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Expect the Unexpected

Differences in Visions and Expectations in the Developing Bioeconomy

by

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The notion of the bioeconomy is a growing topic in both politics as well as in academic papers. Related to sustainable transitions, this paper analyses to what extent differences in visions and expectations exist in the developing bioeconomy. In particular, the aim of this thesis is to increase the knowledge regarding differences in expectations and visions for industries collaborating in the development of the bioeconomy. According to earlier literature, the expectations and visions for the further development of the bioeconomy are highly diverse and sometimes opposing. In order to answer the aim of the thesis a single-case study was performed. The main theories used in the paper is the visions identified by Bugge, Hansen & Klitkou (2016), and the arena of expectations framework developed by Bakker, Van Lente, & Meeus (2011). The case analysed, Skogskemi, is a collaboration between the forest and chemical industry in Sweden in the development of the bioeconomy. It is concluded that several competing visions and expectations can be identified in the case. Furthermore, the different actors in the case interpret credible expectations differently.

Key words: bioeconomy, innovation, visions, expectations

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Introduction

In a world where the global consumption is increasing and natural resources are decreasing new research on sustainable technology is crucial. Whilst the concern of global warming and climate change are getting more critical researchers and policymakers are trying to find different solutions to solve these problems and challenges. Organisations, companies and technologies are all rooted in larger social and economic systems, commonly referred to as socio-technical systems (Smith et al, 2005,p.1493). A change in these systems is known as socio-technical transitions. However, while sustainability is a growing concern, transitions towards sustainability are a lot different than transitions that have occurred historically (Geels, 2011). This is mainly because a transition towards sustainability is defined as goal-orientated and purposive, while historically; the commercial-seeking emergent transition has been more common. Bakker, Van Lente and Meeus (2012,p.1) argue that: "emerging technologies are not 'judged' on what they can do, but rather on what they will be able to do in the future". In other words, the choices between competing technologies are likely to be based on expectations about the future, rather than how the different technologies are performing at the moment. Since a transition towards sustainability is goal-orientated and purposive in its character, it is likely that the expectations about the future matters even more in type of transition. However, the transition toward sustainability is a collective good, which weakens the incentives for private actors to address sustainable transitions (Geels, 2011). Nevertheless, the interest in sustainable transitions is growing; a field related to this transition is the research regarding the development of the bioeconomy. However, exactly what the bioeconomy suggests is still highly diverged, but one mutual understanding of the bioeconomy is the common interest in: "exploration and exploitation of bio-resources" (Bugge, Hansen & Klitkou, 2016,p.14). Likewise, the step in developing the bioeconomy is argued to be an important part towards a more sustainable future. In this paper the bioeconomy is understood as the technology that seeks to develop the exploration and exploitation of bio-resources.

According to Smith et al (2005) market structures, consumer patterns and inadequate infrastructure might be a reason why cleaner technologies, such as the bioeconomy, still haven't spread on the market. When analysing technical changes in the economy a common method of analysis is usually to focus on the observable pressure that are put on organisations, such as pricing, taxes, regulations etc. However, socio-technical systems also include current trends, political landscapes and socio-cultural attitudes. Additionally, each actor that is part of the social regime has their own interests and visions about their future, which influences the development of a technology (A.Smith et al, 2005). Socio-technical systems are related to the quasi-evolutionary perspective on development, which stresses the role of different actors and

their independent strategies for the future development of innovation. Quasi-evolutionary theory views variation and selection as interrelated (Van den Belt et al, 1987).

Visions and expectations are an interesting field of research since they have the power to change the outcome of a project, product or sometimes even a whole market (Bugge, Hansen & Klitkou, 2016). Moreover, the role of visions and expectations can be argued to have a greater role now in the modern industrial society than ever before. This might be related to the growing knowledge society, where knowledge has become a central element of the socio-economic change and thus, according to Borup, Brown, Konrad, & Van Lente, (2006,p.287) "a key site of strategic focus". According to Versteeg, Baumann, Weil & Moniz (2017) the process of technological development is driven by decisions of the different stakeholder involved. Hence, in socio-technical transitions, an important part of the future development is arguably the visions and expectations that dominate both in research, policy and on the market.

The focus of this paper will not be in the technical challenges of the bioeconomy, but rather, to what extent competing visions and expectations can be observed in the development of the bioeconomy. By doing this, the author hopes to create a better understanding of the different drivers in the innovation process for the bioeconomy. In this paper visions are defined as "a subsection of expectations: a coherent, positive, and consistent vision of a specific future, made to guide action in the present" (McKean, 2015,p.86). Expectations are defined as "real-time representations of future technological situations and capabilities" (Borup et al, 2006 ,p.286).

1.1 Background

The development of the bioeconomy has the possibility to influence several of the grand challenges the world is facing today. This could, for example, imply the up scaling of solutions regarding renewable energy sources such as, biofuels, bioethanol and biogas (Bakker, Van Lente and Meeus, 2012). However, the notion of the bioeconomy is still highly diverse, and sometimes even opposing. Bugge, Hansen & Klitkou (2016) stress that the challenges of the bioeconomy are highly complex and there are no easy answers to how these problems should be solved. Whilst examining the different directions of the bioeconomy Bugge, Hansen & Klitkou (2016) found that there are currently three different pathways in the bioeconomy in research and policymaking: (1) the Bio-Technology visions, (2) the Bio-Resource visions and (3) the Bio-Ecology vision. At the same time a high number of collaborations and initiatives regarding the development of the Bioeconomy has emerged all over the world in only a couple of years (Talavyria et al, 2015; Bugge, Hansen & Klitkou, 2016). Whilst the bioeconomy could be a possible solution to climate change and scarcity of resources, it is an on-going discussion in the literature if it is also the answer to the problems regarding food security, health, industrial restructuring and energy security. Some researchers

even claim that the bioeconomy might have a negative impact on these specific issues (Bugge, Hansen & Klitkou , 2016). With this said the bioeconomy could be argued to still be open for clarifications and different interpretations for both policymakers and industries. Since the bioeconomy still consist of uncertainties, it is a highly future oriented technology, where the expectation of the future creation of new opportunities plays a large part in the development of the science (Borup et al, 2006). Moreover, visions and expectations can be seen as the drivers of different innovation activities and are important for more actors than for only scientists and engineers. Expectations and visions can mobilize resources and influence at different layers of the society, both on a macro, meso and micro level. At the macro level visions can mobilize resources, through policy decisions and regulations. At the meso level it can be seen in different innovation networks or organisations and lastly on a micro-level it can be viewed in a single scientist or engineer (Borup et al, 2006).

One industry that has identified the growing interest for the bioeconomy is the Swedish forest industry, where they see an opportunity to increase and develop a new market (Ottosson et al, 2016). The Swedish forest industry is, and has been historically, an important sector in the Swedish industry in both terms of employment and exports. However, the industry is today facing challenges in its future development. The sector is facing great challenges regarding increasing energy prices, at the same time as the demand on traditional paper products is decreasing (Ottosson et al, 2016). For example, it has been a more than a 25% decline in the printed newspaper industry in Europe only since 2007 (Ottoson et al, 2016). Despite the declining growth trend in the forest industry, it is still an important sector in Sweden. For example the Swedish forest industry today only holds 1% of the commercial forest areas in the world, but holds a 10% market share of the timber, pulp and paper that are traded worldwide. Due to the long history of Swedish forest industry, the knowledge regarding the industry is deep and well established (Helander, 2015). The declining forest market has naturally led the forest industry to start looking for new market possibilities such as the involvement in the development of the bioeconomy. However, according to Ottosson et al (2016) an important aspect of the forest industry and its involvement in the bioeconomy is that its primary motives are cost reduction. This could be problematic since the aim of cost reduction might not be justified in relation to the high investments that are required to develop the bioeconomy. It is moreover important for the forest industry that the engagement in the bioeconomy does not disrupt their on-going production, but rather solve current problems regarding for example bottlenecks in the current production (Ottosson et al, 2016).

1.2 Aim of the Thesis and Research Question

A socio-technical transition towards sustainability is argued to be crucial, but at the same time incentives for companies to engage in sustainability seems to be missing. However, a growing interest in sustainability research is the development of the bioeconomy. Still, Bugge, Hansen & Klitkou (2016) claims that the research regarding the bioeconomy is very fluent and

indecisive in its character. The future development of the bioeconomy is therefore an interesting academic debate to take part of and contribute to. Since the transitions towards sustainability is highly complex, it is important to consider the role of each actor in the process. One way to do this is to stress the specific role of visions and expectations in the innovation process. Moreover, it has been concluded by academic papers that different visions and expectations within the bioeconomy are possible to identify, both among industries and in the earlier research that has been made in the field (Bugge, Hansen & Klitkou , 2016; Scordato et al, 2017). Bugge, Hansen & Klitkou (2016) identified three different contesting visions in research and policy regarding the development of the bio-economy. Hence, question arises regarding to what extent the bioeconomy consists of different visions at a smaller scale. To further investigate this topic, this paper intends to take a different approach, and investigate visions and expectations at the actual level where technological decisions are made. Moreover, since a lot of bioeconomy initiatives are developing all over the world at the moment **(**Talavyria et al, 2015; Bugge, Hansen & Klitkou, 2016**)**, it is relevant to investigate if these collaborations consists of different visions an expectations, and if so, if these are conflicting. By investigating one of these cases, it will increase the knowledge, in not only the development of the bioeconomy, but also regarding the role of visions and expectations in sustainable transitions. Hence, the aim of this thesis is to increase the knowledge regarding differences in expectations and visions in the bioeconomy. This will contribute to the research in the field regarding how visions and expectations are connected to the development of the bioeconomy. The research question in this thesis is thereby:

> *What differences in visions and expectations can be identified in the development of the bioeconomy when collaborating over industries?*

In order to answer the aim and the research question of the thesis the author intends to perform a single-case study on a collaboration over industries in the development of the bioeconomy in Sweden. An explanation on how the question will be answered can be read in the methodology chapter.

1.3 Outline of the Thesis

The thesis will start with a theory chapter; the theory section will start with a brief review of sustainable transitions to continue with an overview on the literature regarding the sociology of expectation. After that, the theoretical framework *arenas of expectations* will be presented, which will be used in the analysis section of the paper. The last section in the theory chapter is an overview of the visions identified by Bugge, Hansen & Klitkou (2016) in the bioeconomy, which will also be used as a theoretical framework in this paper. The chapter after the theory section is the methodology of the thesis where the data collection and analysis is explained. After this section an empiric's section follows with more information about the case and a presentation of the results. After the result is presented an analysis where the result of the thesis will be connected to the visions identified by Bugge, Hansen & Klitkou (2016)

and the theory regarding the arena of expectations. Lastly, a conclusion that answers the aim and the research question is presented followed with suggestions for future research.

2 Theory

There are three distinct characteristics in sustainable transitions. The first one, already stated in the introduction, is that sustainable transitions are goal-orientated, purposive and related to a collective good. This is problematic, since it decreases incentives for private actors to engage in sustainable changes, and increases the risk of free-rider problems (Geels, 2011). The second characteristic for sustainable transitions is that it is usually very hard to compete with already established technical solutions. Sustainable technologies are almost always more expensive than established technologies, and since it is a collective good, there are no obvious consumer benefits, besides that it is more sustainable, which also gives companies less incentives to promote sustainable transitions (Geels, 2011). The third characteristic, according to Geels (2011), is the areas where sustainability is most crucial. These are recognised to be the large incumbents that have the resources to actually endorse a change towards sustainability. However, these large incumbents might be the actors that have the least incentives to engage in a change towards sustainability and might rather defend their current market situation and hamper sustainability.

2.1 The Sociology of Expectations

The most famous literature regarding expectations is the Sociology of Expectations that has emerged from a Science and Technology Studies perspective (Borup et al, 2006). Borup et al (2006:286) defines technical expectations as: "real-time representations of future technological situations and capabilities". With this said, expectations can be both positive and negative, in general expectations can be any statement regarding the future. What is most important regarding this definition is that expectations are what an actor think will happen, and not necessarily what an actor want to happen. The Sociology of Expectations suggests that the future is created by the expectations, visions and promises of the people living in the present (Van lente, 1993). What is problematic is when these visions and expectations conflict with each other. Van Lente and Bakker (2010) suggest that in the development of new technology an expectations phase should be added and that competing expectations can be found anywhere between policy makers to researchers at the same R&D department. This statement indicates that it is possible to identify differences in visions and expectations at several layers of the society.

According to Borup et al (2006) the possible conflict between expectations are likely to occur due to the high number of technological promises firms and policymakers are faced with everyday. In alliance with the Sociology of Expectations a more traditional approach to expectations can be seen in, for example, consumer behaviour, if the consumers for example

believe that a new and better technology soon will emerge, the consumers are likely to postpone their consumption. This psychology is also applicable to the expectations between investors and researchers on new technology (Borup et al, 2006). This indicates that expectations have the power to postpone or delay technologies, which stresses the importance of researching this subject further. Borup et al (2006) stresses that the dynamics of expectations are especially important in the early stages of innovation. In the early stages, uncertainty is more likely to be high and thus, conflicts are likely to occur. However, Borup et al (2006) points out that shared expectations can increase the possibilities of successful collaborations between stakeholders. Hence, expectations have the power to influence the outcome of a collaboration. Borup et al (2006) also finds that expectations are highly path dependent and can be hard to reverse and in that sense a subject for lock-ins.

It also seems as if expectations can have different impact on actors in terms of company size and risk aversion. Koetse et al (2006) did a study where they analysed both aggregate investment and investment in energy-saving technologies. According to Koetse et al (2006) there is a difference regarding company-size and level of uncertainty regarding investments. Larger firms are more likely to have the resources to be able to hedge themselves against risk, and might have more access to information than smaller firms. Koetse et al (2006,p.367) also points out that a "negative effect is larger when the degree of irreversibility is higher". In their analysis they conclude that "perceived expectations and uncertainty have a substantial effect on investment spending, and that the specific effect depends on firm size and type of investment". Moreover, they conclude that size of the firm has a substantial large impact on investments in energy-saving technologies specifically. Along with the result of Koetse et al (2006) where risk and perceived expectations is concluded to have a large impact on company investment and the result of Borup et al (2006) that expectations have the power to postpone technologies, it appears highly relevant to investigate expectations at a level where technological choices are made, in order to increase the understanding of the development of the bioeconomy.

Moreover, since resources are limited choices regarding what direction to take in research have to be made constantly. At the same time, the stake for different actors in the development of new technologies is usually high making the situation even more complicated and subject for conflict (Van Merkerk & Van Lente, 2005) Hence, an increased understanding of the competing expectations and visions that drives the development of the bioeconomy is relevant. Since sustainable transitions are argued to be goal-orientated and purposive, visions and expectations are likely to play a large role in the further development of the bioeconomy. Moreover, according to Bakker, Van Lente, & Meeus (2011), decisions that are made on exaggerated expectations have the possibility to hamper the further development of a technology, due to misallocation of resources. Earlier researchers have mostly tried to identify different visions and expectations in policy and industries at a macro level regarding the bioeconomy (McKean, 2015; Scordato et al, 2017). This thesis can deepen the research by investigating visions and expectations at a smaller scale.

2.2 Arenas of Expectations

With origins in the sociology of expectations Bakker, Van Lente, & Meeus (2011) developed a framework called *the arena of expectations,* which addresses differences in expectations among actors, and how these are exchanged between them. The interactions between different actors in the arenas can take place on several levels, at many different arenas, such as scientific conferences and journals, media, committees and different research councils. In the arena of expectations both enactors and selectors exists. The enactors are the developers of new technology and the selectors are the actors that have the power to select the most credible option developed by the enactors. The arena of expectations illustrates how the enactors feeds and maintain the arena with expectations. They do this to receive mandate to develop their technology. If a selector is convinced by an enactor of the future potential of one technology, a mandate is granted. In contrast to the enactors, that feed and maintain the arena with expectations, the selectors inform and constrain themselves with expectations. The process of decision making feed backs into the arena as assessment and picking, and influence the competition for mandate (Bakker, Van Lente, & Meeus 2011). In order to receive mandate for ones expectations, the expectations has to be perceived as credible. In order to receive credibility for ones expectations Bakker, Van Lente and Meeus (2012,p.1069) finds that:

> *"Actors assess expectations as credible when they build on current performance and recent progress, the identification and construction of a path forward and a target performance level that the technological option is supposedly able to meet."*

This statement suggests the current expectations about a technology is important, at the same time as the past and future is essential too. The construction of *path forward* refers to the expectations regarding how much a technology is able to grow in the future. Overall there are three critical elements in order to receive credibility for ones expectation, these three elements are:

> *"the technology's level of performance and its historical progress toward that level, a path forward toward higher levels of performance, and end target that relates to relevant societal needs (Bakker, Van Lente and Meeus, 2012,p.1069)"*

Levidow, Borda-Rodriguez & Papaioannou (2014) did a similar study as the one of Bakker, Van Lente and Meeus (2012) but on the innovation of bioenergy in the UK, where they applied the framework of arenas of expectations. They point out that visions and expectations can easily turn into requirements, and they address this as a *promise requirement cycle*. When an innovator tries to convince a funder to invest in a specific technology, it is not unusual for innovators to exaggerate the characteristic and future possibilities of the new technology, this can create tension and misallocation of costs. Hence, promise requirement cycles is a critical element in the choice of different technologies.

As stated, the arena of expectations is a usable tool when analysing the credibility's and possibilities between different expectations. Levidow, Borda-Rodriguez & Papaioannou (2014) concludes that some expectations have been made more credible, following the promise requirement cycle. Pathways seemed to have been broadened when facing technical difficulties, especially through the development of new arenas. Levidow, Borda-Rodriguez & Papaioannou (2014) also addresses that the expectations regarding *commercialisation* of a product is important regarding the creation of path forward. Likewise, Bakker, Van Lente and Meeus (2011) stresses that in order to receive credibility for a vision, the expectations regarding the possible commercialisation is very important. Hence, looking at commercial expectations is essential when conducting an arena of expectations. In the study of Bakker, Van Lente and Meeus (2011) on hydrogen technologies they conclude that the exchange of expectations take place in more places than just organized bridging events. The exchange of expectations are also communicated through scientific articles, foresight activities, roadmaps and funding decisions to name a few examples (Bakker et al, 2011).

2.3 Visions

According to Morrison & Cornips (2012) visions in novel technologies are not only ideas of the future but in fact are very much contributors and generators of techno scientific projects. Especially within the biotech industry visions are particularly important since biotech products usually have very long lead times. Which means that for a long time span firms look for investment only on the ground of what vision they have for their product. This stresses the importance in investigating visions in the bioeconomy further, since visions are suggested to actually generate technology and scientific projects. For a specific definition of vision this thesis follows the definition concluded by McKean (2015,p.86): "'Vision' is defined as a subsection of expectations: a coherent, positive, and consistent vision of a specific future, made to guide action in the present" Hence, visions can be interpreted as general official positive statements about the future made by any actors. It then becomes clear that the biggest difference between expectations and visions is that expectations are defined by what actors think will happen and that visions are defined as what the different actors prefer to happen.

Since several researchers conclude that it exist differences regarding visions in many industries, and in particular within in the bioeconomy, the question arises if anyone actually has tried to define them. As stated earlier, the research regarding the bioeconomy varies, and there are different opinions on what the bioeconomy actually implies and suggests. Addressing the issue regarding the inarticulate meaning of the bioeconomy Bugge, Hansen & Klitkou (2016) divided the bioeconomy into three different visions: (1) The Bio-Technology vision, (2) The Bio-Resource Vision and (3) The Bio-Ecology vision. The key words Bugge, Hansen & Klitkou (2016) built the three visions around was: Aims and objectives, value creation, drivers and mediators of innovation and spatial focus. After reviewing the current

literature in the bioeconomy Bugge, Hansen & Klitkou (2016) concludes that it currently exists three main visions in the development of the bioeconomy:

(1) The Bio-Technology vision "emphasises the importance of the bio technology research and application and commercialisation of the bio-technology in different sectors " (Bugge, Hansen & Klitkou , 201,p.9). In this vision economic growth and job creation are the main *aims and objectives*. In other words, economic growth is always prioritised over sustainability. Not to say that the environmental effects are ignored, but they are rather assumed than the main objectives of the vision. The *value creation* is highly linked to the possible commercialisation and application of the biotechnology (Bugge, Hansen & Klitkou 2016). In this version of the bioeconomy, investments in research and development are considered very important for the future development of the bioeconomy. Moreover, it is assumed that technological development will resolve issues regarding resource scarcity and waste in the bio-production in the future, hence, this is not considered important in this vision. The bio-technology vision are for example commonly expressed in most national approaches that promotes innovation in the bioeconomy (Staffas, Gustavsson & McCormick, 2013). Examples of organisations that holds this approach is the OECD (Bugge, Hansen & Klitkou, 2016).

(2) The Bio-Resource vision "That focuses in the role of research development, and demonstration (RD&D) related to biological raw materials in sectors such as agriculture, marine, forestry, and bioenergy, as well as on the establishment of new value chains" (Bugge, Hansen & Klitkou , 2016,p.9). In contrary to the Bio-Technology vision the *aims and objectives* in the Bio-Resource vision are related to both economic growth and sustainability. The driver of economic growth in the Bio-Resource vision are expected to be the capitalisation of Bio-Resources. Even if environmental sustainability is considered to be important the main focus is on the development of new technologies in the bioeconomy and the capitalisation on new biotechnologies. *Value* is expected to be created when bio-resources are converted in to new products. In contrary to the Bio-Technology vision, minimising organic waste is a central aspect to this vision. One problem regarding the Bio-Resource vision is that the bioprocess is sometimes considered more important than the environmental outcome of the production in terms of sustainability. Problems such as deforestation and decrease in biological diversity are not a priority in this Bio-Resource vision. One example of an organisation holding this approach is the European commission. This vision also consider the collaboration across sectors to be important for value creation, for example that firms from the forestry industry collaborate with downstream sectors (Bugge, Hansen & Klitkou , 2016).

(3) The Bio-Ecology vision "highlights the importance of ecological processes that optimise the use of energy and nutrients, promote biodiversity, and avoid monocultures and soil degradation" (Bugge, Hansen & Klitkou, 2016:9). The Bio-Ecology vision is the vision, which has the highest concern of global and environmental sustainability. In the Bio-Ecology vision, sustainability is prioritised over economic growth and sustainability.

Value creation in the bio-ecology vision is mainly in the advancement of biodiversity and the protection of ecosystems. Moreover, it is considered important that energy from bio-waste only takes place in the very end of the production chain, after recycling and reusing, hence a cascading use of biomaterial is considered important. The Bio-Ecology and vision also consist of forces that rules out some important parts in the Bio-Technology and Bio-Resource Vision, such as gene-modification. Examples of an organisation holding this vision is the European Technology Platform TP Organics (Bugge, Hansen & Klitkou, 2016).

Table 2.3 Key characteristics of the Bioeconomy visions
Source: Bugge, Hansen & Klitkou (2016) table 7.

	The Bio-Technology Vision	**The Bio-Resource Vision**	**The Bio-Ecology Vision**
Aims and objectives	Economic growth and job creation	Economic growth and sustainability	Sustainability, biodiversity, conservation of ecosystems, avoiding soil degradation
Value creation	Application of biotechnology, commercialisation of research and technology	Conversion and upgrading of bio-resources (process oriented)	Development of integrated production systems and high-quality products with territorial identity
Drivers and mediators of innovation	R and D, patents, TTOs, Research council funders (Science push, linear model)	Interdisciplinary, optimisation of land use, include degraded land in the production of biofuels, use and availability of bio-resources, waste management, engineering science and market (interactive and networked production mode)	Identification of favourable organic agro-ecological practices, ethics, risk, transdisciplinary, ecological interactions, re-use and recycling of waste, land use, (circular and self-sustained mode)
Spatial implications	Global clusters/ Central regions	Rural/Peripheral regions	Rural/Peripheral regions

What is interesting with the visions concluded by Bugge, Hansen & Klitkou (2016) is that although the three visions have their own focus it is important to highlight that they are all interrelated, as well as they sometimes are obstacles to each other. For example, Bugge, Hansen & Klitkou (2016,p.13) points out an interesting conflict between the observed visions, which is the conflict regarding: "the focus on reducing waste-streams of bio-resources on the one hand, and developing new products and economic value chains based on existing waste-streams from bio-resources on the other". This means that as the same time as research and innovation develops regarding bio waste value chains, it reduces the incentives to reduce the total amount of waste, which is a clear conflict between the bio-ecology vision and the other two visions. Scordato et al (2017) did a study in Norway where they applied the typology of the three different bioeconomy visions, developed by Bugge, Hansen & Klitkou (2016). They analysed 41 submissions from a public hearing on the development of a bioeconomy where they analysed the different actors involved in shaping the Norwegian bioeconomy. They concluded that it is possible to categorise the different strategies into the three visions (Scordato et al 2017). Due to the result of Scordato et al (2017), where it is concluded that it is possible to identify different visions in the development of the bioeconomy in the Norwegian industry at a macro level it is relevant to investigate if it is possible to identify different visions and expectations also at a meso level when collaborating over industries. This would contribute to the deeper understanding of the role of visions and expectations at the actual level where technological decisions are made. This leads back to the

research question stated in the introduction: *What differences in visions and expectations can be identified in the development of the bioeconomy when collaborating over industries?*

3 Methods

In order to answer the research question of the thesis, a qualitative case study has been performed. Qualitative research method is interpretative in its nature and is generally used when answering that seek to answer “How?” or “Why?”. In this study, a qualitative approach was chosen since the author tries to understand and gain a deeper knowledge regarding a complex social situation, and constructs a deep-depth analysis regarding a specific setting. Additionally, the study is both deductive and inductive in its approach. Deductive in the sense that it seeks to test and compare developed theories with the findings in the thesis and inductive because it seeks to draw conclusions from observations, and from those, explain a specific phenomenon. The study holds a social constructivist view, which is a common approach when investigating the role of expectations (Keeley Scoones, 2003). Social constructivism does not see knowledge as something neutral or objective, but shaped by groups and individuals (Keeley Scoones, 2003). This is extra suitable for this thesis since it focuses on a specific context where it tries to understand the social settings of the participants in a collaboration over industries in the development of the bioeconomy.

3.1 Case selection

The case study that was conducted was a single case study. Single case studies are appropriate when analysing a representative case of the situation that the researcher seeks to analyse. Because this paper seeks to deepen the knowledge regarding differences in visions and expectations when collaborating over industries in the bioeconomy, the selected case had to be a part of the development of the bioeconomy. Furthermore, the case selected had to be a collaboration over industries, since the author seeks to analyse the notion of competing visions and expectations in the bioeconomy. The case selected, Skogskemi, was found on the homepage of Vinnova, the Swedish innovation Agency, and is part of what Vinnova refers to as “Challenge Driven Innovation”. Hence, the case of Skogskemi was chosen because of the specific characteristics of the case; a collaboration over industries where technological decisions had to be evaluated in the development of the bioeconomy.

Moreover, this specific case study uses an embedded case study design; the embedded units in this specific case are the different industries and organizations that are part of the case. When conducting an embedded design to a single-case study it is important to not only analyse each unit separately, but as a whole, otherwise the characteristics of the research design becomes more similar to a multi-case study rather than a single-case study.

3.2 Data

The data used for the analysis consists of secondary data; an overview of all the sources used is presented in appendix A and a list of all the actors involved in the case is presented in appendix B. The data was collected through literature and examination of official documents available online regarding the case of Skogskemi. In order to access some documents a requests to Vinnova had to be sent in (for example the original project applications for the project). To get a first overview of the case the official final report on the Skogskemi case was read, this gave a good overview of the technical choices and aims of the project. However, to get a better idea of the different visions and expectations of the actors involved in the case more data, from different sources had to be collected. Data was then collected from: technical evaluations of the project, press releases from the different actors involved, the official system analysis of the Skogskemi project, articles that contained interviews made by the actors involved, an online presentation of the project, the official applications of the project and the online homepages of the different actors involved. To have a broad range of data was considered necessary in order to identify patterns regarding expectations and visions expressed by the actors in the case.

3.3 Data Analysis

The case of Skogskemi consists of three different phases, phase 1, phase 2 and phase 3. In this study, phase 2 has been the one studied in most detail, this is because it was in this phase of the case that the technological decisions were evaluated and moreover; it was the phase where most data could be found. Considering the aim of this paper, it is where expectation and visions regarding the future technology are described that is of most interest for the analysis. However, in order to get a complete picture of the case, phase 1 and phase 3 were analysed as well. Since the data only consist of text-sources, textual analysis was applied. This was done in a structured way where different categories were created in alliance with the theories applied in this paper.

In the case of Skogskemi a total of 15 actors were involved in the second phase of the project. For the data analysis all these actors were analysed in terms of their visions and expectations about the future for the project and the development of the bioeconomy. To identify different visions the data were organised in alliance with the key words of Bugge, Hansen & Klitkou (2016). However, the key word “spatial implications” was exchanged to “future market potential”, this was done because “spatial implications” was not considered as relevant as “ future market potential” for this specific paper, since the aim of the paper is to find differences regarding visions in the future development of the bioeconomy. Hence, the data was coded under four key words (1) “Aims and objectives”, (2) “Value Creation” and (3) “Driver and mediators of innovation” and (4) “Future Potential Market”. Three different

visions were identified in the result and compared to the visions concluded by Bugge, Hansen & Klitkou (2016) in the analysis.

To organize the data on expectations, the documents were coded in alliance with the arena of expectations framework, with focus *on commercial expectations* and *requirement cycles*. These two key words were chosen because; in alliance with the theory and for this specific case, they were considered most appropriate. After coding the data in alliance with the arena of expectations an "arena of expectations" was concluded. This was done to get a clear picture of the different actors roles in the project and the possible differences among them. When submitting the arena of expectations an embedded design was taken. Hence, the 15 actors involved were divided into 5 different categories. This was done primarily because in the data available the actors were sometimes referred to by name and sometimes by industry. Moreover, considering the aim of the paper, it was important for the analysis to divide the actors by industries. Hence, all the actors were categorized by industry, with the exception of Processum that was categorised as the "Project Leader". This was done because even though Processum consists of several actors from different industries, they are part of the project as one unit, and from the data analysed, it is clear that Processum, just like the other industries, has its own agenda, visions and expectations about the project. Hence, it was considered most suitable to analyse Processum as its own unit.

3.4 Validity & Reliability

Validity issues in qualitative case studies are, for example, the inference issue. Every time something can't be directly observed, the investigator has to infer what happened. This is usually applicable to case studies that seeks to explain why point B got to point A (Robert, 2009). Since this case study is not trying to explain a reason to *why* something got from one point to another but rather to what extent visions and expectations can be identified in the specific case, the inference problem is not as problematic in this type of case studies (Robert, 2009). However, an inference problem could possible be the interpreting of different visions and expectations of each actor, which might leave some room for interpretations. Since the thesis only analysis text it might be a higher risk for misinterpretations. One problem that was identified was that, even though the thesis had a clear definition of both visions and expectations, these were sometimes hard to distinguish in the analysed text. However, the key-words identified in the applied theories made it easier to avoid any miss-inferences. When conducting a case study, external validity also has to be considered, which is related to, if the findings in this case study, is applicable to other cases. When conducting a case study no statistical generalisation can be concluded. However, case studies do not aim for statistical generalisation but for analytical generalisation (Robert, 2009). This paper uses well-known and tested theories as a base for its analysis, which indicates analytical generalisation, and similar analysis could be performed on other cases as well. This leads to another concern when performing a case study, which is reliability. The goal of reliability is to minimize any

errors or biases that might occur in a study, and if another researcher were to perform the exact same study again, the same results should be found. In order to minimize these problems the data collection and analysis has been conducted in a structured way following the key-words stated in the data-analysis.

3.5 Limitations and Ethical Considerations

One limitation with the data conducted of the case is that it only consists of secondary sources. This is due to the time-limitations of the thesis and the difficulties to get interviews in time to be able to conduct and analyse the material. Even though interviews would have been an interesting approach to the case, the secondary data collected was considered sufficient to answer the research question and the aim of the paper. However, the author is aware that it might exist a difference between public expectations and visions and the tacit expectations and visions that could have been found through interviews. Since this thesis only analyse public documents and articles available online it naturally only analyse the public expectations communicated by the different actors analysed in the study.

Ethical issues can be extra sensitive when conducting case studies. Ethical issues in case studies could for example be the confidentiality of the participants, the vulnerability of groups that are researched or any harm or deception any actor could be a subject for (Robert, 2009). Since this paper only used secondary sources available for the public as a base for its analysis, the confidentiality is not viewed as an issue. Moreover, the data analysed is the data that has been officially communicated by the actors themselves, hence the study does not harm the participants in any way.

4 Case Study and Empirical Results

In the following section an overview of the studied case will presented. After that the results of the findings will be presented in two tables, the first in alliance with the arena of expectations and the second table is conducted through the key-words identified by Bugge, Hansen, & Klitkou (2016).

4.1 Skogskemi

Skogskemi is the name of a collaboration primarily between the forest industry and the chemical industry in Sweden. The actors involved in the Skogskemi project were mainly from the chemistry cluster of Stenungsunds and the bio refinery organisation of Processum. The aim of the project was to investigate the possibilities in developing three different value chains for the future production of green chemicals with the forest as a potential feedstock (Joelsson & Mossberg, 2014). Both the chemistry industry and the forest industry are important sectors in Sweden. However, both industries are facing future challenges but of different character. The chemical industry is based on the exploitation of fossil resources, but has a clear aim and ambition to start using renewable material instead. At the same time the Swedish forest industry, due to a declining market, is hoping to develop new ways in how to optimize the residues that are under-optimized today, and seeks to find new ways in order to increase their own profit. Moreover the forest and the bio refinery industry hope to reduce some bottlenecks that exist in the forest-industry today (Joelsson & Mossberg, 2014). The aim of the Skogskemi projects was that these two interests could meet in the creation of new value chains in a cross-collaboration over industries (Joelsson & Mossberg, 2014). The project is a part of "challenge driven innovation" that was requested by the Swedish innovation agency Vinnova. Hence, the project is partly funded by Vinnova, and partly funded by the actors involved. The project of Skogkemi consists of three different phases and a new application had to be sent in to Vinnova to receive funding for each phase. Phase 1 took place between November 2011 and March 2012 and was sponsored with 610 000 SEK by Vinnova (Vinnova, 2011). Phase 2 took place between August 2012 and November 2014 and was funded with 9 500 000 SEK by Vinnova (Vinnova, 2012). Phase 3, which was named Skogsmetanol (Forestmethanol) was sponsored with 4 439 000 SEK by Vinnova (Blomberg, 2015).

4.1.1 Phase 1- Bio-based chemicals and materials through increased cooperation between the forest and the chemical industry

The first phase of the Skogskemi project had its focus on idea building and constellation formation. In the Vinnova project A application form it is stated: "This project will initiate creative discussions and change of ideas between the two businesses. This will increase the speed to market for new sustainable chemicals and products" (Engström, 2011,p.2). In the project description it is written that the project especially focuses on two challenges that was asked by Vinnova, green competitive production and sustainable cities. To meet green competitive production the thought out solution was stated to exchange fossil based raw materials with bio-based raw materials in the chemical industry. To meet the challenges sustainable cities the thought out solution was to create new bio-based plastics, composites and materials (Vinnova, 2011). The CEO of Processum, Claes Engström, states in a press release at MoRe (2011, Translated) "The purpose of the project is to create a comprehensive idea exchange for product development between the two industries for the first time". Processum has been the overall project coordinator of the Skogskemi project. The Processum organisation is a meeting point for companies, universities and other society functions where they meet to work on the development of the bio refinery industry. According to themselves:

> *"The major part of the activities consists of support and initiatives concerning research and development in the areas of biotechnology, energy technology, inorganic chemistry, organic chemistry and raw materials with focus on sustainability" (Joelsson & Mossberg, 2014*,p.*6).*

4.1.2 Phase 2- Skogskemi (Forestchemistry) sustainable chemistry and materials

The official project description of phase 2 in the Skogskemi project starts with the statement that: "Forest chemistry sustainable chemistry and materials' will lead the way for long term sustainable competitive production of chemicals and materials in Sweden" (Vinnova, 2012,p.2). More specific, the goal of the project has been to "develop pre-FEED studies for demonstration plants for the targeted chemicals" (Joelsson et al, 2014,p.4). A pre-FEED study is a closer evaluation, both technical and economical of several possible feed options, in this case three different value chains and two platforms were evaluated. The three different value chains that were analysed in the second part of the Skogskemi project were Butonal, Methanol and Olefins (Joelsson & Mossberg, 2014; Andersson, E., 2014; Engström, 2012).

The main idea of the project was that both the interests of the chemical industry and forest industry could meet in collaboration which would increase innovation in the development of the bioeconomy (Joelsson & Mossberg, 2014, Josefsson, 2012). In more specifics, the participating organisations in this part of the project were: AGA, AkzoNobel, Bio4Energy, Borealis, Chalmers, Domsjö Fabriker, Holmen, Ineos, More Research, Perstorp, Processum, SCA, SEKAB, Sveaskog and Umeå University (Joelsson & Mossberg, 2014).

Some actors involved in the project had already outspoken visions regarding the development of the bioeconomy, for example the main vision of the chemical cluster of Stenungsund was: "in 2030 Stenungsund Industry Park will be the hub for the manufacturing of sustainable products within the Swedish chemical industry" (Joelsson & Mossberg, 2014,p.6). The major challenge in this vision is to shift towards renewable feedstock and energy carriers (Joelsson & Mossberg, 2014). In the article "Plast på träd" (Plastic on trees), Lars Josefsson, the project leader of the chemical cluster, states that: "The greenhouse effect is a fact and we have to do something about our carbon dioxide emissions. In the long run, I believe that the price on fossil-based raw materials will increase." (Wilhelmsson, 2015,p.17, translated). In the magazine Kemivärlden, Patricia Oddshammar, Global project manager at Perstorp, concludes that the interest for green chemicals is increasing, and they believe that this interest will continue to increase. However, the waste from green chemicals is still as big as the waste from fossil-chemicals. Nonetheless, Patricia Oddshammar stresses that these issues will most certainly be solved in the future (Jönsson, 2012). Moreover, the chemical industry is very sceptical to use biomaterials for the direct use for bio-fuels. Instead, they believe value is created through the cascading use of biomaterials. One of the project managers at Stenungsund, Robert Onsander, project leader at Stenungsund, stated in Kemivärlden (Jönsson, 2012:1, translated) regarding the use of bio raw materials:

> *"We are basically very critical of the fact that the fine bio raw material is primarily directed to the energy use and thus rapidly becomes carbon dioxide. We advocate serial use or so-called cascading use: the biorage is used in chemicals and materials with a life span of maybe a couple of decades. Only then will it go to energy production"*

The bio refinery industry is certain that further development of the bioeconomy will be the solution to global challenges for future generations (Domsjö, 2017; Sekab, 2017). For example, on the webpage of Sekab it is stated in the first page that their technology ensures: "A sustainable development who meets today's needs without jeopardizing the potential of future generations." However Thore Lindgren, Vice President at Sekab, in the article "Plast på Träd" (Plastic on trees), stresses concerns regarding the high investments needed when developing the bioeconomy, especially if it is to go in the direction towards the production of plastic. Lindgren concludes that actors tend to wait for other actors to take the first step (Wilhelmson, M. 2015). In order to break the current status quo Lindgren states in the article that shared risk with the government could be a possible solution (Wilhelmson, M. 2015).

At the University side, Leif Jönsson, professor at Umeå University states in a press release the importance of continuous research in technical solutions so that the quality of production can increase (SP, 2015). Moreover Lena Heutz, at Chalmers Industrial Engineering, concludes in the article "Forest chemistry phase 2 has been completed", her conclusions regarding phase 2:

> *"For the chemical market, the same policy incentives are not available and it is therefore not economically advantageous to sell the products for chemical purposes. There are significant synergies between the fuel and chemical markets for renewable products, but at the same time it is clear that it is difficult to justify production for the chemical market unless this is given the same conditions as use for fuel (SP, 2015,p.1, translated.)"*

The main concerns of the project have been the uncertainties regarding the possibilities to scale-up to commercial levels, and the current market price on fossil-materials. (Wilhelmson, 2015). In order for the project to be successful economically Lena Heuts underlines in the same article the potential to produce products than can be sold as biofuel:

> *The economic analysis shows that the value chains have the potential to be economically viable if the product can be sold as biofuel with a support equivalent to a tax exemption from energy and carbon tax currently available (SP, 2015,p.1, translated).*

Furthermore, Processum believes that it will be possible to charge green premiums on renewables in the future at a higher extent than now (Johansson & Petterson, 2014). The final recommendation of the project was:

> *We conclude that the technologies for production of butanol and olefins from ethanol and methanol are mature, and the construction of such plants could start today. The step from forest feedstock to methanol and ethanol still carries uncertainties with respect to scaling up of the processes."* (Joelsson et al, 2015,p.2, translated)

4.1.3 Phase 3-Skogsmetanol (Forest methanol) - climate smart competitive chemicals

In phase 3, the value chain methanol, was the one that was chosen for further development. The hopes for the project are that both economics and environmental benefits will follow with the demonstration of a competitive production system (Blomberg, 2015). Processum also states expectations regarding that new business opportunities will emerge from pulp, chemical and the technology supplier sector (Blomberg, 2015). Some of the reasons for choosing the forest methanol value chain, according to the official request to Vinnova, were that the cost of investment were the lowest for this value chain and it gave possibilities for reduction of bottlenecks in some of the industries (Blomberg, 2015).

The most important area for evaluation in this part of the project is the quality of the methanol that is produced, this is important for the decisions regarding what market the produced methanol should be used on. In the project description it is stated that the end products in the value chain would be a central unit in bio-fuel and, depending in the quality of the methanol, for the chemical formaldehyde that is a central unit in plastic (Blomberg, 2015)

4.2 Results

4.2.1 **Arena of Expectations**

Table 4.2.1 Identified Vision

Arena: Selector and/or enactor	**University, Research Institutes**	**Main financier**	**Chemical companies**	**Forest Companies and Bio refineries**	**Project Leader**
Host/funder Bioenergy specific unit	Chalmers, Umeå Universitet, MoRe research, SP, Bio4Energy	Vinnova	Perstorp, AkzoNobel, Ineos Borealis, AGA linde	Sveaskog, SCA, Holmen. *Aditya Birla Domsjö, Sekab*	Processum
Industry role in this specific case	*To research and deepen the knowledge regarding the studied value-chains.*	*Swedish institute that promote innovation*	*Providers of knowledge regarding chemical products*	*Providers of the raw material and knowledge regarding the forest industry (forest companies) and to provide technology and knowledge regarding the conversion of the raw material provided by the forest companies (bio-refineries)*	*Brings together companies, universities and society functions to collaborate in the development of the bio refinery industry*
Commercial expectations	*Have high commercial hopes in the technical development of the bioeconomy, especially regarding more high-quality products.*	*Through "challenge driven innovation" and cross-sectorial innovation. commercial pathways will be found.*	*Expects the demand on renewable products within the chemistry industry to increase in the future and hence sees high commercial possibilities in the green-chemical market*	*The high investment that is needed to start producing chemical-materials is seen as a big risk, hence the best potential for possible commercialisation is in the bio-fuel market*	*The most possible commercialisation is producing for the bio-fuel industry.*
Promise-requirement cycle	No promise-requirement cycle has been identified	No promise-requirement cycles has been identified.	*Technical difficulties regarding for example biological waste will be solved by technical solutions in the future.* Moreover, *the price of fossil raw materials will increase in the future due to global warming. Because of this renewables will have easier to compete in terms of price.*	*The development of the bio-economy will secure sustainability for future generations*	*It will be possible to take out green premiums on renewables to a higher extent than now.*

4.2.2 **Visions**

Table 4.2.2 Identified Vision

	Vision 1	Vision 2	Vision 3
Actors	*Chemical companies,*	*Forest Companies and Bio refineries*	*University, Research Institutes, Vinnova, Processum*
Aims and objectives	*To increase the sustainable production of green chemicals.*	*To maximize the commercialisation of the forest industry.*	*To increase the quality of production and solve technical challenges in the bioeconomy.*
Value Creation	*Value is created through the cascading use of biomaterials*	*Value is created by increasing the profit for the forest industry, and minimize possible bottlenecks in the production.*	*Value is created through further research on the bioeconomy and the optimise use of bio-resources.*
Drivers and Mediators of Innovation	*Cross-sectorial collaborations drives innovation*	*Cross-sectorial collaborations drives innovation*	*Cross-sectorial collaborations drives innovation*
Future Potential Market	*The future potential market is in green chemicals for the production of, for example plastic.*	*Both the biofuel market and the chemical market are seen as possible markets. But at the moment biofuel is considered more profitable.*	*Both the biofuel market and the chemical market are seen as possible markets. But at the moment biofuel is considered more profitable*

Vision 1: The actors that have expressed this vision are the chemical companies, which moreover already have an outspoken vision regarding the goal to be the greenest chemical hub in Sweden by 2030. The focus of this vision is in first hand to increase the lifespan of biomaterials; hence this vision is clearly proposing a cascading use of bio raw material, where the energy use of bio-waste should come after recycling and reusing (Jönsson, 2012). Moreover, they have a strong belief in future technologies and that problems, such as waste, can be solved in the future. They also believe that the demands on renewables will increase in the future, especially within in the chemical industry.

Vision 2: The second vision that has been observed is the one expressed by the forest companies in the case of Skogskemi. This vision is clearly focused on commercialisation of the Swedish forest industry, with a clear focus to increase the profit and value of the forest industry. The forest industry does not have an

outspoken market in which they want to sell, but they see potential in both the biofuel market and the market for green production of chemical materials. It is seen as important in this vision that the development of the bioeconomy should not hamper the current production of the forest industry at the moment.

Vision 3: The third vision identified is the one expressed by Universities, Research Institutes and Vinnova. These actors stresses the importance in solving technical challenges in the bioeconomy, this is believed to be done primarily through more research and cross-sectorial collaborations. Financial stability is considered important in this vision but still with a clear focus on sustainability.

5 Analysis

In the following section an analysis of the result stated in the previous chapter connected with the selected theory will be presented. This is in order to answer the stated research question "*What differences in visions and expectations can be identified in the development of the bioeconomy when collaborating over industries?"* The analysis will start with comparing the identified visions with the one identified by Bugge, Hansen & Klitkou (2016). After that, an analysis of the expectations connected to the theory will be presented.

5.1 Visions

5.1.1 Vision 1

The first vision identified in the result was the vision held by the chemical companies. The main *aims and objectives* identified in this vision are to increase the sustainable production of green-chemicals. This is similar to the Bio-Ecology vision identified by Bugge, Hansen & Klitkou (2016), which stresses the sustainability as the most important factor. The identified *value creation* in this vision is to increase the cascading use of biomaterials, which is also in line with the Bio-Ecology vision. *Drivers and Mediators for innovation* are considered to be through cross-sectorial collaborations, which is also the main idea behind the project of Skogskemi. According to Bugge, Hansen & Klitkou (2016) cross-sectorial collaborations as a driver for innovation are in line with the Bio-Resource vision. However, the Bio-Resource vision seeks to exploit bio-resources both for the production of biomaterials but also for the production of bio-fuels. Biofuel as a *potential market* is strongly in contradiction of the vision held by the chemical companies, which stresses the importance of the cascading use of biomaterials, where the aim is to use biomaterial as an energy source only after reusing and recycling. The vision of the chemical companies also has a strong trust in the future technology of the bioeconomy, which is comparable to the Bio-Technology vision expressed by Bugge, Hansen & Klitkou (2016). According to this, the vision held by the chemical companies in the case of Skogskemi, is a mix between all three visions developed by Bugge, Hansen & Klitkou (2016) which indicates that the bioeconomy is even more diverged than what Bugge, Hansen & Klitkou (2016) suggests.

5.1.2 Vision 2

The second vision that was identified is the vision held by forest and bio refinery companies. The *main aim and objective* in the second vision is the commercialisation of bio-resources. This is in line with the Bio-Resource vision created by Bugge, Hansen & Klitkou (2016). Just like in the Bio-Resource vision, the drivers of economic growth is expected to be through the capitalization of bio-resources. Hence, the main focus in this vision is to exploit bio-resources and from that create economic growth, which is also exactly what Bugge, Hansen & Klitkou (2016) suggests in the Bio-Resource vision. In terms of *value creation* in the second vision this is primarily done through the increased production and the reduction of bottle-necks, this is also very similar to the Bio-Resource vision. *Drivers and Mediators for innovation* are considered to be through the creation of new value chains as well as collaborations over industries. This is, as mentioned before, just in line with the Bio-Resource vision. *Future potential market* is considered to be in the market that is most profitable, at the moment that is considered to be in the bio-fuel market.

5.1.3 Vision 3

Universities, Research Institutes and Vinnova communicate the third vision identified. *Aims and objectives* in this vision are to increase the quality of production and solve technical challenges in the bioeconomy. This is similar to the Bio-Technology vision, which also is the vision according to Bugge, Hansen & Klitkou (2016) that most research institutes hold. *Value,* is believed to be created through the optimal use of bio-resources, which also will benefit the economy as a whole. This is also in line with what the Bio-Technology vision suggests. Drivers of innovation are also in this vision recognized through collaboration over industries, which is in line with the Bio-Resource vision rather than the Bio-Technology vision which stresses a more linear-model of innovation. Similar to the second vision identified, the third vision sees *future market potential* both in the biofuel market and for bio-chemicals. However the production for the chemical market is not yet seen as financially feasible.

5.1.4 Differences among Visions

Even though the different visions identified in the case are somewhat similar they still stand in clear conflict to each other, in terms of *aims and objectives*, *value creation* and *future potential market*. However, in terms of *drivers and mediators of innovation*, cross-sectorial collaboration*s* are favoured among all actors. This is also one of the main reasons why the actors decided to be part of the project. Vision number one is similar to vision number two regarding that commercialisation and economic growth are important. However, vision number two only focuses on the growth of the forest companies and bio refinery companies which of course is conflicting with the agenda of the other actors involved in the project of

Skogskemi, especially the chemistry companies. The main difference that can be identified is that vision number 1 has a clear focus on the cascading use of biomaterial, whereas the other two visions identified are more focused on the financial incentives to develop the bioeconomy. This is similar to what Geels (2011) suggests regarding that firms usually lack incentives to engage in sustainable transitions, since sustainable transitions are a "collective good" and does not necessarily increase the value of a product in the eyes of a consumer. However, according to the result of this thesis, incentives to engage in the bioeconomy does not have to be financial, but can also be because companies have a clear vision to engage in it, as is the case for the chemical companies.

5.2 Expectations

In order to investigate competing expectations an arena of expectations was conducted. It is the selectors in the arena that choose the appropriate technologies and the enactors that develop the technology (Bakker et al, 2012). In terms of identifying the different enactors and selectors in the case of Skogskemi it seems as if, in this specific case, they are highly interrelated. Almost all actors develop some type of technology and, being special with this case, they are also supposed to be collaborating in order to choose the best option, which makes all actors both enactors and selectors. Vinnova is an exception, since they, clearly only possesses the role as a selector, as they do not participate in developing any technology.

The expectation regarding the possible commercialisation is an important factor in the creation of *path forward* (Bakker et al, 2011; Levidow, Borda-Rodriguez & Papaioannou 2014). The creation of path forward is in turn, according to Bakker, Van Lente & Meeus (2012), an important factor in order to receive credibility for one's expectations. In the case of Skogskemi it is possible to identify different commercial expectations among the actors. The research companies and the universities express high commercial hopes regarding the technical development in high-quality products for the future development of the bioeconomy. At the same time the research companies and universities, along with the forest companies, bio-refineries and Processum stress that the best opportunity for commercialisation at the moment is producing for the bio-fuel market. In contrary, the chemical companies believe that the market is ready for green-chemicals, and that the demand on green chemicals will increase in the near future. The fact that the chemical companies stress the future potential in the technology, which is in line with their vision, could be understood as a way to construct a path forward and receive credibility from the other actors. However, it seems as if the other actors, are more focused on the *current* and *recent* progress of technology, which is also important according to Bakker, Van Lente & Meeus (2012) when receiving credibility. In the end, the pathway that received most mandate (as viewed in phase 3) was the one that can be used for commercialisation on bio-fuels with the possibility to be used in he production for green chemicals. This indicates that credibility for expectations are received on the basis of the current expectations rather than the possible future performances.

The construction of path forward is also linked t*o promise requirement cycles*. Possible examples of *promise requirement cycles* identified in the case of Skogskemi are the expectations regarding the prices on fossil raw material, which are expressed a bit different among the actors. The expectation of the chemical companies is that the price on fossil raw materials will increase in the future. In contrary, Processum expresses high expectations regarding the possibility of charging higher green premiums on renewable material in the future. Even though both expectations suggest a bright future for renewable materials, the expectation expressed by the chemical companies is clearly more passive than the one expressed by Processum. If market conditions become a requirement, as suggested by the promise requirement cycle, investments have a risk of being misallocated (Bakket et al, 2012). In this case it could for example be that not enough attention is brought into cost-efficiency, since the market is expected to solve the issue with high prices.

According to Koetse et al (2006) risk aversion is strongly connected to the expectations actors have about the future. The risks identified and expressed in the case of Skogskemi are the ones regarding financial benefits, scaling up and commercialisation. According to Koetse et al (2006) perceived expectations along with uncertainties affect the amount an actor is willing to invest in a new technology. Moreover, Koetse et al (2006) stresses that risk aversion is linked to the size of the company where big companies are likely to be less risk averse than small companies. In the case of Skogskemi, it seems as if the size of the risk an actor is willing to take is linked to the incentives and visions actors have to engage in the development of the bioeconomy. This is similar to what Geels (2011) suggests regarding sustainable transitions. According to Geels (2011) a lack of incentives is a reason why a transition towards sustainability is very slow. However, the development of the bioeconomy could be a possible way to increase the incentives for companies to engage in a sustainable development, since it has financial benefits and is not only a collective good. Nevertheless, as found in this thesis, visions and expectations among the actors are very diverged, which indicates that their incentives for engagement in the bioeconomy are also different. For example, when looking at both the results of this thesis, and the overall review of the Swedish forest industry in connection to the bioeconomy by Ottosson et al (2016), it is clear that the incentive for the forest industry to engage in the bioeconomy is to increase its own profitability and expand their own market. However, the chemical companies incentives to engage in the bioeconomy is clearly connected to come closer to their vision regarding sustainability.

6 Conclusion

As stated in the beginning of the paper the thesis seeks to answer the following research question:

> *What differences in visions and expectations can be identified in the development of the bioeconomy when collaborating over industries?*

Differences in visions among the actors can be found both *in aims and objectives*, *value creation* and *future potential market*. However, for the *drivers and mediators of innovation* the actors were in total consensus, that innovation is created through cross-collaborations between industries, which is not surprising since the case of Skogskemi is a cross-collaboration over industries. When comparing the identified visions in this thesis, with the visions identified by Bugge, Hansen & Klitkou (2016) it was concluded that the second vision is very similar to the Bio-Resource visions and the third one is very similar to the Bio-Technology vision. However, the first vision identified seems to be a mix between all three visions identified by Bugge, Hansen & Klitkou (2016) which indicates that notion of the bioeconomy might be even more diverged than Bugge, Hansen & Klitkou (2016) suggests. The biggest difference observed in terms of visions regarding the development of the bioeconomy, is whether or not the direction of the bioeconomy should be in for green chemicals in first hand, or if it also should be developed primarily for the use of bio-fuels.

Moreover, the result of the paper implies that it is possible to identify several competing expectations among the different industries and actors in the case. The main difference found, similar to the competing visions, is that the chemical companies have high expectations regarding the commercialisation of green chemicals, where as the other actors express concerns regarding the financial risks in developing the bioeconomy towards the market of chemicals. In the end, the technical expectation that received the most mandate was the one that was supported by the *current* most *credible* expectations regarding financial benefits and scaling up potential, rather than the future benefits of that technology, this is in clear contradiction to both the vision and expectation of the chemical companies. Hence, when analysing differences in expectations it seems as if different actors interpret credibility of expectations differently. Connecting the result of this thesis with the theory regarding sustainable transitions, it seems as if the incentives for engaging in the bioeconomy is connected to the different visions and expectations actors have about the future.

Lastly, the aim of this thesis was to increase the knowledge regarding differences in expectations and visions when collaborating over industries in the development of the bioeconomy. By conducting a case study on a collaboration over industries in the

development of the bioeconomy, it has been concluded that several differences both in terms of visions and expectations exist among the different actors.

6.1 Suggestion for Future Research

In this thesis it has been shown that differences in visions and expectations exist to a great extent. Since it is concluded in this paper that actors perceive credibility differently, and that this is likely to be connected to the vision actors have about the future, it would be interesting to research more in detail how different actors receive mandate for their expectations in relation to their visions. Moreover, since this study has analysed the public expectations it would be interesting to compare this to the tacit expectations actors might have. This would increase the understanding regarding the role of visions and expectations even further. Since the findings in this thesis indicates that there is a connection between incentives and visions, this would be interesting to investigate further to see what actors that are the actual drivers of sustainable transitions.

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Appendix A

Table 2.3 Key characteristics of the Bioeconomy visions
Source: Bugge, Hansen & Klitkou (2016) table 7.

	The Bio-Technology Vision	The Bio-Resource Vision	The Bio-Ecology Vision
Aims and objectives	Economic growth and job creation	Economic growth and sustainability	Sustainability, biodiversity, conservation of ecosystems, avoiding soil degradation
Value creation	Application of biotechnology, commercialisation of research and technology	Conversion and upgrading of bio-resources (process oriented)	Development of integrated production systems and high-quality products with territorial identity
Drivers and mediators of innovation	R and D, patents, TTOs, Research council funders (Science push, linear model)	Interdisciplinary, optimisation of land use, include degraded land in the production of biofuels, use and availability of bio-resources, waste management, engineering science and market (interactive and networked production mode)	Identification of favourable organic agro-ecological practices, ethics, risk, transdisciplinary, ecological interactions, re-use and recycling of waste, land use, (circular and self-sustained mode)
Spatial implications	Global clusters/ Central regions	Rural/Peripheral regions	Rural/Peripheral regions

Appendix B

Overview of secondary sources

Name of the Source	Description	Reffered to as
Official Reports on the case of Skogskemi		
Gasification Platform. Sub project report to the Skogskemi project.	*An official description of the Gasification platform, analysed in phase 2 of the Skogskemi project.*	Andersson, E., (2014)., Skogskemi – Gasification Platform. Sub project report to the Skogskemi project. The Skogskemi Project, Örnsköldsvik, Sweden: SP Processum AB.
Final Report on the Skogskemi project.	*An official description of phase 2 on the Skogskemi project*	Joelsson, J. M., Engström, C., & Heuts, L. (2015). From green forest to green commodity chemicals: evaluating the potential for large scale production in Sweden for three value chains
Systems Analysis. Sub project report to the Skogskemi project.	*The System analysis, made in phase 2 of the Skogskemi Project. Where factors like market and current policies were considered.*	Joelsson, J.M., Mossberg, J. (2014), *Skogskemi – Systems Analysis. Sub project report to the Skogskemi project.* The Skogskemi Project, Örnsköldsvik, Sweden: SP Processum AB.
Sugar Platform. Sub project report to the Skogskemi project	*An official description of the Sugar platform, analysed in phase 2 of the Skogskemi project.*	Jönsson, L.J., (2014), Skogskemi – Sugar Platform. Sub project report to the Skogskemi project. The Skogskemi Project, Örnsköldsvik, Sweden: SP Processum AB,
Documents accessed on request from Vinnova		
Appendix to the application for UDI Step 3, Forestmethanol	*In the application it is described why phase 3 in the Skogkemi project is important, its aims and objectives, timeplan and financial plan*	Blomberg (2015), Bilaga till ansökan för UDI steg 3, Skogsmetanol- Klimatsmarta konkurrenskraftiga kemikalier.
Application to Vinnova, challenge driven innovation project form A	*In this application to Vinnova the first phase of the project is briefly described with focus on aims and objectives*	Engström (2011), Ansökan till Vinnova, utmaningsdriven innovation projektform A
Application to Vinnova, challenge driven innovation project form B	*In this application to Vinnova the second phase of the project is briefly described with foucs on aims and objectives*	Engström (2012), Ansökan till Vinnova, utmaningsdriven innovation projektform B
Project description for project form A	*In this application to Vinnova the first phase of the project is described in detail. Both aims and objectives, timeplan and financial plan is*	Vinnova (2011), Projektbeskrivning för projektform A, utmaningsdriven innovation 2011

	presented.	
Project description for project form B	*In this application to Vinnova the second phase of the project is described in detail. Both aims and objectives, timeplan and financial plan is presented.*	Vinnova (2012), Projektbeskrivning för projektform B, utmaningsdriven innovation 2012
Power point presentation		
Green chemistry in the west part of Sweden	*A presentation on the Skogskemi project held by Lars Josefsson at Chalmers University*	Josefsson (2013), *Grön Kemi i Västsverige*, PowerPoint presentation, Chalmers
Online articles		
Future projects between reunited process industries	*An online article containing an interview with Lars Josefsson (Boardmember at Ineos) and Claes Engström (CEO at Processum). Where they first give an historical overview over bio refineries in Sweden and then they describe their goals about the project Skogskemi.*	Back (2012), Framtidsprojekt mellan återförenade processindustrier, SPCI/Svenskpapperstidning Nr 3
Forest chemistry phase 2 has been completed	*An online article containing an interview with Lena Heutz (Project Leader at Skogkemi, from Chalmers Industrteknik), Leif Jönsson (Professor at Chalmers) and Joel Joelsson (One of the project leaders in the Skogskemi project). In the article the outcome of the project is discussed.*	Back (2015), I en framtid kommer såväl byggnadsvirket som plastsäcken från skogsråvaran, SPCI/Svenskpapperstidning Nr 6
Stenungsund wants fossil-free, Kemivärlden Biotech med Kemisk Tidskrift	*An online article containing an interview with the Robert Onsander (project leader of Stenungsund) and Patricia Oddshammar (Global project manager at Perstorp). Where they describe their aims and objectives about the Skogskemi project and the vision for Stenungsund as a cluster.*	Jönsson (2012), Stenungsund vill ha fossilfritt, Kemivärlden Biotech med Kemisk Tidskrift Nr 7-8.

Plastic on trees, Forum Sveaskog	*An online article containing an interview with Thore Lindgren (Vice president of SEKAB E-Technology AB) and Lars Josefsson (Leader of the the Chemical cluster in Stenungsund). Here they dicuss both the Skogskemi project and also a similar project named Locally Produced Plastic.*	Wilhelmson, M. (2015). Plast på träd. *Forum Sveaskog*, (2), p.17.
Press Realeses		
Skogskemi, a collaborative project between the chemical and forest industry	*A press realease where Klas Simes (Manager Holmen Biorefinery Development Centre) and Claes Engström present the phase 1 in the Skogskemi project.*	More Reserach (2011), Skogskemi ett gemensamt projet mellan kemi och skogsindustrin, Örnskoldsvik http://www.more.se/nyheter/2011/skogskemi-ett-gemensamt-projekt-mellan-kemi-och-skogsindustrin/(Accessed 18 May 2017)
Forestry chemistry has laid the foundation for future initiatives	*Pressrealease about the Skogskemi project after phase 2 held by Lena Huetz (Project Leader at Skogkemi, from Chalmers Industrteknik) and Leif Jönsson (Scientist at Bio4Energy). They talk about what has been achieved in the Skogskemi project and the future possibilities for the project.*	SP, (2015) Skogskemi har lagt grunden för kommande satsningar "http://www.mynewsdesk.com/se/sp/pressreleases/skogskemi-har-lagt-grunden-foer-kommande-satsningar-1170524 (Accessed 18 May 2017)

Appendix C

List of actors and their Webpages		
Akzonobel	*Chemical Company*	https://www.akzonobel.com/se/
AGA Linde	*Chemical Company*	http://www.aga.se/sv/index.html
Bio4Energy	*Research Insitute*	http://www.bio4energy.se/
Chalmers	*University*	http://www.chalmers.se/en/Pages/default.aspx
Domsjö Fabriker	*Bio refinery*	http://www.domsjo.adityabirla.com/Sidor/Startsida.aspx
Holmen	*Bio refinery*	https://www.holmen.com/sv/
Ineos	*Chemical Company*	http://www.ineos.com/
More Research	*Research Institute*	http://www.more.se/
Perstorp	*Chemical Company*	http://www.perstorp.se/index.html
Processum	*Organisation*	http://www.processum.se/sv/
SCA	*Chemical Company*	http://www.sca.com/sv/
SEKAB	*Bio refinery*	http://www.sekab.com/sv/
Sveaskog	*Forest company*	http://www.sveaskog.se/
Umeå University	*University*	http://www.umu.se/

Appendix D

Table 4.2.1 Arena of Expectations

Arena: Selector and/or enactor	**University, Research Institutes**	**Main financier**	**Chemical companies**	**Forest Companies and Bio refineries**	**Project Leader**
Host/funder Bioenergy specific unit	Chalmers, Umeå Universitet, MoRe research, SP, Bio4Energy	Vinnova	Perstorp, AkzoNobel, Ineos Borealis, AGA linde	Sveaskog, SCA, Holmen. *Aditya Birla Domsjö, Sekab*	Processum
Industry role in this specific case	*Providing and spreading the research and knowledge needed to develop the project of Skogskemi. This includes handling for example media.*	*Swedish institute that promote innovation*	*Providers of knowledge regarding the production of chemical products*	*Providers of the raw material and knowledge regarding the forest industry (forest companies) and to provide technology and knowledge regarding the conversion of the raw material provided by the forest companies (bio-refineries)*	*Brings together companies, universities and society functions to collaborate in the development of the bio refinery industry*
Commercial expectations	*Have high commercial hopes in the technical development of the bioeconomy, especially regarding more high-quality products.*	*Through "challenge driven innovation" and cross-sectorial innovation. commercial pathways will be found.*	*Expects the demand on renewable products within the chemistry industry to increase in the future and hence sees high commercial possibilities in the green-chemical market*	*The high investment that is needed to start producing chemical-materials is seen as a big risk, hence the best potential for possible commercialisation is in the bio-fuel market*	*The most possible commercialisation is producing for the bio-fuel industry.*
Promise-requirement cycle	No promise requirement cycle has been identified	No promise-requirement cycles has been identified.	*Technical difficulties regarding for example biological waste will be solved by technical solutions in the future.* Moreover, *the price of fossil raw materials will increase in the future due to global warming. Because of this renewables will have easier to compete in terms of price.*	***The development of the bio-economy will secure sustainability for future generations***	*It will be possible to take out green premiuns on renewables to a higher extent than now.*

Appendix E

Table 4.2.2 Identified Visions

	Vision 1	Vision 2	Vision 3
Actors	*Chemical companies,*	*Sveaskog, SCA, Holmen*	*University, Research Institutes, Vinnova, Processum*
Aims and objectives	*To increase the sustainable production of green chemicals.*	*To maximize the commercialisation of the forest industry.*	*To increase the quality of production and solve technical challenges in the bioeconomy.*
Value Creation	*Value is created through the cascading use of biomaterials*	*Value is created by increasing the profit for the forest industry, and minimize possible bottlenecks in the production.*	*Value is created through further research on the bioeconomy and the optimise use of bio-resources.*
Drivers and Mediators of Innovation	*Cross-sectorial collaborations drives innovation*	*Cross-sectorial collaborations drives innovation*	*Cross-sectorial collaborations drives innovation*
Future Potential Market	*The future potential market is in green chemicals for the production of, for example plastic.*	*Both the biofuel market and the chemical market are seen as possible markets. But at the moment biofuel is considered more profitable*	*Both the biofuel market and the chemical market are seen as possible markets. But at the moment biofuel is considered more profitable*