VALUEWASTE

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

D8.3. First insights on social acceptance

Grant agreement number 818312

Co-funded by the Horizon 2020 programme of the European Union

D8.3. First insights on social acceptance

Deliverable D7.3. | VALUEWASTE Project | Grant agreement number 818312

Work Package No	8
Work Package Title	Evaluate social acceptance
Work Package Leader	SAVONIA
Issue Date	29/06/2021

VALUEWASTE's partners:

Disclaimer and acknowledgements

"This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 818312"

Document Information

Acronym	VALUEWASTE
Title	Unlocking new VALUE from urban bioWASTE
Grant Agreement Number	818312
Call	H2020-SFS-2018-1
Project Coordinator	Asociación Empresarial Centro Tecnológico De La Energía Y Del Medio Ambiente De La Región De Murcia (CETENMA)
Document Type (R/DEM/DEC/OTHER)	R
Dissemination Level (PU/CO/CI)	PU

DOCUMENT HISTORY

Issue	Date	Comment	Author
V1	29/06/2021		Tuomo Eskelinen

ADDITIONAL AUTHOR(S) AND CONTRIBUTION

Name	Organisation
Miika Kajanus	SAVONIA University of Applied Sciences

VERIFICATION AND APPROVAL

	Date	Name
Verification final Draft by WP leader	29/06/2021	Tuomo Eskelinen
Approval Final Deliverable by Coordinator	29/06/2021	CETENMA

VALUEWASTE participants

Participant No *	Participant organisation name	Short name	Country	Organisation type
1 COORDIN.	Centro Tecnológico de la Energía y el Medio Ambiente	CETENMA	ES	RTO
2	Eurizon S.L.	INNOVARUM	ES	SME
3	SAVONIA University of Applied Sciences - SAVONIA-ammattikorkeakoulu oy	SAVONIA	FI	University
4	Servicios Urbanos de Murcia, S.A.U.- Servicios Ferrovial	MU-FERROVIAL	ES	Large Company
5	Ayuntamiento de Murcia	MURCIA	ES	Municipality
6	Instituto Tecnológico de Aragón	ITAInnova	ES	RTO
7	Unibio A/S	Unibio	DK	SME
8	Agro Business Park A/S	ABP	DK	Company cluster
9	Asociación Española de Normalización, (Spanish Association for Standardisation)	UNE	ES	Standardisation body
10	Nutrient Recovery Systems bvba	NuReSys	BE	SME
11	Ekobalans Fenix AB	Ekobalans	SE	SME
12	Ingeniería y Desarrollos Renovables, S.L.	INDEREN	ES	SME
13	GAIKER-IK4 Technology Centre	GAIKER	ES	RTO
14	Entomo Agroindustrial S.L.	ENTOMO	ES	SME
16	Kalundborg Kommune	Kalundborg	DK	Municipality
17	European Biomass Industry Association	EUBIA	BE	Industry cluster
18	Creaciones Aromaticas Industriales S.A.	CARINSA	ES	Industry cluster

Index

Executive summary

The main purpose of this deliverable is to report the first insights on the social acceptance as result of stakeholder interviews and survey questionnaire, and a workshop. In-dept analysis of these results will be reported by M44.

SAVONIA started the social acceptance context identification work with a series of interviews and small group discussions with the companies, stakeholders, target groups and experts, which were reported, as part of D8.1 in February 2020. In collaboration with Murcia (Spain) and Kalundborg (Denmark) municipalities, a survey questionnaire on social acceptance and S-LCA has been developed. Answers have been collected, and data analysed and managed according to the European GDPR legislation and ethical requirements as agreed on VALUEWASTE Protection of Personal Data (POPD) D11.2 and Human (H) participation (D11.4).

The social acceptance study has connections on the social life cycle assessment (S-LCA) in WP6, which studies social impacts of the VALUEWASTE value chains. The S-LCA is comprised of different stakeholders, subcategories, and social indicators. One of these stakeholders is “consumers”. This stakeholder comprises different subcategories like health and safety, privacy, and feedback mechanisms. Within the last subcategory (feedback mechanisms), consumers’ acceptance is a social indicator. In this way, the survey performed on WP8 forms part of the S-LCA carried out in WP6, completing the synergy between both WPs. We have identified and formulated the study scope and questions, and analysed questions which are common to both approaches.

First insights of social acceptance are satisfactory. Insights on barriers, opportunities and challenges have been collected from stakeholder and expert interviews, survey questionnaires both at Murcia and Kalundborg municipalities, and from a workshop on Social Acceptance and S-LCA, which applied portfolio techniques for joint future scenario insights. The respondent number is lower than expected, but it gives good basis for qualitative analysis. Kalundborg and Murcia, and the industry partners have actively participated into the survey content development and realisation, with language editions before launch, and CETENMA has brought S-LCA insights, as well as evaluated and given feedback to improve the report.

The preliminary survey results indicate that the citizens are aware of environmental concerns and think they are important. The acceptance of feed protein, and recycled plant nutrients is expected to be high when they are made available to the market. However, we need in-depth analysis on the aspects affecting vital behaviour of citizens and potential customers. Also, the need for information is raised, and will be tackled during the next steps of the VALUEWASTE project.

1. Introduction

The 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 use urban biowaste sidestreams as raw material for its valorization. VALUEWASTE is developed at two very 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.

Circular economy (CE) 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. The opportunity is getting new protein and fertilizer sources from biowaste side streams. The technologies to develop them are being tested in VALUEWASTE. However, there has been very little empirical research focusing on consumer behaviour in the acceptance process of these new products, services or business models. Very little is known on the consumer willingness to adopt new technologies, products and services. There is also a lack of systematic approaches when developing CE business models. CE strategies are crucial and should start from an assessment of the consumers' willingness to engage in and accept different innovation pathways and include all actors of supply chain (Borrello et al., 2016).

Target 12.3 of the Sustainable Development Goals agenda calls for countries to: "halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses", by 2030. This goal may be achievable if production and consumption practices both change (Beretta et al. 2013, UNEP 2020). Consumer behaviour can be influenced on the basis of command-and-control, market-based or voluntary change approaches (UNEP, 2020). Consumers are more averse to command-and-control and market-based measures (also because these are often poorly communicated), making policy makers more inclined to rely on voluntary change. There is little evidence that voluntary behavioural change contributes to significant changes in overall consumer behaviour. Information tools do yield responses, though on modest scales. This highlights the need to improve carbon literacy levels in the wider population to change social norms. Information tools can be optimized to increase their efficiency by considering the complexity of consumer psychology, including gender norms (UNEP, 2020).

Some studies have demonstrated how consuming insects (as a whole or powder) show significant benefits in terms of protein content (Rumpold and Scluter, 2013, van Huis, 2013, Halloran et al., 2015), but the social acceptance is still very low in Western societies (van Huis, 2013, Hartmann and Siegrist, 2017). Amato (2017) has summarized a) barriers to insect-based foods in western societies, and b) potential drivers that might lead to a change in eating habits, which helps to understand whether and to what extent consumers are willing to accept insects (or their components) in their diets which is crucial information when estimating how to organize the food chain towards the introduction of insect-based ingredients in Western diets.

The concept of social acceptance dimensions has been used in studies by Wüstenhagen et al.,

2006, and Moula et al., 2018. The concept and dimensions are applied in the study design. Three dimensions of social acceptance, namely socio-political, community and market acceptance have been identified. Factors influencing socio-political and community acceptance are increasingly recognized as being important for understanding the apparent contradictions between general public support for new innovations and the difficult realization of specific projects. The third dimension, market acceptance, has received less attention so far and provides opportunities for further research.

Models such as the Theory of Basic Human Values (Schwartz, 2012) could be seen as increasingly important for international marketing campaigns (e.g., of products), as they can help to understand values and how values vary between cultures. The Theory of Basic Human Values tries to measure universal values that are recognised throughout all major cultures. Schwartz's theory identifies ten motivationally distinct values and further describes the dynamic relations amongst them. Human values are one of the most powerful explanations of consumer behaviour (Beatty, 2005). These results suggest that culture play a significant role in the success of entrepreneurial efforts across countries— even ones with largely similar governmental structures. Cultural attributes accounted for 60% of the difference in Gross Domestic Product (GDP) variance per capita in countries within the European Union (EU) (Linan & Fernandez-Serrano, 2014). We can assume that cultural attributes are worth to be considered when developing new products or services.

2. Objectives

One of the most important objectives of the VALUEWASTE project is to seek improved perception of citizens on urban biowaste as a local source of valuable materials. For this purpose, citizens are being addressed through several communication campaigns and a citizen & consumer-oriented approaches. The objective of Task 8.3 is to create joint understanding on the social acceptance and awareness, and this report explains the first results and insights of social acceptance.

3. Description of the work

In order to prepare for the social acceptance study, we have earlier reported the following deliverables:

i) *D8.1 – First insights on concept definition*, providing valuable insights on the citizens' perspective towards biowaste valorisation and its derived products.

ii) *D8.2 – Context definition*, defining the research context for the social acceptance and the consumer perspective study, a requisite for successful product and business development.

Information from survey questionnaires and a workshop have been collected to identify insights and knowledge about social barriers, unmet and unarticulated needs, e.g., pains and gains, barriers and drivers, and citizens perceptions and acceptance on the new bioproducts. The participation of two contrasting cities (Murcia and Kalundborg) is expected to also provide data of interest to evaluate biowaste valorisation implementation strategies for those cities.

The social acceptance study has connections on the Social life cycle assessment (S-LCA) in WP6 (Fig 1), which studies social impacts of the VALUEWASTE value chains. The task aiming at evaluating the consumers' acceptance is directly linked to the S-LCA. The S-LCA is formed of different stakeholders, subcategories, and social indicators. One of these stakeholders is "consumers". This stakeholder comprises different subcategories like health and safety, privacy, and feedback mechanisms. Within the last subcategory (feedback mechanisms), consumers' acceptance is a social indicator. In this way, the survey performed on WP8 will form part of the S-LCA carried out in WP6, completing the synergy between both WPs.

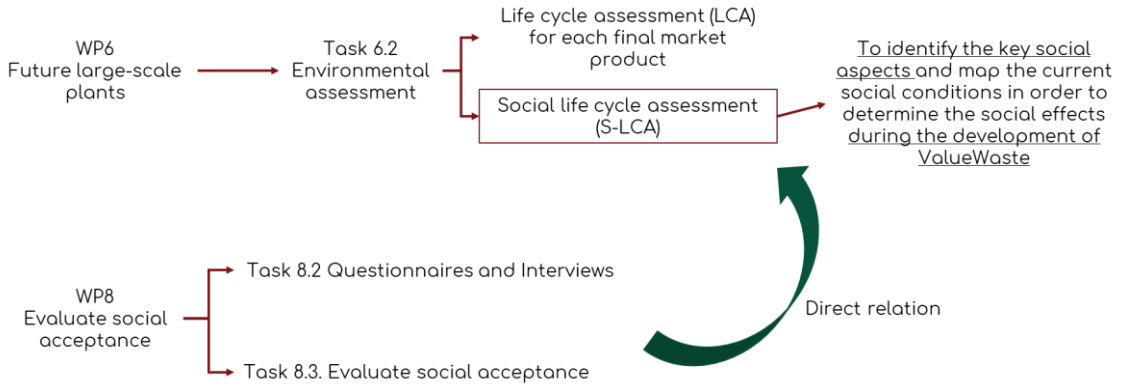


Figure 1. Link between WP8 social acceptance studies and WP6 Social life cycle assessment (S-LCA)

The information generated in the social acceptance studies will be used in the project commercialisation / business model development process- As practical implementation, social acceptance information is needed when developing different topics of the business model: customer needs and drivers affecting customer behaviour, customer segments, company solution –and in comparison with competing solutions, value proposition, marketing channels, and customer relationships, key resources, partners, and activities, and revenue model. Especially value proposition is important part of CE business models. 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.

4. Research design on social acceptance

4.1 Phases

The social acceptance study is designed to have three phases:

4.1.1 Input: Getting information. Context definition and understanding

The first step is to define the research context for the social acceptance and the consumer perspective study, interviews, and questionnaire, focus on group discussion. This step was done in tasks 8.1 and 8.2.

Interviews and questionnaire to citizens

In collaboration with Murcia and Kalundborg Municipalities, a structured questionnaire was developed which has been available online at the citizen participatory platform of the municipalities. The launch of the survey was March-June, 2021. The main purpose of this questionnaire was to measure the public level of social acceptance of the three value chains which produce new biowaste valorising products and services or technologies (Moula et al., 2017). Specifically, the goal of the survey questionnaire was to assess the public's opinion and knowledge about the use of biowaste sidestreams as sources of feed or food protein by using insects. The intention was also to determine consumers motivation towards a better separate collection of wastes.

The scope and content of the questionnaire was discussed with both municipalities, and the VALUEWASTE Innovation Team (VALUEWASTE 2019). Three perspectives (social, community and market) are being considered when implementing innovations or a new product innovation process:

- Socio-political perspective: attempts to measure the respondents' knowledge, awareness and perceptions about the European Union's policies, such as greenhouse gas emission/carbon neutral 2050 policies.

- Community perspective: intends to study the respondents' opinion about the importance of environmental and socio-economic issues, and needs the community has, e.g., new protein and fertilizer sources.

- Market perspective: is designed to study peoples' willingness to purchase new products from insect, bacteria, fertilizer value chains.

Thus, the study questionnaire scheduled for the survey participants has been prepared to include four parts. The purpose of part one is to gather background information about the interviewee such as country of residence, age, educational level and gender. This is to make sure to collect information from a variety of people (e.g., not just interview males, but females too). Also, the information can be used in the analysis of social acceptance in different groups of people.

The survey questionnaire had 17 structured and background Information questions. At first, the questionnaire was designed in a manner that there would be no correct or incorrect answers. The difference between the answers was only dependent on personal viewpoint and experience. The quantitative analysis will be made by summarizing all the data and calculating the percentage of the choices for each question. In terms of participants, it was our aim to include people from different ethnical backgrounds to enrich the sample space in order to make the research results more substantial, reliable, and objective (Moula, 2012a).

As this is an activity involvement the participation of humans, Ethics committee approval, informed consent and the protection of personal data as envisaged in our deliverables (VALUEWASTE 2018: Protection of Personal Data (POPD) D11.2 and Human (H) participation

D11.4) and according to the GDPR legislation of the European Union was applied when interviewing stakeholders or using the survey questionnaire. Therefore, before starting the activity it was communicated to the Ethic Management responsible from Gaiker, who ensured that the activity complies with the ethics requirements.

4.1.2. Analysis of socio-economical, community, and market acceptance

The concept of social acceptance was analysed by addressing three dimensions of it: the socio-economical, community and market acceptance aspects and insights in relation to business model development of protein, feed, or fertilizer production from urban biowaste sidestreams. The concept (Fig. 2) was updated and adapted to this study according to the feedback from interviews.

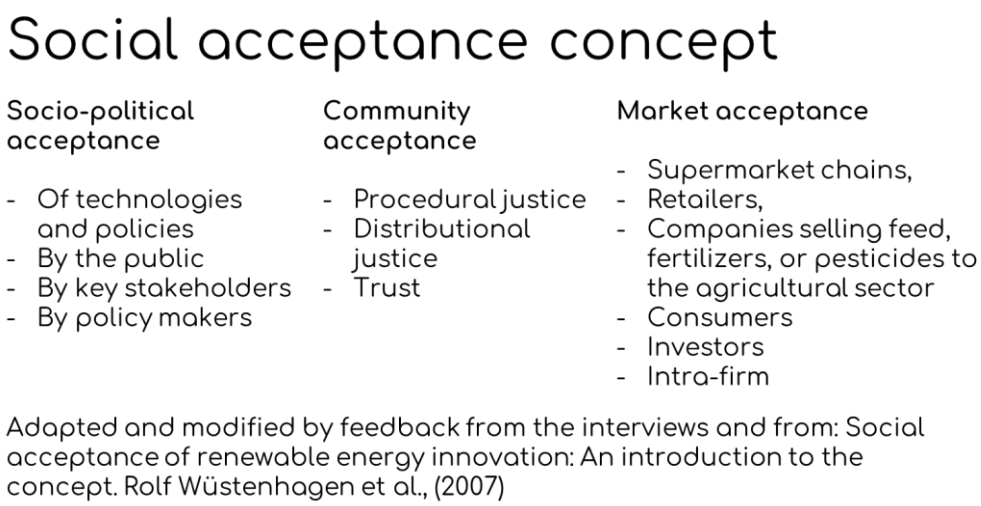


Figure 2. Social acceptance dimensions, adapted to VALUEWASTE from Wüstenhagen et al., (2007) and feedback from the interviews.

Socio-political acceptance: This is a more general level of social acceptance. Socio-political acceptance effectively fosters and enhances market and community acceptance, for example opening many options for new investors and context-based planning systems. *Community acceptance*: This can be explained by the fact that people support new products as long as it is not in their own backyard-NIMBYism. It significantly brings strong sense of ownership in the process of energy policy and decision-making. *Market acceptance*: Social acceptance can also be interpreted as the process of market adoption of an innovation. It focuses on consumer's level of satisfaction. A market acceptance view is not just on consumers, but also investors (Moula, 2021).

The analysis of survey questionnaire results was done through Webropol, an electronic survey system which is used to create surveys, collect answers, and analyse and visualize them. Webropol[1] is available to students and staff members at SAVONIA. The system can be used to

[1] Webropol 3.0 survey and reporting tool at webropol.com; https://www.webropolsurveys.com/Manuals/Insight%20-%20Manual.pdf ;

perform electronic surveys and implement statistical and quality-related analyses of data. Results produced data in tables. We received a total of 447 answers, in comparison to the expected around 200-2000 answers from both Kalundborg and Murcia City citizens. The quantitative analysis summarises all the data and calculates the percentage of the choices for each question. Besides, this study content analysis is used to determine the presence of certain concepts, topics and, 'identifying unique themes within texts or sets of texts' (Moula, 2014, Moula and Törrönen, 2016). The content analysis provides an avenue to understand the social reality in terms of public acceptance of products/services from biowaste sidestreams by using insects or bacteria in a subjective but scientific manner (Jung et al., 2016, Moula and Törrönen, 2016). Also, correlations will be investigated between several questions as to identify certain patterns and beliefs regarding the product or services.

4.1.3. Output: Determining social acceptance level.

In the survey, the scales for answering were Yes/No, or 5-scale Likert from (1) Strongly disagree to (5) Strongly agree, which is used when determining public acceptance. The scale cannot be directly used to derive the social acceptance levels of Thomson and Joyse (2008) and Thomson and Boutilier (2011), but it gives indication whether the citizen acceptance is withdrawal, acceptance, approval, or psychological identification.

4.2 Expected results

4.2.1 Insights on citizen perceptions & social acceptance, and awareness on environmental aspects

i) Getting of insights on the acceptance of citizens, including customer and end user, on new CE products and services related to food, feed protein with insects or bacteria, or biofertilizers in relation to the value chains of VALUEWASTE.

ii) Learning on the consumer willingness to adopt new technologies, products and services.

iii) Developing and applying systematic approaches when developing CE business models.

iv) Gaining on the new insights on three aspects of social acceptance when developing new businesses on CE of urban biowaste.

v) Gathering of information on the changing needs: needs, wants and demands are different in different mindsets and cultures (Moula, 2021).

4.2.2 Practical implications:

Understanding of social acceptance and its limitations will is needed when designing better

https://www.jyu.fi/yliopistopalvelut/surveys/webropoleng/Webropol_3.0_DevelopmentVersion_Manual.pdf

products, services and business models on CE. Understanding people's perceptions of biowaste and their utilization as a new resource on CE - their thoughts, feelings and expectations - is a key component of the project. By participating, the participants' values will influence industry practices and government policy and contribute to one of the most important project outcomes: guidelines for industry, government and communities on how to work together and ensure a more responsible biowaste management and their utilization as a sustainable resource for protein or fertilizer production.

5. Preliminary results from the survey questionnaires at Murcia and Kalundborg

This Section provides the preliminary results from the survey questionnaires in Murcia and Kalundborg. Responses are provided in Annex I.

5.1 General

We had 447 responses, of which 167 (37%) from Kalundborg, Denmark, and 270 (61%) from Murcia, Spain. 10 answers were received from other countries of residence (Belgium, United Kingdom, Italia, Colombia, USA, and Greenland). Bachelor and Master/PhD education represents 75%, of which women represent 62.6% of the answers. 45% of the answers were given from the age group 31-45 years, and 37% from the age group of 46-64 years. Also, young people (18-30 years) were present with 14% percentage of answers. 93 respondents gave free comments and feedback.

5.2 Socio-political acceptance

This is a more general level of social acceptance. Socio-political acceptance effectively fosters and enhances market and community acceptance, for example opening many options for new investors and context-based planning systems. In our survey, the questions 5, 9, 16, and 17 (Annex I) were designed to bring information on the socio-political acceptance.

5.3 Community acceptance

This can be explained by the fact that people support new products as long as it is not in their own backyard-NIMBYism. It significantly brings strong sense of ownership in the process of energy policy and decision-making. In our survey, the questions 5-8 (Annex I) were designed to get insights on the community acceptance.

5.4 Market acceptance

Social acceptance can also be interpreted as the process of market adoption of an innovation. It focuses on consumer's level of satisfaction. A market acceptance view is not just on

consumers, but also investors (Moula, 2021). In our survey, the questions 10-15 (Annex I) were designed to get insights on the market acceptance.

6. Interviews with stakeholders and actors of VALUEWASTE

6.2 Interviews preparation and development

The First set of interviews with focus on groups, companies, Murcia and Kalundborg municipalities, and experts were performed between January 2019, and January 2020. The stakeholders were classified according to: « Technology Developers », « End Users », « Academia », « Research Entities », and « Public Administration». The following questions (Table 1) were used in the interviews to help to define the social acceptance context. The results of this first round of interviews were reported as part of D8.1 in February 2020.

Table 1. Interview questions used during stakeholder and actor interviews.

Context design	Social acceptance points of view
Description of the case(s) Which are the social characteristics of the application of the technology? Which stakeholders are involved? Who is the investor? Is it an outsider? Is the initiator an actor from within the community? Is the community invited to participate in the project? which consumer/end user groups will be engaged and how? Does the local community have significant influence in the process? Is specific local, tacit knowledge used or is the community only expected to say "yes"? If locals can be involved in either the process or the investment, does this apply to all or not? Moreover, who decides about that? Schedule for the survey questionnaire & deciding the target group(s) and size	Discussion on the social acceptance different point of views: socio-political/economical, community, and market acceptance Barriers, opportunities The focus and target groups of the survey questionnaire on social acceptance The questions needed in the survey questionnaire on social acceptance to bring information in relation to the VALUEWASTE value chains. Organisation of the survey questionnaire in the city platforms and social media Ethical considerations and data management (GDPR).

Table 2. Interviews during 2019-2020.

Person	Organisation/company	Month of interview	Type of entity
Dr. Matti Tähtinen	VTT, Finland, current: Founder at Volare Oy Researcher CE, eg, on insect farming and side-streams	11/2019	Research Entity
Mr. Antonio Igualada Fernandez	Ferrovial/CESPA. CESPA is a large company belonging to the group Ferrovial Services that negotiates the contract of the city of Murcia	12/2019	Large Company
Mr. Kell Andersen and Mr. Lars Humholdt	Danish Food and Bioeconomy Cluster	04/2020	Technology developer
Mr. Johan Ib Hansen, Denmark	Municipality of Kalundborg /Symbiosis Center Denmark. Kalundborg is a city located in the Northwestern coast of the largest Danish islands, Zealand, with a population of 16,490 inhabitants (2017). The development department of Kalundborg Municipality runs the Symbiose Center, a group of industrial companies	4 and 10/2020	Public administration
Mr. Per Moller	Symbiosis Center Denmark Kalundborg 1/2019	10/2020	Technology developer
Dr. Martin Soriano	Coordinator VALUEWASTE project, CETENMA, Cartagena, Spain	4-11/2020	Academia/Research Entity
Dr. David Fernández	S-LCA Expert, CETENMA		
Mr. Manuel Valls Sevilla	Murcia City. 450.000 inhabitants, the city of Murcia is the capital of the Region of Murcia. In VALUEWASTE, they are in charge of Communication and citizen engagement and promotion of biowaste selective collection in Murcia.	3, 4 and 10/2020	Public administration
Mr. Olivier Derome	Sopropeche. Innovative nutrients. Internationally recognized as expert in the areas of animal feed, aquaculture, petfood and organic fertilizers. https://www.sopropeche.com/en/notre-activite/	9/2020	Technology developer/Research Entity
Mr. Juan Antonio Cortez, Mr. Diego Amores	Entomo Agroindustrial, Murcia. Entomo AgroIndustrial is a newly created Spanish company with the mission of enabling companies to transform waste from the Food Industry into sustainable food for animals using insects. It was created as a	11/2019; 3,4,9 and 10/2020	Technology developer

	platform of professionals and companies that allow companies to start projects of recovery of waste. In VALUEWASTE, they are responsible of the installation of insect farm DEMO in Ceheg, and conversion of urban biowaste via Black Soldier Fly into feed and food protein.		
Dr.Munjur Moula,	President of the SAS (Social Acceptance Studies) network at Aalto University, Finland and Advisory Group Member at VALUEWASTE	10/2020	Academia/Research Entity
Mr. Michael Jensen	Unibio, Danish biotechnology firm, Copenhagen 1/2019. Unibio is a leading Danish biotechnology company founded in 2001 with core competences within fermentation technologies, allowing a highly scalable production of bacterial protein meal. In cooperation with the Technical University of Denmark (DTU), Unibio has developed an innovative and unique technology as the result of more than 30 years of research and development activities: the U-Loop® fermentation technology. In VALUEWASTE, they Design, implement and test the microbial protein production from upgraded biogas.	10/2020	Technology developer
Ms.Ainhoa Bilbao	Gaiker makes laboratory tests the properties of bio-compounds, toxicological, functionalities, microbiology, Test the toxicology and functionalities of the products in the 3 value chains. Unibio 3 bio-compounds related to SCP. Entomo 2 bio-compounds related to insect production process. Ekobalans biocompunds on biofertilizers, not yet received	10/2020	Research Entity
Dr. Gunnar Thelin and Dr. Wim Moerman	Ekobalans/Nuresys	10/2020	Technology developer

6.3 Results

The interviews produced valuable information and useful insights on the social 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). Results of the interviews are summarised at Table 3.

Table 3. Social acceptance barriers and opportunities -stakeholder insights.

Barriers, challenges	Opportunities
Food products: authorization from EFSA needed; can be difficult as an ingredient; takes a long time or not approved. Results from VALUEWASTE can be good, but the approval may not be received. Unibio is waiting for the toxicological evaluation interested by a possible customer interested of a bio-compound product.	Healthy properties people would like to buy, antioxidative properties (no results obtained yet) Bio-compounds are targeted for food or feed. Gaiker makes laboratory tests the properties of bio-compounds, toxicological, functionalities, microbiology, Test the toxicology and functionalities of the products in the 3 value chains. Currently Unibio has 3 bio-compounds related to SCP, Entomo 2 bio-compounds related to insect production process, and Ekobalans biocompunds on biofertilizers, not yet received
	Possibilities on marketing of biocompunds as ingredient for food or feed. Different customers possible, eg if promotes the growth of the fish
The market is not ready; acceptance of new type of protein, legal framework - partly opening, Unibio has permits for the SCP, consumer safety aspects, end- user acceptance to buy the products.	New jobs, attractive business of sustainability, local resilience, save CO_2, be more sustainable
Acceptance of new products, legislation	Novel products and development of value chains, better use of biowaste, adapting to climate change like water scarcity and soil degradation
Feed: legislative context, prize, some raw materials are cheap and have to compete with them Food: social acceptance is the main barrier, legislation.	Opportunities, impact of novel products on consumers/people for both feed and food. Feed products are easier to bring to the market along with fertilizer products. Business to business.
Heavy metals, toxins or drugs accumulation. Market acceptance can be barrier.	Target group young people – in 5-15 years consumers habits can change
Direct comparisons of new products against traditional ones might not be plausible	Opportunities lay on the use of bio-compounds as ingredient in food and feed products. Fish feed.
Toxicological properties of bio-compounds (possible barrier)	Final marketable product shall be both feed and food for microbe and insect protein.We should address the market acceptance of: Supermarket chain/(s), retailers, and companies selling feed, fertilizers and

	pesticides to the agricultural sector. Business to business.
Citizen awareness (possible barrier)	Biowaste is a resource for recycled plant nutrients that can replace artificial fertilizers

The expert interviews indicate some focus groups on the market acceptance: Supermarket chain, Retailers, and Companies selling feed, fertilizers, and pesticides to the agricultural sector, as well as Business to business.

The safety and legislation are key components in achieving social acceptance. According to the European waste and food legislation, waste cannot be used as material for feed of food, but the technical use, for e.g. biodiesel, is possible. 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 profile 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 CO_2 emissions, and the development of more sustainable society.

7. Preliminary results of the social acceptance and S-LCA workshop

The virtual workshop “Food, feed, and fertilizer from biowaste- customer insights of social acceptance and S-LCA” was organised on 24 of February, 2021. The starting point was that we do not know enough on the social acceptance and social –LCA, or which are the new sources of protein – we need an introductory workshop to gain insights for future. How can we make food system change – which are the barriers, challenges and opportunities. Also, which are the consumer expectations – is it prize, taste and texture? The workshop started with two keynotes by Dr. Moula and Dr.

Fernández, first, an introduction to social acceptability and new bioproducts – needs, wants and demands (Moula, 2021), and introduction to the S-LCA.

The workshop applied PRIA approach – Prospective Rapid Impact Assessment (Eskelinen et al., 2021). PRIA is a future scenario workshop method focusing on the future impacts. Often the issues are portfolio problems where the task is to find a set of actions that meet the objectives of the various stakeholders as well as the specific targets (e.g., CO2 emission reduction) and constraints (e.g., costs). The challenge is that the development and evaluation of portfolios can become very complicated, especially if the number of candidate actions is large and there are synergies or antagonistic effects among the actions. Portfolio Decision Analysis (PDA) is a powerful approach for dealing with portfolio problems. The PDA is used to develop decision scenarios, in this case on social acceptance. The portfolio is a collection of actions, which can be recommended to be taken into account in designing and deciding actions how to improve (Paldanius & Kajanus 2021).

At the workshop, ideas were brainstormed to 6 categories, and evaluated fast-track by a multicriteria (MC) visual evaluation tool INTO at into.SAVONIA.fi. The categories were: 1) weaknesses, missing capacities, and vulnerabilities, 2) strengths and existing capacities, 3) values, hopes and goals, 4) actions, strategies and means, 5) threats, risks and fears, and 6) opportunities and possible worlds (Kajanus et al., 2019 & 2019; Eskelinen et al., 2017, 2020, and 2021). The ideas were then moved to an evaluation environment, where they were evaluated easily from 1 to 7. The evaluation criteria were: 1) policy makers point of view: does the idea increase social acceptance(1= not at all, 7= very much); 2)producers & value chain point of view: opinion of the producer on the social acceptance or social impact from the value chain point of view (1 = not acceptable at all 7= very easily acceptable idea); and 3) social acceptance from the consumer or citizen point of view:(1 = not acceptable at all, 7 = very easily acceptable idea). 57 ideas were created, and 14 evaluators evaluated them against the three evaluation criteria, resulting into 763 individual evaluations of ideas.

The INTO tool features PDA -analysis based on core index and reporting according to three PRIA-zones. PDA was used *to select an optimum portfolio of actions for the future*. The overall results are presented at the PRIA frame (Figure 3), where the ideas are listed, the ideas having best core-index at top of each category. Figure 4 lists the best ideas according to their core-index by PRIA-zones. The PRIA-zones are: 1) protection zone, where threats meet weaknesses, 2) empowerment zone, where opportunities meet strengths and finally 3) innovation zone, where objectives meet actions (Kauhanen & Kajanus 2021; Eskelinen et al., 2021) jkljñkñjk,

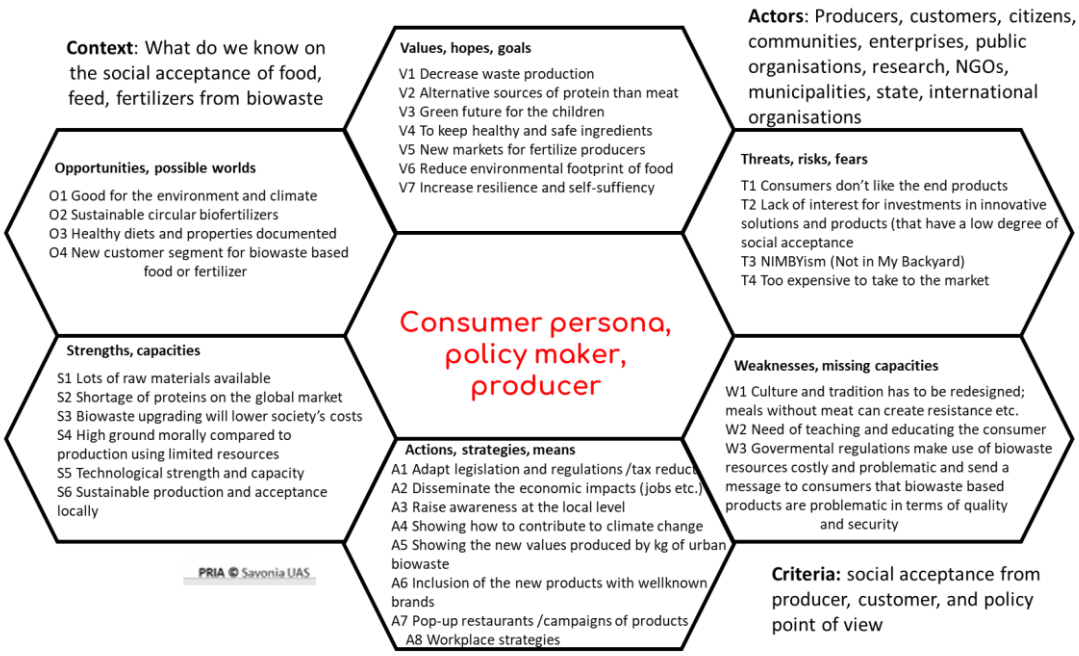


Figure 3. The social acceptance workshop results at the PRIA frame, where the ideas are prioritized according to their core-index.

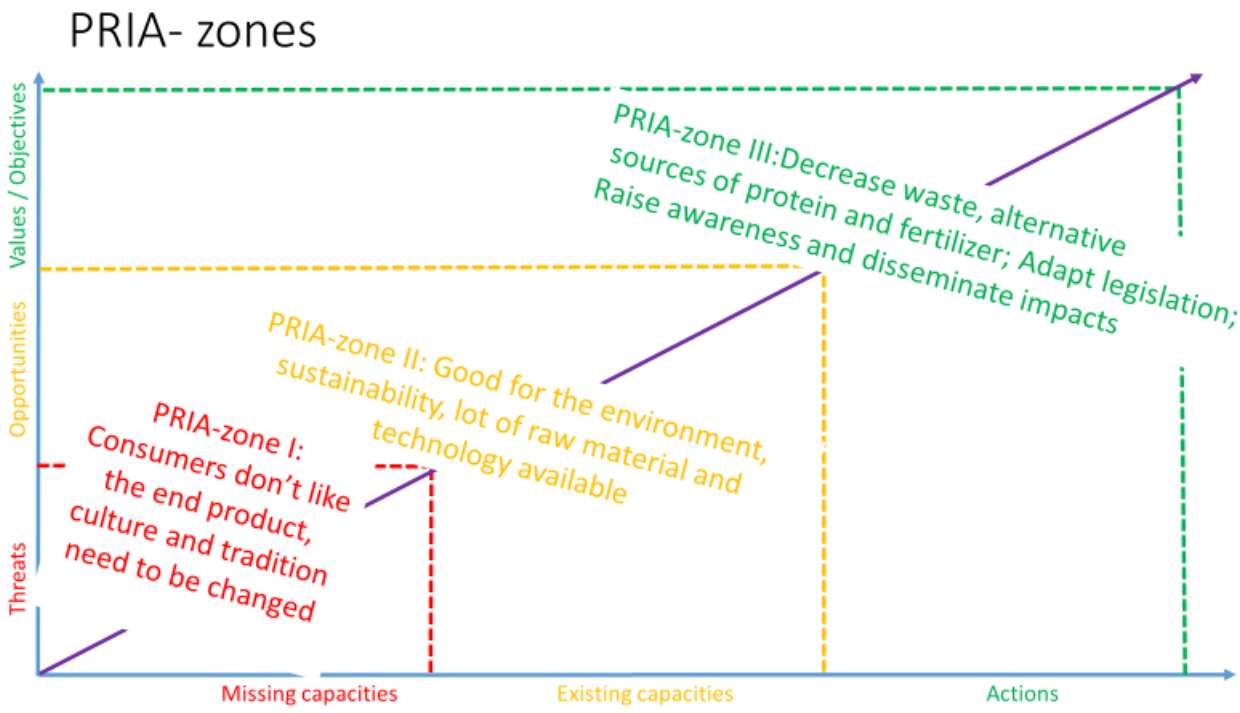


Figure 4. The social acceptance workshop results by three PRIA-Zones (Eskelinen et al., 2021, Paldanius & Kajanus, 2021).

8. Discussion

Our survey results indicate that the citizens are aware of environmental concerns and their importance (eg.,on climate change and low carbon society) and, as a key insight, would like to welcome new bioproducts which cause less environmental effects. The results indicate also that the acceptance of feed protein and recycled plant nutrients would be higher than food protein. However, the citizens, and consumers have only little experience of such products. There are citizens who are willing to change their eating habits to a more sustainable direction. One major finding is, the lack of information, and need to get more information on waste management, new policies and trends, and information to the public, is obvious at different levels, including the EU. The citizens think information on taste, functionability, technical quality, and vitamin/mineral content are important. We can estimate that the products VALUEWASTE will produce need to fulfill the expectations of consumers what comes to taste, functional properties, technical quality, and vitamin/mineral content.

The social acceptance workshop produced a joint view of social acceptance based on, firstly, policy makers point of view; secondly, producers & value chain point of view: opinion of the producer on the social acceptance or social impact from the value chain point of view; and thirdly, consumer or citizen point of view. As a major threat, the participants identified that consumers would not like the end product, and as weakness, the culture and traditions which need to be changed. As opportunity, the products are positive for the environment and are sustainable. As existing capacity, there is a range of raw material and technology available. The biggest value comes through the decrease of waste, and the obtention of alternative sources of protein and fertilizer. The main action would be adapting legislation and raising of awareness and dissemination of information on the impacts. The results will be interpreted critically since the participants of the workshop were mainly representing the value chains and experts, and the consumer, citizen, and policy makers viewpoints were present only indirectly through the expertise of the participants. The PRIA approach seems to work well to gain joint understanding on the different aspects of social acceptance.

9. Next steps

Preliminary results on the first insights of social acceptance were formed with three study approaches, interviews, survey questionnaire, and a workshop. A final report on social acceptance of biowaste-derived products will include in-depth analysis of the data gathered, and discussion on the results with Murcia and Kalundborg municipalities, as well as implementation of the results with the industry partners Unibio, Entomo, and EkoBalans, when developing CE business models. This includes also the development of the VALUEWASTE overall business model. Insights from some stakeholders outside VALUEWASTE covering supermarkets, retailers, or companies selling feed, fertilizers, or pesticides to the agricultural sectors, as well as some municipalities, would bring value added on market acceptance. The industry partners need to recommend such stakeholders for further interviews which are of interest to their business cases.

The survey questionnaire results from the Murcia and Kalundborg municipalities will be

analysed on their opinion of the valorisation of biowaste and on their views as potential consumer of the new generated bio-based products. This is an ongoing process which will be completed when all the information is collected. A final report on social acceptance of biowaste-derived products and services will be prepared by M44 (Deliverable 8.4., June 2022). We will also use feedback to further develop the social acceptance and S-LCA study approaches and methodologies, and communicate the result to target audiences, social and target groups, values, objectives/goals, and prioritize potential opportunities based on the insights. Social acceptance and S-LCA studies will be coordinated between WP8 and WP6.

The participating municipalities, Murcia and Kalundborg, have shown interest in knowing the citizens perceptions on sorting of biowaste, and whether people' mindsets can be changed on the products VALUEWASTE is producing. We are going to need need in-depth analysis of the results to answer these questions. Our goal is to gain understanding on the complex factors affecting consumer behaviour and sustainable food system. The consumer behaviour can be influenced on the basis of command-and-control, market-based or voluntary change approaches (UNEP, 2020). We need to change both the production and the behaviour. The key question is, which is the vital behaviour we need to change (Grenny et al., 2013).

One key finding, the lack and need for information of the citizens and consumers, needs to be addressed in the next steps of the project. The survey results indicate that this could be important factor to influence customer behaviour. Consumers identify and favour the product entailing lower carbon emissions.

10. Conclusions

Preliminary results on the first insights of social acceptance were produced with three study approaches: interviews with stakeholders, a survey questionnaire at Murcia and Kalundborg, and a workshop on social acceptance and S-LCA. The respondent number of the survey questionnaire (447 in total) is lower than expected, but it gives good basis for qualitative analysis. Even 93 respondents gave also verbal feedback and ideas, which will be included in further analysis. Kalundborg and Murcia, and the VALUEWASTE industry partners Unibio, Ekobalans, and Entomo, have actively participated into the survey content development and realisation, with language editions before launch, and CETENMA has brought S-LCA insights, as well as evaluated and given feedback to improve the report.

The main insights represent the production and value chain point of view, as well as citizens, consumers, and the society in general. Production and value chain point of views were provided by interviews, and a social acceptance workshop. 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.

The main scope of the social acceptance survey questionnaire was to measure the public level of social acceptance of the three value chains which produce new biowaste valorizing products and services or technologies. The preliminary results indicate that, overall, the citizens have awareness and interest in new bioproducts like protein ingredients and recycled plant nutrients.

They think that environmental factors are important and we can expect that the acceptance level will be high when these products enter to the market. As a first insight, we can expect citizen acceptance level of “acceptance”, or “approval”, or even “psychological identification” with some products, according to Thomson and Joyse (2008) and Thomson and Boutilier (2011). However, only few citizens have experienced novel bioproducts and they are not available at the market We need further analysis of these results.

The safety and legislation are key components in achieving social acceptance. 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. 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 CO_2 emissions, and the development of more sustainable society.

Results will be useful and applied when making new business models in WP7, where social acceptance is used to develop and evaluate the new business models. Also, our goal is to gain understanding on the complex factors affecting consumer behaviour and sustainable food system. The consumer behaviour can be influenced on the basis of command-and-control, market-based or voluntary change approaches. We need to change both the production and the behaviour. The key question is, which is the vital behaviour we need to change (Grenny et al., 2013). Also, how can we improve with the consumer getting better information.

11. References

Amato M (2017). Insects as food: A cross-cultural comparison of consumers intention and behaviour. PhD Thesis. Università degli Studi di Napoli Federico II. 121 p.

Beretta, C., Stoessel, F., Baier, U. & Hellweg, S. (2013). Quantifying food losses and the potential for reduction in Switzerland. Waste Management 33 (3), 764–773. https://doi.org/10.1016/j.wasman.2012.11.007

Borrello M, Caracciolo F, Lombardi A, et al. (2017). Consumers' Perspective on Circular Economy Strategy for Reducing Food Waste. Sustainability.Boutilier RG (2014). Frequently asked questions about the social licence to operate. Pages 263-272. https://doi.org/10.1080/14615517.2014.941141.

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, Fernández-Gutierrez D, (2020). Circular Economy Business Models Addressing Social Acceptance. The ISPIM Innovation Conference – Innovating Our Common Future,Berlin, Germany on 7-10 June 2020.

Eskelinen T, Kajanus M, Wuorisalo J, et al. (2021). Method for Human Security based Prospective Rapid Impact Assessment (PRIA) -analysis of 5 case studies. Society for Risk Analysis (SRA) Conference, June 2021, Espoo.

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.

Halloran, A., Vantomme, P., Hanboonsong, Y., & Ekesi, S. (2015). Regulating edible insects: the challenge of addressing food security, nature conservation, and the erosion of traditional food culture. Food Security, 7(3), 739-746.

Hartmann C & Siegrist M (2017). Insects as food:perception and acceptance. Findings from current research. Science & Research. https://www.ernaehrungs-umschau.de/fileadmin/Ernaehrungs-Umschau/pdfs/pdf_2017/03_17/EU03_2017_Hartmann_englisch.pdf

IPIFF (2019). IPFF vision paper for 2030. The European Insect Sector Today: Challenges,

Opportunities, and Regulatory Landscape.

Jung N., Moula MME., Fang T., Hamdy M., Lahdelma R. (2016). Social acceptance of renewable energy technologies for buildings in Helsinki Metropolitan Area of Finland. Renewable Energy, 99 (2016), pp. 813-824, 10.1016/j.renene.2016.07.006

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.

Moula ME (2012a). Street children and services: a qualitative study of street children in the context of service delivery system in Bangladesh, department of social sciences. University of Helsinki, Finland (2012)

Moula ME (2012b). Street children and services: a qualitative study of street children in the context of service delivery system in Bangladesh. Pattern of Data Analysis, Department of social sciences, University of Helsinki, Finland.

Moula ME, et al. (2018). Public acceptance of biofuels in the transport sector in Finland. International Journal of Sustainable Built Environment (2017) 6, 434–441

Moula MME., Törrönen M. (2016). Children on the streets: a review of their identification in Bangladesh. J. Res. Humanities Social Sci., 1 (1) (2016), p. 514. http://www.scischolars.com/journals/index.php/jrhss/article/view/14

Moula ME (2021). Social Acceptance of BioWaste Products in Needs, Wants and Demands. Social Acceptance and S-LCA Workshop, VALUEWASTE Project-H2020. Savonia University of Applied Sciences, 24.2.2021.

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.

Paldanius, Kalevi & Kajanus, Miika (2021). Future Divercities-project (e)valuation report. Savonia University of Applied Sciences.

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

Piñeroa P, Cazcarrob I, Arto I, Mäenpää I, Artti Juutinen A, (2018). Accounting for Raw Material Embodied in Imports by Multi- regional Input-Output Modelling and Life Cycle Assessment, Using Finland as a Study Case. Ecological Economics 152 (2018) 40–50.

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

Rumpold, B. A. & Schlüter, O. K. (2013). Potential and challenges of insects as an innovative source for food and feed production. Innovative Food Science & Emerging Technologies, 17, 1 11

UNEP (2009). Guideline for social life-cycle assessment of products. http://www.fao.org/sustainable-food-value- chains/library/details/en/c/266243/

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.

van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., Halloran, A., Muir, G., & Vantomme, P. (2013). Edible insects: Future prospects for food and feed security. FAO Forestry Paper 171. Food and Agriculture Organization of the United Nations, Rome.

Schwartz SH, Cieciuchlan S, Vecchione M et al. (2012). Refining the theory of basic individual values. Journal of Personality and Social Psychology 103(4):663-88. DOI: 10.1037/a0029393.

Thomson I and Joyce S (2008). The Social License to Operate. What it is and why does it seem so difficult to obtain? PDAC Convention

Toronto, March, 2008. https://socialicense.com/publications/PDAC_2008_Social_Licence.pdf.

Thomson I, Boutilier RG (2011). Modelling And Measuring The Social License To Operate: Fruits Of A Dialogue Between Theory And Practice. https://socialicense.com/publications.html.

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.

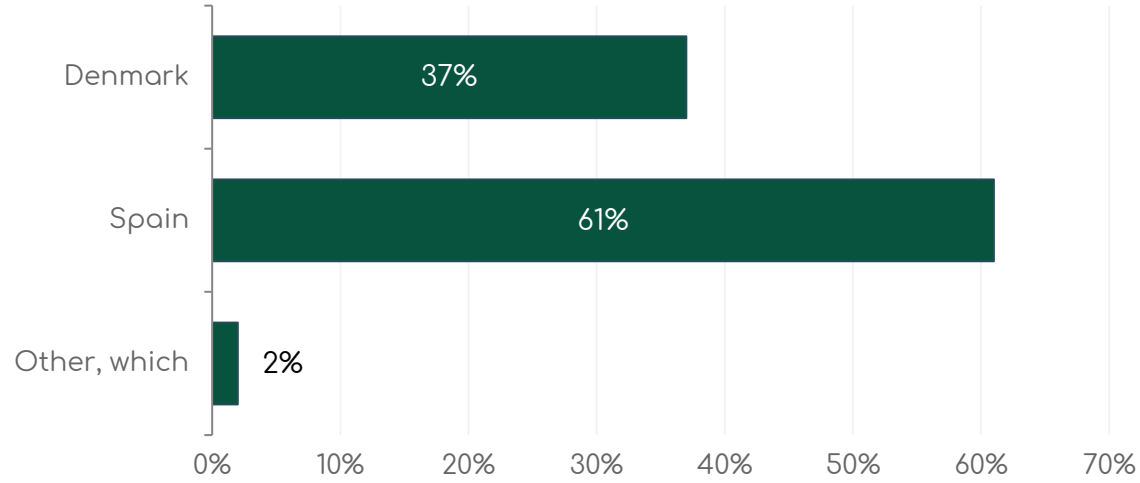
Webropol 3.0. https://www.webropolsurveys.com/Manuals/Insight%20-%20Manual.pdf; https://www.jyu.fi/yliopistopalvelut/surveys/webropoleng/Webropol_3.0_DevelopmentVersion_Manual.pdf.

Wüstenhagen R, Wolsink M, Mary MJ (2007). Social acceptance of renewable energy innovation: An introduction to the concept. Energy Policy. Volume 35, Issue 5, May 2007, Pages 2683-269. https://doi.org/10.1016/j.enpol.2006.12.001

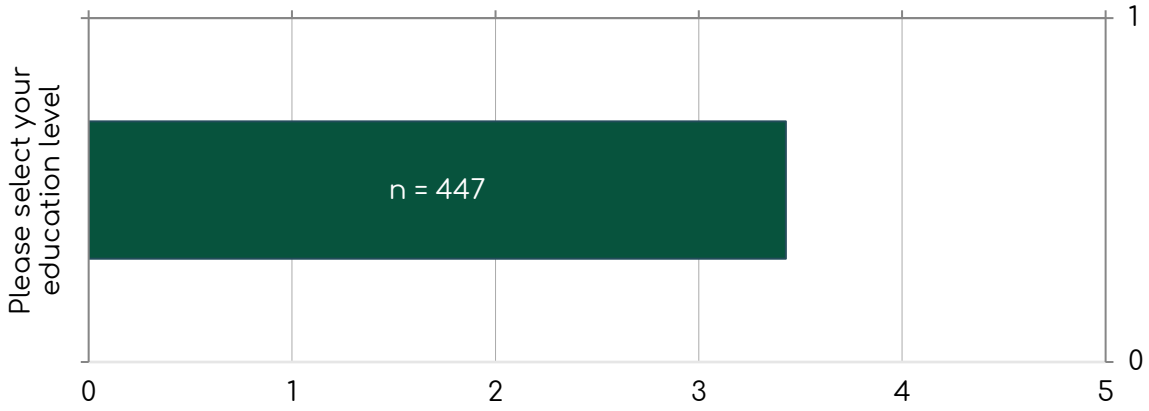
12. Annex I. Social acceptance study Spain Denmark Basic report. Survey questionnaire on social acceptance (VALUEWASTE)

Total number of respondents: 447

1. Country of residence
Number of respondents: 447



2. Education level
Number of respondents: 447



Average: 3.4

	Elementary/ High school	Technical/ vocational program	Bachelor	Master/PhD	Other/ No answer	Average	Median
Please select your education level	2.9%	16.3%	21.5%	53.7%	5.6%	3.4	4.0

3. Gender

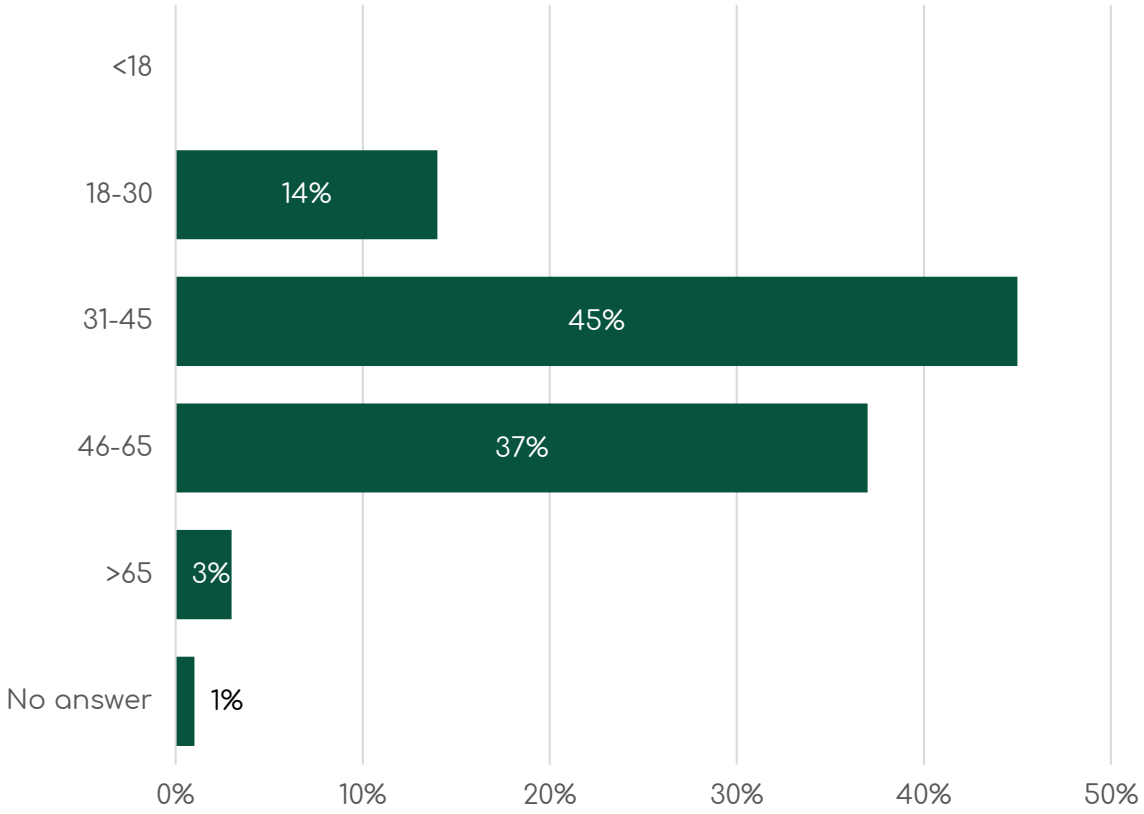
Number of respondents: 447

Average: 1.4

Female	Male	No answer	Average	Median
62.4%	37.4%	0.2%	1.4	1.0

4. Please select your age group

Number of respondents: 447



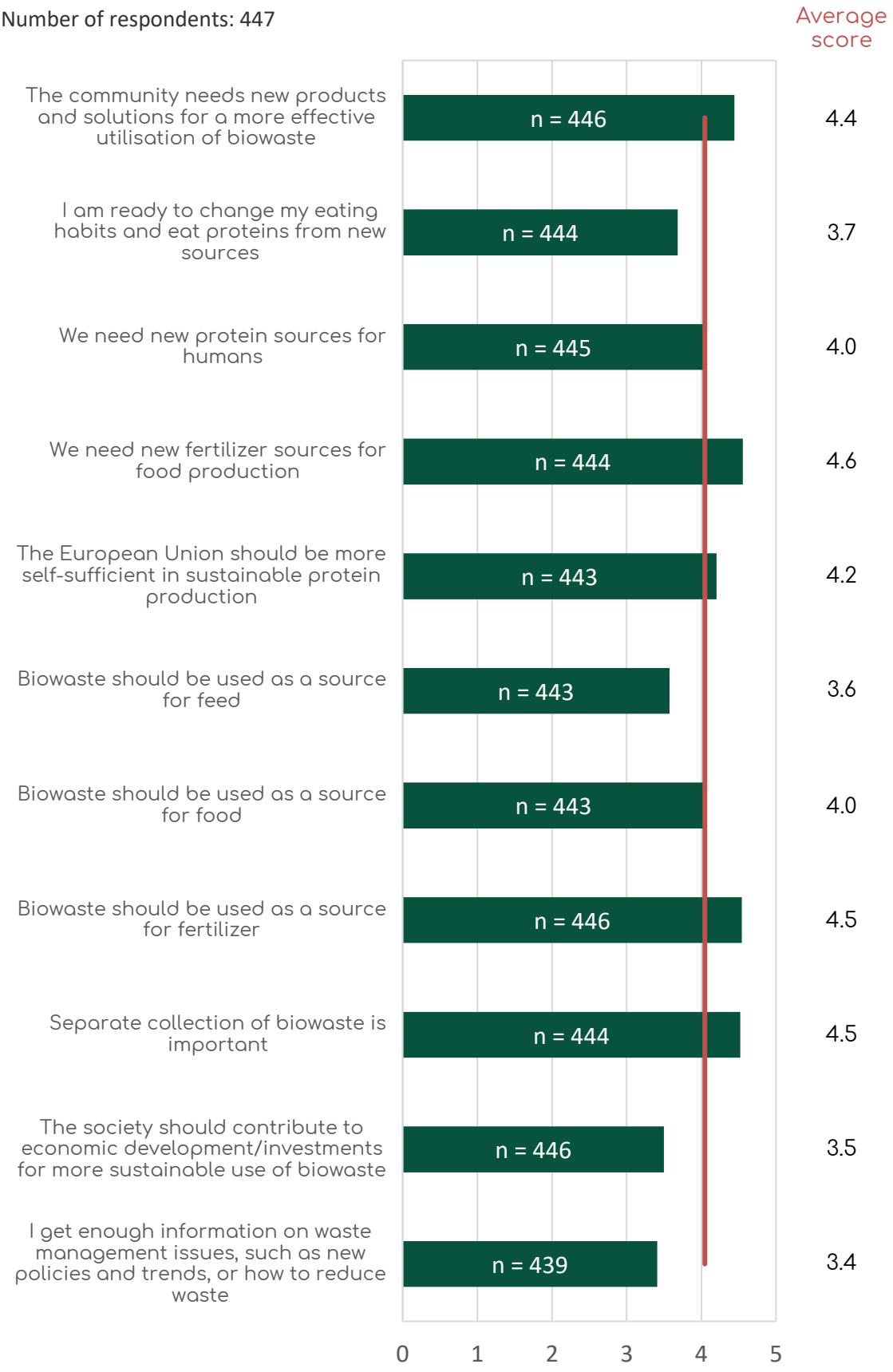
5. Are you aware that

Number of respondents: 447

Average: 1.3

6. Do you agree on the following statements?

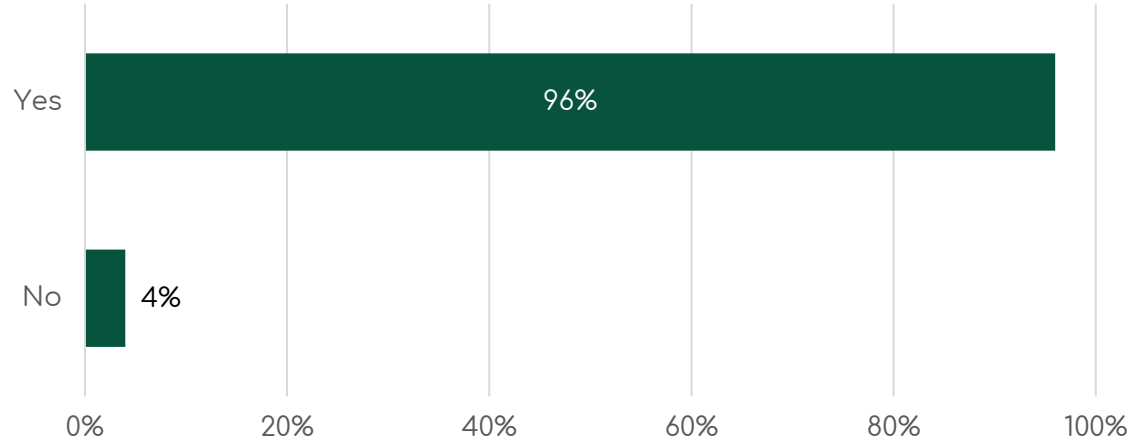
Number of respondents: 447



Average: 4.0

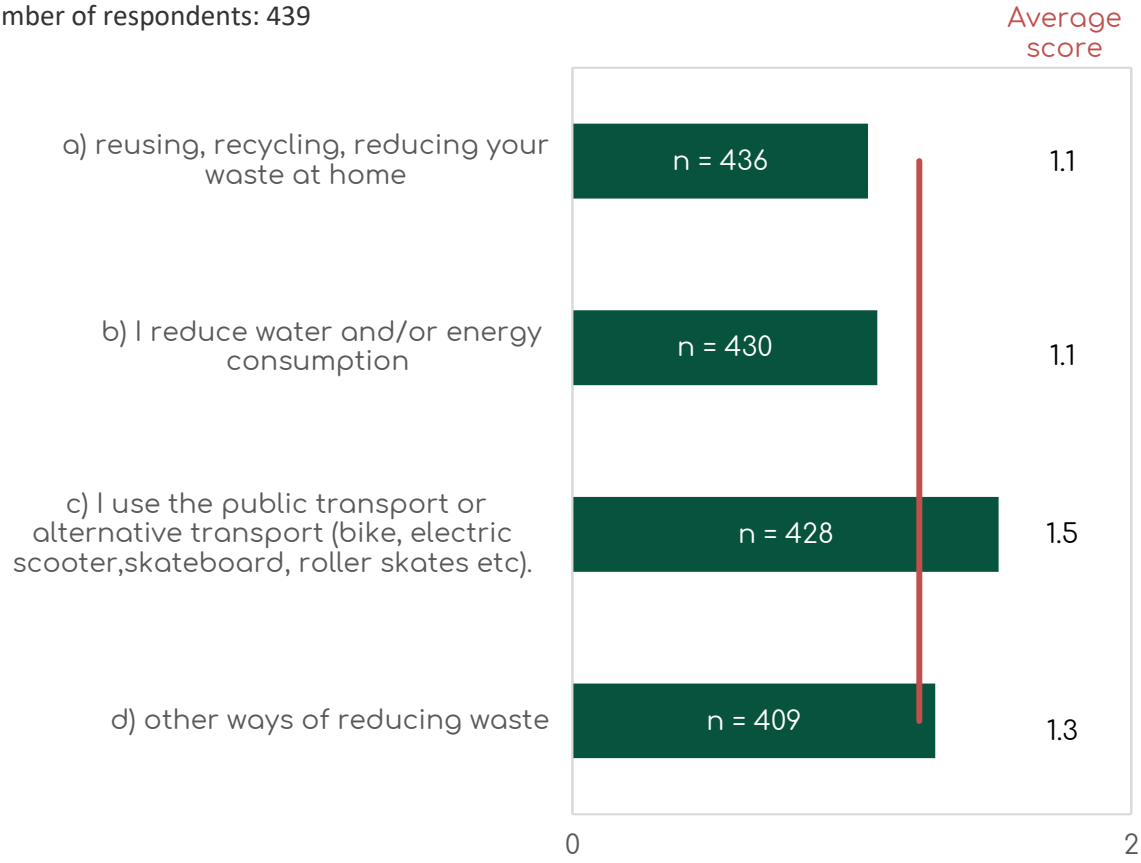
7. Do you take any kind of measures to palliate the climate change?

Number of respondents: 445



8. If yes, please select of the following options

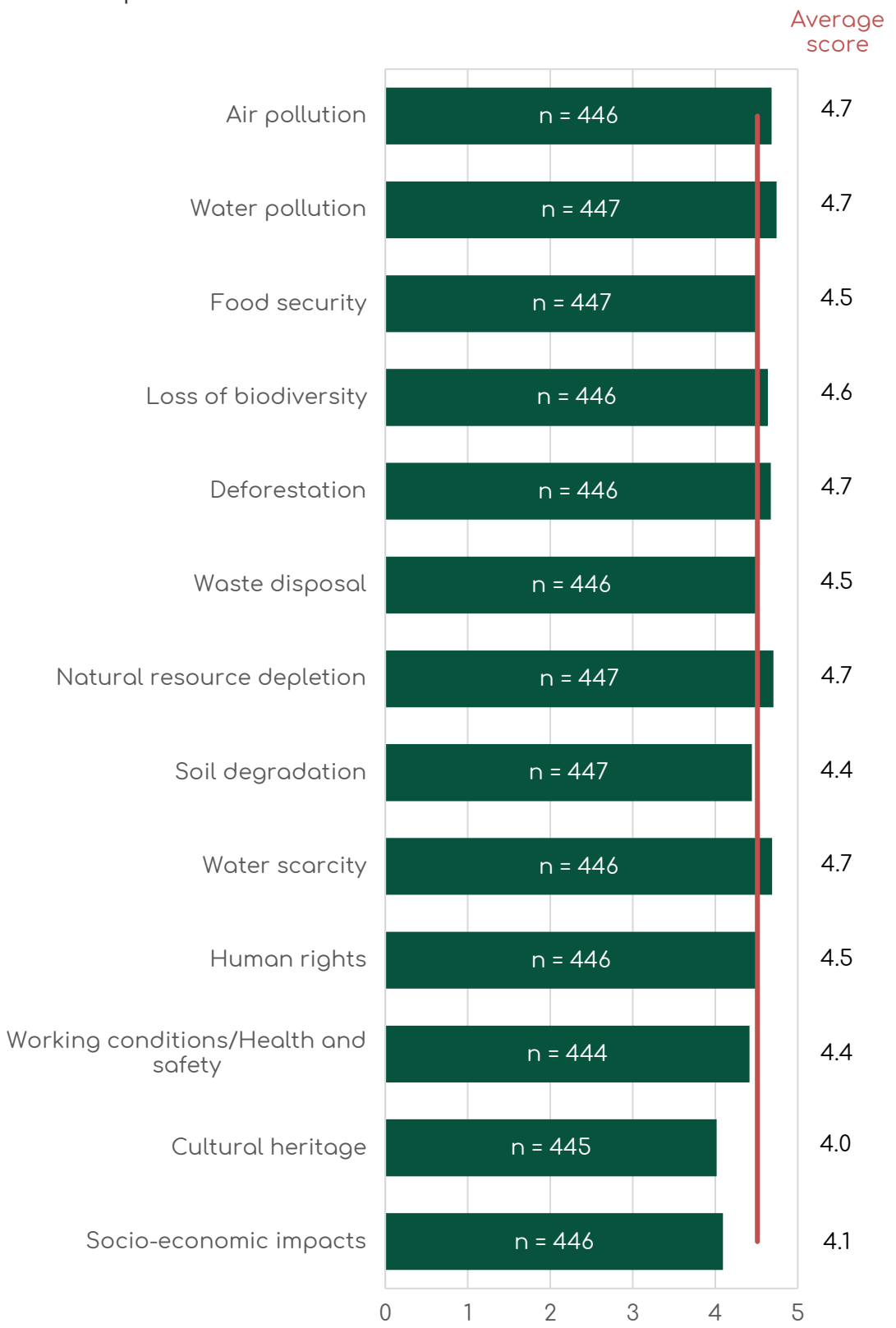
Number of respondents: 439



Average: 1.2

9. Please disagree/agree on the importance of following environmental and socio-economic issues

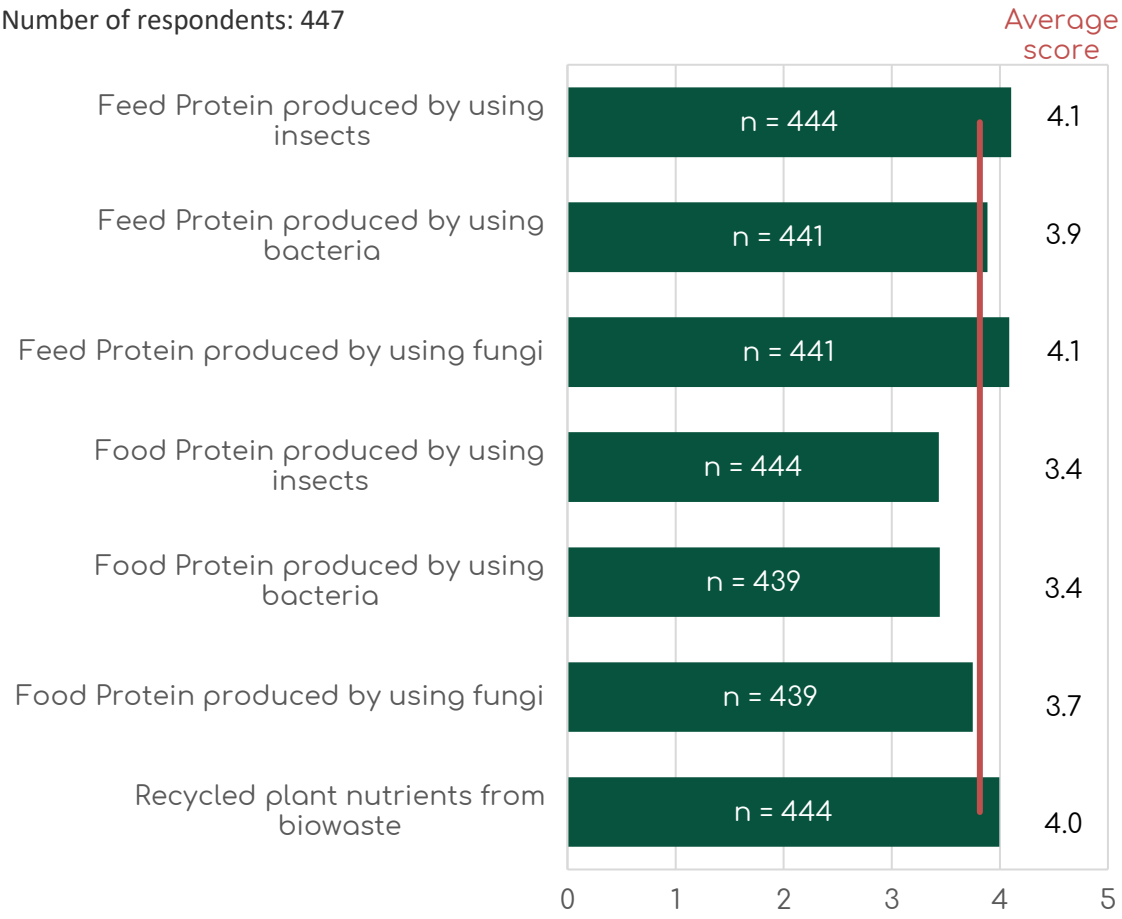
Number of respondents: 447



Average: 4.5

10. Would you agree to choose from the following new protein or fertilizer sources when made available?

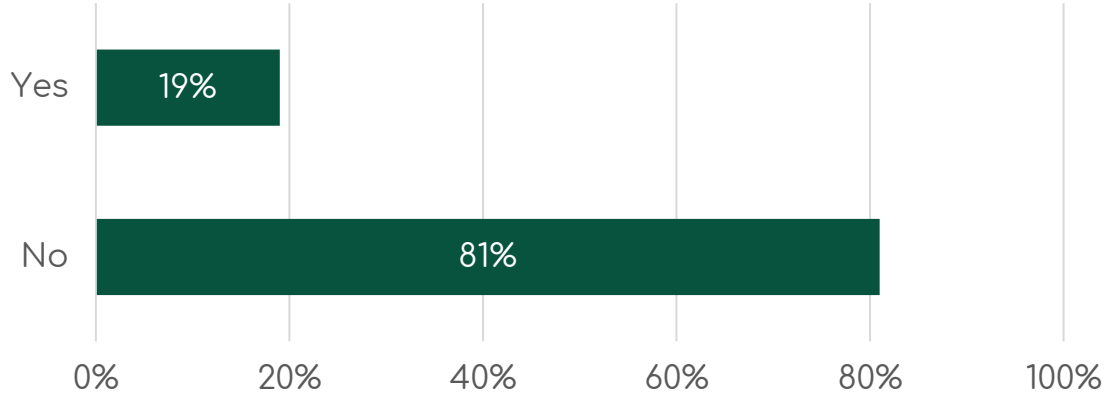
Number of respondents: 447



Average: 3.8

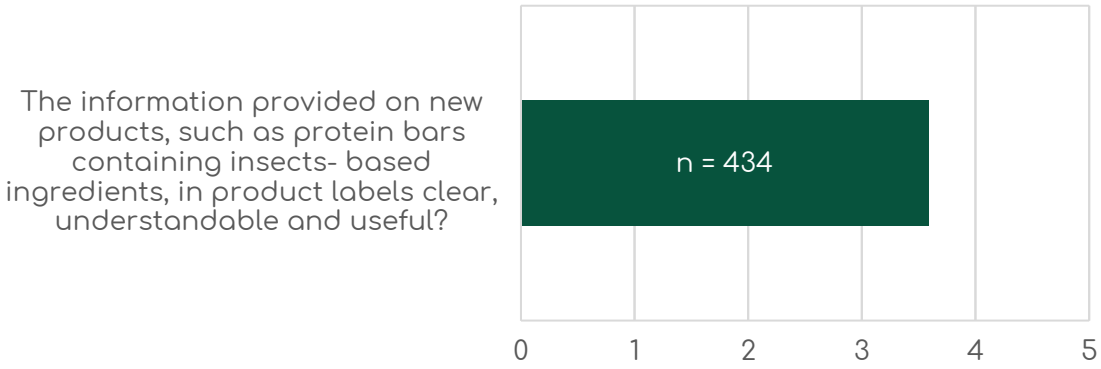
11. Have you bought products which contain insect/bacteria-based products, for example, protein bars or protein powder

Number of respondents: 441



12. Please, rate the following statement

Number of respondents: 434

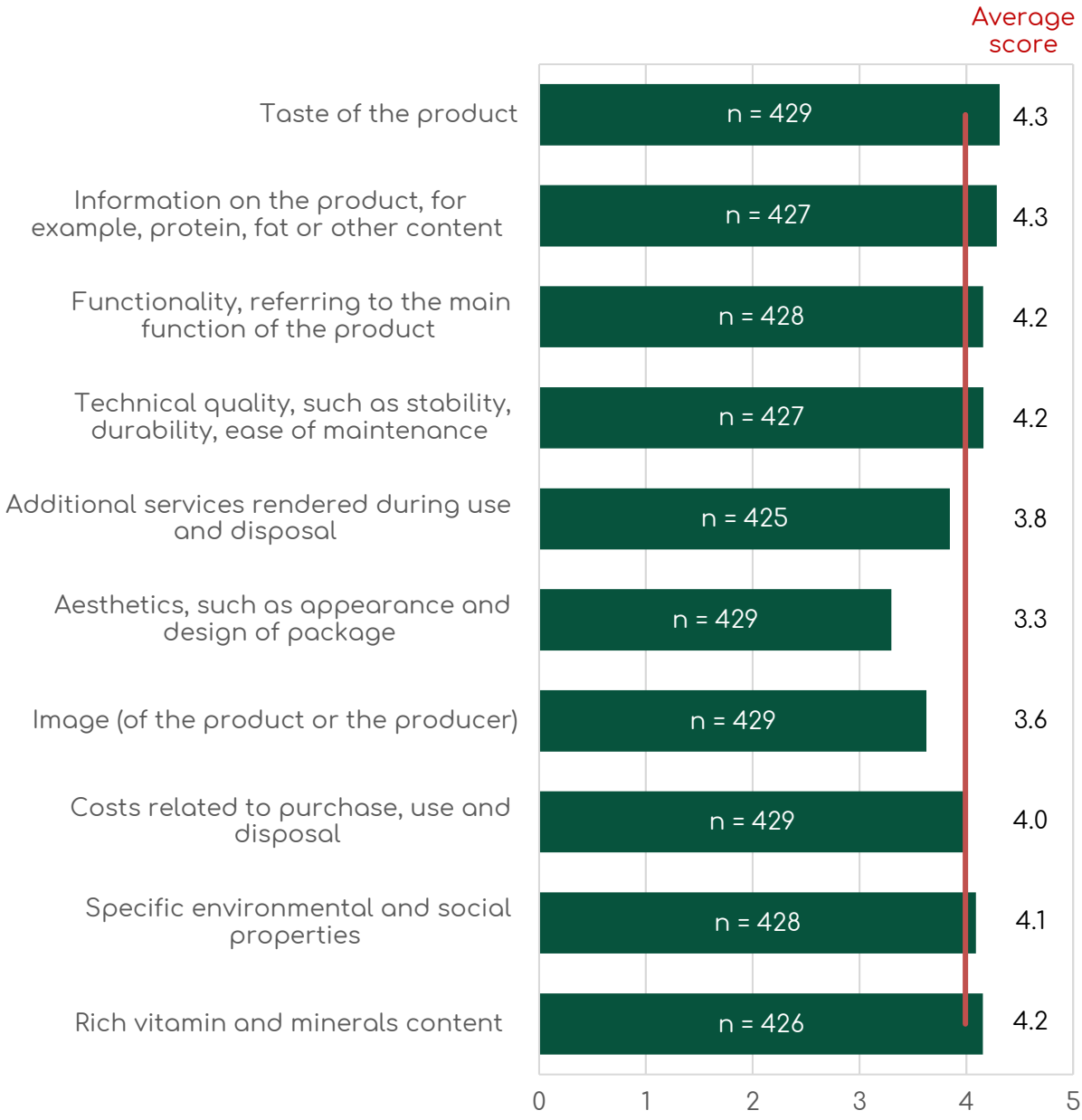


Average: 3.6

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Average	Median
The information provided on new products, such as protein bars containing insects-based ingredients, in product labels clear, understandable and useful?	3.0%	5.1%	46.8%	20.7%	24.4%	3.6	3.0

13. Please evaluate the importance of following properties of the insect/bacteria-based product

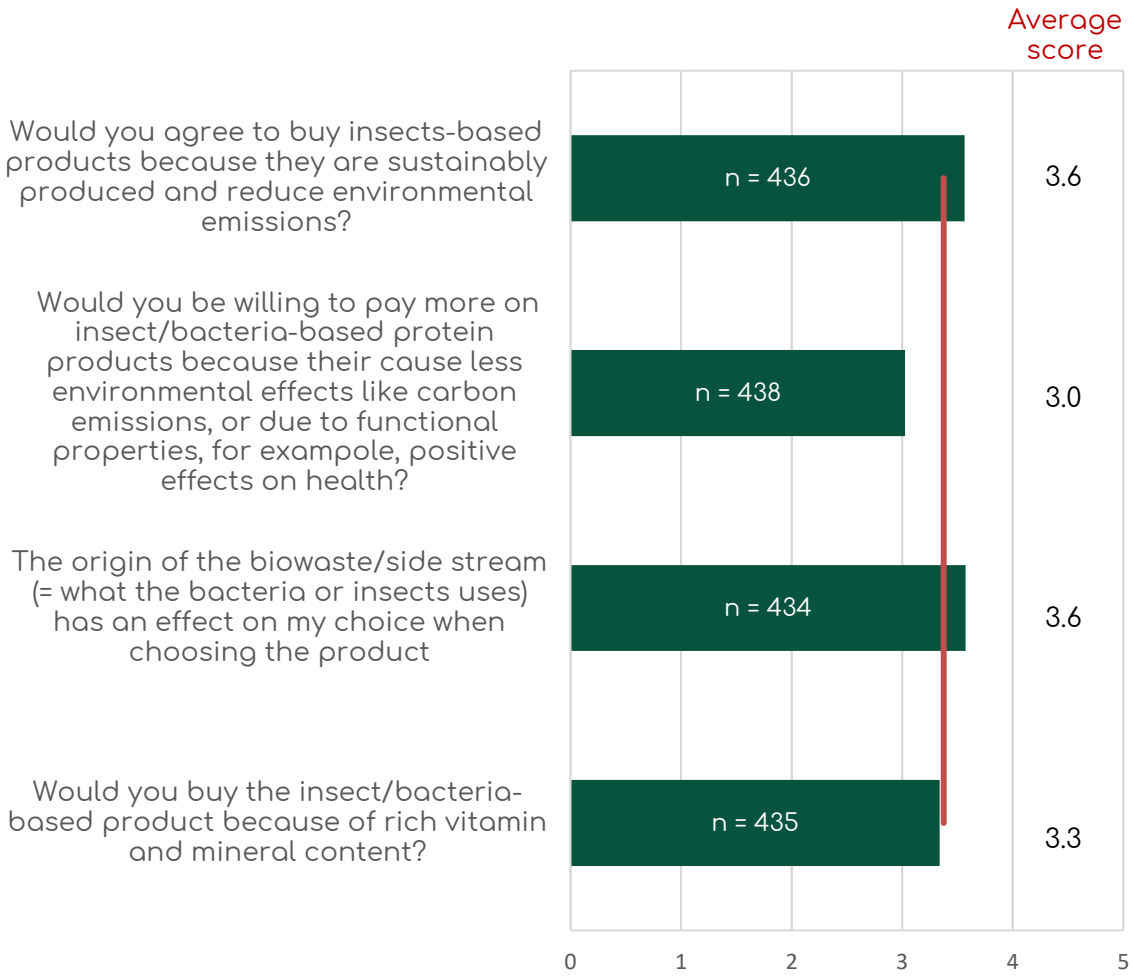
Number of respondents: 430



Average: 4.0

14. Please, rate the following statements on insect/bacteria-based recycled products

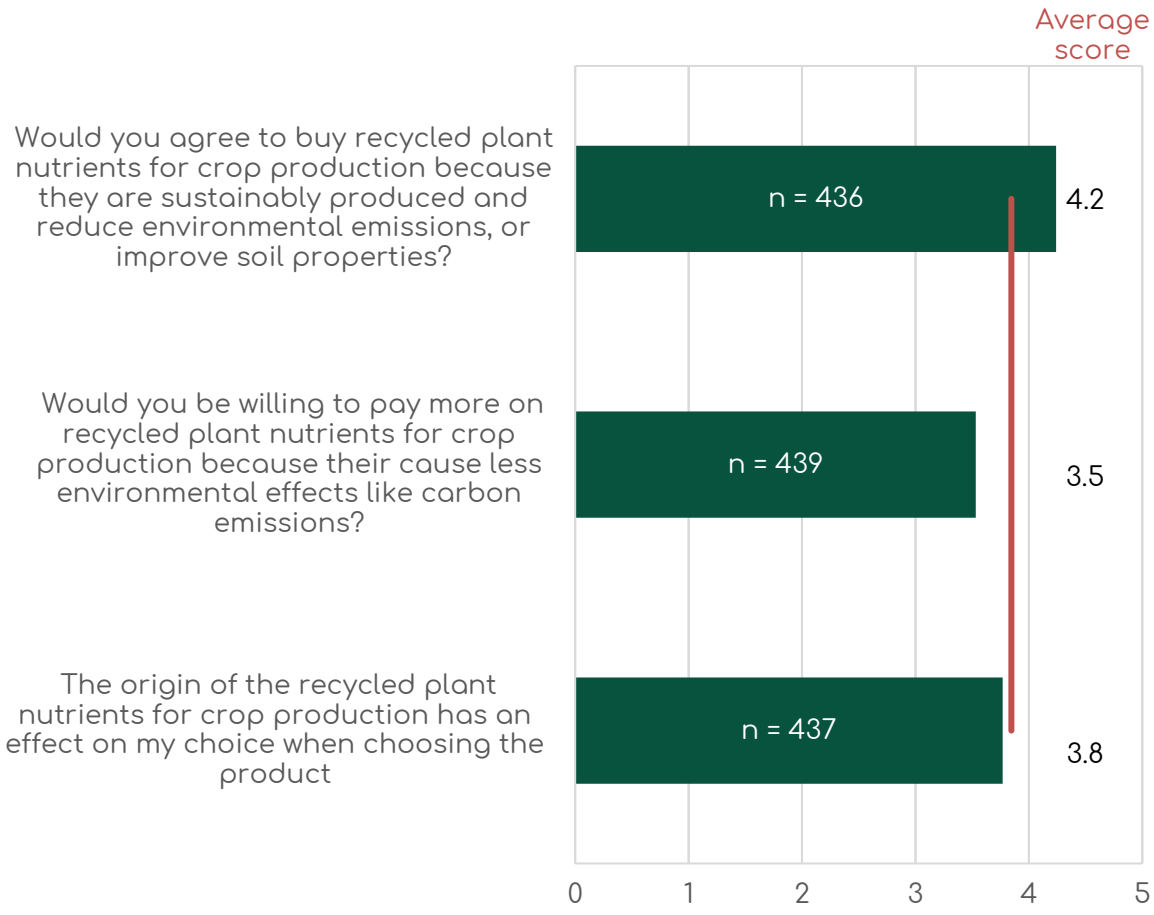
Number of respondents: 438



Average: 3.4

15. Please, rate the following statements on new, innovative recycled plant nutrients which are aimed at plant production

Number of respondents: 440



Average: 3.8

16. How do you think the EU and governments should motivate customers to choose recycled products

Number of respondents: 441

Average: 4.1

17. Please give any additional comments

Number of respondents: 93

VALUEWASTE

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

"This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 818312".

Co-funded by the Horizon 2020 programme of the European Union