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REPORT

Benchmarking Finnish and Dutch bioeconomy transition governance

Both Finland and the Netherlands are developing transition strategies to switch from fossil to green resources in order to tackle challenges of climate change and resource dependencies and to exploit the economic opportunities that arise in this area. This report benchmarks the transition efforts in both countries and provides recommendations to strengthen the Finnish approach based on insights from transition governance.

Authors

Rick Bosman
Jan Rotmans

0 Executive summary

Both Finland and the Netherlands are developing strategies to switch from fossil fuels to green resources and to switch from fossil carbon to biomass in order to tackle challenges of climate change and resource dependencies and to exploit the economic opportunities that arise in this area. TEKES has commissioned DRIFT to assess the Finnish bioeconomy transition governance including the recently published Finnish bioeconomy strategy from a transition perspective and provide inspiration from the Dutch governance of the biobased economy transition in order to provide recommendations that could inform Finnish transition governance.

0.1 Benchmarking Dutch and Finnish bioeconomy transition efforts

The biobased economy in the Netherlands is driven mostly by the chemistry sector together with the government. It is mainly about breaking away from fossil resources and towards biobased resources. The sense of urgency is rather high, with a regime characterised by the economic topsector policy and niches, where alternatives to the regime are developed, focused on radical innovation and connected through regional clusters and systematic long-term vision and pathway development. Finland's bioeconomy can be characterised more as a transition from bulk dominated production to high value added specialty products. The process is mainly driven because bioeconomy and innovation are in the genes of the nation. Paradoxically, because natural resources already play such a large role in the country, the urge for real change and accelerating the transition is less. Based on the above we assess that the bioeconomy transition in the Netherlands is in the predevelopment phase. While Finland is just before take-off, pressures are increasing, the country's competencies in the area are very rich and promising pilots are numerous, although still scattered.

Concerning the governance of the transition we find that the Netherlands uses a transition governance approach, focussing on co-creation, and searching, learning and experimenting based on shared understanding of the persistent problems and a long term vision that informs short term action. The government facilitates the connection of radical innovations in regional clusters. Finland adopts a more traditional top-down sector based approach focussed on shorter term incremental innovations.

Table 1 below summarizes the main insights of the comparison between the Dutch and Finnish transitions.

Table 1 Comparison of Dutch Biobased Economy and Finnish Bioeconomy Transitions

	Dutch Biobased Economy	**Finnish Bioeconomy**
Transition	from fossil based to biobased	from bulk to specialty
Drivers	chemistry sector/government	bioeconomy & innovation in genes
Urgency	rather high	average
Phase	pre-development	before take-off
Regime	economic top-sectors	powerful silo structure
Niches	systematic experimentation	many unconnected niches

Vision	industry-led vision for 2050	government-led vision for 2025
Governance	transition governance	traditional governance
Scale	regional approach	national approach
Approach	conceptual, network based	practical, sector based
Focus	radical innovation	incremental innovation
Government role	facilitator	Director

0.2 Governing the Finnish bioeconomy transition

Based on a transition analysis of Finland's efforts with regards to the bioeconomy, we identify six areas that require specific attention:

- Sense of urgency: although pressure is mounting because of the decreasing demand for paper, and increasing concerns about climate change and resource dependencies, the sense of urgency amongst stakeholders to move towards a bioeconomy is variable, from highly urgent to rather limited. Many stakeholders think that the transition will be a continuation of the bio-innovation process that has been going on for more than a century. This lack of urgency seriously hampers a swift transition;
- Ownership and implementation: main efforts regarding the bioeconomy are concentrated within ministerial working groups, with limited cooperation and exchange with societal stakeholders and business. Since most stakeholders do not feel responsibility or ownership for the transition, succesful implementation of the bioeconomy strategy could prove difficult;
- Silo structures: The Finnish economy is organised in strict silo's with little exchange accross silo boundaries. The character of radical innovations, which are necessary for the transition, is that they cut accross the boundaries of these silo's. This leads to tensions, confusion and barriers that hamper the innovation process;
- Industrial regime: the dominant way of thinking and working within the paper & pulp and energy industries is focussed on low-cost, high-efficiency bulk production, while the bioeconomy transition requires high-quality specialty products at the top of the biomass value pyramid. Therefore it is questionable whether these industries can and will play a leading role in the bioeconomy transition. A more likely candidate could be the chemical industry, which is alredy involved in refining sidestreams of the paper & pulp industry;
- Type of innovation and coherence: Finland has innovation in its genes, but most attention is focussed on incremental innovation that maintain the general powerful economic structures. When we did encounter more radical innovations, they often took place in isolation with little coherence with similar initiatives. A full-fledged transition, however requires radical innovations that are organised in such a way that they become able to undermine vested interests;
- Cultural issues: The aim of the bioeconomy strategy is that Finland gains global recognition for the bioeconomy and becomes an export champion in this field. Although Finland could already boast several world class bioeconomy innovations, we found stakeholders rather modest

about Finnish achievements and opportunities. Becoming world champion bioeconomy requires an attitude and outreach that fits such a position.

We come to the conclusion that Finland adopts an approach to govern the transition to a bioeconomy that does not seem to be specifically tailored to deal with the complexity of the manifold changes at hand. The country is well positioned for the bioeconomy: it provides an excellent breeding ground for innovation, including radical innovation, with a plethora of innovation projects end experiments going on in the field. What lacks however, is interconnectivity, a shared vision and a joint agenda that connects long-term change to short term action. Overall, the Finnish bioeconomy transition could benefit from a higher level of ambition, a clearer, sharper and longer-term oriented transition agenda co-created between government and frontrunners. A network approach, that brings together regime players (elephants) and small and medium enterprises (niche players or mice), to form hybrid combinations of collaboration and stimulating coherence and interconnectivity. A regional governance approach stimulating specific biobased activities and applications that fit within particular regions such as in the successful Seinajöki region. And last but not least by removing barriers and forces that hamper the transition.

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1 Introduction

In response to the challenges of global climate change, limited supply of fossil resources and increased dependence on unstable and controversial regimes such as Russia, and to exploit the economic opportunities that lie in developing new technologies and processes for the bioeconomy, both Finland and the Netherlands are developing strategies to switch from fossil fuels to green resources and to switch from fossil carbon to biomass. In view of the current war and crisis in the Ukraine, the argument of becoming energy-independent is gaining more momentum, also in countries as Finland and the Netherlands. Against this background DRIFT has been commissioned by TEKES to assess the bioeconomy efforts in Finland and the recently announced bioeconomy strategy of the Finnish government from a transition perspective. The analysis will be informed by insights from the Dutch biobased economy governance approach. The aim of this report is to benchmark the efforts in governing the bioeconomy transition in both countries and to explore lessons that can be learned from comparing both approaches.

1.1 Transition to a bioeconomy

The bioeconomy, as it is called in Finland, or biobased economy, as the Dutch call it, is based on the idea that for an economy to be truly sustainable, it should source its inputs from renewable resources. The Finnish bioeconomy strategy illustrates this by defining bioeconomy as follows:

"Bioeconomy refers to 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."

The Dutch Businessplan Biobased economy adds that[1]: "A highly developed BBE [Biobased Economy] 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."

This refers to the biomass value pyramid (figure 1), which lies at the heart of the biobased economy transition approach in the Netherlands. This pyramid depicts where biomass could have the highest value added. Applications such as pharmaceuticals or fine chemicals is 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 innovation is involved, which requires different kinds of skills and knowledge. It is therefore easier to start at the base of the biomass pyramid, but more rewarding to aim at the top of the pyramid.

[1] Werkgroep Businessplan Biobased Economy (2011) Een punt op de horizon: aanzet voor een intersectoraal Businessplan Biobased Economy. Available online: http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2011/06/17/een-punt-op-de-horizon.html

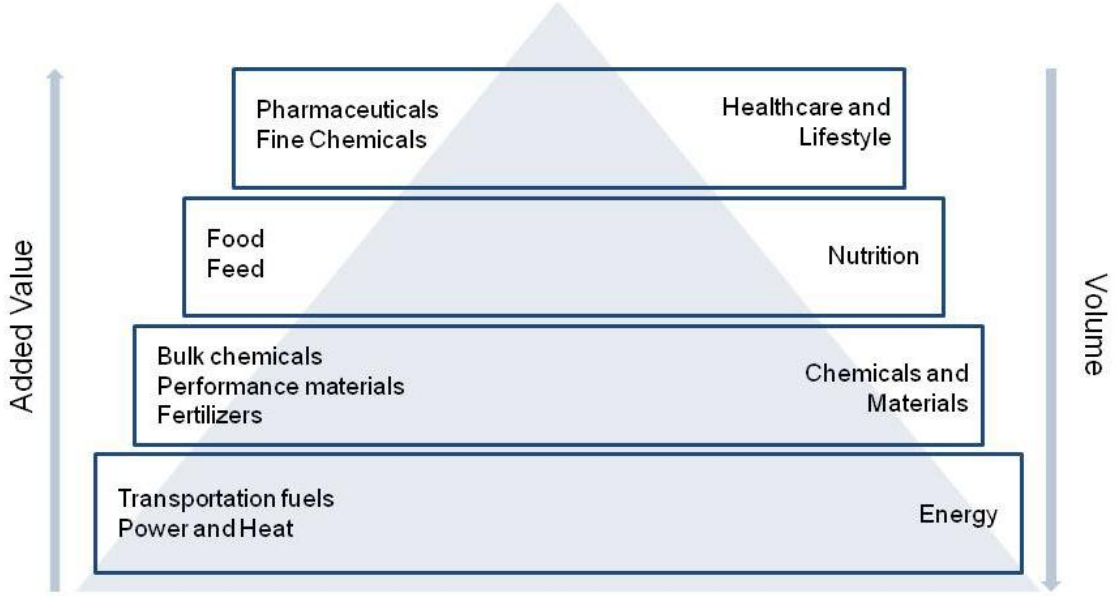

Figure 1 Biomass value pyramid

1.2 Transition perspective on bioeconomy

The transition to a bioeconomy or biobased economy should be seen in the context of the transition to a low-carbon economy and the transition to a circular economy, since the driving forces in these transitions are similar, i.e. depletion of (affordable) fossil fuel resources, geopolitical tensions, and concerns over environmental pollution, climate change and biodiversity loss. Such transitions develop as co-evolution between fundamental technological, societal, institutional and cultural changes. These processes are long term (two generations), highly complex and involve a variety of domains and stakeholders[2].

With regards to the bioeconomy transition, several sub-transitions can be distinguished:

- agricultural sector must be untwined from fossil sector
- chemical sector must be untwined from fossil sector
- chemical sector must be converted into food-health sector
- forestry sector should shift focus from bulk to high-end specialty products

Such changes will take decades and demand for radical innovation and incremental innovation. Radical innovation is disruptive and involves radical change, aiming at producing and doing things entirely different rather than doing things more efficiently. Radical innovations are about system innovations

[2] See also: Rotmans, J., Kemp, R., & Van Asselt, M. (2001). More evolution than revolution: transition management in public policy. *foresight*, *3*(1), 15-31; Loorbach, D., & Rotmans, J. (2010). The practice of transition management: Examples and lessons from four distinct cases. *Futures*, *42*(3), 237-246; Loorbach, D. (2010). Transition management for sustainable development: a prescriptive, complexity-based governance framework. *Governance*, *23*(1), 161-183.

and thus transitions, so transitions are not possible without radical innovation. However, radical innovations often face fierce resistance from vested interests in the energy, petro-chemical, agriculture and forestry sectors. Such resistance can often be obvious and clear but also be very subtle and should thus be manoeuvred delicately. This report conveys the results of a benchmarking of transition governance approaches in Finland and the Netherlands in order to draw lessons to accelerate the bioeconomy transition.

1.3 Report structure

This report consists of four consecutive parts. It will start with a transition analysis of the Finnish bioeconomy innovation system, based on desk study research and two two-day fact finding research missions to Finland in March and May 2014 we identify six areas of attention in section two. In the third part we assess the Finnish bioeconomy strategy[3] that sets out the governance approach for the Finnish bioeconomy and from a transition perspective asses its strengths and potential weaknesses in connection with the areas of attention we identified in section two. In section four we discuss the Dutch biobased economy approach. In section five we conclude with a comparison of the governance approaches in the Netherlands and Finland and propose several recommendations to accelerate the bioeconomy transition based on insights from transition management and the Dutch approach.

[3] The Finnish Bioeconomy Strategy: Sustainable Growth from Bioeconomy. Available online: https://www.tem.fi/files/40300/The_Finnish_Bioeconomy_Strategy_11062014.pdf

2 Transition analysis of Finnish bioeconomy

In order to assess the feasibility of the bioeconomy in Finland, we start with a brief transition analysis of its economy. We will first focus on its general outline and then continue with its specific strengths and challenges regarding the bioeconomy. Based on the fact findings missions we are also able to asses 'softer' indicators for the state of the transition in Finland, such as sense of urgency amongst stakeholders.

2.1 Finnish economy

Finland has a highly industrialized, largely free-market economy, which is highly dependent on fossil fuels. Exports account for over one third of GDP in recent years. The economies' main strengths 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 startups in gaming, cleantech, and biotechnology sectors. The ICT sector continues to be a significant economic factor, although its role is changing since 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 which are sourced within the country. The Nordic climate conditions mean that agricultural development is limited to maintaining self-sufficiency in basic products. Forestry plays an important role in the country's exports, see figure 2, and provides a secondary occupation for the rural population.

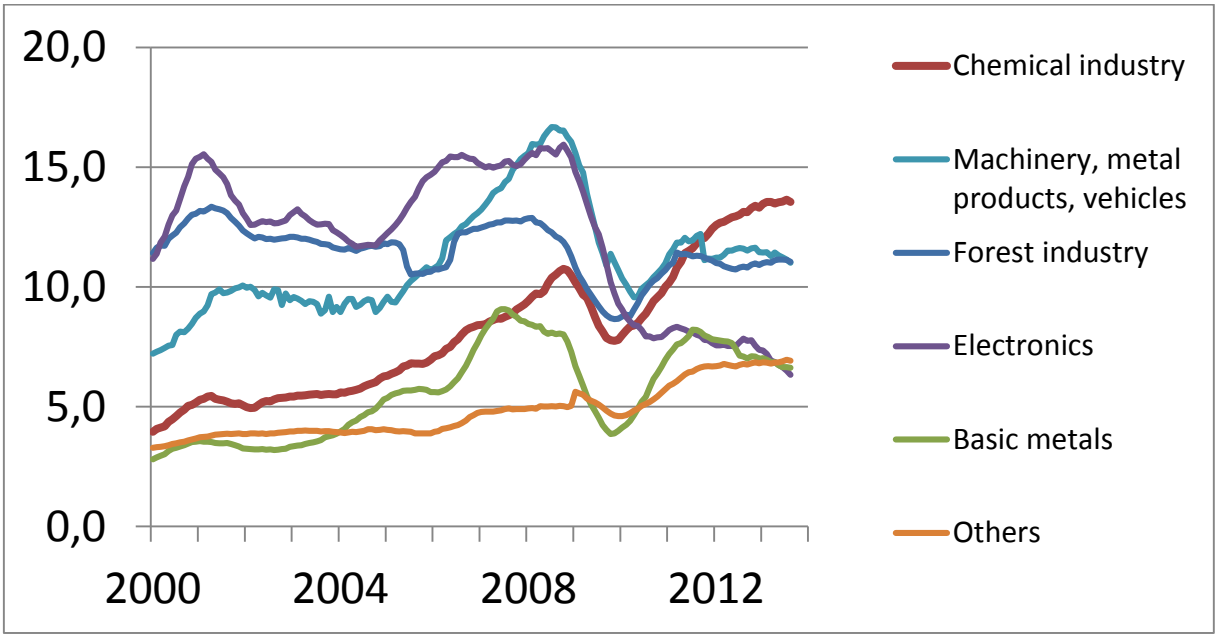

Figure 2 Finnish exports by sector (Source: Board of customs)

Finland had been one of the best performing economies within the EU in recent years and its banks and financial markets avoided the worst of global financial crisis. However, the world slowdown hit exports and domestic demand hard in 2009, with Finland experiencing one of the deepest contractions

in the euro zone. After initial recovery of exports, domestic trade, and household consumption in 2010-11, continued recession within the EU hurt the Finnish economy in 2012-13.[4]

2.2 Finland well positioned for bioeconomy transition

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 in forests. This has led to a strong presence of forestry and related industries. Currently four out of the top ten Finnish export products are related to this industry (see figure 3). Its share to total exports is 20% and total value around € 11 billion euros in 2012. The Finnish bioeconomy strategy estimates that already 16% of Finnish GDP is related to the bioeconomy. Furthermore, its highly educated work force, strong cooperation between business and research and innovative capacity form a strong foundation for the transition.

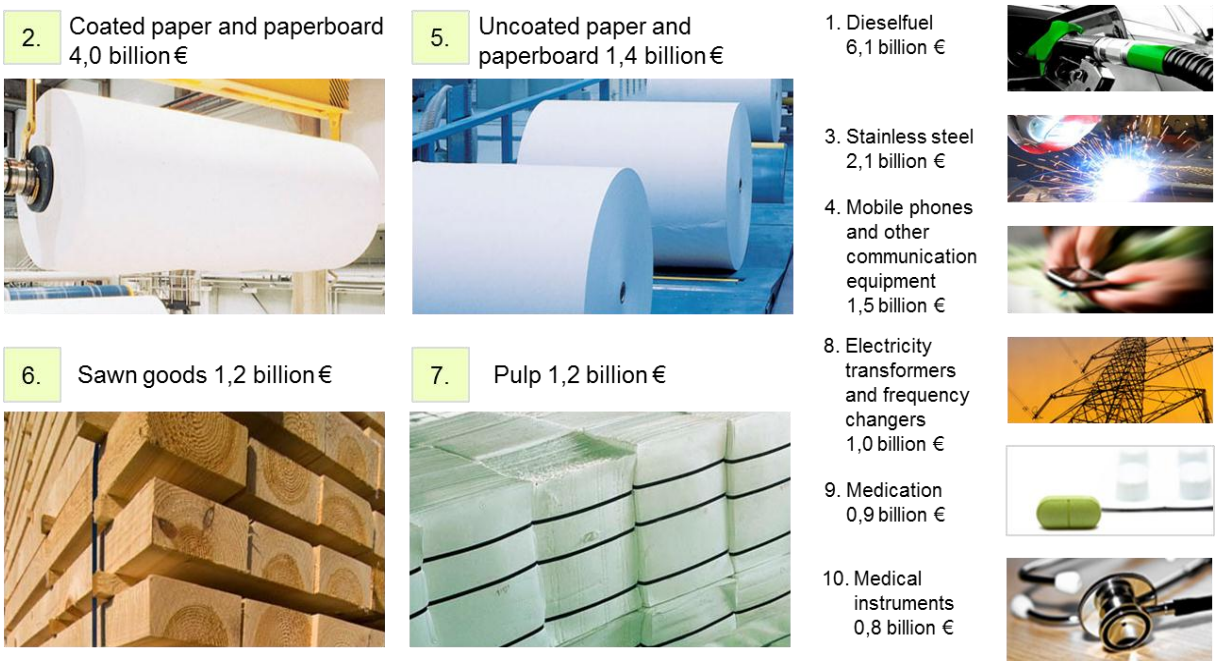

Figure 3 Forestry based products in top 10 Finnish exports (Source: Board of customs)

Based on the ample supply of biomass Finland has built up a strong **forestry and pulp & 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. Up to now, most innovations have taken place in paper making machines, the challenge is to move to the pulp refining industry. An interesting characteristic of the forestry sector is that the majority of forest is privately owned by 600.000 landholders.

[4] CIA World Factbook (2014) Country profile: Finland. Available online: https://www.cia.gov/library/publications/the-world-factbook/geos/fi.html

There are strong links between the forestry and **energy industry**. The forestry industry produces almost 70% of Finland's renewable energy, although often in the form of traditional biomass – burning wood logs in a stove for heating purposes. Respondents state that the efforts of the Finnish government have so far been focussed too much on energy (which is lowest in the biomass pyramid), which has obscured the strengths of the country in other areas of the bioeconomy.

Another sector that evolved alongside Finland's biomass base is the **chemical industry**. This sector makes up 23% of Finnish exports with a value of € 13,3 billion. It has evolved out of refining side streams of the distributed pulp & paper industry, producing for example alcohol, chemicals and yeast. However, when the pulp & paper industry became more centralized in the '70's the diversified upcycling of side streams went into decline and the businesses involved often were sold off to foreign companies.

The **agriculture and food** sector plays 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 in food related innovations. An interesting innovation that is the result of a cross-over between the food- and forestry sectors is Benecol developed by dairy company Raisio, a cholesterol lowering product made from a side stream of the pulp industry and added to margarine or other dairy products.

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 (which interestingly used to be a paper company). Although less obvious than the chemical or forestry sector, also the ICT sector has links to the bioeconomy, e.g. GPS systems for efficient timber harvesting.

It is interesting that the **pharmaceutical** and **construction** industries do not seem to play an important role in the Finnish bioeconomy discourse at the moment. As the use of biomass (could) play(s) an important role in these sectors, it could lead to interesting synergies when these sectors are involved in the process.

A prominent feature of the bioeconomy, which is also recognised in Finland, is its **distributed nature.** One of the drivers for this distribution is the high water content of fresh biomass, which means that unnecessary transport should be avoided. The most promising strategy is to strike a balance between refining materials as close to the source as possible, and efficiency benefits of scale. Furthermore, the innovations with most value added will lie in high quality specialty products instead of bulk production. The distributed nature of the bioeconomy fits very well to developments in other domains, e.g. decentralized electricity production with solar panels or wind turbines, but also the distributed nature of IT-technology: PCs, smart grids, microblogging etc. These mutually reinforcing trends could result in a more distributed economy with the possibility to close different loops locally or regionally. It also means that old hierarchies will disappear and more horizontal networks and steering will emerge. However, this requires a change in mind set from traditional players which are currently more focussed on centralized bulk production.

2.3 State of the Finnish Bioeconomy transition

In the transition analysis we pay specific attention to the transition dynamics and roles of different actors in the process. During our fact-finding missions we had a series of interviews with a variety of Finnish stakeholder (see Appendix A and B) and have read relevant documents among which policy documents of ministries. The results of the transition analysis provide indicators for the state of the Finnish Bioeconomy transition that we treat point-wise below. Furthermore, it raises specific issues that transition governance should address, which will be discussed in section four.

- **Urgency.** There seems a broad consensus on the need for a transition to a bioeconomy. However, the urgency varies significantly among stakeholders. Some stakeholders argue that Finland is already well on its way to a biobased economy, while others argue that there are still many barriers to overcome. The crucial part is 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). So the overall urgency for the bioeconomy needs to be strengthened among stakeholders.
- **Ownership.** There seems a lack of ownership of the bioeconomy transition. The Ministry of Economics and Employment seems to claim some ownership (together with the Ministries of Agriculture and Forestry and of Environment), however, that is not recognized by other private en public partners. In any case the Ministries play 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 way it can or should be stimulated. The problem is that without a major role of the industry and societal partners the bioecononmy transition is doomed to fail.
- **Silo Structure.** The Finnish economy and governance structure are organized along the axis of strict silo's, which are quite powerful. This silo structure is a typical characteristic of the old, fossil economy. The new, bioeconomy cuts across this silo structure, because it deals with energy, chemistry, transport, agrifood, forestry in an integral and coherent manner. This implies that the silo structure needs to be broken down and a new, horizontal, cross-sectoral economic structure needs to be built up to further the bioeconomy transition. Collaboration at a regional level could be useful in this respect because bridging these silos is often easier at a regional than at the national level.
- **Industrial Regime.** The industry, in particular the forestry industry, plays a pivotal role in the Finnish economy in general and in the bioeconomy in particular. The Forestry regime is characterized 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. These are the only ones that can take the biomass out and therefore are the gatekeepers of the bioeconomy. This poses problems, whereas most stakeholders look at the forestry industry as the potential leader of the bioeconomy transition, they do not take up that leading role yet. This sector has been focussing predominantly on high-efficiency, low-cost bulk products, such as paper, or biomass (black liquor) co-firing for energy production, while the highest value added in the bioeconomy comes from high quality specialty products, which require a more diversified business ecosystem. The same holds for the agricultural sector that seems to be lagging behind in the bioeconomy transition process. A more

promising sector to take the lead in the bioeconomy transition therefore seems the chemical industry, which potentially important role is generally underestimated by the other partners.

- **Transition pace.** All parties seem to agree that the bioeconomy transition goes too slow. Even the representatives from the forestry and chemical sector admit this. One explanation for this is the focus on the short-term and on product and technological innovation. This results in a focus on quick fixes and ready-made solutions, such as 'looking for the new Nokia' as one of the interviewees put it. Instead the bioeconomy transition is a cumbersome, long-term process of searching, learning and experimenting.

- **Cultural drawbacks.** We found a kind of Finnish modesty in judging Finnish economic and innovation achievements and averseness to risk taking in scaling up radical innovation. scaling up from small-scale radical innovation to mainstream requires risk taking and willingness to leave the beaten track. According to one of the respondents "the good ideas are there, but nobody is prepared to take the risk." In general Finnish culture seems to be characterized by modesty. In most cases this is a laudable trait, however, it might obscure radical innovations within a transition process. If Finland wants to lead the global bioeconomy transition, it is necessary to share Finnish best practices and innovations with the rest of the world. A highly interesting area we encountered is the refining that happens to side streams of the pulp industry. An example in this area is ForChem, aa company that refines tall oil into high quality specialty products, such as antibiotics, printing ink and adhesives.

- **Implementation gap.** 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. We also see that reflected in the Finnish bioeconomy strategy that focuses more on the 'what' (content) than on the 'how' (process), see also next section. At the same time we find a plethora of pilots and innovations taking place from the bottom-up, which are often still small-scale, fragmented and lack an overarching vision that connects the dots. Somehow these bottom-up innovations and top-down vision development need to be connected to drive the transition forward.

2.4 Multi-phase and multi-level analysis

The foregoing leads to a provisional assessment of the stage in which the Finnish bioeconomy transition is and the dynamics at multiple scales that either reinforce or hamper the transition. We assess that the Finnish bioeconomy transition is at the end of the pre-development phase (see figure 3 below). Although there are ample bottom-up developments, the transition has not yet reached the tipping point phase, due to lack of urgency, common understanding and ownership. In the tipping-point (or 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 and most hampering forces at the meso-level, in particular the silo structure and the dominance of the forestry regime is a major barrier. Figure 4 summarises the findings of the multi-level analysis.

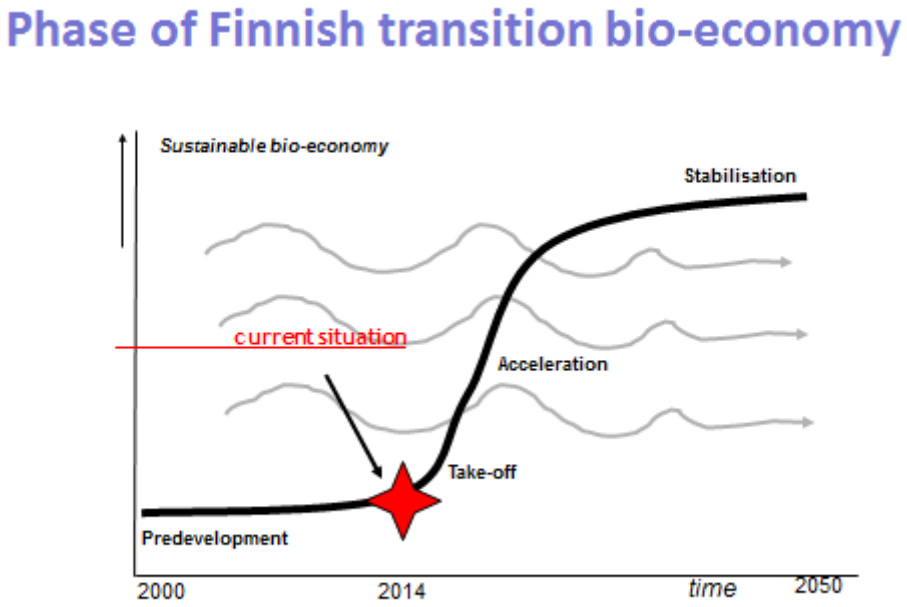

Figure 3: Phase of Finnish bio-economy transition

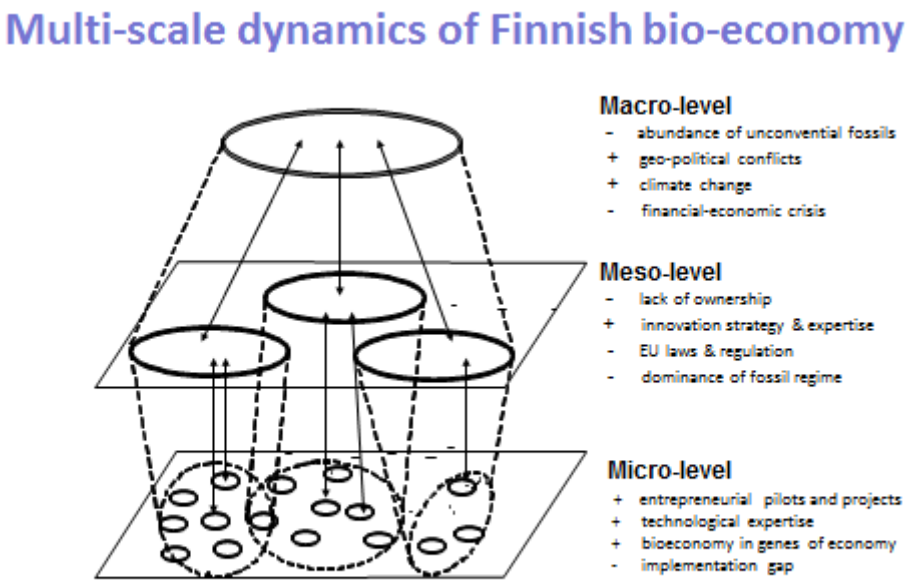

Figure 4: Multi-scale dynamics of Finnish bio-economy transition

3 Governance in the Finnish Bioeconomy

The main principles for governance of the bioeconomy in Finland are set out in "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 strategy sets out the objectives and goals of Finland's bioeconomy which is to "generate new economic growth and new jobs from an increase in the bioeconomy business and from high added value products and services while securing the operating conditions for the nature's ecosystems." Ultimately the aim is to grow the bioeconomy from about €60 million nowadays to €100 billion in 2025 and creating 100,000 new jobs in the process. Underlying these ultimate objectives are four strategic goals:

1. A competitive operating environment for the bioeconomy;
2. New business from the bioeconomy;
3. A strong bioeconomy competence base; and
4. Accessibility and sustainability of biomasses.

3.1 Assessing the strategy from a transition perspective

The Finnish bioeconomy strategy provides an integral approach to the grand challenges facing Finnish society. It has been developed in cooperation between different Ministries providing a systemic perspective that transcends longstanding silo boundaries. The vision it pursues is clear and appealing. It presents the bioeconomy as an interesting opportunity for Finland to take a strong position in future growth markets.

At the same time from a transition perspective we are able to identify some weaknesses in the strategy which are connected to the issue areas we identified in the previous section. First of all, by focusing on the opportunities the bioeconomy presents the persistent problems that necessitate a transition remain underdeveloped. The systemic risks of continuing business-as-usual are not thoroughly addressed. In-depth analysis of the persistent problems and systemic risks to which the transition forms an answer could help in creating and strengthening a sense of urgency amongst different stakeholders.

Connected to this first remark is that the positive framing focused on (business) opportunities obscures the (potential) barriers and resistances. The transition analysis in the previous section shows that Finland has strong silos and an influential industry regime that is likely to hamper the transition process at several stages. Governing a transition is like playing chess at three different chess boards. It is developing a new game, with new players and new rules. Such a process inherently involves resistances of players that have vested interests in the current system and are trying to defend the status quo. A transition governance strategy needs to be aware of these (potential) resistances and manoeuvre them in a subtle way. At the same time, there will be (new) players that could potentially reap the

benefits of the transition, but are often not aware of this yet. The strategy does address the areas where new business is likely to emerge, but it could be more explicit in how the players active in this field will be mobilized to contribute to the transition strategy and build up counterweight for the vested interests.

Thirdly, as we noted already in the previous section the focus of the Finnish bioeconomy strategy is more on the 'what' than on the 'how' question. The vision on the future bioeconomy is clear. However, transition process are extremely complex, take decades and cannot be controlled and commanded in a top-down manner. An implementation strategy or transition agenda that plays into this complexity, is supported by progressive industrial players and key societal stakeholders and details the necessary next steps is largely absent. A transition governance strategy requires a subtle, consistent, long-term strategy of searching, learning and experimenting in multiple domains and at multiple scale levels. This requires a common vision, joint urgency and commitment from a diversity of stakeholders. There is no roadmap or blueprint, it is a quest with multiple possible outcomes and possible pathways. It would be helpful to work on connecting the vision outlined in the strategy to promising transition pathways and ongoing pilots which provide the seeds of radical change.

Fourth, and most problematic, regards the ownership issue, already discussed in the previous section. One of the main results from our fact finding missions is that the 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 carries the risk that the Finnish bioeconomy strategy remains a dream on paper. Section four of the Finnish bioeconomy strategy addresses the implementation and monitoring, but is very brief on this part. It actually does address the set-up of a bioeconomy panel consisting of actors from bioeconomy sectors. This could help in involving different stakeholders and this is a laudable effort from a transition perspective. However, selection of panellists should be done with great care, making sure that the panel will not be dominated by the usual suspects representing the vested interests but includes the frontrunners and new players from sectors that are expected to play a key role in the future bioeconomy system, e.g. clean tech, food, health, and services sectors as detailed in the strategy but also other sectors relating to the pathways which will be discussed in the next section. By including frontrunners from different domains a clearer image will emerge of the outlines of the future system and the barriers that face new developments. This increases the potential to come to novel solutions and accelerating the transition process.

So overall, the Finnish bioeconomy strategy is clear and integral, but too much a top-down strategy that needs to be mixed with a bottom-up approach so that it can develop into a co-creation strategy.

4 Transition governance in the Dutch biobased economy

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 mechanized agricultural sector that employs only 2% of the labour force but provides large surpluses for the food-processing industry and for exports.[5] However, in terms of the emergence of the green, carbon-low economy, the Dutch green economy is a laggard rather than a frontrunner in Europe,[6] also due to the huge vested fossil fuel interests.

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 biobased economy. 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 for rising fossil fuel prices. Another asset in the bioeconomy is its highly developed agro- and food industry, which makes up almost 10% of GDP.[7] Also the country's competences in the energy domain are strong, although still mostly fossil fuel oriented. The only disadvantage regarding the bioeconomy is that the Netherlands does not have a huge biomass potential, in particular no forestry biomass, the only potential available domestically is agricultural biomass.

4.1 Dutch biobased economy transition strategy

The biobased economy transition approach starts with a vision and high ambition level. This vision has been developed by the Dutch Chemical Topsector, in co-creation between industrial partners and the Dutch government, in particular the Ministry of Economic Affairs. The Dutch vision regarding the bioeconomy is based on two main ambitions for 2050[8]:

1. In 2050 the Netherlands is known worldwide as the country of green chemistry. For the production of food, energy and plastics, biomass forms the basis. Chemistry has developed clean and sustainable production processes that enable the use of biomass in a plethora of existing and new products.
2. In 2050 the Netherlands is in the global top-3 of producers of smart materials. Companies based in the Netherlands develop creative and innovative products with a high-value added: materials for energy storage and catalysts are made of readily available and accessible

[5] CIA World Factbook (2014) Country profile: Netherlands. Available online: https://www.cia.gov/library/publications/the-world-factbook/geos/nl.html
[6] Netherlands Environmental Assesment Agency (2014) Green Gains: In search of opportunities for the Dutch economy. Available online: http://www.pbl.nl/sites/default/files/cms/publicaties/PBL-2014-Green-gains-1262.pdf
[7] Ministerie van Economische Zaken, Landbouw en Innovatie (2011) Agro&food: De Nederlandse Groeidiamant. Available online: www.rijksoverheid.nl/bestanden/documenten-en-publicaties/rapporten/2011/06/17/agro-food-de-nederlandse-groeidiamant/rapport-min-eli-agrofood1.pdf
[8] Topsector Chemie (2011) New Earth, New Chemistry: Actieagenda Topsector Chemie

resources instead of scarce materials. Plastics are light-weight, self-repairing, self-cleaning and fully recyclable.

These two main ambitions are complemented by several medium term goals:

1. The contribution of the chemical sector to the Dutch GDP is on average 1-2% higher than the average growth of the contribution of other sectors;
2. The amount of new chemistry students has doubled by 2015;
3. In 2020 80% of Dutch people has a positive view on the contribution of the chemical sector to prosperity and well-being in the Netherlands;
4. In 2030 CO_2-emissions have been cut with 11,6 Mton and energy use has been reduced by 171 PJ.

4.2 Co-creating transition pathways

Central in the governance approach of the Ministry is co-creation. Rather than top-down steering of societal change, as was common place in the '70's and '80's, or a market driven bottom-up policy as in the 90's, the administrators used a combination of top-down and bottom-up approach, using the principles of transition management[9]. It involves challenging the market on the one hand and mobilizing society on the other. It starts from the premises of searching, learning and experimenting. In other words, it is both strategic and action oriented. The strategic focus is on searching for high value added innovations that have a competitive edge internationally, meaning innovations high up in the biomass value pyramid. Furthermore, the parties involved developed six pathways in co-creation, providing the possibilities to aligning them with their own specific goals and ambitions. These six pathways are[10]:

- Biobased materials
- Bioenergy & biochemicals
- Integrated biorefining
- Plant cultivation & biomass production
- Recycling: water, nutrients, soil
- Economy, policy and sustainability

Developing the vision and pathways together with industrial partners creates a shared sense of urgency and ownership amongst the parties involved. This means that the government is no longer the only responsible for protecting common goods, but that responsibility becomes shared with industrial and societal partners.

4.3 Building radical coalitions and regional clusters

Around these pathways, coalitions started to form. This was promoted by the Ministry through a network approach, bringing together diverse parties, both parties with vested interests and new and emerging players. The pathways give direction in the transition process, new coalitions start to emerge around them and concrete projects (transition experiments) are developed in order to realize the

[9] See e.g. http://www.drift.eur.nl/?page_id=4496

[10] Groene Groei: van biomassa naar business. Innovatiecontract voor de Biobased Economy 2012 – 2016. Available online: http://www.biobasedeconomy.nl/wp-content/uploads/2012/04/7250-ELI-Innovatierapport-aanpv3.pdf

pathways. 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. For SABIC it creates the opportunity to learn alongside the entrepreneurs and play a role in scaling up their innovative ideas. For the bio-entrepreneurs it creates the opportunity of making use of world class facilities and of large demand in case of successful experimenting. At the same time, this experiment runs into problems of cultural differences between biotech entrepreneurs and often more traditional petrochemical engineers who need to comply with the highest safety standards.

The goal was not to develop broad coalitions, but rather to bring together a select number of parties that find each other in their high ambitions and together strive for excellence. Figure 5 gives an overview of the different coalitions and platforms that have emerged meanwhile in the Dutch bioeconomy.

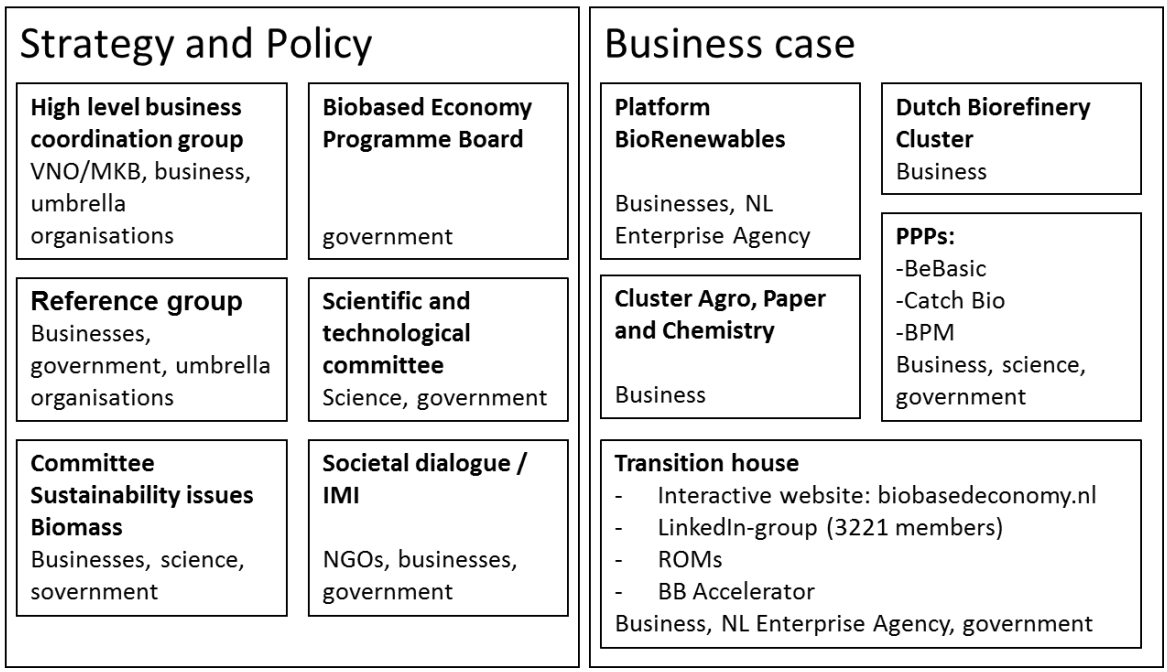

Figure 5 Dutch biobased economy transition network approach. Adapted from: Ministry of Economic Affairs, 2014

Furthermore, the governance approach facilitates the development of regional clusters with their own specific strengths in the biobased economy. Figure 6 gives an overview of the main Dutch clusters and their focal themes. The ministry of Economic Affairs supports these regional clusters in their vision development and buildup of competencies for cluster management.

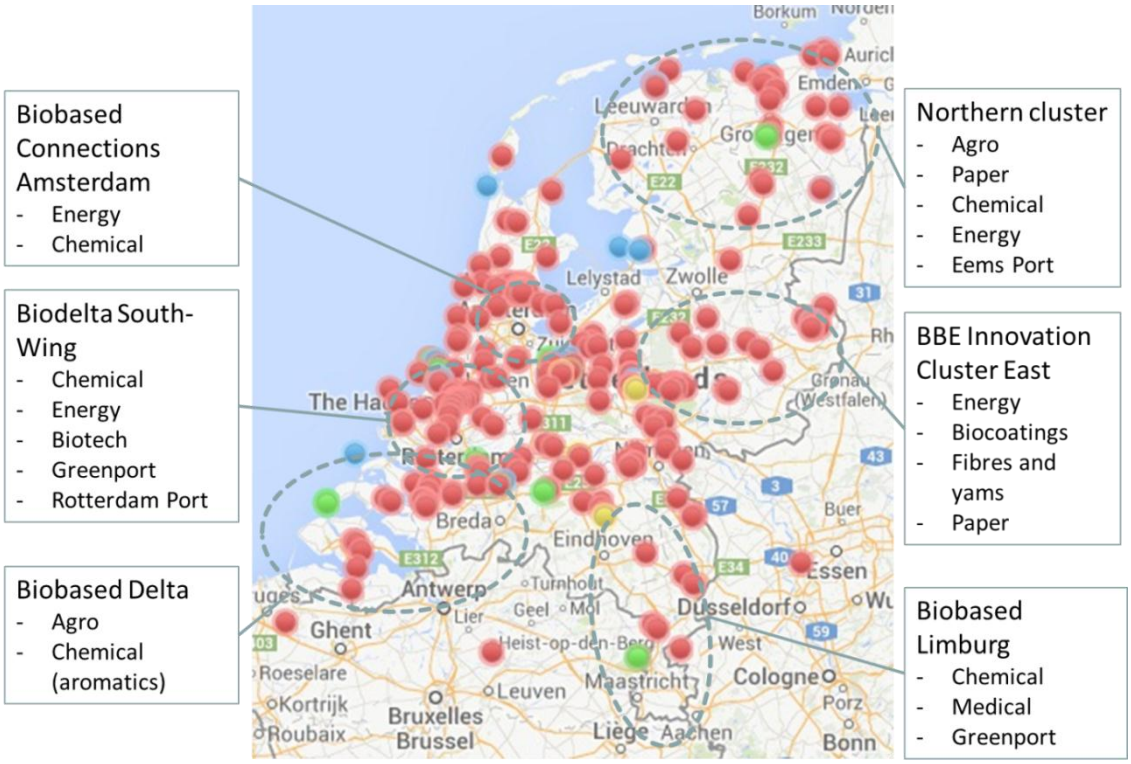

Figure 6 Regional biobased clusters in the Netherlands. Sources: Agentschap NL, 2013; biobasedeconomy.nl, 2014

4.4 Mapping barriers

An influential initiative that was commissioned by the ministry of Economic Affairs is the mapping of barriers to the bioeconomy.[11] Through a survey amongst business companies active in the bioeconomy 200 barriers have been identified. Subsequently in-depth interviews were conducted with 25 key stakeholders and 69 unique barriers were identified and categorized 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 of such a barrier is the REACH-regulation, which requires new chemical substances to be registered and validated before they are allowed in the European market. Although such 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.

[11] SIRA Consulting (2011) Botsende belangen in de biobased economy. Available online: http://www.biobasedeconomy.nl/wp-content/uploads/2012/03/Botsende-belangen-in-de-BBE-SIRA-consulting.pdf

5 Conclusion

We conclude this report by benchmarking the Finnish bioeconomy and Dutch biobased economy transitions and governance approaches and providing recommendations for the Finnish transition governance. Since the transition contexts, drivers, actors and strategies are very different in both countries, the aim here is not to judge whether strategy is better or worse, rather the comparison is aimed at teasing out the differences and identifying areas that require attention in order to accelerate the transition to a bioeconomy. In the second part where we will provide recommendations for improving the Finnish transition governance based on insights from transition studies and transition management in particular and inspired by the Dutch biobased economy approach.

5.1 Comparing Dutch and Finnish transition efforts

First of all, if we look at the characteristics of the transition we note an interesting difference that for the Netherlands it is mainly about breaking away from fossil resources and towards biobased resources. Although this also plays a role in Finland the focus of the transition lies more on a transition from bulk dominated production to more attention on high value added specialty products, because of its already high share of bioproducts in the overall economy. Second, while the main drivers for the transition in the Netherlands are the chemistry sector and the government, in Finland the process is mainly driven because bioeconomy and innovation are in the genes of the nation. The forests play a key role in Finnish society illustrated by the large number of private forest owners and the country has shown a remarkable ability for high-tech innovation. In the bioeconomy these two factors come together. In the Netherlands we observe a rather high sense of urgency for the biobased economy, while in Finland this is average. Paradoxically, this has to do precisely with the fact that natural resources already play such a large role in the country. Because of this the urge for real change and accelerating the transition is less. If we consider the phases of transition we asses that the Netherlands is in the predevelopment phase, still widely experimenting with promising solutions but not real taking off yet. While Finland is just before a take-off, pressures are increasing, the country's competencies in the area are very rich and promising pilots are numorous, although still scattered. In the Netherlands the regime is made up of the economic topsectors that work together with the Dutch government on strengthening the already strong positions (which does not always lead to the most innovative outcomes). In Finland the regime is characterised by a powerful silo structure that hampers innovations that cut across these silos, which is often the case in the bioeconomy. The niches, where the alternatives to the regime are developed, are connected in the Netherlands through regional clusters and systematic vision and pathway development. This provides coherence and a shared goal. In Finland the pilots seem to be numerous but unconnected, with different experiments going on at many different places., often without being aware of the others. If we look at the vision development we observe that in the Netherlands there is a coherent vision that was co-created between the government and progressive industrial partners. It has high ambitions and concerns the long term (2050). In Finland the vision is mainly government led and has 2025 as its target year, which in transition terms is a relatively short period of time.

Moving to the governance of the transition we find that the Netherlands applies transition governance, focussing on co-creation, and searching, learning and experimenting based on shared understanding of the persistent problems and a long term vision that informs short term action. Finland adopts a more traditional and 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 networking and vision development, while 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. In the process the Dutch government acts as a facilitator, doing a lot of networking behind the scenes, while the Finnish government acts more as a director prescribing the necessary changes. Table 1 below summarizes the main insights from comparing the Dutch and Finnish transitions and governance approaches.

Table 2 Comparison of Dutch Biobased Economy and Finnish Bioeconomy Transitions

	Dutch Biobased Economy	**Finnish Bioeconomy**
Transition	from fossil based to biobased	from bulk to specialty
Drivers	chemistry sector/government	bioeconomy & innovation in genes
Urgency	rather high	average
Phase	pre-development	before take-off
Regime	economic top-sectors	powerful silo structure
Niches	systematic experimentation	many unconnected niches
Vision	co-created vision for 2050	government-led vision for 2025
Governance	transition governance	traditional governance
Scale	regional approach	national approach
Approach	conceptual, network based	practical, sector based
Focus	radical innovation	incremental innovation
Government role	facilitator	director

5.2 Recommendations for Finnish bioeconomy governance

Given Finland's strong position in different sectors related to the bioeconomy as described in section 2, it has the potential to take a leading role in the global transition towards a bioeconomy. Based on the transition analysis of the Finnish bioeconomy, assesment of the Finnish bioeconomy strategy and inspired by the Dutch biobased economy transition approach, we come to the conclusion that Finland adopts a more traditional approach to govern the transition to a bioeconomy. The approach does not seem to be specifically tailored to deal with the complexity of the change process at hand. Finland does seem to be an excellent breeding ground for innovation, including radical innovation, with a plethora of innovation projects end experiments going on in the field. What lacks however, is interconnectivity and coherence. This raises questions on how to stimulate systemic change in Finland directed to

strengthen the coherence or interconnectivity on behalf of the government? How to identify and overcome the barriers that hamper the transition? How to come to an overall transition governance approach with a facilitating role of the government and a leading role of progressive industrial partners? In this section we therefore provide several recommendations that address these questions based on insights from transition studies and transition governance with which the Finnish bioeconomy governance could be strengthened.

First of all, for providing coherence and interconnectivity, it could prove helpful to build upon the bioeconomy strategy by co-creating several transition pathways with stakeholders involved. Transition pathways don't provide a blue print for a sustainable future, but help to structure the transition challenge. By fleshing out these pathways in co-creation with frontrunners in the bioeconomy, they can provide trajectories along which coalitions can be build and synergies across parties and sectors can be promoted. Next to the areas that have been identified as promosing in the Finnish bioeconomy strategy already, we identify four different pathways that seem worthwhile to explore 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-3D-printing
- Bio built environment
    - Wooden buildings
    - Construction material
- Biohealth
    - Food (supplements)
    - Pharmaceuticals

A transition approach could be helpful in further elaborating these pathways in co-creation with frontrunners in the bioeconomy. That means more systematically experimenting with radical innovative experiments from an overall long-term vision. Setting up breeding grounds for radical innovation is of crucial importance: transition arenas, in which about 10-15 frontrunners and change-inclined regime-players are brought together and develop a transition agenda, including a collaborative structured problem analysis and an overall vision. This agenda of reform contains next steps for accelerating the biobased economy transition. The arenas provide an opportunity for cross-silo interactions and thereby contribute to overcoming barriers relating to the dominance of silo structures in the Finnish economy.

Furthermore, given the distributed nature of the bioeconomy, promoting regional collaborations and clusters could prove helpful in bringing together different parties across sectoral boundaries. The INKA-programme with Joensuu region in the lead of the bioeconomy part forms an interesting example in this respect. They aim to develop demonstration platforms from which R&D to commercialisation can be speeded and scaled up. Identifying and promoting such entrepreneurial ecosystems further on a regional scale requires further investigation.

Thirdly, it could be helpful to direct more attention to the barriers that hamper the transition and finding smart ways to manoeuvre these barriers. Such barriers can lie in policies, regulations and silo structures, but experience also shows that industrial regimes can frustrate the transition process, as they have vested interests in the existing power balance. Especially the forestry industry, as gatekeepers of traditional bulk production, seem to be holding off and slowing down the bioeconomy transition in Finland. More pressure on the silos and on the market would certainly help to further the transition to a bioeconomy. When pressure on these stakeholders builds up, due to lower demand for their products and or rising resource prices, they will start looking for alternatives. The announcement of the Metsagroup to invest in a biorefinery plant and invite SME's to co-create radical bioeconomy innovations seems promising. Such a cooperation between large companies and innovative SME's (elephants and mice) can be fruitful in the take-off phase of a transition. Often SME's adapt to changing circumstances more easily and can build up new competencies quickly, but lack the scale and resources of large companies. Elephants on the other hand are often listed companies, therefore have to report to shareholders, which often leads to short term thinking and risk averseness. A lot of promising innovations remain on the shelves, because they don't fit the core business of the company. A way to circumvent this is to develop policies to incentivize spin-offs from such elephants. Creating added value by promoting spin-offs could lead to a boom in innovative start-ups and interesting cooperations with larger companies that accelerate the bioeconomy transition. Combining the agility and risk taking of SME's with the resources and networks of large companies they can benefit from each other's strengths.

Fourthly, a change in mindset and culture is needed with regard to the bioeconomy. Rather than being defensive, prudent or modest a more courageous and entrepreneurial attitude and mindset is needed here. The current approach in general terms seems risk-averse and modest, which is at odds with the whole notion of a transition. Every kind of transition requires risk taking, and a risk-averse strategy will not bring Finland further and will not stimulate the transition to a bioeconomy. In this pre-development stage of the transition, a handful of pioneers is leading the transition, which is risky if this continues without broadening the support and commitment. In order to expedite the transition, therefore more (foreign) entrepreneurs are needed who are willing and able to take these risks.

Overall, the Finnish bioeconomy transition could benefit from a higher level of ambition, a clearer, sharper and longer-term oriented transition agenda co-created between government and a diversity of frontrunners. A network approach, that brings together regime players (elephants) and small and medium enterprises (niche players or mice), to form hybrid combinations of collaboration and stimulating coherence and interconnectivity. A regional governance approach stimulating specific biobased activities and applications that fit within particular regions such as in the successful Seinajöki region. And last but not least by directing more attention to possible barriers and forces that hamper the transition.

Appendix A: Programme of Fact Finding Mission 1

Time	Interviewee	Place
DAY 1, March 20th		
9.00 – 11.00	1. Bioeconomy developments and policy in the Netherlands • Presentation by Jan Rotmans, Rick Bosman 2. Tekes bioeconomy-related activities • Heikki Aro, Pirjo Kyläkoski, Christopher Palmberg • Teija Lahti-Nuuttila, Kari Herlevi	Tekes
11.00 – 13.00	Lunch and transfer • Heikki Aro, Christopher Palmberg, Tuomo Suortti, Raine Hermans	
13.00 – 15.00	1. Bioeconomy developments and policy in the Netherlands • Presentation by Jan Rotmans, Rick Bosman 2. Finnish bioeconomy strategy -developments and policies • Presentation by Liisa Saarenmaa & Mika Aalto 3. Roundtable discussions about viable bioeconomy transition pathways and challenges in Finland	Ministry of Employment and Economy
15.00 – 15.30	Break and transfer	
15.30 – 17.00	Roundtable discussions about viable bioeconomy transition pathways and challenges in Finland • Jyri Arponen, (Mari Pantsar-Kallio)	Sitra
DAY 2, March 21th		
9.00 – 11.30	1. Bioeconomy developments and policy in the Netherlands • Presentation by Jan Rotmans, Rick Bosman 2. Roundtable discussions about viable bioeconomy transition pathways and challenges in Finland (?) • Sami Nikander, (Carmela Kantor-Aaltonen); Chemical Industry Federation of Finland • Alina Ruonala-Lindgren; The Finnish Forest Industries Federation	The Finnish Forest Industries Federation
11.30 – 13.00	Lunch and transfer • Heikki Aro, Christopher Palmberg	

13.00 – 15.00	1. Bioeconomy developments and policy in the Netherlands • Presentation by Jan Rotmans, Rick Bosman 2. Roundtable discussions about viable bioeconomy transition pathways and challenges in Finland • Christine Hägström-Näsi, Markku Leskelä; FIBIC • Harri Välimäki, Aki Gröhn; Bioeconomy INKA	FIBIC Bieconomy Centre of Excellence (SHOK), Bioeconomy INKA
15.00 – 16.00	Break, summarizing discussion, next steps	Otaniemi
16.00	Transfer to airport	

Links to organizations and other material:

Ministry of Employment ant the Economy http://www.tem.fi/en

Sitra http://www.sitra.fi/en

The Finnish Forest Industries Federation http://www.forestindustries.fi/

Chemical Industry Federation of Finland http://www.kemianteollisuus.fi/en/

FIBIC – Finnish Bioeconomy Cluster http://fibic.fi/

Bioeconomy INKA http://www.tekes.fi/en/programmes-and-services/tekes-programmes/innovative-cities/, http://www.carelian.fi/about

Appendix B: Programme of Fact Finding Mission 2

Time	Interviewee	Place
DAY 1, May 26th	**Transitions related to the agroindustry**	**City of Turku**
9.30 – 11.30	1. Bioeconomy developments, clusters and partnership models in the Netherlands • Presentation by Jan Rotmans, Rick Bosman 2. The case of Raisio and Benemilk • Development manager Ilmo Aronen, Mira Povelainen and Jaakko Laurinen Background information: http://raisio.com/www/page/mainpage http://raisio.com/www/page/8351 3. Q&A, discussions	Raisio Group and the case of Benemilk
11.30 – 13.20	Lunch and transfer to the city of Rauma (85 km. from Turku)	
13.00 – 15.00	1. Bioeconomy developments, clusters and partnership models in the Netherlands • Presentation by Jan Rotmans, Rick Bosman 2. The case of Forchem • CEO Risto Näsi and N.N Background material: http://www.forchem.com/ http://www.tekes.fi/en/tekes/results-and-impact/cases1/2014/suomen-rehu-has-developed-a-resin-based-product-for-use-in-supporting-animal-welfare/ 3. Q&A, discussions	Forchem and the case of refining pine-resin into animal feed
15.30 – 16.30	Break and transfer back to Turku	
17.00 – 18.52	• Train from Helsinki to Turku and Hotel Haven	

Time	Interviewee	Place
DAY 2, May 27th	**Transitions to sustainable food systems**	
9.30 – 11.30	1. Bioeconomy developments, clusters and partnership models in the Netherlands • Presentation by Jan Rotmans, Rick Bosman 2. The case of Seinäjoki and Green Creative Gardens • Development manager Erkki Välimäki, city of Seinäjoki, Project manager Pauliina Hautamäki, N.N Background information: http://www.seinajoki.fi/en/index.html http://www.greencreativegarden.fi/ 3. Q&A, discussions	Tekes
13.00 – 13.00	Lunch (possibly arranged as a round table discussion related to Tekes strategy work)	Tekes
13.00 – 15.30	1. Bioeconomy developments, clusters and partnership models in the Netherlands • Presentation by Jan Rotmans, Rick Bosman 2. Finland – A Designer for Cellulose-based Products? • Professor Ali Harlin, Technical Research Centre of Finland (VTT) • N.N, representative from Finnish textile (Marimekko or Nanso) 3. Q&A, discussions	Tekes
15.30 – 16.30	Break, summarizing discussion, next steps	Tekes
16.30	Transfer to airport	