VALUEWASTE

Unlocking new **value** from urban bio**waste**

D.7.3. first insights on new business models

Grant agreement number 818312

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D.7.3. First insights on new business models

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18	Creaciones Aromaticas Industriales S.A.	CARINSA	ES	Industry cluster

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Executive summary

This report describes the circular economy Business model creation processes for the three value chains of VALUEWASTE. The overall aim is to use a new conceptual framework for business model innovation in circular economy and explore the social acceptance of business models in this context (Eskelinen et al., 2020). For these objectives, we have analysed the characteristics of circular economy business models (CEBs) and studied how the social acceptance can be integrated into the CEBs development. We recognize the importance of fundamental values (Keeney, 1992) when identifying decision opportunities and the creation of better alternatives. The intent is to be proactive and to select the best decisions to ponder before attempting any solutions.

Three business cases have been co-created in three business model processes. The process includes context design, identification of opportunities through interviews, small group meetings and business model workshops. In addition, we have started the design of Business model for the overall cascading approach (the so-called VALUEWASTE solution), which includes the development of a system for urban biowaste valorisation where the three value chains can be integrated. The cascading approach gives priority to higher value uses that allows the reuse and recycling of products and raw materials We explain the processes and results and discuss on the first insights of the outcomes. Also, the next steps are introduced. These include the value-based multicriteria evaluation of the business models.

The business cases aim is to find new solutions and valorising models from urban biowaste, thus being sustainable solutions, which can be evaluated, for example, by a smaller amount of greenhouse gas emissions, and which try to enhance self-sufficiency in protein and fertilizer production. We expect to develop solutions with environmental, social and economic advantages. We are talking about new ways of producing protein and fertilizers from waste, and creating circular economy valorising models. Social acceptance and behavioural change are important parts of sustainable development, and essential when designing new valorising and business models and when introducing the new products to market. For this reason, the work on business cases and models reported here is tightly integrated to social acceptance work at WP8 of VALUEWASTE.

1 Introduction

Circular economy provides many opportunities for companies, customers, and the society. The European Union has recognized both the challenges, and the needs to develop new products and services from urban biowaste. One of the most interesting opportunities is related to the obtention of new protein and fertilizer sources from biowaste side streams. The technologies to develop them are being tested in VALUEWASTE. We also tackle the challenge of developing a systematic approach when developing circular economy business models (CEBs).

VALUEWASTE project proposes an integrated approach in urban biowaste upcycling for the production of high-value bio-based products, developing the first complete solution to fully valorise biowaste across Europe. Three value chains will use urban biowaste side-streams as raw material for its valorisation. VALUEWASTE is developed at two quite different European locations, Murcia (Spain) and Kalundborg (Denmark) with the purpose of finding solutions both technically and socially adopted to the different socio-economic contexts.

This report describes the circular economy Business model creation processes for the three value chains of VALUEWASTE (Task 7.2). The overall aim is to use a new conceptual framework for business model innovation in a circular economy and to explore the social acceptance of business models in this context (Eskelinen et al., 2020). We have analysed characteristics of CEBs. We have studied the social acceptance integrated to the circular business models development. We recognize the importance of fundamental values (Keeney, 1992) when identifying decision opportunities and the creation of better alternatives. The intent is to be proactive and to select better decisions to ponder before attempting any solutions.

Three business cases have been co-created in three business model processes. The process includes context design and identification of opportunities through small group meetings and business model workshops. In addition, we have started the design of business model for the overall cascading approach (the so-called VALUEWASTE solution). The cascading use principle gives priority to higher value uses that allow the reuse and recycling of products and raw materials. In this report, we explain the processes and results, and discuss on the first insights of the outcome. Also, the next steps are introduced. These include the value-based multicriteria evaluation, for example, against sustainability and feasibility.

The business cases aim is to find new solutions and valorising models from urban biowaste, thus being sustainable solutions linked to a smaller amount of greenhouse gas emissions, which enhance self-sufficiency in protein and fertilizer production. We expect to develop solutions having environmental, social, and economic advantages. We are talking about new ways of producing protein and fertilizers from waste, and creating circular economy valorising models. Social acceptance and behavioural change are important part of sustainable development, and essential when designing new valorising and business models and when introducing the new products to market. For this reason, the work on business cases and models reported here is tightly integrated to social acceptance work of VALUEWASTE.

2 Objectives

The objective of this deliverable is to identify opportunities and get insights on new CEBs in relation to three valorising chains of the VALUEWASTE project. This is done by interviews, survey questionnaires, and Business model workshops. The overall aim is to use a new conceptual framework for business model innovation in a circular economy and to explore the social acceptance of business models in this context (Eskelinen et al., 2020). We study social acceptance integrated to the circular business models development. We recognize the importance of fundamental values (Keeney, 1992) when identifying decision opportunities and the creation of better alternatives. The intent is to be proactive and to select better decisions to ponder before attempting any solutions.

3 Elements of circular economy business model

A business model describes the rationale of how an organization creates, delivers, and captures value, in economic, social, cultural, or other contexts. The importance of the context where a business model is established is crucial for understanding the overall logic of the company, the design and creation processes, and the company interconnectedness with other entities (Kajanus et al., 2019).

A business model can be defined as “a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams.” (Osterwalder et al., 2005).

Circular Economy (CE) is a new economic model that aims to reduce and eventually close the resource loop, enabling resources to be used as many times as possible and allowing sustainable and carbon-free economies to thrive globally (Ellen MacArthur Foundation, 2013; European Commission, 2016, 2020). Previous research on business models has addressed the need for novel business models within the CE context. However, the topic is understudied, and real-life cases have not been extensively addressed (Antikainen & Valkokari, 2016), and the CEBs differ from the traditional linear economic model. The linear economic model lacks sustainability, and it will be replaced by novel CE models in which the focus is to keep materials in use for as long as possible and so to preserve – or even upgrade – their value through services and smart solutions. CE models require interaction between all involved actors, including both the core-business network and other stakeholders (Antikainen & Valkokari, 2016).

CEBs fall in two groups: those that foster reuse and extend service life through repair, remanufacture, upgrades and retrofits; and those that turn old goods into as-new resources by recycling the materials. The model is people centric. Ownership gives way to stewardship; consumers become users and creators (Stahel, 2015).

A CEB articulates the logic of how an organization creates, delivers, and captures value to its broader range of stakeholders while minimizing ecological and social costs (Ellen McArthur

Foundation; Board of Innovation, 2021). Linear business models are based on the following logic: extraction of natural resources, make products for consumers that eventually become waste. CEBs contribute to a CE by adhering to the CE's three fundamental principles: 1) Design out waste and pollution, 2) keep products and materials in use, and 3) regenerate natural systems. As main principles, CE sources products and materials from the economy, not from ecological reserves, creates value for customers by adding value to existing products and materials, and creates valuable inputs for businesses beyond your customer.

The key component in a CEB is the value proposition (Piispanen et al., 2020, Planing, 2015). Value creation is an opportunity on environmental and societal levels. Although the CEB must be viable and profitable, it contains more green values that can create value within a broader context (Piispanen et al., 2020). Value creation can happen, for example, with customers, subcontractors, and distribution and logistics partners, meaning value opportunities throughout the entire supply and value chain. In addition, the new information can be used by managers planning their businesses (Piispanen et al., 2020). The value proposition or the delivery can be virtual (Lewandowski, 2016). Additionally, selling the value proposition can take place through virtual channels as well as through interaction with customers (Ellen MacArthur Foundation, 2015).

The CEBs have specific characteristics on the other business model elements as well, such as revenue streams, customer relationships, segments, key resources and partnerships (Lewandowski, 2016), being cost structure an important benefit of CE (Piispanen et al.,2020). The take-back system component shares the same core idea as material loops, which are central to the idea of CE (Ellen MacArthur Foundation, 2013). The adoption process of CEB is characterized by many internal and external factors (Piispanen et al., 2020). For example, in the cases of Product service systems (PSS) and remanufacturing, their adoption has fallen short in the business-to-consumer sector, due to lack of consumer acceptance (Camacho et al. 2017). Literature addressing this issue has failed to provide a systematic approach to the problem (Camacho et al., 2017).

4 Business model development processes

As part of commercialisation of new products, Savonia University of Applied Sciences conducted a series of workshops on business models and performed social acceptance studies in Murcia and Kalundborg, our case study cities in VALUEWASTE. The social acceptance of the new products is studied by using the consumer research and social acceptance approaches (Task 8.1. and 8.2. in WP8).

The business model process (Fig1 and 2) is a participative business model development process with multi-criteria evaluation/development system (MCDS) and portfolio analysis (Eskelinen et. al, 2017 and Kajanus et al., 2014, Kajanus et al., 2019). The expanded canvas framework with 12 BM blocks is used. The business model process (Fig. 1) starts with context definition, participant identification, and decision on the schedule and objectives. Business cases are identified in three value chains of circular economy (Fig 2), insect production from biowaste side-streams, single cell protein (SCP) from biomethane, and fertilizer production. The innovation pathway follows the ISO (56002) standard on innovation management: 1. Identification of opportunities, 2.

Creation of potential concepts, 3. Validation of concepts, 4. Developing working solutions, 5. Deployment to realize value.

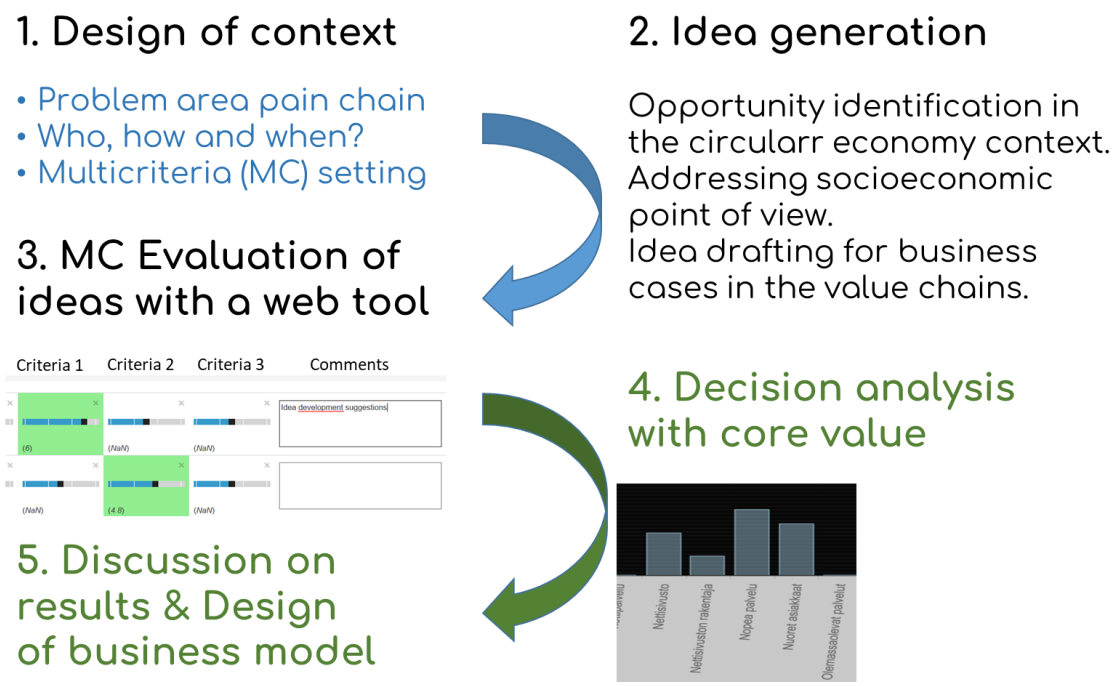

Figure 1. The CE business models process with MCDS (Kajanus et al., 2014, Eskelinen et al., 2017, Eskelinen et al., 2020).

Opportunity identification (idea generation for the business model) with interviews and brainstorming of ideas to business model, is facilitated by using business model questions. The questions are "traditional" business model questions boosted by questions related to circular economy, social acceptance, and sustainability. Business model ideas are validated in a multi-criteria (MC) evaluation with online visual evaluation tool. Value-based evaluation criteria are used: social acceptance, sustainability, feasibility. Portfolio analysis (Kajanus et al., 2014, 2019) applying core index is used to find best idea portfolios to business models.

To make sure that the innovation management plan is properly developed and implemented in the VALUEWASTE project, a dedicated Innovation Team has been created including those partners directly involved in innovation commercialisation (VALUEWASTE D7.2, 2019). Such a team meets annually to exchange views and ideas; review the technology scan for future developments; follow up market opportunities and trends; update market research including follow up prices' evolution for proteins, phosphorus, and key compounds of interest; evaluate different business models, follow up competitors' evolutions; contribute a to the development of commercialisation plans; and invite external experts to discuss topics of interest for results exploitation. The results from the business model process are discussed by the Innovation Team, where the elements of the business model are challenged by additional questions. For example, the value proposition or customer expectations can be challenged in the context of circular economy, sustainability, or social acceptance. The challenging and additional information to answer questions raised will be used to improve the model in an iterative process.

Interviews and a survey questionnaire are used to study social acceptance of business models (Fig 2). The business models are designed by using the information from the interviews by

identifying new ideas to the business model in each business case. The insights are used when validating and challenging the business model.

The input received will be used during the commercialisation / business model design process (Fig 1) when designing business models (D7.4; due by October 2022) on the new products or services as part of the commercialization strategy (D7.6; due by October 2022). As practical implementation, social acceptance information is needed when developing different topics of the business model: customer needs and behavioural change, and customer segments, company solution –and in comparison, with competing solutions, value proposition, marketing channels, customer relationships, key resources, partners, and activities, and revenue model. As discussed above, value proposition is an important part of CEBs (Piispanen et al., 2020). Also, it is important to identify the vital elements affecting behaviour (Grenny 2013; UNEP 2020; see the public document D8.3 First insights on social acceptance for further details). When developing business models, social acceptance is one of the evaluation criteria of the business model along with other criteria, like sustainability and business potential.

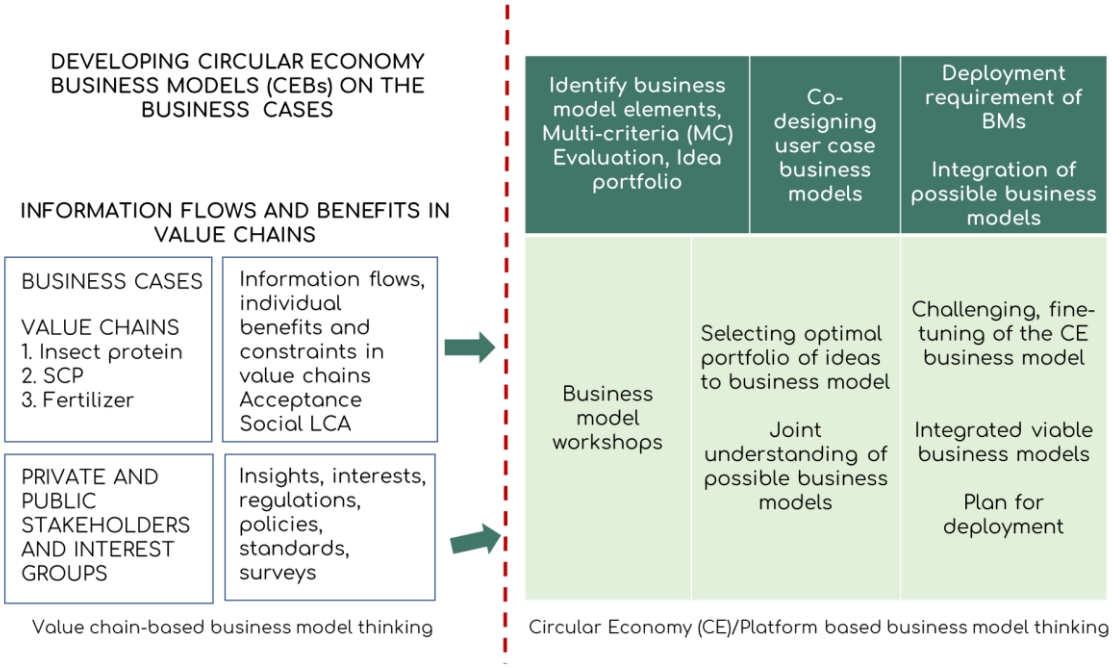

Figure 2. The overall commercialization process links social acceptance to business models development at WP7, task 7.4.

The results of the business models are presented in the canvas framework (Osterwalder and Pigneur 2010), which is a strategic management and learn start-up template for developing new or documenting existing business models. It is a visual chart with elements describing a firm's or product's value proposition, infrastructure, customers, and revenue logic, and consists of nine interrelated building blocks. The one used in this project is the expanded canvas (Kajanus et al., 2014 & 2019) which has three elements in addition to the original model: customer need, company solution, and competing solutions. In addition, a new element, catalyst of change of customer behaviour (societal driver), has been added as an addition to explain the customer needs. This model addresses the importance of social acceptance and customer behaviour -we need to understand which is the vital behaviour we need to change, and which is the driver or catalyst to change it (Grenny et al., 2013 and UNEP 2020). The method enables co-creation and learning on how the users could create and consume value in economic, social, cultural, or other

contexts as part of the business models.

The canvases were developed, firstly, by a pre-survey made with Webropol, and including 13 questions on Business model adapted from Osterwalder & Pigneur 2010, Ellen McArthur Foundation, and Kajanus et al., 2014 and 2019). Then, 2-3 questions of interest to the business partner were discussed more in detail in the business model workshop, to find ideas and solutions to the question. Value proposition was included in the discussion of each workshop.

5 First insights on the business cases

5.1 Context

VALUEWASTE general objective is to develop a system for urban biowaste valorisation through the development of three value chains (Fig 3), that can be integrated following a cascading approach. Two different routes for protein production (as well as other valuable compounds susceptible to be used as feed and food ingredients) and one combining system for nutrients recovery (P and N) will be demonstrated at TRL7 within the project.

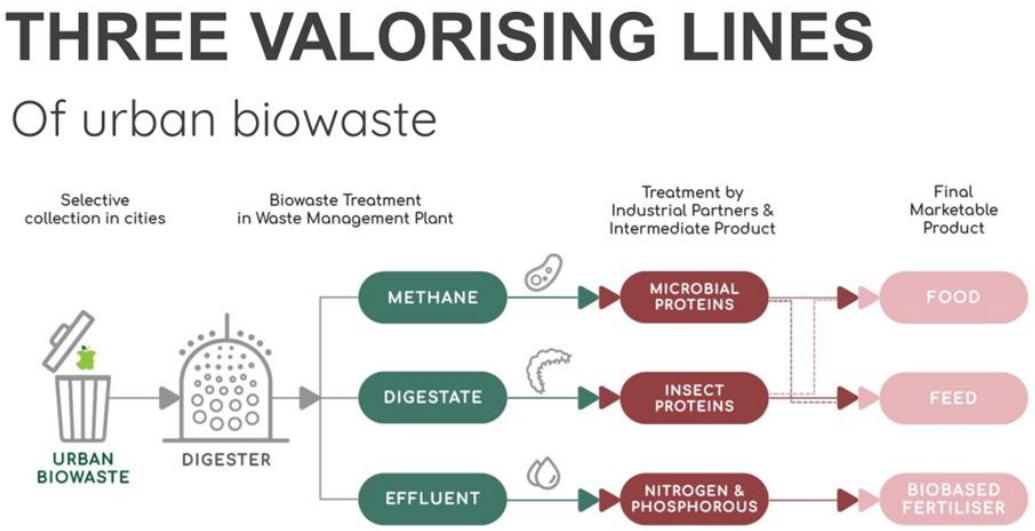

Figure 3. VALUEWASTE three value chains.

To define the context for the business cases, and to identify challenges, barriers, and opportunities, series of interviews of stakeholders have been organised, including value chain responsibles (Unibio, Entomo, and EkoBalans), experts of the VALUEWASTE Project and beyond. The interviews produced valuable information and insights on the business case context: end-products definition, goals of the study and target groups, participants, acceptance levels, as well as information on the operational environment (e.g., legislation, political). These interviews have been reported (VALUEWASTE D8.3, 2021).
The expert interviews indicate some focus groups on the market acceptance: supermarket chains, retailers, and companies selling feed, fertilizers and pesticides to the agricultural sector, as well as business to business.

Safety and legislation are key components in achieving social acceptance. Definitions and requirements in the waste and food directives should be followed. Biowaste from catering, if processed correctly, could possibly be an option for a side-stream which could be used in the value chain, if not classified as waste. Novel foods, in practice, for example, produced with

insects, need authorization from the European Commission. Safety of such novel food is assessed, upon request by the Commission, by the European Food Safety Authority, EFSA (EU, 2015).

In order to achieve market acceptance, there are indications that people would like to buy products with bioproducts having healthy properties. Gaiker performs laboratory tests on the toxicological, functionality and microbiological properties of the bio-compounds produced in the 3 value chains. Unibio develops 3 bio-compounds related to single cell protein (SCP), Entomo 2 bio-compounds related to insect production process, and Ekobalans biofertilizers which are not yet under laboratory testing. The bio-compounds could be sold as ingredient for food or feed. Different customer profiles are possible (e.g. customers cultivating fish).

The driver for change of customer behaviour can be related to attractive novel products and circular value chains, better use of biowaste, sustainability, and adaptation to climate change related to water scarcity and soil degradation. However, the market is not ready for these new bioproducts, and we lack information on the customer profile and drivers of behavioural change which will be needed in order to increase the market acceptance.

There are factors which may increase socio-political, and community acceptance. For example, creation of new jobs, attractive business of sustainability, better local resilience, less CO2 emissions, and the development of more sustainable society.

5.2 The business model canvases on the three business cases and whole solution.

The three business model processes have resulted into three preliminary business model canvases. This chapter introduces the business cases, and preliminary canvases obtained at Tables 1-3 for each of the value chains of VALUEWASTE. In addition, the preliminary overall business model canvas for the VALUEWASTE solution is also provided at Table 4.

5.2.1 Unibio

Unibio was founded in 2014 with a vision of revolutionizing protein production. By using bacteria to ferment methane, Unibio produces protein without creating an additional negative impact on the environment. In fact, they capture the impactful greenhouse gas, methane, and only release clean water as a waste product. Doing so, Unibio can help solving the problem of climate change arising due to conventional protein production, protein malnutrition and the increase in demand for protein of a growing world population.

In the VALUEWASTE project, Unibio role is to design, implement and test the microbial protein production from biowaste biogas. Unibio business model is based on a fermentation technology development (Unibio's U-Loop technology), later on the protein production development, *from methane to protein/food*. The technology decreases the need for land or sea utilization in the production. Also, CO_2 emissions decrease. Uniprotein®, the end-product resulting from Unibio's U-Loop technology, addresses the world's growing need for animal protein, which will continue to increase in line with population growth and the emergence of a large middle class with strong purchasing power. Uniprotein® is a protein-rich biomass (72.9% protein) and can be used as a direct supplement in animal feed compounds. UniProtein® is comparable to high-quality

fishmeal[1]. In 2014 the average price of one Metric Ton of such fishmeal was USD 1921.47 (World Bank).

Table 1. Business model canvas, Unibio

Customer/competition	**Customer segments** Feed: distributors or global big animal feed producers Food: The leading global big food ingredient producers	**End user, customer need** High value protein and ingredient solutions in various feed and food application Feed: functional properties, features & benefits, availability & regulation oand the price Food: Functional properties, features & benefits, availability, novel food approval and the price **Catalyst of change (of customer behaviour)** There is a shortage of proteins on the market in the long run. The green focus areas are important: sustainability, low environmental load, organic profile and products, LCA profile, low carbon foot print. Safe product for the customer.	**Company solution** High value protein and ingredient solutions in various feed and food application to be included in our customers final product solution Commercial plant	**Competitive solution** Other bacteria protein meal producing companies, very young at industrial scale
Offering	**Value proposition** Sustainable solution (no Farmland) and high protein content Sustainable product -data demonstrates the features & benefits of the products Competitive price Secure supply Vitamin contents	**Channels (Go to market strategy)** Feed: A commercial agreement Feed sales organisation through distributors and direct sales to the global feed producing companies, Unibio needs only very small sales organisation Bacterial meal protein products are new to the market. Demonstrate the functional and nutritional properties of our products to the market.	**Customer relationship**	**Profit Formula** **Revenue streams** Food ingredients sales and revenue easier than feed and price higher

[1] https://www.unibio.dk/technology/sustainability/#accordion-1

Resources	**Key resources** Food: Fully owned own production facilities	**Key partners** Feed: distributor, global feed producing companies	**Key activities** Make the products available for customer trial applications by the customer	**Cost structure** The fermentation solution is expensive - capex cost is high, Funding of production plant Feed: licensing and royalty payment on technology

5.2.2 Entomo Agroindustrial

In VALUEWASTE project, Entomo is responsible of the installation of insect DEMO farm in the waste treatment plant of Murcia in Cañada Hermosa, and conversion of urban biowaste via Black Soldier Fly.

Entomo Agroindustrial is a SME company based in Cehegin (Murcia, Spain), providing industrial solutions for the treatment of organic matter using insects. Their mission is enabling companies to transform waste from the food industry into sustainable food for animals using insects. Entomo's role is biowaste valorization implementation concerning the conversion of digestate and urban biowaste to food protein via Black Soldier Fly. Business concepts development started in 2016, and the current business lines are:

- URBAN: Solid urban waste,
- NON-VEGETABLE: Waste industry, sewage sludge, etc.,
- VEGETABLE: feeds.

The business lines have possibilities and potential to produce numerous additional valuable end-products, for example, chitosane, peptides, and fertilizers. A Business model workshop was held with Savonia in December 2019.

Table 2. Business model canvas, Entomo Agroindustrial.

Customer/competition	**Customer segments** **the food manufacturing industry and produce large quantities of organic waste** **The companies who produce waste or by-products**	**End user, customer need** Reduction and recycling of the organic fraction of urban waste in a profitable way. It is important because there are little technologies to treat the organic fraction of urban waste in a profitable way and according to EU regulations no organic waste can end in land field from now and waste manager have to invest in new technologies to reduce and recycle this fraction.	**Company solution** **Organic waste solution with insects – a turnkey solution** The solution shows several interesting features, aside from being profitable, which means to create profits out of waste, it is very adaptable and scalable, adapting to customers needs and	**Competitive solution** Most of the companies working with similar technology, act as independent companies which get the waste and process with the larvae (Agriprotein, Protix, Nextprotein, Entocycle, Nasekomo) but we provide technology for the waste producers to manage their own farm so the add value stay in the waste producer and not in the insect farm

		Catalyst of change (of customer behaviour) culture, information, quality **Trends**: Main one legislation, since according to EU law no organic fraction should end in land field. It affects either to pay a fine for not complying with regulation or to pay more for the treatment of this organic fraction	seasonality. In addition, the investment can be recovered in a period of 3 years. It directly applies to circular economy since the by-products or waste of one company is converted by larvae in several products that can be used directly in another industries as input. A solution which helps entering to a new business	
Offering	**Value proposition** Our unique value proposition is to offer engineering for the technology implementation of waste management with insects and runs the operation from start to product sale to keep most of the add value in the waste producer. So they have the waste, the have the farm and they get the profits.	**Channels** Direct relationships with the customer	**Customer relationship** Direct peer to peer Close personalized proposal Interviews – first budget – further relationship	**Profit Formula** **Revenue streams** 3 % of insect farm/insect factory construction cost plus a fee for product sale of 5%.
Resources	**Key resources** Knowledge about the waste and waste producers and managers IPR patenting Knowledge about industrial applications of insects	**Key partners** Big waste managers and producers	**Key activities** R & D activities Demo of products Demonstration of technology Certifications	**Cost structure** Our cost of sale, since our structure is fixed (personnel and indirect cost) depend on the number of projects we sale, but approx 100k € per factory.

5.2.3 Ekobalans/Nuresys

The research context on the third business case related to biofertilizers will be identified and designed in the coming months. In this Section preliminary information about the companies

involved in this business case is provided.

Nutrient Recovery Systems – NuReSys (Belgium). NuReSys, founded in 2011, seeks to promote and provide technologies for the recovery of valuable nutrients out of liquid streams (mainly wastewater and sewage sludge from wastewater treatment plants). NuReSys constructed its first industrial struvite plant in 2006, at that moment one of the largest worldwide. Ever since 7 additional plants have been under construction and 2 more are in design stage. The role in VALUEWASTE is related to the implementation of the struvite crystallization process.

EkoBalans (Sweden) was founded in 2008 and offers solutions for sustainable recycling and recovery of plant nutrients from food industry, biogas production, and wastewater treatment plants. EkoBalans has designed complete concepts for replacing wastewater treatment plants with Resource Water Recycling Plants and refining digestates into fertilizer.

Table 3. Business model canvas, EkoBalans/NureSys.

<table>
<tr><td rowspan="2">Customer/competition</td><td>Customer segments
1. Private consumers, municipalities, golf courses, and more
2. Food producers</td><td>End user, customer need
Replace fossil based artificial fertilizers with recycled products to become regenerative, sustainable, and minimize negative climate impact
Catalyst of change (of customer behaviour)
Information, Sustainability, quality
Driver
Food producers: Demands from food industry buying their products. Most food producers don't sell direct to customers. We really need to convince foos industry, rather than the farmers....
Others: Possibility to display modernity, responsibility, CSR</td><td>Company solution
Recycled raw materials, locally produced, low climate impact, more complete product including organics and micro-nutrients</td><td>Competitive solution
continue with artificial fertilizers
Use unrefined rest products, such as raw digestate
Use rest product based product that are not local</td></tr>
<tr><td>Offering</td><td>Value proposition
1. Recycled, sustainable added value product that can be transported, stored, and handled as artificial fertilizer
2. Help consumers to move from fossil-not sustainable to</td><td>Channels (go to market strategy)
1. Find partner for sales to private sector (small packages)
2. Sell directly to farmers, municipalities etc (big bag)
3. Convince food industry to put demands on farmers – to add pressure on their suppliers (farmers9</td><td>Customer relationship</td><td>Profit Formula
Revenue streams
Payment for product</td></tr>
</table>

	regerarative and sustainable 3. Less climate impact 4. Minimising of import of P 5. Less transport 6. Nutrient dense foods			
Resources	Key resources Recycled plant nutrients Human and technological resources	Key partners The VALUEWASTE partners Other partners	Key activities	Cost structure Staff costs, storage, logistics Production plants (investment)

5.2.4 VALUEWASTE Overall business model

The VALUEWASTE overall Business model design has been started with a survey questionnaire provided by CETENMA. The specific content on this business model will be developed from autumn 2021 to spring 2022. At idea level, the overall concept is presented at Table 5.

In order to design the VALUEWSATE solution, a business model process and workshop will be developed. As part of this, all the valuable information and insights from the individual BM's will be used and applied. The Innovation Team (VALUEWASTE D7.2) and Innovarum will give expertise as experts in Innovation, and responsible of C&D from a point of view of defining the communication and stakeholder's engagement strategy. The workshop itself will require the participation of all the technology providers because the VW solution consists in the integration of the three value chains in a single integrated approach. As the system is to be integrated in a waste management facility, and scaled up, Ferrovial and Itainnova, responsible for the selective collection of urban biowaste and scaling of the VALUEWASTE solution, respectively, will be also invited. The design of the process started in May 2021 and will continue during 2021. The workshop is planned to be organised during autumn 2021.

Table 4. The VALUEWASTE solution, pre-drafted canvas

Customer/competition	**Customer segments** VALUEWASTE solution: Municipalities Waste management companies technology investors (Biobased products Feed and food industry, farmers)	**End user, customer need** Better use of resources Sustainability Efficient production of high-value products Self-suffiency Reduce market vulnerability Catalyst of change (of customer behaviour) Socio-economical context, social acceptance and awareness; creation of	**Company solution** The first complete and out-of-the-box solution to fully valorise urban biowaste The products from the companies	**Competitive solution** One-way flow systems in which materials and resources are underused, limiting its potential recovery into high-value products.

		jobs at new sectors; need for new information for the elaboration of future regulations and policies Trends: Legislation requirements Social pressure Environmental issues Increased population in cities Global issues, eg COVID-19 Pandemic		
Offering	Value proposition an integrated approach in urban biowaste upcycling for the production of high-value biobased products, developing the first complete solution to fully valorise biowaste that can be easily implemented and replicated	**Channels (go to market strategy)** A company by all the implicated VALUEWASTE partners to offer the technologies as a whole to customers(Especially waste management companies)	**Customer** relationshipDifferent ways will be considered to keep in contact and engage with the customers, social media etc.	**Profit Formula** **Revenue streams** The new created company (or association) could give to each partner the profits related to their own technology implemented and keep a fee(lets say 1%) for keeping the structure
Resources	**Key resources** Technology and business develepers	**Key partners** VALUEWASTE partnership, industrial and other partners	**Key activities** Establsih the design process for the VALUEWASTE solution	**Cost structure** Technology and business development, dissemination, marketing costs

6 Discussion on the canvas business models

The canvas business models (Tables 1-4) were drafted on the basis of interviews, business model survey, and workshops. About 20 persons, stakeholders, and experts, have been interviewed, who mostly represent the VALUEWASTE partners, but also external expertise. Most of the items of the canvases were obtained from the survey answers. Some specific questions were raised and discussed during the business model workshops, where 5-10 key experts of each business case participated. Value proposition was the main question discussed and developed during all workshops, together with the market strategy. Also, the development of digital platform-based solutions was discussed as part of the business models, as an important feature of CEBs (Mattila et al., 2020). The drivers of customer behavioural change needed for the new bioproducts to enter to market were addressed both at the survey, and during workshop, and added to the canvases for the first time. Aspects like culture, access to information and its quality can be important factors affecting behavioural change.

7 Next steps

The work initiated will continue to fine-tune and complete the draft canvas business models on the business cases. The business models will be evaluated in a multicriteria evaluation process, including criteria like sustainability and social acceptance. In addition, the design of the overall business model of VALUEWASTE will be made. This includes the development of a system for urban biowaste valorisation through the development of three value chains that can be integrated following a cascading approach. Additional interviews will be needed both among the VALUEWASTE partnership, and beyond.

Also, the drivers of customer vital behaviour will be analysed in-depth (in WP8, Grenny 2013), and developed and applied as part of the canvases. Results from the social acceptance studies will be used when developing the CEBs, applying the systematic process towards the development of CEB. When developing CEBs and systemic changes in food systems, it is crucial to understand the consumer willingness to adopt new technologies, products, and services, include all actors of supply chain is needed and the assessment of the consumers' willingness to engage in and accept different innovation pathways and (Borrello et al., 2016, UNEP 2020).

8 Conclusions

Three Business model processes are undergoing and resulted into three preliminary business model canvases presenting the three value chains of the VALUEWASTE project. In addition, the design of overall business model of VALUEWASTE has been started, and it includes the development of a system for urban biowaste valorisation where the three value chains can be integrated. Understanding of social acceptance and behavioural change are of interest to develop the new CEBs and make changes in food systems.

9 References

Antikainen M, Valkokari K (2016). A Framework for Sustainable Circular Business Model Innovation. Technology Innovation Management Review July Volume 6, Issue 7.

Board of Innovation (2021). https://www.boardofinnovation.com/circular-economy-business-models-explained/

Borrello M, Caracciolo F, Lombardi A, et al. (2017). Consumers' Perspective on Circular Economy Strategy for Reducing Food Waste. Sustainability.Camacho Otero C, Pettersen J, Boks C (2017). Consumer and user acceptance in the circular economy: what are researchers missing? PLATE conference Delft University of Technology 8-10 November 2017.

Ellen MacArthur Foundation (2013) Towards the circular economy. Opportunities for the Consumer Goods Sector [online]http://www.ellenmacarthurfoundation.org/assets/downloads/publications/ TCE_Report-2013.pdf.

Ellen McArthur Foundation (2019). https://www.ellenmacarthurfoundation.org/assets/downloads/Cities-and-Circular-Economy-for-Food_280119.pdf.

Ellen McArthur Foundation. https://www.ellenmacarthurfoundation.org/circular-economy/what-is-the-circular-economy

Eskelinen T, Räsänen T, Santti U., et al. (2017). Designing a Business Model for Environmental Monitoring Services Using Fast MCDS Innovation Support Tools. Technology Innovation Management Review, 7(11): 36-46. http://doi.org/10.22215/timreview/1119

Eskelinen Tuomo, Kajanus M, Wuorisalo J, Moula ME, Soriano-Disla JM, Fernandez-Gutierrez D, (2020) CEBs Addressing Social Acceptance. The ISPIM Innovation Conference – Innovating Our Common Future,Berlin, Germany on 7-10 June 2020.

EU (2011). Novel foods, amending Regulation (EU) No 1169/2011 of the European Parliament and of the Council and repealing Regulation (EC) No 258/97 of the European Parliament and of the Council and Commission Regulation (EC) No 1852/2001. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32015R2283&from=fi#d1e995-1-1.

EU (2015). REGULATION (EU) 2015/2283 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2015 on novel foods, amending Regulation (EU) No 1169/2011 of the European Parliament and of the Council and repealing Regulation (EC) No 258/97 of the European Parliament and of the Council and Commission Regulation (EC) No 1852/2001. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32015R2283&from=fi#d1e995-1-1

Grenny J, Patterson K, et al. (2013). Influencer: The new Science of leading Change. II edit. England.

Kajanus M, Iire A, Eskelinen T, et al. (2014). Business model design: new tools for business systems innovation. Scandinavian Journal of Forest Research 08/2014; 29(6). DOI:10.1080/02827581.2014.949301.

Keeney RL (1992).Value-Focused Thinking: A Path to Creative Decision making. Harvard

University Press, Cambridge, MA (1992).

Lewandowski M (2016) 'Designing the business models for circular economy – towards the conceptual framework', Sustainability, Vol. 8, No. 43, pp.1–28.

Mattila M, Mesiranta N,Heikkinen A (2020). Platform-based sustainable business models: reducing food waste in food services. Inderscience online https://doi.org/10.1504/IJEIM.2020.108258.

Osterwalder A, Pigneur Y (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers (The Strategyzer Series) Paperback – Illustrated, 20 Aug. 2010

Osterwalder A, Pigneur Y, Tucci CL (2005).Clarifying business models: origins, present, and future of the concept. Commun. Assoc. Inf. Syst., 16 (2005).

Otero C, Pettersen J, Boks C. (2017). Consumer and user acceptance in the circular economy: what are researchers missing?

Parsons R & Moffat K (2014). Constructing the Meaning of Social Licence. Journal Social Epistemology. A Journal of Knowledge, Culture and Policy. Volume 28, 2014 - Issue 3-4: Social Licence to Operate Pages 340-363 | Published online: 31 Jul 2014. https://doi.org/10.1080/02691728.2014.922645

Piispanen, V. V., Henttonen, K., & Aromaa, E. (2020). Applying the circular economy to a business model: an illustrative case study of a pioneering energy company. International Journal of Entrepreneurship and Innovation Management, 24(4-5), 236-248.Ministry of Education and Culture 12.4.2017.

Planing P (2015). Business Model Innovation in a Circular Economy. Reasons for Non-Acceptance of Circular Business Models.

PLATE conference Delft University of Technology 8-10 November 2017.

Stahel WR(2015). In The Circular Economy — A Wealth of Flows (ed. Webster, K.) 86–103 (Ellen MacArthur Foundation, 2015).

UNEP (2020). Consumer Information Tools and Climate Change. The Consumer Information Programme of the 10 Year Framework of Programmes on Sustainable Consumption and Production.
https://www.oneplanetnetwork.org/sites/default/files/consumer_information_tools_and_climate_change.pdf

VALUEWASTE (2018). Protection of Personal Data (POPD) D11.2 and Human (H) participation 11.4. Cetenma.

VALUEWASTE (2019). Innovation management team. D7.2. Danish Food and Bioeconomy Cluster (DFBC).

VALUEWASTE (2021). First insights on social acceptance. D8.3. Savonia University of Applied Sciences.

VALUEWASTE

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