Dubrovnik International ESEE Mining School (DIM ESEE)

Industry-academia workshop report

27th June 2017

Domžale, Slovenia

This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation

CONTENT

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1. INTRODUCTION – GOAL, TOPIC AND PARTICIPANTS OF THE WORKSHOP

The Industry-academia workshop was held on June 27th, 2017 in Domžale, outside Ljubljana, Slovenia. The workshop was implemented as part of the WP1 in the DIM ESEE project financed by EIT under the KIC Raw Materials program. University of Zagreb -Faculty of Mining, Geology and Petroleum Engineering is the project coordinator, while the workshop was organized in collaboration with project partners from Slovenian National Building and Civil Engineering Institute. The workshop was organized as a preparatory activity for this years' Dubrovnik International ESEE Mining School.

GOAL OF THE INDUSTRY WORKSHOP

The Industry Workshop is intended to be an annual event with the following goals:

1. establishing an open dialogue between academia/research community and industry partners leading to exchange of knowledge, know-how and experience within annual topic in order to create a tailor-made education program each year in Dubrovnik;
2. engaging a number of national industry stakeholders form active urban/mining areas of the partner countries within EIT RM consortium, relevant to the topic;
3. networking activities between partners form all sides of the knowledge triangle facilitating successful matches and development of new project ideas, which would eventually result in new EIT RM partners, new projects, start-ups, pilot plants and prototypes.

Since the topics of the Dubrovnik School are going to change yearly, the feedback of participants of the Industry Workshop is essential in creating an up to date and relevant program with current issues and topics in the sector.

TOPICS OF THE INDUSTRY WORKSHOP 2017

The topics that were discussed during the first annual Industry Workshop were in fact the thematic areas that will be covered in this year's School program. The topics are as follows:

(1) recycling in general – including legislation aspects, methods for recycling of mining and industry waste, selected good practices on steel slag; applications in building sector;

(2) large-scale landfilling of industrial, mining, and municipal waste across the region, and its use in construction;

(3) reclamation of contaminated areas, polluted by past industrial and mining activities;

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(4) demonstration of sustainable additional purifying of water from small wastewater treatment plant;

(5) enhancing a circular economy through industrial symbiosis by demonstration on selected cases how to use big data mining and decision tools on one hand and demonstrating possible innovative processes and services, that enable product and material reuse, recycling, and recovery on the other hand;

(6) environmental impact and benefits of recycling waste –using Life Cycle Assessment tools.

Based on this year's topics, our lecturers were asked to each give two or three lecture titles they find relevant in these fields with short bullets that described what will be processed during the School. Below you can find all of the lectures and their respective bullets as suggested by our lecturers:

1. Recycling of ferrous slags for construction purposes - presentation of best practices in Slovenia

- Background of the European policies on ferrous slag
- Production and types of ferrous slags
- Properties of different types of ferrous slags
- Production of ferrous slag aggregate
- Properties of ferrous slag aggregate in comparison with natural aggregates
- Application of ferrous slag aggregate in asphalt layers in road construction
- Other methods of utilization in the building sector
- Testing of ferrous slag aggregate
- Life cycle assessment

2. Landfill mining - recovery of high value materials for construction

- Background of the European policies on raw materials
- Legislative approach to landfill mining
- Prospecting and technological approach
- Development of new technologies: the HEFAIST project
- Zero waste solutions: the use of recycled waste as secondary raw materials in the construction sector
- Examples

3. In-situ remediation of soil contaminated by past industrial activities

- Background of soil contamination
- Soil immobilization and remediation approaches

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- Soil immobilization with ashes from incineration processes
- In-situ performance of soil remediation
- Case study: in-situ remediation of Pb and Zn contaminated soil
- Environmental aspects of in-situ remediation
- Life cycle assessment

4. Nano-remediation of water from small wastewater treatment plants

- Fresh water as an essential substance for living beings
- The global water crisis
- Recycling of water from small municipal wastewater treatment plants
- Nanoremediation of water: mechanism and principles
- Recycling of solid waste from the process
- Life cycle assessment
- Social life cycle assessment: change in people's behavior

5. Enhancing a circular economy through industrial symbiosis

- Background: European policies on the circular economy
- What the CE can bring to industry?
- How to measure your circularity (indicators)?
- Industrial symbiosis: what is it, and how is it applied in the EU
- Examples

6. Life cycle assessment tools - quantification of environmental impacts

- Background on EU politics
- Life cycle thinking and measuring environmental, economic and social impacts in the whole life of products and services
- A standardized quantitative method for measuring environmental impact – Life cycle assessment
- The role of LCA in circular economy
- LCA and critical raw materials
- Examples

7. Circular waste economy

- Europe's transition towards more sustainable resources and energy oriented waste management.
- New Ternary Diagram method to analyze Waste Management Development.
- Dynamic visualization of European (EU 28) municipal waste management performance described by using the Ternary Diagram Method.

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- Using Ternary Diagram Method, three types of visualization for the municipal waste management performance have been investigated and extensively described.
- Therefore, for better understanding of municipal waste management performance in last 20 years, dynamic visualization of the Eurostat table-form data on all 28 member states of the EU has been carried out in three different ways.
- Results obtained show that the Ternary Diagram Method is very well suited to be used for better understanding of past developments and coherences, for monitoring of current situations and prognosis of future paths.
- Technical solutions and possibilities to reach new European Recycling Targets
- Advantages and chances of sensor based sorting systems.
- Information about the new research project ReWaste4.0

8. Technical waste treatment systems

- The European Directive on waste (2008/98/EC) sets definitions and issues the basic concept for development of sustainable waste management in the EU.
- The proposed new circular economy package of the EU supports further development of waste management into resource management.
- Separate collection of individual waste fractions (i.e. paper, glass, metals, plastics and bio-waste) is a pre-condition for fostering high quality recycling.
- Austrian municipal waste management is based on separate collection of valuable fractions and treatment of mixed municipal waste in incineration as well as MBT plants.
- Separation of valuable fractions like plastics and metals from mixed waste for recycling processes as well as unwanted materials like PVC plastics by using modern technology becomes very attractive.
- Three types of Solid Recovered Fuels (i.e. “SRF LOW Quality”, “SRF MEDIUM Quality” and “SRF PREMIUM Quality”) that are used in energy recovery plants are manufactured in Austrian mixed municipal waste system.
- Recovery of thermal energy from mixed municipal solid waste usually is accomplished by mono-incineration plants or in co-incineration units.
- In New Competence Centre for Excellent Technologies - K-Project "ReWaste4.0" Industry 4.0 approaches in waste management are investigated.

9. Environmental Geotechnics

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- To explain the reasons for the development of a new engineering sub-discipline called environmental geotechnics/geotechnology.
- To list some typical geotechnical structures and engineering problems related to the mutual interactions between structures and environment
- To elaborate the difference between Burlands triangle in classical soil mechanics and extended Burlands triangle for environmental geotechnics
- To show the application of geotechnical principles in waste disposal practice
- Example 1: Site selection
- Example 2: Barriers in waste containment systems – CCL vs GCL
- Index properties, design parameters and long term performance of GCLs

10. Life cycle assessment of the silica sand – case study

- Silica sand description, production and use
- Material flow analysis: Extraction
- Material flow analysis: Basic Processing
- Material flow analysis: Concentration/separation techniques (gravity)
- Material flow analysis: Concentration/separation techniques (flotation)
- Material flow analysis: Concentration/separation techniques (electrostatic separation)
- LCA study (goal and scope, inventory)
- LCA study (life cycle impact assessment)
- LCA study (results and conclusion)

11. Life cycle assessment the bauxite – case study

- Bauxite Mines Jajce: bauxite deposits and mining method description
- Bauxite production in close- five year graphics based on foreman's diary
- Bauxite production in 3 sites (company's data)
- LCA study (goal and scope definition)
- LCA study (inventory, life cycle impact assessment)
- LCA study (results and conclusion)

12. Tailings Disposal

- Introducing the concept of tailings disposal as a major environmental concern regarding mining activities;
- Defining the main environmental problems related to tailings disposal;
- Outline the alternative approaches to tailings disposal;
- Outline the general objectives and design criteria in planning tailings storage facilities;
- Present and explain basic types and constructions of tailings impoundments;
- Presenting the examples coming from mining practice;

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- Stimulating interest and motivating further questions and discussion.

On the basis of these topics and sub-topics, we drafted a questionnaire that was sent to industry partners of all of the project partners. The results of the questionnaire are described in the chapter “Questionnaire results”.

The participants of the Industry Workshop were presented with the topics, results of the questionnaire regarding these topics (see below) and they were given the opportunity to express their opinion, exchange ideas and give commentaries on the topics and their relevance.

PARTICIPANTS OF THE INDUSTRY WORKSHOP

One of the main goals of the workshop was to gather participants from the relevant national industry of the Slovenia (mining, recycling, construction industry) as the targeted stakeholders of annual topic, along with a number of academia/research stakeholders.

In total, there were 22 participants that actively engaged in the discussion and the know-how and idea exchange. Excluding the industry partners, six project partners participated in the workshop following a preparatory and kick-off meeting the day before. The structure of the Workshop was as follows: 7 companies, 5 universities and 1 research institute (Figure 1). The following companies participated in the Workshop: Termit d.d., IME-Insol d.o.o., PKG – Projects of circular economy, Stonex d.o.o., Radeče papir nova d.o.o., SIJ Acroni d.o.o., Harsco Minerali d.o.o. The following universities participated: University of Zagreb – Faculty of Mining, Geology and Petroleum Engineering, Montanuniversität Leoben, Technical University of Košice, National Mining University Ukraine, University of Beograd - Faculty of Mining and Geology. One research institution participated: Slovenian National Building and Civil Engineering Institute.

Figure 1 The structure of the Industry Workshop participants

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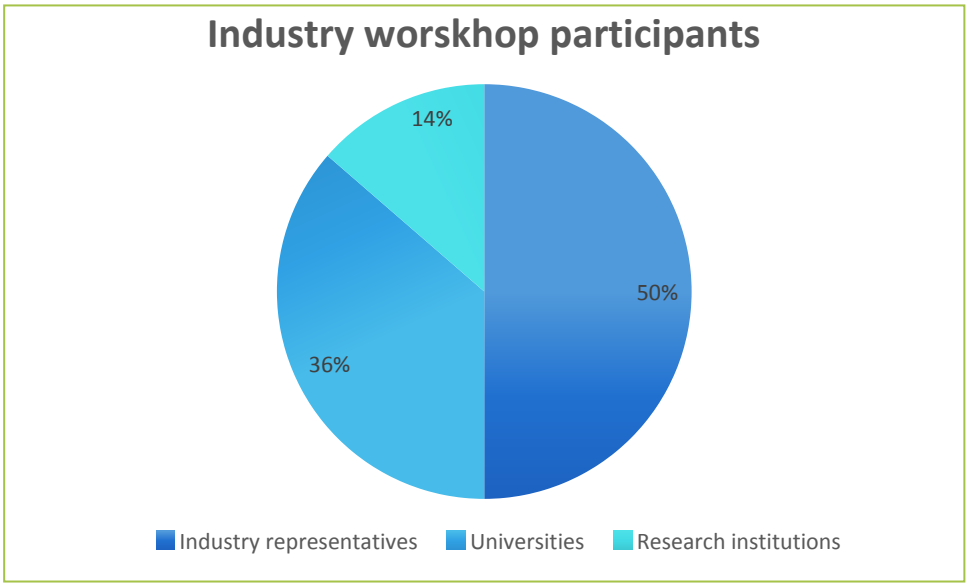

Since our project partners from AGH University of Science and Technology and University of Miskolc couldn't participate in our meeting in Ljubljana, we have held separate meeting with them, either via skype or in person. The meeting with AGH was held on July 6th via Skype, while the meeting with the representatives of the University of Miskolc was held in Zagreb, on September 27th.

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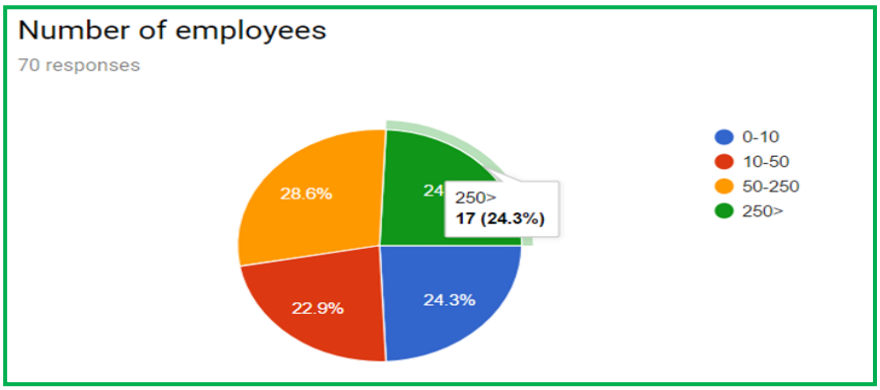
2. QUESTIONNAIRE RESULTS

During March, April and May, the project coordinator and partners have prepared a questionnaire intended for relevant stakeholders, such as industry partners, academia and other professionals from the sector. The questionnaire consisted of School topics with sub-topics and the stakeholders were asked to rate their interest in each topic and sub-topic and to give their commentaries on the subject (topics listed within chapter TOPICS OF THE INDUSTRY WORKSHOP 2017). Each partner had to contribute with at least 10 filled out questionnaires from their industry partners – they were given the instruction to disseminate the questionnaire to a large number of relevant addresses, using their personal and business contacts in order to fulfill our goal and create the best possible experience for Dubrovnik. A total of 70 questionnaires were filled and processed – the participants in the workshop were presented with the results.

An important part of the questionnaire was the structure of the respondents regarding the type and size of the institution they work in. The intention of the questionnaire and the workshop was to create a network of industry partners, so a score of over 50% of SMEs that filled out the questionnaire was helpful in tailoring the program intended for industry professionals, as well as academia (Figure 2).

Figure 2 Structure of the analyzed questionnaires according to the number of employees



As seen in the picture below, the number of filled out questionnaire per country was in some cases not satisfying and not in accordance to at least 10 filled questionnaires per partner. Some partners had problems because of the weaker bond with their industry partners and the lack of use of personal contacts. This issue has been discussed during the Ljubljana meeting and mitigation measures were established for the following activities – all partners are going to expand their network of industry partners by involving more of their colleagues and using personal contacts (Figure 3).

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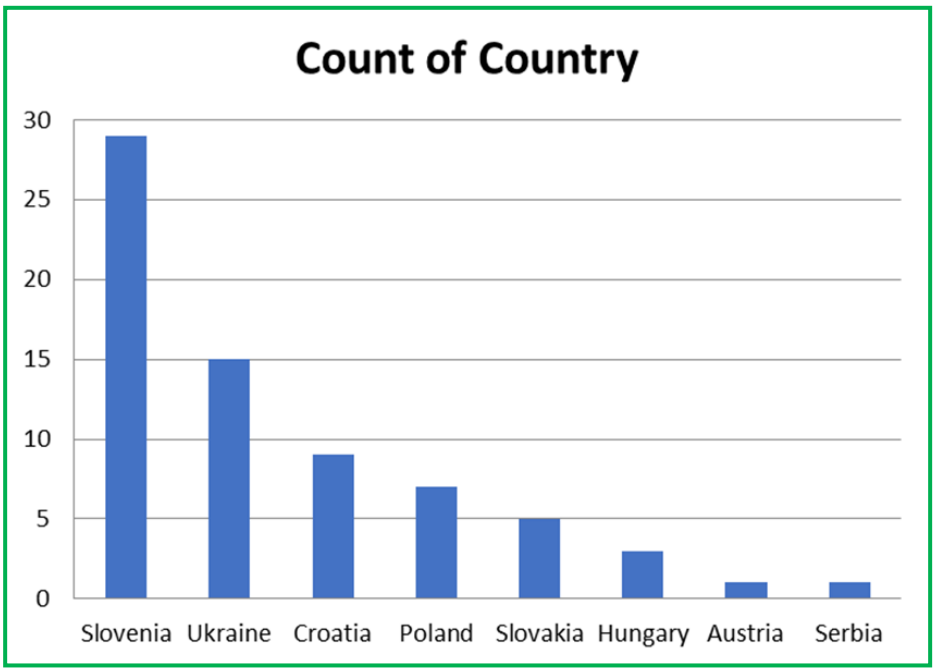
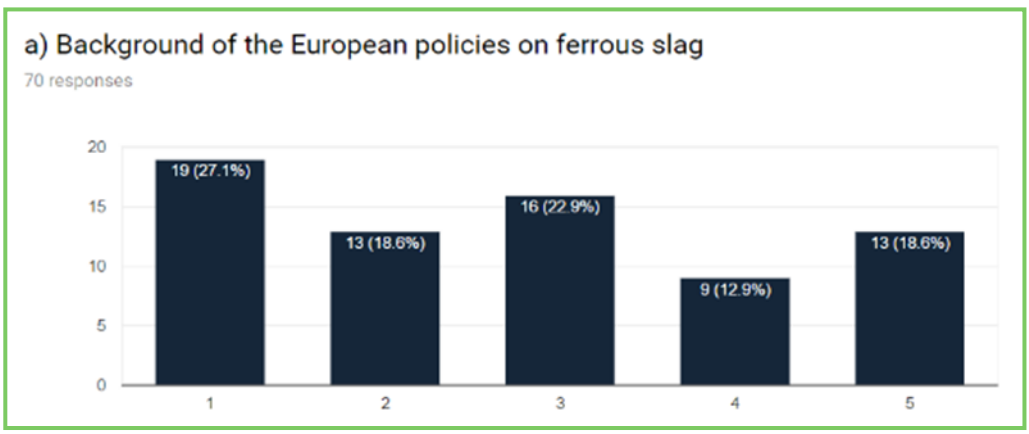
Figure 3 Structure of the analyzed questionnaires according to the country



The sub-topics were rated on a scale from 1 to 5, with one being *not interested*, while 5 was *very interested.* The interest in the school topics was generally favorable with a few comments that steered the partners in the direction in which the topic will be dealt with in Dubrovnik. Below you can find all of the questionnaire answers summarized:

1. Recycling of ferrous slags for construction purposes



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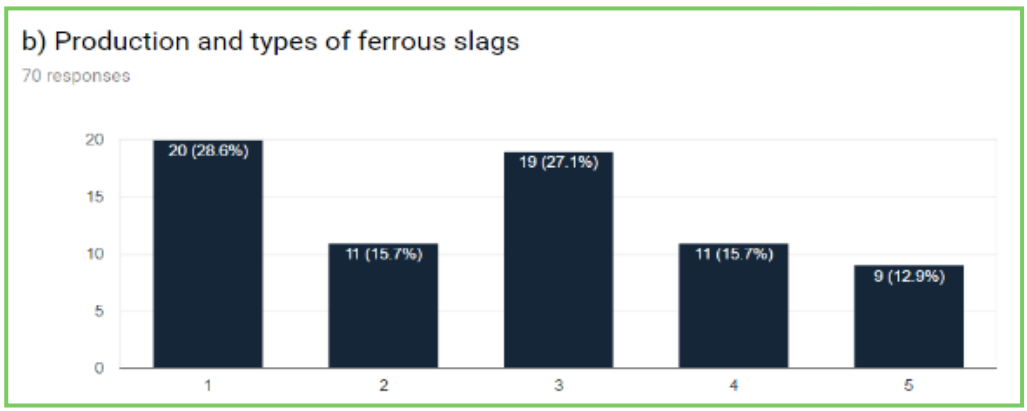

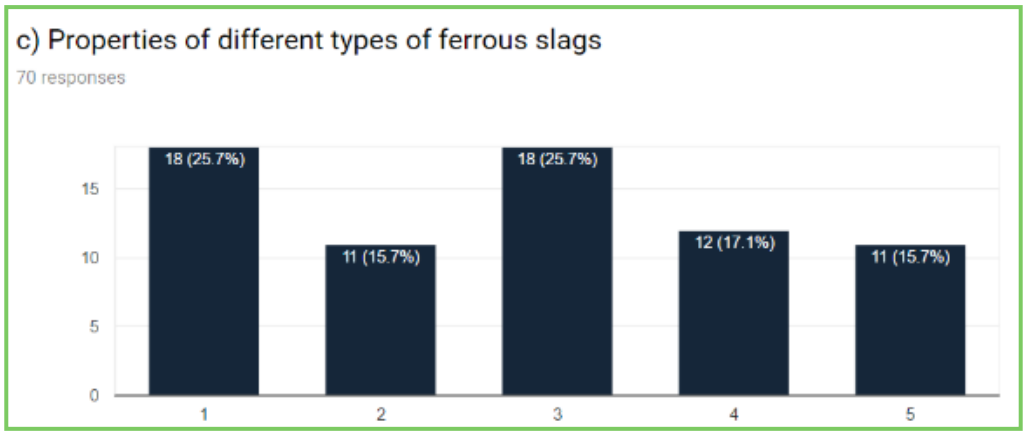

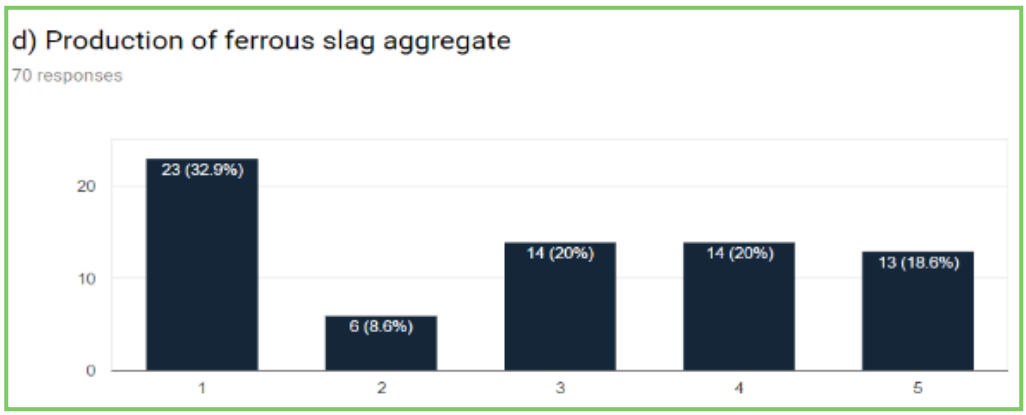

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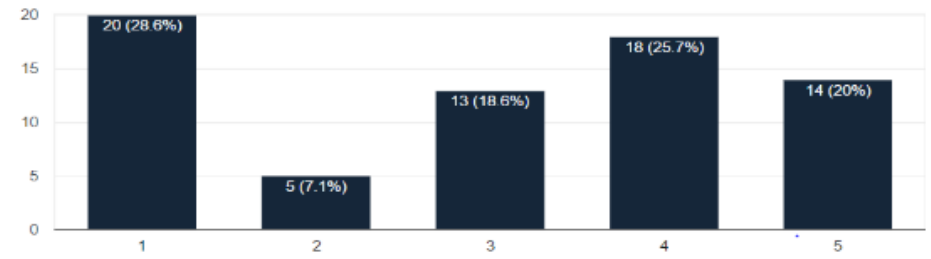
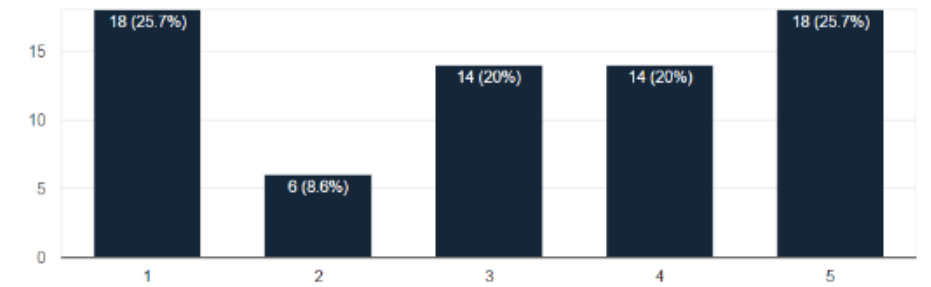
e) Properties of ferrous slag aggregate in comparison with natural aggregates

70 responses



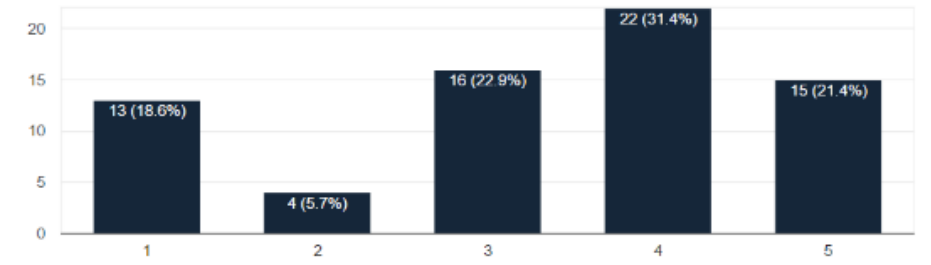
f) Application of ferrous slag aggregate in asphalt layers in road construction

70 responses



g) Other methods of utilization in the building sector

70 responses



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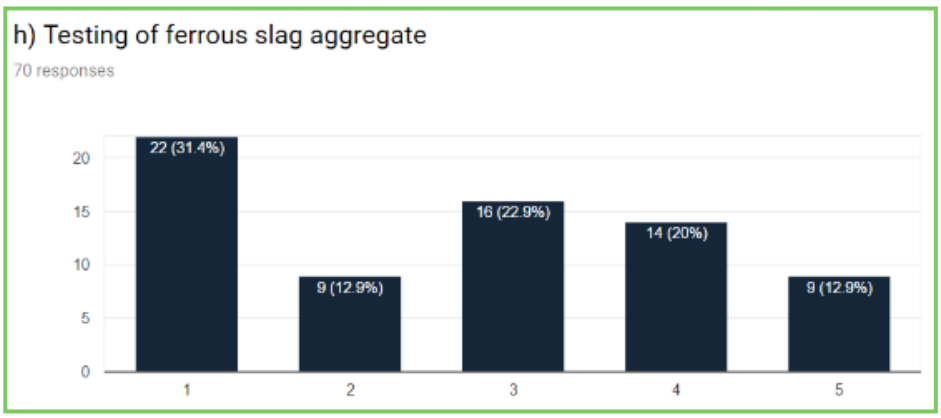

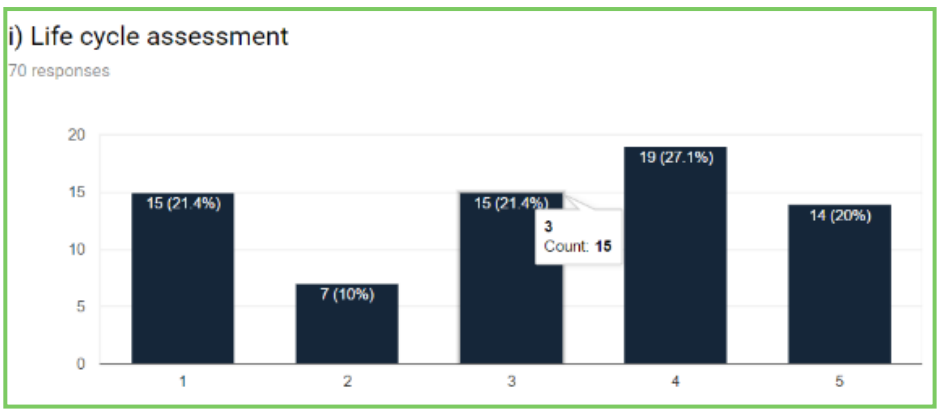

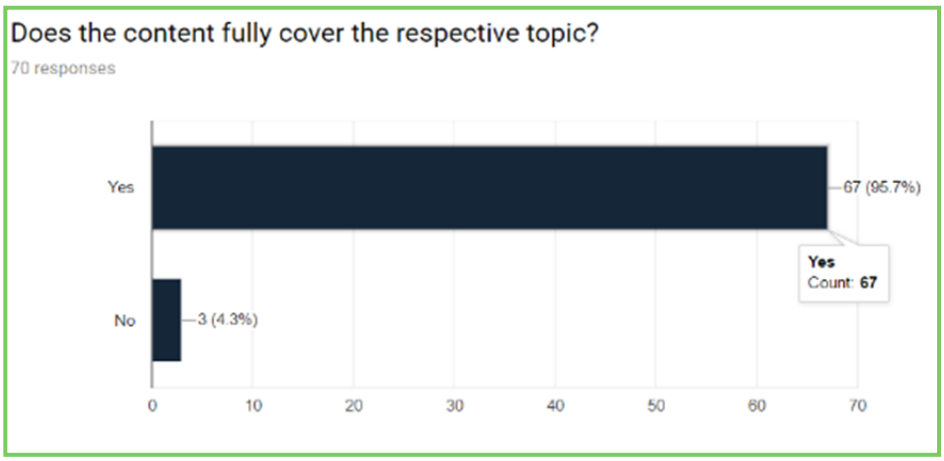

Comments:
Usage the slag aggregate in industrial purposes
Specificity and problems of recycling

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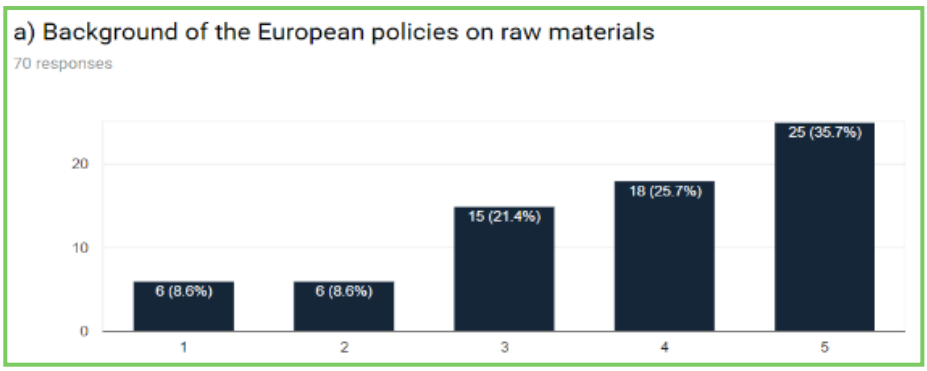
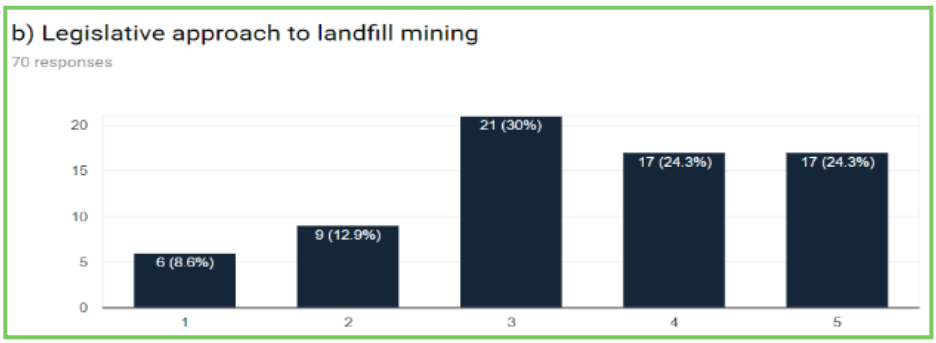
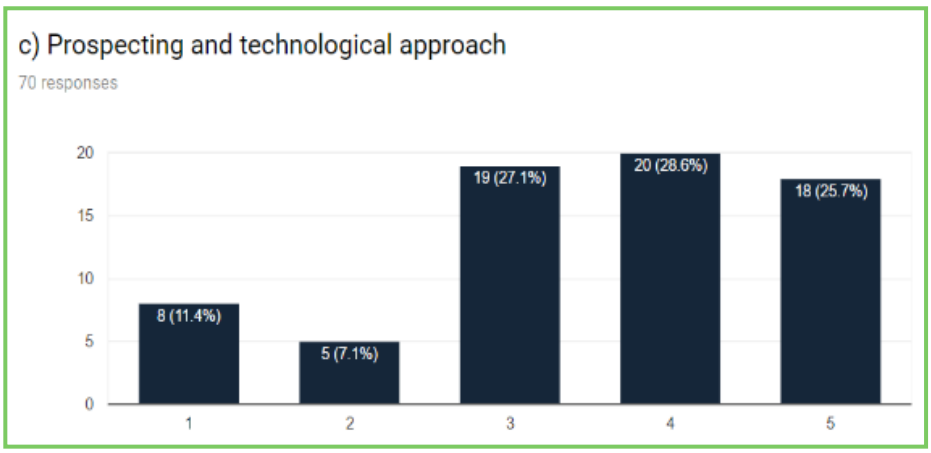
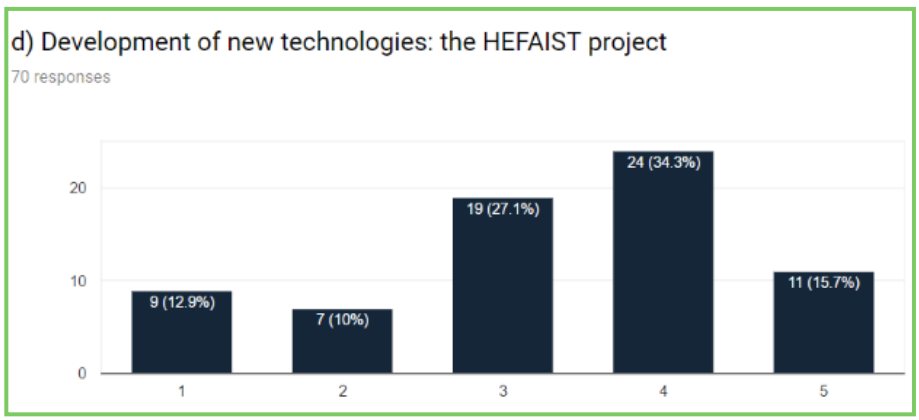
2. Landfill mining - recovery of high value materials for construction









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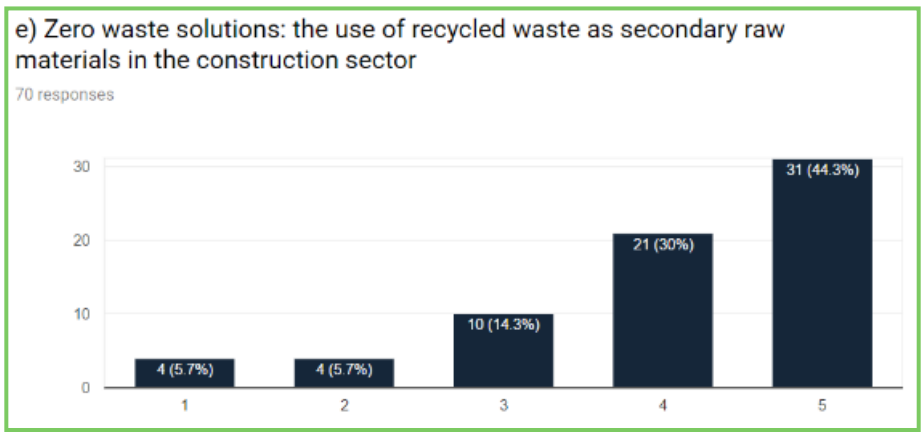

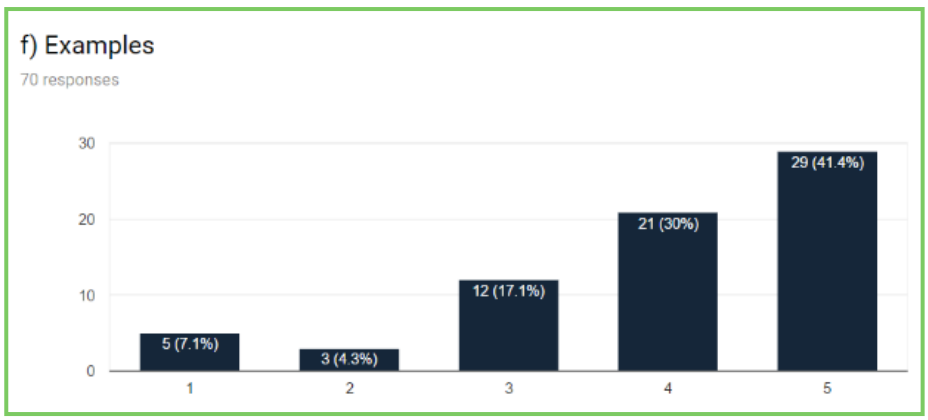

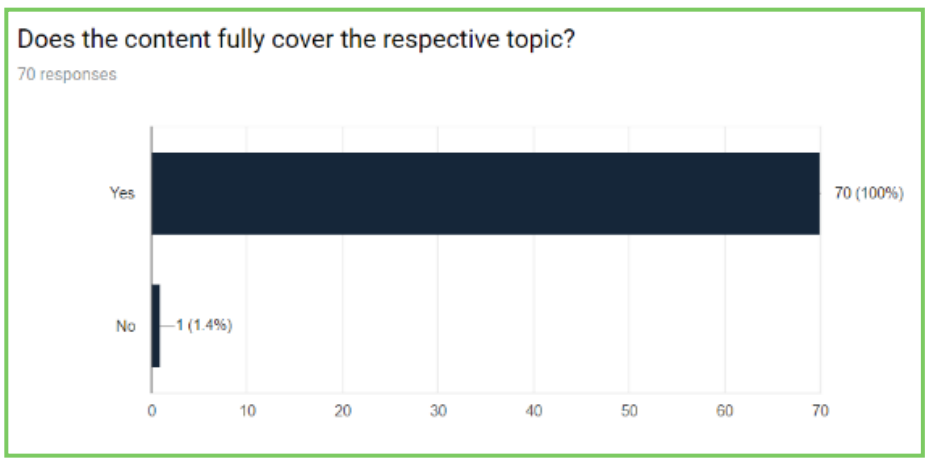

Comments:
Regulations are missing

3. In-situ remediation of soil contaminated by past industrial activities

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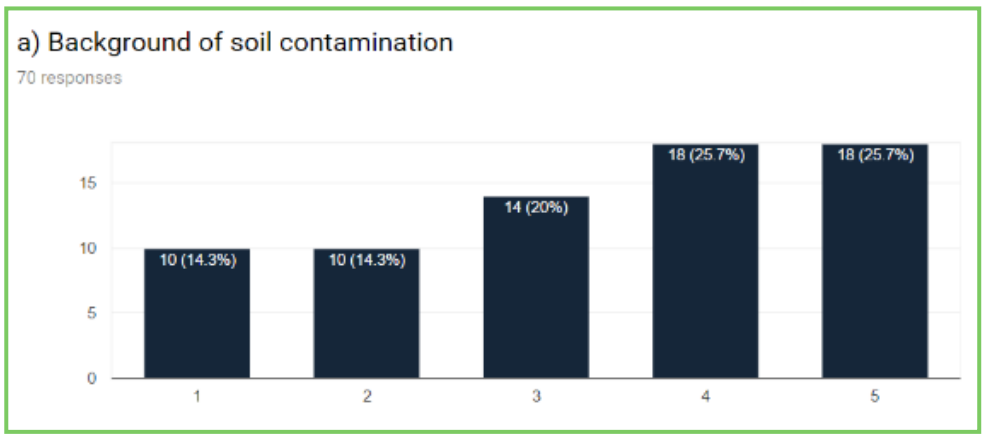

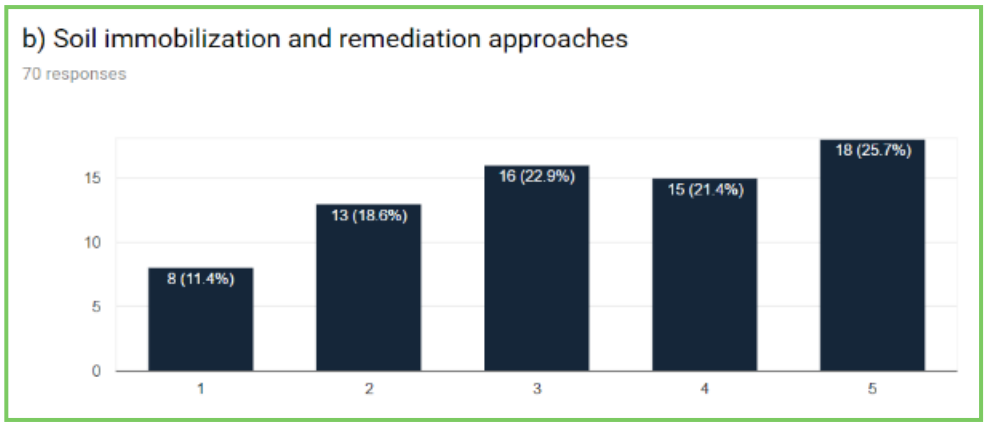

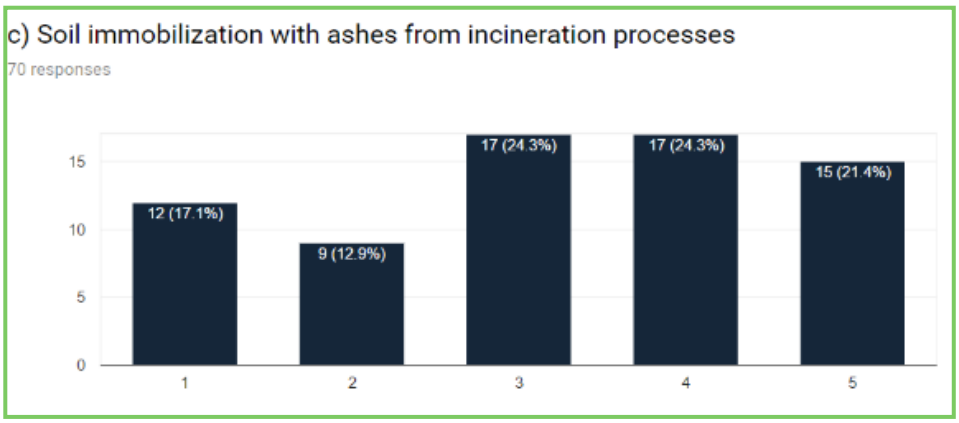

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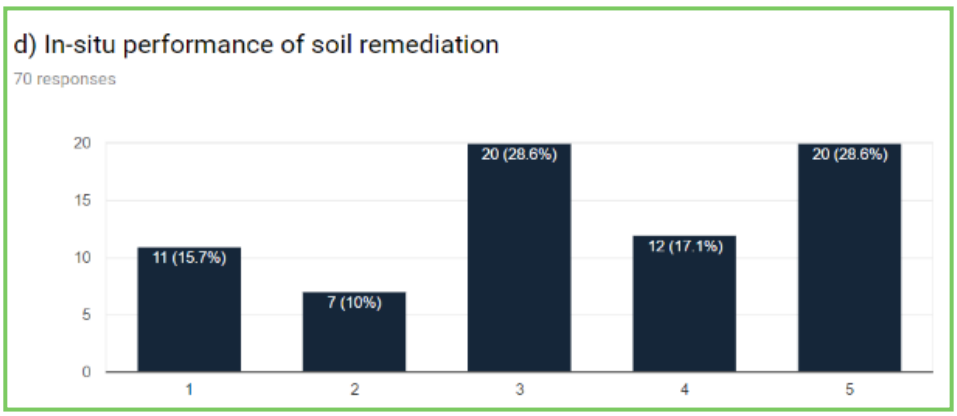

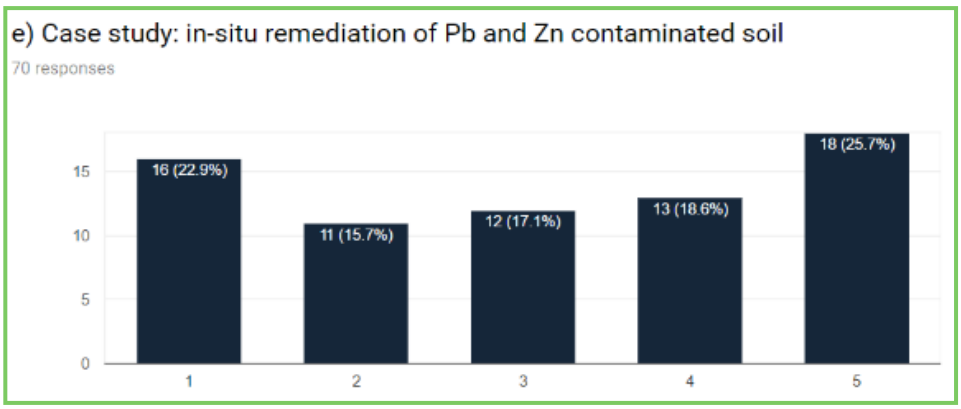

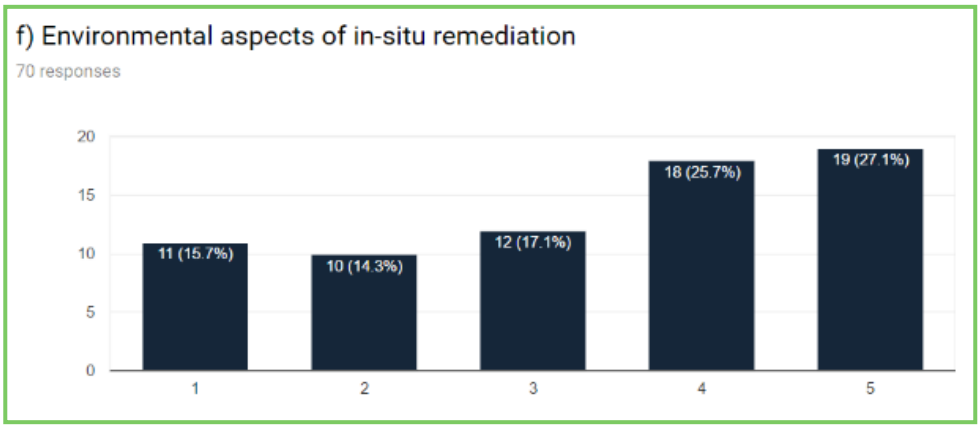

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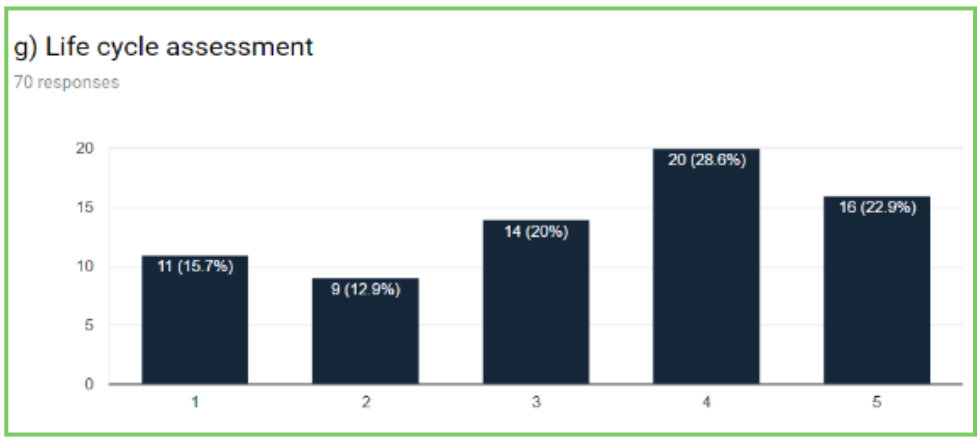

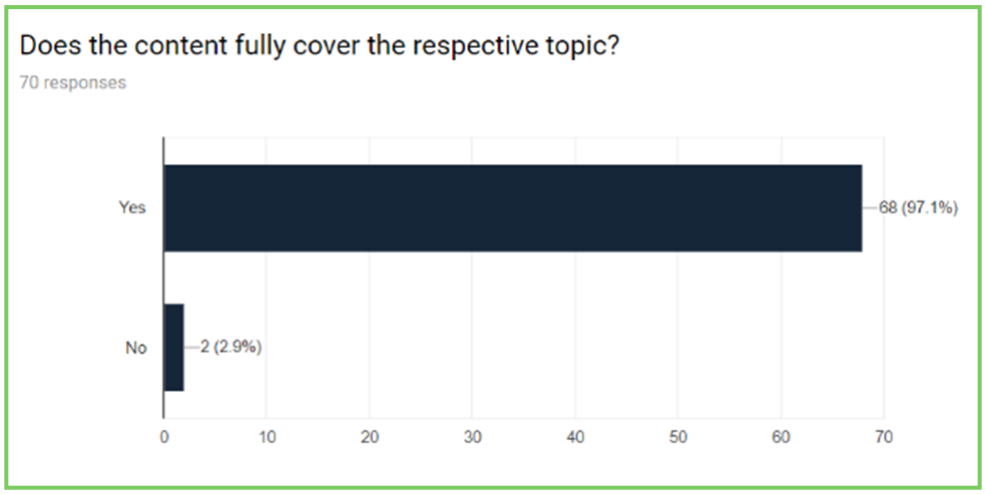

Comments:
Industrial water remediation
Good examples are missing
In situ contaminated soil restoration with use of young lignite as absorbent of heavy metals and soil conditioner
Presentation of good practices in the world and EU

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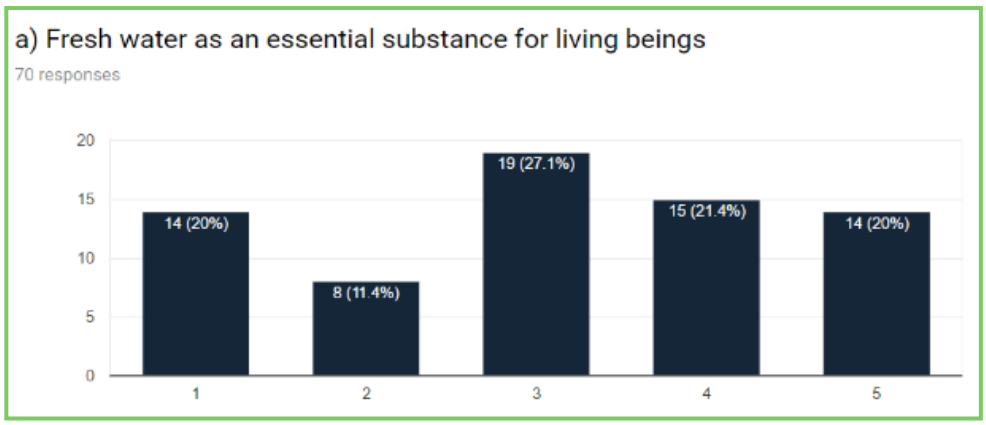
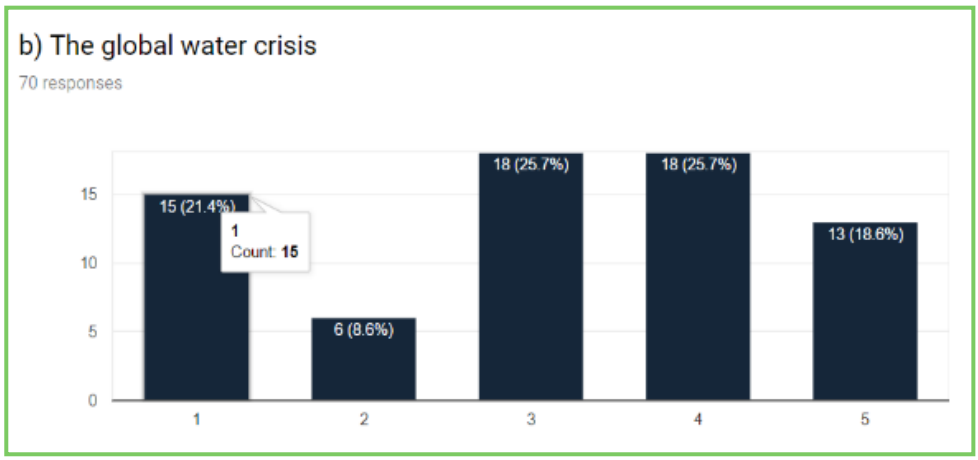
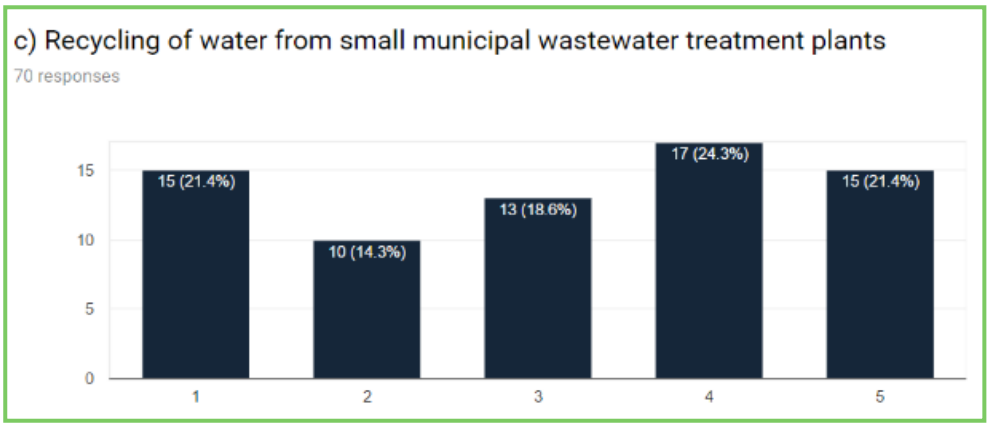
4. Nano-remediation of water from small wastewater treatment plants







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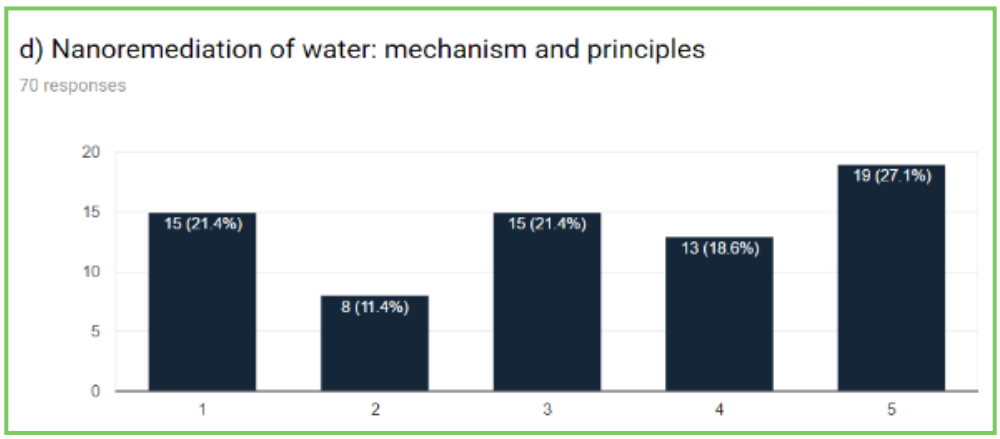

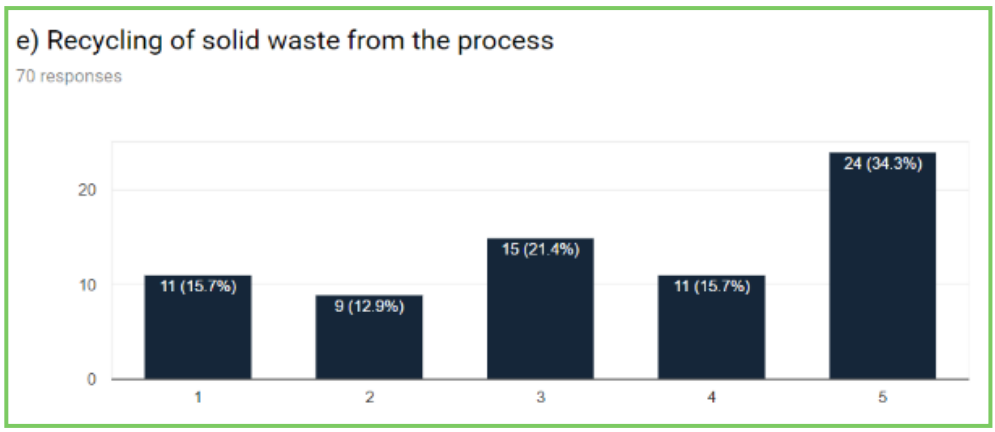

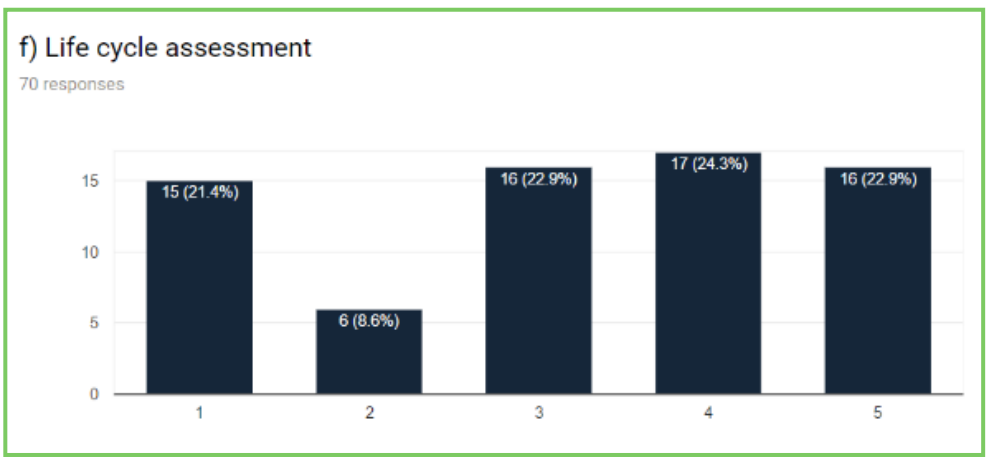

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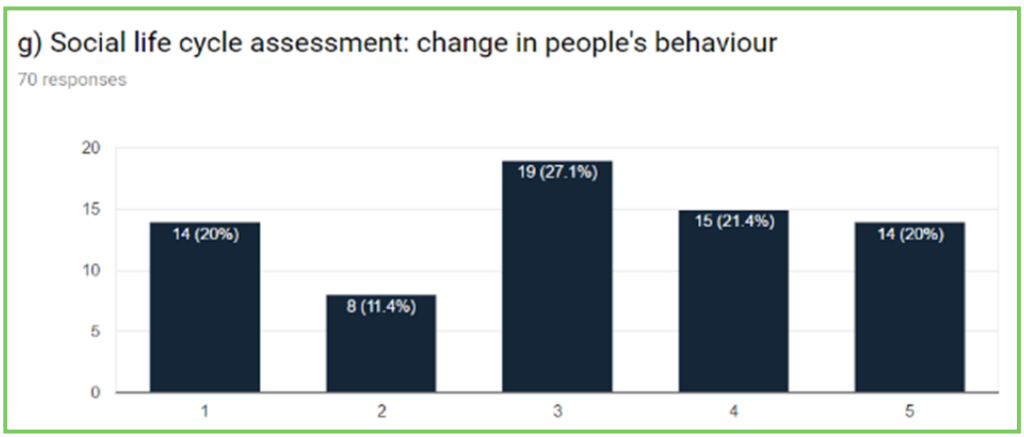
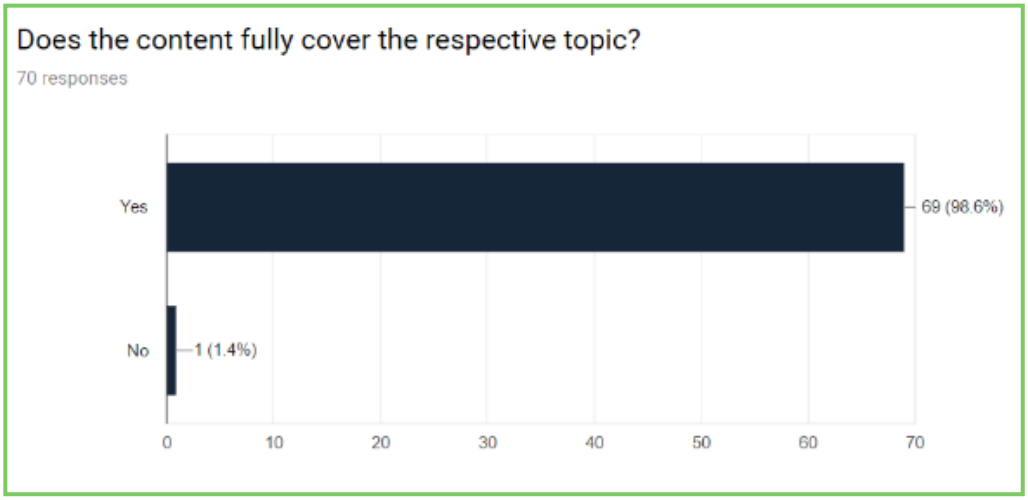
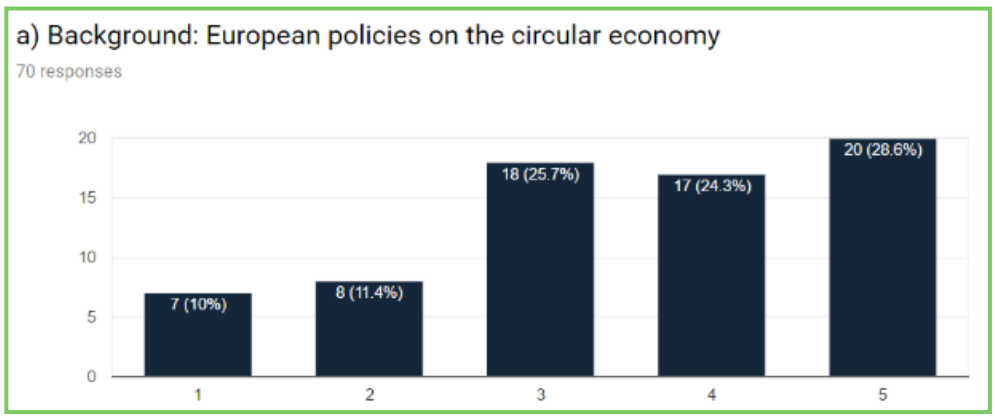




No comments

5. Enhancing a circular economy through industrial symbiosis



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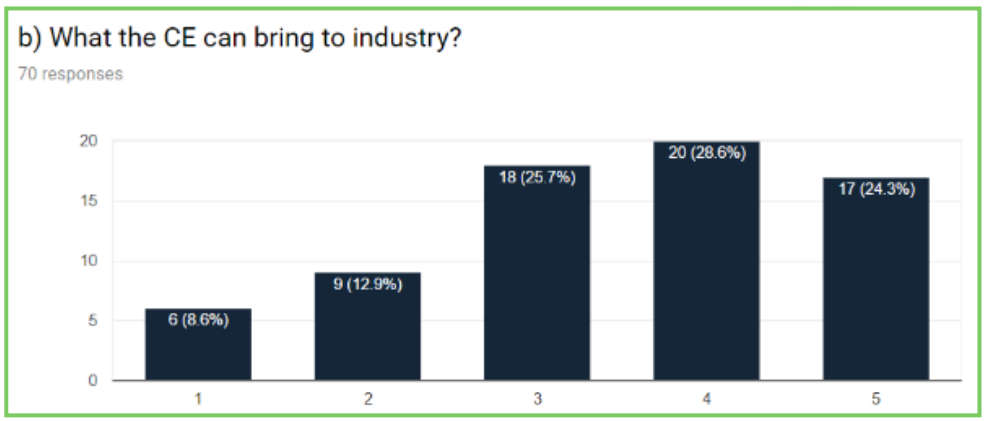
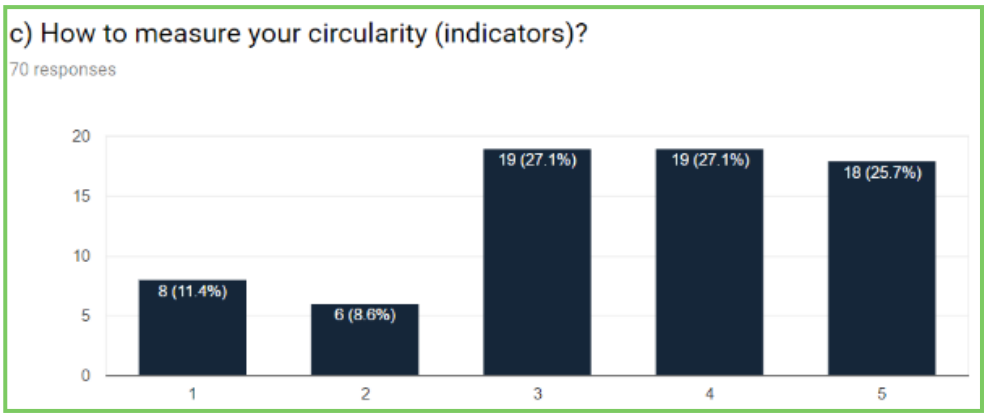
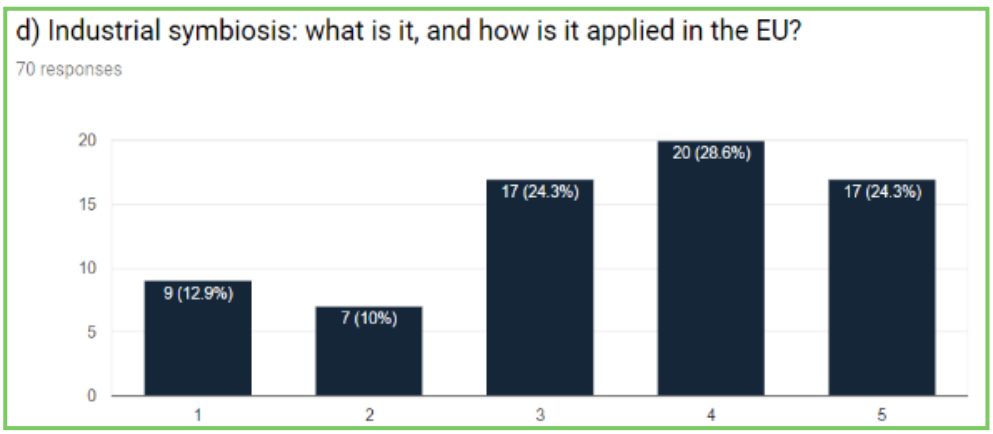
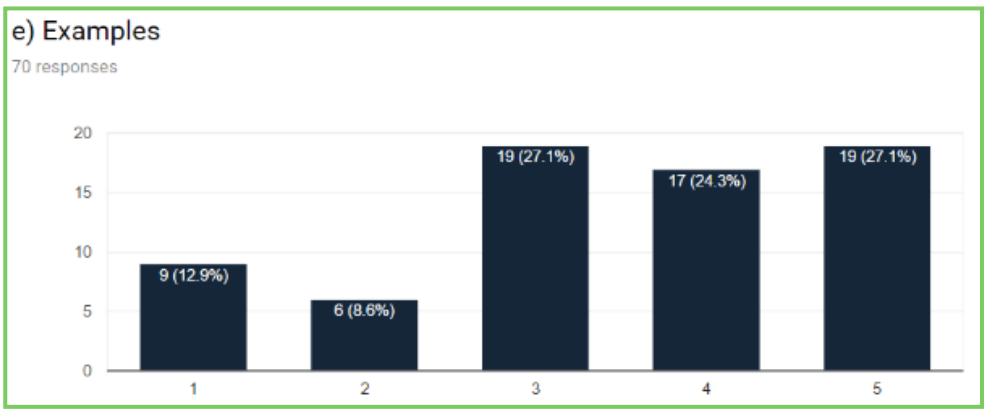
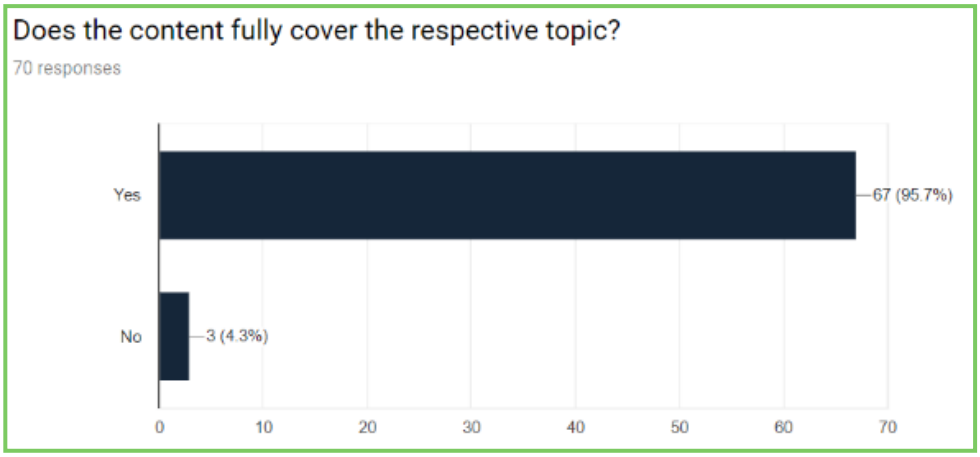






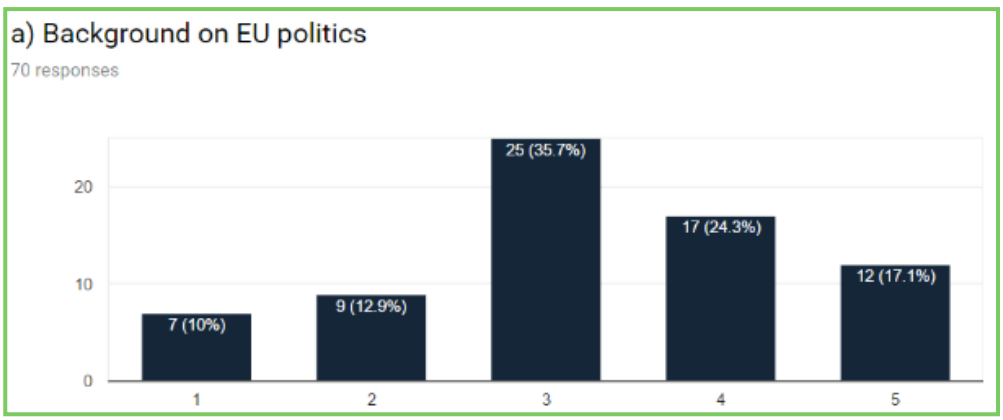
This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation





No comments

6. Life cycle assessment tools - quantification of environmental impacts



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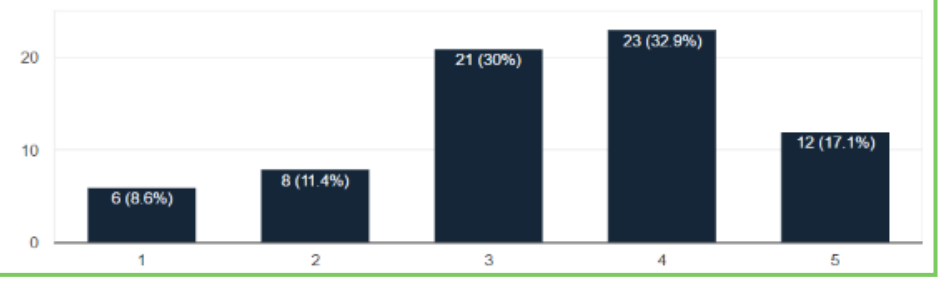
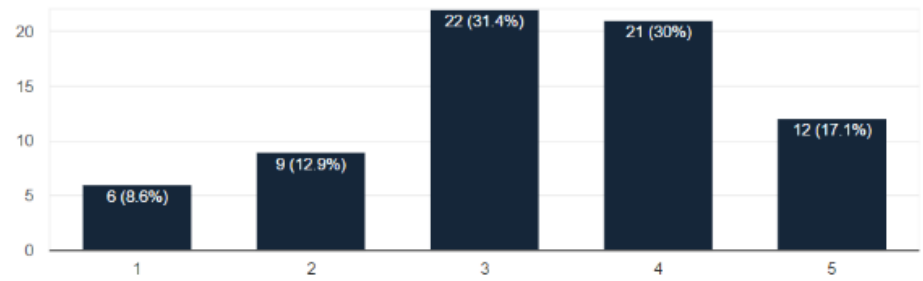
b) Life cycle thinking and measuring environmental, economic and social impacts in the whole life of products and services

70 responses



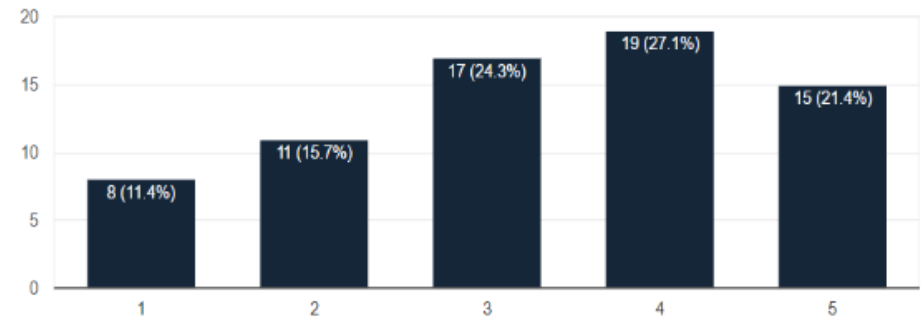
c) A standardized quantitative method for measuring environmental impact – Life cycle assessment

70 responses



d) The role of LCA in circular economy

70 responses



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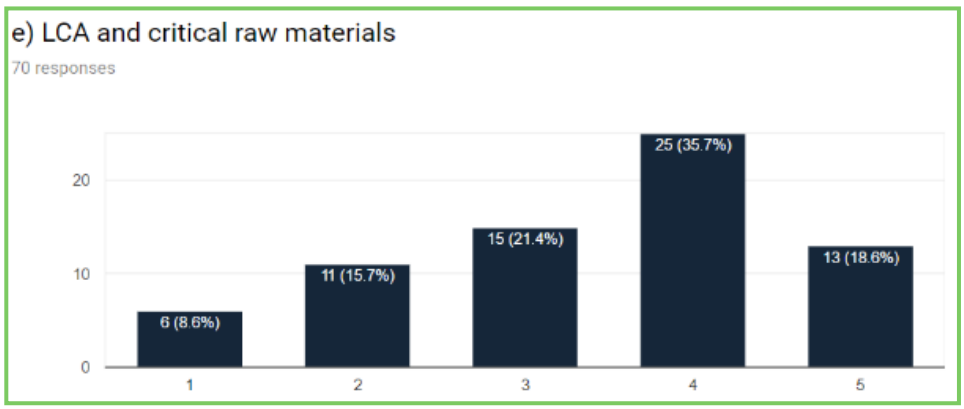

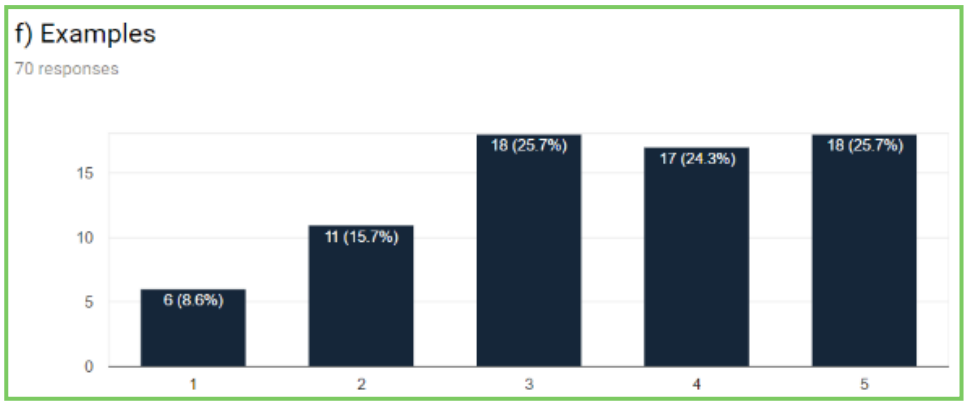

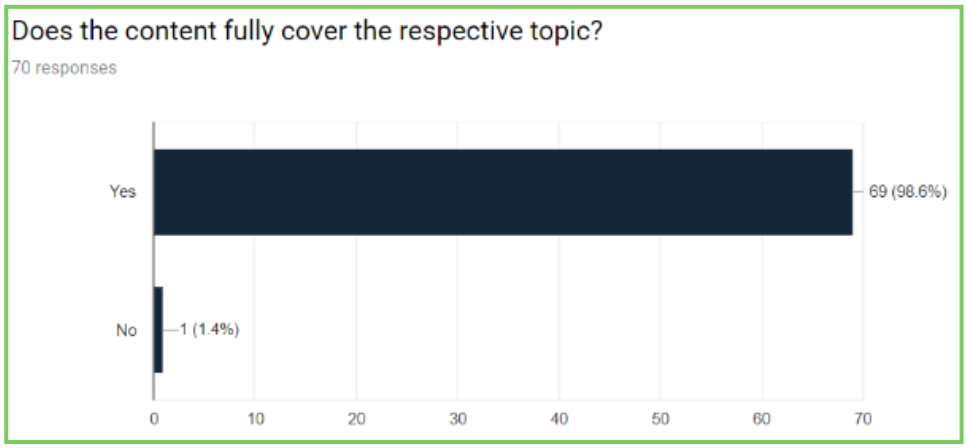

No comments

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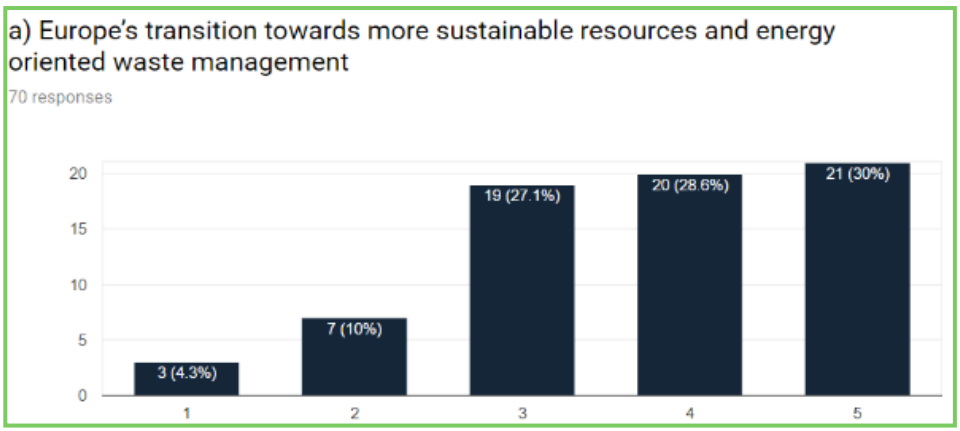
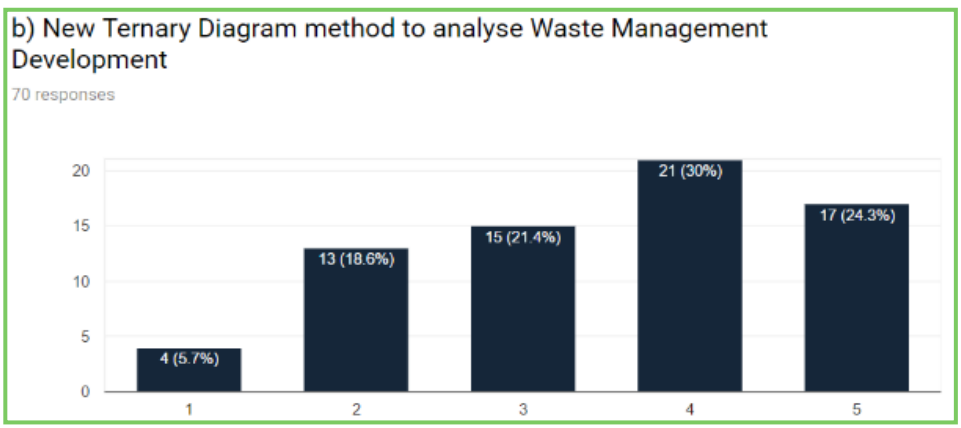
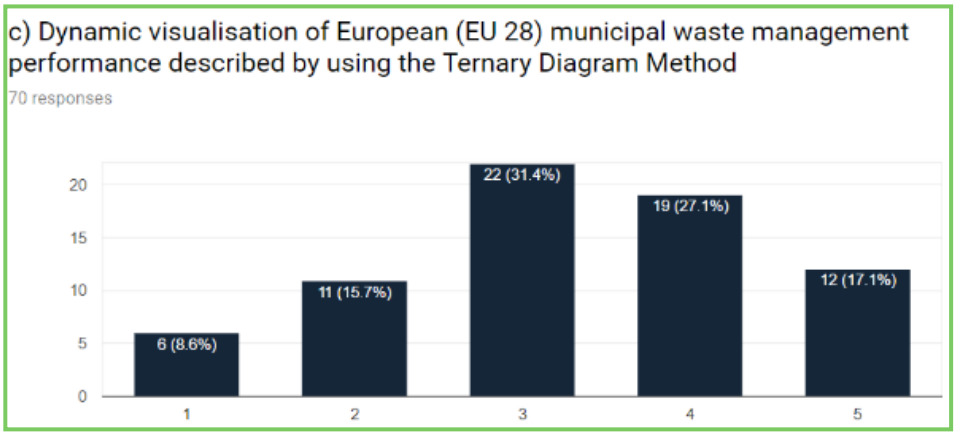
7. Circular waste economy







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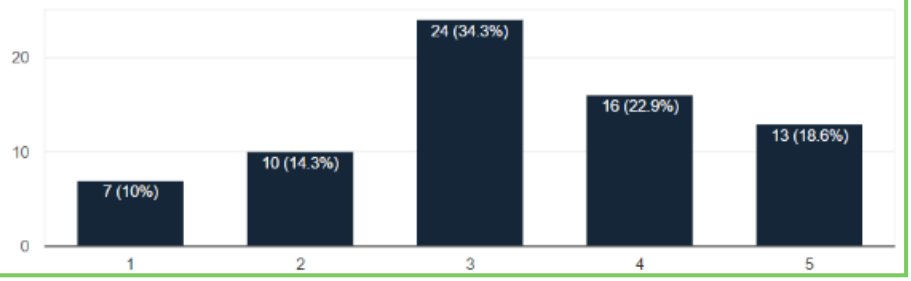
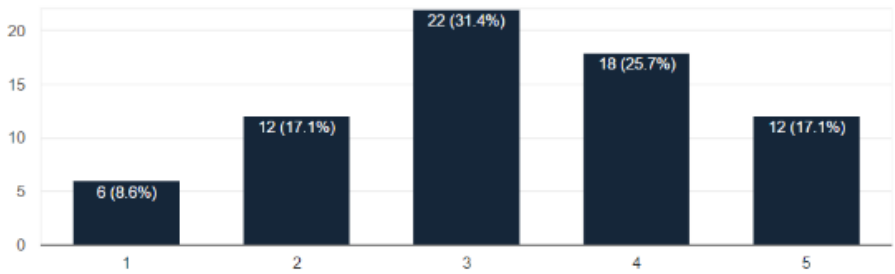
d) Using Ternary Diagram Method, three types of visualization for the municipal waste management performance have been investigated and extensively described

70 responses



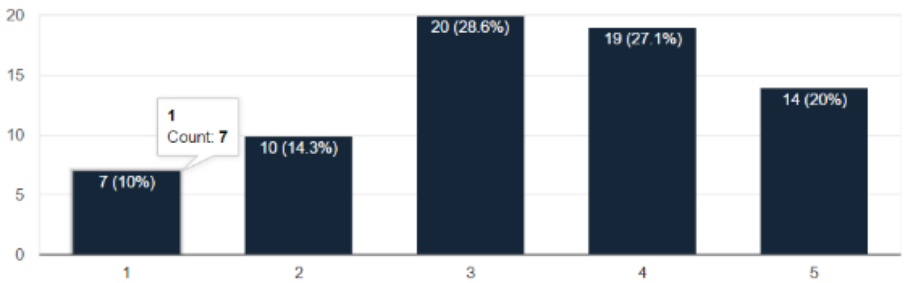
e) Therefore, for better understanding of municipal waste management performance in last 20 years, dynamic visualisation of the Eurostat table-form data on all 28 member states of the EU has been carried out in three different ways

70 responses



f) Results obtained show that the Ternary Diagram Method is very well suited to be used for better understanding of past developments and coherences, for monitoring of current situations and prognosis of future paths

70 responses



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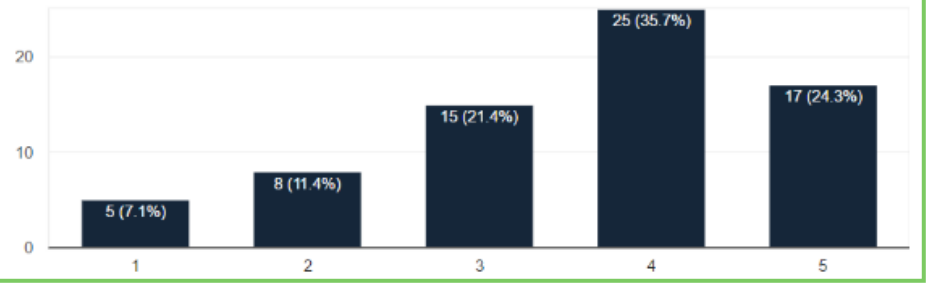
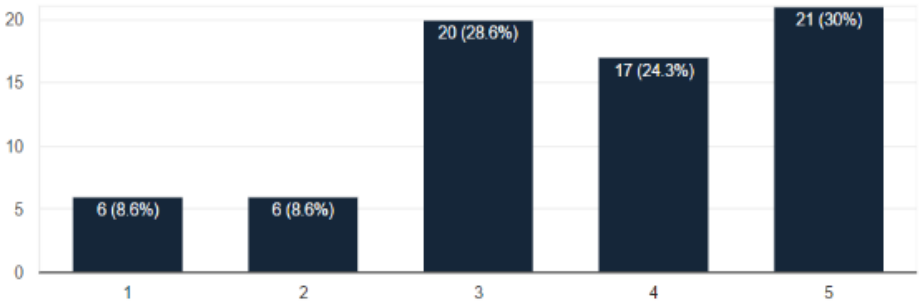
g) Technical solutions and possibilities to reach new European Recycling Targets

70 responses



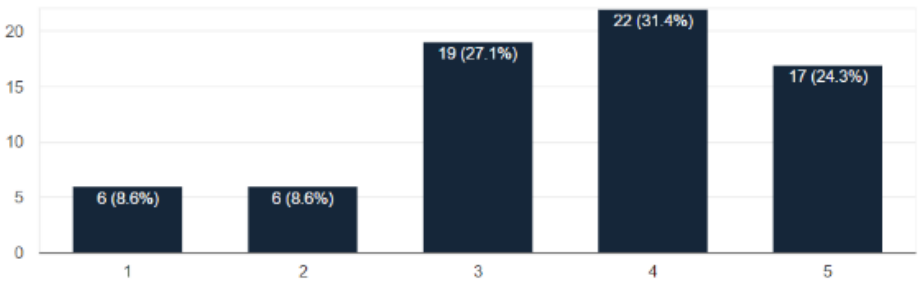
h) Advantages and chances of sensor based sorting systems

70 responses



i) Information about the new research project ReWaste4.0

70 responses



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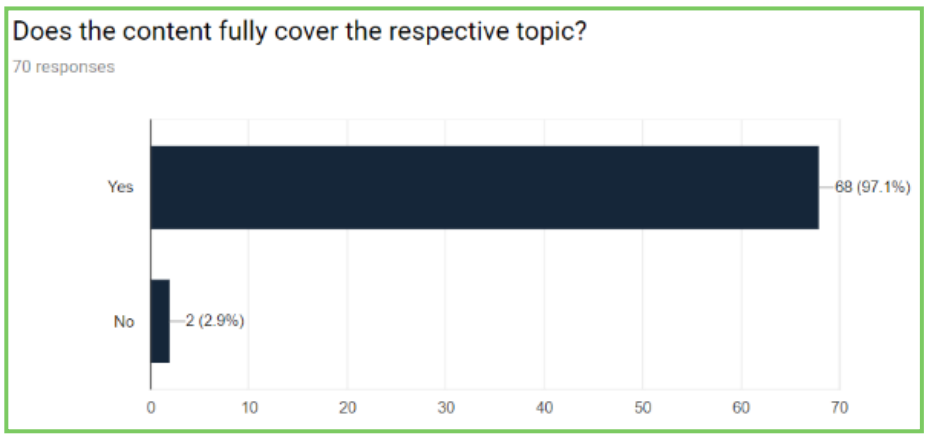
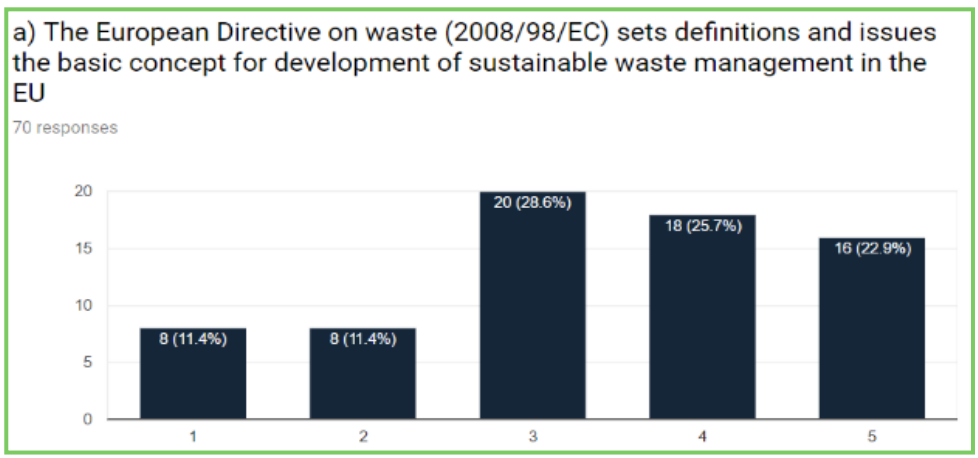
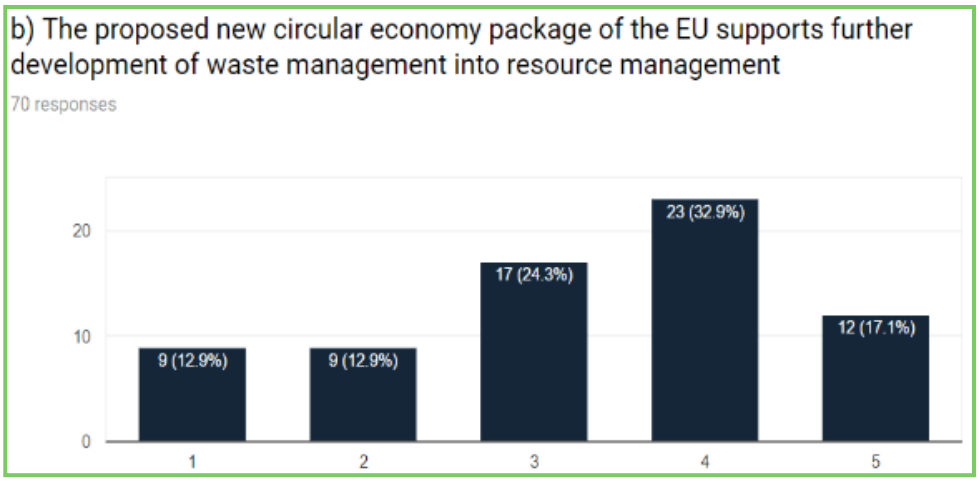


No comments

8. Technical waste treatment systems





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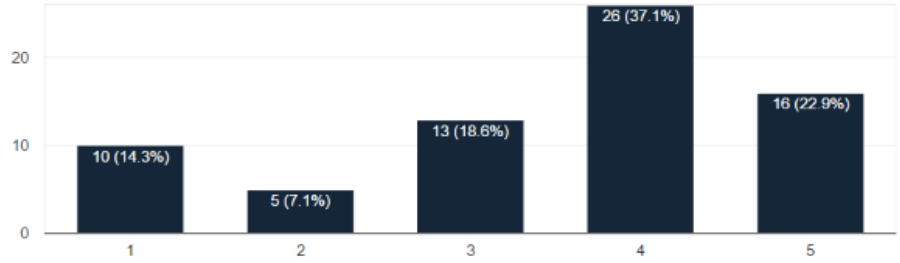
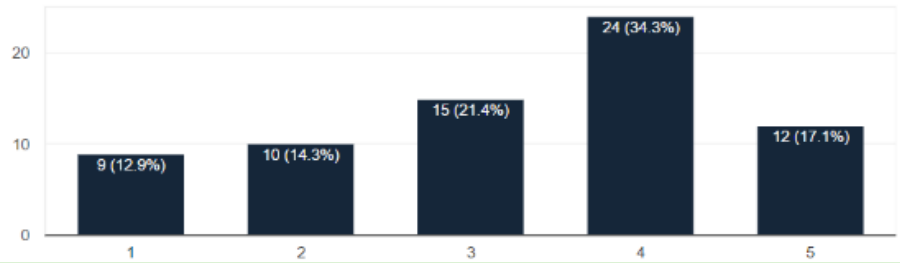
c) Separate collection of individual waste fractions (i.e. paper, glass, metals, plastics and bio-waste) is a pre-condition for fostering high quality recycling

70 responses



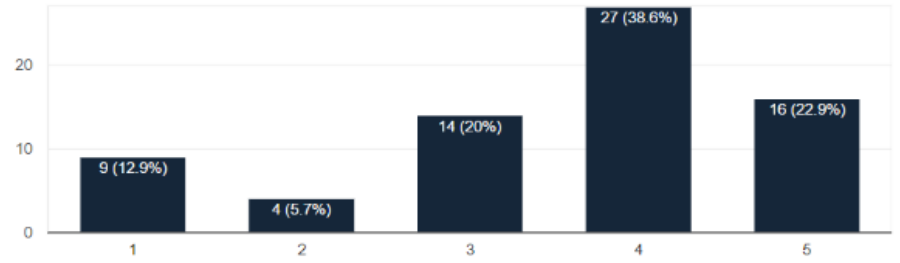
d) Austrian municipal waste management is based on separate collection of valuable fractions and treatment of mixed municipal waste in incineration as well as MBT plants

70 responses



e) Separation of valuable fractions like plastics and metals from mixed waste for recycling processes as well as unwanted materials like PVC plastics by using modern technology becomes very attractive

70 responses



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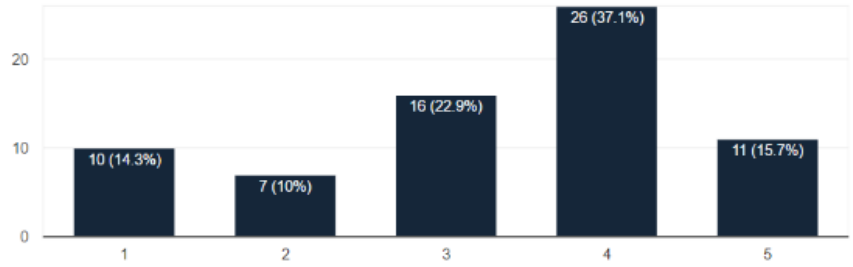
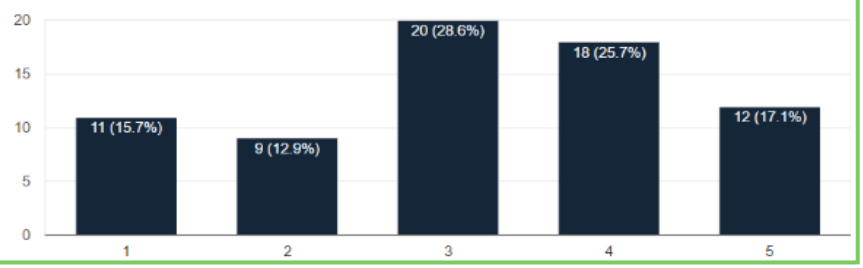
f) Three types of Solid Recovered Fuels (i.e. “SRF LOW Quality”, “SRF MEDIUM Quality” and “SRF PREMIUM Quality”) that are used in energy recovery plants are manufactured in Austrian mixed municipal waste system

70 responses



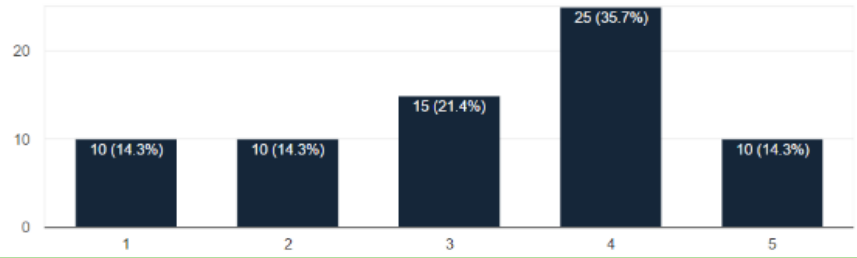
g) Recovery of thermal energy from mixed municipal solid waste usually is accomplished by mono-incineration plants or in co-incineration units

70 responses



h) In New Competence Centre for Excellent Technologies - K-Project "ReWaste4.0" Industry 4.0 approches in waste management are investigated

70 responses



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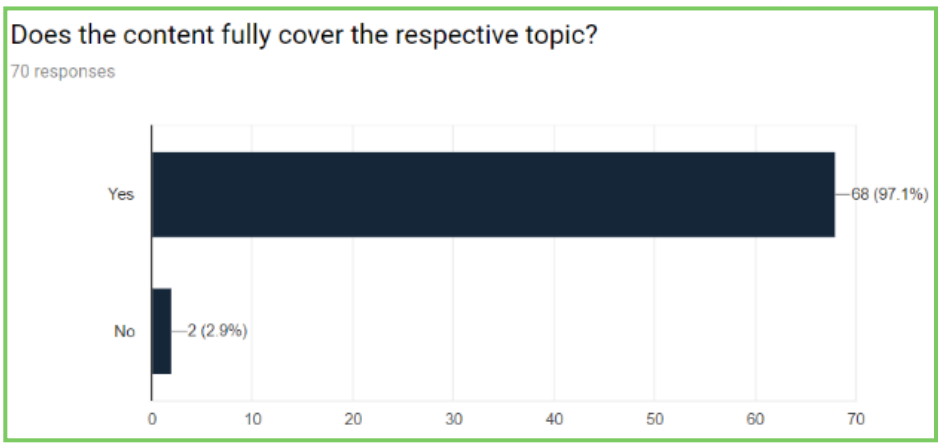
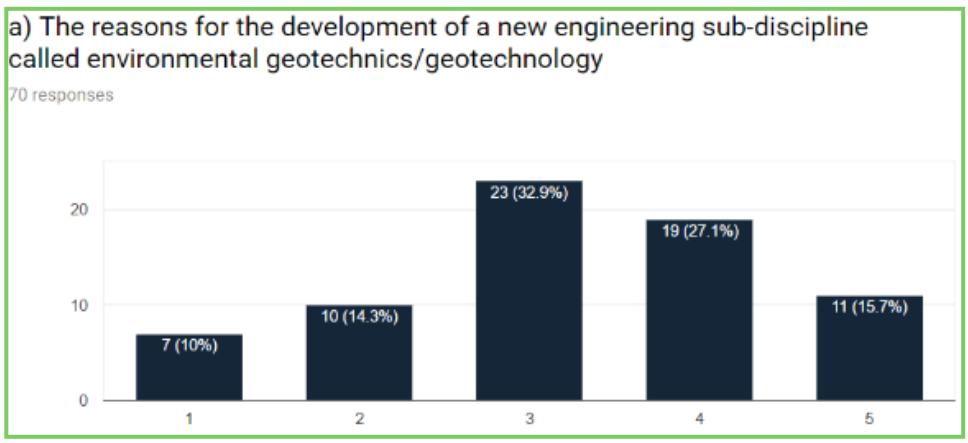
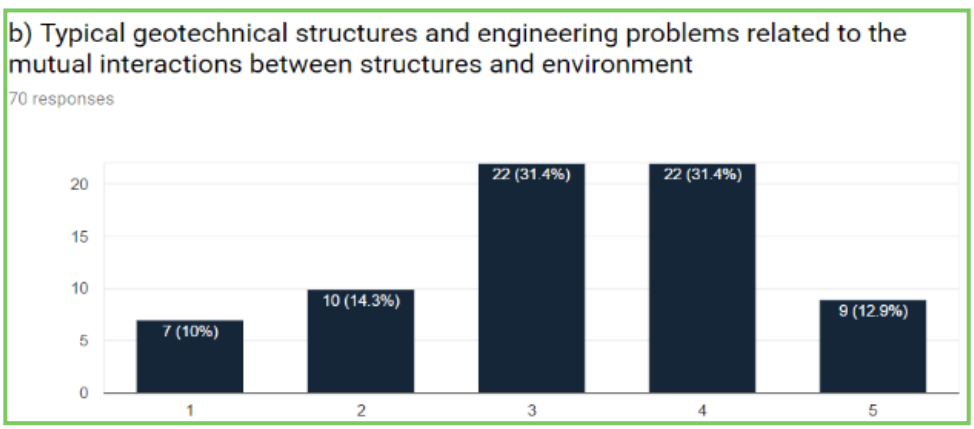


No comments

9. Environmental Geotechnics





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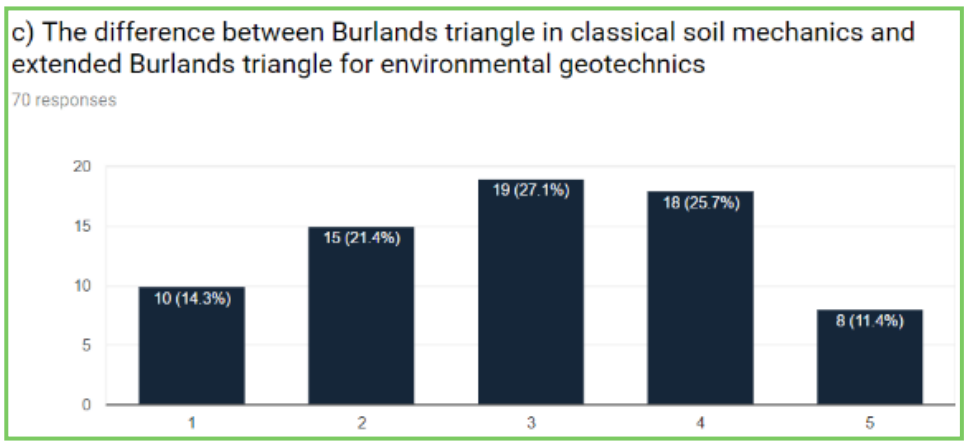

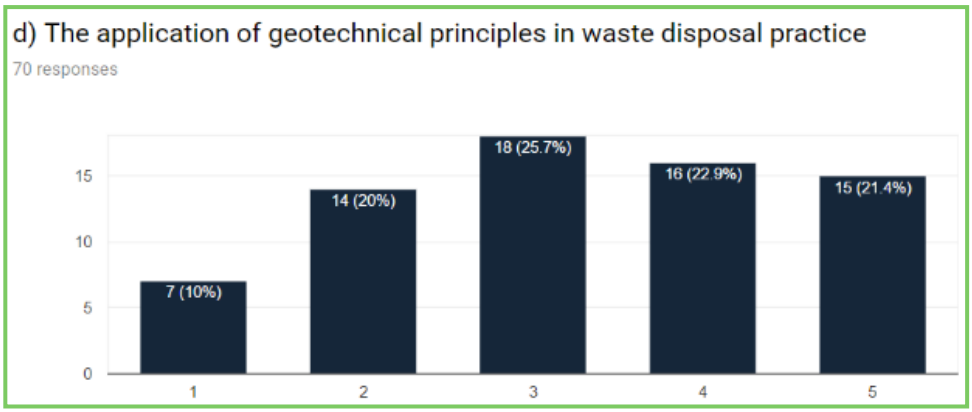

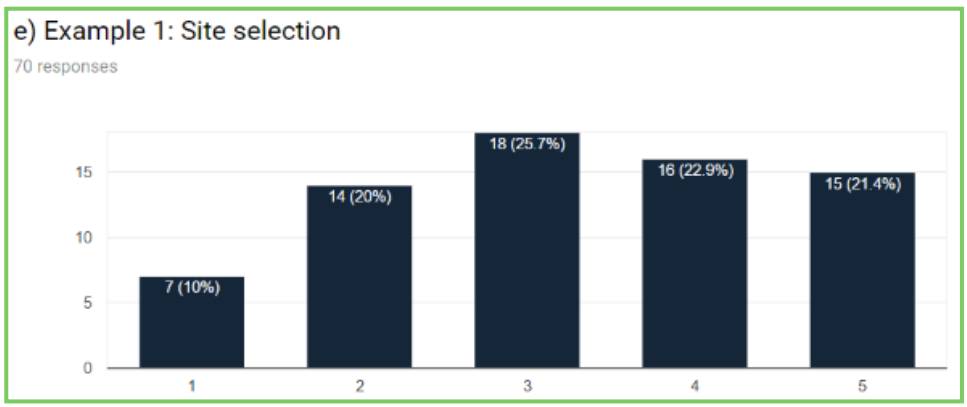

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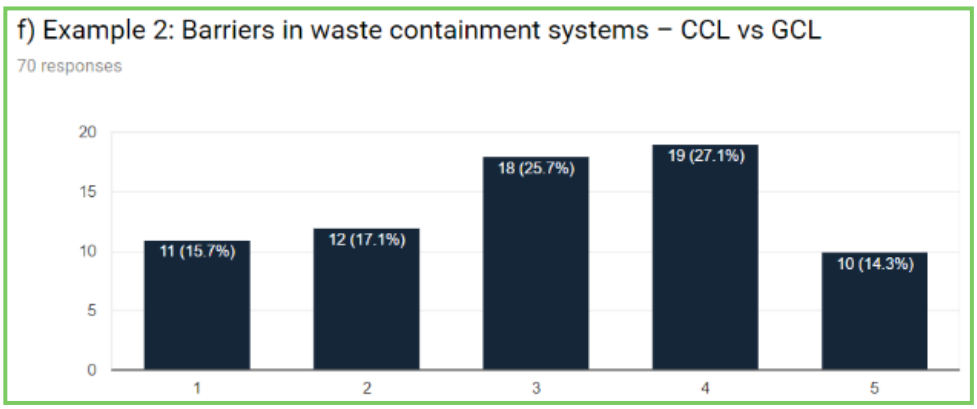

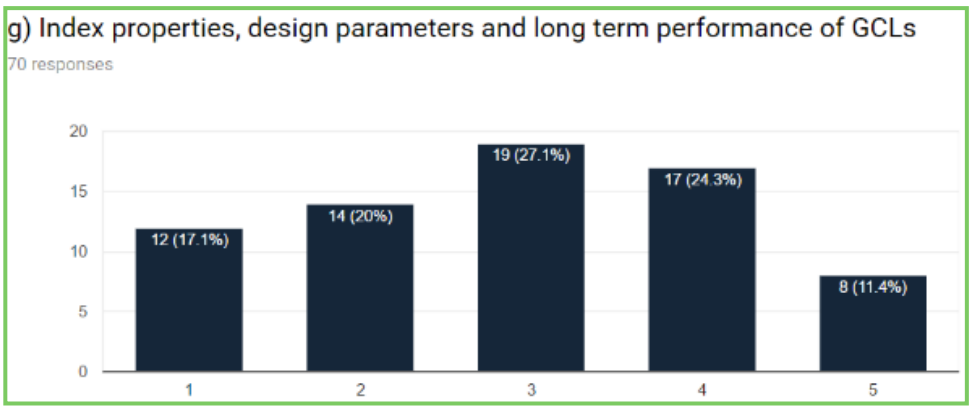

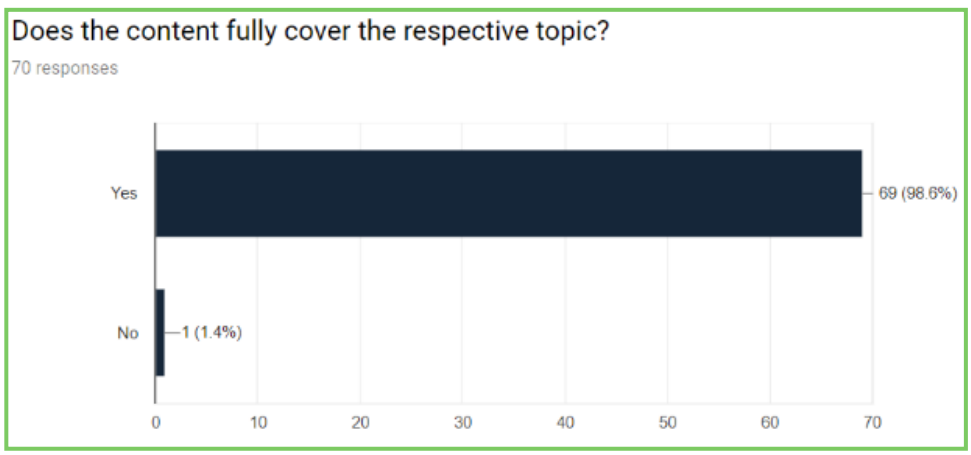

No comments

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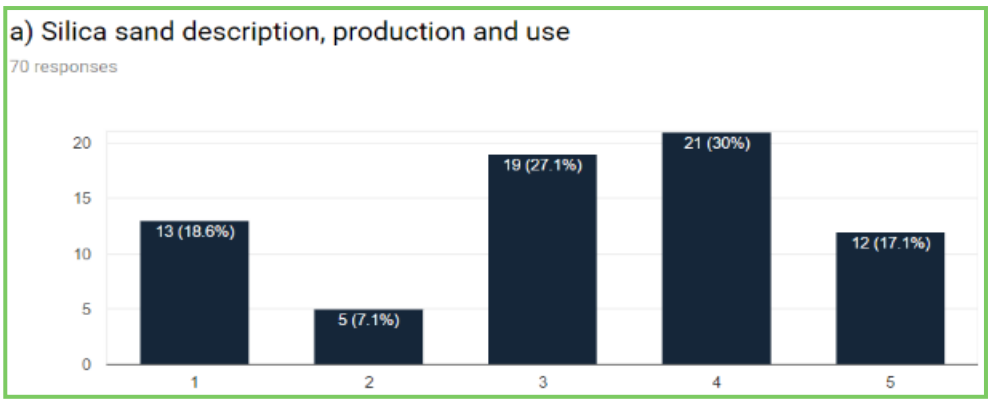
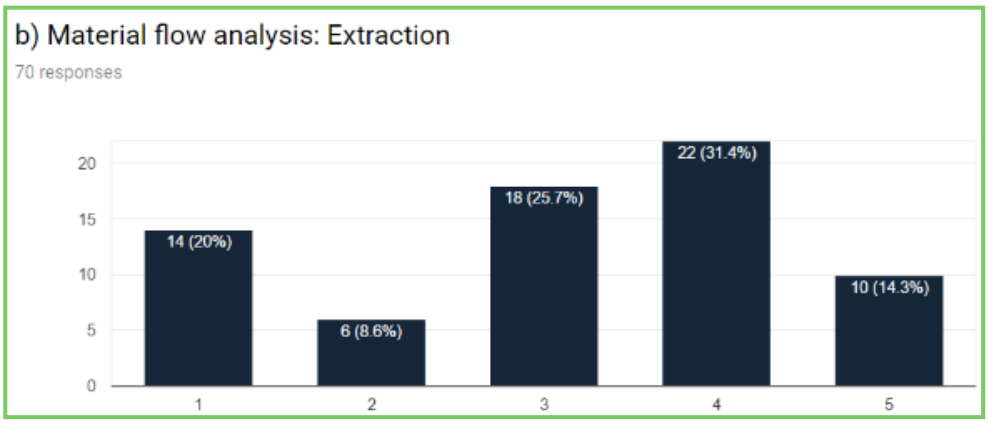
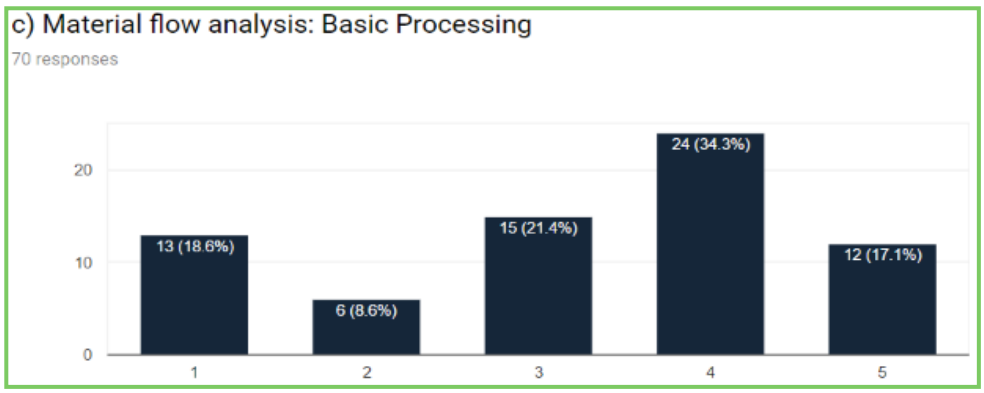
10. Life cycle assessment of the silica sand – case study







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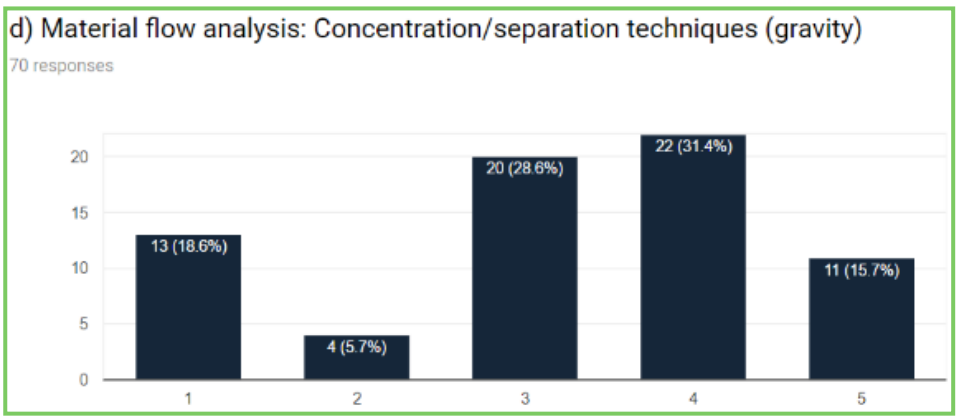

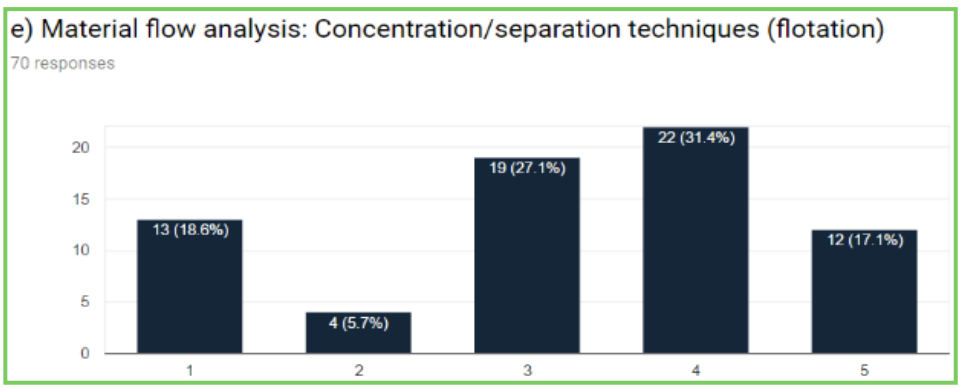

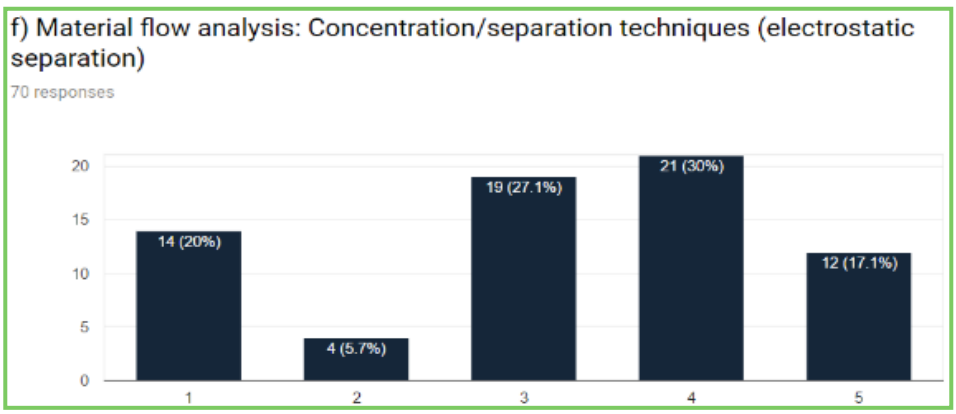

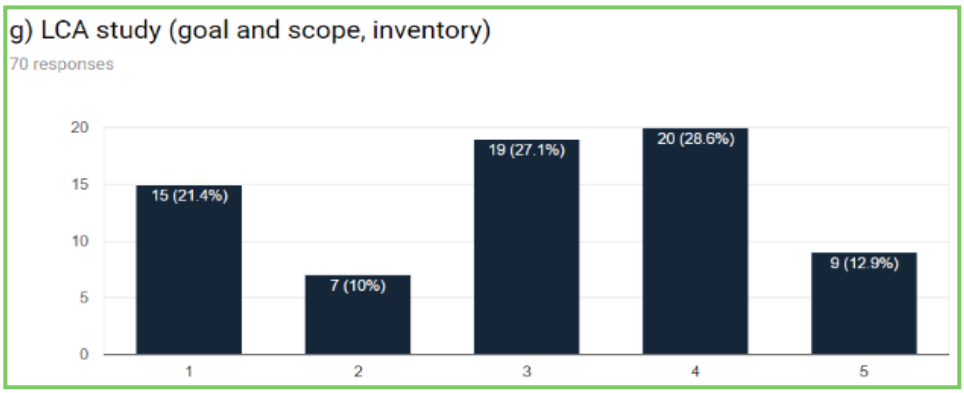

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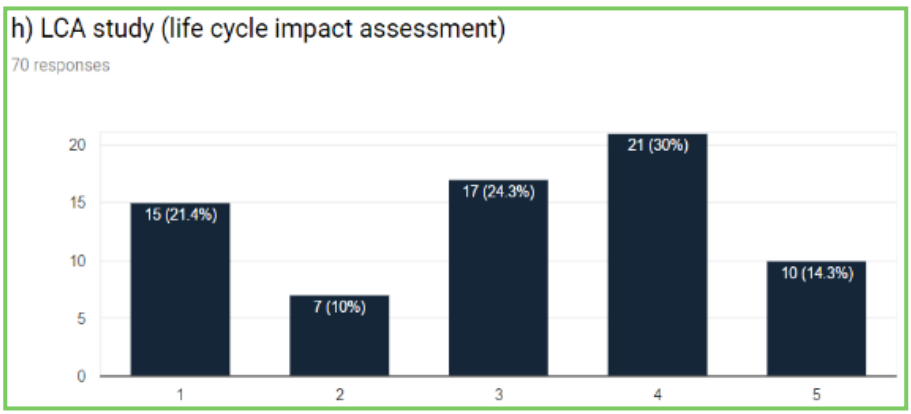

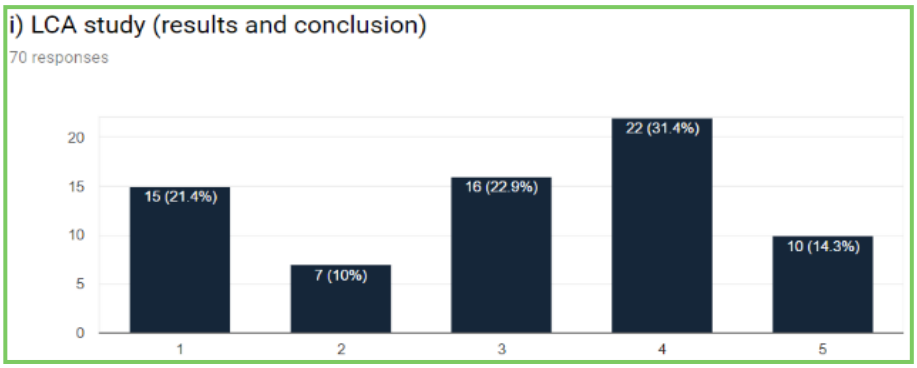

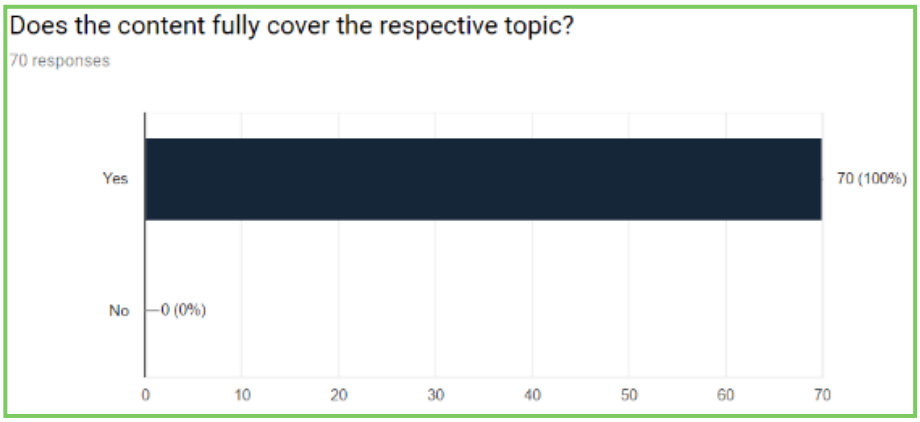

No comments

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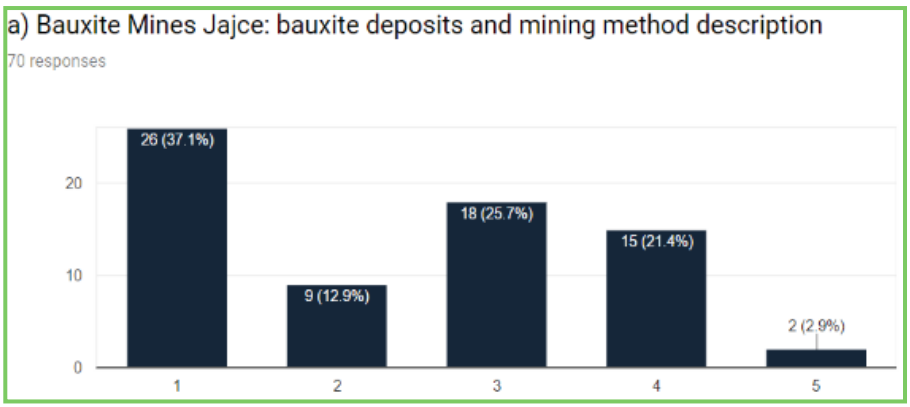
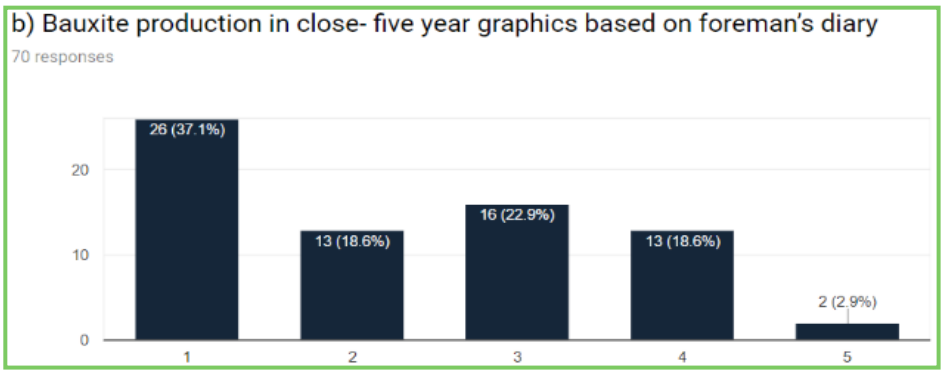
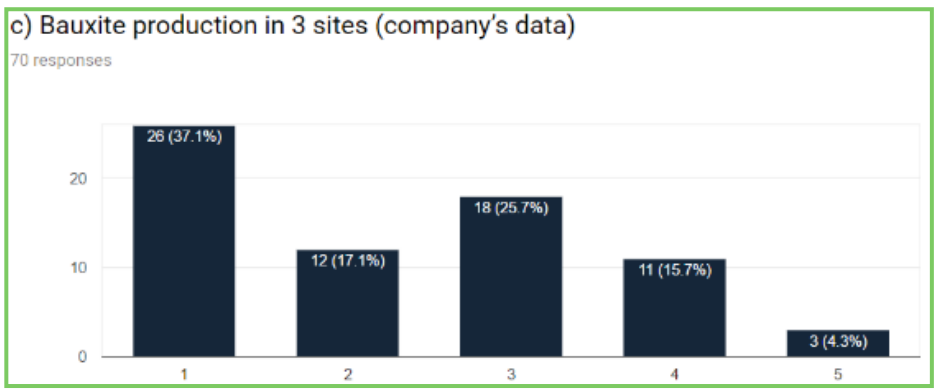
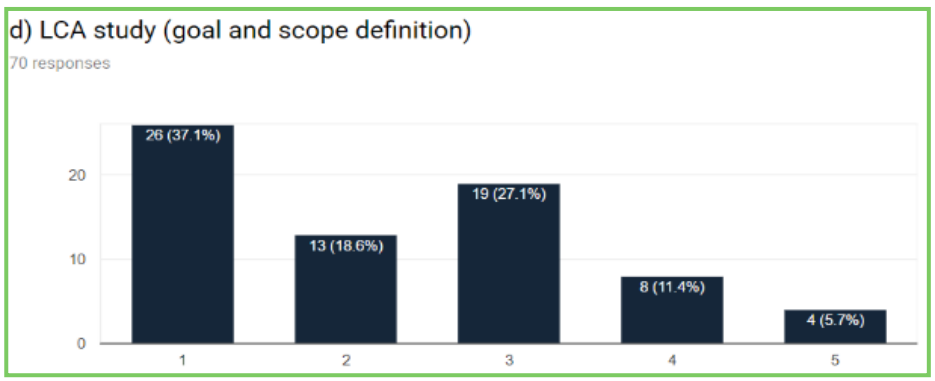
11. Life cycle assessment the bauxite – case study









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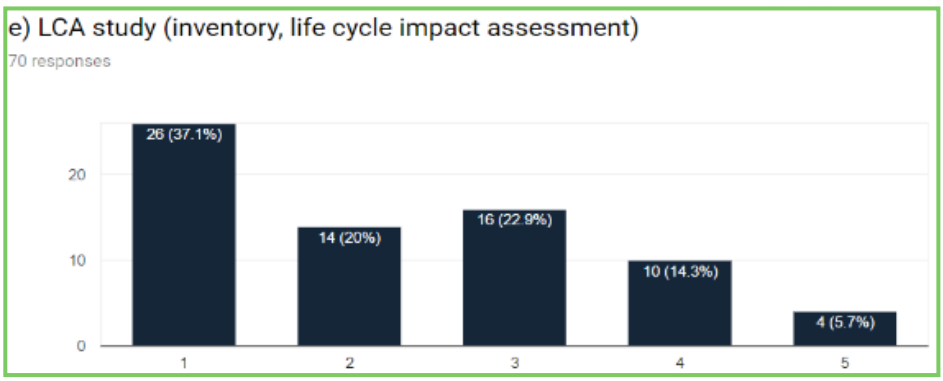

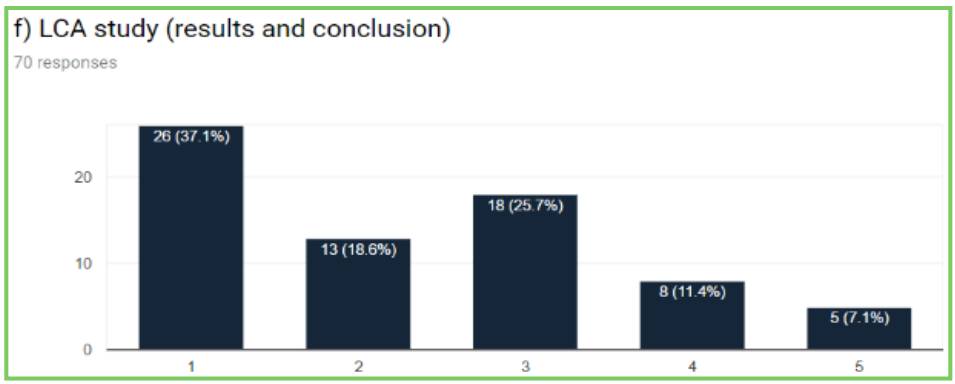

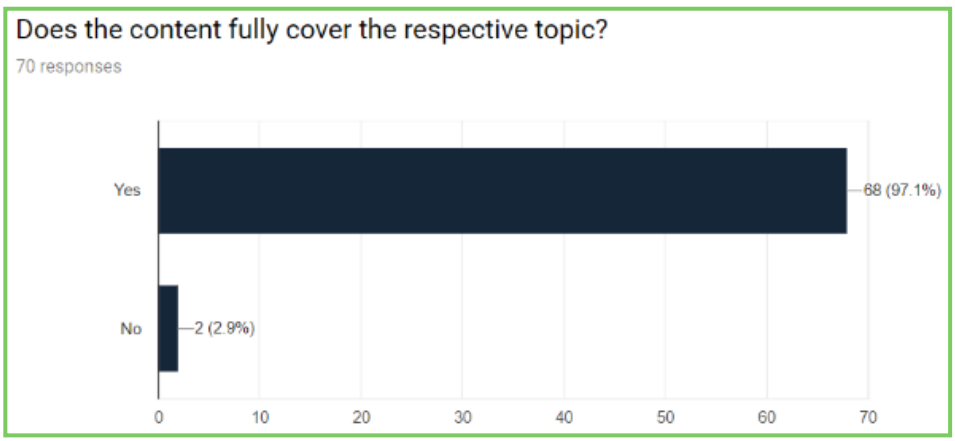

Comments
Not interested for our industry

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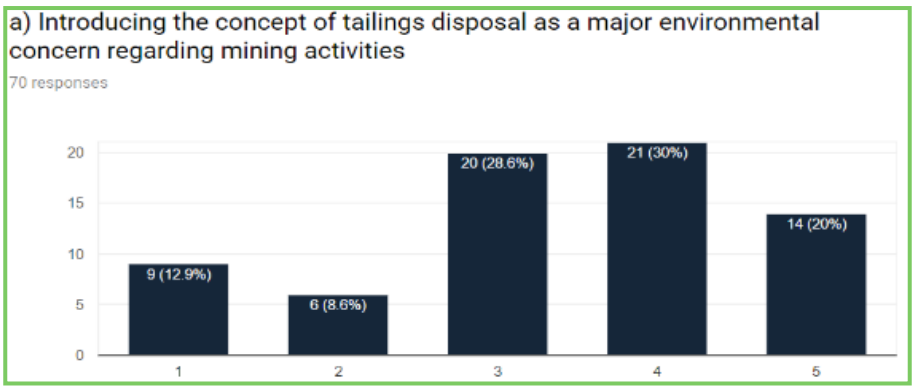
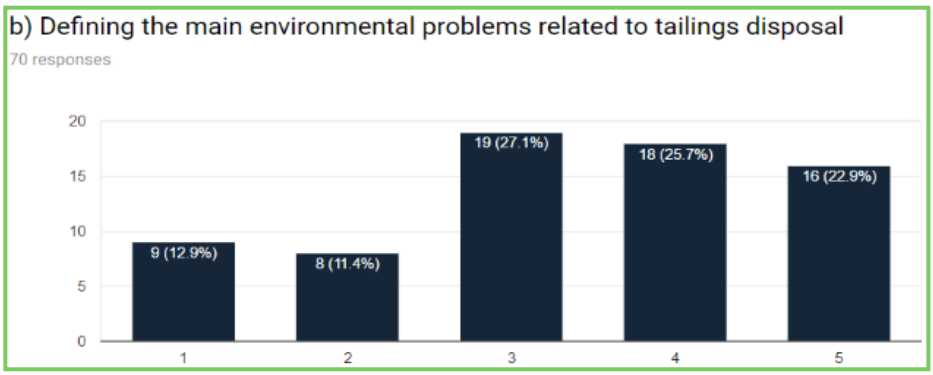
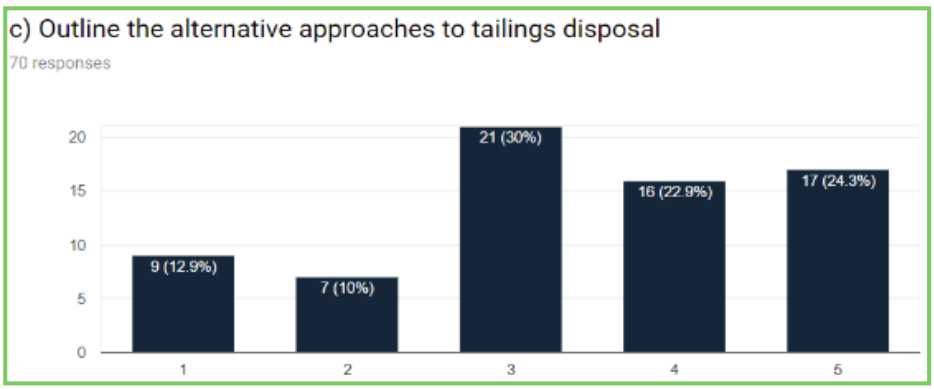
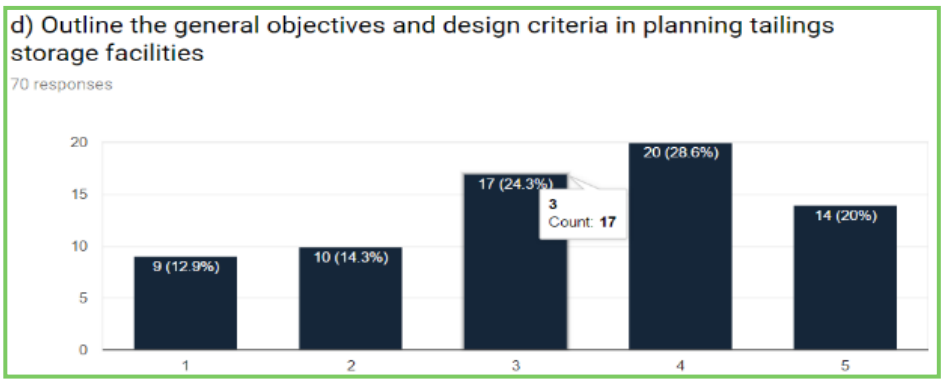
12. Tailings Disposal









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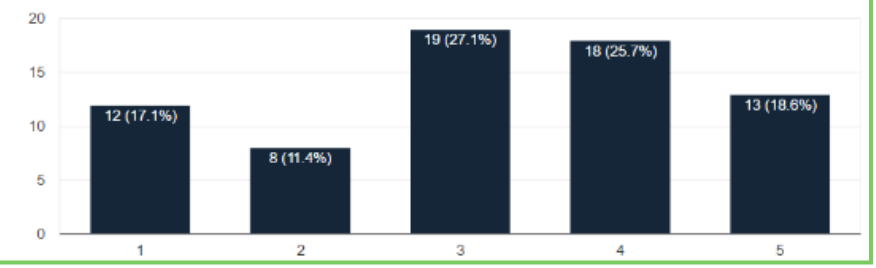
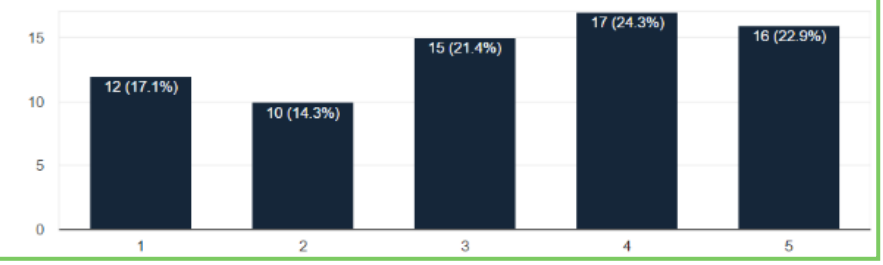
e) Present and explain basic types and constructions of tailings impoundments

70 responses



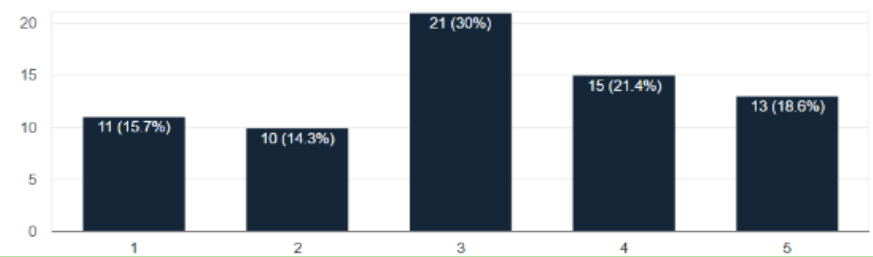
f) Presenting the examples coming from mining practice

70 responses



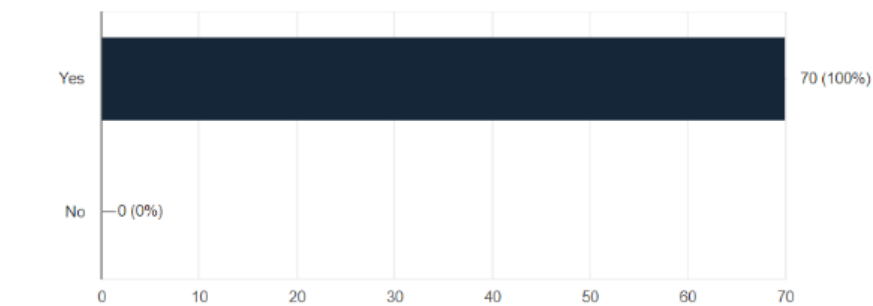
g) Stimulating interest and motivating further questions and discussion

70 responses



Does the content fully cover the respective topic?

70 responses



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No comments

Due to insufficient interest, one topic was excluded from this year's program (*Life cycle assessment the bauxite – case study*).

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3. PROGRAM DISCUSSION AND FEEDBACK

The participants were presented with the questionnaire results, as well as the comments for improvement. The discussion was filled with ideas and good practice examples from the industry partners. Below is the main outline of the participants' ideas and good practices, as well as problems they think need to be addressed:

- Unclear legislation in the field of mining – better communication with all relevant stakeholders like public administration, academia, industry
- The participants of the School would benefit from a real case study workshop that would present all stakeholders in the process and their view of things
- The negative public connotation of waste that creates obstacle for companies dealing with such issues
- Problem with cooperation with government: investing in projects of remediation
- To stress the importance of good practice examples to motivate and educate other stakeholders

With the help of the participants and their comments, the output of the workshop was finalizing the schedule for the School. The workshop has also generated a successful match between two Slovenian companies who were interested in a collaboration regarding the waste one of them was producing and the other that can find a use for that waste. The participants expressed their interest in joining this year's School and actively participating in the School program. We enclose the finalized program below (Figure 4).

Figure 4 The finalized schedule of the DIM ESEE School for 2017

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	Morning 9-12	Afternoon 13-16
Monday 20.11.	**Check-in and registration** **Introduction** Administrative Matters Academic Matters **Welcome reception drink** **Zero waste management horizontal programme: Presentation of a case study – exploring the consequences and various aspects of the presented case in groups (1h)**	**Round Table Challenges in the Society Directors + Teaching Staff (1 hour)** **Lesson number 1 – Overview on Zero waste management, Ignacio Calleja, KIC RM (30 min)** **Lesson number 2 – Sustainable products and consumption, Lana Žutelija, DG Environment (30 min)** **Lesson number 3 – Circular economy in relation to the Smart specialization strategy; Robert Blažinović, Ministry of Economy, Entrepreneurship and Crafts (30 min)** **Sponsored Welcome Dinner**
Tuesday 21.11.	**Lesson number 4 - Technical waste treatment systems; MUL (90 min)** **Lesson number 5 - Circular waste economy; MUL (90 min)**	**Lesson number 6 – Environmental Geotechnics; RGNF (90 min)** **Lesson number 7 - Local and regional circular economy; PKG, industrial partner (90 min)**
Wednesday 22.11.	**Lesson number 8 - Life cycle assessment tools - quantification of environmental impacts; ZAG (90 min)** **Lesson number 9 - Life cycle assessment of the silica sand – case study; RGNF (90 min)**	**Lesson number 10 - Nano-remediation of water from small wastewater treatment plants; ZAG (90 min)** **Debate on Zero waste management (2 hrs)** **City Tour**
Thursday 23.11.	**Best practice examples of the industrial participants (15 min per participant)** **Lesson number 11 - Recycling of ferrous slags for construction purposes; ZAG (90 min)**	**Lesson number 12 - Enhancing a circular economy through industrial symbiosis; ZAG (90 min)** **Excursion**
Friday 24.11.	**Lesson number 13 - Tailings Disposal; RGNF (90 min)** **Lesson number 14 – Landfill mining - recovery of high value materials for construction; ZAG (90 min)**	**Lesson number 15 - In-situ remediation of soil contaminated by past industrial activities; ZAG (90 min)** **Lesson number 16 – Good practice examples; ZAG (90 min)** **Zero waste management horizontal programme: Case study – a revision based on new knowledge (1h)** Closing Ceremony
Saturday 25.11.	**Departure**	

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