SAVONIA

OPINNÄYTETYÖ - **AMMATTIKORKEAKOULUTUTKINTO**
TEKNIIKAN JA LIIKENTEEN ALA

ASSESSMENT OF THE INVESTMENT MEMO OF ABOWE PILOT A FINLAND

TEKIJÄ: Mika Vehviläinen

SAVONIA-AMMATTIKORKEAKOULU

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Tiivistelmä

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Ohjaaja(t) Pertti Varis, Lehtori, (DI), Tuotantotalous	
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Tiivistelmä
Tämän opinnäytetyön tavoitteena oli selvittää asiakastarvetta ja täyden kokoluokan mahdollisuuksia ABOWE-projektiin liittyvän Pilot A bio-jalostamoa varten tehdyn investointimuistion pohjalta. ABOWE tarkoittaa Implementing Advanced Concepts for Biological Utilization of Waste, eli toteutetaan edistyksellisiä konsepteja jätteiden biologiseen hyötykäyttöön. Investointimuistio tehtiin kunkin pilotin testausalueen tietojen pohjalta. Investointimuistion teossa vaadittiin tiedonhakua ja käsittelyä, alueellista mallinnusta, liiketoimintamalleja, kustannusarvioita ja täyden kokoluokan laitoksen mahdollisuuksia. Investointimuistio laadittiin englanniksi, joten myös tämä työ on englannin kielellä. Investointimuistiota varten tehty liiketoimintamalli-kysely toimi lähdetietona asiakastarvetta varten. Kysely tehtiin webropol-sovelluksen ja Kuopiossa pidetyn investointilaisuuden avulla.

Työn ensimmäisessä varsinaisessa kappaleessa tarkasteltiin biojalostamoa varten tehty investointimuistio. Kappaleessa on projektin tarkempi esittely, kuvaus operatiivisesta ympäristöstä, energia -ja kemikaalimarkkinoista pilotointialueella, kuvaus pilot-laitoksesta ja testauksesta, alueellinen mallinnus, liiketoimintamallinnus ja strategioita täyden mittakaavan laitokseen liittyen. Seuraavassa vaiheessa selvitettiin liiketoimintamalli-kyselyssä tulleiden vastausten perusteella biojalostamon asiakastarvetta. Vastauksia kerättiin alan asiantuntijoilta ja osa vastauksista valittiin tarkempaan tarkasteluun. Tarkempaa tiedonkeruuta tehtiin jätteen käsittelyyn, liikenteen biopolttoaineisiin ja teollisuuden bioenergiaan liittyen. Tämän jälkeen työssä tarkasteltiin täyden mittakaavan biojalostamon mahdollisuuksia. Nämä mahdollisuudet jaettiin kolmeen osaan, laitokseen teollisuuslaitoksen yhteydessä, itsenäiseen laitokseen ja tutkimuskäyttöön.

Työn lopussa käytiin läpi johtopäätöksiä selvitystyön perusteella tulevaisuuden asiakastarpeesta ja täyden mittakaavan mahdollisuuksista. Johtopäätöksien perusteella voidaan todeta, että asiakastarve eloperäisten jätteiden käsittelyn tehostamiseksi on olemassa. Myös liikenteen biopolttoaineiden käyttö tulee lisääntymään merkittävästi vuoteen 2020 mennessä EU:n ja Suomen valtion tekemien pitkänajan ilmasto -ja energiatavoitteiden vuoksi.

Avainsanat
Bio-jalostamo, ABOWE, Investointimuistio, asiakastarve, jätehuolto, biopolttoaineet, bio-jalostamoiden potentiaali

SAVONIA UNIVERSITY OF APPLIED SCIENCES

THESIS
Abstract

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Author(s) Mika Vehviläinen			
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Supervisor(s) Mr.Pertti Varis, Lecturer, M.Sc., Production and Operations Management			
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Abstract

The object of the thesis was to assess customer needs and full scale possibilities with the investment memo based on the ABOWE project novel biorefinery pilot. ABOWE stands for Implementing Advanced Concepts for Biological Utilization of Waste. The investment memo was made based on independent piloting on the testing region. In order to make an investment memo, the following attributes and actions are needed: data research, regional modeling, business models, cost estimates and strategy for full scale business. The investment memo and this thesis were both written in English. The business model survey made for the investment memo was the basis reference to customer needs. The survey was made by using a web based webropol-survey maker. The survey was also made to participants of the investment memo event held in Kuopio.

The first part of the thesis consists of the investment memo made for the piloting of biorefinery in Savon Sellu. The investment memo chapter consists of the executive summary, description of the operating environment, energy and chemical markets in the testing region, description of the pilot plant and tests and business model. The second part of the thesis consists of customer needs based on the survey made on the business model. Answers collected from the experts of the field were chosen for further assessment. A closer research and analysis were made to waste management, biofuels for transport and bioenergy for industry. The third part of the thesis consists of full scale possibilities for biorefinery technology. Possibilities were split into three different scenarios, a full scale plant beside industry, an independent full scale plant and a plant for research use. Custom biorefineries running around the world were used as reference.

The last part of the thesis consists of conclusions made from the customer needs and full scale possibilities. Clear customer needs for enhancing the waste management of biodegradable waste were proven to exist. Also the use of biofuels in transport sectors is going to increase by the year 2020 due to the EU's and government's long-term energy and climate targets.

Keywords
Biorefinery, ABOWE, investment memo, customer needs, waste management, biofuels, potential of biorefiniries

CONTENTS

1 INTRODUCTION

The basis for the thesis is a project study which started in fall 2012. The ABOWE project was already running and there was a period at school where there an opportunity to create a report for the Pilot A process as a group. That was followed by an opportunity to work in the project by co-authoring the investment memo.

ABOWE comes from Implementing Advanced Concepts for Biological Utilization of Waste. It is a project which is partially financed by the European Union. It started in 2012 and there are many partners behind the project. Savonia University of Applied Sciences is the main partner and other partners are Ostfalia University of Applied Sciences in Germany, Marshall Office of lower Silesia in Poland, Klaipeda University in Lithuania, Mälardalen University in Sweden, Estonian Regional and Local Development Agency, University of Eastern Finland and Finnoflag Oy in Finland.

The results of the project, two mobile pilot plants were built and will be tested in several Baltic Sea Regions. Pilot A is a novel biorefinery process and Pilot B a dry fermentation process. Pilot A was built in Finland and Pilot B in Germany. There are six different pilot locations, three for each pilot. The format in the locations will be the same.

The biorefinery pilot will be used in three different locations, Savon Sellu in Finland, a chip factory in Poland and a slaughterhouse in Sweden. There will be approximately 2 months' piloting period in all of the testing sites. Tests in Finland will end in the beginning of April 2014. The results from the tests will be used to draw up the investment memo.

In Finland's case two different investor events will be held.The first was held in Kuopio on 12 March 2014 and another will be held on 22 April 2014 in the Heureka science center in Vantaa.
The reasons for these events are to invite possible interested parties to listen to the results so far.

The following pages will present a closer look at the investment memo which is a report based on the possibilities and results from the regional area of Northern Savo considering a biorefinery pilot and its full scale possibilities.

Part of the investment memo was a survey for the business models which is the basis to a lot of the information used in this thesis. The surveys were made with webropol, a web-based survey maker and by hand in the investor event in Kuopio.

2 INVESTMENT MEMO

The investment memo is a report that is presented to potential investors. It usually presents the investment case in a detailed view to the reader.

In the ABOWE project the purpose of the investment memo is to present possibilities in the future with both the pilot and full scale operations. Investment memos will be made for each pilot location.

The template for the investment memo will be used as a basis for memos from all testing regions. The template was made in co-operation with Savonia UAS and Ostfalia UAS.

The original investment memo consists of nine different topics including a regional model and cost structure calculations which are not part of this thesis.The investment memo for Pilot A in Finland was made by Tuomo Eskelinen, Miika Kajanus, Tuomas Huopana, Mervi Lappi, Ari Jääskeläinen, Marja Kauppinen, Elias Hakalehto, Anneli Heitto and Mika Vehviläinen.

This chapter is based on the actual investment memo and it shows some of the information used in the investment memo.

2.1 Introduction

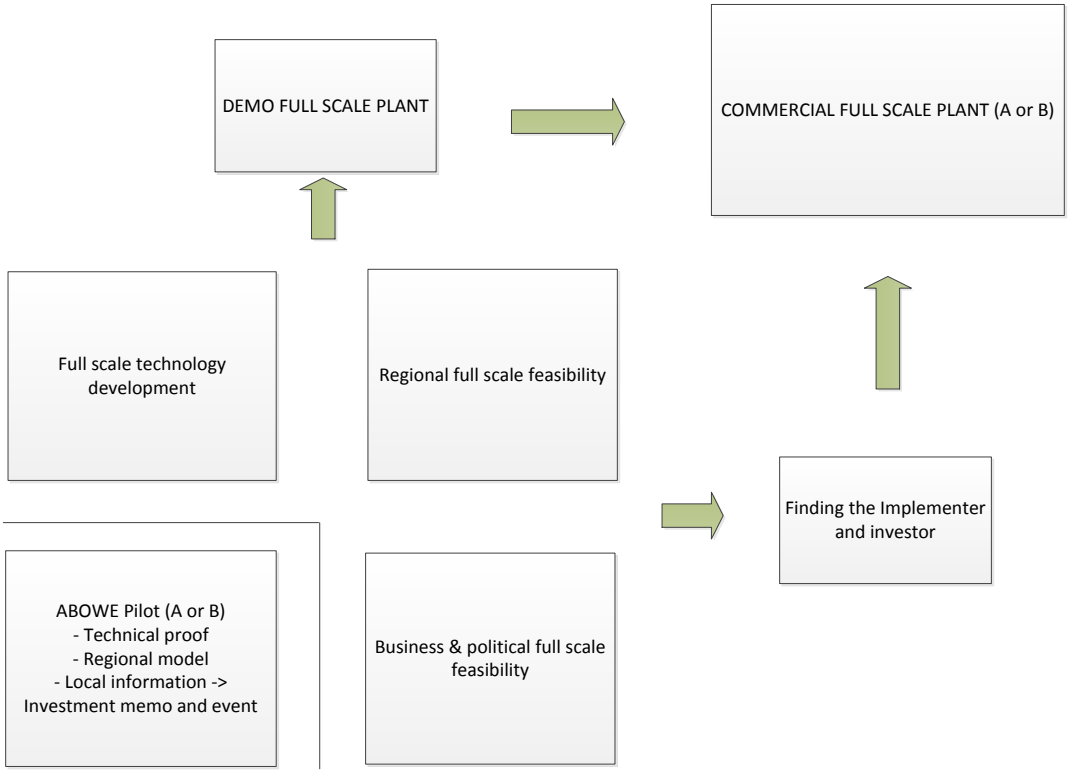

FIGURE 1. ABOWE in the path towards full scale plants (Kajanus 2013).

Figure 1 shows the importance of the ABOWE project in the path towards full scale implementation. Follow-up projects are needed to be able to reach the goal of the full scale implementations.

2.2 Executive summary

The ABOWE Pilot A Finland Investment memo is a document that gives a view of the operating environment, energy and chemical market in Finland, pilot plant and tests, regional model, business model and strategy to full scale business.

Research and development and innovations are increasing in finding sustainable solutions for waste management and reducing the overall environmental load. They are part of the EU's long-term climate and energy targets.

The novel biorefinery concept was developed by Dr. Elias Hakalehto and Finnoflag Oy. The upstream bioprocess that will be piloted is based on bacterial metabolism in the 2,3-butanediol fermentation. Other valuable products are also formed of this fermentation. The technology for the actual downstream process is being developed in Ostfalia University of Applied Sciences in Germany.

The piloting period in Finland presented that the concept works and concentrations of butanediol, butanol and hydrogen have been formed. Raw materials used in piloting are considered to be in league of million euro expense annually.

In order to move forward in looking for investors for the full scale plant all the scheduled piloting will be needed in Poland and Sweden with different kind of raw materials. The Downstream process is also a substantive part of the whole process so follow-up projects will be needed to attract possible investors.

2.3 Operating environment

Political views on handling waste are changing due to the European Union's policy.The EU has set objectives on decreasing GHG emissions by the year 2020 in the Member States (EC 2009,28). The EU uses guiding methods to achieve a 20% decrease on GHG emissions. Finland has set even greater objectives on GHG emission reductions by the year 2020. The new waste act has objectives to increase recycling and reuse of waste by 2016 and 2020. By the year 2016 half of the municipal waste should be recycled for material recovery and by the year 2020, 70 per cent of construction and demolition waste should be recycled or reused. Also all biodegradable waste consisting of over 10 per cent total organic carbon (TOC), cannot be put to a landfill. (Statistics Finland 2013).

Economical aspects guides political and legal environment by fares and different kind of tax-reliefs and bursaries from the EU and the government. Finland has set higher objectives on emission reductions by the year 2020. This means that there are also more financial endorsements from the government. The EU is funding European reseach and development projects between years 2014-2020 for the total amount of 70.2 billion euros (Horizon 2020 2014). This biobased economy has and will be stepping on new levels. According to some wild estimates, biobased economy in 2040 will have a market value of around 90 billion euros.

Sustainability is one of the most important criteria when new kind of technology is applied to use. The base for the EU's climate and energy targets is to make a sustainable way to use world's resources. This project follows the same principle (EC 2009,28).

When looking things from the technological point of view, the situation at the moment is mainly focused on producing bioethanol or bio-oil from side streams in Finland. Waste is used as raw material and this can bring a certain amount of competition, particularly waste from forest industry is a highly desired raw material. Waste management has been large expense to the forest industry in the past years.

The goal of this project is to utilize new kind of technology to produce waste-to-energy and also to get commodities from the process e.g. liquid biofuels and other useful chemicals. The pilot has been proven to work after the first pilot period ended in Savon Sellu. Demand for waste utilization will be increasing and technological innovations are researched.

Energy and chemical markets in Finland are potential in the foreseeable future. Especially bioethanol production will rise towards the year 2020. Chemicals that can be made with the process are considered as platform-chemicals.

2.4 Products

Following products can be made with the process depending on raw material; 2,3-butanediol, ethanol, acetone, butanol, hydrogen and methane. Some are products due to fermentation and other by-products. It is noticeable that some of these chemical products can also be used as an energy source.

2.4.1 Chemical products

The most attractive of them all, 2.3-butanediol is a substance that is used as raw material in the making of material like synthetic rubber, plastic monomers, anti-icing chemical, textiles, cosmetics and many other substances. (Hakalehto, Jääskeläinen, Suhonen 2013).

Ethanol is an alcohol which can be used as motor fuel, mainly as a biofuel additive for gasoline. In Finland the ethanol concentration of 95 octane petrol was raised in January 2011. The highest possible bioethanol concentration for E10 petrol is 10 per cent v/v. (Finnish Petroleum Association 2013). Finland has also set the biofuel blending mandate at 6 per cent (Cansino, Del, Pablo-Romero, Roman, Yñiguez 2012, 5). Domestic bioethanol production will be crucial in future.

Acetone is a chemical that is one of the most widely used industrial solvents. It is also used increasingly as chemical intermediate. About 75 per cent of the available acetone is used to produce other

chemicals. Use of acetone applications range from surface coatings to pharmaceutical applications. (Dow Chemical Company 2006).

Butanol is an alcohol that can be also used as transport fuel. It is also used to produce other chemicals, like in an ingredient in formulated products like cosmetics and solvents such as paints, coatings, resins, alkaloids and rubbers. (Dow Chemical Company 2006).

2.4.2 Energy products

Hydrogen is a gas which has the highest combustion energy release per unit of weight of any commonly occurring material. It is considered as the fuel of the future due its non-polluting combustion products. (Universal Industrial Products Inc, 2013). Hydrogen is most commonly produced either from steam reformation of methane or electrolysis. Hydrogen is also common by-product in chemical industry. Hydrogen as biofuel for transport is still considered quite expensive due to cost of the fuel cell system needed to combust the hydrogen. Fuel cell technology will become more common and cheaper in the future but the growth will happen in certain areas in the world. In Finland the use of hydrogen as biofuel of transport will happen periodically. (Yle 2014).

Methane is a gas and it is the main component of natural gas. It is mainly used as a fuel in energy and transport sector. In Finland methane is mainly used in combined heat and power (CHP) production and partly as biofuel for transport. (Statistics Finland 2007).

2.4.3 Fertilizers

Biorefinery process will leave some amount of residue. Depending on raw material this residue can be used as fertilizer. Due to high concentration of some substances in residue the most applicable use would be the use as a forest fertilizer. It has been proven that one-time fertilization adds the growing stock in eight years by 13-25 m^3/ha. Fertilizers can be also used in the households if the high concentrations of some substances are removed. (Mustonen 2012,30).

2.5 Price levels of products

Price levels of the products are separated and they all are estimates. Some products have remarkable market prices at the moment.

2.5.1 Gate fees

Gate fees are paid by the waste producers to the company that is responsible for managing the waste. This makes waste management economically worthwhile. Gate fees are dependant on the contents of the waste. Gate fees are also in correlation with the total investment costs of the biorefinery and the profit of the outputs. That way the competitive gate fee amount can be solved. Savon Sellu produces 34 000 tons of sludge waste annually. That makes expense in class of million

euros per year. For example gate fee of the CHP biogas plant in Oulu in Northern Finland, is for the municipal waste as high as 87 euros per ton without VAT (Sankala 2012). That way a rough estimate can be given that gate fees vary between 30-90 euros depending on waste concentrations and the waste handler.

2.5.2 Energy products

Hydrogen in liquid fuel form costs at the moment approximately 10 euros per kilo. If hydrogen fuel cell technology takes off in larger scale, estimate is that costs are going down. 5 kilos of hydrogen fuel gives effective range of about 600 kilometers. At the moment there are only few pumping stations for hydrogen in Finland. (Yle 2014).

Methane Biogas on Gasum pumping stations at the moment costs 1.505 euros per kilo. Primarly biogas comes from Russia, so lot different aspects affect the market price. (Gasum 2013).

Estimates are that depending on the blend rate of 200-400 million litres of bioethanol would be consumed in Finland in 2020. This would translate into value of 50-100 million euros for the Finnish ethanol market. At the moment Finland has biofuel blending mandate of six per cent. So effectively Finland have committed that six per cent of the energy used in transport sector comes from biofuels. (Härmälä 2010,7).

2.5.3 Chemicals

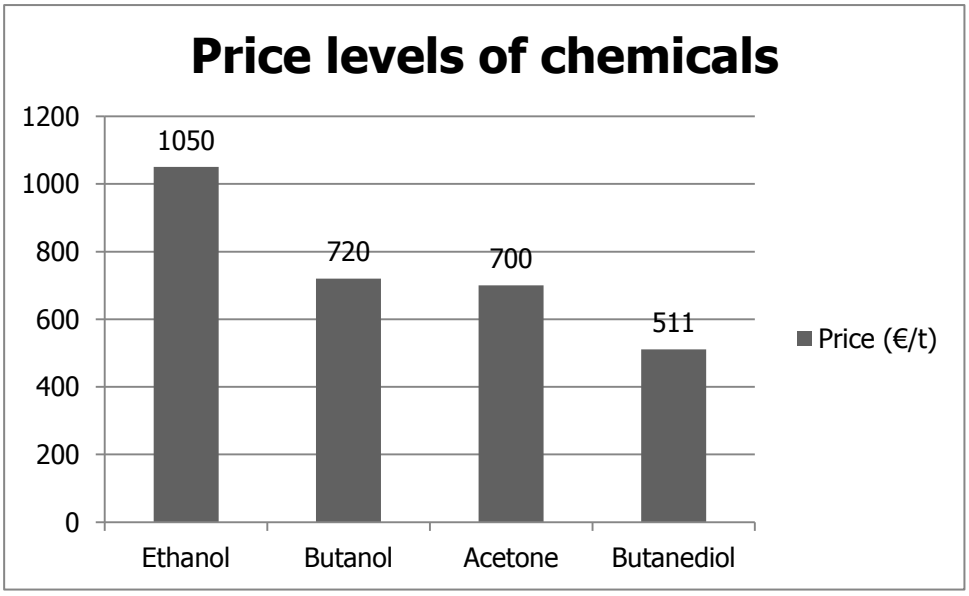

FIGURE 2. Price levels of chemicals. (Huopana 2014), CMAI 2008,3).

Figure 2 shows chemical price levels of 2,3-butanediol, acetone, butanol and ethanol in certain concentrations. Prices are collected from different sources. (Huopana 2014), CMAI 2008,3).

2.5.4 Fertilizers

Price levels of the forest fertilizers ranges depending on the type of the fertilizer. Yara Finland price levels for forest fertilizers range from 400-529 euros per ton without VAT. These are 2012 price levels. The Fertilizer price levels depends on the nutrient ratio. (Mustonen 2012,13).

2.6 Competitors

The biorefinery technology is relatively new form of business in Finland. Therefore competition is at the moment minimal although big energy companies are using a lot of R&D in the field.

Bioethanol production will be increasing greatly in the next years to meet the government's climate and energy targets by the year 2020 and after that. Finnish energy solution company St1 has currently seven bioethanol plants in Finland. Their plants are using various waste and residues as inputs to produce the bioethanol. That brings competition on the gate fees. (St1 2014).

Finnish Green Fuel Nordic is a biorefining company. They have aims to build several biorefineries in Finland in upcoming years. Their plants will utilize commercially proven RTP^{TM} technology. Their first plant is being built in Iisalmi in Northern Savo and second plant is on planning stage. Their goal is to produce a second generation bio-oil. Their main raw material will be renewable wood biomass. Their target market is industrial and municipal electricity and heat production alongside the use of bio-oil to power marine diesel engines. (Greenfuel Nordic 2014).

2.7 Pilot plant and tests

The ABOWE Pilot A is a novel biorefinery build in Kuopio, Finland for the purpose of researching three different kinds of outputs. The technology and innovation is based on Dr. Elias Hakalehto's concept of biorefining process. Process uses methods similar found in nature and human digestion. Fermentation process happens with the help of bacteria and microbes.

Tests in Finland, Savon sellu cardboard factory, started in the end of 2013 and ended in April 2014. Test results came up with promising amount of energy products like hydrogen and chemicals like butane and butanediol.

2.8 Business model

In the investment memo, business model is created by using an Extended Business Model Canvas template (Eskelinen, Kajanus 2013). In this thesis work, focus was put on the 1) collection of business model items, and 2) in the evaluation of the items against two evaluation criterias. Items for the business model blocks were collected in two steps with a survey and interviews with specialists. The answers were analysed by using decicion making tools.

2.9 Business Model Canvas

Figure 3 shows an example of the Business Model Canvas template with some of the answers obtained. The template was created in the workgroup (Eskelinen, Kajanus 2013). Questions for the business model survey were created by using the template. Canvas shows some answers collected from the survey.

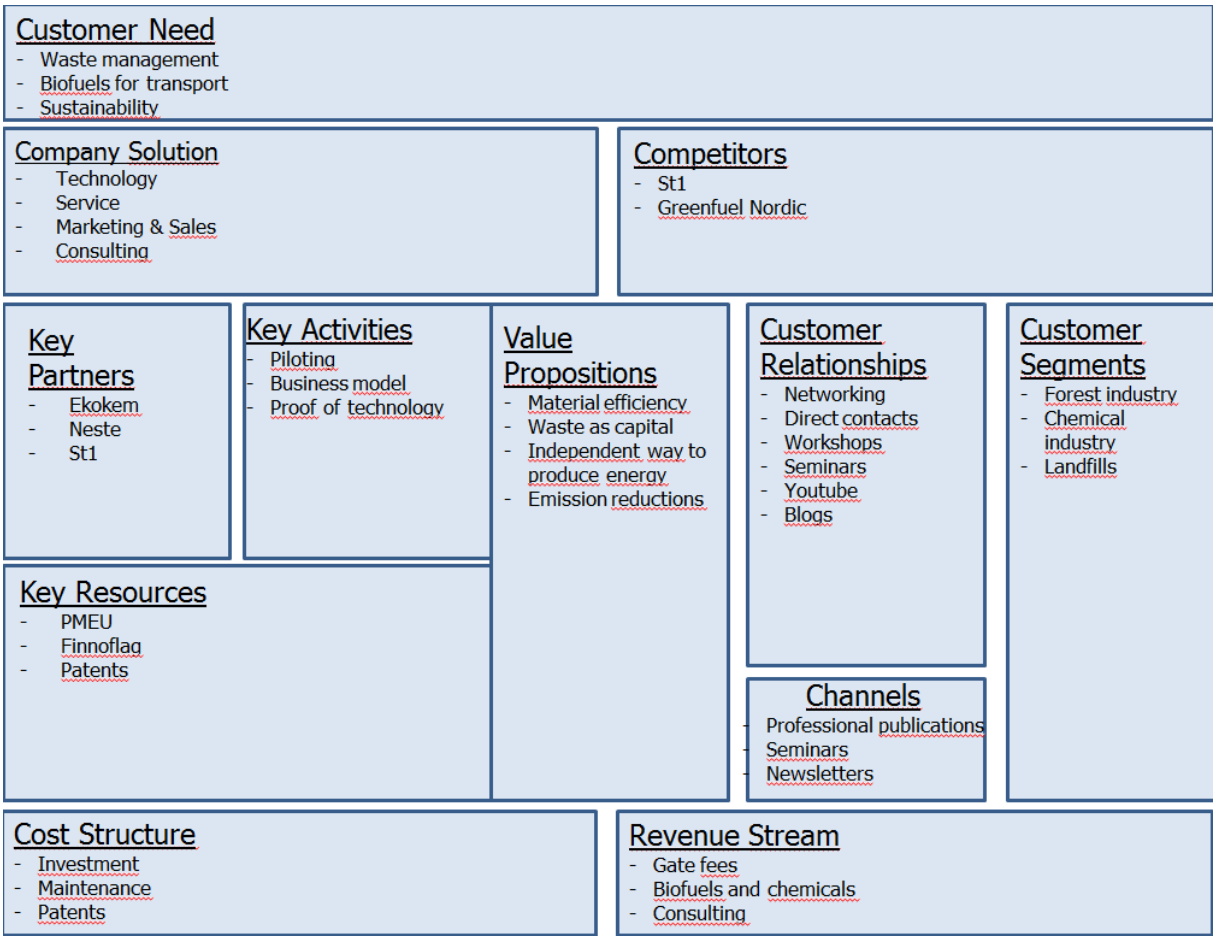

FIGURE 3. Business Model Canvas with some answers from the survey.

2.10 Business model survey

The survey for the business model was made in two steps. The first survey was made by using a web-based survey maker, webropol. The first survey was made entirely to Finnish specialists. All the questions were in Finnish.

Ideas for the business model were also collected in an Investor Event that was held in Kuopio in February 2014. The Event had participants from all the Baltic Sea region partner countries, and the brainstorming was carried out in English. All together, these both parts gave a lot of answers to the next stage of the business model creation. Analysis of the results will be reported in a separate thesis study.

2.11 SWOT analysis

The SWOT analysis illustrates strengths, weaknesses, opportunities and threats. Work group that done the investment memo brainstormed SWOT analysis illustrated in figure 4.

FIGURE 4. SWOT analysis.

3 CUSTOMER NEEDS

The surveys made for the business model also gave answers to customer needs in biorefinery technology. Following topics were some of the results from the survey; better material efficiency, development of waste management, turning waste into money, results for challenges in waste handling, decreasing the environmental load and image. These were the answers from the experts chosen to the business model assessment phase.

Material efficiency is a way to produce competitive products and services with smaller material portions by the way that its harmful effects decrease in life cycle. It has become an important factor because of the environmental issues regarding the use of natural resources. The main objective is to minimize the use of materials and energy and the second objective is to reduce all the harmful effects to the environment of the products and life cycle of services. Natural resouces are more efficiently used if also the material input is smaller. This makes cost effectiveness a big factor for the industry. (Environment.fi 2014).

There are ways to improve the material effiency of products. Possible scenarios can be to use raw materials and forms of energy and transport that uses low lifetime energy and material consumption. Other means can be enhancing the production process by increasing the efficiency of material and energy consumption, by minimizing and optimizing logistics, by developing longevity, versatility and serviceability of products and by reusing products and developing systems for doing so. Reviews in collaboration with pilot businesses according to the Finnish Environmental Institute indicate that potential savings of 20-30 percent can be achieved with reuse and recycling. Turning waste into money can be achieved in a lot of different ways. The most common ones are to process the waste and turn it into energy. (Environment.fi 2014).

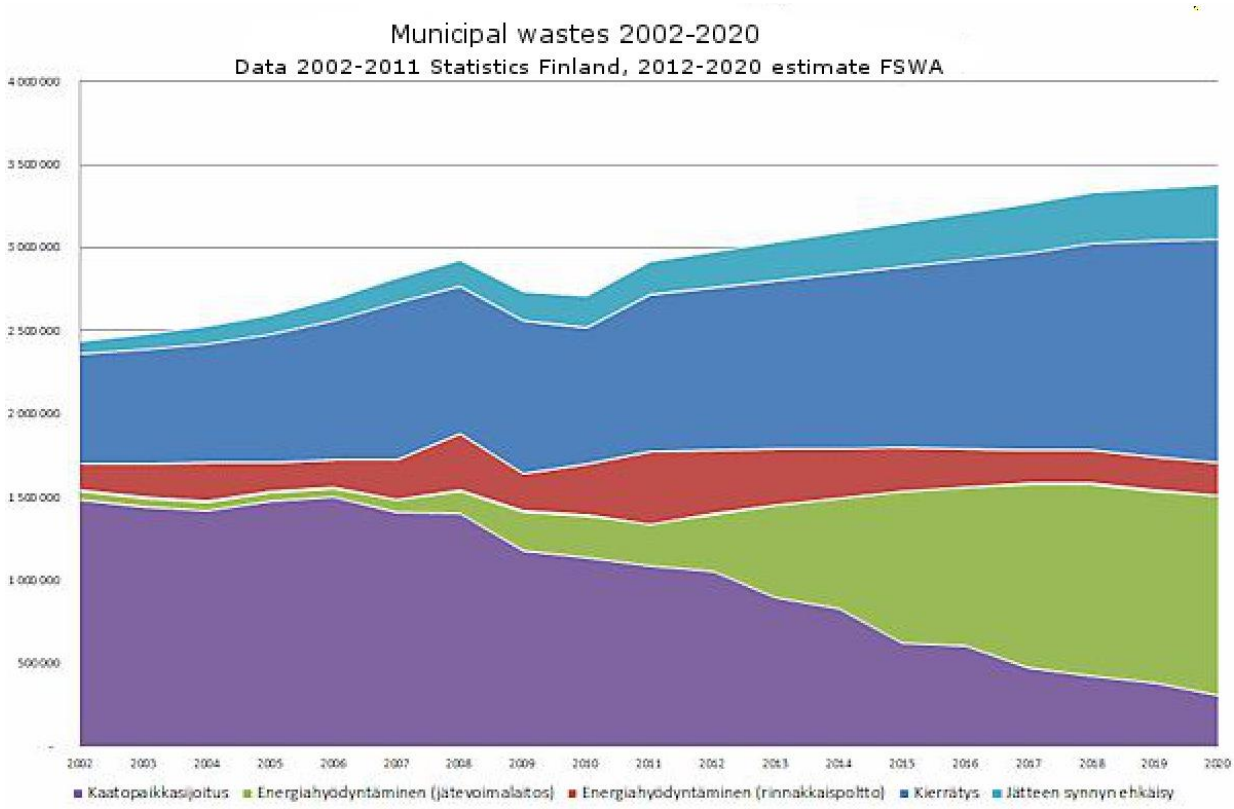

FIGURE 5. Prosessing of the municipal waste 2002-2020, (Finnish Solid Waste Association 2013).

Figure 5 shows the process of the municipal waste in Finland between 2002 and 2020. Information between years 2002 to 2011 are from Statistics Finland and years 2012 to 2020 are an estimate by Finnish Solid Waste Association. Utilisations of energy are shown by red and green colors in the figure. Green shows utilization to energy by a waste power plant and red the utilization to enegy with co-incineration. Co-incineration is not as a material efficient way to produce energy as by doing it with waste power plants. Over 60 percent of the municipal waste that is unusable for recycling coming from residential areas is renewable material and can be classified as renewable fuels. By using this kind of waste as an energy source, use of fossil fuels like coal can be reduced. Earlier this kind of municipal waste was put to the landfills but due to the restrictions coming after the year 2016 this is no longer possible. (Finnish Solid Waste Association 2013).

The positive image is a very sought after factor in business. Recycling and material efficiency and using renewable energy will bring a positive image to the company.

3.1 Waste management

Waste management will be very big challenge to Member States of European Union. According the Council of State – act for treatment of waste, all biodegradable waste consisting over 10 % TOC (Total Organic Carbon) cannot be put to landfill after the year 2016, so alternative type of solutions have to be used. Turning waste-to-energy is good way to do so but it can be done by lots of different ways. It can be burned in waste power plants or to make compost or used in biorefineries. Biorefinery is especially useful when processing the biodegradable waste that is difficult to recycle. (Act for treatment of waste 19.4.2012/179).

The new waste acts purpose is to ensure material-efficient and responsible waste management in Finland. It started already in beginning of 2012 and its goal by 2016 is that half of the all municipal waste should be recycled for material recovery and by the year 2020 70 per cent of construction and demolition waste should be recycled or reused.

FIGURE 6. Waste hierarchy (Ekokem 2014).

Waste hierarchy is certain kind of classification to waste management and its options. European Union Waste Framework Directive 2008 has five steps in its waste hierarchy. Hierarchy is also shown in figure 6. (Ekokem 2014).

1. Reducing the quantity and harmfulness of waste; Prevention
2. Preparation waste for reuse
3. Recycling of waste
4. Recovery of waste
5. Disposal of waste

The prevention happens with better planning of process and consulting. Reuse can be enhanced by advanced services for customers. Recycling can be increased by replacing construction materials with indrustial by-products and contaminated soils. Recovery of metals, plastics and fibres are also essential. Recycling processes can also be modified better in connection with outsourcing. Recovery

can be enhanced by recovering waste to energy. Especially municipal and hazardous waste should be used. The last option is to dispose of the waste by incineration and safe disposal to landfill. (Ekokem 2014).

TABLE 1. Generation of waste by sector and by type of waste 2011, 1,000 tonnes (Statistics Finland 2011).

Industry	Type of waste												
	Chemical waste	Metallic waste	Glass waste	Paper and cardboard waste	Plastic and rubber waste	Wood waste	Animal and vegetal waste	Household and mixed waste	Sludges	Mineral waste	Other waste	Total	of which hazardous waste
Agriculture, forestry and fishing [1)]	0	0	0	0	0	2 760	0	0	0	0	0	2 760	0
Mining and quarrying	0	0	0	0	0	0	0	0	0	56 910	0	56 910	0
Manufacturing	1 085	216	40	208	34	8 340	600	1 455	470	1 360	16	13 825	442
Food products and beverages	2	9	4	7	6	4	589	35	14	192	9	871	7
Manuf. textiles, wearing apparel and leather products	5	0	0	1	0	0	0	1	0	0	5	12	1
Wood and wood products	6	2	0	1	0	5 376	0	5	2	10	0	5 403	26
Paper and paper products printing and reproduction of recorded media	342	17	0	185	8	2 935	1	1 312	288	123	1	5 212	8
Coke and refined petroleum products	16	0	0	0	0	0	0	0	0	2	0	18	18
Chemicalt, chemical products and rubber and plastic products	511	4	0	5	18	6	5	44	124	51	0	768	95
Non-metallic mineral products	1	3	36	1	0	1	0	23	1	462	0	582	2
Basic metals and metal products	194	149	0	5	1	5	4	23	41	502	1	925	276
Machinery and equipment n.e.c and elect.equipmenet	7	32	0	3	1	6	1	11	0	18	0	79	8
Manufacturing n.e.c.	1	0	0	0	0	7	0	1	0	0	0	9	1
Electricity, gas, steam and air conditioning supply	9	6	0	14	11	225	0	35	54	1 158	0	1 514	22
Construction	0	265	1	6	0	253	1	70	14	17 815	0	18 425	334
Households and services	19	16	61	367	23	88	389	1 531	245	83	339	3 161	146
Total	1 113	503	102	595	68	11 666	990	3 091	783	77 326	355	96 595	944
- of which hazardous waste	343	166	0	0	0	33	0	0	57	248	97	944	

1) Sludge, dry weight. Wood waste excluding logging waste left on site.

In table 1 the generation of waste is shown by sector in 2011 according to the Statistics Finland. In total, Finland generated over 96 million tonnes of waste in 2011. Most of it, almost 75 million tonnes of it was either mining or construction waste. The rest, over 20 million tonnes was waste of which 50 per cent should be either recycled or reused by the year 2016. (Statistics Finland 2011).

TABLE 2. Waste treatment 2011, 1,000 tonnes, (Statistics Finland 2011).

	Treatment				
	Treatment total	Recycling	Energy recover	Incinerated	Landfilled
Chemical waste	656	143	52	150	311
- of which hazardous waste	199	80	11	87	21
Metallic waste	1 281	1 272	0	0	9
Glass waste	161	161	0	0	0
Paper and cardboard waste	363	319	30	14	0
Plastic and rubber waste	64	33	20	11	0
Wood waste	11 063	2 809	8 206	37	11
- of which hazardous waste	26	0	26	0	0
Discarded vehicles	92	92	0	0	0
- of which hazardous waste	42	42	0	0	0
Discarded equipment	57	54	0	0	3
- of which hazardous waste	37	36	0	0	1
Animal and vegetal waste	1 266	1 003	129	89	45
Household and mixed waste	2 445	315	853	16	1 261
- of which hazardous waste	44	0	8	12	24
Sludges	593	187	163	60	183
- of which hazardous waste	64	0	6	7	51
Mineral waste	76 991	27 543	106	5	49 337
- of which hazardous waste	547	37	30	5	475
Other waste	877	0	846	0	31
- of which hazardous waste	6	0	0	0	6
Total	95 909	33 931	10 405	382	51 191
- of which hazardous waste	965	195	81	111	578

Table 2 presents statistics of waste treatment in 2011 according to the Statistics Finland. In 2011 over 50 per cent of the waste was landfilled. A large proportion of this was mineral waste mainly from mining and construction. Also percentually over half of the household and mixed waste was landfilled. In total over 51 million tonnes of waste was landfilled. This will bring lots of challenges toward the future. All biodegradabe waste should be recycled and reused. (Statistics Finland 2011).

3.2 Fuels for transport

Finland has the highest objective for renewable energy participation as a final energy consumption in the transport sector with 20 per cent by the year 2020. Table 3 shows the EU-27 countries' objectives and intermediate objectives by the year 2020. (Cansino etc. 2012).

TABLE 3. Objectives for renewable energy participation (Cansino, Del, Pablo-Romero, Roman, Yñiguez 2012,3).

Table 2
Objectives for renewable energy participation as a percentage of final energy consumption in the transport sector (2005–2020).
Source: National Renewable Action Plans (nREAP) (2011).

	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Germany	3.9	7.3	7.5	7.6	7.0	7.0	7.0	7.1	9.3	9.4	9.7	13.2
Austria	2.3	6.8	6.9	7.0	7.2	7.4	7.7	8.1	8.5	9.2	10.1	11.4
Belgium	0.0	3.8	3.8	4.8	4.8	5.7	5.8	6.3	6.5	7.9	9.0	10.14
Bulgaria	1.12	1.3	2.0	2.6	3.1	3.8	4.4	4.9	5.8	6.4	7.0	7.8
Cyprus	0	2.2	2.4	2.5	2.8	2.9	3.1	3.5	3.8	4.2	4.6	4.9
Denmark	0.2	1.0	3.5	5.9	6.0	6.0	6.7	7.3	7.9	8.6	9.4	10.1
Slovakia	0.6	4.1	4.2	4.3	4.4	5.0	6.0	6.3	6.8	8.3	8.5	10.0
Slovenia	0.3	2.6	2.8	3.1	3.5	4.0	4.7	5.6	6.6	7.7	9.0	10.5
Estonia	0.0	0.0	0.0	0.6	1.2	1.3	1.3	1.6	1.8	2.1	2.4	2.7
Spain	1.1	6.0	6.1	6.5	6.5	8.2	9.3	10.4	11.1	12.0	12.7	13.6
Finland	0	6	7	8	10	11	12	14	15	17	18	20
France	1.2	6.5	6.9	7.2	7.5	7.6	7.7	8.4	8.8	9.4	10.0	10.5
Greece	0.02	1.7	3.3	4.1	4.8	5.6	6.3	7.1	7.8	8.6	9.4	10.1
The Netherlands	0.1	4.1	4.2	4.6	5.1	5.6	6.0	6.8	7.7	8.5	9.4	10.3
Hungary	0.22	3.7	4.6	5.0	5.0	5.2	5.4	5.8	6.4	7.3	8.0	10.0
Ireland	3.1	6.6	8.1	9.0	10.5	11.0	11.8	12.2	12.9	14.0	14.4	16.0
Italy	0.87	3.50	4.12	4.72	5.35	5.98	6.63	7.30	7.98	8.68	9.40	10.14
Latvia	0.9	4	4.1	4.2	4.4	4.5	4.6	5.5	6.3	7.2	8.2	10
Lithuania	0.3	4	4	5	6	6	7	8	9	10	10	10
Luxembourg	0.0	2.1	1.3	1.8	2.4	3.2	3.8	4.4	5.4	6.5	8.3	10.0
Malta	n.a.	2.8	3.0	3.3	3.6	3.9	4.2	4.6	5.8	7.1	8.2	10.7
Poland	n.a.	5.84	6.30	6.76	7.21	7.48	7.73	7.99	8.49	9.05	9.59	10.14
Portugal	0.19	5.0	5.1	5.3	5.7	5.9	8.0	8.2	9.0	9.3	9.7	10.0
United Kingdom	0.2	2.6	3.4	4.0	4.5	5.3	6.2	7.0	7.8	8.6	9.5	10.3
Czech Republic	0.1	4.1	4.6	5.2	5.9	6.5	7.1	7.7	8.3	9.6	10.2	10.8
Romania	1.39	5.82	6.37	6.90	7.32	7.72	8.11	8.43	8.80	9.23	9.69	10.00
Sweden	4.0	7.4	8.1	8.8	9.4	10.1	10.7	11.3	11.9	12.5	13.2	13.8

Note: Figures expressed as a percentage of final energy consumption in the transport sector.

To reach these objectives, member states may use different kind of energy sources, like biofuels, green electric power and hydrogen. Member states do not have to produce all the energy domestically so they can import biofuels from other EU countries or outside with surplus of them. According to National Renewable Energy Action Plans (nREAP) by the year 2020 is expected that 90 per cent of total renewable energy consumption for the transport sector comes from biofuels, biodiesel in particural. Green electric power have estimate less than 10 per cent and hydrogen do not have any estimate. (Cansino etc. 2012).

"Some MSs implemented biofuel blending mandates, either separately or in conjunction with other fiscal measures, to boost the use of biofuels in the transport sector. Biofuel blending mandates are implemented by each MS so that the quotas set by them through their respective legislations are legally binding for fuel suppliers. Thus, the blending rate shows the mandatory requirements on the biofuel share of the total transport fuel that is sold. Fossil fuel suppliers have an obligation to supply a certain percentage of biofuel in their total fuel sales. They provide evidence of this by redeeming renewable transport fuel certificates. Blending mandates do not always adopt the same form. In some cases, biofuel blending mandates only refer to a specific percentage of biofuels that the suppliers have to place in the market, through the sale of either pure biofuels or as blends with traditional fuels. In other cases, the suppliers are required to blend their fuels with a minimum proportion of biofuel, thereby establishing minimum require- ments for diesel and petrol"(Renewable and Sustainable Energy Reviews 16, Promotion of biofuel consumption in the transport sector: An EU-27 perspective, J.M. Cansino, M.del P Pablo-Romero, R. Román, R. Yñiguez 2012).

In 2011 the ethanol concentration of 95 octane petrol was raised in Finland. This was done in order to meet the legislative transport biofuel obligation. This is only one of the measures that is aimed to achieve the environmental targets for the transport sector. Petrol called E10 may contain bioethanol concentration of 10 % v/v at its highest. E10 can also contain alternatively ethers and other alcohols permitted by Fuels Quality Directive. In 2012 over billion litres of E10 petrol were sold in Finland. (Finnish Petroleum Association 2013).

The demand for biofuels has increased and will be increasing in coming years. Ethanol needed for blending the petrol will be imported from the non-EU region, mostly from Brazil. Biofuels have strict regulations and they have to meet the EU biofuel sustainability criteria and greenhouse gas emission targets. There is principal that biofuels cannot be harvested from regions with high biodiversity or from high carbon concentration soils. (Finnish Petroleum Association 2013).

Finland's original target was to reduce carbon dioxide emissions from road transport by 15 percent from their 2005 level by the year 2020. This target was pushed to 20 percent in the national legislation of biofuel distribution requirements (1.1.2011). The target was raised since Finland is able to increase biofuel production with new kind of technologies. By this way Finland can benefit from the so called double credit mechanism. In the double credit mechanism the country can count biofuels made from certain kind of materials as double to the goal of the biofuel obligation.This kind of biofuels are manufactured from materials like residue materials, waste, non-food cellulosic materials and lignocellulose. (Finnish Petroleum Association 2013).

Double credit biofuels have a potential to have 80-90 per cent lower life cycle emissions than those of fossil fuels. The increase in domestic biofuel production would improve Finland's self sufficiency in energy. Another goal was to reduce the carbon intensity of fuels by 10 percent by 2020 with the Fuel Quality Directive along with the Renewable Energy Directive. (Finnish Petroleum Association 2013).

Biofuels have to achieve certain kind of greenhouse gas emission reductions. Biofuels have to bring at least a 35 per cent reduction compared to fossil fuels and in future that requirement will be tightened. (Finnish Petroleum Association 2013).

Most typical biofuels and their emission reductions and life cycle emissions are listed in the Renewable Energy Directive. Brazilian sugar cane ethanol gives a very high emission reduction compared to others. The emission reduction is over 70 per cent in comparison to fossil motor gasoline. All of the emissions over the entire chain of operation are taken into account starting from the cultivation of raw material and production up to refining, transportation and distribution. (Finnish Petroleum Association 2013).

Contributions formed from transportation to the "carbon balance" are minor. This same applies to all imported goods that are transported to the EU as ocean freight. The share in the product's total life

cycle emissions is very small when calculated per product unit. (Finnish Petroleum Association 2013).

Act on sustainability of biofuels and bioliquids are prepared by The Ministry of Employment and the Economy. Plan is to have provisions on the sustainability criteria of biofuels and bioliquids. (Finnish Petroleum Association 2013).

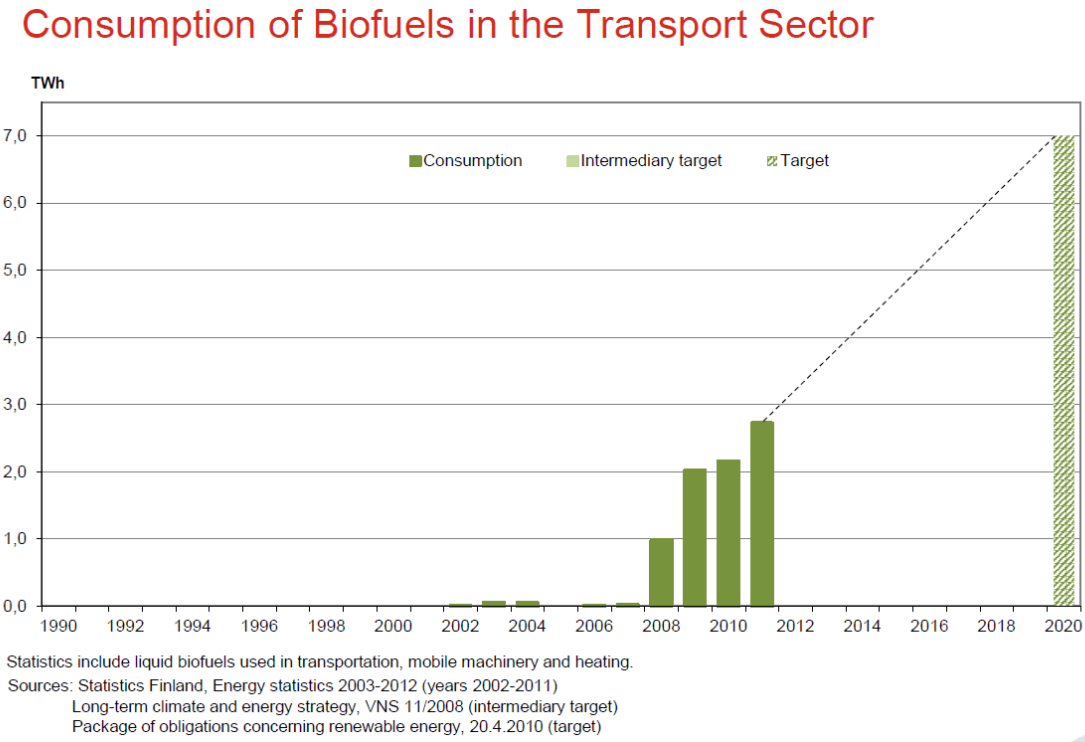

FIGURE 7. Consumption of biofuels in transport sector (Motiva 2013,7).

Figure 7 shows the consumption of biofuels in the transport sector in Finland according to Statistics Finland. In 2011 consumption was little bit under 3,0 TWh. Figure shows immediate rise in biofuels consumption between 2010 and 2011. National target by the year 2020 is 7,0 TWh. Target is part of the national long-term climate and energy strategy. Finland has the highest target of the EU-27 countries with 20 per cent of total energy consumption in the transport sector by the year 2020. (Motiva 2013, 7).

Hydrogen will also have big fuel markets in the future. At the moment hydrogen as biofuel do not have a big demand in Finland.

RES (Renewable Energy Sources) Directive has the requirement that biofuel and bioliquids have to comply with sustainability criteria if biofuel or bioliquid is included in the binding national target for RES. This also means that national obligation systems are applied or the use receives financial support. (Ministry of Employment and the Economy 2013).

Sustainability criteria have five groups. According to the Ministry of Employment and the Economy, Sustainability of biofuels and bioliquids, they are the following:

"Greenhouse gas emission saving
The life-cycle greenhouse gas emission saving from the use of biofuels or bioliquids shall be at least 35% in comparison with the substitutive fossil fuel and at least 50% with effect from 1 January 2017. For batches of biofuels or bioliquids produced in an installation in which production started on or after 1 January 2017, the greenhouse gas emission saving shall be at least 60% with effect from 1 January 2018. If at least one installation in the production chain of biofuel or bioliquid was in operation on 23 January 2008, the greenhouse gas emission saving requirement shall only apply from 1 April 2013.

Biodiversity
Biofuels or bioliquids shall not be made from raw material obtained from land with high biodiversity value in or after the reference period (January 2008).

Change of land use status
Biofuels or bioliquids shall not be made from raw material obtained from land with high carbon stock in the reference period (January 2008). However, raw material obtained from such land may be used if the land had the same status at the time the raw material was obtained as it had in January 2008.

Drainage of marshlands
Biofuels or bioliquids shall not be made from raw material obtained from land that was marshland in the reference period (January 2008), if the production involves drainage of previously undrained marshland.

Agricultural raw material
Agricultural raw materials cultivated in the EU and used for the production of biofuels or bioliquids shall be obtained in accordance with the requirements and standards establishing common rules for direct support schemes for farmers and in accordance with the minimum requirements for good agricultural and environmental condition.

Compliance with sustainability criteria must be verified (see Article 18 of the RES directive):
in accordance with the national system of the Member State;
in accordance with the voluntary (certification) system approved by the EU Commission;
in accordance with a bilateral or multilateral agreement concluded by the EU with third countries"(Ministry of Employment and the Economy,Sustainability of biofuels and bioliquids, 2013).

3.3 Bioenergy for industry

One of the ways to apply biorefinery is to unite it with some indrustial factory. Inputs needed for refinery are therefore close and costs to transport the waste are minimal. Figure 8 shows the use of energy in manufacturing industry in 2010-2012 in Finland by Tera joules (Tj). The figure shows that wood fuels dominate the energy use in manufacturing in Finland. It is the only renewable energy source that has a big use at the moment. It is also the only form of energy that has grown between the years 2010 to 2012 along with other energy sources. Other energy sources have a minor share with about 10 000 Tj per year. (Statistics Finland 2013).

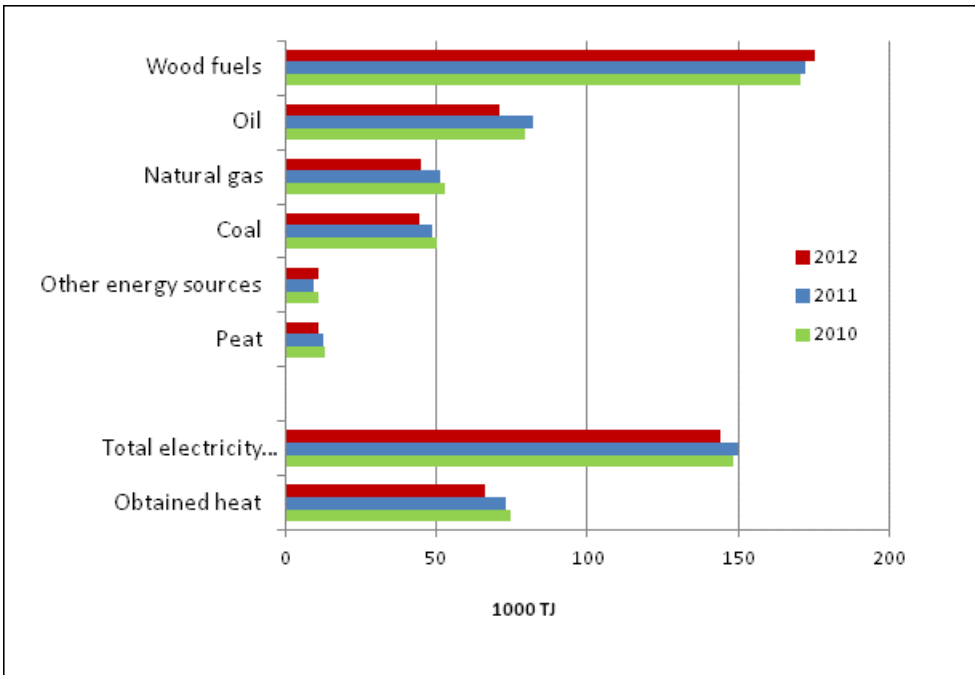

FIGURE 8. Use of energy in manufacturing in 2010-2012,(Statistics Finland 2013).

The EU has long term climate and energy targets for year 2020. These targets are known as "20-20-20". Objectives are to reduce greenhouse gas emissions from levels of 1990 by 20 per cent, raise the energy consumption of renewable resources in the EU by a total share of 20 per cent and improve energy efficiency in the EU by 20 per cent. (European Comission 2014).

These three objectives give a great platform for renewable energy sources. It also explains the use and growth of the wood fuels. These same three objectives are also valid with the other energy sources, like processing the waste coming from the industries to energy. (European Comission 2014).

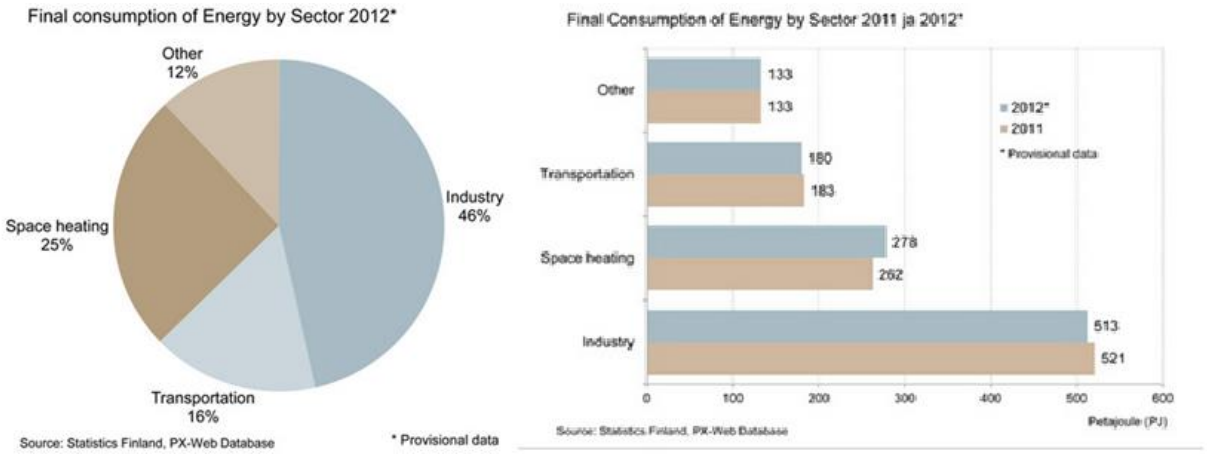

FIGURE 9. Final Consumption of Energy in Finland by Sector 2012 in per cent and energy (Pj) (Motiva 2013).

Figure 9 shows the final consumption of energy in Finland by sector in 2012. Industry consumes 46 per cent the total consumption which translates to 513 Petajoules in energy. (Motiva 2013).

Industry uses almost a half of the energy consumed in Finland. Therefore it is the area that has the greatest potential considering reductions on emissions, better material efficiency and usage of renewable resources in energy consumption.

Industries that produce waste that is difficult and expensive to handle would have a great potential in using this waste as an energy resource rather than have significant annual costs with handing the same waste.

4 FULL SCALE POSSIBILITES

The enviroment for full scale possibilities are tremendous. The government and the EU are commited to contribute with financial assistance if greenhouse gas reductions and sustainability criteria are met. After year 2016 biodegradable waste cannot be landfilled so it has to be processed by some other kind of way.

Full scale plants could work beside the industry facilities and process their waste to accomodities. At the moment waste process costs are great and they are rising. When a reasonable repayment time for the investment is met this could be the best way to process industrial biodegradable waste.

Laboratory test conducted by Finnoflag, Finnish company who specializes in microbe diagnostics, have successfully reached concentrations up to 8 g/l/h 2,3-butanediol from high organic biobased waste. 2,3-butanediol is so called platform chemical for make up industry and it normally produced from fossil fuels. ABE-fermentation is also formed with this kind of technology. ABE stands for acetone, butane and ethanol. (Hakalehto etc. 2013). They are all useful chemicals with good market values. Best value for the chemicals would be found with the right market channels.

4.1 Full scale plant beside the factory

By building the full scale plant beside the factory where the raw materials are coming from lot of costs can be minimized. For example costs coming from transporting the waste are practically none, although this gives limitations regarding the volume of waste produced by the factory. In Savon Sellu's case, the only pilot location so far, processing the sludge waste costs over 1 million euros per year. That amount is going to rise in the near future when restrictions on processing the biodegradable waste go forward. To place the plant this way means also that plant can built to match the customers need perfectly by the volume of the waste.

Biofuels from the process have to be refined so they can be pumped straight to the pumping stations. Particulary hydrogen could have vast potential since it's the most potent biofuel formed so far. One scenario could be that pumping stations would be build near to the biorefiniers. That way pumping stations would have endless supply of fuel coming from the refinery. Piloting has proven this far that Savon Sellu waste slugde is highly potential regarding hydrogen with daily potential high as 10 000 vehicle kilometres. Currently there is only one hydrogen pumping station in Finland by Woikoski and there is no short term targets for the hydrogen as biofuel for the transport sector although its potential is well known.

At the moment there are few plants in the world that can be used as references, although raw material used in this plants are biodegradable, it is not entirely waste. In Norway, company called the Borregaard has one of the most advanced biorefineries in the world. The plant uses wood as raw material to produce environmentally friendly and sustainable biochemicals, biofuel and biomaterials. (Dahlquist 2013, 141).

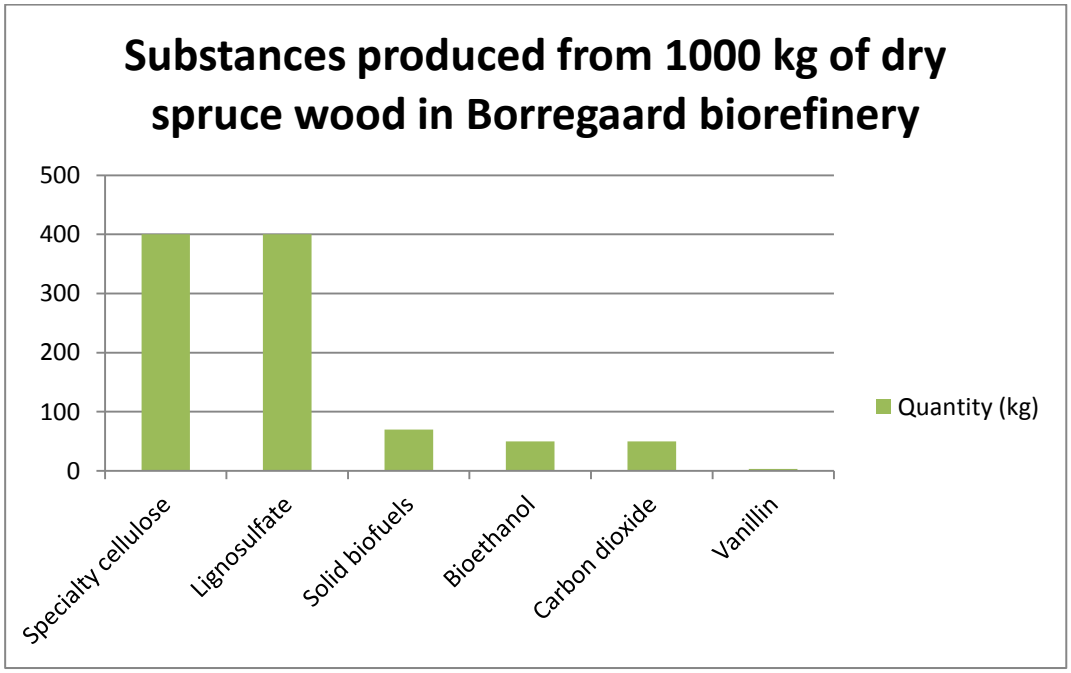

FIGURE 10. Borregaad biorefinery substances produced from 1 tonnes of dry spruce wood in 2011.

Figure 10 illustrates the amount of marketable products produced in Borregaard biorefinery in 2011. 400 kg of specialty cellulose, 400 kg lignosulfate, 70 kg solid biofuels, 50 kg bioethanol, 50 kg carbon dioxide and 3 kg vanillin is produced from 1000 kg of dry spruce wood. Less then five per cent of the raw material used in the process ends up in the waste treatment plant. A large portion of that waste is converted to biogas. The Borregaard company has also developed a new biorefinery separation process called the BALI process. Its aim is to utilize low value biomass and convert it to various competitive products, mostly based on hemicelluloces, celluloses and lignin. (Dahlquist 2013, 144).

4.2 Independent full scale plant

A business can be also made entirely around a full scale biorefinery. The plant would then be independent and all the needed inputs woud be received from companies producing the waste. The business would be built with gate fees received from the companies delivering the waste and with the substances made from the biorefinery process. Again all the funding from the EU and the government woud be essential to successful business. Companies that would also be interested in independent plant would be national landfills and waste handling companies like Ekokem.

Ekokem is a big Finnish operator in the field of the environmental management. Their services include treatment of contaminated soils, construction of landfills and also many kinds of waste treatment operations. (Ekokem 2014).

Ekokem used 2.5 million euros of its turnover in research and development in 2011. The foundation for Ekokem's R&D is saving the natural resources. One of their key objectives is to new waste recy-

cling and other recovery methods and also new kinds of waste-to-energy generation methods. (Ekokem 2014).

These kinds of waste treatment operators would be ideal places for independent full scale plants. They have responsibilities to process the waste at the moment and invest on new kinds of methods to do so.

4.3 Full scale plant for research

The full scale plant can also be used as a research facility. Reseach activities can be with either academic or related to business. Currently there is a medium scale biorefinery in near Ghent, Belgium. (Figure 11). It is run by the company called Bio Base Europe. The biorefinery is part of the open innovation and education center and is used for research purposes. It is a flexible and multipurpose plant. (Bio Base Europe 2013).

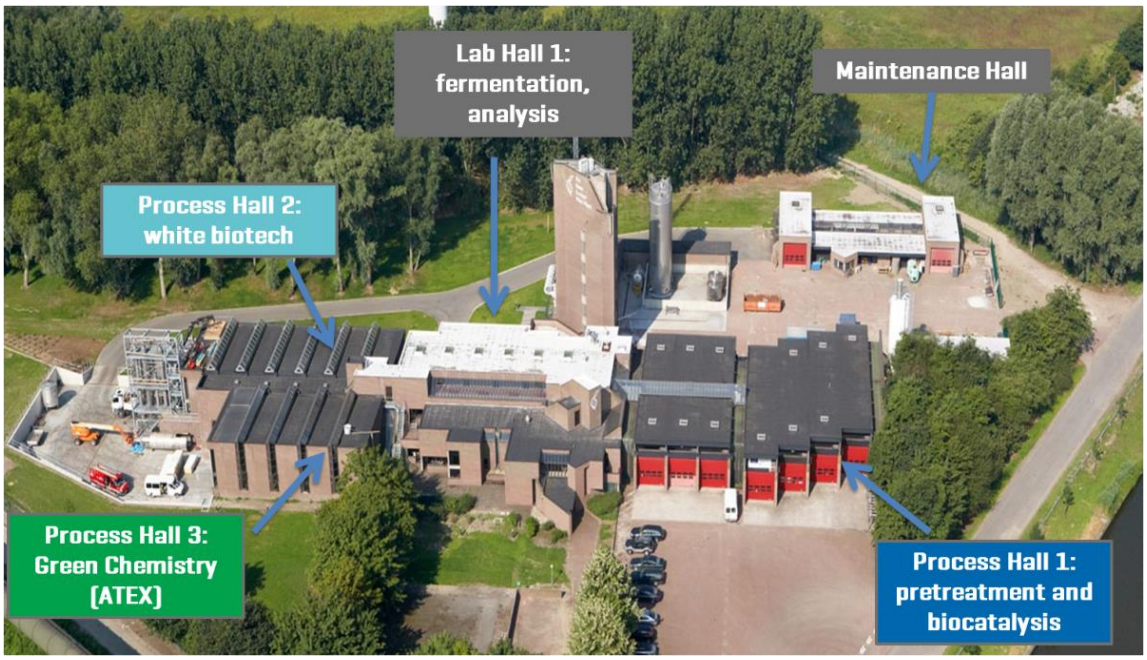

FIGURE 11. Aerial view of the Bio Base Europe Pilot Plant in Belgium (Bio Base Europe 2013).

The pilot plant currently services companies and research institutes from all over the world. Plant's services include process development, scale up, custom manufacturing, start-up assistance, project and funding opportunities and markets. (Bio Base Europe 2013).

The idea of their process development is to bring scientific feasibility and and industrial applications of biobased ideas together. The plant can scale up a biobased process up to the ton scale. Scaling up can be done in reactors scaled between 10 to 50 m^3. The scaling up enables to assess the actual operating costs and also the strengths and weaknesses of the process. With custom manufacturing, the customer can test the application and market potential of the production before investing large sums of the capital to actual facility.The start-up assistance includes technical support for process

design for the customers' own facility with the help of the process engineers. The project and funding opportunities are also offered with the substantial knowledge of funding channels and with the large international network of companies active in biobased economy. The Bio Base Europe can also form a strategic partnership with customers to decrease the risks involved and share the outcomes. (Bio Base Europe 2013).

All together Bio Base Europe pilot plant looks like a great business venture. One of its strengths is the multipurpose processes and also the flexible way to do business with customer's conditions.

4.4 Other business possibilities with the full scale plants

Other possibilities to do business with full scale plants could be this central control where either processes coud be monitored and enhanced or consultant services could be offered to the plant users on demand. This 24/7 service could be useful if a certain amount of technology is being used in the world. This low cost operation could be a functional business in future.

5 CONCLUSIONS

In conclusion, Member states of the European Union will have a lot of challenges to reach the targets set for the year 2020. Especially Finland who has the biggest target for biofuel use in the transport sector has to innovate and invest remarkable amount in research and development for domestic biofuel production.

Costs for handling the waste will rise in the near future, especially after 2016 when landfilling the biodegradable waste are prohibited. New kind of technologies include these biorefineries which can reach far greater potential than burning the waste, which is the most common way to handle biodegradable waste at the moment.

The government and the EU offer many different kinds of funding and economic remission for projects involving greenhouse gas reductions and and enhanced waste management. The total budget of 70.2 billion euros is signed for Horizon 2020 project. The Project will be funding R&D to reach the long term climate and energy targets.

ABOWE biorefinery technology can serve different kinds of end users. A biorefinery can process different kind of biodegradable waste. So far biorefinery has been tested with waste from forest industry. This waste sludge is highly potent input for the process and results so far have presented remarkable concentrations of hydrogen and also butane and butanediol.

There are examples of large scale biorefineries working at the moment. With the right investor and with the help of all the funding from the EU and the government ABOWE Pilot A is applicable. More successful piloting is needed to get new information about the waste potential of different kind of inputs. In that way further projects and investments towards full scale plants are reality in future.

REFERENCES

ACT 19.4.2012/179. 2012-04-19. Council of state. [online material]. Act for treatment of waste 2012. [Accessed 2014-01-20]. Available from: http://www.finlex.fi/fi/laki/ajantasa/2012/20120179

BIO BASE EUROPE. 2013. Pilot plant. [website]. Bio Base Europe, About the pilot plant, virtual tour. [Accessed 2014-02-14]. Available from: http://www.bbeu.org/bio-base-europe-pilot-plant

CANSINO, DEL, PABLO-ROMERO, ROMAN, YÑIGUEZ. 2012-06-04. Department of Economic Analysis and Political Economy, University of Sevilla. [web document]. Promotion of biofuel consumption in the transport sector: An EU-27 perspective. Renewable and Sustainable Energy Reviews 16:2012. [Accessed 2014-01-20]. Available from: http://eee-tech.org/sites/default/files/pdf/Promotion%20of%20biofuel%20consumption%20in%20the%20transport%20sector_an%20EU%2027%20perspective.pdf

CMAI. 2008-01-31. Acetone market report. [web document]. Market repot issue 98:2008, page 3. [Accessed 2014-05-20]. Available from: http://www.cmaiglobal.com/MarketReports/samples/acetone_98.pdf

DAHLQUIST Erik. 2013. Series: Sustainable Energy Developments 3, Biomass as Energy Source: Resources, Systems and Applications, CRC Press

DIRECTIVE 2009/28/EC. 2009. Use of renewable energy sources. [web document]. European Commission Directive 28:2009. [Accessed 2014-05-20]. Available from: http://faolex.fao.org/docs/pdf/eur88009.pdf

DOW CHEMICAL COMPANY. 2006-05-02. Acetone. Product Safety Assessment. [website]. Dow Chemicals, Product Safety. [Accessed 2014-05-20]. Available from: http://www.dow.com/productsafety/finder/acetone.htm

DOW CHEMICAL COMPANY. 2006-05-02. Butanol. Product Safety Assessment. [website]. Dow Chemicals, Product Safety. [Accessed 2014-05-20]. Available from: http://www.dow.com/productsafety/finder/nbut.htm

EKOKEM. 2014. Social responsibility. [website] Ekokem Group, Sustainability. [Accessed 2014-02-20]. Available from: http://www.ekokem.fi/en/sustainability/social-responsibility

EKOKEM. 2014. Waste management in Finland. [website] Ekokem Group, Ekokem. [Accessed 2014-01-20]. Available from: http://www.ekokem.fi/en/ekokem/waste-management-finland/waste-hierarchy

ENVIRONMENT.FI. 2014-01-13 Material efficiency. [website] Finland's environmental administration, Consumption and Production, Resource efficiency. [Accessed 2014-01-20]. Available from: http://www.ymparisto.fi/en-US/Consumption_and_production/Resource_efficiency/Material_efficiency

ESKELINEN Tuomo, KAJANUS Miika. 2014. Business Model Canvas template, Savonia Business. [ppt document]. Savonia Business Workgroup.

ETELÄ-SUOMEN SANOMAT. 2013-02-11. Öljytuotteiden kulutus laski – e10-bensan osuus noussa. [web publication]. Etelä-Suomen Sanomat,Economy. [Accessed 2014-01-20]. Available from: http://www.ess.fi/uutiset/talous/2013/02/11/oljytuotteiden-kulutus-laski---e10-bensan-osuus-nousussa

EUROPEAN COMISSION. Updated 2014-05-21. Greenhouse gas emissions and targets. [website]. European Comission's climate action policies. [Accessed 2014-01-20]. Available from: http://ec.europa.eu/clima/policies/g-gas/index_en.htm

EUROPEAN COMISSION. Updated 2014-05-21 The 2020 climate and energy package. [website]. European Comission's climate action policies. [Accessed 2014-02-20]. Available from: http://ec.europa.eu/clima/policies/package/index_en.htm

FINNISH PETROLEUM ASSOCIATION. 2013. Biofuels in Finland [website]. Finnish Petroleum Association, Useful information. [Accessed 2014-01-20]. Available from: http://www.oil.fi/en/useful-information/biofuels-finland

FINNISH SOLID WASTE ASSOCIATION. 2013. Waste to energy. [website]. Finnish Solid Waste Association, energy utilization, waste-to-energy. [Accessed 2014-05-20]. Available from: http://www.jly.fi/energia1.php?treeviewid=tree3&nodeid=1

GASUM. 2013. Price level of biogas. 2013. [website]. Gasum, price levels of biogas. [Accessed 2013-11-23]. Available from: http://www.gasum.fi/liikenne/Sivut/Hinta.aspx

GREEN FUEL NORDIC. 2014. Bio. [website] Greenfuel Nordic, About us. [Accessed 2014-05-20]. Available from: http://www.greenfuelnordic.fi/about_us

HAKALEHTO Elias, JÄÄSKELÄINEN Ari, SUHONEN Anssi. 2013. Production of energy and chemicals from biomasses by micro-organisms: ABOWE Project, Pilot A. [poster]

HORIZON 2020. 2014. The EU Framework Programme for Research and Innovation. [website]. European Comission, The EU Framework programme. [Accessed 2014-01-20]. Available from: http://ec.europa.eu/programmes/horizon2020/

HUOPANA Tuomas. 2014-03-18. Gabi 6.0 International. [software]. [Accessed 2013-05-21]

HÄRMÄLÄ Esa. 2010. Production of Cereal-based Ethanol In Finland, PPT Working Papers 121. [web document]. Pellervo Economic Research, PPT Working papers 121:2010, page 7. [Accessed 2014-04-20]. Available from: http://ptt.fi/wp-content/uploads/2013/04/ethanol_conclusions_2502100915.pdf

IHONEN Jari, LAURIKKO Juhani, UUSALO Heidi. 2012-11-19. VTT, Vety- ja polttokennoalan eteneminen meillä ja maailmalla, Suomen vetytiekartta. [web document]. VTT, Teknologiasta liiketoimintaa 2012. [Accessed 2014-04-20]. Available from: http://www.tekes.fi/Global/Ohjelmat%20ja%20palvelut/Ohjelmat/Polttokennot/Aineistot/ihonen_vety__ja_polttokennoalan_eteneminen_meillä_ja_maailmalla__suomen_vetytiekartta_oulu2012.pdf

KAJANUS Miika. 2013. Investment memo template. Version 1.0. ABOWE Project. Co-operation with Savonia UAS and Ostfalia UAS.

MINISTRY OF EMPLOYMENT AND THE ECONOMY. 2013-11-21. Sustainability of biofuels and bioliquids. [website]. TEM, energy, renewable energy sources. [Accessed 2014-04-20]. Available from: http://www.tem.fi/en/energy/renewable_energy_sources/sustainability_of_biofuels_and_bioliquids

MOTIVA. 2013-12-20. Final consumption of energy. [website]. Motiva, Energy Use in Finland, Final Consumption of energy, 2013. [Accessed 2014-01-20]. Available from: http://www.motiva.fi/en/energy_in_finland/energy_use_in_finland/final_consumption_of_energy

MOTIVA. 2013-09-25. Renewable Energy Trends in Finland. [web document]. Motiva, Energy in Finland, page 7. [Accessed 2014-01-20]. Available from: http://www.motiva.fi/files/8144/Renewable_Energy_Trends_in_Finland_2013.pdf

MUSTONEN Ilkka. 2012. Yara Finland, Lannoitusvaihtoehdot suometsien ravinnetalouden hoitoon. [web document]. Metsäkeskus, fertilizer options, pages 12,13,30. [Accessed 2014-04-20]. Available from: http://www.metsakeskus.fi/fi_FI/c/document_library/get_file?uuid=99375130-91f0-4d5d-a560-966d074da169&groupId=10156

SANKALA Kari. 2012-01-02. Kaleva, Jätteenpolttolaitokselle tulevasta jätteestä peritään porttimaksu. [web publication]. Kaleva, Environment. [Accessed 2014-04-20]. Available from: http://www.kaleva.fi/uutiset/oulu/jatteenpolttolaitokselle-tule-vasta-jatteesta-peritaan-porttimaksu/564385/

ST1. 2014. Company in Brief. [website] St1, Company in brief. [Accessed 2014-04-20]. Available from: http://www.st1.eu/st1-in-brief

STATISTICS FINLAND. 2013-05-17. Generation of waste by sector and by type of waste in 2011. [web publication]. Statistics Finland, Environment and Natural Resources, Waste statistics, 2011. [Accessed 2014-01-20]. Available from: http://www.stat.fi/til/jate/2011/jate_2011_2013-05-17_tau_002_en.html

STATISTICS FINLAND. 2013-05-16. Greenhouse gas emissions in Finland at lowest level since 1990. [website]. Statistics Finland, Environmental and Natural Resources, Greenhouse gases, 2012. [Accessed 2014-01-20]. Available from: http://www.stat.fi/til/khki/2012/khki_2012_2013-05-16_tie_001_en.html

STATISTICS FINLAND. 2007-04-18. Suomi on bioenergian suurvalta. [website]. Statistics Finland, Articles. [Accessed 2014-04-20]. Available from: http://www.stat.fi/artikkelit/2007/art_2007-04-18_004.html?s=0

STATISTICS FINLAND. 2013-10-31. Use of energy in manufacturing. [website]. Statistics Finland, Energy, Energy use in manufacturing, 2012. [Accessed 2014-02-20]. Available from: http://www.stat.fi/til/tene/2012/tene_2012_2013-10-31_kuv_001_en.html

STATISTICS FINLAND. 2013-05-17. Waste treatment in 2011. [web publication]. Statistics Finland, Environment and Natural Resources, Waste statistics, 2011. [Accessed 2014-01-20]. Available from: http://www.stat.fi/til/jate/2011/jate_2011_2013-05-17_tau_001_en.html

UNIVERSAL INDUSTRIAL GASES INC. 2013. Hydrogen Propertiesm, Uses, Applications, Hydrogen Gas, and Liquid Hydrogen. [website]. UIG, Gas properties, Uses, Applications. [Accessed 2014-04-20]. Available from: http://www.uigi.com/hydrogen.html

YLE. 2014-04-09. Teollisuusjätteestä kosmetiikan raaka-ainetta – valmistuksessa otetaan mallia ihmisen ruuansulatuksesta. [web publication]. Yle uutiset, kotimaa. [Accessed 2014-04-20]. Available from: http://yle.fi/uutiset/teollisuusjatteesta_kosmetiikan_raaka-ainetta__valmistuksessa_otetaan_mallia_ihmisen_ruuansulatuksesta/7182833

YLE.2014-01-24.Vetyautoille tehtaillaan tankkauspisteitä - autoja on Suomessa tasan yksi. [web publication]. Yle uutiset, kotimaa. [Accessed 2014-05-20]. Available from: http://yle.fi/uutiset/vetyautoille_tehtaillaan_tankkauspisteita__autoja_on_suomessa_tasan_yksi/7048701

APPENDIX 1: BUSINESS MODEL SURVEY

Business Model for Pilot A Finland

ABOWE –hankkeessa pilotoidaan uudenlaista biojalostamoteknologiaa, jonka avulla voidaan tuottaa orgaanisista jätteistä mikrobien avulla kemikaaleja ja/tai biopolttoaineita.

Hankkeessa testattavia jätejakeita ovat metsäteollisuuden lietejakeet, maatalouden lannat, elintarviketeollisuuden hiilihydraattipitoiset sivuvirrat.

Tässä kyselyssä haetaan tietoa ja ideoita liiketoimintamallin rakentamiseksi hyödyntäen testattavaa teknologiaa.

Lisätietoja www.abowe.eu

1. Luettele mahdollisia asiakasryhmiä ko. biojalostamoteknologialle?

2. Mitä ongelmia voitaisiin ratkaista tämän projektin tuloksilla?

3. Millaisia hyötyjä näille asiakkaille voidaan tuottaa?

4. Kuinka nämä asiakkaat saavutetaan?

5. Kuinka pidetään yllä asiakassuhteita eri asiakasryhmille?

6. Kuinka toiminta saadaan kannattavaksi? Mistä tulovirrat muodostuvat?

7. Mitä resursseja tarvitaan tämän liiketoiminnan rakentamiseksi?

8. Mitä toimenpiteitä tarvitaan liiketoiminnan rakentamiseksi?

9. Ketä avaintoimijoita ja kumppaneita tarvitaan?

10. Millaisia kiinteitä ja muuttuvia kustannuksia syntyy liiketoiminnan rakentamiseksi?

11. Kuinka rakennetaan kilpailijoista erottuva liiketoimintaratkaisu?

12. Mitä erilaisia yritysratkaisuja voidaan rakentaa?

13. Kuka voisi toimia mahdollisena investoijana?

14. Yhteystiedot

Etunimi

_____

Sukunimi

_____

Matkapuhelin

_____

Sähköposti

_____

Puhelin

_____

Yritys / Organisaatio

_____

APPENDIX 2: ANSWERS FROM THE BUSINESS MODEL SURVEY

Business Model for Pilot A Finland - Perusraportti

1. Luettele mahdollisia asiakasryhmiä ko. biojalostamoteknologialle?

Vastaajien määrä: 8

- metsäteollisuusyritykset
  maatilat
  Atria
  Kaatopaikat
  Yliopistot, testilaite
  ..
- Elintarviketeollisuus
  Kunnalliset jäteythiöt
  Kauppaketjut
- Jätteiden tuottajista:
  Valio, Maitomaa, Olvi, Atria, HK, Snellman, Stora Enso, UPM Kymmene, Metsä Board, Leipomoteollisuus, S-kaupat, K-kaupat.

  Palveluntarjoajat saattaisivat kiinnostua ostamaan teknologian:
  Ekokem, Kuusankoski, Jätekukko.

  Energiantuottajat voisivat myös kiinnostua:
  Biotehdas, Sti1, Neste.

  Energiantuotantoteknologian tarjoajat:
  Metso, Foster and Wheeler, Valmet.
- Mahdollinen Ekokemin palvelu asiakkaille.

  Lietejakeita erilleen teollisuudessa, näiden hyödyntäminen.
- Jätteentuottajat, jätteenkäsittelijät, kemikaalien ja polttoaineiden jalostajat
- metsäteollisuuden lietteet/jäteveden puhdistamot
  kunnalliset jäteveden puhdistamot
  elintarvike teollisuuden jätteet
- Metsäteollisuus, Savon Sellu
- Metsäteollisuus, Kemianteollisuus jne.

2. Mitä ongelmia voitaisiin ratkaista tämän projektin tuloksilla?

Vastaajien määrä: 8

- Jätteiden käsittely ja niistä tehtävät energia (metaani) sekä eri jakeet tistaluksen avulla.

  Metsäteollisuus - suuri määrä raaka-ainetta, jota voidaan hyvödyntää.
  maatilat, vaatii kohtalaisen suuren tilan ennen kuin kannattaa
  Atria - teurastamojätteen käyttö raaka-aineena
  Kaatopaikat, metaani ja muut jakeet (butaanidioli?)
- Jätehuolto
  Biopolttoainevelvoitteet
- -Jäteperäisistä aineksista voitaisiin saada uusia lisäarvotuotteita, joita tähän mennessä ei ole vielä kyetty tuottamaan.
  -Biokemikaalien ja -polttoaineen tuotannon piiriin voitaisiin saada sellaisia raaka-aineita, joita tähän mennessä ei vielä ole kyetty hyödyntämään.
  -Riippumattomuus öljystä vähenee.
  -Materiaalitehokkuus paranee.
  -Päästöt voivat pienentyä.

-Edesauttaa yritysten ekologisen imagon luonnissa.
- Kuinka paljon saadaan energiaa/käsittelytonni.

- Uusi ratkaisu orgaanista ainesta sisältävien jätteiden hyödyntämiseen.

- kaatopaikalle menevän materiaalin määrän pienentäminen
hajuhaittoja
- Lietteen käsittelymenetelmä, energianlähde, pääomaa lietteestä
- Jätteistä voi saada kierrätysmateriaalia ja mahdollisesti vähentää syntyvän jätteen määriä.

3. Millaisia hyötyjä näille asiakkaille voidaan tuottaa?

Vastaajien määrä: 8

- Raaka-aine, joka on jätettä, voidaan hyödyntää prosessissa. Tuotot voivat olla suuret =(kannattavuus)
- Kaupallisia, eli jätehuollon kustannusten säästö joka osittain tulee sivutuotteiden positiivisesta kassavirrasta
- -Mallinnus ja mittauspalveluita mikrobiologisista prosesseista, mikä auttaa asiakkaita ymmärtämään prosessiensa hallittavuutta entistäkin paremmin.
-Jatkossa myös mahdollisesti ko. teknologian myynti asiakkaille.
-Ko. teknologian rakentamispalvelut.
-Konsultointipalvelut jätteentuottajille, joille jätteen syntyminen on kallista.
-IT palvelut etäohjattavan mittausjärjestelmään liittyen.
- Rahallinen hyöty, imago, julkisuuskuva.

Käsittely 2016 lainsäädännön mukaisella tavalla, orgaanisen jätteen sijoituskielto.
- Kestävä ratkaisu tuotantojätteen käsittelyyn
Uutta kierrätettyä raaka-ainetta prosesseihin
- ympäristöä asioiden hoitaminen helpottuu
tukee kestävän kehityksen etenemistä
tukee yrityksen luonnetta uudistuvana yrityksenä
- Lietteen käsittelymenetelmä, energianlähde, pääomaa lietteestä
- Suoria säästöjä kustannuksiin ja mahdollisesti myös jätteiden hävittäminen voisi olla helpompaa tai jätteitä ei välttämättä syntyisi enää.

4. Kuinka nämä asiakkaat saavutetaan?

Vastaajien määrä: 8

- Seminaarit, joissa kerrotaan hankkeen tuloksista. Ammattilehdet ja julkaisut aiheesta. Maaseudun Tulevaisuus -> maatilat
- Aktiivista etsintää netistä ym, henkilökohtaiset yhteydenotot, tapaamiset
- Asiakkaat voitaisiin saavuttaa suoralla kontaktoinnilla esim. alan konferensseissa sekä olemassa olevia kontakteja hyödyntämällä. Puhelintiedustelu- ja yhteydenotot oikeisiin henkilöihin voivat myös avata uusia mahdollisuuksia.
- Ekokem voisi toimia kanavana asiakkaiden hankintaan/ TKI puoli Riihimäellä.
- Tuottamalla vakuuttavia teknisiä tuloksia ja liiketaloudellisia laskelmia
- "seulomalla" suurimmat jätevirrat jotka soveltuvat ko prosessille -> yritysvierailu ja esittely
- Onnistunut pilotointi, täyden kaavan laitos, palvelukanavat
- Tutkimalla ja kokeilemalla

5. Kuinka pidetään yllä asiakassuhteita eri asiakasryhmille?

Vastaajien määrä: 8

- Internet sivut/blogit, joissa kerrotaan aiheesta ja tutkimustuloksista. Metsäteollisuuteen suorat kontaktit ja henkilökohtaiset suhteet ympäristöstä vastaaviin päälliköihin.
- henkilökohtaisilla tapaamisella ja sähköpostin avulla
- Tiedottamalla asiakkaita uutiskirjeillä, olemalla mukana alan konferensseissa, uusia projektiehdotuksia tarjoamalla, olemalla mukana alan keskeisimmissä medioissa (lehdissä, TV:ssä, radiossa, internetissä) sekä tar-

joamalla suoria asiakastilaisuuksia.
- Suorat kontaktit, sähköposti, puhelin.
- Tuottamalla asiakkaalle jatkuvasti lisäarvoa
  Ennkoimalla asiakkaan tulevaisuuden tarpeet
- vierailut on aloitus vaiheessa paras tapa edetä.
- Markkinointi ja myynti
- Tapaamisilla ja kertomalla tutkimustuloksia mahdollisimman laajalalle kuulijakunnalle.

6. Kuinka toiminta saadaan kannattavaksi? Mistä tulovirrat muodostuvat?

Vastaajien määrä: 8

- Raakaainejakeiden myynnistä (butaanidioli, asetoni). Jos jätteiden käsittelykustannukset nousevat niin tuo laitteisto tulee killpailukykyiseksi yritykselle.

Metaani - lämmitys, muu

- Porttimaksuista (tai että säästytään niistä), polttoaineet ja muu energiantuotanto, lannoitteet, ym
- Kannattavaa toimintaa voisi syntyä useassa eri vaiheessa monista eri osaamisalueista:
  -Tässä vaiheessa projektia kannattava toiminta voisi keskittyä asiakkaille tarjottavaan mittaus- ja mallinnus-palveluihin sekä konsultointiin.
  -Jos asiakkaan jätteissä havaitaan potentiaalia biojalostamoa varten, niin asiakkaalle voisi tarjota pilotointia kohteessa.
  -Jos pilointi toimii, niin asiakkaalle voisi edelleen tarjota ko. teknnologian rakennus, operointi- ja ITC palve-luita.
- Asiakas maksaa joka tapauksessa jätteen käsittelystä esim. investointi lietteen kuivaustekniikkaan/polttoon maksaa.

- Tulovirrat koostuu luultavasti pienistä osista, jotka ei erillisinä ole kannattavia

- tässä täytyy varmaankin rakentaa ns. palveluyritys joka palvelee alueen kaikkia yirityksiä joista ko jätevirtoja syntyy.
  Tällä tavoin pienenpikin yritys pääsee osaksi uutta teknologiaa
- Lietteen käsittely
  Täyden kaavan laitos
  Asiakaspalvelu
  Konsultointi

- Investointikustannukset pitää saada sille tasolle, että investointi on oikeasti kannattava. Lisäksi tulee tutkia syntyvät jakeet, että ne ovat oikeasti kaupallisesti kannattavia.

7. Mitä resursseja tarvitaan tämän liiketoiminnan rakentamiseksi?

Vastaajien määrä: 8

- Perustella miksi prosessi on kannattava. Ei ole kyllä helppo tehtävä ennen kuin testilaitteisto on käynyt kaik-ki kolme kohdetta läpi.

Laskelma suuresta laitteistosta.
- Myynti ja asiakassuhderesurssit
  Tekninen suunnittelu ja ylläpito
  Tuotanto
  Logistiikka ja hankinta
  Hallinto (tietotekniikka, laskutus, reskontra, kirjanpito, jne)
- Tarvitaan osaavaa mittaus- ja mallinnus henkilöstöä sekä biologisia prosesseja ymmärtäviä asiantuntijoita konsultoijiksi. Pilotointivaiheessa tarvitaan hyvää insinööriosaamista prosessin toteuttamiseksi hyväksi havai-tussa kohteessa. Toiminnan ylläpitämiseksi tarvitaan lisäksi myös ICT palveluiden tarjoajia.
- Jätettä.

Lietejakeet tehdaskohtaisia.

- T&K resurssit riittävien teknisten näyttöjen antamiseen
  Liiketalousresurssit tarvittavien laskelmien tekoon.
  Sopimusjuridiset resurssit
  IPR osaaminen teknologian suojaukseen
- alan tunteva insinööri/konsulttitoimisto pohjatietoja kokoamaan jonka jälkeen resussien lisäyn tarpeen mukaan niin talous kuin tekniikka puolelle.
- Mikrobiologi
  Insinöörejä
  Markkinointia
  Johtajia
  Rakennuttajia ja alihankkijoita
- Tuote pitää saada ensin niin hyvin toimivaksi, että joku rakentaa siitä ensimmäisen teollisen sovelluksen. Tämän jälkeen tulokset puhuvat puolestaa ja siihen tarvitaan sopivia ihmisiä "myymään" tuotetta eteenpäin.

8. Mitä toimenpiteitä tarvitaan liiketoiminnan rakentamiseksi?

Vastaajien määrä: 8

- Onnistuneet koekäytöt pilottilaitteistolla. Karkea laskelma suuresta laitteistosta ja mikä on jakeiden arvo ja markkinahinta.
- Liiketoiminnan suunnittelu (Business Process Development)
  Organisaation ja työtehtävien suunnittelu
- Pitää rakentaa moniportainen liiketoimintakonsepi, joka koostuu hyvin tunnetun prosessin (2.3 butanidiolin / asetoni butanoli fermentoinnin) käyttöönottamiseksi teollisissa prosesseissa tai teollisten prosessien sivu- tai päämateriaalivirroista.
- Pilotointi, neuvottelut, sopimukset, investoinnit.
- Vakuuttavat tekniset tulokset ja laskelmat
  Teknologian suojaus ja sopimusasioiden suunnittelu alusta asti
- varmaankin olisi hyvä tehdä ns. malli business case jolla voidaan osoittaa hankkeen kannatavuus ja jolla voidaan myös tehdä ns herkkyys analyysi. -> sopimus mallien laadinta

  referenssitapausten esittelyt on tärkeitä.
- Kannattavuuslaskelmat
  Pilotti
  Lietteen tutkiminen
  Prosessin tutkiminen
  Suunnittelu asiakkaan toiveiden mukaisesti
  Liiketomintamallin rakentaminen
- Saavutettujen hyötyjen pitää olla riittävät, että investointi kannattaa.

9. Ketä avaintoimijoita ja kumppaneita tarvitaan?

Vastaajien määrä: 8

- Insinööritoimisto ko. tekniikasta
  Asiantuntevat tekniset myyjät, jotka tuntevat prosessin.
  Pioneerihenkiset yritykset mukaan joka asiakassegmentistä, jotka investoivat laitteistoon.
- Yllä olevien toimintojen asiantuntijoita
- Mainittu kohdassa 7.
- Ekokem

  Uuden liiketoiminnan kehittäminen alihankintana.
- Laitetoimittaja, konsulttiapu (laki, patentti)
- valtio/kunnat
  yritykset
  alan tunteva (jätevirrat) konsultti/insinööri toimisto
  tukes
  motiva
- Alihankkijat Pohjois-Savossa / Toivalan konepaja, Brandente, prosessiautomaatio/ Savonia, HW, Schneider LVI / Onninen, LVI-Dahl
  Savonia

Sakky
UEF
Finnoflag
Samplion
- Suunnittelutoimistot, viranomaiset, teollisuus.

10. Millaisia kiinteitä ja muuttuvia kustannuksia syntyy liiketoiminnan rakentamiseksi?

Vastaajien määrä: 8
- Muuttuvat: energia laitteiston ylläpidossa ja käytössä, huolto, raaka-aineet, ja niiden kuljetus. lämmitys, tuotantohenkilöstön palkat+ sosiaalimaksut.

Kiinteät: laitteiston rakentaminen ja sitä kautta poistot yritykselle. Muut investoinnit laitteen ylläpitoon. Onhan myös brändiarvo (ympäristöarvo)
- Laitosinvestinnit
logistiikka
henkilöstö
jne
- Asiakas laittaisi omaa rahaa peliin sitä mukaan miten heidän prosessinsa tai jätteensä voisi soveltua Abowen biojalostamoon.
1. Esiselvitysvaihe: Mittaus, mallinnus, konsultointi. Tarvitaan vain mittalaite-, mallinnus- sekä henkilöstö resurssit.
2. Pilotointivaihe: Pilotin vuokraus asiakkaalle, insinööriosaamisen henkilöstöresurssit.
3. Teknologian toteutusvaihe: Investointikustannukset teknologian tilanneelle asiakkaalle. Operointikustannukset asiakkaalle laitoksen toiminnasta.
- Palvelun kustannus sisäänostettua euroa/tonni.

Juoksevat kulut liiketoiminnan aikana.

Lietteen käsittely, lietteen lämmittämisen kustannukset.
- Patenttikustannukset
Sopimuksen valmisteluajan kustannukset
Pilot koeajot
Konsultointiapu
- kiinteät on palkkoja ja vuokria. muuttuvia syntyy vasta kun prossesi on saatu "tulille".
- Työ
Varusteet
Palvelu
Tilat
Johto
Oikeudet
- Käyttökulut, henkilöstökulut, markkinointi jne.

11. Kuinka rakennetaan kilpailijoista erottuva liiketoimintaratkaisu?

Vastaajien määrä: 8
- en edes tiedä mitä kilpailijat käyttävät, olen lukenut muutamia tekniikoista, joita käytettiin Saksassa 40-luvulla butaanidiolin tekoon.

En osaa sanoa.
- Tekninen osaaminen, matala kulurakenne, kevyt organisaatio, asiakastarpeet hyvin ymmärtävä liiketoiminta. Ongelmien pikainen ratkaisu, kompromissikyky
- Tarjotaan moniportainen palvelu- ja pilotin toteutus sekä mahdollisesti täyden mittakaavan teknologian toteutusratkaisu, johon kenelläkään muulla ei löydy vastaavaa osaamista tai kokonaisuutta. Kilpailijoista erotutaan, kun tarjotaan yksilöllistä asiakaslähtöistä asiantuntevaa palvelua.
- Kaikki lietteet tällä hetkellä hyötykäyttöön.

Polttaminen kilpaileva ratkaisu.

Biokaasulaitokset merkittävin kilpailija.

Ohjaaminen hyötykäyttöön paras kilpailutekijä. Etäisyys muodostuu rajoittavaksi tekijäksi.

Osankin ohjaaminen muualle käyttöön helpottaisi Savon Sellua ja Ekokemiä.
- Luotan edelleen ammattitaitoisesti tuotettuihin teknisiin tuloksiin ja liiketoimintalaskelmiin
- rakentamalla business case kestävän kehityksen periaatteella. ympäristö asiaa voimakkaasti korostaen. Pohjalla tekniikka joka toimii vielä "huomennakin".
- Mikrobiologian käyttö kemikaalien valmistuksessa uudella tavalla

- tähän osaa varmaankin vastata joku markkinoinnin ihminen

12. Mitä erilaisia yritysratkaisuja voidaan rakentaa?

Vastaajien määrä: 7
- Jokaiselle asiakasryhmälle omanlainen markkinointi, suurin lienee metsäteollisuus.

Jokainen asiakasryhmä on suuri.
- Joint Venture
Kumppanuutta
Tarvikkeiden ja palvelujen osto/myynti
- 1. Konsultointipalvelut: Mittaus, mallinnus.
2. Pilotointi: Abowen insinööriosaamisen siirtäminen asiakkaalle.
3. Teknologian toimittaminen.
- Palvelumalli
Koulutus
Tutkimus

Metsäteollisuuden volyymi suurin, Elintarviketeollisuus, Prosessiteollisuuden orgaaniset jätteet.
- Teknologian lisensointi asiakkaalle
Palvelun tuottaminen asiakkaalle
Suorat sopimukset jätteen tuottajan ja jalosteen vastaanottajan kanssa, oma tuotanto
- jonkin sortin "kompus" alueen yrityksistä kuulostaa ehkä parhaalle. Tosin näiden "kompuskien" ongelmana on hidas käyntiinlähtö - "niin monta mielipidettä kuin toimijaa"
- Voi olla esim. täysin yksityinen toimija, joka tuottaa toisen jätteistä uusia tuotteita tms.

13. Kuka voisi toimia mahdollisena investoijana?

Vastaajien määrä: 3
- Jos tulokset on vakuuttavia, investointi voisi löytyä asiakkailta.
Välivaiheen rahoitus hankittava muualta.
- tässä tarvitaan usean toimijan yhteenliittymä jo pelkästään jatkuvan jätevirran varmistamiseksi - uskoisin.
Uutta tekniikka tulee myös motiva ja tekes.
Pää vastuunkantaja toki tarvitaan joka pyöritään toimintaa.
- Teollisuus, jätteisiin erikoistuneet yhtiöt jne.

14. Yhteystiedot

Vastaajien määrä: 8