds for radical innovation is of crucial importance, for example transition arenas, in which about 10–15 frontrunners and change-inclined regime-players are brought together to develop a transition agenda; an agenda of reform. The arenas provide an opportunity for cross-silo interactions and thereby contribute to overcoming barriers stemming from the dominance of silo structures in the Finnish economy. Promoting regional collaborations and clusters is also helpful in bringing together different parties across sectoral boundaries. The plans for the Oulou region [50] and INKA-programme in the Joensuu region, with demonstration platforms from which research and development to commercialization can be sped and scaled up, form interesting examples in this respect.

It could also be helpful to map the various barriers that hamper the biobased transition: political, legal, structural (regime) and mental, and finding smart ways to manoeuvre these barriers. In The Netherlands such a mapping of these barriers was done successfully, after which quite a few of these barriers were resolved.

More pressure on the silos, in particular on the forestry sector, would certainly help to further the transition to a bioeconomy. Stimulating hybrid collaboration between agile and risk-taking niches (start-ups and small- and-medium enterprises), and risk-aversive elephants (traditional big companies), could be fruitful in accelerating the transition.

7.2. Lessons for The Netherlands

The Netherlands has a well thought through network approach for systemic change towards a bioeconomy that is rooted in the principles of transition management. The overall ambition is to become a world leader in the bioeconomy, and the coherent vision developed by the chemical sector, in co-creation with other industrial partners and the Dutch government, reflects that high level of ambition. A whole network configuration has been designed and implemented and many diverse partners have been mobilised, so it all seems to be well conceptualised and thought through from a transition management perspective.

However, a typical Dutch danger looms here. More ambitious projects have failed in The Netherlands because they became bogged down in the typical 'clay layer' of Dutch bureaucracy and polder model, based on consensus building. There used to be a similar process, the Dutch energy transition, that started in 2001 and lasted for about 10 years. It has been extensively documented and investigated [17,27,45]. The transition project was a success in terms of networking, agenda setting, experimenting and social learning but a failure in terms of policy implementation. The whole transition project was taken over by the fossil fuel regime and all radical elements were taken out, mainly because the whole project became a serious threat to the regime. Overall, the implementation results of sustainable energy over the last 25 years have been dramatic, only 5.6% is generated in a sustainable manner, ranking The Netherlands 25th out of the 27 European countries [51]. Obviously, the incumbent, fossil-fuelled regime is still very powerful in The Netherlands.

This potential risk and the lessons learned from the energy transition project were extensively discussed with Roel Bol, project leader of the bioeconomy transition trajectory. In his philosophy the biobased transition needs to stay away from the regime and not be encapsulated by the Ministries in The Hague. He therefore strongly advocated a regional approach, based on emergence and self-organisation.

There is definitely a need for more mass and volume in the bioeconomy transition in The Netherlands. More pilot projects that could be scaled up fairly soon, more successes that could be shared with others, more hybrid combinations such as the Green Chemistry Campus, and greater collaboration between big traditional companies (elephants) and start-ups and small-medium enterprises. Clear signals of scale and volume are needed, until that point the transition is still vulnerable and the whole process remains fragile.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Overview of Research Activities Carried Out in The Netherlands.

Date	Activity	Actors Involved	Organised by
6 December 2011	Lecture and panel discussion	50 > researchers, policy makers, entrepreneurs	Ministry of Economic Affairs
8 December 2011	Lecture and panel discussion	50 > researchers, policy makers, entrepreneurs	Province of Zeeland, Biobased Economy Network
5 February 2013	Lecture and panel discussion	50 > researchers, policy makers, entrepreneurs	Ministry of Economic Affairs
15 February 2013	Lecture and panel discussion	Eight policy makers, regional and national level	Provinces of Groningen, Friesland and Drenthe
4 April 2013	Panel discussion	20 chemical engineers, entrepreneurs, farmers	SABIC and Urgenda
13 March 2014	Panel discussion	15 farmers and policy makers	Municipality of Tholen
12 November 2013	Group interview	35 policy makers, entrepreneurs, intermediaries	Biobased network Region West-Brabant
13 March 2014	Dialogue session	15 farmers and chemical engineers	SABIC/own initiative
5 July 2014	Interview	Two policy makers	Ministry of Economic Affairs

Appendix B

Table B1. Overview of Research Activities Carried Out in Finland.

Date	Activity	Actors Involved	Organised by
21 March 2012	Group interview	12 policy makers of Ministries of Economic Affairs, Environment, and Agriculture and Forestry	TEKES (Finnish Funding Agency for Innovation)
22 March 2012	Lecture and panel discussion	Eight researchers	TEKES
13 February 2013	Interview	Two researchers	SITRA
8 May 2013	Lecture and panel discussion	50 > researchers and policy makers	SITRA
30 September 2013	Group interview	12 entrepreneurs of Digile Ltd.	SITRA/TEKES
20 March 2014	Group interview	Five researchers	TEKES
20 March 2014	Group interview	Eleven policy makers Ministries of Employment and Economy, Environment and Agriculture and Forestry	TEKES
20 March 2014	Group interview	One researchers and one intermediary of SITRA	TEKES
21 March 2014	Group interview	Three representatives of chemical and forestry industries	TEKES
21 March 2014	Group interview	Four researchers and intermediaries of FIBIC and INKA	TEKES
26 May 2014	Group interview	Three entrepreneurs of Raiso Group	TEKES
26 May 2014	Interview	One entrepreneurs of ForChem	TEKES
27 May 2014	Group interview	Three policy makers and intermediaries of Seinäjoki region	TEKES
27 May 2014	Group interview	Two researchers of VTT	TEKES
10 September 2014	Lecture and discussion	13 policy makers of Ministries of Employment and Economy, Environment and Agriculture and Forestry	TEKES
10 September 2014	Interview	Four researchers	TEKES

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