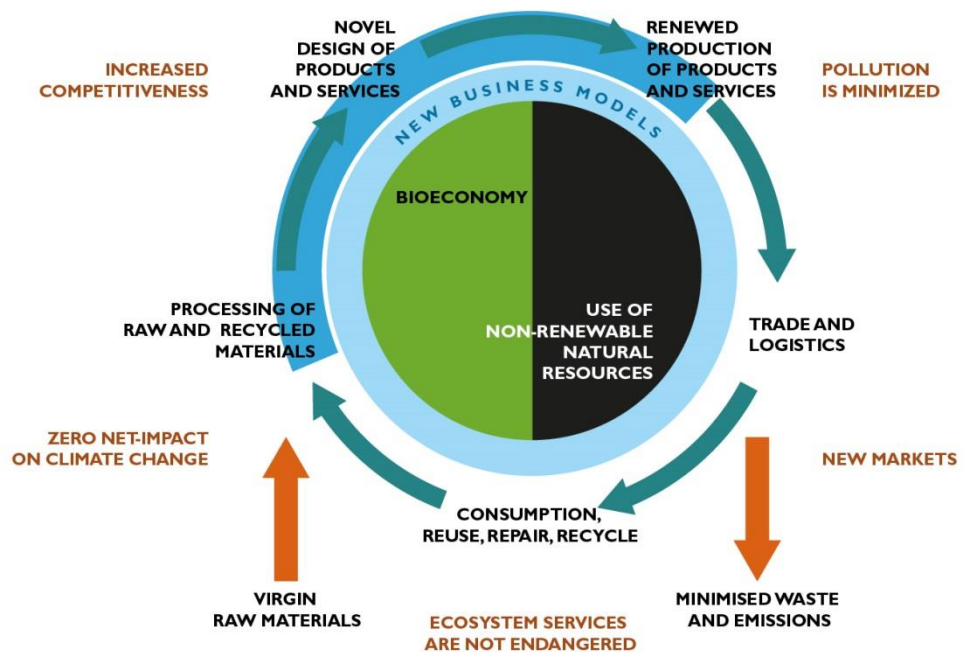


2015

Media Analysis of Sustainable Circular Bioeconomy in Finland



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1. Introduction

A transition from an old socio-technical system to a new one is a highly complex phenomenon, which requires innovations, pressure on existing socio-technical system, replacement of existing system with a new one through adjustments at the existing regime and creative destruction of the existing system. It is marked by conflicting interests and is often lacking a clear rational-minded trajectory. The process is more dynamic than planned. These differing viewpoints and visions meet in the media, wherein society's views on different phenomena are revealed in the ways that news stories discuss them. (Geels & Kemp 2007)

In the recent past, Circular Economy has become a new trend definition for the renewal of European economy while also purporting to solve the upcoming global sustainability crisis. In Finland it is often presented as means to end the current economic depression in a sustainable way. The renewal of industry can only be made truly sustainable by embracing the ideals of circularity. The main intention of the Recibi -project is to study whether the ongoing renewal of forest-based industry in Finland and Sweden supports transition towards Circular Bioeconomy

The Finnish and Swedish economies were and still are marked by their dependence on wood based industries. The Recibi -project intends to locate the areas of innovation in this cluster, namely in its applications of textiles, biorefineries and high construction. The purpose of this report is to provide background to the main project and its case studies by explaining how Circular Economy is framed as a societal phenomenon in Finland and by gathering news stories on relevant wood-based innovations. These goals were conducted by quantitative and qualitative media content analysis. The point was to present what has been developed and at which stage the industry is currently.

2. Research Material and Approaches

The research was conducted by media content analysis in two parts while the research questions are based on the particulars of circular economy rather than some branch of media theory. First, the societal view on circular economy was estimated to provide a solid background to the second media analysis provided information about the innovations related to the textile industry, biorefineries and high-rise wood construction. The selection of media sample was accordingly intended to provide a good coverage of different parts of society and socio-technical innovations. Thus the newspapers were narrowed down to Helsingin Sanomat (HS), the main newspaper of Finland, Kauppalehti (KL), a prominent economic newspaper, and thirdly to Maaseudun Tulevaisuus (MT), which is the largest newspaper of the countryside. The innovation analysis is more constrained with regards to coverage, as it focuses on business magazines Talouselämä (TE) and Tekniikka & Talous (T&T). What these magazines lack in coverage they make up for in specific knowledge about technological innovations and business models.

In methodological terms the societal newspapers and the business magazines include both a quantitative approach and a qualitative one. Media content analysis is often carried out only with quantitative methods, but this does not produce any actual information about the content of the news articles. The focus of the quantitative media analysis is simply to describe at which point circular economy and its innovations

emerge in the public. The analysis was carried out by using a variety of search terms, weeding out possible double hits and irrelevant results, listing the results in Excel, and finally by drafting graphs.

There are a few issues in this type of media content analysis. The selection of search words naturally draws the results into a certain direction. The final time series can be easily skewed in the wrong direction by omissions of relevant synonyms. Even, let's say, circular economy ("kiertotalous") has not always been a self-evident term, since one can find some mentions of a recycling economy ("kierrättävä talous"). Yet the said problem can be resolved by additional searches using other search terms. See the annex 1 for search terms. One can find more examples related to the problems of media content analysis in Deacon 2007.

Since the aim is to study how a circular economy is prescribed in the media in particular, the qualitative data was also gathered with the help of key word searches. The qualitative analysis introduces a questionnaire framework:

1. To what degree is circular economy is addressed? (1=At the foreground, 2=One or two paragraphs, 3=One or two sentences)
2. In which contexts is circular economy presented in?
3. What fields of business are mentioned?
4. How is circular economy defined and what perspective is emphasized?
5. Does the article describe environmental effects? (Positive, Negative, Not presented, Both)
6. How are the environmental effects presented?
7. Does the article describe economic effects? (Positive, Negative, Not presented, Both)
8. How are the economic effects presented?
9. Which stakeholders and key players are described?
10. What are the described enablers and barriers?

The news stories regarding the innovations related to Circular Economy were analysed by using the following framework. To what degree is circular economy is addressed? (1=At the foreground, 2=One or two paragraphs, 3=One or two sentences)

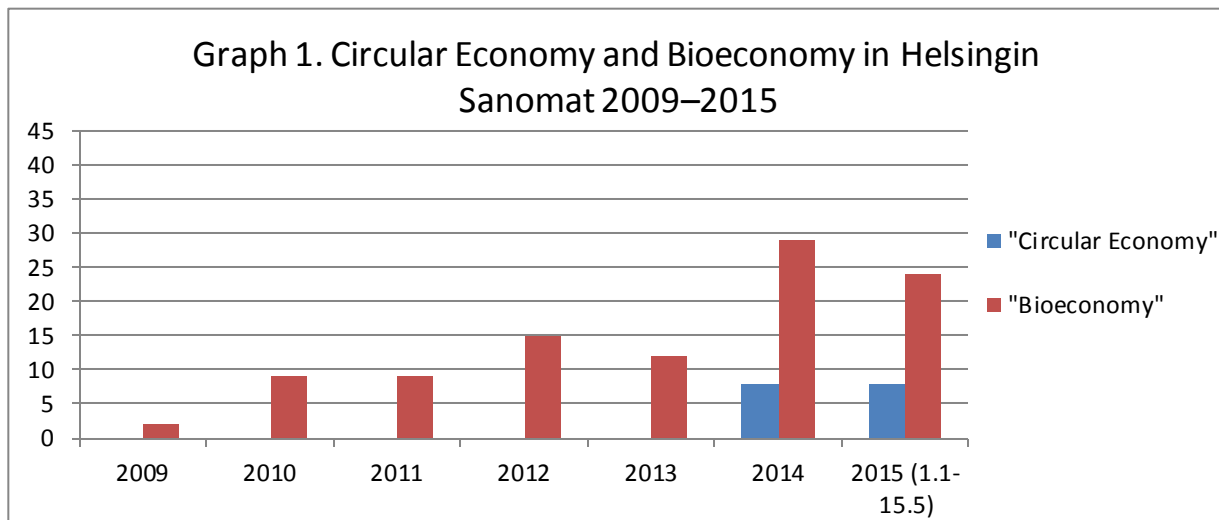
1. What new innovations are described?
2. What is being told about business model?
3. What fields of business are mentioned?
4. At which stage is the development of the innovation?
5. Does the article describe environmental effects? (Positive, Negative, Not presented, Both)
6. How are the environmental effects presented?
7. Does the article describe economic effects? (Positive, Negative, Not presented, Both)
8. How are the economic effects presented?
9. What aspect of circular economy is improved by the innovation? (Planning, raw materials, process, logistics, reusability, recyclability, sharing economy)
10. Is the role of public policy mentioned?

11. Which stakeholders and key players are described?
12. What are the described drivers and barriers?

3. Quantitative Analysis

Helsingin Sanomat is the largest newspaper in Finland.¹ It is also more generalist in comparison with Maaseudun Tulevaisuus and Kauppalehti, whose views are more related to their stake-holding groups in agriculture and business sector respectively. One could make the same conclusion regarding HS, but nonetheless it is still reasonable to assume that the newspaper would express the general societal view of circular economy best. The results of keyword searches can be seen in Graph 1, Graph 2 and Graph 3. One can make some generalizations on the basis of the three newspapers, though there are some interesting differences as well.

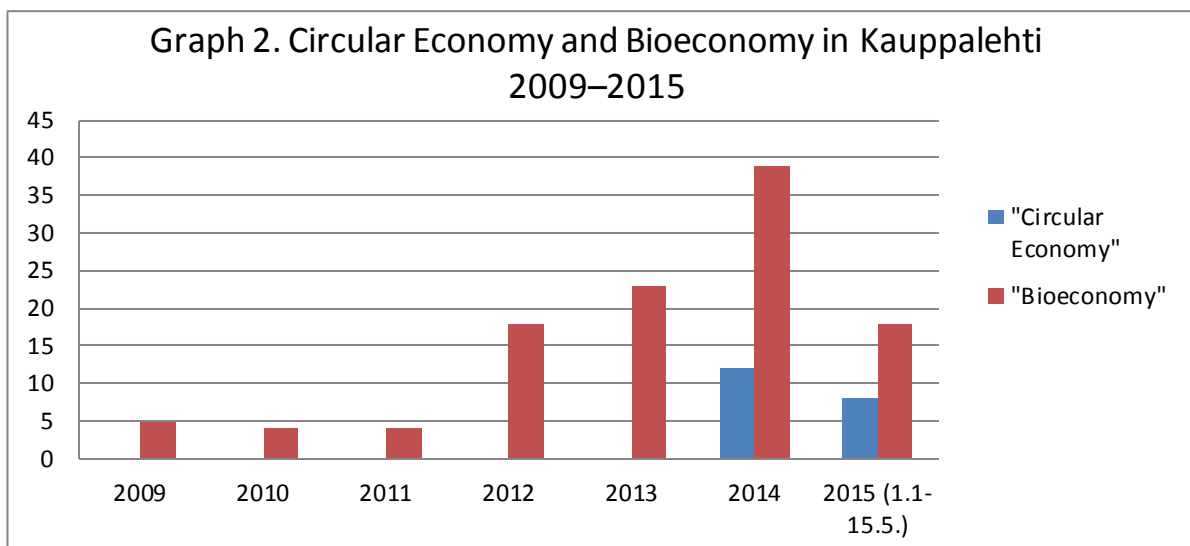
The most important general finding is that as a term *bioeconomy* is more prevalent than *circular economy* both by longevity and quantity. Circular Economy enters the discussion only in 2014 with only a single article mentioning it in 2013 in Maaseudun Tulevaisuus, whereas the first mention of Bioeconomy can be found as early as in 2001 in HS. Naturally some news stories bring out both terms – sometimes even treating them as synonyms – so the analysis is not completely exact. Nevertheless these handful articles do not change the trend in any meaningful way. It is abundantly clear that Circular Economy is overshadowed by the older concept though the rates of 2015 implicate that the trend is gaining momentum. On the other hand so is Bioeconomy.



Generally speaking Bioeconomy entered the media circa 2005 in MT and HS and generated a few mentions until the turn of the decade. KL had a single news story in 2006 before resuming in 2009 with five stories. This is the point where an upward trend began, though HS picked the trend in 2010. Even with preliminary observation one can witness two upward surges in all newspapers around 2012 and 2014.

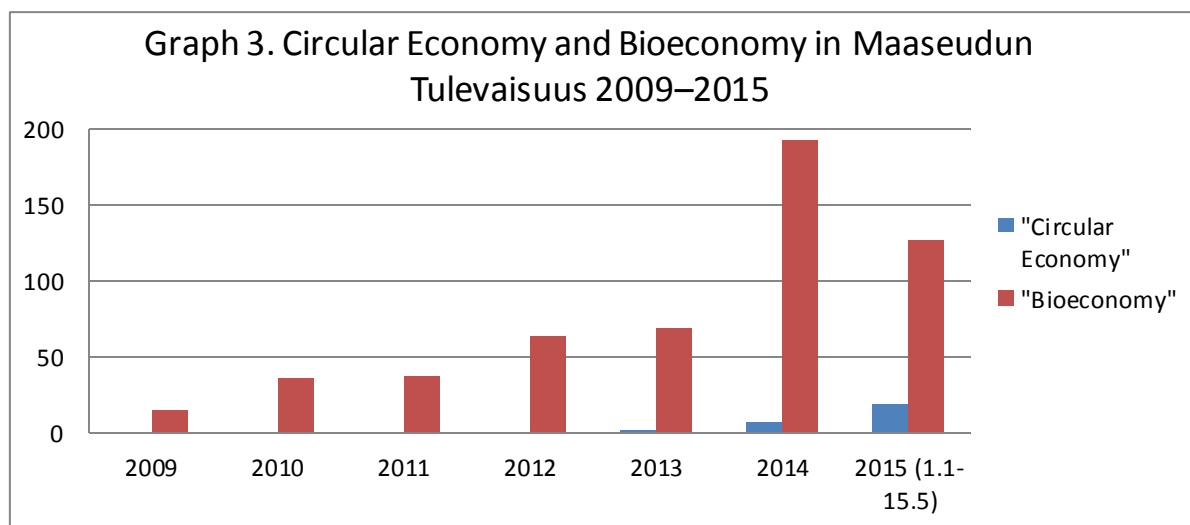
Furthermore both terms are gaining more coverage from the same year onwards which clearly indicates a growing relevance. On that point one ought to mention that the amount of 2015 doesn't even include the first half of the year which suggests that Circular Economy and Bioeconomy are becoming even more prevalent than in 2014.

¹ Read the Graph 8 in the Appendix for further information.



Finally there are some interesting cross-newspaper comparisons. MT certainly stands out. Relatively speaking the only clear difference to the other newspapers is the stronger surge in 2014. Yet the absolute annual amounts are staggeringly high. In 2009–2015 neither HS or KL nor both of them combined produced as many stories on Bioeconomy. By 2015 Circular Economy had reached a similar situation. One might speculate that the reason for this interest in MT relates to its background in agricultural and forestry economy.

Other differences are not so stark. KL lacked interest in Bioeconomy before 2012 whereas HS had a more static trend before 2014. With regards to Circular Economy, KL used the term more so than HS in 2014.²



4. Societal Analysis

4.1 Helsingin Sanomat

4.1.1 Centrality of Circular Economy

The main newspaper of Finland had 16 articles mentioning or treating Circular Economy in some manner. The gathered data was first classified according to the rate of “centrality”. Number three is essentially one

² KL had full spread dedicated to Circular Economy which included three stories in 2015. This should be taken account due to proximity of KL’s and HS’ results.

Table 1. Centrality of Circular Economy in HS	
9.5.2015	3
3.5.2015	3
29.4.2015	3
18.4.2015	3
28.3.2015	3
26.3.2015	3
13.2.2015	3
20.1.2015	2
18.12.2014	1
17.12.2014	2
16.12.2014	2
29.11.2014	1
1.9.2014	1
27.8.2014	1
9.4.2014	1
24.3.2014	1

or two mentions, number two one or two sentences and number one meaning that Circular Economy is clearly the centre of the news story. Table 1 illustrates how the articles tend to treat the concept as focal during the first year of its appearance, but the term increasingly loses its centrality.

The context of the articles points to two explanations. First the parliamentary election 2015 had a clear effect. For example, two of the stories related to the mention of Circular Economy in would-be Prime Minister Juha Sipilä's questionnaire for political parties that formed the basis of government negotiations. A few other articles had more or less direct relation to the election. When for example Jyri Häkämies, a former Coalition party minister and the Director General of Confederation of Finnish Industries, passingly mentions Circular Economy as a part of renewal of Finnish Economy, one might very well suppose that the text relates to an upcoming election. The other reason for the decreasing centrality is that term has already been introduced to the degree that it can be used in a rhetoric manner. Less than half of HS's articles detailed fields of economy related to Circular Economy.

4.1.2 Contexts of Circular Economy

The contexts themselves vary a bit, but there were a few that could be classified. Naturally these categories are not mutually exclusive or all-encompassing:

EU -legislation: HS, which has a Brussels correspondent, was particularly interested in the Circular Economy Package that the Commission discarded as a part of their regulation cutting and reintroduced later on. Indeed six of the 16 articles focus on this long-running story, which was often defined as regarding environmental policy. The Member of European Parliament Sirpa Pietikäinen comes up as a writer and an interviewee. Additionally the second article, which was actually an opinion piece related to waste legislation, clearly refers to waste directive besides national legislation.

The Election of 2015 is clearly visible in the context of the articles. Besides the government negotiations, for example, one columnist complains about the economy defining the entire election whereas the chairperson of the Green league, Ville Niinistö; mentions Circular Economy in an election interview.

Source of Growth: The interview with Ville Niinistö defines Circular Economy as a part of "Forerunner Economy". Generally speaking the parliamentary election seems to introduce Circular Economy as an answer of sorts to economic woes of the country. Articles related to Sitra often refer both to the sustainability crisis and the source of growth

Sustainability crisis and the competition of resources: Besides Sitra's articles an article related to EU legislation defines Circular Economy in this context.

Various: Most of the articles fall into the previous categories, but for example a certain letter to the editor detailed an innovation targeted at the environmental problems of the Baltic Sea. The first two articles in HS discuss the problems of waste management.

4.1.3 Fields of Economy

Table 2. Fields of Economy in Helsingin Sanomat			
A: Agriculture (2)	B: Energy Industry (2)	C: Waste Management (4)	D: Others
Food production, Fertilizing Industry	Clean-tech, Clean Energy, Waste incineration and power plants	Forerunner companies in reuse of waste, “industrial sorting and refining”	Sharing economy and Lifespan increases, Construction Industry

4.1.4 Definition of Circular Economy

An important facet regarding the discussion around Circular Economy is that its definition is not as clear cut as one might assume. Since the concept is a novel one it might reach different meanings or at least different emphases. Furthermore if a certain emphasis gains prevalence at the expense of other facets, it is possible that it draws future activity to certain paths. Hence the need for analysing what is actually said of Circular Economy. Aspects that were also considered concerned whether or not the treatment was concrete – i.e. whether Circular Economy was treated in a cursory fashion without any mentions of practical applications – and secondly whether the idea of a closed circle emerged in the news story. The latter question was designed to estimate whether or not Circular Economy was thought to be a completely new model of economic activity.

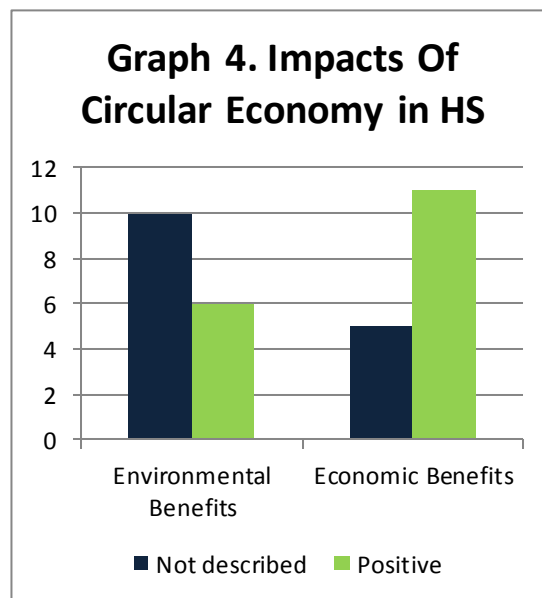
Five articles did not define the concept. For example Sipilä’s questions regarding the Government negotiations posited Circular Economy alongside Bioeconomy, Sustainable Development and the manufacturing of food without additional explanations. Not surprisingly many of those were the ones that only mentioned the term once or twice. Three texts defined it as something related to clean-tech and two related it to resource efficiency.

Generally speaking there was a tendency to define Circular Economy “correctly” as an economic model based on a value circle during 2014. Out of these four, two also described new business models based on e.g. sharing economy and reuse of products. After these articles the concept was usually defined as the reuse of material or recycling of waste. One might speculate that this change is a result of the fact that those first articles were letters to the editor written by experts of some kind. Yet not even Sitra defined Circular Economy in detail in every article. One opinion page text written by Mari Pantsar and Tiina Kähö simply discussed clean-tech and the transformation of the energy industry with Circular Economy being always indirectly present, but never defined clearly.

Since HS is a general newspaper it might be unsurprising that Circular Economy was usually presented with concrete examples of possible applications only twice. Even the first text written by Mari Pantsar and Ville Niinistö, though detailing clearly the problems of waste management and policy, did not deal with practical solutions of the issue. The second text that was written by a MP in the Coalition Party and waste management stake-holders was concrete in the sense that it dealt with the negative effect legislation has with fuel created out of waste in comparison with biofuel. And this was a borderline example.

4.1.5 Environmental and Economic Impacts

The question of environmental and economic effects is very important because it also reveals what the article represents as the rationale for Circular Economy. Yet these questions were also conceptually the most difficult ones to handle. Circular Economy is by definition something related to the minimization of waste and to environmental legislation. In this analysis the aim was to estimate what sort of a causal effect was to be gained, since a mere connotation would not adequately reveal what the article presented as the benefit of adapting Circular Economy. As a result, waste reduction is counted as a benefit if the article clearly treats it as a problem that Circular Economy is going to solve and left unaccounted when not. Economic benefits tend to be related to economic growth, efficiency and job creation, whereas environmental effects can be defined as setting society on a sustainable track or reducing the use of fossil fuels and emissions of greenhouse gases.



Quantitatively speaking HS tends to explain Circular Economy as economically beneficial rather than environmentally so. Furthermore two of the articles presenting both sides stressed economic benefits in greater deal. In one case the comparison was with roundabout effect of sustainable development and the creation of 600 000 workplaces directly and million indirectly in Europe, with Finland benefiting from increased jobs, innovations, business activity and so forth. The second article did not stress economic factors to that degree, but the general impression was similar.

The most practical of described environmental benefits was an innovation related to Circular Economy that would reduce phosphor emissions in the Baltic Sea. The reduction of greenhouse gases was mentioned alongside achieving sustainable development, which was a rationale for moving into Circular Economy in two other news stories as well. Other counted benefits were also the stopping of climate change with clean-tech and the mention of resource efficiency solving “environmental problems”. In these cases the context made it sufficiently clear that Circular Economy was being discussed.

Economic benefits were prescribed as increased opportunities for domestic business, also in the form of exports worth of billions of euros. This type of rationale was alluded to five times with Ville Niinistö also making the case that Circular Economy is a way to renew Finnish economy. In comparison Sitra’s estimate

of 1,5—2,5 or 2 billion euros worth of benefits was mentioned twice, whereas job creation was brought up thrice, for example by taking up estimates on how many jobs EU's Circular Economy Package would create – 600 000 workplaces to be exact. Another story made the additional revelation that the Package would produce 3% of GDP growth. A further depicted effect was the ability to survive with fewer resources that came up five times especially in the first news stories in 2014.

4.1.6 Stakeholders and Key Players

Described stakeholders naturally depend on the nature of the article. The news stories detailing European Union's legislation related to Circular Economy refer often to the Commission – sometimes clearly to Jean-Claude Juncker, Janez Potocnik and Frans Timmermans – and Sirpa Pietikäinen. BusinessEurope, European Parliament, environmental secretaries of EU countries, environmental NGOs and European citizens themselves are described in different articles.

Sitra, the Finnish Innovation Fund, and its Director of “Resource-wise and carbon-neutral society” program Mari Pantsar and Ville Niinistö, the Minister of Environment at the time, were and for example their first article referred to the public and private sectors in a general fashion and more specifically to Motiva and its service for sustainable procurements. HS's articles tend to present stakeholders and “innovative” companies in a general level. Pantsar, for example, mentioned Sitra's cooperation with Helsinki, Espoo and Vantaa in the Smart&Clean project. The letter to the editor detailing the phosphor problem of the Baltic Sea on the other hand listed the Finnish Environment Institute, Professor Markku Ollikainen from the University of Helsinki with farmers and the ministries of environmental affairs and agricultural and forestry affairs. Both Tekes and Akava – the latter being part of a coalition promoting Circular Economy – come up once.

A clear distinction is that HS prefers to underline the public sector in comparison with the private sector. The public actors usually include high politics whereas municipalities and cities are mentioned only once. NGOs or Third Sector organizations come up rarely: twice in terms of research and once in terms of trade unions.

4.1.7 Drivers and Barriers

HS has a tendency to depict drivers instead of barriers. Both differ from article to article though there are some common threads such as legislation. The news stories treating EU's environmental legislation tend to see it as a driving factor, which might be a foregone conclusion since the Circular Economy Package *is* a piece of legislation. Certainly one can infer that this sort of legislation is not always held to be beneficial. BusinessEurope for one is presented as lobbying against environmental legislation. And conversely this sort of interest group is implicated to be a barrier. One should also add that some of these articles link the topic to the Commission's regulation cutting which is presented in a negative fashion.

Some more general texts describe ambitious environmental and climate legislation as growth-inducing as long as they do not hinder “forerunner companies”. These sort of innovative entrepreneurs were also briefly mentioned by Ville Niinistö during election campaigning. On that point, an Akava spokesperson stressed

the importance of public procurements in creating forerunner markets alongside education. Jyri Häkämies also highlighted these two drivers though from another perspective. One of Sitra affiliated texts also mentioned a development platform for domestic companies.

The first article by Pantsar and Niinistö alluded to most of these factors. The public sector was not treated only as a source of procurement though, since the text mentioned Environmental Ministry's economic guidance programs with the government being able to force municipalities to adopt environmental technology. On that point they felt that the fact that public procurements necessitate the use of previously approved technologies was a hindrance as far as innovative solutions were concerned. A further barrier was increased waste burning. Pantsar's and Kähö's text referred to tax incentives as drivers and political discussion constrained by austerity talk as a barrier since it directs attention away from climate change and the energy-based solutions that would tackle it.

First of the concrete texts mentioned waste directive and waste legislation of 2011 as barriers to developing a wide waste infrastructure. This might not be surprising considering the interest group status of the authors. The letter to the editor regarding phosphor emissions depicted agricultural environment support system, a possible pilot project of wide scale and public funding as drivers of Circular Economy.

Various other drivers included the increasing lack of resources, citizenry's ability to influence legislation and a "coalition" that promotes Circular Economy. A coalition of organizations was mentioned in Akava's text alluding to the benefits of cooperation.

4.2 Kauppalehti

4.2.1 Centrality of Circular Economy

Interestingly enough the salience of the concept begins in KL's 20 news stories in a similar fashion as in HS. Centrality can be witnessed initially, but it decreases over time. A clear difference is the fact that while HS was clearly introducing the term in roundabout fashion in 2015, KL had news stories concentrating on Circular Economy throughout the period. One could suppose that the smoother decrease is partly explained by the fact KL is a business magazine that tends to focus its articles more so than the more general societal or political HS. Actually even in the KL material two of the "3" –articles of 2015 relate to the upcoming elections.

4.2.2 Contexts of Circular Economy

As in HS, **European Union and its Circular Economy Package** were the most common terms of reference in KL news stories.³ Eight texts out of 20 at least mentioned them and both the first and the last article refer to the package. European Union released a bulletin about Circular Economy in July 2014 which was the topic of the two first articles by Editor Ilkka Lampi who asserted that Circular Economy has great advantages as long as it does not become "an environmental initiative". The idea being that it should be

³ Like HS, KL has a Brussels correspondent, which explains in some degree the attention on the Union.

Table 3. Centrality of Circular Economy in KL	
5.5.2015	1
23.4.2015	1
23.4.2015	1
23.4.2015	3
20.4.2015	2
14.4.2015	3
9.3.2015	2
9.2.2015	3
16.12.2014	1
1.12.2014	1
17.11.2014	2
13.11.2014	2
23.10.2014	1
23.10.2014	1
17.10.2014	3
14.10.2014	1
1.8.2014	1
14.7.2014	1
4.7.2014	1
13.6.2014	1

accomplished with market-oriented solutions and not with environmental regulation. Lampi and later authors refer to EU's recycling goals that should be reached by 2030. The lobbying for and against the package was described in great detail just before its removal. Aside from opinions of BusinessEurope and the environmental organizations KL also pointed to the Grand Committee's opposition of the new waste directive that would impede the manufacturing of biofuels for transports. The revision of the package was likewise detailed. An interview with the new commissioner, Jyrki Katainen, in charge of the package's preparation, emphasized that the previous iteration had been too focused on waste and the revised package had a wider scope. The final text in the material was a letter to the editor that effectively underlined the views of big business on the matter.

Quite a few of the EU –articles dealt with **waste policy and management**, which were another focal point for KL. Waste legislation on the union level affects the domestic stakeholders especially with regards to the conflict between waste burning and recycling. One article asserted that private entrepreneurs wish to recycle waste with profits in mind whereas municipal ones prefer to incinerate it. The text implied that Finland's recycling levels were not adequate enough for the EU. The Grand Committee's stance on biofuels was replicated in a letter to the editor written by two SRF –fuel advocates who maintained that the fuel would contribute to Circular Economy if it would be counted as an energy source. That discussion ties into the

legal issue on the mutually exclusive definitions of waste and resource. One writer suggested that Finnish target levels on recycling were unfeasible due to high levels of incineration and the problem might be solved by applying waste taxation for incineration. A further change in waste policy was the introduction of producer responsibility concerning the recycling of plastics for large companies, which also ties into the political attempt to move from incineration to recycling.

KL itself seemed to be either positive or neutral in its tone regarding waste policy. Stakeholders writing letters to the editor seemed to represent their interests as aligned to Circular Economy.

Minor points of focus were the **parliamentary elections** and **Sitra**. News stories regarding the elections did not contain much information about Circular Economy other than Ville Niinistö and Seppo Kääriäinen making positive if offhanded allusions of it. Niinistö suggested that government funding could be directed to it. Sitra's opinions were described jointly with a thorough rundown of the report co-authored with McKinsey and an interview the fund's researcher Susanna Perko.

Unlike HS there were rather detailed news stories regarding **companies engaging in Circular Economy**, those being Ekokem and Suomen Uusiomuovi Oy, Envi Grow Park and Repack. Ekokem's Circular Economy Village was associated with the upcoming recycling targets, but generally speaking the articles merely describe the content of the business models and their possibilities without dealing with Circular Economy per se.

Various other mentioned contexts were the problems of Chemistry Industry and possibilities for its future growth, Green Growth -program of Tekes, better utilization of office spaces and the generally false mindset concerning Circular Economy.

4.2.3 Fields of Economy

The wide variety of fields of business is reflective of the fact that Kauppalehti is a business newspaper. Only one article lacked any substantial mention of a field of economy, though the mention about domestic renewable raw materials is a borderline case. Waste management and novel business models of Circular Economy are prominent fields. Clean-Tech and the Energy are treated as separate cases due to the former concept's offhanded use. However, if the two categories were combined due to their linkage, the number of articles noting that category would be the largest one.

A: Novelties of Circular Economy (Sharing, Digitalization etc.) (6)	B: Waste management (8)	C: Agriculture (4)	D: Forest Industry (4)
Digitalization (automation, robotics, internet of things, information transfer and gathering between companies) Sharing Economy, Internet Shops , Maintenance and repair in mobile phone industry and home appliances, Leasing of jeans, "Service business of Circular Economy"	Waste management and incineration/ power plants, recycling of plastics, biogas, recycling phosphor and nitrogen into agriculture	Biofuels, Manure, Foodstuff, phosphor and nitrogen, fertilizing, Small energy producers in Germany, who produce electricity out of manure and field mass	Paper, Chemical Forest Industry
E: Energy Industry (5)	F: Clean-Tech (4)	G: Chemical/ Pharmaceutical Industry (5)	H: Mining (2)
Biofuels, Biogas (also in liquid form), Waste Incineration, Wind Farm, German manure electricity	Indirecly exports, Domestic renewable raw materials	Pharmaceutical appliances, Biomaterials (biocarbon, fodder, chemicals), Chemical Forest Industry,	x
I: Construction (2)			
x			

4.2.4 Definition of Circular Economy

There were curious differences to HS in KL's way of defining Circular Economy. First of all, after the summer of 2014 when the concept was introduced in the context of EU's legislative efforts, 10 articles did not define the term in a meaningful way. In the election texts Kääriäinen defined it as something related to clean-tech whereas Niinistö connected it to Bioeconomy. A news story regarding the problems of Chemical Industry also referred to Circular Economy in connection with industrial symbioses and Bioeconomy. A few other news stories tended to present it in the context of Bioeconomy. Some of the articles, which account a half of KL's material, did not even go to such lengths.

This offhanded tendency on the other hand did not mean that the articles lacked tangible approach to possible applications. Possibly due to KL's business orientation 12 out 20 articles presented a concrete

application or business model related to Circular Economy. Some did so in great deal such as the articles dealing with Repack and Ekokem while some did so only briefly as in the cases where it was mentioned that manure could be used to produce electricity or how EU's waste directive affects the production of biofuels. Five news stories were did not define Circular Economy while being still concrete in their approach. One might suppose, for example, that the authors advocating SRF -fuel in terms of waste legislation used the concept rhetorically while the Repack -article benefited from Kari Herlevi, then an expert of Tekes, who labelled the business model as belonging to Circular Economy.

HS and KL are rather similar in their way of discussing the idea of a value circle. First three articles define Circular Economy rather correctly with the idea of moving away from a linear economic model. Two more news stories follow in 2014 and two in 2015. Furthermore the two latter news stories do not stress that the value circle ought to be a closed one. The other articles might not be always explicit about the matter, but they at least implicate the idea in some degree. Nonetheless it should be stressed that unlike HS, the KL articles did maintain the idea of a value circle right to the end of the time span analysed.

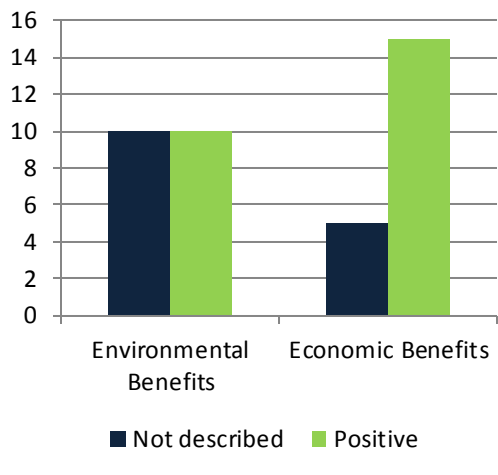
The ties between sharing economy and new business models related to leasing, product lifespans and so on, were referred to eight times as can be seen in the fields of economy section. On the other hand there is of course the conceptual difference of between a part of Circular Economy and being related to it in another way. For example a news story specified innovations of digitalization that support Circular Economy while essentially maintaining that the concept means resource efficiency. The other articles tended to include the novel business models in Circular Economy more integrally however. The ones that did not while specifying the concept comprehensively, were the first two news stories.

Resource efficiency was another way of defining Circular Economy. Three articles defined it those terms only, while a few underlined it alongside with other aspects. Recycling of waste and material was a rather common definition, but unlike HS it was used to frame Circular Economy without other aspects only once in the material when dealing with Ekokem's waste management village and even then the article was laid out in conjunction to two news stories with more comprehensive definitions. Nonetheless the idea of material circle tended to be at the centre of the concept even when describing e.g. novelties of sharing economy.

4.2.5 Environmental and Economic Effects

A few conclusions can be drawn from the Graph 5. First both economic and environmental benefits are more prominently described than in HS. Likewise the gap between the amount of environmental and economic benefits is closer than in HS. However environmental benefits tend to be described in a more cursory way when accompanied with economic benefits. For example in the interview with Jyrki Katainen the text mentioned that the recycling of nutrients would purify water systems. But even this one sentence was in the context of technology exports and alongside references to Sitra's estimates of 1,5—2,5 billion euros worth of benefits and the fact that Circular Economy would decrease Europe's dependence on imports, availability of resources and the effects of price volatility.

Graph 5. Impacts of Circular Economy in KL



Environmental benefits were thrice defined as just that – “environmental benefits” or “improvements”. One article referring to the lobbying around the Circular Economy Package described environmental NGOs as linking the legislation to environmental protection alongside creation of jobs and human welfare. Waste minimization, ecological products and the prevention of climate change were other causal benefits. The fact that these goals were described only briefly and none of the articles demonstrated environmental benefits without economic profitability suggest that KL propagates Circular Economy in mostly economic grounds.

Only news story had environmental benefits in a clearly more prominent position than economic ones. The article in question was the one where stakeholders in SRF – fuel advocated changing of waste legislation on the grounds that increasing the use of SRF would reduce the use of fossil fuels and greenhouse gases. The economic benefit would have been possible exporting of technology. On the other hand, the writers were clearly propagating their companies’ interests.

Economic benefits were usually macroeconomic i.e. potential for growth, efficiency and employment. These benefits were often accompanied by monetary estimates. Sitra’s calculations of 1,5 to 2,5 billion euros was directly alluded to four times. Likewise the articles of Circular Economy Package mentioned Commission estimating a 17—24 percent productivity increase by 2030, creation of 180 000 jobs, or the fact that its total benefit would be five times over the TTIP –agreement with the United States. Sitra’s expert, Susanna Perko, also claimed that the adoption of Circular Economy would create 100 000 jobs in just five years and 3-4% GDP growth in Europe. Economic growth was the most standard rationale for Circular Economy with seven mentions while job creation was noted five times.. Easier coping with the future resource deficit was noted a few times and so were cost saving by companies. Of course cost saving is intrinsically connected with productivity and growth.⁴

Other various benefits were tax increases in waste management, admittedly a borderline case, and local job creation mentioned in the news stories related to Ekokem and Envi Grow Park while noting possible overseas activity in the form of expansion of business and technology-based exporting. Exports were mentioned four times in total.

4.2.6 Stakeholders and Key Players

Acknowledged key players can be essentially classified into three groups: Public Sector, Private Sector and Research. Due to the primacy of European Union it has been separated from Finnish actors for simplicity’s sake. The most important difference between HS and KL is the latter’s interest in specifying forerunner

⁴ There is of course a very cynical side to the discussion about the efficiency and productivity. On the short term it practically manifests itself in companies letting go of excess work force in some part of the value chain. Unsurprisingly that period of adjustment is not noted in news stories.

companies of Circular Economy. Aside from those articles which solely demonstrated a company's, such as Ekokem's or Repack's, business model the forerunners were apparently listed by Sitra. The political actors specified in conjunction with private business were usually the ministries of the Environment and of Employment and the Economy. Two articles referring to waste legislation obviously mentioned the EU in some way.

EU: The most prominent EU actor was clearly the Commission. Two out of five news stories mentioned individual commissioners: Jean-Claude Juncker and Frans Timmermans were noted in the context of withdrawing the Circular Economy Package while Jyrki Katainen (Competitiveness, Innovations and Employment) introduced the commissioners in charge of the revised package as Phil Hogan (Agriculture), Karmenu Vella (Environment) and Elzbieta Bienkowska (Interior markets and industry). Other actors were the European Environment Agency EEA or simply the EU. Referring to the Union itself often took place when discussing its recycling targets.

Finnish Public Sector: Political actors were often simply designated as Finland or its government. Political parties i.e. The Green League and The Centre Party were only specified when their leading politicians were speaking. The ministries of the Environment and of Employment and the Economy were otherwise mentioned. Vantaa Energy (project manager Kalle Patomeri) was depicted in a negative fashion. Further actors were the Association of Finnish Local and Regional Authorities (Henrik Rainio, head of Brussels Office) and the Grand Committee in terms of Finnish lobbying around the Circular Economy Package. Envi Grow Park –article revealed considerable ties to the public sector including Forssa Region Development Centre (and its manager Juha Pirkkamaa) alongside its Centre for Exporting Knowledge of Circular and the municipality of Honkajoki

Research and Consultation: Sitra was mentioned very often. McKinsey was also referred to more than once alongside VTT and Tekes. Other actors were Keksintösäätiö (in Repack Article), Syke, Bioruukki (a co-project of Aalto University and VTT) and Finland Futures Research Centre (Prof. Markku Vilenius). Mari Pantsar-Kallio, Jyri Arponen from Sitra, Antti Törmänen from McKinsey and Kari Herlevi from Tekes Green Growth were referred once by name. The only international actors besides McKinsey were Ellen McArthur Foundation and World Economic Forum.

Private Sector: In terms of waste management Lakeuden Ympäristöhuolto Oy (CEO Timo Hirsimäki, JLY (CEO Markku Salo) Lassila & Tikanoja (Community Relations Manager Jorma Mikkonen) and Ekokem (CEO Timo Piekkari, Strategy Manager Mari Puoskari). In the context of Ekokem's Circular Economy Village also Biotehdas (Kaisa Suvilampi, CEO) Suomen Uusiomuovi Oy (Vesa Soini CEO) were mentioned. Envor Oy was described in the context of Envi Grow Park. Furthermore Martela Oyj (Heikki Martela, CEO), Confederation of Finnish Industries (Tellervo Kylä-Harakka-Ruonala, Director), BHM Technology Oy (Technology Manager Hannu Lepomäki) and Hollming Oy (Panu Helamaa, Corporation Lawyer) and Lassila&Tikanoja (Mikkonen again) wrote letters to the editor. Mikkonen was also a speaker on Circular Economy in Suomi Areena. BusinessEurope was also mentioned in the context of the Circular Economy Package.

Forerunners: Ponsse, AGCO Valtra and John Deere do maintenance work for industrial machines whereas globally “Caterpillar, Rolls-Royce, Renault and Hitachi” also remanufacture in addition to maintenance. Domtar (lignin) and Sappi (wood-based fibers) and St1 (plans of making biofuel out of sawdust). Furthermore jeans of Bert van Son. Apparently leasing and sharing economy is practiced by Philips, Mud Jeans, Puma, Google and its Blockphone, AirBnb and Uber. Vodafone also increases the lifespan of its products by maintenance. Finally the Repack article naturally referred to Peruste (Jonne Helgren CEO) with Varustelevä, Globehope, Post Nord and Isku as its customers.

4.2.7 Drivers and Barriers

Just as in HS, legislation and regulation play a key role in Circular Economy. However KL represented it as a far more contentious issue. The first articles written by the newspaper’s editorial reporter warned of “environmental bureaucracy”, “heavy, overlapping and nationally inapplicable” legislation. The same reporter cited Sitra when claiming that authorisation procedures were barriers and that one-stop-shop was the solution. Mari Pantsar herself remarked in a later news story that legislation was a barrier in the construction industry, but it was partly a driver alongside political direction in other fields of business. The director of Confederation of Finnish Industries argued herself that EU legislation concerning Circular Economy would result in a “chaotic jungle of statutes” due to the complexity of recycling material.

However not all news stories shared the same view. Jyrki Katainen naturally felt that his own tax model that targeted emissions was a beneficial factor though the commissioner did mention problems in agriculture. He thought that EU -legislation would “level the playing field”. Although the matter was not always addressed explicitly it was quite clear in some that the EU’s recycling targets were a driving factor. On that topic Jorma Mikkonen, Community Relations Manager of Lassila&Tikanoja, depicted waste taxation as a driver if it would be applied to waste incineration. Pantsar characterized incineration as a barrier as well.

Waste legislation was clearly a contentious issue. The grand committee of the Finnish Parliament and Chemical industry were particularly interested in EU’s waste directive that would have impeded the production of biofuels. Interestingly enough the two advocates of the SRF -fuel article did not complain about the legislation itself, since the waste/material status of SRF was dependent on a government statute and not on any law. Hence the real problem lied in the lack of political will.

Although political action was mostly thought to be a barrier in these cases there were positive examples. For one, an editorial of the newspaper advocated a similar Bioeconomy Strategy that had been formulated in Netherlands. Furthermore Jorma Mikkonen mentioned material efficiency program that some ministries had co-authored while specifying that applying VAT for maintenance was a clear barrier. Mikkonen had also formed some sort of a “coalition” to advance Circular Economy.

Cooperation and business ecosystems were decidedly drivers though they were often asserted only implicitly. Ekokem and Envi Grow Park for example are clearly attempting to create a business model on the basis of industrial symbioses. Bioproduct investments in Äänekoski and Kuopio were also mentioned by

Seppo Kääriäinen although he was relating them to Bioeconomy. Susanna Perko likewise brought attention to the cooperation of companies.

Research and development were noted as drivers a few times. An editorial of the paper advocated cooperation of Sitra, VTT, Chemical Industry and Chemical Wood Industry also on an international level. The Green Growth Program of Tekes was mentioned in a positive fashion in one article alongside EU's Horizon funding. At the same the article stressed that someone had to take charge of further development. Repack was also funded by Tekes and Keksintösäätiö, but its business was impaired by small volumes that are allowed within a small economy like Finland and the country's underdeveloped internet trading.

Further drivers were existing experience of material efficiency that several industries already possess new fields of digitalization, public subsidies, positive references and better planning of business offices. Additional barriers were "Gray Circular Economy", difficulty of moving into a completely different business model and the incorrect sentiment that waste is trash instead of a resource. Jorma Mikkonen felt that this

was a key problem for Finns in comparison with Western European outlook.

4.3 Maaseudun Tulevaisuus

4.3.1 Centrality of Circular Economy

MT was the first of the newspapers to introduce the term in an article by Sitra's expert in 2013. The interval between this news story and the next lasted for over a year. Therefore it is conceivable that the popularity of the concept is linked to two factors: the article of Mari Pantsar-Kallio and Ville Niinistö on one hand and the Circular Economy Package of the European Union on the other. In fact, 6 out of 8 news stories in 2014 featured the Circular Economy Package, Sitra or Ville Niinistö.

Whereas HS and KL had a tendency to present Circular Economy as central in their news stories initially and then in decreasing quantities, MT did not show signs of such a trend. The first articles include some type "3" –news stories and they continue to be sporadic throughout the timespan. A partial explanation can be found in the fact that MT often treated Circular Economy as a part of bioeconomy. For example an article named "Bioeconomy elevates Finland to growth" had Ville Niinistö noting that Circular Economy also requires virgin fibre while the article itself framed its subject matter in terms of bioeconomy. Six out of eight "3" -articles equated the concepts in some degree.

It is also important to point out that the large amount of "hits" in MT is clearly a result of increasing mention of the term in 2015. February alone included eight articles that dealt with Circular Economy. The elections of 2015 explain only a

Table 5. Centrality of Circular Economy in MT

15.5.2015	3
13.5.2015	1
13.5.2015	3
8.5.2015	1
29.4.2015	3
24.4.2015	3
10.4.2015	1
11.3.2015	2
4.3.2015	3
27.2.2015	2
25.2.2015	1
23.2.2015	1
18.2.2015	2
16.2.2015	2
11.2.2015	1
6.2.2015	2
2.2.2015	2
14.1.2015	2
14.1.2015	2
31.12.2014	3
19.12.2014	2
1.12.2014	1
1.10.2014	3
19.9.2014	1
15.9.2014	3
4.7.2014	1
4.2.2013	1

small part of the surge.

4.3.2 Contexts of Circular Economy

The usual context given to Circular Economy was **agriculture**, which might not be altogether surprising considering the newspaper's affiliation. The idea of **recycling nutrients** was especially prominent. The first article in the entire material – and quite possibly the first news story in Finland to reference Circular Economy – was partly based on a pilot program of Sitra and Järki -project that focused on making agriculture self-sufficient and removing the need for oil and fertilizers. Nine articles in total referred unambiguously to agriculture and nutrients. Some were individual news stories and mentions that might allude to taking care of the soil, the possible applications of common reed waste or how manure is the best type of Circular Economy that there is. There was also coverage on two seminars related to the Baltic Sea and the circulation of nutrients. Centre for Economic Development, Transport and the Environment for Southwest Finland was also reported to be engaged in a pilot program that would enforce the recyclability of nutrients.

Although Circular Economy is conceptually equated with **Bioeconomy**, it can also be treated with a context due to MT's clear interest in it. Aside from simple connotations like mentioning Bioeconomy and Circular Economy together there were articles which focused on some aspect of Bioeconomy and cited Circular Economy in that context. Such topics included the critical appraisal of Bioeconomy discourse in Finland, the biorefinery competition of the Ministry of Employment and Economy, and the future possibilities of Forest Industry. Bioeconomy was also mentioned in an article of UPM worksite that was visited by EU civil servants.

European Union received less attention in MT than in HS and KL. Its plans on the Circular Economy Package were mentioned a few times alongside its postponement. The recycling targets were likewise mentioned by Ville Niinistö for one.

Waste management was also a topic of discussion with a handful of articles referring to it. Ekokem's Circular Economy Village was noted as was the attempts of two waste management companies investing Tanzania due to their exporting capabilities of Circular Economy. Two news stories discussed waste management as a socio-political phenomenon.

Unsurprisingly **the elections of 2015** were also noted in MT. First, two letters to the editor written by members of the Green League referred to Circular Economy as a source of business and growth and secondly articles that discussed Juha Sipilä's government talks likewise mentioned Circular Economy as one the topics.

Various other contexts were resource deficit, Uusi puu –competition, environmental taxation from the viewpoint of Big Business and Sitra's report on Circular Economy.

4.3.3 Fields of Economy

Table 6. Fields of Economy in MT			
A: Agriculture (12)	B: Forest Industry (10)	C: Waste Management (8)	D: Energy (6)
Fertilizer production, food production, leasing of nutrients, domestic animal farms, "garden and organic farmers, forest owners", Fishing, Forestry	Paper Industry, Pulp Industry, Wood Construction, Forestry, tall oil diesel	Sewage treatment plant, Wasteyards (negative), Incineration, Biorefinery,	Biorefinery, tall oil diesel, biogas plants
E: Construction (3)	F: Services, Sharing Economy (3)	G: Various	
Wood Construction, Concrete Construction	Digitalization, Leasing of nutrients	Chemical Industry, Clean- Tech, Technology Industry, Foundries	

4.3.4 Definition of Circular Economy

Circular Economy was left undefined 12 times. The amount increased over time and in fact all these examples are from 2015. In some cases the context alluded to recycling of waste, but the concept was not defined clearly as that. Some news stories did mention the lifespan increase of products, recycling of nutrients or upgrading waste material for biofuels for example, but in a way that did not adequately stress that the factor concerned Circular Economy by definition.

Vast majority of the articles that defined Circular Economy did so in terms of circularity, but only six of them referred to some sort of a closed value circle or establishment of a stable recycling of materials. One could disclose the matter as the maintaining materials without creating waste, a "perfect cycle" or "a steady cycle". The idea of a closed value circle did not clearly diminish over time like in HS and KL although the two first news stories stressed the idea consecutively. Shunt currents were explicitly mentioned only twice and once implicitly.

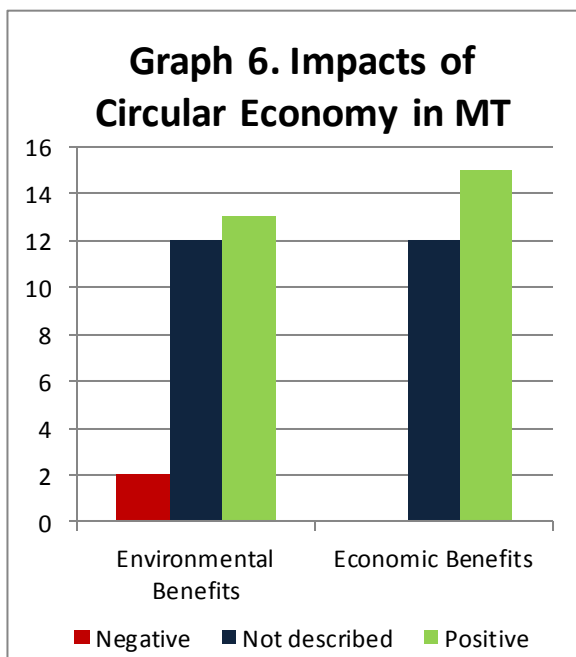
As one can surmise from the fact that the recycling of material was the usual definition, novel business models were not typically introduced. Five news stories referred to them; one as digitalization and services, another as reuse, remanufacturing, maintenance, novel service concepts, leasing and digitalization. Some more concrete depictions mentioned leasing of nutrients for example.

15 news stories presented a concrete application or business model related Circular Economy. There was not a discernible difference across time or between defined and undefined cases. When Circular Economy was introduced in the context of recycling nutrients, the outlook was often practical. One article included a suggestion about using insects to feed cattle, turning sewage water plants to "nutrient factories", making fertilizer producers lease nutrients. Horse manure was mentioned once in another text. On the topic of phosphor and nitrogen one article included statements from various speakers that advocated environmental protection taxation, separation of manure, better treatment of community sewage water and subsidizing the plastering of clay fields. Other concrete applications were Ekokem's Circular Economy

Village, Biodiesel of UPM, EN590 –diesel and various forerunner companies that Sitra cited as positive examples.

Nine stories had a tendency to refer to Circular Economy as Bioeconomy. One columnist claimed that “Circular Economy is unfinished Bioeconomy” while another maintained that “Bioeconomy is Circular Economy and Circular Economy is Bioeconomy”. Other articles tended to present the case more implicitly and perhaps as self-evident enough not to warrant further explanations. Many of these articles lacked a definition of Circular Economy.

4.3.5 Impacts of Circular Economy



The most striking difference in the way that MT depicted the impact of adopting Circular Economy is that first Environmental benefits are quantitatively closer to economic benefits and secondly that there were even articles that characterized the impact in a negative fashion.

The two news stories that did refer to Circular Economy in this manner were describing the problems in applying recycled waste material or silt into fields. The earlier text was a brief interview with the Environmental Manager of the Central Union of Agricultural Producers and Forest Owners who framed Circular Economy as an “environmental challenge” and suggested that the soil’s decaying could be solved with “environmental technology”. The second article

had a more concrete approach. It maintained that the use of recycled community silt could result in “second class” fields due to possible residues. Although the article asserted that Circular Economy should be promoted, both news stories framed Circular Economy as a problem.

Although the economic benefits were mentioned more often than the environmental ones, the difference is not so wide as in KL and HS. There were a couple of articles on both sides that addressed the other counterpart as more beneficial. For example one article related the adoption of Circular Economy in the Construction Industry to the prevention of climate change whereas the economic impacts were described in a brief mention that “product as a service” –model saves resources and produces better results. The phosphor emissions of the Baltic Sea likewise trumpeted the economic highlights in one article while in another Mari Pantsar framed the question of being about Finnish employment and economy and mentioned solving nitrogen emissions passingly. In conclusion, comparative appraisals do not change the overall picture.

The depicted environmental benefits tended to be either abstract or about e.g. phosphor emissions and the Baltic Sea’s problems. Preventing global warming was mentioned four times whereas roundabout impacts such as environmental “benefits” and “viewpoints” or the reduction of environmental hazards were likewise

mentioned. A couple of times the benefits were characterized clearly in terms of solving the “waste problem”. Global carrying capacity and environmental burden were likewise mentioned as problems that Circular Economy would solve.

Economic impacts tended to be rather abstract as well. The most tangible ones were the mentions that Ekokem’s Circular Economy Village would employ 40 people, that phosphor emissions cost 1.7 billion euros annually and that Circular Economy had 2.5 billion euros worth of growth potential in Finland and 700 billion globally according to Sitra and Ellen McArthur Foundation. Other economic benefits were job creation, economic growth, competitiveness of the European Union, correcting the balance of payments, possibilities of technology exporting and new business activity. Additionally the coverage on the Biorefinery Competition of the Ministry of Employment and Economy included depictions of two winners creating local economic benefits, but otherwise the focus was usually on a national or European level.

4.3.6 Stakeholders and Key Players

Unlike HS, MT did not describe European Union actors in great detail – Karl Falkenberg (Director of the Commission’s Environment Department) and Antti Peltomäki (Vice President of the Entrepreneurship and Industry Department) were mentioned in an article that described a Commission trip to a UPM worksite -- companies like KL. Political actors were often described in roundabout ways such the government, parties, parliamentary groups or environmental administration. Some politicians such as Petteri Orpo, Jan Vapaavuori, Sanni Grahn-Laaksonen and Ville Niinistö were referred by name. Centre for Economic Development, Transport and the Environment for Southwest Finland and Helcom (Baltic Marine Environment Protection Commission) were also presented. The Ministry of Employment and Economy mentioned was naturally mentioned in conjunction with its Biorefinery competition.

Spinnova Oy, Biovakka Suomi Oy, Kemijärvi-konsortio, Ostems Consulting Oy were the winners of the top three winners of the Biorefinery competition. MT detailed companies usually when the news story clearly focused on them. Such companies included UPM and smaller actors such as RK-Halli Oy, Ecoinnovation Group, Yara and Ekokem who are all engaging in Circular Economy in some way. Other companies specified as forerunners were Kemppe, ST1, Ponsse, RUdus, Martela, Globe Hope and the “three Finnish Forest Giants”.

Sitra was mentioned quite often naturally. The first article in the material was written by Johanna Kirkkinen about Sitra’s cooperation with Järki-Hanke. Aside from Mari Pantsar and Kari Herlevi, Mikko Kosonen was the one to complain about the withdrawal of the Circular Economy Package. Sixten Korkman was also a speaker on recycling nutrients. Ilona Joensuu, the coordinator of JÄREÄ –project, was also referred to by name from the Finnish Environment Institute. Other institutions mentioned were VTT, Lappeenranta technical university, European Forest Institute and the Ellen McArthur Foundation. Roel Bol, a Dutch Bioeconomy expert, was noted in an early text.

Aside from the Fishery Cooperative of Tutju-Roukalahti and the only third sector organizations that were mentioned were business interest groups i.e. Technology Industry, Forest Industry and Construction

Industry. The Central Union of Agricultural Producers and Forest Owners was mentioned a couple of times, possibly due to MT's affiliation with it.

Finally the environmental problems regarding the Baltic Sea brought together participants from a wide range of areas in two seminars. Stakeholders in question were Sitra, Baltic Deal –farm network, Baltic Sea Action Group, Ilkka Herlin, professor Lassi Linnanen from Lappeenranta Technical University, Matti Vanhanen, Petteri Orpo, Yara, Tekes, Sixten Korkman, Helcom and Timo Mäkelä (a Commission director in the department of environment)

4.3.7 Drivers and Barriers

The first article regarding Circular Economy in agriculture referred to Finnish “planning economy” as a barrier due to heavy propensity to produce reports that are not taken into practice. Furthermore the participants lack knowledge about the possible benefits, practical assistance and incentives. Generally speaking Finland lacks an all-encompassing approach to the problem. The article indirectly references pilot programs and research as driving factors. Sirpa Pietikäinen also referenced the European Forest Institute as a driver. One might also regard the Finnish environment Institute's JÄREÄ –project as a driver.

Legislation was mostly regarded as a driver. Sirpa Pietikäinen, for one, referred to it in a positive manner in the summer of 2014, advocating environmental protection taxation and subsidies for environmental innovations. A barrier in her mind was the subsidizing of environmentally detrimental business activities. Apparently a companion article to this one framed waste regulation as a driver in the case of Construction industry. A Sitra spokesman likewise regarded Circular Economy Package as a driver. The recycling targets involved were mentioned likewise a few times as drivers and waste incineration as a barrier

The two negative opinions were voiced by members of Big Business. First UPM regarded unpredictable legislation as a barrier while advocating the development of standards and technology simultaneously. The point was that there would not be any catching-up period in either side. The second article was a letter to the editor written by the director in the Confederation of Finnish Industries who underlined the complexity of environmental legislation. She advocated the appraisal of economic impacts and clarity of legislation alongside predictability and a long-term outlook. Another example of legislation being a barrier was related to the use of community silt in agriculture, but that was actually thought to be a positive thing. Finally Mari Pantsar thought that strict legislative definitions are barriers for new business activities.

Public subsidies were mentioned a few times. For example the Biorefinery Competition included monetary assistance in addition to increased publicity that the projects received. Tekes funding was mentioned once. Furthermore Government politicians promised funding through different programs for local projects related to advancing the recycling of nutrients in the article regarding the Centre for Economic Development, Transport and the Environment for Southwest Finland was.

Technology was another factor that was regarded as a driver. On the topic of Äänekoski investment it was also noted that the shunt currents were made possible by the advancement of technology. On the other

hand weak technology related to the treatment of sewage water was mentioned to hinder progress on that area.

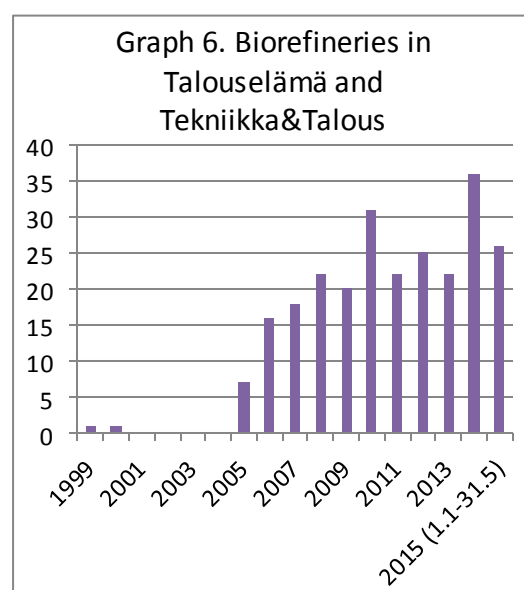
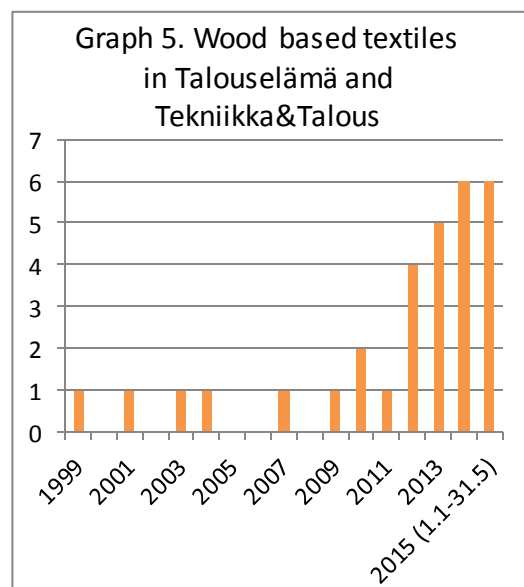
Interestingly enough MT also defined misleading public discussion as a barrier. The topic did not come up often, but quite a few times. One opinion text described the discussion as “shattered” while a columnist essentially thought that the concept of Bioeconomy was muddled by the adjacent terms. Another columnist also focused on Bioeconomy, but mentioned for example that Äänekoski factory was debunked too quickly as “greenwash” instead of seeing the more ground-breaking qualities of it. Lack of ambition and practicality were also underlined especially in comparison with the Netherlands. Finally Timo Mäkelä (the EU environmental civil servant) felt that Finnish decision-making was too focused on workforce costs instead of Circular Economy.

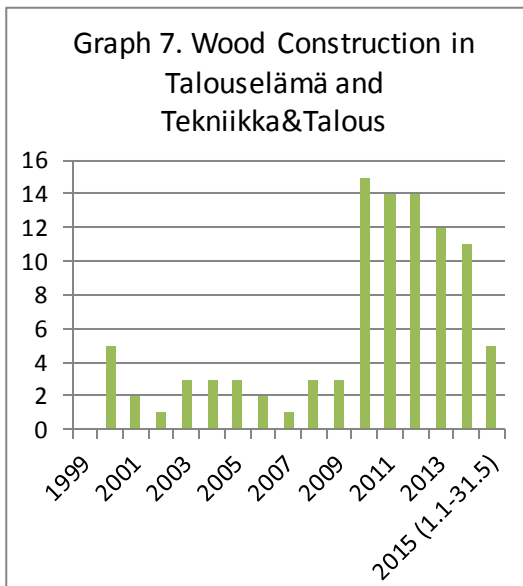
5. Innovation Analysis

The innovation analysis was also based on a preliminary quantitative analysis that was followed by a qualitative framework mostly similar to the one used in the societal analysis. It was however supplemented by a few additional questions targeted at the innovation itself, its nature and its current stage. Role of public policy was emphasized as a separate category. Before analyzing the selected three fields of business within the Forest Industry through innovations, a brief examination of the results of quantitative analysis gives some context to the innovations detailed in the following few pages. The time period of the qualitative analysis was 2010-2015 in textiles, 2014-2015 in biorefineries and 2013-2015 in wood construction.

The textile innovations are particularly noteworthy due to their low amount and relatively recent emerging into the public. One ought to stress that not all cases are purely “relevant” cases of new innovations of wooden fibres. For example the renewal of viscose industry through the tumultuous case of Säteri/Avilon Fibres is featured throughout 2010-2014 with one news story from 2001. The older news stories contain references about the possibilities of using wood in textiles, or waste material to manufacture fire-proof textiles. Nonetheless the upward trend beginning in 2012 details new wood-based innovations of our interest making the graph a credible figure.

The low amounts of textile cases are in stark contrast to those of Biorefineries. In 2014 the latter was mentioned seven times more than the former. There is also clear





growing trend from 2005 onwards. On one hand this is probably a result of the clarity of the search terms. Biorefinery and its synonyms were more unambiguous than the two other groups. On the other hand the large amounts suggest a genuine interest in the media. The early emergence of biorefineries however predates the growing trend of Bioeconomy by four or five years.

Wood Construction falls into the middle ground between the previous innovations in quantitative terms. Although the field lacks the strong interest concerning biorefineries, it is the only of the three fields that has had a stable, if low at times, attention in the media after 2000. Indeed, the first year of the decade was characterized by the discussion related Sibelius –house in Lahti.

Afterwards wood construction was a recognized phenomenon though it lacked substantial emphasis until 2010. Although the quantitative analysis did not extend beyond 2013, one might speculate that the peak of 2010 related to changes in regulation. Curiously the media analysis gave less attention to it afterwards.

A few quick observations can be made on the basis of the graphs. First biorefineries are the wood-based innovation of Circular Economy that draws the most attention in the media. Secondly, although there are differences between the results of societal and innovation results, they point to a link between Bioeconomy – rather than Circular Economy – and the innovations. Circular Economy is certainly featured in the recent articles, but it does not explain the overall trend beginning in 2010.

The biorefineries remain a curious case. It is possible that their development is largely independent of media discussion related to Bioeconomy. Yet the causal connection, if it exists, can be speculated to work in more than one way. The increased media attention of Bioeconomy from 2010 onwards might be a result of emerging innovations rather than the increasing focus on Bioeconomy resulting in attention given to emerging innovations related to it. However, it is not within the scope of this report to prove if biorefineries enforced Bioeconomy as a phenomenon or if that linkage in turn laid the ground for wood-based textiles and wood construction. Quite possibly the recent developments might be independent of each other and of any media discussion.

5.1 Wood-based Textiles

The following list is compiled from Talouselämä and Tekniikka&Talous articles. Due to the low amounts of textile cases most of the following innovations only had one or two news stories related to each of them. The innovation analysis did not compare the two business magazines, though one should note that Tekniikka&Talous included more articles from all the three fields of innovation.

A few general findings ought to be mentioned. Only eight of 19 articles had at least a weak linkage to circular economy, in the form of i.e. mention of shunt currents, with a somewhat increasing focus in 2014-2015. Four of those were clearly concentrated on the ideas of Circular Economy. Twelve articles were analyzed in total and of those seven underlined economic impacts and five environmental impacts.

5.1.1 Spinnova

Spinnova is VTT –based start-up company that made headline news when it won the Biorefinery Competition of the Ministry of Employment and the Economy in spring 2015. The company itself was developed during 2011 and established in 2014. Their innovation is a procedure that makes yarn directly out of wooden fibres whereas previously it required a chemical process wherein the pulp had to be split to the polymeric level before reformed into fibre. The financial benefit is that the production costs are halved. Furthermore the procedure does not include poisonous chemicals such as sulphur compounds or lye. Furthermore the process water is totally recyclable. In a sense, the Spinnova fibre is an advanced substitute for viscose.

The procedure requires long-staple trees such as pine and spruce, but apparently other raw materials than wooden fibres can be used in the future as well. This point was not addressed in great deal.

According to the entrepreneurs the annual amount of Finnish logging surplus could substitute 20-30% of global cotton production. During the time of the writing Spinnova had not decided whether it would eventually produce the yarn or merely sell the technology involved to others. Their plans for the next three years were be an establishment of a pilot of pre-industrial scale production. Industrial production would start circa 2020. It was mentioned that the plant could be established in conjunction with a cellulose factory. Their current funding is 1.95 million euros.

5.1.2 FuBio Cellulose

Although this Fibic related research program originates from 2013 in Aalto University, it is based on research started by University of Helsinki in 2006. It received some coverage during November 2013 and January 2014, and finally in 2015 when it won the “Uusi Puu 2014” -contest.

Table 6. Spinnova	
Fields of Business	Forest Industry, Textiles (viscose, cotton), Biorefineries
Aspect of Circular Economy	Process
Environmental Impacts	“Environmentally friendly”
Economic Impacts	Decreasing production costs, indirectly the creation of new business models and the possibilities for Finnish forests in global markets
Role of Public Policy	Biorefinery Competition of the Ministry of Employment and the Economy
Stakeholders	CEO Janne Poranen, Technology manager Juha Salmela (other owners Timo Jussila, Timo Soininen). Investors: VTT Ventures Oy (Chairman Petri Kalliokoski), Lenzing AG, Besodos Oy, Markku Kaloniemi, Yrjö Neuvo, Timo Soininen
Drivers	The Biorefinery competition, new consumer habits (ecological, recyclable), Need for a cotton/viscose substitute, the planned fund of VTT Ventures’ fund of 35 million € concentrated on research-based start-ups, basic research in Forest Sector
Barriers	Possibly the problems involved in transition to industrial production

The product presented was birch-based textile and the procedure as called Ioncell. As Spinnova fibre was an advanced version of viscose, Ioncell was of Lyocell. Both procedures produced cellulose fibres without cutting cellulose chains, but Lyocell required stabilizing components whereas Ioncell did not. Apparently no poisonous chemical were used. Most of the lignin and hemicellulose were removed before the dissolving process, which in turn made the molecules stretchable. Afterwards the dissolvent mixed up with water and the cellulose started to crystallize, forming fibres. Apparently the researchers broke up the delivered birch-based dissolving pulp themselves. The dried fibres were sent to University of Borås in Sweden where they were developed into yarns. The production capacity – at least in 2014 – was 60 grams daily at most and the product is about the same strength as flax. The first textile made was apparently 150 gram scarf given to the CEO of Fibic.

A long-term aim was the use of waste paper, cardboard and rags as resource. Researcher Michael Hummel thought that commercial products could be made in a decade and special materials, such as antibacterial products, might be viable a tad sooner. Interestingly enough one future prospect was also the direct exploitation of wood material and biomass. The articles did not make it quite clear what was the actual stage of the innovation during the contest. Nonetheless the judges did maintain that the awarded innovations were not to be from the distant future, but applicable in the near. Finally the context referred to the competition between cotton and food production.

Table 7. FuBio Cellulose
Fields of Business
Forest Sector, Textiles (cotton), Food production
Aspect of Circular Economy
Process, though raw material in the sense that waste newspaper might be used in the future
Environmental Impacts
“Environmentally friendly”, “Ecological”
Economic Impacts
Solves the problem of growing demand for textiles, a great possibility for the beleaguered Finnish Forest Industry, “Great market potential”
Role of Public Policy
X
Stakeholders
Fibic OY (CEO Christine Hagström-Näsi), Michael Hummel, Ilkka Kilpeläinen (Prof. of Organic Chemistry in HY), Herbert Sixta (Aalto), University of Borås, Marjaana Tantru (textile student), Marimekko, VTT, Stora Enso and Metsä Fibre
Drivers
Ecological consumer habits, wide coalitions and cooperation, Uusi Puu -competition, Need for a cotton substitute, indirectly basic research in universities
Barriers
The lack of facilities in Finland for yarn development

5.1.3 Design Cellulose and the Nano-cellulose centre

The case does not refer to a concrete innovation as the previous examples did. Rather it is based on two articles that showcase a research project by TTY, VTT, Aalto University and UPM. The research is based on a “Nanocellulose Centre” in Otaniemi and established in 2008. Apparently a hundred researchers work there, which is cited as unusually large a number for the Forest Industry. Nonetheless the research project is design-oriented cellulose that would be used in both technical textiles and consumer products. UPM was mentioned in conjunction with the Centre and its Lappeenranta biorefinery.

Apparently the testing had reached the level where cellulose fibres can be manufactured into yarn without “spinning”. Oddly enough a TTY researcher mentioned that the competitiveness compared to cotton does not apply for nanocellulose, but to other cellulose types. The actual type of innovation and its concrete applications remained on an abstract level in the news stories. The only textile application mentioned was

the plan to make the rector of Aalto University a gown for the Presidential Independence Day reception. It was also noted that cellulose was developed to reach the same comfortability as in cotton.

One ought to stress that unlike the previous applications this one was based on articles published in 2013. The stage of the project during 2015 was not revealed in the media analysis, though it was cited that Tekes funding would extend to 2015. Consumer-oriented production was speculated to be under way in five years, though probably in household textiles and not in clothing.

The context given to the Design Cellulose was the scant investing of the Forest Industry. The steady demand for textiles and the limits of cotton field sizes were likewise noted. A solution suggested by VTT's Johanna Buchert was textile industrial ecosystem comparable to a one in Northern Italy. Furthermore the claim that the annual logging surplus in Finland could substitute for a fifth of global cotton production was underlined by Buchert jointly with the argument that “five small machines could cover 90 percent of the exports of the Forest Industry” and that the current pulp export level of 700 € a ton could be raised to 5000 € a ton.

5.1.4 Non-Carbon disulphide Procedure

The last innovation is based on an article from January 2012. It is also based on a cheaper and more ecological method that does not include carbon disulphide. The project has its background in the early years of the 1990s, but the lack of funding stalled its progress. The innovation itself was based on the treatment of cellulose with enzymes, mixing it in alkali and then freezing the mixture in over -20 degrees Celsius. The melted result was a “stiff solution”.

As can be guessed the innovation was not quite ready. The best enzymes were yet to be located and the solutions applicability to textile material was still in need of progress. The benefits of the procedure were the small amount of enzyme needed and their recyclability due to their use only as catalysts. Apparently the raw material used was paper pulp and its price could be multiplied if manufactured into refined products. The applied products were estimated to be found first in the hygienic and medical products and later on in mass markets of clothing and packaging. Pilot production was predicated to begin in 2014 and industrial production would begin afterwards.

Table 8. Design Cellulose
Fields of Business
Forest Industry (paper, cardboard), Energy (Biofuels), Textiles (cotton, polyester)
Aspect of Circular Economy
Process apparently
Environmental Impacts
A substitute to cotton, which is harmful to environment
Economic Impacts
A possibility for the renewal of Forest Industry
Role of Public Policy
Tekes is funding the project for 3 mil. € for two years. Director General Pekka Soini mentions Darpa as positive example for reserving 20 million € for growth-oriented initiatives. Two more are supposed to funded.
Stakeholders
VTT (research coordinator Johanna Buchert), TTY (prof. Jyrki Vuorinen), Finnish Forest Industries (CEO Timo Jaatinen), KCL (in Otaniemi), UPM
Drivers
Investments particularly in R&D (majority of the innovations in Forest Industries are claimed to be developed in Finland), long-term basic research and previous know-how in the form of KCL, Limits of cotton production
Barriers
Consumer habits that prefer soft and comfortable material

Table 9. Non-Carbon Disulphide Procedure
Fields of Business
Textiles, Medical Industry, Packaging
Aspect of Circular Economy
Process due to ecological method of refining wooden fibres.
Environmental Impacts
Removing the need for carbon disulphide and “unpleasant chemicals”
Economic Impacts
A great economic impact globally and for Finland and its exports if a competitive price level is reached.
Role of Public Policy
Funding from the EU was the enabling factor.
Stakeholders
TTY and its research group (Prof. Pertti Nousiainen, researchers Marianna Vehviläinen, Taina Kamppuri and Maija Järventausta)
Drivers
The limits of cotton production and the growing demand for textiles
Barriers
Lack of funding, had there been sufficient funding the procedure would have been developed over a decade ago.

5.1.5 Various

The rest of the textile results tended to be either cursory remarks of wooden based textiles or other mentions such as the reference to “milkofil, seacell, ingeo and crabyon” that, interesting as they are, are not related to the Forest Industry.

The various news stories of 2010-2013 focused on the viscose factory of Valkeakoski. The factory had been originally owned by Säteri, then sold to a Singaporean company and renamed Kuitu Finland Oy and then rescued from abolition by the Finnish Neo Industries and renamed Ailon Fibres. Not for long though, since the last article refers to it going bankrupt once more despite the owners and even the Ministry of Employment and the Economy believing in its viability due to limits of cotton production. Viscose made of dissolving pulp was thought to be the answer, though in hindsight the idea seems to have been faulty at best. The Stora Enso factory producing dissolving pulp in Uimaharju was likewise mentioned. The key point is that apparently only a few years ago the substitute for cotton and the wooden fibre of great potential was thought to be viscose.

Although there was a cursory mention in 2011 – in the context of Metsäklusteri Oy’s Rami-project – of a wooden fibre based on new dissolving and refinement methods and old research by Kemira, most of the stories noting new wooden fibres were published in 2014. Nonetheless these handful comments were of cursory nature. For example one article simply noted that biomaterials and compound materials could be used in a variety of applications, including clothing. The Kemijärvi and Äänekoski projects included mentions of manufacturing fire-proof textiles and lignin based textiles respectively.

5.2 Biorefineries

5.2.1 Äänekoski Factory

The first articles in the analysed material concerning Äänekoski were both published in 25.4.2014. Almost all news stories in the material during the following month at least alluded to it and it remained quite dominant in the material even if most stories did not detail it or its innovations very much. Kemijärvi-consortium and Fimpulp did not receive so much attention from the magazines.

Even in the beginning there were some implicit doubts regarding the title of Bio-product factory. The first article called it a fashionable name, but the “hard core” of the factory was deemed to be softwood pulp, since its demand and market price were growing. Indeed, Kari Jordan later on admitted that the steady demand for Northern softwood pulp convinced the company to go through with the project. The other

bioproducts could enhance its competitiveness. Even though there was not much attention given to factors related to Circular Economy in the first article – indeed the additional questions were related to hardwood pulp – the idea that all wood content would be used was considered “wise”. Another article referred to the possibilities of using waste material that could be used in Chemical Industry for example. These products were estimated to potentially produce 10% of the pulp profits.

The factory was said to be twice the size of Metsä Group’s then largest factory in Joutseno, i.e. of the same capacity and cost as the Latin American pulp mills. The manager of the Äänekoski project, Timo Merikallio, suggested that the bioproduct units could include “bioethanol or -carbon”. He was quite explicit about the fact that Metsä Group would not invest in this type of production by itself. The research manager of Metsä Fibre asserted that calling a pulp mill a Bio-product factory was legitimate since Äänekoski was a new “type of thinking”. In more exact terms, the title was explicitly based on a “bioeconomical ecosystem”. That symbiosis could be treated as an innovation in itself. Quite interestingly Metsä Fibre underlined the role of small and medium enterprises in forming the ecosystem that could sustain the competitiveness pulp production. This was not mere rhetoric because Metsä Fibre had actually organized a contest between different companies even before deciding to invest in Äänekoski. The winners were Mikon Metsäpalvelu” and enzyme producer Metgen. Valmet and Andritz were the subcontractors of the factory’s machinery whereas Sweco was apparently involved in the factory’s project services and implementation.

An early interview with Hanna Lappi of Finnish Forest Research Institute shed some light on the possible innovations based on the excess material of the pulp mill. She suggested that Äänekoski’s shunt currents could be used to manufacture to “health food, nutrients, medicine, cosmetics and antioxidants”. More specifically birch bark could be utilized in the Chemical Industry, tall oil in preventing heart and pulmonary diseases, spruce bark in cancer medicine in addition to heart and pulmonary disease whereas lignans had a variety of uses in e.g. treating heart and pulmonary diseases, osteoporosis, menopause and hormonal cancers, in the case of lignan 7. Lignans, stilbenes and tannins had also antiseptic qualities that could lengthen the working life of different products. Antibacteric betulin was also mentioned to be used in cosmetics and nutrients in the US and

Table 10. Äänekoski
Fields of Business
Forest Industry, Energy, Chemical Forest Industry, Medicine, Nutrients, Cosmetics
Aspect of Circular Economy
Processes, based on shunt currents
Environmental Impacts
One columnist charged Äänekoski with the grounds that its sulphate emissions would be twice the amount of Talvivaara
Economic Impacts
Job creation of 6000 during the construction, and 1 500 employees in the final value chain (200 of those in the factory)
Role of Public Policy
Sympathy, but no substance
Stakeholders
Hanna Lappi (Metla), Anu Salonsaari-Posti (Valmet), Kari Jordan (Metsä Group), Sari Tupitsa (Metsä Group), Timo Merikallio (Metsä Group), Niklas von Weymarn (Metsä Fibre), VALMET, Kari Tuominen ANDRITZ, Päivi Uusitalo and Niko Ruokolainen SWECO, Neste Jacobs, VTT, Itochu Corp
Drivers
Research on extracts, market price of pulp, public investments (possibly), one columnist wryly remarked that all interest groups supported the pulp mill because it was marketed as a bio-product factory, dollar appreciation with regards to pulp production, industrial ecosystems, collaboration between companies, investments (in effect a great deal of capital is needed to even enable the investment)
Barriers
Paula Horne (Pellervo) contended that pulp mill investments would not be limited by wood supply, but the distance between the factories and railway stations could in effect raise transportation costs, Tarasti working group: environmental permission procedures, Valmet’s PR manager mentioned that despite growing focus on Bioeconomy concrete investments were still scarce.

Russia. Some of these examples such as xylitol, steroids, Lignan 7 and Benecol are existing products whereas “betulin, suberin, linoleic acid and stilbene” were said to be under development. At the time of the article tall oil and turpentine were the only substances aside fibres that were utilized. The news story recommended that the extracts in the inner bark and foliage could be exploited too since they were of no use in pulp mills. It is not altogether clear whether or not these extracts were eventually included in the Äänekoski ecosystem.

Later articles referred to a variety of different products. Biocomposites were said to include “biodissolving” construction materials, “thermductile” fibre composites for panels and slabs and fibre packages. Lignin could be produced into adhesive materials, coatings, textile fibres, resins and glues for wooden products, new products alongside incineration. Suggested energy-based products were bioethanol, biogas and product gas. Finally ductile structures were said to include coatings.

The Äänekoski factory was presented as using 6.5 million square meters of fibre wood and producing 1.3 million tons of pulp annually. The pulp would be used in refining paper, cardboard and tissue. Biochemicals included tall oil and turpentine, which were respectively exploited in order to produce “paint, lubricants, medicine, glues and ink” and “paint industry and perfumes”. Bioenergy products include “bioelectricity, process steam, district heating and wood fuel”. The factory’s energy supply should be entirely wood-based. All in all, half of the raw materials were estimated to be used in pulp production and the other half in shunt currents. Half of the pulp was estimated to be directed to Chinese markets. All in all it was not quite clear what innovations were in a commercial stage and which were under development.

The national importance of the factory was demonstrated by the fact that the Stubb Administration put Äänekoski first on the list of suggestions for EU’s stimulus funding. That is not to say that there was a true intention of allocating funds there, since the stimulus fund was already depleted. It seemed that the public actors did not have a deciding role in the matter and indeed, the final enabling factor that ensured the investment was a loan of 150 million euros

Table 11. Kemijärvi	
Fields of Business	Forest Industry (besides pulp, wood refinement like sawmill), Energy, Textile Industry (Viscose and Cotton), Livestock, Salmon Farming
Aspect of Circular Economy	If shunt currents, process. Largely unknown.
Environmental Impacts	Small focus: current fodder of salmon was said to be harmful
Economic Impacts	Not a strong focus, but alleviating unemployment
Role of Public Policy	The Biorefinery competition was described as important not simply because the state-gathered investor group would help in obtaining funding for the project. Nivala also stressed that winning the competition if only in the top three, made it more convincing. For this reason the consortium also wished for the government to be an owner in the factory. The city of Kemijärvi was also involved. Finnish Industry Investment was mentioned.
Stakeholders	Stora Enso (closed down a factory), Arktos Group (bankrupt), Antti Kerkelä (forest owner), Heikki Nivala ("Massaliikke", Chairman of the City council of Kemijärvi, Consortium) VR, UPM, Metsä Group, Finnerpulp, Aalto, Dermot Smurfit, Tomi Salo (Finnish Forest Industries) Esa Härmälä (Forest Government), Lappi Timber
Drivers	The large amounts of available supply, especially in Lapland, good infrastructure, electrification of the railroads by VR and the potential roads to Sokli mines, indirectly abandoned factory facilities, university research and patents, market price of pulp, competitive wage levels
Barriers	Large investments involved, one journalist openly questioned whether Kemijärvi and Finnerpulp factories could be accomplished simultaneously. It was suspected that the Centre Party would eventually choose Kemijärvi through the Finnish Industry Investment.

by Itochu Corporation. The pulp mill was said to begin its operation in August 2017 and the rest of the factory in June 2018.

5.2.2 Kemijärvi Factory

Aside from the prominent Äänekoski investment, Kemijärvi Consortium's biorefinery project was featured the most in material though only two articles detailed in great detail. The potential innovations and the products are still a secret. The head man of the project, Heikki Nivala, only revealed that the Aalto University was involved and that it had patents for some of the products, which were said to be based on C5 and C6 sugars, that is, pentose and hexose. Another story referred to using bark bread as fodder in salmon farms, "microcrystalline" pulp as fodder for cattle, and also fireproof textiles. There were some mentions of micro fibers, chemicals produced with the help of lactic acid and raw material for the textile industry and for fodder and the production of energy. The textile industry was probably related to viscose.

The 700--800 million investment, making the Kemijärvi project smaller than either Äänekoski or Finnpulp, was described by Nivala as a "third or fourth generation biorefinery that is a bit smaller than the current pulp

Table 12. Finnpulp	
Fields of Business	
Forest Industry, Energy, Chemical Industry	
Aspect of Circular Economy	
Process (Eucalyptus technique), but it is apparently an old innovation	
Environmental Impacts	
x	
Economic Impacts	
x	
Role of Public Policy	
Distorting effect on tall oil legislation was noticeable. Even the Commission was claimed to reprimand Finland and Sweden on this point. The ministry of Employment and the Economy was said to attempt to reduce subsidies for renewable energy, since the subsidy draws resources away from the Forest Industry and is distorting in itself. MTK and the Energy Industry, among others, argued against this, MTK paradoxically claiming that it would reduce the wood supply. Finally one journalist asserted that Kemijärvi and Kuopio projects would practically require the "steel fist" of the Finnish Industry Investment to be successful.	
Stakeholders	
"Forest Industry veterans" Niilo Pellonmaa, Jyrki Yrjö-Koskinen and Timo Piilonen (Finnpulp), Martti Fredrikson (CEO Finnpulp), Arizona Chemicals (Juhani Tuovinen), Jyrki Kettunen (Prof. in consulting firm Da Wo), Risto Näsi (CEO Forchem), Erno Järvinen (MTK) the Energy Industry, "Koneyrittäjät", Metsä Group, Neste Oil	
Drivers	
x	
Barriers	
x	

mills". The proposed production was described to include 200 000 of softwood pulp, rest in dissolving pulp and in new products. The reporter surmised that the "industrial partner" that was mysteriously mentioned by Nivala could be a Finnish viscose producer. Indeed, as in the Finnpulp project the business partners were still a secret. It ought to be mentioned that another article referred to an "industrial actor" and not in plural form regarding Kemijärvi. The reason for investing in dissolving pulp and "dexterity" was said to be the economies of scale. The business model was said to be competitive simply due to long-fibred pulp having a market price of 900 euros a ton. Hence the cellulose production alone would make the factory profitable with the said market price.

The machine investments needed for the innovations had not been made yet. If successful, the biorefinery was estimated to start production in two to three years.

5.2.3 Finnpulp Factory in Kuopio

The third major biorefinery project under planning during the research period was the Finnpulp factory in Kuopio. The caveat with the project is that while Äänekoski is decidedly designed as an ecosystem of

Table 13. Kainuu factory
Fields of Business
Forest Industry, mentioned in the article unrelatedly: Bioethanol, Wood Construction, Mining
Aspect of Circular Economy
Process
Environmental Impacts
x
Economic Impacts
The proposed factory was said to employ 2000 people in total. Talvivaara was mentioned in a negative fashion, but due to job decreases.
Role of Public Policy
The whole project is a public initiative
Stakeholders
UPM, mentioned St1 and Crosslam unrelatedly.
Drivers
Investment of Äänekoski, because it gave impetus for this project as well. Large surplus of wood due to the closing of the UPM paper factory
Barriers
Lack of an industrial partner

shunt currents, Finnpulp's major stakeholders were even said to refrain from calling it a biorefinery in February 2015.

The only described innovation in the few articles detailing Finnpulp was a technique applied to eucalyptus pulp in Latin America where the pulp mills produced short fibre mass out of it.

With regards to shunt currents the only relevant factors in the describes business model were the increased production of tall oil and the production of bioelectricity that would satisfy a percent Finnish demand of electricity. All pulp and tall oil would be exported and tall oil could also be refined into biodiesel or for the use of the Chemical Industry as UPM did. One news story defined it as a 1.4 billion € investment. At any rate the Finnpulp plans were still in early stages and they were moving into applying for an environmental permit. The process was said to last a year or year and a half.

5.2.4 Kainuu Factory

The final proposed bio-product factory was that of Kainuu. Indeed, the main initiative to the project came from political actors, namely the

Regional Council of Kainuu and the Provincial Government of Kainuu. The Finnpulp and Äänekoski projects were mentioned in the article in positive fashion, suggesting that the successful investments were spurring similar investments. The main business model considered in this plan was a softwood pulp mill like the Finnpulp project, but an alternative could also be production of fuels and chemicals out of shunt currents. The proposed business partner was UPM, which had previously abandoned property in the area – in other words it had closed down a paper factory. This was thought to be a positive opportunity because there were available facilities for the new factory.

The obscure project was in very early stages and only under consideration with a full report being finished in August 2015.

5.2.3 Chemical Industry Park in Raisio

A Raisio-based Chemistry Park was essentially an industrial R&D ecosystem. Although most of the companies involved were related to Circular Economy and the Park itself with its shared laboratories was an example of the phenomenon only two of the companies were clearly related to wood-based industries.

BLN Woods was a company that was developing a procedure for separating the main components of wooden chips – that is hemicellulose, cellulose, lignin and extractives. The technique's advantage was the high standard of fineness of the separated components. Cellulose gain was almost 100 % which was said to open up new possibilities for the production of paper and cardboard. The resulting lignin was free of sulphur and thus different from the currently used "sulphate lignin". Ekolite, the second company, was

Table 14. Chemical Industry Park, BLN Woods and Ekolite

Fields of Business
Chemical Industry, Clean-tech, CH Polymers (paper, cardboard, paint, construction, paper cloth), BLN Woods (Forest Industry), CrisolteQ (Metal Industry), Ekolite (Energy, Construction, Wood Industry, Metal Industry), FP-Pigments (Packaging)
Aspect of Circular Economy
Process, Planning (Ekolite), Sharing (The park facilities)
Environmental Impacts
x (unless BLN's lack of sulphate)
Economic Impacts
Chemical Industry is the largest exporting sector
Role of Public Policy
Tekes Green Growth Program apparently finances the Park together with the City of Raisio
Stakeholders
Ekokem, University of Oulu, Bob Talling (CEO of Renotech Oy and owner of Ekolite), Valter Widgren ja Kristian Gunnelius (Ekolite), Lari Vähäsalo (BLN Woods). Kenneth Ekman and Kemira (Crisolte Q). Generally Metsä Group and Forchem, Neste. Bayer and Orion are a part of BioTurku -cluster. Markku Heino and Jyri Arponen (Tekes Green Growth), Tapio Poutiainen (Spinverse), FP-Pigments (Markus Blomquist), Maija Pohjakallio (Chemical Industry's bioeconomy expert), Reeta Huhtinen and Linda Fröberg-Niemi (the managers of the park, working for Turku Science Park), the higher education institutions of Turku and Raisio
Drivers
Industrial symbioses and infrastructure, BLN Woods highlights easy access to modern facilities usually unavailable to small actors, investments for work-in-progress innovations
Barriers
x

developing a method for categorizing ashes, their mineralogy and morphology, which in turn could be used to determine different sorts of refinement for bioashes. Apparently the company was able to change the ashes during their creation by introducing minerals into the fuel compound.

Furthermore a third company called CH-Polymers was said to manufacture polymer-based binders for a variety of industries including paper, cardboard, paint, construction and paper cloth. The background of the business model was in paper chemicals. Other companies were CrisolteQ that recycles metals and FP-Pigments which manufactures “aqueous insulators” for packaging and substitutes for titanium dioxide.

BLN Woods had apparently received funding from Tekes in order to upgrade the process into an industrial scale. Ekolite was originally focused on making “lite products” out of the shunt currents of wood refinement, but it changed its business model due to larger volume of bioashes. A volume of 200 tons a week in large power plants was mentioned. The innovation itself was apparently already ready though not industrially applied and the company spokesman claimed that it was entirely viable in the construction industry where it can be used in bricks, plaster and rock wool.

The Äänekoski factory was mentioned in positive fashion in the article, though the Chemistry Park did not have any direct linkages to it. Chemical Industry was presented as the leading exporter in the Finnish Industry.

5.2.4 A New method for BTX-Chemicals

An article in 2014 described a VTT –based procedure that manufactures so called BTX –chemicals that are used in turn to produce industrial chemicals. The innovative method consists of uses wood mass as a raw material and combines gassing, Fischer-Tropsch synthesis and aromatization. Apparently the new ingredient is the use of an iron catalyst which had not been previously applied to biomass.

The method was relevant because it was based on the possible shunt currents of biorefineries. The context given to the new innovation was described as a side effect of expanding shale gas production that

Table 15. BTX-Chemicals
Fields of Business
Forest Industry, Bioenergy, Chemical Industry, Medical Industry
Aspect of Circular Economy
Process
Environmental Impacts
x
Economic Impacts
x
Role of Public Policy
EU-funding was mentioned in the context of the cancelled UPM biodiesel plant in France.
Stakeholders
Stora Enso, Neste Oil, Vapo ja Metsä Group, UPM in biodiesel. VTT (leading researcher Matti Reinikainen)
Drivers
Shale gas production inadvertently
Barriers
Lower price of oil that decreases the competitiveness of renewable aromatics

decreases the production of pyrolysis benzene which decreases the volume of fossil aromatics. In other words, there was a growing demand for a substitute which could be found in biomass aromatics.

Finnish biorefineries could replace the troubled biodiesel-projects with this chemical production. Indeed the article presented the entire Finnish biodiesel business in trouble due to the high level of investments required. A clear advantage in favor of BTX-chemicals was the smaller scale involved. A competitive biodiesel plant would require a production of 100 000 ton annually whereas the VTT method only needs 20 000-50 000 tons to be profitable. Hence the investment involved need not be large as large in biodiesel production where even the first plant would require half a billion euros. VTT researcher maintained that it would be easy to establish a plant of this kind next to an industrial complex and that possible applications could be located, for example, in the production of the painkiller parasetamol due to the pureness of the source material. However, these chemicals were still under development.

Table 16. Biohat
Fields of Business
Energy (district heating, electricity, diesel), Paper Industry
Aspect of Circular Economy
Process
Environmental Impacts
"Benefits related to the environment"
Economic Impacts
x
Role of Public Policy
The importance of public funding for further refinement (Tekes, Finnvera and Rauma are mentioned in the main story)
Stakeholders
Airia Group (CEO Reijo Alander), researched in LTY, TTY and Numerola Oy as well (Sitra, Oilon, Wärtsilä and BMH in the main story)
Drivers
Previous knowledge in different technology (Paper Industry)
Barriers
Lack of funding, the complexity of the used technology (only ten persons are said to understand it in Finland)

5.2.5 Externally Fired Solid Fuel Micro Gas Turbine and Biohat

The article from June 2015 was added to the material even though it falls outside the analyzed time period. Its side story mentions a small power plant that apparently produces district heating out of biomass. Even though the role of shunt currents is not underlined in great detail the context of the innovation alludes to Circular Economy. The procedure itself was hindered for a long time because of low electricity supply ratio, but Airia Group, a company cluster formed in 1994, has developed it to the point where the technique that apparently obtains smoke gases with two medium substances and produces 30-35% more heat from the "cauldron". The heat efficiency might even be increased to 50%. The technique's background is in the vaporization diagram of a paper machine

The problem is the one that is showcased in the main story, namely the difficulty of ensuring funding for pilot facilities. On this

point an investment fund in Rauma was presented, but it was not entirely clear whether or not it would apply for Airia Group and its power plant concept. The concept, named Biohat, could produce electricity

and heat for sparsely populated areas and developing countries. If the plant was used to substitute diesel oil its payback period would be 1.5 years at most, or so is claimed. Nonetheless it is uncertain whether or not the innovation can be passed successfully into commercial use. Furthermore its description of environmental benefits involved is rather roundabout.

5.2.6 Prefabricated biogas and biodiesel plants, BioGTS

A company based in Jyväskylä had essentially adapted a prefabricated house production model to biorefineries. The plants were scalable and they could be delivered in parts or in whole. The company had its own workshop where subcontractors would deliver components. Apparently this has kept the investment costs low, but on the other hand the fast growth of turnover ties up capital.

The smallest facilities produced could process a thousand ton of waste in a year whereas the largest ones had the capacity of one thousand tons in a day. Mentioned customers were waste management, energy, agricultural and foodstuff companies.

Table 17. BioGTS	
Fields of Business	x
Aspect of Circular Economy	Logistical in a sense
Environmental Impacts	x
Economic Impacts	x
Role of Public Policy	x
Stakeholders	Animari Lehtomäki
Drivers	x
Barriers	x

Table 18. Bioruukki	
Fields of Business	Forest Industry, Energy, Chemistry, Process-related Workshop industry
Aspect of Circular Economy	Probably process and planning
Environmental Impacts	x
Economic Impacts	The applied research was presumed to speed up and Bioeconomy and thus exports as well
Role of Public Policy	The ministry of Employment and the Economy (department head Petri Peltonen) was mentioned though its actual relationship with Bioruukki was not revealed. Also the national bioeconomy strategy, where bioeconomy was supposed to be raised into 20 % of GDP in 2025
Stakeholders	VTT (Director Kari Larjava)
Drivers	Applied science, commercialization, collaboration of companies and research partners
Barriers	x

5.2.7 Bioruukki

Another innovation of VTT was Bioruukki, which was framed essentially a cluster of laboratories and pilot units for applied sciences regarding Bioeconomy and Circular Economy in March 2015. The innovations involved were rather roundabout. The facilities were said to permit testing of technical and economic viability of the biorefinery -related concepts and ideas. The manufacturing methods of biofuels and "precious" chemicals were especially underlined on this point. Besides chemistry, biomass and viscose were mentioned.

Bioruukki consisted of 8000 square meters of facilities, 60 million euros a year and 500 man-years. The number of employees was estimated to rise from 15 to 40. Circular Economy as certainly involved because the fuels were not only mentioned to be the shunt currents of wood but also waste. The test facilities, such as the "fraction lines of biomass and the treatment machinery of cellulose" were to be implemented in the next two years.

5.2.8 Cobiolube

The innovation was a biobased lubricant manufactured by a

company called Jarmat. The article did not reveal its specific composition since the innovation was not yet patented. It did, however, mention that the product's main raw material was shunt currents of a biodiesel plant. Cobiolube was apparently the only lubricant in Europe that did not include oil. It was applicable for individual chain saws and those embedded in forest machinery.

Table 19. Cobiolube

Fields of Business
Forest Industry
Aspect of Circular Economy
Process
Environmental Impacts
x
Economic Impacts
x
Role of Public Policy
The main innovation was developed in part of the Tekes Green Growth Program, Hydraulic lubricant too with Tekes in addition to VTT, EU Ecolabel.
Stakeholders
Jarmat (CEO) Matti Kyllönen, VTT, Forest machinery manufacturer Komatsu, John Deere
Drivers
x
Barriers
x

The benefits of the innovation were said to include the fact that it can endure both high and freezing temperatures, that it is both adhesive and lubricating and that it dissolves in nature and that it does not consist mineral or vegetable oil elements. Also the additional substances that increase "adhesiveness and temperature fluctuation" were biobased. Indeed, it was noted to have obtained the EU Ecolabel.

Cobiolube was ready for commercial use after three years of production. Its price was estimated to be between the mineral and vegetable oil -based lubricants, but on the other hand it was claimed that the required amount of Cobiolube was less than of those lubricants.

Further innovations under development were products directed at industrial processes "such

as the tracks of transport machines, heat transfer liquid and cutting and conductor liquid of metal processing machinery". There was also a mention of a hydraulic lubricant developed with the aid of Tekes and VTT. That lubricant was said to be fitting for arctic use and for high pressures.

5.2.9 Bio-oil

The innovation in question was a UPM manufactured wood-based bio-oil that was essentially a substitute for biodiesel. It was more advantageous due to lower costs and emissions of nitrogen and nitrogen oxide involved. It could have been used to replace light fuel oil and eventually transport fuels as well. The innovation is only under planning and its applying for a "lignocellulosic fuel" apparently requires a new type of "catalytic pyrolysis technique".

UPM, Valmet and Fortum are cooperating in order to develop such a technology. The wood-based material was apparently tall oil.

Table 20. Bio-oil

Fields of Business
Forest Industry, Energy, Chemical Industry
Aspect of Circular Economy
Process
Environmental Impacts
Lower emissions
Economic Impacts
Lower production costs
Role of Public Policy
The EU target of 25% ratio of transport biofuels by 2030 was mentioned
Stakeholders
Prof. Janne Jänis (University of Eastern Finland), UPM, Valmet, Fortum, Stora Enso, Neste Oil, Vapo, Metsä Group
Drivers
Research, the disadvantage of biodiesel
Barriers
Chemical composition of bio-oil is not well-known, it does not mix with ordinary fuels like ethanol, its water content reduces its usage, and its acidity limits its use with other materials.

The context of the bio-oil was the failures of the forest companies in making biodiesel competitive. Stora

Enso and Neste Oil – which still had its own biodiesel -projects – and Vapo and Metsä Group had withdrawn their biodiesel initiatives due to costliness of the Fischer-Tropsch –technique. The UPM biorefinery in Lappeenranta was mentioned though.

Table 21. Tall Oil
Fields of Business
Forest Industry, Transport, Chemical Industry
Aspect of Circular Economy
Process apparently
Environmental Impacts
UPM relates to EU's climate policy, Chemical Industry to sustainable development
Economic Impacts
UPM relates to the renewal of Finnish Forest Industry, Chemical Industry to job creation and tax income
Role of Public Policy
European climate policy, and Finnish maneuvering, are at the heart of the conflict, Bioeconomy Strategy
Stakeholders
Jussi Pesonen (CEO, UPM), UPM (Marko Janhunen), Arizona Chemical (Juhani Tuovinen), Forchem (Risto Näsi), Ecofys, Metsä Group
Drivers
Climate policy, R&D since UPM has a research "pool" where the company has stored ideas for decades and nowadays 300-350 patents a year, Finnish bio-engineering education, well-cared forests
Barriers
The misuse of Climate Policy, Lobbying, according to UPM three-tiered innovation subsidy system results in innovative companies being sold before the commercial stage

5.2.10 Tall Oil

Tall oil was noted multiples times during 2014. It was cited in the plans regarding Finnpulp's would-be factory in Kuopio and in two letters to the editor by stakeholders of UPM and Forchem and Arizona Chemicals. The texts, though quite revealing in themselves, were only cursory regarding the possibilities of tall oil in Circular Economy.

UPM's description for one asserted that tall oil could be manufactured into e.g. lipstick, chewing gum, renewable diesel or printing ink. The chemical companies also referred to chewing gum and ink jointly with car tires, glue, Benecol and even as fodder material for livestock. Not surprisingly these products require chemical refinement. Apparently these innovations are already in use.

The context of these letters to the editor was naturally in the legal definition of tall oil. The Chemical Industry was hostile to the political initiative to define tall oil as waste, because it would be counted doubly in the EU's transport fuel target, drawing production into biofuels. UPM on the other hand claimed that there was

already over-production of tall oil globally.

Quite a few articles referred to the UPM biorefinery in Lappeenranta, which is apparently based on tall oil. The previous Bio-oil innovation is thus related to it. One news story described UPM winning the Energiateko -contest due to its promotion of biofuel target ratios and the fact that it required no public subsidies. UPM CEO furthermore alluded to the possibilities of biochemicals and biocomposites besides biofuels. Raw materials were cited as waste and shunt currents of wood. If there were any products under development, they were in early stages. Micro fibres and nanocellulose were mentioned as promising.

5.2.11 Various

Neste Oil had had biodiesel collaboration with Stora Enso – while also coming into conflict with UPM due to Lappeenranta Biorefinery's patent – in January 2014. The biodiesel was based on woodchips and Fischer-

Tropsch technique, but was shelved on the basis of the latter's costliness. Possible future procedure mentioned was applying microbes and algae to wooden biomass.

A Tekes column referenced Sybimar and Envor in 2014, companies engaged in Circular Economy. Sybimar apparently produces energy out of fish guts alongside bio-oil whereas Envor owns a biorefinery that is said to combine many methods "innovatively". The potential product would be an energy source from organic waste and plants not applicable for food, but grown in fields. Rest of the article mentioned possible biomaterials in construction, clothing, packaging and interior decoration.

ST1 Biofuels has a factory in Kajaani, which produces lignin as a shunt current which is delivered to Kainuun Voima, which apparently produces heat and electricity out of it. Although the described business model is not very innovative, the company did illustrate possibilities of using waste cellulose in creating ethanol. Chempolis was also engaged in refining ethanol and cellulose out of biomass, for example out of straws and sugar cane waste. It was also in negotiations during 2015 with an Indian oil company to establish a bamboo-based biorefinery.

There were some rather roundabout comments regarding the future possibilities of biomaterials. Karl-Erik Sundström, the up-coming CEO of Stora Enso, underlined in an interview that the future of the Forest Industry was determined by innovations and R&D. Biomaterials were mentioned with "wood products" and biorefineries. He did also stress renewable energy, but on the other hand forest is a renewable resource. Another story depicting Äänekoski and ST1 Biofuels also mentioned "progressive bio-based fibres, polymeric products and chemicals", which could be refined into "new textile and carbon fibres, nanocellulose and bioplastics". Biofibrils were also mentioned. Lastly Spinnova was mentioned due to it winning the biorefinery contest.

5.3 Wood Construction

5.3.1 Cross Laminated Timber

Table 22. CLT

Fields of Business
Construction Industry
Aspect of Circular Economy
Process
Environmental Impacts
CLT's glue does not include formaldehyde or other poisons
Economic Impacts
x
Role of Public Policy
Rules and regulations, fire ordinances prohibit wood surfaces indoors and it is practically unpermitted in outdoor surfaces too, but these regulations were said to be changing in order to accommodate wood construction, Worksites requires sprinkler systems too, City of Kuhmo was investing in the Crosslam factory
Stakeholders
Construction Company Reponen, Matti Mikkola and Janne Manninen (Stora Enso), Jyrki Moilainen (Crosslam), Versowood and Metsä Wood, Ari Tiukkanen (Metsä Wood), Antti Aaltonen and Antti Raunemaa (SRV), Skanska, Mikko Viljakainen (CEO Puuinfo), Asuntosäätiö, VTT, Jukka Miettinen (Hartola),
Drivers
R&D, especially in Stora Enso, good quality of available raw material (pine), company acquisitions
Barriers
Only a few industrial actors and small markets

Cross laminated timber (CLT) is the most prominent innovation regarding wood construction in Finland. It is essentially made of thin wooden laths that are glued and pressed crosswise into large lumber. The product weighs 400—500 kg/m³ which is a quarter of concrete's weight and is usually made of pine or spruce. The advantages of CLT were said to be fast rate of production, the need for only a few subcontractors whereas the noted disadvantages were claimed to be the immutability of the final product, higher price of wood in comparison with concrete and the fact that rainy weather stalls the production.

There were two CLT manufacturers in Finland: Stora Enso and Crosslam. Stora Enso was the older one since it was described in 2014 to have been developing CLT and high-rise wood construction for five years. Apparently the company has one worksite in Pälkäne and another one in Hartola though the CLT sheets themselves are delivered from the company's Austrian factory. Indeed, the innovation itself is of Central European origin, invented during the 1990s. Actually the company that installed the Austrian CLT-sheets in Finland was Eridomic, purchased by Stora Enso in 2010. Eridomic was making prefabricated wood buildings even before the acquisition. Stora Enso claimed that only it and Construction Company Reponen were the only active developers of wood construction. Metsä Wood and Versowood were conversely designated as inactive.

At any rate, the company had apparently moved its focus away from prefabricated components, such as outer walls, into prefabricated units as far as CLT was concerned. One news story mentioned that the prefabricated units were assembled in Hartola whereas the components were built in Pälkäne. The unit elements were apparently uncertified and

unlicensed at the time. Apparently Metsä Wood also had the necessary know-how to manufacture CLT, but the company wished to remain as a supplier of construction material without moving into the Construction Industry itself. Stora Enso on the other hand did not see manufacturing CLT as assuming the role of a constructor.

The company had refrained from establishing a CLT factory in Finland due to low demand for wood construction – it was claimed that USA had a 90% ratio of new high-rise apartments made of wood, 50% in Scotland, 20% in Sweden and only 3-4% in Finland. One Stora Enso manager claimed that the

phenomenon would become self-enforcing at 20 percent and indeed in another news story the company expressed the belief that this was a growing industry simply because Finland had no wood construction. At any rate, one journalist presumed that a large industrial actor as Stora Enso was hesitant to make any investments regarding even a small factory

The Crosslam factory in Kuhmo was the first, and only, Finnish CLT factory. The company was founded in January 2014 and the first machinery acquisitions were done in the following March. The initial investments were three million euros. In September it was waiting for VTT approval. Crosslam was later described to deliver its six meter CLT-sheets, i.e. the frame material and the floors of the buildings, to Taiwan. Its production rate was described to be “10 000 cubes in one work shift annually”.

5.3.2 Laminated veneer lumber

Table 23. LVL

Fields of Business
Wood construction, Paper Industry (Closed)
Aspect of Circular Economy
Process
Environmental Impacts
x
Economic Impacts
Job creation of 150 workplaces in the Varkaus area.
Role of Public Policy
x
Stakeholders
Jari Suominen, Stora Enso, Metsä Group (manufactures LVL under the trade mark “Kertopuu”)
Drivers
Closed down paper factory, as existing facilities, Stora Enso also had "industrial infrastructure, raw material and work force" in the area
Barriers
x

The innovation's novelty was not revealed in the material. Laminated veneer lumber (LVL) is similar to CLT and can be combined with it and saw products. Although other tree types could be used as a raw material, spruce was the intended resource for most part. More specifically it was designated as a substitute for CLT in wooden high-rise buildings. Its width was described as 10-20 cm and its load capacity was expected to be quite strong, even stronger than CLT's. Hence it could be used especially in invisible structures. A common feature with CLT is the fact that doorways and windows are carved into the material. Although other tree types could be used as a raw material, spruce was the intended resource for most part.

Stora Enso estimated that half of CLT could be replaced with LVL though the company spokesman apparently refused to discuss price differences between the two products. He did mention that LVL was more fitting in some contexts and hence more affordable, which one might interpret as saying that LVL was indeed more expensive to make than CLT.

The investment in the new production line in Varkaus was 43 million € and it was expected to commence its operation in the second quarter of 2016. The expected capacity was 100 000 square meters annually. Stora Enso was planning to use it itself and to sell it to other actors as well. The work sites in Hartola and Pälkäne were the explicitly mentioned as refining areas where prefabricated elements of wooden high-rise buildings are manufactured.

One might suppose that LVL was Stora Enso's plant to compete with Crosslam in the growing wood construction market.

5.3.3 BoKlok

BoKlok was presented as an Ikea Concept developed in 1990s and one news story mentioned that it had been tried before unsuccessfully. Not it was making at least a small comeback. The Swedish process was based on "industrial serial production" and the articles referred to it as partly manual work and partly

Table 24. BoKlok

Fields of Business
Wood Construction, Forest Industry, Ikea
Aspect of Circular Economy
Process
Environmental Impacts
x
Economic Impacts
x
Role of Public Policy
Public procurements, nursing homes/ City of Helsinki involved in Pukinmäki project
Stakeholders
Matti Mikkola, Janne Manninen (Stora Enso), Lakea Oy, Ikea, Riku Patokoski (Skanska)
Drivers
Collaboration of companies (Stora Enso attempting to create a common model with Skanska, Lakea, SRV). Nursing home complaints with regards to Lakea OY,
Barriers
"Unknown risks" of wood construction, wood construction is based on single projects which lack continuity and further refinement of the business model, a technical problem is ensuring rigidity in high-rise buildings (so far elevator shafts made of concrete), Skanska claimed that slow production of wood construction and building in different municipalities. Requires well-developed standards "unfit for consumer trade"

computer manufactured. To put it shortly, the final product is a prefabricated small high-rise apartment building. The wall frame, insulation, floors etc. are all industrially manufactured. The described production was resemblant of an assembly line.

The final product was not described as "not the most expensive, but of good enough quality and good looking". A BoKlok apartment is based on two prefabricated units that are then stacked on top of each other. The costs of the production were probably reduced because of the singular immutability of the product -- not even the white color could be changed. The resulting price was 3300 euros a square meter, i.e. a price less than 200 000 euros for a two person flat.

Stora Enso was in the process of assembling BoKlok -elements for the Skanska construction site in Vantaa, Kivistö. Lakea Oy had also its own concept that was based on assembling prefabricated nursing homes. Due to local protests that impede the establishment of such public facilities, nursing homes benefit from fast construction and hence create markets for prefabricated buildings.

Although CLT sheets were mentioned in the BoKlok news stories, it ought to be stressed that the two innovations focus on different things. CLT and LVL are technical procedures that create resources and BoKlok is a procedure for assembling those resources into buildings. Furthermore BoKlok had only been applied for small high rise buildings.

5.3.4 RunkoPES –Standard and others

One news story depicted a variety of innovations that enhance the viability of wood construction. It was not altogether clear at which stage the innovations were.

The listed innovation included first the RunkoPES -standard, which sought to provide a platform in which a building could be constructed regardless of the constructor or the solutions involved. Secondly the so-called pillar-beam system which included laminated or veneer beams made dividing walls unnecessary.

Table 25. RunkoPES etc.
Fields of Business
Wood construction
Aspect of Circular Economy
Planning, process
Environmental Impacts
x
Economic Impacts
x
Role of Public Policy
Public procurement mentioned (Piispala's national youth centre)
Stakeholders
Metsä Wood, Titta Vuori (Puuinfo), Modelark
Drivers
"Industrial element systems" and their standards, technological progress in other words.
Barriers
x

Table 26. Wood Stones
Fields of Business
Construction (waste), Garden shops
Aspect of Circular Economy
Process, recycling maybe
Environmental Impacts
x
Economic Impacts
x
Role of Public Policy
EU's patent application, the company had obtained a permit from Regional State Administrative Agency of South Finland (AVI), also mention of waste law that requires 70% of construction and demolition waste to be used otherwise than in energy by 2020.
Stakeholders
Reino Partanen, Destamat
Drivers
Partner networks, legislation, fairs and events in marketing purposes
Barriers
x

Furthermore there were several fire safety innovations including fireproof material in the ground floor and automatic extinguishing system based on water mist and fire stoppers in the facade's ventilation gaps.

A high-rise wood apartment building was claimed to be manufactured in half the time that the "traditional" building requires. The news story noted that there were over 37 two-floor wooden apartments in Finland which included 649 flats.

5.3.5 Desta Clean wood stones

These wood stones were the only innovation in the Wood Construction material that was introduced in the context of Circular Economy. Indeed, recycling was quite central to the innovation, whose raw materials were "wooden fibres, natural stone matter, cement and water". Apparently the existing production lines of concrete stones only allow for 25 % ratio of recycled wood chippings whereas the wood stones could include 50-60 % of wooden fibres.

The business-side benefit is that the composite stone weighs 20% less than concrete stone and its transportation and installation are therefore cheaper. Although the innovation was basically substituting garden stones, Destamatic was planning to produce other recycled products under the Destaclean concept and thereby widening its customer base and partner networks. The company claimed that it had successfully tested the manufacturing of these products out of nearly all sorts of construction waste.

The patent process was still on-going and the costumer deliveries were beginning in April 2015.

5.3.6 Additional wooden floors in concrete buildings

The innovation is based on an interview in 2012 with Markku Karjalainen who had begun his tenure as the development director of wood construction program in the Ministry of Employment and the Economy. The civil servant made a number of assessments regarding the state of wood construction, but the most concrete application mentioned was the idea of renovating concrete apartment houses built in the 1960s and 1970s with additional

Table 27. Adding wooden floors
Fields of Business
Construction (Wood, Concrete)
Aspect of Circular Economy
Reuse in a way
Environmental Impacts
There are "environmental viewpoints" in favor
Economic Impacts
A solution to structural change and employing 50 000 people in total
Role of Public Policy
A public actor, the wood construction program had apparently been a part of the Katainen Administration's strategic program for the Forest Sector. Furthermore wood construction had been mentioned four times in a government platform without yielding any results according to Karjalainen.
Stakeholders
Markku Karjalainen, the Ministry of Employment and the Economy
Drivers
Education related to Wood Construction. Some institute in Oulu did have wood construction knowledge.
Barriers
Concrete Industry dominates the industry, therefore the sector's education emphasizes it, and therefore education on wood construction is limited. The number of private actors is therefore limited. Fire ordinances indirectly.

wooden floors. That was apparently possible

under the existing fire ordinance. 280 000 apartments could be created in such a manner according to Karjalainen. There were not any additional remarks related to the idea in the media materials, which suggests that the idea never materialized.

5.3.7 Various

There were a variety of different projects related to wood construction, but which did not include a specific innovation. For examples Stora Enso was noted to be working with Skanska regarding the BoKlok -concept and with SRV concerning Wood City in Jätkäsaari and four high-rise apartment buildings in Pukinmäki. Metsä Wood was planning a wood block in Tapiola with Asuntosäätiö. Its other projects were not public yet. One article in 2012 referred to the "biggest wooden high-rise apartment building in Finland for the time being" that was built in Viikki. However that title was taken over by the planned "wooden giant" that was constructed by the construction company Reponen in Vantaa Kivistö. It was not altogether clear whether or not this project was linked to that of Skanska and Stora Enso in the same district.

Versowood on the other hand had already built a five floor building in Heinola. Stora Enso and SRV were also involved in manufacturing wooden student housing in Joensuu. Generally speaking the business field was thought to be a growing one. One article claimed that ten wooden high-rise buildings were built in a decade whereas "now the same amount is built in 2-3 years". Hence the industry would grow to 10-15 % of all construction during the next five years.

One news article in 2012 also cited a letter of intent between the City of Espoo, Aalto University and the Ministry of Employment and the Economy that included plans of establishing a wood sector pilot area for new business, products, services, innovations etc. in Tapiola, Keilaniemi and Otaniemi area. The pilot area was framed as "all-encompassing" since it included architecture, design and marketing among other things. In a sense this was a case of industrial ecology or symbiosis, though it remained uncertain whether or not

the pilot area was ever established.

Finally there was a rather interesting article that examined the controversy regarding a doctoral thesis by Vesa Ijäs. He had effectively contended that false stances were impeding wood construction; it was still viewed as "test construction" and the constructors were not familiar with industrial systems of wood construction. The greatest issue, however, was thought to be the unpredictability of administrative control,

which was a result of the ignorance of municipal civil servants and lack of a regional supervision on construction. Ijäs' solutions were a risk-sharing business model, a Swedish approach where a constructor builds high-rise apartment buildings with the intention of also owning them in the long-term and that the Forest Companies would assume a "grynder" -status in wood construction.

6. In Conclusion

Circular Economy is treated with some differences in the three societal newspapers. HS for one did not seem very interested in depicting the business fields that might be associated with Circular Economy. MT on the other hand did reveal its affiliations due to large amount of attention to Agriculture and Forestry even if the said affiliation was not otherwise very visible in the content.

The European Union was clearly a shared topic with all of the newspapers as was waste management and legislation. Generally speaking there was a tendency to associate Circular Economy with economic benefits more so than with environmental ones, though the difference was not always very wide.

One of the most interesting topics in this analysis was a question of how Circular Economy is defined. A key finding was that it was more often than not framed in terms of circulating waste rather than e.g. sharing economy. The idea of a closed value circle did not emerge often. There were certainly differences in newspapers. For example HS was rather abstract in its treatment of the concept whereas KL and MT introduced concrete applications to greater extent.

Especially in professional magazines, textile innovations were introduced as rather novel innovations with potentials for upscaling, though there were indications that there had in fact been long-term research concerning them. High-rise Wood Construction was more prevalent a phenomenon among professional magazines, although that is not to say that the related innovations would have been described to the same extent.

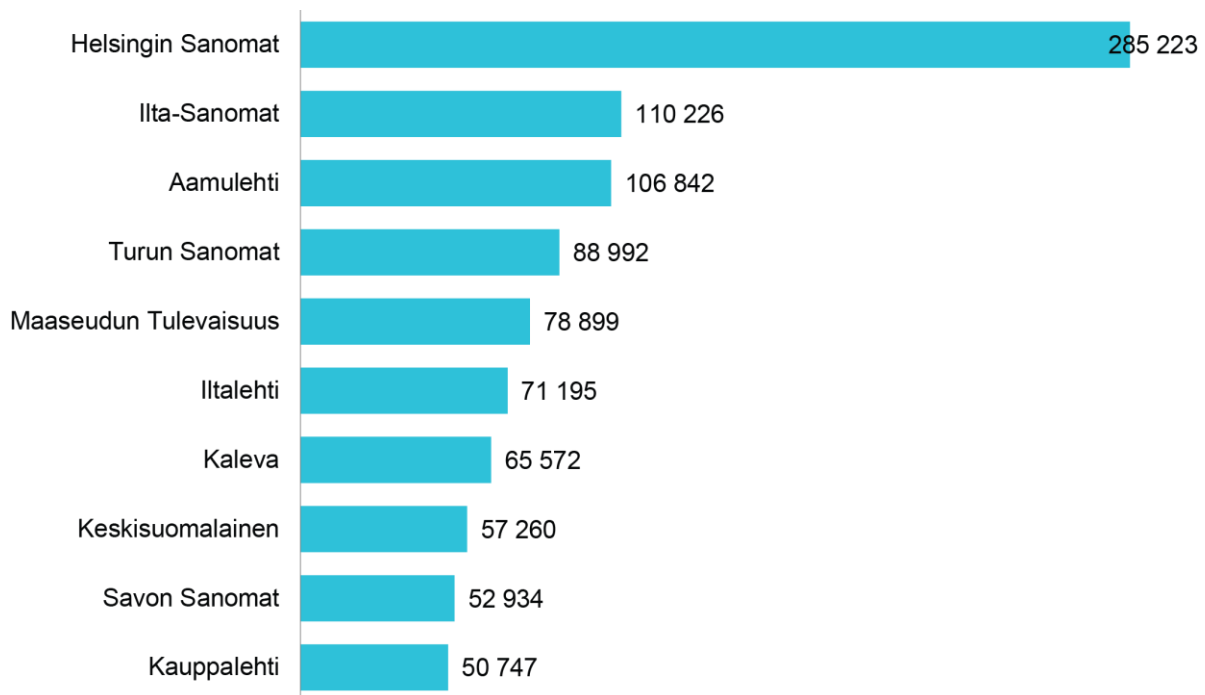
Biorefinery was the most prominent innovation in the media material looking at the number of articles alone. Especially after the beginning of the Äänekoski –project similar initiatives seem to have taken ground. The ideals of Circular Economy were not always as visible in them as in Äänekoski, and they might, for example merely include plans of tall oil production out of shunt currents. Furthermore their completion is not guaranteed by any means. Yet it would seem that out of all these fields, the biorefineries are the ones that are vested with the hope of renewing Finnish Economy.

7. Appendix

Annex 1: The societal analysis was based on the key words “Circular Economy” and “Bioeconomy”. The innovation analysis had more varied search terms. For textile industry the key words were *tekstiil** + (*sellu**, *puumat**, *puumas**, *puukui**). For biorefineries the key words were *Biojalostam**, *biopolttoainelaito**, *biodiesellaito**, *biodieseljalostam**, *biodieselteh**, *biotuoteteh**. All of the terms were actually synonyms, which might reveal something about the novelty of the said innovation. For wood construction the key words were *puurakenta**, *puuelement**, *puukerrost**, (*puurakente** + *kerros**). Additionally two news stories were added to analysis on the basis of the keyword “Circular Economy”. After listing these “hits” on excel, relevant the news stories were analysed through the questionnaire frameworks presented in Chapter 2-

Annex 2: Newspaper Circulation Data

Graph 8: The Ten Largest Newspapers in Finland by Circulation (2014)



Source: Media Audit Finland (Taken from http://www.sanomalehdet.fi/sanomalehtitieto/levikki/suomen_10_suurinta_sanomalehteja_levikin_mukaan_in_30.6.2015)