VOICES FOR RESPONSIBLE RESEARCH AND INNOVATION:

ENGAGING CITIZENS TO SHAPE EU RESEARCH POLICY ON URBAN WASTE

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Views, Opinions and Ideas of Citizens in Europe on Science

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For more information on the report, the results of the VOICES project, please contact Marzia Mazzonetto (mmazzonetto@ecsite.eu).

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Introduction

VOICES was a groundbreaking consultation process, gathering opinions and ideas about urban waste and innovation from citizens across the EU. Led by the European network of science centres and museums (Ecsite), VOICES used science centres and museums as powerful spaces for public engagement. The results were fed back to policymakers in order to influence the direction of EU research policy.

At the heart of the VOICES project is the concept of Responsible Research and Innovation (RRI). This means engaging the public more in research and innovation (R&I), making R&I more socially responsive and encouraging shared responsibility for R&I agendas, practices and outcomes.

VOICES took as its subject matter the topic of 'urban waste as a resource', and the transition to a 'zero waste society'. The results of the VOICES consultation were integrated into the European Commission's Horizon 2020 calls for research funding in the field of waste management. As such, VOICES is a model for incorporating citizens' voices into RRI. The project outcomes in this document can also be used by other stakeholders at a local and national, as well as European level.

VOICES consulted citizens using a renowned method - focus groups - in a unique way. In terms of structure, the VOICES focus groups incorporated four exercises, which engaged the participants on the relevant topics, drawing out collective opinions and ideas in a carefully facilitated face-to-face process. The VOICES focus groups were led by trained moderators from science centres and museums, following a semi-structured script designed by researchers of the Athena Institute (VU University Amsterdam). This specific methodology ensures the results are both meaningful and valid, and was successfully implemented in a range of cultures and contexts, across 27 EU member states.

This report goes through the results of the overall, Europewide analysis of the focus groups in detail (chapters 4 and 5). It summarises these results in chapter 6. Chapters 7 and 8 go into detail on the main findings of the project in the context of RRI and provide perspectives for future work.

1. About VOICES

1.1 The VOICES project

VOICES (Views, Opinions and Ideas of Citizens in Europe on Science) was a year-long, Europe-wide citizen consultation exploring the concept of waste as a resource.

Funded by the European Commission and led by Ecsite, the European network of science centres and museums, the VOICES project was a response to the Science in Society 2013.1.2.1-1 call on citizen participation in science and technology policy. Citizens from 27 EU countries were invited to give input - in the form of ideas and priorities - to a group of experts (the 'Consolidation Group') who contributed to defining the priorities for the next Work Programme of EU research calls on waste. VOICES therefore represented an innovative method of integrating public opinion into the 'Climate action, environment, resource efficiency and raw materials' dimension of the Horizon 2020 Work Programmes launched in 2014.

The main aim of VOICES was to yield valuable insight on methods and procedure for engaging citizen participation to help set the research agenda for Europe's Responsible Research and Innovation (RRI) framework. The knowledge gained through VOICES will be put to use in similar participatory actions across Horizon 2020.

1.2 Citizen participation in social innovation

A national and European capacity-building initiative, VOICES united science communication practitioners and academics, and, as such, served as an effective method through which to consult the public on science and technology related issues.

Compared to many other consultation initiatives, VOICES represents a breakthrough in its commitment to formally include the results of the citizens' consultations in the main policy directions, shaping the priorities of future European research.
VOICES was also particularly innovative because of its scale (covering all of the EU member states at the time) and because of the methodological approach used on this wide scale: an approach which made use of a qual-

itative methodology (focus groups), which gathered and analysed citizens' views, fostering real governance processes and social innovation. Another unique element is that the knowledge gained with this pilot project, in terms of methodology, infrastructure and results, can be used to organise similar participatory actions across Horizon 2020.

1.3 The process

One thousand European citizens participated in focus group discussions about 'waste as a resource' using a structured VOICES methodology which spans training, implementation and analysis. The method, infrastructure and results of VOICES are fully documented on an open access portal (www.voicesforinnovation.eu) designed for similar participatory actions occurring throughout Horizon 2020.

VOICES engaged citizens in 33 locations covering 27 EU countries. 27 Ecsite network institutions make up the Third Party task force which organised the 100 focus groups, with approximately ten citizens each, in their respective countries.

Ecsite project managers and researchers from the Athena Institute, VU University Amsterdam, were responsible for structuring and organising the focus groups, analysing public consultations, writing the country and synthesis reports and coordinating public events to disseminate their outcomes.

Focus group participants came up with ideas to move us in the direction of a 'zero waste society'. A total of over 350 such ideas were identified from all over Europe. The full list of ideas is available on the project website (www.voicesforinnovation.eu).

The VOICES 'Consolidation Group' was composed of nine independent experts. They contributed to assessing, prioritising and transforming the citizens' outcomes into future directions for research and innovation in the field of urban waste and the transition to a 'zero waste society', in the form of topics for the European Commission's Horizon 2020 work programmes. The group was composed of participants from research and academia, business/industry/SMEs, public authorities, civil society and non-government organisations, and other key stakeholders. They built on the ideas that emerged from the citizen consultations and on the feasibility/relevance assessments of the outcomes provided by the VOICES Advisory Board. The European Commission drew on their findings in order to draft calls for proposals for the 'Climate action, environment, resource efficiency and raw materials' dimension of the Horizon 2020 Work Programmes launched in 2014.[1]

1.4 Structure of the report

This report gives a European overview of the outcomes from focus groups in all 27 EU member states covered by the VOICES project. The VOICES research methodology is further detailed in the following chapter. In chapter 3, some specific data is provided on the national urban waste figures and on specificities of the participants of the focus groups. Chapter 4 describes the results of the citizens' consultation on waste management at household level, such as barriers and concerns experienced in prevention and management of waste, while chapter 5 presents the ideas for research and innovation, policy, management and communication which have emerged. Chapter 6 gives a conclusion and discussion of the findings. Chapter 7 looks at the results from the perspective of the concept of Responsible Research and Innovation (RRI) as it is currently defined by the European Commission. The report ends with reflections on the VOICES process and a look at future perspectives for research which the consultation findings brought up (chapter 8).

[1] Available at: http://ec.europa.eu/research/participants/portal/doc/call/h2020/common/1597693part_12_climate_v1.1_en.pdf

2. Methodology and approach to topic

This chapter provides general information about the method used for the consultation - focus groups - and in particular about the specificities of the VOICES approach. It also describes the particular structure of the VOICES focus groups and the process of data analysis. Lastly, it provides information on the topic of the consultation and how it was approached.

As a qualitative research method, the focus group is increasingly used in political and social sciences, and can be defined as "a carefully planned discussion designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment".[2] An important advantage of focus groups in comparison to other research methods is that participants can respond to and build on the views expressed by the other participants. Because of this interaction, focus groups generate a large variety of opinions and ideas which provide insightful information, while maintaining a specific focus during the discussion. The method provides the opportunity to gain in-depth insight into experiences, values, wishes and concerns of participants and stimulates shared creative thinking. A specific characteristic of the focus group method is that it seeks understanding of a research topic from a particular perspective; in the case of the VOICES project, the perspective of European citizens.

In order to carry out the consultations, a script for conducting VOICES focus groups was developed, tested, and assessed by the VOICES Advisory Board. Focus groups were important for VOICES because of their structure: the four exercises of which they were composed engaged the participants on the relevant topics, drawing out collective opinions and ideas in a carefully facilitated face-to-face process. Flexibility was also a key asset: the VOICES methodology was successfully implemented in a range of cultures and contexts, across 27 EU member states, and can also be adapted for use at national and local levels, and with a range of policy topics. The expertise of the academic team involved in the development of the methodology was also essential in ensuring its successful implementation.

2.1 The VOICES focus group approach

In the VOICES project, a total of 100 focus groups were held, each of them with approximately 10 citizens. Participants were selected by local recruitment agencies, according to predefined selection criteria. The selection criteria were applied in order to obtain diversity in focus group participants, and to represent society at large. General selection criteria with respect to demographic information included: sex (50% men and 50% women), education (low, medium and high levels of education)[3] and employment (employed, unemployed, retired and student). The focus groups were stratified by age using the following categories: 18 to 35 years of age, 36 to 50 years of age and 50+. Other criteria addressed elements relevant to the VOICES project's specific topic, including: participants from urban and non-urban areas,[4] diversity of types of municipality (at least five different municipalities, including bigger towns and smaller villages), and diversity of housing situation (flat or house). These selection criteria were applied in all EU member states. Because of the local context and the availability of participants there are minor differences between member states in the resulting composition of focus groups.

In most EU member states, three focus groups were conducted, all in one location. However, all member states with a population of over 25 million (Germany, France, Spain, Poland, Italy and the UK) had two sets of three focus groups each in two different locations, resulting in six focus groups in total in these countries.

The focus groups lasted 3 hours and followed a semi-structured script consisting of an introduction, four main exercises and an evaluation part (see box 2.1). During the focus groups, specific attention was paid to keeping the environment noise-free and providing enough space to relax, walk around and engage in the conversation. Each focus group was led by a moderator, who was in charge of stimulating and guiding the discussion. The moderator's role was also to maintain the focus of the discussion by ensuring that key themes were covered, while managing group dynamics.

Moderators facilitated the discussion by following the focus group script, which was provided to them in advance and contained questions and exercises to guide their work and ensure equal individual input as well as group discussion. Because of their crucial role in the focus groups, all moderators involved in the VOICES project followed a specific 2.5-day training course. The training focused on specificities of the VOICES focus group script as well as on refining important competencies of the moderators' role, including interpersonal communication, process management and understanding of the topic addressed.

In order to capture the data generated during the process, audio and/or video recordings were made of all focus groups. A note taker was also present for the entire duration of the focus groups, in order to record additional data and to assist the moderator. All visual data generated by the participants, for example, individual drawings or collective mind maps, were collected at the end of each focus group and photographed.

[2] Krueger R.A. (1994). Focus Groups: A Practical Guide for Applied Research. Sage: Thousand Oaks, California

[3] The typology of low, medium and high education level is based on the International Standard Classification of Education (http://en.wikipedia.org/wiki/International_Standard_Classification_of_Education)

[4] The urban–rural typology is based on the new urban/rural typology developed by the European Commission (http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Urban-rural_typology)

BOX 2.1 SUMMARY OF VOICES FOCUS GROUP SCRIPT

INTRODUCTION
The moderator introduces himself/herself, the note taker and any observers and asks the participants to introduce themselves. The moderator then explains the aims and topic of the focus group using a PowerPoint presentation.

EXERCISE 1
The goal of Exercise 1 is to raise the focus group participants' awareness of household waste and related waste management systems. It also identifies what people know and do with respect to their household waste. Participants are asked to draw on an A3 sheet of white paper how they think the waste streams are managed around their house. When they have finished, the papers are collected and taped to the wall. The moderator then asks the participants to explain their drawings and encourages them to elaborate.

EXERCISE 2
Exercise 2 aims to identify barriers and concerns of the participants with respect to current urban waste pathways (including prevention) and to go into more depth on the causes and underlying reasons for the reported barriers and concerns. The moderator shows the participants PowerPoint slides about the four most common pathways of waste and prevention. After this, participants are asked to think about barriers and concerns they experience regarding waste, waste management and prevention of waste and to write two examples of these barriers or concerns down on Post-Its. The Post-Its are collected and for each, the moderator asks the participants to explain what they wrote down and why.

EXERCISE 3
The objective of Exercise 3 is to stimulate creative ideas for improvement and solutions for problems and possibly to translate ideas and solutions into research topics or questions. The moderator introduces the concept of a 'zero waste society' to the participants using PowerPoint slides. The participants are then asked to work in groups and brainstorm about ideas for achieving the aims of a zero waste society, focusing especially on what research and innovation would be needed for this. Participants are then asked to present their ideas to the entire group, while the moderator uses a flip chart to list all concrete ideas for research and innovation suggested by the participants. The moderator then asks the participants to reflect further on possible futuristic technical solutions and 'wild' ideas regarding waste management and prevention.

EXERCISE 4
The aim of Exercise 4 is to attribute a level of priority to the research topics formulated in Exercise 3.
Participants are given three stickers, which represent money (1 million each) that they can spend on ideas written down during Exercise 3. They are asked to assign one or more stickers to the ideas that they feel should be prioritised because of the importance of the problem they address and/or the quality of the solution they provide. Once the participants have assigned their stickers, a plenary discussion is held to talk about which ideas got the most stickers and why.

EVALUATION
The moderator ends the sessions and asks the participants to share feedback on their experience taking part in the VOICES focus group. Participants are also asked to fill in an evaluation questionnaire.

2.2 The VOICES approach to urban waste

In the focus groups, citizens of Europe were consulted on the topic 'waste as a resource'. Urban waste is defined as solid waste collected by or on behalf of municipal authorities and disposed of through the waste management system. Most of this waste is produced by households, although similar waste from sources such as commerce, offices and public institutions is included. Consumer products disposed of by citizens, like clothes, electronics and furniture etcetera, are also considered urban waste. Industrial waste is not considered urban waste and is outside the scope of this project.

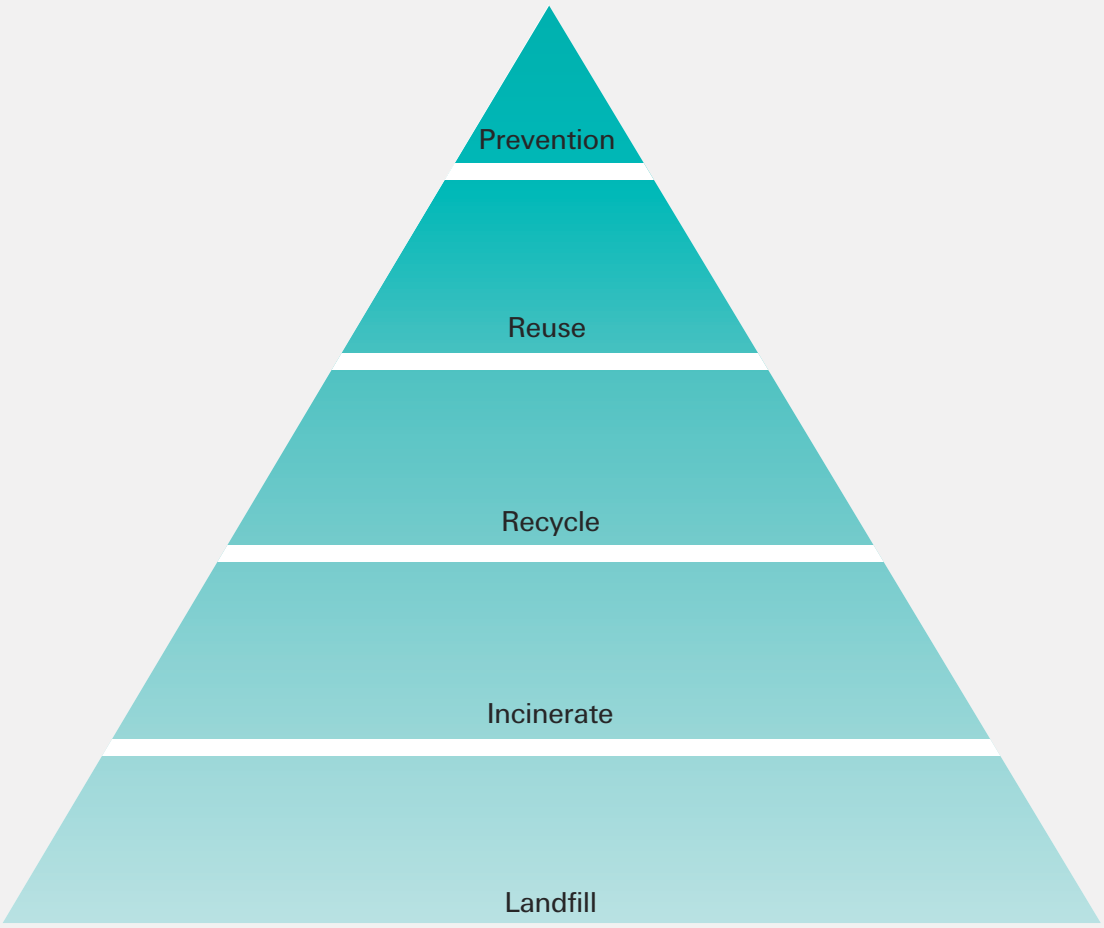
On average, each of the 500 million people living in the EU throws away around half a tonne of household rubbish every year.[5] This amounts to 70 million truckloads of household rubbish for the EU as a whole every year (one truckload is considered to be 3500 kg, the maximum weight for a truck). All this waste has a huge impact on the environment, resulting in pollution and greenhouse gas emissions that contribute to climate change, as well as significant loss of materials – a particular problem for the EU, which is highly dependent on imported raw materials. Current EU policy aims to reduce both the environmental impact of waste and the use of raw materials needed for production processes.

Nowadays, the challenge of urban waste is approached from two perspectives; the waste hierarchy and the life-cycle approach. These combined approaches are the building blocks of the current thematic strategy on waste.[6]

In order for the results of the focus groups to be translated into outcomes which are relevant and beneficial for European research, the VOICES focus group design explicitly uses these same two approaches in presenting the topic of urban waste and in structuring the exercises. The vision of a zero-waste society is used as a focus for the participants while thinking about possible innovations and the techniques and knowledge necessary to develop them.

The waste hierarchy is initially depicted as a pyramid with a wide base representing disposal in a landfill, a second layer representing recovery of energy through incineration, a third layer representing recycling, a fourth representing reuse and the top (and smallest one) representing prevention (see figure 2.1). This reflects the current situation of waste management in Europe. In order to achieve a zero waste society, this pyramid should be turned around and its top, prevention, should become very wide while its base, landfill, very narrow.

Figure 2.1 The five-step waste hierarchy roughly representing the current distribution of treatment of MSW in the EU[7]



The five-step waste hierarchy can be used as a rule of thumb when choosing between options of waste management, with prevention as the most preferred and disposal in landfill as a last resort. However, all products and services have environmental impacts in various stages of their existence. To avoid shifting negative impact from one stage to another, the life-cycle approach is also considered. Life-cycle thinking involves looking at all stages of a product's life – from the extraction of raw materials for their production to their manufacture, distribution, use and disposal – to find out where improvements can be made to reduce environmental impacts and use of resources.

2.3 Analysis of the focus groups

After each focus group, a summary report was written by the moderators based on the note taker's notes and the information on the flip charts. A draft of this summary report was sent to the focus group participants who were asked to comment on it. Moderators collected any feedback and included it in the final version of the summary report as an annex.

The audio recording of each focus group was transcribed word-for-word and translated into English for analysis. The translated transcripts were coded and analysed using MaxQDA, a programme for qualitative data analysis. For the analysis of the data, both structured analysis as well as open coding were used. Structured analysis was carried out by using a predesigned coding sheet based on preliminary research. This type of analysis allows for all relevant outcomes to be extracted from the raw data. Open coding runs parallel to the structured analysis and allows for insights unforeseen by preliminary research to emerge. The summary reports of the individual focus groups were used to validate and complement the analysis.

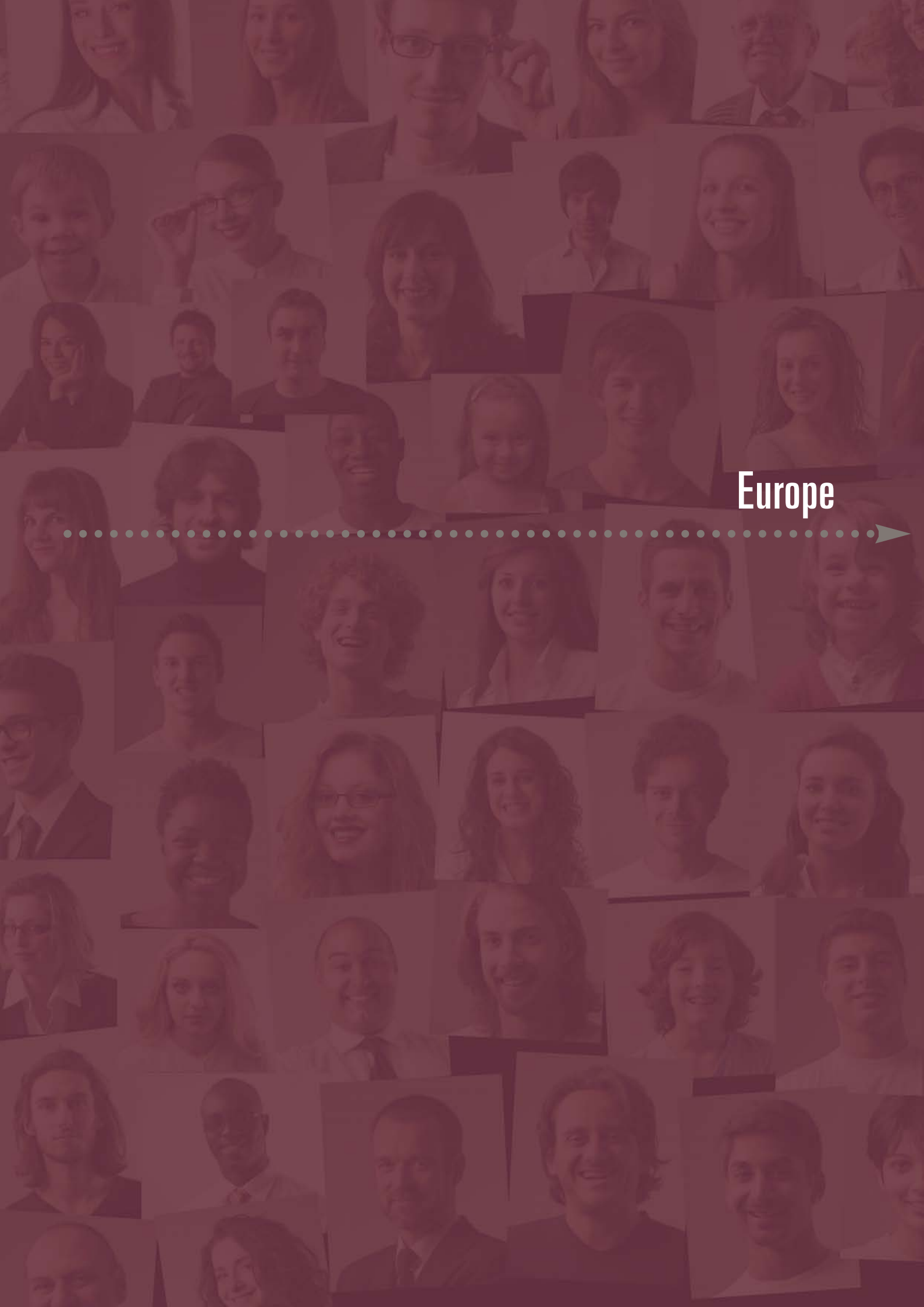
2.4 Ethical issues

At the beginning of the focus groups, all participants were asked to sign an informed consent form providing information on the topic and aims of the focus group. It was explained that participation was voluntary and participants were free to withdraw at any time, without giving reason. The form obtained participants' approval for audio and video-recording of the focus group, for the use of the resulting data for research purposes, including the use of anonymous quotes, and for data storage for five years. All data were processed anonymously.

[5] Questions and Answers, Thematic Strategy on the prevention and recycling of waste and the proposal for the revision of the Waste Framework Directive (Available at: http://ec.europa.eu/environment/waste/pdf/faq.pdf)

[6] Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee of the Regions on the Thematic Strategy on the Prevention and Recycling of Waste, Brussels, 19.1.2011, COM (2011) 13 final; EU Waste Policy – The Story behind the strategy, 2006

[7] Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee of the Regions on the Thematic Strategy on the Prevention and Recycling of Waste, Brussels, 19.1.2011, COM (2011) 13 final; EU Waste Policy – The Story behind the strategy, European Union, 2006; Waste as a Resource, European Union, 2010; Being wise with waste: the EU's approach to waste management, European Union, 2012



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3. Data on waste management and focus group composition

This chapter of the report presents relevant data about waste management in the EU member states and demographic data of the focus group participants.

3.1 Waste management in Europe

In the 27 countries of which the European Union was composed on the start date of the project, in 2010 on average 502 kg of municipal waste per person was generated, while 486 kg of municipal waste per person was treated (see Figure 3.1). 38% of the waste treated was landfilled, 22% incinerated, 25% recycled and 15% composted.

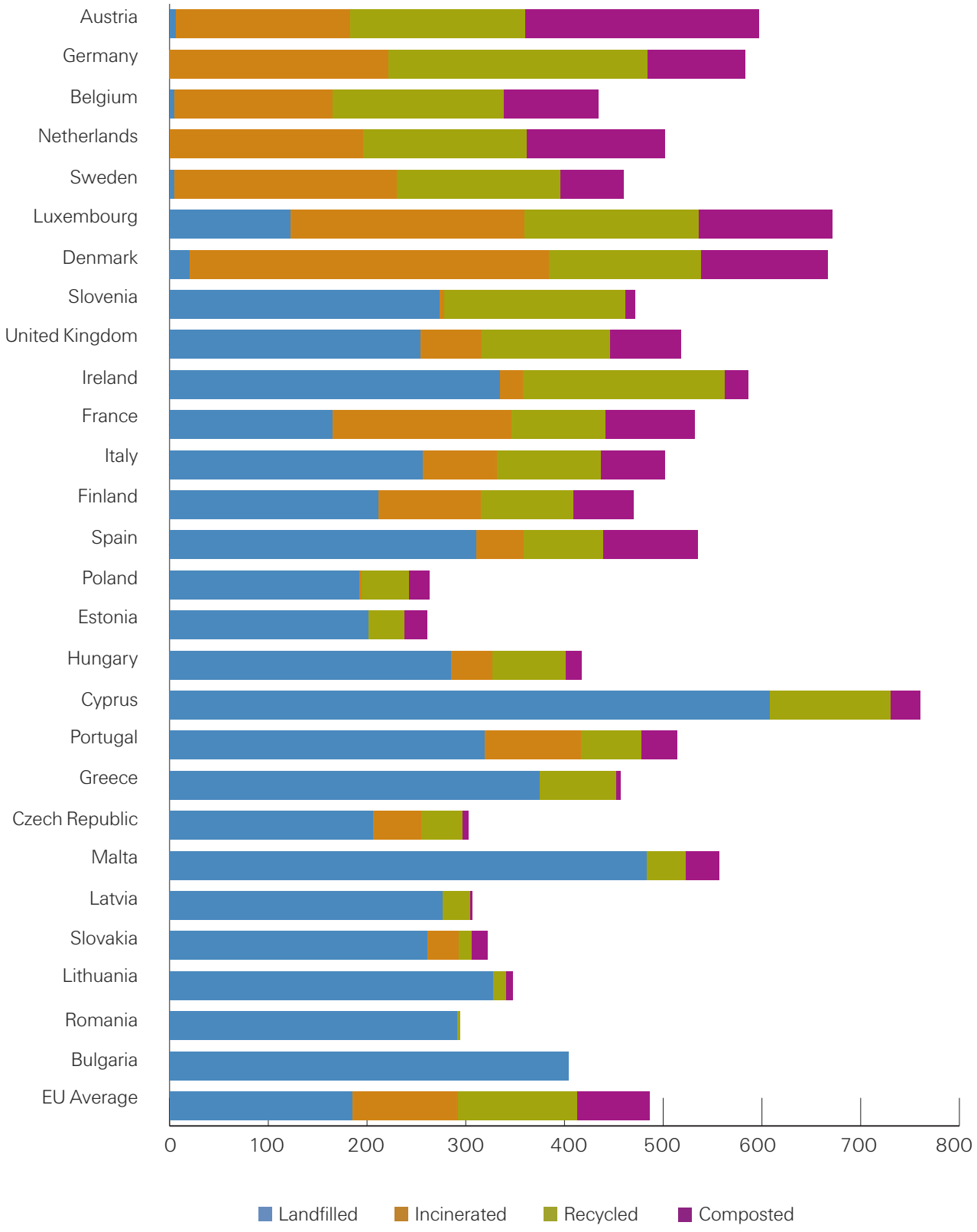
The amount of municipal waste generated varies significantly across member states. Cyprus, with 760 kg per person, had the highest amount of waste generated in 2010, followed by Luxembourg, Denmark and Ireland with values between 600 and 700 kg per person. Values of under 350 kg per person were recorded in Latvia, Estonia, Poland, Czech Republic and Slovakia.

The methods of waste treatment also differ substantially between member states. In 2010, the member states with the highest share of municipal waste landfilled were Bulgaria (100% of waste treated), Romania (99%), Lithuania (94%) and Latvia (91%). The highest shares of incinerated municipal waste were observed in Denmark (55% of waste treated) and Sweden (49%). Recycling was most common in Germany (45%), Belgium (40%) and Slovenia (39%). The member states with the highest composting rates for municipal waste were Austria (40%), the Netherlands (28%) and Belgium (22%).

Table 3.1 provides an overview of the ranking of 27 EU member states according to the percentage of Municipal Solid Waste (MSW) recycled (Eurostat, 2010).[8] The table shows that the highest percentages of MSW recycled are found in Austria, Germany, Belgium, the Netherlands and Sweden. Countries ranking at the bottom of this list include Bulgaria, Romania, Lithuania, Slovakia and Latvia.

[8] The data in Table 3.1 do not exactly match the data presented in Figure 3.1. Data are based on different sources and deviations are likely to appear due to differences in the definitions used.

Figure 3.1 **Statistical facts of EU member states according to % MSW waste recycled, based on the MSW waste generated (2010)[9]**



[9] Eurostat Newsrelease (http://europa.eu/rapid/press-release_STAT-12-48_en.pdf)

Table 3.1 Ranking of EU member states according to % MSW waste recycled, per MSW waste generated (2010)[10]

Rank	EU member state	% of MSW waste recycled	Rank	EU member state	% of MSW waste recycled	Rank	EU member state	% of MSW waste recycled
1	Austria	63	10	Italy	35	20	Portugal	19
2	Germany	62	11	France	35	21	Greece	18
3	Belgium	58	12	Spain	33	22	Czech Republic	16
4	Netherlands	51	13	Finland	33	23	Latvia	13
5	Sweden	49	14	Slovenia	31	24	Slovakia	9
6	Luxembourg	47	15	Hungary	21	25	Lithuania	5
7	Denmark	42	16	Poland	21	26	Romania	1
8	United Kingdom	39	17	Estonia	20	27	Bulgaria	0
9	Ireland	36	19	Cyprus	20			

3.2 Composition of the focus groups

Almost a thousand citizens (n = 992) participated in 100 focus groups. There was an almost equal distribution of males (49.1%) and females (50.9%). The age of the participants ranged from 18 to 77 and each of the categories contained approximately one third of all participants: 33.3% were between 18 to 35 years old, 33.7% were between 36 and 50 years old and 33% were aged over 50. Educational levels were diverse: 40.5% of participants had a high level of education, 39.5% a medium level and 20% a low level. The majority of participants were in employment (60.5%), while just over one fifth of the participants (21.4%) were unemployed. Others were retired (12.2%) or were studying (5.9%). Participants were divided in terms of their housing situation: almost half (49.8%) lived in a flat or apartment, while the other half (50.2%) lived in houses.

Table 3.2 Demographics of focus group participants[11]

		Total number of participants	Percentages
Participants	Total	992	100,0%
Gender	Male	487	49,1%
	Female	505	50,9%
Age	18 – 35	330	33,3%
	36 – 50	334	33,7%
	50+	328	33,0%
Education	High	401	40,5%
	Medium	391	39,5%
	Low	198	20,0%
Employment	Unemployed	212	21,4%
	Employed	599	60,5%
	Retired	121	12,2%
	Student	58	5,9%
Housing	Flat	493	49,8%
	House	497	50,2%

[10] European Environment Agency (2013). "Managing municipal solid waste - a review of achievements in 32 European countries" EEA Report No 2/2013 (http://www.eea.europa.eu/publications/managing-municipal-solid-waste)

[11] For one focus group in Malta and one in Italy, specific demographic data on education, employment and housing of one participant each was missing. In one focus group in Lithuania, one participant was visually impaired and was therefore accompanied by an assistant

4. Waste management, barriers and concerns

This chapter describes the overall results of all focus groups held in 27 EU countries. The chapter includes two sections, which are structured according to the exercises of the focus groups. The first section provides insights into what people think and do with respect to waste management at the household level. The second section provides an overview of barriers and concerns that the participants face with respect to current urban waste prevention and management, and identifies underlying reasons for the reported barriers and concerns. Throughout the results, quotes of focus group participants are provided for illustrative purposes.[12]

4.1 How is waste managed at household level?

This section describes what people know and do with respect to household waste. It includes four parts. First, an overview is given of the types of waste that are generally collected separately and those that go in the general bin. The second part provides insight into how the waste is collected, while the third part describes what participants think happens to the waste after it is collected. The fourth part describes whether people deal with waste as they are supposed to and to what extent they think waste management is conveniently organised.

4.1.1 Waste separation in the household

In all countries involved, participants in all the focus groups discussed waste separation at the household level. However, the extent to which participants separate waste varied strongly between member states, and between municipalities within member states. In some member states, especially the ones ranking low on the EU27 list of Municipal Solid Waste Recycling, a considerable number of the participants indicated they do not separate any waste.

Participants that did separate waste typically described the following waste streams (a waste stream is defined as one type of waste that is collected separately): paper, glass and residual waste. In a number of member states, waste streams of plastic/packaging and cans were also mentioned. In addition, participants from rural areas often separate organic waste. This is a less common practice in urban areas, especially in countries ranking low on the EU27 list. In some municipalities in member states ranking high on the EU27 list, there are facilities for organic waste separation, for example in the UK and the Netherlands.

Waste streams that were less frequently mentioned include: bulky waste, batteries, chemical waste and electronic appliances. Some participants explicitly stated that they keep these types of waste separate, while many others only referred to this in terms of disposal. This suggests that these waste streams are often not part of standard waste separation practices in the household, but might still be disposed of separately.

The exact organisation of waste in the household differs considerably within as well as between member states. In many member states, participants have different bins or bags for different types of waste in the house. In particular, participants from countries ranking high on the EU27 list reported that they have complex waste management systems involving as many as three or four bins or bags of different colours. In some cases, the bins are provided by the municipality, sometimes accompanied by additional costs. In countries with a lower ranking on the EU27 list, for example Latvia and Bulgaria, waste management systems are less developed.

[12] Abbreviations used in quotes: FG# = number of focus group, P# = number of specific focus group participant, PX = focus group participant unknown, M = Moderator

The housing situation of the participants generally influences how they manage waste in their household. For example, flats often have facilities for recycling downstairs, sometimes (for example in the UK) even with personnel to separate it. Family houses are usually allocated a certain number of bins or bags per household. Houses, especially those with gardens, often have a separate bin for organic waste or organic waste is fed to animals.

"Yes, I am in the lucky position that I live close to my mother who owns hens, and they eat everything. There isn't much, but what there is, is reused by the hens." (Hungary FG2, P3)

"For biological waste we also have 3 ways, right. One is compost, it is completely natural. Then food waste can be for certain animals, because we have a dog, rabbits and so it is used on. Then the citrus fruit waste we put in the organic waste bins of course." (Slovenia FG 1, P6)

4.1.2 Waste collection and disposal

Waste which is separately collected and disposed of in many member states includes: residual waste, glass, metal, plastics, chemicals, batteries, electronics, drugs, clothes, organic waste and construction waste. All countries have a system in place for separate waste collection or disposal: waste is either picked up from the streets in bags or containers.

"You collect waste in these plastic bags that you throw in a wheelie bin which they come and collect and take care of it." (Sweden FG 1, P 1)

"There is a bin for plastics, paper, glass, and the municipality comes once a week for recycling, for recyclable materials, and there is also the usual individual bin outside each house which is emptied twice a week by the municipality." (Cyprus FG 1, P4)

In addition, waste can be brought to central waste disposal facilities.

"Oh yes, then I must have a car, drive further away - furniture, clothes, white goods go to an environmental centre that's a driving distance away." (Sweden FG2, P 7)

Some types of waste might be brought to specific locations such as local shops, schools or charity organisations. For example, batteries and electronic equipment can sometimes be returned to shops, empty egg boxes are sometimes brought to schools, and clothing can be donated to charity organisations. However, clothes are also often donated to family or friends.

"I do not dispose of any clothing, but rather give it to friends." (Hungary FG 1, P 1)

The results from the focus groups show that there are considerable differences between member states and within member states with respect to waste collection and disposal. The systems for waste collection and disposal are much more developed in member states ranking high on the EU27 list such as Germany, Austria, Belgium and the Netherlands. In these countries, there are often detailed schedules indicating when certain types of waste are being picked up and facilities are more abundant and in better condition. In countries with a lower EU27 ranking, generally less waste is collected separately, schedules for waste collection are less reliable and facilities are of lower quality and less accessible.

"There are also some bins, of course... it is very hard to find such bins, they only have them in very few areas. It is not easy." (Greece FG2, P4)

"I don't have any glass recycling bins near where I live... I would recycle more, but it's like I don't have anything to put it in." (Czech Republic FG 1, P 7)

In addition, in many countries, participants reported that some waste is initially collected separately but afterwards all waste is put together and brought to landfills or incineration points.

"There may be something that I didn't write down, but it is something that I noticed when I lived in Brussels, paper separate too, packaging separate and blue bag separate. And you set all of it out and the waste truck came and what did I see, they just threw it all in the same. [The group recognises this problem and agrees with P 7.]" (Belgium FG 1, P 7)

In countries with a lower EU27 ranking, participants seemed to have more informal ways for disposing of waste. Waste might be picked up by individuals who make a living out of collecting waste. It is sometimes burned at home, it is reused in some way or another, or it is dumped alongside roads, in the countryside or forests.

Within many member states, there were differences among municipalities as to whether participants have to pay for waste collection and disposal.

> *"The black bin is all the plastics, packaging. For example, we get newspapers wrapped in plastic, we have to remove the plastic and put it in the black bin. Uh, everything that is really plastic packaging must go into the black container, which is also weighed. We pay per pickup and per kilo." (Belgium FG3, P2)*

There are also differences between rural and urban areas. Participants in rural areas often have to travel further to reach waste containers and collection points than participants in urban areas. Furthermore, in rural areas, burning waste at home is reported to be more commonplace and organic waste is more often composted and used.

4.1.3 Knowledge about waste pathways

In all 27 countries, knowledge about waste pathways was limited. Generally, participants had no idea what happened to their waste after it was collected.

> *"Yes, batteries go to some place or other where they do no harm anyway. I don't think you can, I don't know if they can be recycled. I don't actually know." (Denmark FG3, P5)*
> *"[M] And where does this [separated waste] end up?*
> *[P7] I don't know.*
> *[M] And what happens to it then?*
> *[P8] Recycling, I imagine.*
> *[M] But they are incinerated?*
> *[P8] I believe yes... [...]*
> *[M] So, plastic bottles are put outside the house in a plastic bag and they go for recycling?*
> *[P5] I don't know where they go.*
> *[M] Oh?*
> *[P5] Recycling. That's all I know. We don't know anything else." (Cyprus FG2)*

Some participants knew what happened to specific types of waste. In some cases, they knew, for example, that electronic appliances are stripped for metals and other reusable parts, that organic waste is used for composting and that new glass is made out of glass waste.

> *"And the garden waste, we drive that out next to the recycling station and it gets unloaded and then it either gets composted or, on site where you can then pick it up again as compost." (Denmark FG2, P8)*

In countries ranking higher on the EU27 list, there seemed to be slightly more knowledge about waste pathways among the participants. In some focus groups, for instance in Belgium, some participants had visited waste management companies during open days and were able to tell other participants about what they saw and learned there. In all countries, participants tended to assume that separated waste was recycled. However, there was also much doubt as to whether recycling actually took place. Suspicion regarding recycling practices of waste management companies was stronger in countries at the bottom of the EU27 list, but also reported by some participants in countries higher on the EU27 list, such as the UK, Belgium and the Netherlands.

4.1.4 Waste management behaviour and convenience

Many participants across member states claimed to take recycling seriously and recycle correctly most of the time. However, the extent to which people separate and recycle correctly differs greatly between member states. In countries ranking high on the EU27 list, most participants said that they do recycle and separate correctly. They are often quite satisfied with the facilities that are available and the way the waste system is organised. However, some participants in these member states said that separating and recycling is very complex because of the many rules and exceptions.

It is often mentioned that recycling takes a lot of effort and is not always done correctly. For instance, some participants admitted that sometimes, when they are in a hurry, all waste ends up in the general waste bin, even though they know how to recycle and have the facilities available. Others do not recycle at all because they find it too much of a hassle.

"Ooh, I'm probably not so tidy, I throw away light bulbs with my potato peelings and batteries and everything like that there... I really don't give a damn; it takes time when I have to take the rubbish out despite it being in my courtyard... I find it a pain..." (Sweden FG3, P1)

"Yes, well, in my house we don't normally recycle, well, due to lack of space, because the kitchen is small. Besides, we don't have bins nearby. There is only one, the standard usual one, for organic waste. [...] and well, finally, on the issue of domestic appliances, as you were saying... Well usually I, perhaps I'm hopeless, but I throw them in the bin. If one is in good condition, I try to sell it, I try to get some profit from it, but if not... And medicines, the other day I threw a pile of medicines into the bin, so ... [I don't dispose of them properly] either because of lack of time. I work a lot, I don't... recycle much either, to be honest..." (Spain, Granada FG3, P6)

In countries ranking lower on the EU27 list, many focus group participants recycle to some extent. However, a considerable number of participants from these countries also admitted that they do not recycle at all, or at least not correctly. They put this down to the inconvenience of the waste management system, the lack of reliable and accessible waste management services, and general distrust of the companies in charge. Despite this, improvements are noticed as well.

"I think that, if we compare how it was for instance 5 or 10 years ago, there was more of a chaos with all this, because everything went into one bin. And now, if nothing else, I have noticed at home that our rubbish doesn't smell as bad, which is good, because organic waste is in its own place and we empty it more often and we also probably do something good for the environment." (Slovenia FG3, P9)

Also, some participants stated that either they do not know how they are supposed to manage their waste, they think that separating waste does not make a difference because it will end up together in landfills anyway, or they do not want to pay the fees at the central waste disposal facility. As a consequence, participants (and other people they know) sometimes dump their waste alongside roads or in the forest.

"There are problems with tyres and so on. They throw them into bins... If you take them to the landfill, you have to pay a lot of money. Basically... we even have to pay for it ourselves. People come, then [having found out the conditions] turn around and throw away the tyres by the roadside." (Lithuania FG1, P8)

4.2 Barriers and concerns regarding urban waste

This section provides an overview of the participants' barriers and concerns with respect to current urban waste and identifies underlying reasons for the reported barriers and concerns. The section consists of three parts. The first part, 'Waste prevention and production', focuses on barriers and concerns related to the phase before products enter the household. The second part, 'Waste management in the household' addresses

products and waste in the household. The third part, 'Waste disposal and pathways', describes barriers and concerns related to the phase in which waste is collected and disposed of.

4.2.1 Waste prevention and production

IParticipants across the member states shared many barriers and concerns related to waste prevention and production. Four main clusters of barriers and concerns emerged from focus groups in the member states: (1) excessive packaging and use of plastic, (2) overconsumption, (3) limited knowledge on production and prevention of waste, and (4) lack of awareness and motivation in preventing waste.

The most frequently mentioned barrier across member states involves **excessive packaging of products** purchased by participants. Participants felt that this packaging contributes substantially to the total amount of waste produced. They explained that various materials and multiple layers of packaging are used. In addition, products are often individually wrapped so more packaging is needed. For some products, individual packaging was thought to be for hygienic reasons but, in many cases, participants considered that producers do this to make the products look more attractive and to persuade them to buy the product. **Plastic** was a very problematic material according to many participants. They complained, in particular, about plastic bags, which are provided free by many shops.

"Just look how many bags there are lying around, even just outside the shop, so people go outside and throw away these bags - polythene ones, I mean." (Latvia FG3, P2)
"Because when I go to the supermarket, I take home 20 or 30 plastic bags. What do I do with them all? I keep them, but sometimes I have to throw them out." (Portugal FG3, P9)

In several member states, participants mentioned that alternatives for packaging and plastic are not available, and they often feel that such materials are forced upon them. This is seen as a significant barrier to waste prevention.

"When I go to a store, it is wrapped, already complete, for example a cream is in a good... really, in a plastic or in a small box, still there is a larger box and when I go from the store, they push me to take a plastic bag, and I really don't need it." (Slovakia FG3, P 1)
"Even broccoli comes in plastic!" (Ireland FG2, P 10)

Overconsumption is another important barrier. Participants indicated that they are often unable to buy products in the amounts that they need because of the way products are packaged. As a consequence, consumers buy more than they need, especially with regard to food, resulting in more waste. Next to the producers, consumers themselves and society in general are blamed for waste production as a result of overconsumption. Participants often referred to the 'consumer society', in which consumers seem to always want to buy more and more and have the latest versions of products; they are never satisfied. Many participants expressed their worries about society being increasingly driven by consumption.

"Our consumption is enormous and it's growing all the time. And it's as though, there isn't really anyone who considers, what are we going to do with the by-products?" (Denmark FG3, P2)
"We're used to buying food and then throwing it away. Next, I thought about clothes on more than one occasion, how shops are packed full of clothes. We buy them without thinking. OK, maybe we give some of them away but, really, most of them are just thrown away and the production just goes on." (Lithuania FG2, P 1)

Another cluster of barriers and concerns involves **limited knowledge** regarding the prevention and production of waste. The participants often mentioned that they lack the knowledge to determine to what extent certain products contribute to the production of urban waste.

"You and I don't think about it so much, about how you can reduce your waste [...] I believe if one had another consciousness... yes if you knew more about what's happening [with your waste] then maybe one would think differently..." (Sweden FG2, P3)

They also stated that people in general are **insufficiently aware** of the effects of waste on the planet which is why they are not motivated to prevent waste. They also said there are people in their municipality who are simply too lazy to care about this issue and take action.

"I don't have the time to shop anywhere else so I buy it on the internet. And then I know too that our waste depot is overflowing with tons of Amazon packages." (Germany, Munich FG3, P 10)

4.2.2 Waste management in the household

Waste management in the household was associated with four clusters of barriers and concerns, including: (1) inconveniences related to waste bins and bags, (2) costs in terms of money, time and effort, (3) the lack of information on how to separate waste, and (4) low awareness and motivation concerning waste separation. Although many barriers and concerns were shared by participants across different EU member states, some differences were also identified.

Many barriers and concerns that were mentioned by participants relate to the **inconvenience of waste bins and bags** in and around the house. Participants with many different bins complained about the amount of space that these bins take up. Such problems were mentioned relatively often by participants living in small houses and flats, usually in urban areas, and those from member states ranking high on the EU27 list, with more developed waste management systems.

"In apartments [...] it's small there [...] Short on space. Where should I put these 3 types of rubbish and bins? Well, in my case, at home there are bottles and general waste and that's [...] because there's no space. With houses, it's different. If you've got a house, it's right outside and one can go in and out with it as well." (Austria FG2, P4)

"The only thing that annoys me is because yes you need more space. It's like a bag for this, a bag for that." (Malta FG2, P3)

Another inconvenience related to bins and bags is the smell they produce when bins are not emptied or bags are not collected frequently enough. The participants considered that the foul smell attracts vermin, such as rats or cockroaches.

"Yes and those sacks, sometimes they smell and so you wouldn't want that all the time in your house." (Belgium FG2, P 10)

If sorted waste is beginning to smell bad, people may throw it out with whatever waste stream is being collected soonest; often the residual waste.

Participants across the member states often referred to barriers with respect to the **costs of separating waste** in terms of time, effort and money. They complained, in particular, about items that need to be cleaned, such as glass, and about packaging comprising different materials that cannot be separated easily.

"But the recycling of cans and glass, I rebel a little against, as I waste way too much water and cleaning on them before I can put them in that recycling place because they have to be cleaned." (Denmark FG3, P3)

"Take for example the milk tetra pack. You have a part that is of plastic, inside has aluminium and on the outside it is made of cardboard." (Italy, Milan FG 1, P9)

In several member states, the participants also mentioned financial costs related to waste separation in the household. These costs arise when participants have to pay for bins or bags for separate waste collection, for instance, or when they have to use tap water to clean glass waste, adding to the bills for metered water.

"Yeah, but I think that it's the same with these costs as with the [rubbish] bags... you can put everything together in a single container without separating, but if you want to do the right thing, you need to buy your own bags, one zloty [1 PLN, approximately Euro 0.20] for four bags." (Poland, Warsaw FG3, P5)

Another cluster of barriers and concerns involved the **lack of information** about what and how to separate waste. Participants often mentioned that products are not labelled with information on how to separate them. Some did not know whether it was necessary to wash glass waste or how to deal with cat litter or cooking oil, for example. Because of this uncertainty, they often put these kinds of waste in the general waste bin.

"Cat litter? I looked it up and... well, clearly you don't recycle it... you're not meant to put it into your normal rubbish. And you're not meant to flush it down the toilet, so... I'm not entirely sure what their policy is on that. But I just put it in the bin." (United Kingdom, Newcastle-upon-Tyne FG 1, P4)

"[...] the sprays, there are many sprays, there are those against insects or those for food or even for example toothpaste tubes, I don't know what to do with them." (Malta FG2, P9)

"I need to see written on packaging 'this box must be thrown into this, the inner package into that'... otherwise I am left there holding the box and the packet in my hand and I ask myself what to do with it? Where do I throw it? What do I throw where?" (Italy, Naples FG2, P3)

In countries ranking lower on the EU27 list, participants reported barriers related to lack of information more frequently.

Finally, **lack of awareness and motivation** is often considered a barrier, or a cause of concern. Participants frequently explained that they, or other members of their household, are not aware of the importance of waste separation, or they just do not care about it.

"What stops me putting PET bottles in the PET containers is comfort... and a lack of common sense." (Romania FG 1, P6)

"They are not interested in looking for the relevant information and so they are not interested in recycling and they just chuck it all into one dustbin. Too lazy to recycle." (Czech Republic FG2, P2)

4.2.3 Waste disposal and pathways

Most barriers and concerns mentioned by participants in the focus groups related to the disposal of waste and waste pathways. These barriers and concerns can be grouped into five clusters: (1) waste collection from the streets, (2) waste disposal in containers, (3) waste disposal at collection points, (4) laziness, and (5) lack of knowledge on waste disposal and packaging.

In all member states, barriers were mentioned related to **collection of waste from the streets**.
Many participants mentioned that waste is not collected frequently enough, or that collection schedules are confusing or not easily available.

"If they would collect it more frequently, you know, like two or three times a week... right now we take away the rubbish, after we keep it in our flat for some time, or we put it in some other bin that is nearest, but then we fill up their bin you know." (Slovenia FG 1, P 1)

Participants also mentioned that rules can be strict regarding how rubbish should be presented. Waste is not always collected if, for example, lids of containers are open, when a container or bag contains waste that should not be in there, or when the bag is too heavy.

"In terms of newspapers, it's also once every 15 days at the same time as the blue bags. Then they should be wrapped in a box or taped, but definitely without plastic. Because if there is plastic, we get a label and it stays there." (Belgium FG3, P2)

"They won't take it if the bin's too heavy." (United Kingdom, Newcastle-upon-Tyne FG 1, P 7)

When bringing waste to **containers in the neighbourhood**, participants also experienced barriers with regard to the mess surrounding these containers. Many participants said the containers were not emptied frequently enough or that people in their neighbourhood were to blame for the mess because they put waste in the wrong container or dump waste next to the container, and they sometimes do not bother to compress waste.

"[...] they are sometimes so full that people end up throwing garbage on the ground around them, and I can't stand it." (Malta FG2, P7)

"They put bags down all over the ground, which break open and everything goes everywhere on the ground; it's oranges, it's bananas, it's a mess. People go by and almost fall over, they slip on all that mess." (Portugal FG3, P10)

"If they would collect it more frequently, you know, like two or three times a week... right now we take away the rubbish, after we keep it in our flat for some time, or we put it in some other bin that is nearest, but then we fill up their bin you know." (Slovenia FG 1, P1)

When this includes organic waste, it may even cause foul smells and attract vermin.

"Sundays and rubbish! This excessive number of bags, above all organic, as they don't fit in the bin any more, although there are two bins for organic waste. There are always bags spilling out everywhere. Especially now that summer is coming. That creates a lot of flies, mosquitoes, lots of insects." (Spain, Granada FG 1, P4)

Several participants also complained about the complexity of the system that often involves bins of different colours for different kinds of waste. This can be confusing when different municipalities use different colours for similar types of waste.

"Information is lacking on the bins as well. Throughout Italy the bins aren't the same colour for paper and glass, so it is a problem of information. If I go to Sicily the glass bin might be yellow, I come to Milan then it is blue, I go to Cremona and there it's another colour." (Italy, Milan FG 1, P1)

Some waste has to be brought to **collection points** in the neighbourhood or further away. In many member states, participants indicated that the distance to these collection points poses a significant barrier. Large waste items can be heavy to carry and difficult to transport to such sites, especially if one does not have a car or van.

"... my own situation is good in the sense that some 10 kilometres away there's a so-called sorting station where people can take their stuff. And, you know, even sort those larger items, if one happens to have a trailer or is able to borrow one. But the down side is that they usually charge." (Finland FG2, P2)

"[M] Oh, yes, the remoteness of a landfill from your house, so the transportation [poses a problem].
[P3] It's like that, right. You have to get a van to take it away [the waste]... a passenger car is no good...
[M] [...] so you can't get a utility service... you can't arrange them...
[P3] No, no, no. It used to be like that... they cancelled it two years ago, so now we have to do it ourselves." (Slovenia FG2)

Participants also explained that waste collection points often have limited opening hours and can be very crowded on weekends. In addition, they sometimes turn out to be full, upon arrival.

"Well I can't dispose of the batteries, for instance, I come to the shop and that box is already full, there's nowhere to put them. So consider where you'll put these, they don't accept these in the shop." (Latvia FG 1, P6)

Participants, especially the ones from rural areas, explained that, for these reasons, waste is sometimes brought to other collection points even further away.

Furthermore, in several countries, participants mentioned that there are fees for waste disposal at waste collection points, which discourages them from taking their rubbish there. Several participants also said they know people who dump their waste by the side of the road or in the countryside because of the fees.

"[...] to a certain amount it is for free and then you have to pay. So waste you cannot get rid of you just dump in the woods." (Netherlands FG 1, P7)

In a range of countries, participants admitted that **laziness** is a barrier to correct waste disposal because they do not want to make the extra effort to dispose of waste properly. They felt that this laziness comes from a general lack of interest in waste-related issues and the environment.

"People don't like to walk an extra fifty metres to go to the car park; instead we double park in front of the shops. The same with rubbish: we don't take the trouble going another hundred or two hundred meters, but throw it in the rubbish or throw it out of the window." (Portugal FG2, P3)

"Across the street you can see through the window the residence hall for single persons, and the people there take a bag of rubbish and drop it on the floor, while my mother spends lots of time separating her waste. And I can also see how time consuming it is for me, this separating business. And on top of everything it's not very valued, one person does it this way and another way, you know." (Slovenia FG 1, P6)

In several focus groups, participants also mentioned that they, or others in their communities, had **insufficient knowledge** of the options for waste disposal. They considered this a barrier to correct disposal.

"I mean if there was the right information from municipalities [...] I think people would be able to follow this and recycle." (Greece FG2, P4)

Many participants had concerns about waste pathways, especially as they realised they had very limited knowledge of what happens to waste after collection. These concerns mainly focused on the polluting effects of waste on the environment.

"A really important question is: Where is our waste going to end up? Is it going to landfills? To incineration? I think of diseases for our health and pollution of our planet." (Italy, Naples FG 1, P 10)

In addition, concerns were raised that all separated waste might end up on one big pile, for incineration or landfill. In many focus groups, there was at least one participant who had witnessed refuse collection vehicles throwing all the separated waste together during collection, or who suspected this of happening.

"[P 1] But when they come [...] to pick up the rubbish, and they pick up all three containers together, in one truck... I wonder why are we collecting it separately...

[P 7] This is completely not motivating people to collect waste separately." (Bulgaria FG 1)

"We recycle and sort it, completely pointlessly, and then they heap it all in one pile." (Czech Republic FG2, P8)

"[P3] We also have the blue bags and there was a scandal. People who filmed some collectors who mixed all of it. So you go to the trouble at home to do proper sorting, and then well the collectors then mix it all...

[P4] Those two bins? Actually those who pick up the garbage?

[P3] Yes, absolutely.

[P4] Oh yes they mixed the bags all in one truck!

[P3] Yes it was filmed! That is outrageous! It makes me so angry because we say to ourselves we did all that and then..." (Belgium FG3)

"We collect everything, but I don't know, what is the point? Is there really a lorry that takes away each thing separately, and doesn't just pour all the waste in together? Is this just for show, or is it really collected in this way?" (Hungary FG3, P6)

5. Citizens' ideas on how to achieve a 'zero waste society'

This section presents participants' ideas for achieving a 'zero waste society'. A distinction is made between ideas related to environmental sciences and technology, and ideas related to policy, management and communication, both of which are divided into several research categories. Below, these ideas are described in separate tables. For each idea in the table, the research category is mentioned, as well as the aim of the research and the proposed target group.

In addition, the priority of the research idea as perceived by the participants is indicated using stars (☆ or ☆☆). This priority rating is shown per country, not per focus group. In general, an idea was considered to have high priority (☆☆) when it received more than three priority stickers on country level (adding priority stickers assigned to the same idea across all three conducted focus groups), and low (☆) when it received up to three in total. For the bigger countries, where six focus groups were conducted instead of three, this benchmark was raised to more than six stickers for high priority and up to six for low. When no star sign is shown, the respective idea was mentioned in this member state, but not assigned priority. Throughout the results, quotes from focus group participants are provided for illustrative purposes.[13] Below, we describe the most popular ideas, which emerged in several member states for each research category. A full list of research ideas can be found on the VOICES website at **www.voicesforinnovation.eu**

5.1 Environmental sciences and technology

This domain groups four research categories, including: 'technical, physical, chemical, engineering', 'material', 'bio(techno)logical' and 'ICT'.

5.1.1 Technical, Physical, Chemical, Engineering

The category 'technical, physical, chemical, engineering' is the largest category in the domain 'environmental sciences and technology' and includes 72 ideas in total. The category contains several clusters of ideas relating to: waste prevention, waste separation, collection and disposal of waste, disintegration or elimination of waste, waste as a resource and other ideas. Most ideas related to the notion of using waste as a resource.

Waste prevention constituted the second largest cluster in this category, with 19 ideas. This cluster mainly aims to use fewer resources and produce less waste. It targets both producers and consumers (see Table 5.1.1). A very popular idea within this cluster is the use of technology to develop higher quality products with a longer lifespan. This would reduce production, resulting in less waste and less use of resources. This was mentioned in eight member states and assigned high priority in five of them.

> *"[P7] That's the problem, making clothes and household items that lasted for much longer before and now last for 5-10 years whilst you can still find a fridge made 25-30 years ago which is still working. So we need raw materials which are high quality.*
> *[PX] They are programmed to last for less time.*
> *[P9] Today things are not made to last!" (France, Grenoble FG2)*

The most frequently mentioned idea within this cluster, but not assigned high priority, is a system to transfer all sorts of products directly to the customer, from the shop or producer. This idea was put forward in ten member states with the aim of reducing waste and packaging in particular. Participants discussed various versions of such a system, including a system made up of pipes and a teleportation system.

A related idea was mentioned in six different member states and involved the use of a 3D printer for producing all sorts of products and spare parts. In some countries, participants suggested that this 3D printer should use waste as a raw material, thereby also making effective use of waste.

> *"[M] Just give me a bit more time, the 3D printer... I'm noting that down. What does it do exactly?*
> *[P2] With the 3D printer, I can print out whatever three-dimensional objects I want. And then in the future I could do that with material that's recyclable, for example in developing countries they print out three-dimensional houses... Pilot projects... As far as organ transplants and so on, well..." (Austria FG2)*

Several other ideas, like the previous one, focused on developing products that reduce the production of waste and the use of resources. One idea proposed the development of products in such a way that they have more standardised, exchangeable and replaceable parts, focusing on chargers and plugs in particular. Another idea is to develop electronic devices that do not require batteries in order to reduce the use of batteries. Yet another idea involves a multifunctional machine, which makes all other household appliances redundant. Each of these three ideas was mentioned in six different member states.

[13] Abbreviations used in quotes: FG# = number of focus group, P# = number of specific focus group participant, PX = focus group participant unknown, M = Moderator.

The cluster **waste separation** includes 10 different ideas. A very popular idea (mentioned in 17 member states) involves the development of a device that automatically sorts and disposes of waste in the household. Such a device was referred to in different ways by participants; it could be a machine, robot or a special bin.

"Ours is a very unconventional idea. I've thought of a subterranean system for managing waste, where anyone from their house, like water running out of a faucet, you'll throw whatever type of trash and it will automatically separate into recyclable material." (Greece FG3, P2)

In some member states, participants suggested that this device could use the waste it sorts as fuel.
Another idea in this cluster, proposed in 11 member states, is a machine that compresses waste so it takes up less space in the house and makes disposal and recycling easier.

"[P4] ...a device - container-pressuriser, if you put in a plastic bottle, they immediately get crushed. [P2] Yeah, so that there would immediately be more space, the containers should be spacious. Because most people throw them away without crushing them. Make it so that the container would crush it itself." (Lithuania FG2)

In the cluster **collection and disposal of waste,** containing eight ideas in total, two ideas were relatively popular. One idea, proposed in 12 member states, proposed building houses with integrated disposal systems, consisting for example of pipes or chutes.

"There should be a system of pipes from our homes to the recycling plants, similar to the waste water drainage system." (Bulgaria FG3, P9)

"[P1] We are thinking here about a house, from which three pipes are coming out. These three pipes would naturally conduct things, which would then be centralized...
[P9] ... to a centre...
[P1]... to a centre, which would in turn be linked with the appropriate transformation: paper for recycling...
[P9] It would immediately be mashed; the paper would immediately be mashed." (Portugal FG3)

The other idea involved the development of a device or facility that would make it possible to sort waste by useful components and parts, instead of sorting by different types of waste. This would make it easier to reuse different parts for new products. This idea emerged in seven member states.

Another cluster of ideas focuses on the **disintegration or elimination of waste** grouping 10 ideas. In 19 member states, participants proposed eliminating waste by sending it somewhere beyond reach or sight, for example by sending it into space, dumping it into a volcano or burying it under the sea.

"A crazy idea... one option is to go up, the other is to go down. Just break down the earth's crust, deep enough, and burn waste there." (Bulgaria FG 1, P 1)

However, some participants questioned whether this would be a good solution with respect to a 'zero waste society' since waste is not really gone and may result in the loss of valuable resources.

"[P3] No, personally a clear future vision for me would be, maybe we can achieve space transportation and shoot all that crap to Mars. [But] what will bring the energy back?
[P 10] At least the crap is out of sight, but it's not gone." (Austria FG3)

An idea focusing more on disintegration of waste involved a machine that decomposes waste into its smallest parts, possibly to a molecular level. Participants thought that such a process would make it easier to develop new products out of waste.

"[M] So that means anything is convertible into anything? What kind of technology do we need for this? [P2] A machine that can split basic elements and then create whatever you require at a given moment." (Luxembourg FG2)

With 25 ideas in total, the cluster **using waste as a resource** forms the largest cluster in this category. The most popular idea in this cluster was new technology generating energy from waste. This was mentioned by participants in 24 EU member states. Most of the participants specifically referred to technology to be used at household level, such as a home incinerator that could be used for generating energy for domestic use, and for heating in particular.

"And another utopic idea is basically, the waste that is flammable, make a bigger bin and put it underground, because I added that those recycling bins take up a lot of space. So, that whole bin, connect it to the central heating system, there would be motivation to recycle and competition for Kaunas Energy [waste processing company], think about it, if they connected the bins in every courtyard to the central heating system, it would be fantastic." (Lithuania FG2, P8)
"Come up with a design that can manufacture a stove that is partially giving out heat into your home but maybe at the side of it or behind it... You're burning your waste, your packaging, your whatever and it's giving you heat and heat to your home and it's also getting rid of the rubbish." (Ireland FG3, P6)
"[P3] There's incinerators too, right? Incinerators for households or for municipal buildings, whatever. They should develop such an incinerator where you can easily throw the trash.
[P3] That'd harm the environment though, right?
[P9] But it could use it!
[P3] Yeah, and utility panels and solar power on the house.
[P9] Yeah, self-sufficient!" (Austria FG3)

The second most popular idea in this cluster involved a machine to turn waste into new products and materials. Such a machine would create new clothes, building materials, furniture or even food from waste. This idea was mentioned in 22 member states.

"Waste can become building material... For example, furniture we throw away can be used to make boards. Also waste from building material, like broken glass, cement, sand etc. should be converted back to building material..." (Romania FG 1, P2)
"[P 1] I think every household should have a replicator. Anyone who's ever seen Star Trek or Star Trek Voyager will know what it is. It's, like, a machine that collects old energy and charges it up again and you can use it to make whatever you want. A drink, or a jumper. Whatever.
[M] So it transforms waste.
[P 1] Yes. Exactly. It transforms waste and energy." (Germany, Munich FG2)

In 15 member states, participants proposed the use waste to create petrol or fuel, mainly to be used for cars.

"The person takes a collective bin and empties it into the machine and then in the afternoon takes the car there and fills up the car." (Portugal FG2, P4)

A related idea, which emerged in eight member states, is the development of products that run on household waste. In many member states, this idea specifically involved the development of cars running on household waste but other types of products were also mentioned, including barbecues and furnaces.

"Well, the waste we take out of the house, apples, bones, other things, I don't know, we should build a car and put this waste in the place where you put fuel or petroleum, to melt them and use them in the car as combustible material." (Cyprus FG2, P 10)

An idea, which was mentioned in nine member states, proposed to improve incineration plants, in particular to make more effective use of the waste and the incineration process. Many participants specifically thought that the heat coming from the incineration plant could be used as a source of energy.

"Rubbish would go to a power plant with a filter, of course [laughter]. The energy would not be lost, but let's say that could be used for heating and electricity, it would not be lost in the form of smoke. And everything would run on waste. Rubbish should not be piling up in landfills, but we should incinerate it here." (Hungary FG3, P 1)

Another idea supporting the use of waste as a resource is the idea to develop technology to extract useful raw materials from waste, making it possible to use these raw materials to develop new products. This idea emerged in nine different EU member states.

"All materials will be converted back to raw material. It is the purest form of recycling." (Italy, Milan FG2, P3)

Summary of results

In total 18 ideas for research and innovation were prioritised in the category 'technical, physics, chemical, engineering'. Most ideas relate to the notion of 'using waste as a resource', including the two most popular ideas of this category. These ideas predominately aim to make effective use of waste with management companies as the main target group.
The most popular idea of the entire category, mentioned in 24 member states, involved developing technology to use waste for generating energy at the household level. The second most popular idea involved a machine or device, which can be used to turn waste into new products and materials (mentioned in 22 member states). The idea that ranks third in this category, mentioned in 19 member states, is found in the cluster disintegrating or eliminating waste, and aims to eliminate waste by sending it somewhere beyond reach or sight, to space, volcanoes or seas. Another very popular idea, belonging to the cluster of waste separation, involves the development of a device that automatically sorts and disposes of waste in the household (mentioned in 17 member states).

Table. 5.1.1 Most frequently mentioned and highly prioritised ideas within the category 'technical, physical, chemical, engineering'

Idea	Aim	Target group	Country
Prevention			
Develop products of higher quality and longer life span	Less use of resources/ Less waste production	Producers	France ☆☆, Germany ☆☆, Hungary ☆☆, Luxembourg, Netherlands ☆, Slovakia ☆☆, Slovenia ☆☆, Spain
Develop a system (teleportation/ pipes) to transfer products directly from the shop/ producer into your house	Less waste production/ Less packaging	Consumers/ Producers	Belgium ☆, Czech Republic, Finland, France, Germany ☆, Netherlands, Portugal, Spain, Sweden ☆, UK ☆
Develop universal/ standardized/ changeable parts of products (i.e. chargers, plugs, etc.)	Less use of resources	Producers	Austria ☆☆, Belgium ☆, Denmark, Germany ☆, Latvia, Luxembourg
Develop electronic devices that do not need (or need less) batteries	Less waste production	Producers/ Consumers	Cyprus ☆, Denmark ☆, Ireland, Malta, Netherlands ☆, Portugal
Develop a 3D printer (possibly with waste as input)	Effective use of waste/ Less waste production/ Less packaging	Consumers	Austria ☆, Belgium, Finland ☆☆, Netherlands, Spain ☆, UK
Create a multifunctional machine that incorporates multiple (or all) household appliances in one	Less use of resources	Consumers	Belgium, Cyprus ☆, Finland ☆, Netherlands ☆, Poland
Waste separation			
Create a machine/ bin/ robot to be used in the house that automatically sorts/disposes your waste (and is also possibly fuelled by waste you throw away)	Convenience in the home/ Improve recycling	Consumers	Austria ☆, Bulgaria, Cyprus ☆☆, Denmark, Estonia ☆☆, Finland ☆, France ☆, Greece ☆☆, Italy ☆, Lithuania ☆☆, Luxembourg ☆, Netherlands ☆, Poland ☆☆, Portugal ☆, Romania ☆, Slovenia ☆, UK ☆☆
Create a machine that compresses waste (making reuse, recycling and disposal easier)	Convenience in the home	Consumers	Belgium, Cyprus ☆, Czech Republic ☆☆, Estonia, France ☆, Ireland ☆, Latvia, Lithuania ☆, Luxembourg, Malta, Netherlands ☆, Poland, Portugal ☆, Spain ☆, UK ☆

Idea	Aim	Target group	Country
Collection/disposal of waste			
Build homes with an integrated disposal system (e.g. pipes, chutes)	Convenience in the home/ Improve recycling	Consumers/ Producers	Bulgaria ☆, Cyprus ☆☆, Denmark ☆, France ☆, Germany, Italy ☆☆, Latvia ☆, Lithuania, Netherlands ☆, Portugal ☆☆, Sweden, UK ☆☆
Develop a facility, with technology to sort waste by (useful) components/ parts (for reuse)	Improve recycling	Waste management companies	Germany, Hungary, Ireland, Italy, Latvia, Netherlands, Sweden ☆
Disintegration or elimination of waste			
Send waste into space, bury it under the sea or deep underground, dump it in a volcano or in a black hole, send it to the sun	Eliminate waste	Waste management companies	Austria ☆, Bulgaria ☆, Czech Republic, Estonia ☆☆, Finland, France ☆, Germany ☆, Hungary, Ireland, Italy ☆, Latvia ☆, Lithuania, Luxembourg ☆, Netherlands, Poland ☆, Portugal, Spain, Sweden, UK ☆
Create a machine to disintegrate waste (possibly to the molecular level), and then use it for building new products	Eliminate waste	Waste management companies	Austria ☆, France ☆, Germany, Italy ☆☆, Latvia ☆, Lithuania, Luxembourg ☆☆, Malta, Poland ☆, Spain, UK ☆
Waste as a resource			
Develop a technology which will allow to use waste for energy (in house, for example through waste incineration to produce energy)	Effective use of waste	Consumers/ Waste management companies/ Producers	Austria ☆, Belgium ☆☆, Cyprus ☆☆, Denmark ☆, Estonia, Finland, France ☆, Germany ☆, Greece ☆☆, Hungary ☆☆, Ireland ☆☆, Italy ☆☆, Latvia ☆, Luxembourg ☆☆, Malta ☆☆, Netherlands ☆☆, Poland ☆, Portugal ☆☆, Romania ☆☆, Slovakia ☆☆, Slovenia ☆☆, Spain ☆☆, Sweden ☆, UK ☆
Create a machine to turn waste into new materials and products (i.e. food, clothing, building material, water, furniture)	Effective use of waste	Producers/ Waste management companies/ Consumers	Austria ☆, Belgium, Bulgaria ☆☆, Cyprus ☆☆, Denmark ☆☆, Finland ☆, France ☆, Germany ☆, Greece ☆☆, Ireland, Italy ☆, Latvia ☆☆, Lithuania ☆, Luxembourg ☆, Malta ☆, Netherlands, Poland ☆, Portugal ☆, Romania ☆, Spain, Sweden, UK ☆
Develop techniques which will allow to turn waste into fuel/ petrol/ oil	Effective use of waste	Waste management companies/ Producers	Austria ☆, Denmark ☆, Estonia, Finland, France ☆, Germany ☆, Ireland ☆, Latvia ☆, Malta ☆☆, Poland ☆, Portugal ☆☆, Romania ☆, Slovakia, Spain ☆☆, UK ☆
Improve incineration plants (e.g. make use of the heat and energy generated from them)	Effect on planet	Waste management companies	Bulgaria ☆☆, Denmark, Finland ☆, Greece, Italy, Luxembourg, Netherlands ☆, Slovakia ☆, Spain ☆
Develop methods of extracting useful (raw) materials from waste, and returning to raw material for new products	Less use of resources	Waste management companies	Estonia, Ireland, Italy ☆, Luxembourg, Malta, Netherlands ☆, Slovakia ☆, Slovenia, UK ☆
Develop products (such as cars, BBQ, furnaces) and appliances that run on household waste	Effective use of waste	Producers/ Consumers	Austria ☆☆, Cyprus ☆☆, Germany, Hungary ☆☆, Italy ☆☆, Netherlands, Poland, Slovenia ☆

5.1.2 Material

A second category related to the domain of 'environmental sciences and technology' contains ideas that focus especially on the 'material' dimension (see Table 5.1.2). The category 'material' is the second largest category in this domain, including 30 ideas in total. Related ideas generally involve research into and development of new materials with certain characteristics that are thought to reduce waste. Ideas are grouped in two clusters: packaging and products. Ideas predominantly target producers and mainly aim to reduce the production of waste, in particular of plastic and packaging.

The cluster **packaging** contains 16 ideas focusing on materials involved in the packaging of all sorts of products, in particular plastic bottles and bags. In 15 different member states, participants introduced the idea of developing more biodegradable packaging, particularly biodegradable bags, mainly with the purpose of reducing the use of plastic:

"It's actually in the interest of prevention... development of new plastics, some sort of materials that are easily biodegradable." (Czech Republic FG3, P4)

"New or some more biodegradable, compostable materials used in packaging, whether they be new materials or materials that are already around now. Cause I don't understand why we still use black bags and things that are not biodegradable." (United Kingdom, London FG2, PX)

Another idea that focuses on effective use of waste is to create reusable packaging. In other words, bottles, cans and containers would be developed to be easy to reuse for alternative purposes. This idea emerged in nine member states.

"But it is, those plastic bottles went to reuse. So, all the other plastic should be reused as well... Why just bottles?" (Estonia FG3, P9)

A related idea, mentioned in 14 member states, involved creating edible packaging. This would reduce packaging waste and, at the same time, waste would be used effectively, namely as food and feed.

"Scientists, scientists at Kaunas University of Technology have discovered how to pack curd in packaging made from the same dairy product powder, they pack it and you can eat it, nothing gets left." (Lithuania FG 1, P6)

Another idea involved the development of packaging that disintegrates or dissolves automatically after a certain time or after it has been used. This was proposed by participants in eight member states.

"[...] But then what I had thought for packaging, that's another thing, I say why not create packaging that once it's empty, it disintegrates?" (Belgium FG3, P4)

Finally, participants put forward an idea, combining the aforementioned ideas, to develop packaging that is 100% recyclable, reusable or degradable in order to produce less waste. This was mentioned by participants in five different member states.

The cluster **products** includes 14 ideas related to technical aspects of product development. The most frequently mentioned idea in this cluster proposes that all products should be made in an environmentally friendly way. In other words, products have to be created in such a way that only natural, organic or biodegradable materials are used, that do not harm the environment. This was mentioned by participants in 19 different member states.

"[P2] In the long run, this could be used not only for packaging but for anything else. There could be biodegradable TVs... [laughter]

[P3] The TV would decompose in the middle of a movie? [laughter]

[P2] But seriously, the TV set we purchase works for about 10 years to begin with. I think it was you who said that they are manufactured to break down and we should have the urge to buy a new one. So it could be achieved that these TV sets, I do not say that on their own, but with a simple technical solution would become degradable." (Hungary FG 1)

Eight member states came up with the idea to develop materials with a longer, and possibly infinite, lifespan, while maintaining good quality. As a consequence, fewer products would have to be made, resulting in use of fewer resources as well as less waste production.

"[...] materials that could be recycled longer, or more times, that might be more durable so they last longer [...] They're less likely to break. But also you can recycle them more times, so there's not like a limit of how many times." (United Kingdom, Newcastle-upon-Tyne FG 1, PX)

"[P5] Invent another type of material which... I don't know... which, for example, is disposed of in water...

[P6] And there's no need to process it so much in order to be able to use it, which for example, I don't know, is easier to turn into another plastic bottle. You don't need to melt the plastic again, make the bottle again, put the label on it... so we'd save energy and the process would be easier." (Spain, Barcelona FG2)

Another idea with similar aims, which was mentioned in five member states, referred to creating materials that can be transformed into other materials or substances.

Summary of results

Within the category 'material', ideas were grouped in two clusters (packaging and products), with a comparable number of ideas grouped in both clusters.

The most popular idea of the entire category, mentioned in 19 member states, is found in the cluster focusing on products and this idea entails that all products should be made in an environmentally friendly way. The second most popular idea in the category, falling in the cluster with ideas related to packaging, is developing more biodegradable packaging, in particular biodegradable bags (mentioned in 15 member states). The idea ranking third in this category came up in 14 member states. It also relates to packaging and involves the development of edible packaging.

Table. 5.1.2 Most frequently mentioned and highly prioritised ideas within the category 'material'

Idea	Aim	Target group	Country
Packaging			
Develop biodegradable packaging and bags (instead of plastics)	Effect on planet/ Less waste production/ Less plastic	Producers	Czech Republic ☆☆, Denmark ☆, Finland, Hungary ☆☆, Ireland ☆, Italy, Luxembourg ☆, Malta, Netherlands, Poland ☆, Portugal, Romania ☆☆, Slovenia ☆, Spain, UK ☆
Create edible packaging	Effective use of waste/ Less waste production	Producers/ Consumers	Austria ☆☆, Czech Republic ☆, Estonia, Germany, Greece, Italy, Latvia, Lithuania ☆, Luxembourg ☆, Poland ☆, Portugal, Slovakia ☆, Spain, UK
Develop reusable packaging (i.e. for bottles, cans, etc.)	Less waste production	Producers/ Consumers	Czech Republic, Estonia ☆☆, France ☆, Germany ☆☆, Ireland, Malta, Poland ☆, Portugal, Slovenia
Develop packaging that disintegrates/ dissolves by itself	Less waste production	Producers	Belgium ☆☆, Bulgaria, Denmark, France, Italy ☆☆, Latvia ☆☆, Portugal, Slovakia ☆, Spain ☆☆
Develop packaging that is 100% recyclable, reusable or degradable	Less waste production	Producers	France ☆☆, Italy ☆☆, Latvia, Lithuania, Luxembourg ☆
Products			
Products in general should be made out of natural/ organic/ non-polluting/ bio-degradable materials	Effect on planet/ Less plastic	Producers	Austria ☆☆, Belgium, Czech Republic, Denmark, Estonia ☆, Finland ☆☆, France ☆, Germany, Greece, Hungary ☆☆, Ireland ☆, Italy ☆, Lithuania ☆, Luxembourg, Malta, Netherlands ☆, Poland ☆☆, Portugal ☆, UK
Develop materials with a longer (infinite) lifespan (without losing quality)	Less waste production	Producers	Estonia, Finland, Italy, Luxembourg ☆☆, Poland ☆, Slovenia ☆☆, Spain ☆, UK ☆
Develop materials that can be transformed into other materials or substances	Effective use of waste	Producers	Estonia, Finland, Greece ☆, Poland ☆☆, Slovakia ☆

5.1.3 Bio(techno)logical

The third category in the domain of 'environmental sciences and technology' is concerned with bio(techno)logical ideas (see Table 5.1.3). It groups 15 ideas related to biological processes and organisms. The category contains two clusters of research ideas: waste prevention and waste as a resource. Ideas related to waste prevention often target both consumers and producers, while ideas focusing on waste as a resource mainly target waste management companies. The category 'bio(techno)logical' is one of the smaller categories.

The cluster **waste prevention** contains six ideas in total. An idea mentioned in 15 member states is to develop food in alternative forms, for instance in the form of pills or tablets. This would reduce waste production and specifically waste coming from food packaging. However, in several focus groups, participants also expressed doubts regarding this idea, mainly because of the social function of having meals together and the pleasure of eating. Therefore, some participants suggested special additional characteristics to such tablets,

e.g. having them transform into a full meal or contain the flavours and taste of normal food.

"[P5] I don't know if that's even feasible, but there wouldn't be any packaging, actually, there would just be a countless amount of pills...
[M] Freeze-dried food pills...
[P5] Exactly, and as soon as you put them inside some machine, they'd be turned into a cooked meal." (France, Paris FG 1)

Another idea in this cluster was mentioned in only two member states and involves the development of food that does not need packaging. This refers to food that cannot be contaminated by germs, for example by making it naturally antibiotic.

"Basically to stop the packaging of food, antibiotic food will help - it does not matter how many hands come in contact with it, you know there is no germs spreading on it - you eat it and ... [Horror expressed]." (United Kingdom, London FG2, PX)

In the cluster **waste as a resource** there are nine ideas. The most popular idea, which emerged in 13 member states, suggests developing organisms that destroy or process waste. In many member states, participants specifically talked about waste eating bacteria, or organisms that process waste after which it can be used again, making it possible to use this waste effectively.

"Our idea concerns micro-organisms which would feed on rubbish, and they could be used for their proteins, like those little worms... you pop them in your mouth and eat them." (Bulgaria FG3, P2)
"[P2] For example, instead of incinerating things, create a bacteria or something, you know? To turn plastic back into oil, you know? Or something so that it can be reused... I don't, I don't know...something that [hasn't been] invented [yet], but I don't know for...
[P 1] To turn into energy..." (Spain, Barcelona FG2)

An idea, which closely relates to the previously described idea, involves creating organisms that can remove single atoms or molecules from waste. This was mentioned in three member states.

"Good! We're in favour of GM [genetically modified] organisms. Or we would produce organisms that would break everything down. Or we would produce organisms that produce biodegradable packaging." (Poland, Warsaw FG2, P2)

Two other ideas focusing on waste as a resource both relate to processing of organic waste. The first idea, forwarded in three member states, suggests creating biogas or bio-fuel from organic waste. Another idea involves the improvement of composting of organic waste. This idea emerged in two member states. Participants specifically proposed that composting should be improved by speeding up the composting process or eliminating the smells that often accompany this.

"They should be cleaner, and should not stink and bother people." (Bulgaria FG2, P8)

Summary of results

Within the entire category of 'bio(techno)logical' ideas only two ideas were mentioned in a considerable number of countries. Both ideas focused on the aim of preventing waste production and packaging in particular. The most popular idea in this category, mentioned in 15 member states, is to develop food in alternative forms, for instance in pills or tablets, although it should be noted that this idea also raised concerns among participants. The second most popular idea in the category entails developing organisms that destroy or process waste, possibly preparing it for effective use (mentioned in 13 member states).

Table. 5.1.3 Most frequently mentioned and highly prioritised ideas within the category 'bio(techno)logical'

Idea	Aim	Target group	Country
Prevention			
Develop food in pill, tablet or air form	Less packaging/ Less waste production	Consumers/ Producers	Austria ☆, Belgium ☆, Bulgaria ☆☆, Cyprus ☆, Czech Republic ☆, France ☆, Germany ☆, Ireland ☆. Latvia, Luxembourg, Netherlands ☆, Portugal ☆, Romania, Spain, Sweden
Develop food that does not need packaging (e.g. by being naturally antibiotic)	Less packaging	Producers/ Consumers	Sweden ☆, UK ☆
Waste as a resource			
Create (micro)organisms or bacteria which can destroy/ process rubbish (by eating it), possibly for effective use	Eliminate waste/ Effective use of waste	Waste management companies/ Producers	Bulgaria ☆☆, Czech Republic ☆, Denmark ☆☆, France ☆, Germany ☆, Italy ☆, Latvia ☆, Luxembourg, Netherlands ☆, Poland, Slovenia ☆, Spain ☆☆, UK ☆☆
Create biogas or bio-fuel from organic waste	Effective use of waste	Waste management companies/ Producers	Germany, Malta ☆☆, Slovenia ☆
Create bacteria or organisms that can remove individual atoms from waste materials (for recycling purposes)	Improve recycling	Waste management companies	Germany ☆, Italy, Poland ☆
Improve composting of organic waste (not smelling, faster)	Improve recycling	Consumers	Austria, Bulgaria ☆

5.1.4 ICT

The last category in the domain of 'environmental sciences and technology' focuses on information and communications technology (ICT) (see Table 5.1.4). Ideas in this category often target consumers and have diverse aims such as behaviour change, improving recycling and convenience in the home. The category contains three clusters of research ideas, including: waste prevention, waste separation/collection/disposal and general ideas. The category 'ICT' is one of the smaller categories, containing 17 ideas in total, five of which are in the cluster waste prevention, 10 in the cluster waste separation/collection/ disposal and two in the cluster with general ideas.

The most popular idea in the cluster **waste separation/collection/disposal** involves an online programme, app or text service that would help consumers to recycle. This would provide personalised information about correct separation and collection (e.g. location and times) and disposal of waste. The aim is to increase knowledge and awareness of separation and recycling possibilities among citizens, and to enhance recycling by helping them to manage waste correctly. This idea was mentioned by participants in eight different member states.

> *"So to stop people putting general waste into recycling bins. Obviously if all that gets dumped into one big massive skip at a recycling plant, then you don't know who are good recyclers and who are bad recyclers. So if there was a way of scanning the waste and ... you know if you see the waste coming out of one bin there's a lot of non-recyclable stuff in it and then that gets marked. So you can track back to where that bin came from." (Ireland FG 1, P 10)*

"Since we don't know what happens to the rubbish after we throw it away, this app will tell us where it is." (Italy, Naples FG2, P3)

The second idea in this cluster was mentioned in five member states. Participants suggested developing smart bins or containers that can inform you about waste and correct inappropriate separation. Thus, citizens would be notified when disposing incorrectly and informed about what they should be doing. Participants mentioned different versions of this smart bin, including bins with voice control, barcode recognition or a credit system rewarding citizens for correct disposal. By correcting citizens' behaviour, recycling and convenience would be improved.

"An intelligent bin is one where you throw something in, and if you make a mistake he makes a sound that you have made a mistake. It will shout at you." (Italy, Milan FG3, P9)

Summary of results

The category ICT is the smallest in the domain of 'environmental sciences and technology'. Only two ideas gained considerable support in multiple member states. Both of them aim to introduce innovations which would contribute to improving waste separation and collection. The first idea, mentioned in eight member states, is to create an online programme, app or text service that helps consumers to recycle better. The second is to develop of smart bins or containers that can inform citizens about waste and correct separation (mentioned in five member states).

Table. 5.1.4 Most frequently mentioned and highly prioritised ideas within the category 'ICT'

Idea	Aim	Target group	Country
Waste separation, collection and disposal			
Develop an online programme, app or text service that helps consumers to recycle (personalised information about ways of collection and disposal and appropriate separation)	Improve recycling/ Awareness of possibilities/ Behaviour change	Consumers	Estonia ☆, Finland, France, Ireland ☆☆, Italy ☆☆, Lithuania ☆, Spain ☆, UK
Develop smart bins and containers, that can inform you about waste and correct or inappropriate separation, possibly combined with voice control, barcode recognition and credit system	Improve recycling/ Convenience in the home/ Behaviour change	Consumers	Bulgaria ☆☆, France ☆☆, Ireland ☆☆, Italy ☆☆, Lithuania, Malta

5.2 Policy, management and communication

'Policy, management and communication' groups four research categories, including: 'policy', 'management and logistics', 'communication and education' and 'local initiatives'.

5.2.1 Policy

The category 'policy' is the second largest category under in the domain of 'policy, management and communication' with 48 ideas in total. The category contains several clusters of ideas relating to: waste prevention (29 ideas), waste management (14 ideas) and general ideas (five ideas). The ideas have diverse aims and are generally targeted at producers, although consumers and the government were also commonly mentioned as a target group. Ideas that were mentioned most frequently by member states are described below and included in table 5.1.5.

With 29 ideas, the cluster **waste prevention** forms the largest cluster in the category 'policy'. Many ideas focus on product development. Within this cluster, the most popular idea was to reduce the amount and change the type of (materials that producers use for packaging through regulations and financial incentives. Participants suggested increasing taxes on materials that are harmful for the environment, banning plastic completely or setting a target for the elimination of plastic, for example. This idea emerged in 20 different member states.

> *"And maybe there could be withdrawal, like with nuclear energy, so you say, 'From 2015 we only want to have that... we want plastic to...' because if you just say, 'Hmm, we'll support that', then the others will try to fight against it. So you really need to say, 'for the sake of the environment, that's the only real alternative for us, the number one and everything else will just slowly disappear from the market'..." (Germany, Bremen FG3, P3)*

The second idea, mentioned in 12 member states, relates closely to the previous idea. It proposes legislation stating that producers should use as much recyclable or reusable materials as possible in the production of products. In this way, more effective use could be made of waste and fewer resources would have to be used for new products. In several member states, participants proposed to achieve this through incentives, such as subsidies.

> *"If a producer can prove that he doesn't use raw materials, freshly extracted, but only recycled materials [...] he should have a discount on the taxes he pays to the state." (Romania FG1, P6)*
> *"By using a high-quality method of separation, I think that you can actually separate almost 100% of waste back into raw materials, and at the point, when it's obligatory that product can only be brought onto the market when it has reused those raw materials from start to finish, that's what I thought. [...]" (Netherlands FG3, P1)*

A third idea specifically targets consumers and involves encouraging consumers to buy and use products that are organic, biodegradable, recyclable or reusable. This would help to minimise the harmful effects of waste on the planet. Participants suggested doing this by reducing prices of such products or by imposing higher prices, taxes and bans on products that do not have these qualities. This idea was proposed in 11 different member states.

Another idea, supported in 11 member states, proposes legislation to demand producers to deliver products with a longer lifespan and a guarantee. This could be done by providing spare parts or rechargeable batteries. As a consequence, fewer resources would have to be used and less waste would be produced.

> *"We should have a manufacturing quality that means that something should last for a certain amount of time. If it doesn't last for this time then you get your money back." (Sweden FG3, P10)*
> *"... in this way, more or less, when you use the appliances longer, not that I won't get sick of watching them at home, but at least you are decreasing the throwing out of them. And you save on unnecessary expenses." (Bulgaria FG2, P10)*

The last broadly supported idea in this cluster involves regulations to make producers responsible for the environmental burden of their products and of packaging in particular. Participants expected that this would improve recycling of waste and reduce the amount of waste from packaging. This idea emerged in seven member states.

"[...] and that might encourage the manufacturers to manufacture their products in such a way that they last longer... like, have a longer lifespan, because they're the ones who'd have to pay for their disposal." (Germany, Bremen FG3, P6)

The cluster **waste management** includes 14 different ideas. The most popular idea in this cluster was mentioned in 26 member states. This idea proposes incentives to make consumers recycle more or reuse products more often. Incentives could involve receiving money upon return of products or waste, vouchers, lower taxes or rewards. In some focus groups, participants suggested that recycling centres should be free of charge in order to encourage consumers to use these services.

"They could then lower the bills for, I don't know, for energy, for water, for these... And then people would have the motivation to do this [...]." (Poland, Warsaw FG3, P10)

"Incentives for people to recycle... be it tax relief or something similar... so that people, well, recycle more." (Spain, Barcelona FG2, P2)

The second idea in the waste management cluster targets national and European governments. In 13 different member states, participants suggested standardising and regulating waste management at a national level and possibly also at the level of the European Union.

"Standardisation and simplification of management of waste disposal at the European level. For each product it must be clear for the consumer how it can be recycled... So you won't be standing downstairs and not knowing where to throw away the waste..." (Italy, Milan FG1, P10)

"For example, when we're talking about deposit systems, I mean, if I buy a can in Germany, France, Sweden, Italy or for some reason or other it wanders back to Denmark, I should be able to dispose of it in Denmark." (Denmark FG2, P4)

Part of this process would be to investigate and adopt best practices from other member states in the EU, as suggested by some countries that ranked low in the EU27 list.

"[P2] There are countries with way better waste handling. Why do we not adopt ideas from them...? For example, you can read everywhere that Sweden has a recycling plant so huge that they take waste from foreign countries. Even so, they do not run with full capacity. They are almost like waiting for the waste from Europe to be processed. If they can do it, why could not we do it...?

[P3] Yes, models should be adopted." (Hungary FG1)

A third idea focuses on consumers and proposes to use disincentives (e.g. fines) on citizens who are not managing their waste correctly. This would push them to improve their recycling behaviour. This idea emerged in 12 member states.

"[PX] Whoever doesn't separate will have to pay a fine.

[M] Fines ... OK, was there anybody else who had this idea?

[P4] To it we added the times, for example you should not take it out in the evening to be collected in the morning ... if someone takes out the garbage they are fined.

[M] A fine. So specifically, law enforcement." (Malta FG3)

In eight different member states, focus group participants came up with the idea that the government should assign (more) funds to projects and initiatives that aim to improve the waste management system.

In the cluster of **general ideas** one idea is listed that was mentioned by more than one member state. In focus groups in nine member states, the idea was proposed to stimulate scientific/technological research related to waste management/new packaging/green ideas through government funding.

"A second thing: creating technological scientific studies. How to reorganise waste, how to use it, create nanotechnology, generate as little waste as possible. Designate quite a bit of money towards scientific research." (Lithuania FG1, P9)

Summary of results

Within the category 'policy', most ideas belonged to the cluster 'waste prevention', but the most popular idea of the entire category falls in the 'waste management' cluster and focuses on incentives for recycling.
The top idea, mentioned in 26 member states, involves incentives to make consumers recycle or reuse products more often. The second most popular is to reduce the amount and type of harmful material that producers use for packaging by regulations and incentives (mentioned in 21 member states). The idea to standardise and regulate waste management on a national or EU level (adopt foreign models with good practices) was mentioned in 14 member states. 12 member states proposed legislation and subsidies that ensure that producers make use of as much recyclable and reusable materials as possible in the manufacturing of new products.

Table. 5.2.1 Most frequently mentioned and highly prioritised ideas within the category 'policy'

Idea	Aim	Target group	Country
Prevention			
Create regulations/ incentives to reduce the amount and type of (harmful) materials that businesses can use for packaging (i.e. increase taxes, ban on plastic, plastic elimination date target)	Less plastic/ Less packaging	Producers	Austria, Cyprus ☆, Czech Republic ☆, Denmark, Estonia, Finland ☆, France ☆☆, Germany ☆, Hungary ☆, Ireland, Italy ☆☆, Latvia ☆☆, Lithuania, Luxembourg, Malta ☆☆, Netherlands, Portugal ☆, Slovakia, Slovenia, Spain, UK ☆☆
Implement legislation which states that producers should make use of as much recyclable/ reusable materials as possible in the manufacturing of new products (and possibly provide incentives for this: subsidies)	Improve recycling/ Less use of resources/ Effective use of waste	Producers	Austria ☆☆, Cyprus ☆, Czech Republic, Denmark ☆☆, Finland, France ☆, Ireland ☆, Italy ☆☆, Latvia ☆☆, Lithuania, Netherlands ☆☆, Romania ☆☆
Implement legislation to demand products with a longer lifespan and guarantee, for example through providing spare parts or rechargeable batteries	Less waste production/ Less use of resources	Producers	Austria ☆☆, Bulgaria ☆, Czech Republic ☆☆, Estonia, Finland, Germany ☆, Luxembourg, Netherlands ☆☆, Romania ☆☆, Sweden ☆☆, UK
Stimulate the use of products that are organic/ biodegradable/ recyclable/ reusable (at reduced price), and impose higher prices/taxes or even ban the use of products that are not	Improve recycling/ Effect on planet/ Behaviour change	Consumers	Czech Republic, Denmark ☆, Estonia ☆☆, Germany, Greece ☆☆, Italy, Luxembourg ☆, Netherlands ☆☆, Poland ☆☆, Spain
Implement regulations to make producers responsible for the burden of their products (including packaging)	Less packaging/ Improve recycling	Producers	Estonia, Germany ☆, Italy ☆, Luxembourg, Slovakia ☆, Sweden ☆☆, UK ☆☆
Waste management			
Introduce incentives to make consumers recycle/ reuse more (i.e. by receiving money upon return, vouchers, lower tax, reward, recycling centres should be free of charge)	Improve recycling/ Behaviour change	Consumers	Austria ☆, Belgium, Bulgaria ☆☆, Cyprus ☆, Czech Republic ☆☆, Denmark ☆, Estonia ☆☆, Finland ☆, France ☆, Germany ☆, Greece ☆, Hungary ☆, Ireland ☆☆, Italy ☆☆, Latvia, Lithuania, Luxembourg ☆, Netherlands ☆☆, Poland ☆, Portugal, Romania ☆, Slovakia, Slovenia ☆☆, Spain ☆☆, Sweden ☆☆, UK ☆☆

Idea	Aim	Target group	Country
Waste management			
Standardise and regulate waste management on a national/ EU level (e.g. adopt foreign models with good practices)	Improve recycling/ Eliminate waste/ Awareness	Government	Austria, Bulgaria, Czech Republic, Denmark ☆, Hungary ☆, Ireland, Italy ☆, Latvia, Lithuania, Netherlands Poland, Portugal, Slovenia ☆, UK ☆
Introduce disincentives (fines) for consumers if they do not separate waste correctly	Behaviour change/ Improve recycling/ Less waste production	Consumers	Bulgaria ☆, Estonia ☆☆, France, Hungary, Latvia, Luxembourg ☆, Malta ☆, Netherlands ☆ Poland, Portugal, Slovakia ☆, Spain
Assign funds to projects/ initiatives that aim to improve the waste management system	Improve recycling	Government	Bulgaria ☆☆, Germany, Greece ☆, Latvia, Lithuania ☆, Poland ☆, Romania, Slovakia
General			
Designate funding to scientific/ technological research related to waste management, new packaging, green ideas	Other	Government	Belgium ☆☆, Cyprus ☆, Estonia, Germany ☆, Hungary ☆, Lithuania ☆☆, Luxembourg ☆, Portugal, Spain

5.2.2 Management and logistics

The category 'management and logistics' is the largest category in the domain of 'policy, management and communication', including 105 ideas. The category contains several clusters of ideas: waste prevention (40 ideas), waste separation (three ideas) and waste collection and disposal (62 ideas). The ideas often aim to improve recycling or use fewer resources, usually targeting producers or consumers. The category 'management and logistics' contains many specific ideas which were mentioned in only one member state. Ideas that were mentioned most frequently by member states are described below and included in table 5.1.6.

The cluster with ideas on **waste prevention** includes 40 ideas, focusing strongly on reducing the use of packaging and resources. The most popular idea emerged in 17 different member states and proposes to provide facilities in supermarkets for customers to bring their own containers, bottles and boxes to buy from a bulk stock. The aim of this idea is to reduce the amount of waste from packaging and plastic in particular.

> *"[P4] We wrote down that you should encourage bulk distributors. This happens in organic stores for cereals and it could be useful for pasta, rice, it stops waste [...]*
> *[P7] For the first visit, you buy the milk with the bottle, and then afterwards you go along with the same bottle." (France, Grenoble FG2)*
> *"Well they can refill them in supermarkets, you know instead of buying things and packaging, you could actually take your packaging back, that you're responsible for cleaning in your own household, and you could fill a jar up with tomato sauce, fill the jar with jam." (United Kingdom, Newcastle-upon-Tyne FG2, PX)*

The idea ranking second in the cluster about waste management also relates to packaging. It suggests that producers should standardise types of packaging, preferably using less plastic and more reusable, recyclable and environmentally friendly types of packaging. This idea was supported by participants in 14 member states.

Another idea, mentioned in ten member states, focuses specifically on plastic (bags and bottles) suggesting that they should be replaced by alternatives that are recyclable or reusable or decomposable or biodegradable, for instance paper, leather or wicker.

In eight different member states, participants proposed a restructuring of the entire packaging industry. This restructuring would mean current packaging materials are replaced by new ones that are recyclable or reusable. As such, this idea is linked strongly to the ideas described above.

The idea to digitalise physical goods and administration emerged in seven member states, aiming to use fewer resources and produce less waste. Focus group participants specifically suggested that books, manuals and advertising should be replaced by digital versions.

> *"...the zero use of paper. [...] Such as all those letters, I don't know, they should be sent electronically. Is it necessary for the bank to send you five letters a week?" (Cyprus FG3, P9)*

Another idea suggests that shops should sell food by weight or piece instead of in pre-set amounts in larger packaging. This would enable consumers to buy exactly the amount of food that they need, thereby preventing production of food waste and packaging. This idea was brought up by participants in six member states.

> *"[. . .] that one could buy just the correct amount, of this raw material or whatever. Then people would not throw so much bad food away, then they wouldn't necessarily buy too much food." (Finland FG2, P6)*

The last idea in this category presented here was mentioned in five member states. It focuses on reducing the production of food waste by managing food production and distribution more efficiently. In other words, no more food should be produced than is actually needed and transport routes should be shorter to increase shelf life.

The cluster of ideas related to **waste collection and disposal** forms the largest cluster in the category 'management and logistics' with 62 ideas, most of which aim to improve recycling. The most frequently mentioned idea proposes more recycling points for separate collection at a convenient location in the neighbourhood. Participants in the focus groups considered it highly important that these recycling points should be accessible, for example by providing sufficient parking space or by setting up pick-up services for waste. This idea was supported in 16 member states.

"The containers for recycling should be placed every hundred yards or something. In my area, the one for the central zone is at the main square. And for some people it is so inconvenient to go there... really!" (Italy, Naples FG2, P6)

Another popular idea, brought up in 14 member states, involves increasing the use of deposit return systems for various types of items, for instance bottles, glass jars, aluminium, cartons, electronic appliances, plastic and cooking oil. This aims to reduce the use of resources and plastic in particular.

"I was asking myself, why are more things not recycled. Like cans, for example. These days you have plastic bottles that you can return, and you are given a return deposit for it. But in Germany, there you can return your cans and are given a return deposit for them. They should also do that in the Netherlands. Because there are so many cans along the side of the road. And that should not be the case. That you can hand them in for a return deposit; I think that's the perfect solution. [...]" (Netherlands FG4, P4)

"[P5] If there were deposits on lots of things, then people would learn to take them back and not chuck them away... We were thinking plastic bottles, glass, cans - they could be returned via machines – and then you could have deposits on clothes, electrical goods and furniture. Everything would be returned... The deposit would work the same way it does now on bottles of beer...
[P3] I just thought that the system could be based on barcodes... we said here that the barcode could incorporate the deposit." (Czech Republic FG2)

Five different member states mentioned the idea of collective or regional composting facilities for organic waste to make fertiliser. Participants felt this would be convenient because consumers would not need to have such facilities at home but would still be able to recycle organic waste.

"Funds should be allocated to newly established compost facilities, where we can get rid, finally, of all biological waste... Definitely for more than one municipality. Let's say for at least 100,000 people, or 200,000 people. All the organic waste from the municipalities would be taken there, because organic waste rots, so it would have to be taken there regularly... it would be spread back on gardens and you wouldn't have to buy fertiliser." (Czech Republic FG3, P1)

The last broadly supported idea described in this cluster suggests reusing of plastics, tyres and other non-toxic waste. Such waste can be used, for instance, in construction work, side barriers along roads, or playgrounds. This idea was mentioned by participants in four different member states.

Summary of results

Most ideas in the category 'management and logistics' belong to the cluster of waste collection and disposal, but the most popular ideas of the entire category fall in the category of waste prevention.
The idea which ranked highest was mentioned in 17 member states. It involves creating facilities in supermarkets for customers to bring their own containers, bottles, boxes and buy from a bulk stock. The second most popular idea, from the cluster on waste prevention, is more accessible recycling points for separate collection in neighbourhoods (mentioned in 16 member states). Another popular idea, mentioned in 15 member states, is to set up deposit return systems for various items. In addition, in 14 member states the idea was raised that producers should standardise types of packaging, using reusable, recyclable and environmentally friendly materials.

Table. 5.2.2 Most frequently mentioned and highly prioritised ideas within the category 'management and logistics'

Idea	Aim	Target group	Country
Waste prevention			
Provide possibilities in supermarkets for customers to bring their own packaging and buy from a bulk stock (i.e. containers, bottles, boxes)	Improve recycling/ Less packaging/ Less plastic	Consumers/ Producers	Austria ☆, Belgium ☆☆, Cyprus ☆☆, Estonia, France ☆☆, Germany, Ireland ☆, Italy ☆, Latvia ☆☆, Lithuania ☆☆, Luxembourg ☆, Netherlands ☆☆, Poland ☆, Portugal ☆, Spain ☆, Sweden ☆☆, UK ☆
Standardise the different types of packaging, preferably by making usage of less plastic and more reusable/ recyclable/ environmentally friendly materials	Less plastic/ Improve recycling/ Effect on planet/ Less use of resources	Producers	Austria, Belgium ☆☆, Czech Republic ☆, Denmark ☆, Germany ☆☆, Latvia ☆, Lithuania, Luxembourg ☆☆, Netherlands ☆, Slovakia, Slovenia, Spain ☆, Sweden ☆☆, UK ☆
Replace all plastic bags and bottles by alternatives that are recyclable or reusable or decomposable or biodegradable (i.e. glass, paper, leather, and wicker)	Less plastic	Consumers/ Producers	Bulgaria ☆, Cyprus ☆☆, France, Hungary ☆, Ireland ☆, Lithuania, Luxembourg, Poland, Portugal ☆, Slovakia ☆, Spain ☆
Implement a restructuring of the packaging industry, replacing current packaging materials by new ones that are recyclable and/or reusable	Less use of resources	Producers	Germany ☆☆, Italy ☆☆, Malta ☆, Netherlands ☆☆, Portugal ☆☆, Slovakia ☆, Spain ☆, Sweden ☆
Provide foods sold by weight or piece instead of in large and preset amounts so that people can buy exactly as much as they need	Less waste production/ Less packaging	Producers	Austria ☆, Finland ☆, Ireland, Luxembourg, Malta ☆, Spain ☆
Replace 'real' goods and administration by digital forms, e.g. e-books, DVD downloads, advertising	Less waste production/ Less use of resources	Producers/ Consumers	Cyprus ☆, Finland, France, Germany, Latvia, Lithuania, Slovakia ☆☆, Sweden ☆☆
Introduce better management and distribution of food: do not produce more than is being used and have shorter transport routes in order to have longer shelf-life of food	Less waste production/ Less use of resources	Consumers/ Producers	Cyprus, Denmark, Germany ☆, Latvia, Malta, Netherlands, Spain ☆
Waste collection and disposal			
Increase the use of deposit return systems for various types of waste (i.e. bottles, glass jars aluminium, cartons, electronics, plastic, cooking oil)	Less plastic/ Less use of resources	Producers	Bulgaria ☆, Cyprus ☆☆, Czech Republic ☆, Denmark, France, Germany, Hungary ☆☆, Ireland ☆☆, Netherlands ☆☆, Portugal ☆, Romania ☆☆, Slovakia, Spain
Provide more recycling points for separate collection at a convenient location, closer together, so that many people can get to them, with parking spaces and pick up service	Improve recycling	Waste management companies/ Consumers	Bulgaria, Czech Republic, Finland ☆☆, France ☆, Germany ☆, Hungary, Ireland ☆, Italy ☆☆, Netherlands, Poland ☆, Portugal, Romania ☆☆, Slovakia, Spain, UK

Idea	Aim	Target group	Country
Waste collection and disposal			
Establish collective or regional compost facilities for organic waste which can be used to make fertiliser	Improve recycling/ Convenience in the home	Consumers	Czech Republic ☆, France ☆, Italy, Portugal ☆
Improve the reuse of plastics, tires and other non-toxic waste in construction works and as side barriers along the road, or at playgrounds, to increase safety	Effective use of waste/ Effect on planet	Producers	Cyprus ☆☆, Italy ☆, Latvia ☆☆, Portugal, Slovakia

5.2.3 Communication and education

The category 'communication and education' includes 42 ideas in total. The category contains three clusters of ideas: education (18 ideas), awareness campaigns (nine ideas) and providing information (15 ideas). The ideas generally aim to raise knowledge and awareness among consumers about waste-related issues and to change their behaviour accordingly. Ideas that were mentioned most frequently by member states are described below and included in table 5.1.7.

The clusters of ideas related to **education** is the largest cluster in the category 'communication and education' with 18 ideas. Most popular was the idea to educate citizens about the importance of good waste management. According to participants, such education should take place nationwide, focusing on the negative effects of incorrect waste separation and recycling, the options concerning waste separation, and benefits of recycling. This idea was put forward in 22 different member states.

"Showing them 'worst case scenarios'... say you're contributing to this when you don't recycle. So making a conscious decision like, oh, no, for the sake of just doing this for five minutes I could..." (Ireland FG 1, P2)

The second most popular idea in the education cluster involves educating children in schools about waste in general and more specifically about a 'zero waste society', waste pathways, recycling and reuse. Participants in 20 different member states considered it important that children are taught about this topic from a young age in order to change their behaviour accordingly.

"I'm thinking to get this all started much earlier and focus on it, because it's important that the next generations know how to sort their trash." (Denmark FG 1, P8)

"We should start with education at school, as a compulsory subject, right from the primary school. Education about ecology and the environment in every aspect... materials, disposal etc..." (Italy, Milan FG3, P3)

"In the first place we have, of course, a change in life-style and thinking, which is done through education and awareness, OK. [...] Actually, it's a bit late for our generation, it should have been [...] from infancy on [...] it should be a taught subject in primary school [...] so that we all know what it's about and we know how to go about it and so on. That's the first thing." (Slovenia FG 1, PX)

Another idea focuses specifically on providing education on 'consumerism'. In focus groups in 12 member states, participants came up with the idea that education about this topic should be given in order to change citizens' behaviour regarding overconsumption.

"[P5] Yes, but if you go to buy things from your biofarmer [organic farm], then you only buy... then only those things are available. If you go to the Cactus [supermarket], then you often buy something else that you don't actually need and then more gets consumed that way...

[M] Yes, I am absolutely with you, I believe you too! But how do we do that?

[P9] By teaching people from infancy onwards to eat healthy, and with natural products, and not by getting used to eating strawberries in winter, for example, and by knowing that we only have strawberries during strawberry season and then we would avoid a lot." (Luxembourg FG 1)

In the cluster of ideas about **awareness campaigns**, there were nine ideas in total, of which two were mentioned in five different member states. One idea focuses on raising awareness about waste management and recycling in general. Participants suggested introducing this information gradually, for example through TV programmes and commercials on environmental topics.

Another idea involves setting up a shocking public campaign about the negative effects of waste on the environment using various media, such as TV commercials, posters in public spaces and billboards. Although this was mentioned in five different member states, it should be noted that it did not receive any priority.

There were 15 ideas on **providing information** within the category communication and education. The most popular idea is for producers to label their products to provide the consumer with information about their recycling properties. Focus group participants in 11 member states thought that this would help to raise awareness about recycling options, thereby improving recycling.

"[P4] Yes, we also had that idea, it should say on the package how it should be sorted. And in large print, not in some tiny print that needs a magnifying glass to be readable.
[P2] For example some colour-coded system.
[P 10] In colours maybe, like it is on deposits for bottles.
[P4] Well, yes, some marking, packaging classifications or something." (Estonia FG2)

The idea that ranked second in the cluster about providing information is to have advertisements in the media, such as TV and newspapers, to inform citizens about possibilities for reuse of all sorts of products. This includes information about where and how people can trade and reuse useful products like clothes, shoes, and furniture. This idea emerged in seven member states.

A final idea in this cluster focuses on improving the transparency of production processes in order to give consumers (and others) insights into how producers manage waste. In addition to creating awareness, this could encourage producers to handle waste in a better way and it would help consumers to buy or use 'good' products based on this information. This idea emerged in four different member states.

Summary of results

The three most popular ideas of the entire category are found in the cluster of education. One idea, mentioned in 22 member states, relates to educating citizens about the importance of good waste management. Another idea is to educate children in schools about waste in general and more specifically about a 'zero waste society', waste pathways, recycling and reuse (mentioned in 20 member states). The third most popular idea, mentioned in 12 member states, is to provide education on how to change the lifestyle of overconsumption.

Table. 5.2.3 Most frequently mentioned and highly prioritised ideas within the category 'communication and education'

Idea	Aim	Target group	Country
Education			
Educate people, on a nationwide level, about the importance of proper waste management (possibilities of waste separation, benefits of recycling, etc.) and about the negative effects of not separating waste properly and not recycling	Awareness of negative effects and possibilities/ Improve recycling	Consumers	Austria ☆☆, Belgium, Bulgaria ☆, Cyprus, Czech Republic ☆☆, Denmark ☆☆, France ☆☆, Germany ☆☆, Hungary ☆☆, Ireland ☆☆, Latvia, Lithuania ☆, Luxembourg ☆, Malta, Netherlands, Poland ☆, Portugal ☆☆, Romania ☆☆, Slovakia ☆, Slovenia ☆☆, Spain ☆☆, UK ☆☆
Educate children in schools about waste, a zero waste society, waste pathways, recycling, reuse, consumption, etc. They should be influenced from a young age	Behaviour change/ Awareness	Consumers	Bulgaria, Cyprus, Denmark ☆☆, Estonia ☆☆, France ☆☆, Germany ☆☆, Hungary ☆☆, Ireland ☆, Italy ☆, Latvia ☆☆, Lithuania ☆☆, Luxembourg ☆, Netherlands ☆☆, Poland ☆, Portugal, Romania ☆☆, Slovakia ☆, Spain ☆☆, Sweden ☆, UK ☆☆
Provide education on how to change the lifestyle of overconsumption	Behaviour change/ Awareness	Consumers	Bulgaria, France ☆, Germany ☆, Hungary, Ireland, Italy ☆, Lithuania ☆, Luxembourg ☆☆, Poland, Portugal, Slovenia ☆☆, Spain ☆
Awareness campaigns			
Provide a gradual introduction of information about waste management and recycling in the media, for example with TV programmes/ commercials about the environment	Awareness/ Behaviour change	Consumers	Estonia, Finland, France ☆, Malta, Poland ☆
Make a shocking public campaign (i.e. TV commercials, posters in public spaces, billboards, etc.) about the effects of waste	Awareness of negative effects	Consumers	France, Germany, Latvia, Luxembourg, Malta
Providing information			
Make producers label their products so that the consumer knows if they can be recycled and how to do this	Improve recycling/ Awareness of possibilities	Producers	Czech Republic, Denmark ☆, Estonia ☆☆, Finland, France, Germany, Ireland, Italy, Latvia ☆, Luxembourg, Portugal
Include more advertisement in the media (TV, newspapers, etc.) informing about where and how people can trade and reuse useful products like clothes, shoes and furniture	Awareness of possibilities/ Less use of resources/ Behaviour change	Consumers	France ☆, Hungary, Italy, Netherlands, Portugal, Slovakia, UK
Provide open information sharing of production lines and waste processing lines, showcasing recycling behaviours of producers	Awareness/ Behaviour change	Producers	Finland, Italy ☆, Lithuania, Spain ☆

5.2.4 Local initiatives

The category 'local initiatives' includes 23 ideas in total. The category contains four clusters of ideas, including: waste prevention (eight ideas), reuse/shared use/continued use (eight ideas), recycling (five ideas) and waste collection and disposal (two ideas). The ideas often aim at effective use of waste, targeting consumers. Ideas that were mentioned most frequently by member states are described below and included in table 5.1.8.

The most popular idea in the cluster **waste prevention** aims for more local production and less packaging through increased self-sufficiency of communities. Focus group participants in eight member states proposed that communities set up initiatives to produce food in communal gardens or on roofs.

"[P10] Locally produced food; then you don't need packaging, shipping.
[M] How do you solve the problems with locally produced food?
[P10] You place the farm in the inner city.
[M] How do you do that?
[P3] You grow on rooftops in the city and in parks." (Sweden FG2)

Another idea, closely related to the previous idea, focusing on both consumers and producers, is to stimulate consumption of locally produced food, accompanied by more local production and distribution of food. This idea emerged in six different member states.

"[P3] [...] Agricultural products straight from their producers.
[P4] To consumers.
[P3] To consumers, right. From producers to consumers... someone brings it all with a van, or we go there, take it, put it all in the bag and leave. And not [go] to a shop ...[...] I call a farmer, and he brings what I order; he comes twice a month [...] on the parking lot, so two vans bring apples, pumpkin oil, olive oil, kohlrabi, cabbage, everything. Home-grown products from his garden straight to my bag, I pay and I leave." (Slovenia FG2)

Another idea in this cluster, mentioned in five member states, is organising contests or competitions to encourage producers to make more environmentally friendly products.

"[P8] I think if it was more personal though, like a local issue, one estate say, all their waste went to one depot or something. So then you could see like, the effect that was having on the estate, compared to [others]. You could have like a challenge of something to, you know [...]
[P10] Cause everyone likes to boast don't they? Like, my street's better than your street." (United Kingdom, Newcastle-upon-Tyne FG1)

The cluster **reuse/shared use/continued use** includes several popular ideas. The idea that was most frequently mentioned is to set up special shops, centres or events where people from the local community can exchange and swap products or skills. This idea was brought up by participants in 12 different member states.

"I like the idea of the barter area... particularly for furniture and electrical goods... so they won't end up at garbage belts." (Italy, Milan FG3, P2)

A related idea is to encourage sharing in communities. This could involve, for example, renting or sharing of household appliances or skills to repair such products. Fewer resources would be needed, resulting in less waste. This idea was supported by participants in seven member states.

"[P5] In Berlin there's now a range of 'lending shops' where people bring things they don't need and then someone else can take it if they need it.
[P3] Yes, there's already sort of internet cafes and places where people bring their stuff and then there are proper specialists who repair, or try to repair it. Toasters and televisions and if they can't fix it, then you've got to buy a new one of course. But at least the idea's come back. And I think that's great, much better than nowadays when you can't fix it yourself, or when the electrician says, no, I haven't got the part for that, you know, or it's not worth it, chuck it away, you know, and then there's still people who say they'll give it another go." (Germany, Bremen FG1)

In six member states, focus group participants suggested that consumers could take more initiative in bringing used products and leftover food or medicine to charity organisations, or to donate it to other people that need it, for instance the homeless or poor people in other countries.

The cluster on **waste collection and disposal** consists of one idea. This idea is to organise clean-up activities in neighbourhoods, involving schools or the local community to collect and clean up waste. This idea emerged in six member states, but did not receive much priority.

Summary of results

The category 'local initiatives' is the smallest category in the domain of 'policy, management and education'. The highest priority ideas in the category aim at prevention and promotion of reuse, shared use and continued use. The most popular idea in this category, mentioned in 12 member states, is to set up special shops, centres or events where people from the local community can exchange and swap different waste, products or skills. The second most popular idea focuses on increased self-sufficiency of communities by producing food in for example communal gardens or rooftops (mentioned in eight member states). Another popular idea, mentioned in seven member states, concerns renting or sharing household products, goods and skills in communities.

Table. 5.2.4 Most frequently mentioned and highly prioritised ideas within the category 'local initiatives'

Idea	Aim	Target group	Country
Prevention			
People and communities should be self-sufficient by producing foods in gardens and on roofs	Local production/ Less packaging	Consumers	Austria ☆, Belgium, Estonia, Finland ☆, Germany ☆, Slovenia ☆, Spain ☆, Sweden ☆☆
Make more use and consumption of local production and distribution	Local production	Consumers/ Producers	Austria ☆, France ☆, Germany ☆, Latvia, Malta, Slovenia ☆, Spain ☆
Organise contests and competitions on ideas on how to make less polluting and less waste producing goods	Behaviour change/ Improve recycling	Consumers/ Producers	Finland ☆, Poland, Portugal, Slovakia ☆, UK ☆
Reuse, shared use, continued use			
Set up exchange and swapping shops, centres and events in communities (for waste, products and skills)	Less use of resources/ Effective use of waste	Consumers	Estonia ☆, Finland ☆, Germany ☆, Greece, Hungary ☆, Ireland, Italy ☆, Luxembourg ☆☆, Malta, Netherlands ☆, Slovakia, Slovenia ☆☆
Rent or share household products, goods and skills in communities	Less use of resources	Consumers	Belgium ☆☆, France, Germany ☆, Ireland ☆, Italy, Netherlands ☆, Spain
Stimulate consumers to take left overs (foods, medicines or used products) to charities or other people who need them	Effective use of waste	Consumers/ Other	Cyprus, Hungary, Italy ☆, Luxembourg, Poland ☆, Portugal
Waste collection and disposal			
Organise waste collection and clean-up activities with schools and communities	Other	Consumers	Estonia, Latvia ☆, Luxembourg, Poland, Portugal, Romania

6. Summary and discussion of results

This report presents findings from 100 citizen focus groups held in 27 EU member states. It is part of a wider consultation process called VOICES, which involves almost one thousand European citizens in discussing the European research priorities for the theme 'Urban Waste and Innovation'. In the smaller member states, three focus groups were conducted in one location, while in the bigger member states six focus groups were held in two different locations (three focus groups in each location).

The overall aim of the VOICES project is to identify citizens' preferences, values, needs and expectations with respect to research priorities for the theme 'Urban Waste and Innovation'. This provides input for the Consolidation Group that defined the actual priorities for the next work programme on 'Urban Waste' (call SiS.2013.1.2.1-2). In addition, it provides the methodology, the tools, the know-how and recommendations that can be adapted and used in coming years for similar initiatives.

Below, we present the main findings of the VOICES project. First, we address the use of the focus group approach and the VOICES project. Next, we go into the citizens' perspectives and ideas on urban waste.

6.1 The focus group approach and the VOICES project

The focus group method that was used in the VOICES project was successful in eliciting citizens' opinions and ideas on urban waste as shown by the large number of ideas for research and innovations that were collected. The design comprising four exercises helped the participants to discuss a topic they usually hardly think about. The participants were given free space to exchange their own experiences and views, which seems to have created an atmosphere, from which some interesting ideas could emerge. During evaluations held at the end of each focus group, participants often mentioned that they found the focus group meeting enjoyable and well organised. Many of them said that they learned a lot about urban waste and had become more aware of this topic.

It appears that the third exercise, asking participants for ideas on how to achieve a 'zero waste society' was sometimes challenging for them. Some of the ideas brought up during this exercise were very down to earth and may have already been in operation in some countries for many years, such as the deposit return system. Others are more far-fetched and futuristic, especially with respect to technological innovations, such as a machine that disintegrates waste to molecular level. Some of the ideas did not focus on achieving a 'zero waste society', such as ideas to get rid of waste by dumping it in a volcano or sending it into space, which rather resembles the idea 'out of sight, out of mind'. The feasibility of ideas and the extent to which they already exist in practice is difficult to judge for participants. The evaluation by waste management experts and social innovation experts was therefore an important part of the process, in order to assess the ideas in more detail.

There was a high level of uniformity in opinions and ideas across the different member states, although some country-specific outcomes were also observed. For example, in the focus groups in Naples there was a general mistrust in the local authorities who are responsible for the disposal of waste. The participants mentioned that the political system has links with the Camorra and is not transparent. In Latvia, participants claimed that a waste management company had a monopoly position and provided poor quality services for increasingly higher fees.

In all member states, the moderators successfully led the focus groups and followed the script. However, there was some diversity in the quality of the focus groups. In some member states, moderators sometimes let the discussion wonder off in the direction of more general issues of sustainability. Occasionally moderators

became engaged in the conversation to the extent that they were almost bringing in their own ideas for research and innovation. In a few other cases, moderators did not seem to probe participants sufficiently in order to identify reasons for bringing up certain ideas. But overall the focus group design proved to be robust and the quality of data was good. The independent evaluators of the VOICES project concluded that:

> *"The focus group component of the project has generally been highly impressive: the design process (genesis) provided a degree of rigour that is rarely found in public engagement events, and the skill and dedication of the moderators helped to ensure that the design was well implemented." (VOICES Evaluation Report, First Part)*[14]

The EU initiative was much appreciated by the participants. Many participants said that they are pleased that the EU is taking an interest in their ideas and are curious to find out what will be done with the ideas brought up in the focus groups. Some of them raised doubts whether the discussion would actually have an impact, while many expressed the hope that it would influence EU policy.

6.2 Citizens' perspectives on urban waste

The findings from the focus groups show that most participants recycle to some extent. However, the ways that waste separation and collection are organised vary considerably between member states. Many differences also exist between municipalities in individual member states. Waste management systems in member states that rank high on the EU27 list of Municipal Solid Waste Recycling often had more developed and more complex systems. Their barriers and concerns were different to those with less developed systems, in member states ranking low on the EU27 MSW list. In general, participants in member states with less developed systems were more critical about waste management in their countries and seemed to be more creative with local and personal initiatives for recycling and reusing waste. Differences between rural and urban areas appear also relevant, as this affects the availability and accessibility of waste management facilities.

Many participants seemed to feel that they bear a lot of responsibility with regard to waste separation. A considerable number of participants wondered whether waste separation at household level makes a difference at all. This relates to their suspicion of waste management companies, questioning whether they really keep sorted waste separate, or whether everything ends up on one big pile. In general, participants had very limited knowledge about waste pathways, often with no idea of what happens to household waste after it is thrown away.

A large number of ideas for research and innovation concerning urban waste emerged from the focus groups: over 350 in total, and with a great deal of diversity. The participants' ideas were strongly connected to the barriers and concerns they mentioned regarding urban waste. The ideas often seem to reflect the personal situation of participants, focusing on all sorts of innovations at household level. A range of ideas came up across many member states. Although ideas appear in different research categories, they can still be linked, as these ideas often need to be developed on various levels requiring several types of innovation in the domains of technology, policy and management, for example.

When considering the stages of waste life-cycles (waste prevention, waste management at the household level and waste collection/disposal), **waste prevention** was identified as an important topic for focus group participants. Participants came up with ideas that would prevent waste, such as systems that would transport products from producers or shops directly to houses, 3D printers that can print products or spare parts and local production of food in communal gardens. A range of other ideas focuses more on preventing waste by using fewer resources. In general, participants were very concerned about the use of plastic and suggested using more environmentally friendly materials. Examples of such ideas include packaging that is biodegrad-

[14] Available at: http://www.voicesforinnovation.eu/phase_9_new.html

able, reusable or recyclable, improving the quality and lifespan of products, the development of universal, standardised or changeable product parts, electronic devices that do not need batteries and renting or sharing household appliances. For many of these ideas, participants mentioned that regulations and incentives were needed, often aimed at producers in order to reduce the amount and type of harmful materials that producers use for packaging. Some other ideas aim more generally at reducing waste production, including possibilities for consumers to bring their own bottles and bags and buy from bulk stock, a machine to determine whether food is still edible and developing food in pill form (although this latter idea is somewhat controversial, since many participants also mentioned the pleasure experienced in eating full meals).

With respect to **waste management at the household level**, participants came up with a range of ideas focusing on the developing machines or systems that help dispose of waste. Participants were very enthusiastic about developing devices that would automatically sort or compress waste, possibly in the form of 'intelligent' bins. The development of a pipe system for waste disposal, connecting households to recycling plants, also gained considerable support in the focus groups. Participants also talked about apps or online services that could help them recycle. They suggested labels providing information on how to recycle specific products. Furthermore, participants thought that the provision of incentives would stimulate consumers to improve their recycling behaviour. Another very popular idea regarding waste at household level was new technology to use waste to produce energy or products directly.

Regarding the **collection and disposal of waste** some of the very popular ideas focus on the effective use of waste. This might entail machines that turn waste into new material or products, techniques to turn waste into fuel or improving incineration plants in order to generate energy. There were also ideas to improve recycling and reuse practices, to expand the current deposit return system, to increase the number of (accessible) recycling points and to set up exchange or swap shops. In many countries, participants also came up with ideas in order to simply get rid of waste (by dissolving or disintegrating it, dumping it in oceans or volcanoes or, more futuristically, by sending it into space, e.g. the moon, the sun and black holes). Such ideas were often accompanied by a discussion among participants, in which they agreed that this type of solution would not contribute to reaching a 'zero waste society'. They underline the fact that citizens are aware of waste treatment problems in our current world, and keen to find 'quick solutions' which would allow us to get rid of the waste we produce on short term.

Many participants highlighted the importance of education on waste-related issues. This is a cross-cutting issue which is relevant for all phases of the waste life-cycle. Education could encourage people to consume less in order to prevent waste and improve behaviour regarding waste separation and disposal.

Some interesting trends can be observed when comparing the priorities given by the five highest-ranking countries in Municipal Solid Waste Recycling across the 27 EU member states (Austria, Germany, Belgium, the Netherlands and Sweden) to the five lowest-ranking (Latvia, Slovakia, Lithuania, Romania and Bulgaria). Both groups of countries assigned slightly more priority to the research domain 'policy, management and communication' than 'environmental sciences and technology'. They show similar patterns concerning the ranking order of the priority assigned to the different categories.

However, differences can also be observed. For example, topics within the 'prevention' cluster were assigned considerably higher priority in the group of high-ranking countries than in the group of low-ranking countries. Almost half of all priority stickers from participants in the group of high-ranking countries were assigned to ideas that relate to the prevention of waste; more than twice as much as in low-ranking countries. Low-ranking countries, however, assigned much more priority to the category 'management and logistics' than their high-ranking counterparts, particularly topics related to the cluster 'collection and disposal'. In the group of low-ranking countries, ideas related to the organisation of the waste management system received roughly double the number of priority stickers of similar ideas in the group of high-ranking countries. The low-ranking countries also assigned higher priority to the topic of 'education' and 'awareness campaigns' in the category 'communication and education', as compared to high-ranking countries.

7. VOICES and Responsible Research and Innovation (RRI)

7.1 About RRI

In recent years, the European Union has been focusing on its strategy to create sustainable, inclusive growth and prosperity and address the societal challenges of Europe and the world. In line with this strategy, in the context of Europe 2020, the Innovation Union and the ambition to develop a European Research Area, the European institutions are working to address societal needs and ethical questions in research and development. We refer to this work using the term Responsible Research and Innovation (RRI). The European Commission defines RRI in its 2013 expert group report 'Options for Strengthening Responsible Research and Innovation':[15]

> *"To achieve better alignment of research and innovation with societal needs a number of initiatives have been undertaken by EU Member States and the European Commission. These initiatives have shown that there is a need for a comprehensive approach to achieve such an improved alignment. Responsible Research and Innovation (RRI) refers to the comprehensive approach of proceeding in research and innovation in ways that allow all stakeholders that are involved in the processes of research and innovation at an early stage (A) to obtain relevant knowledge on the consequences of the outcomes of their actions and on the range of options open to them and (B) to effectively evaluate both outcomes and options in terms of societal needs and moral values and (C) to use these considerations (under A and B) as functional requirements for design and development of new research, products and services. The RRI approach has to be a key part of the research and innovation process and should be established as a collective, inclusive and system-wide approach."*

The VOICES initiative was taken in line with the RRI approach, in order to demonstrate how policymaking related to research and innovation can be directly influenced by the opinions of European citizens. As the expert group report states:

> *"There are many examples in which the outcomes of research have been contested in society, because societal impacts and ethical aspects have not adequately been taken into consideration in the development of innovation. In many cases, the related research funding was wasted. On the other hand, there are many cases in which the successful and early consideration of societal needs has brought up innovation which were particular successful also in economic terms."*

Consultations such as that of VOICES therefore contribute to ensuring societal needs are taken into account. The report underlines the importance of coordinating these actions in order to maximise impact.

7.2 VOICES key findings related to RRI

The work of the VOICES Consolidation Group, as described in Section 1.3, was to take the outcomes of the VOICES focus group analysis from across the 27 countries where consultations took place, and integrate them into future priorities in European research and innovation policy. The work of the Consolidation Group drew out a number of key points from the analysis of the VOICES focus groups.

[15] European Commission EUR 25766 – "Options for Strengthening Responsible Research and Innovation", Luxembourg: Publications Office of the European Union 2013. Available at: http://ec.europa.eu/research/science-society/document_library/pdf_06/options-for-strengthening_en.pdf

In 2012, the European Commission released a policy document which outlined its priorities on research and innovation in waste management, entitled 'Waste as a Resource – EU research'.[16] The document states that, "The top priority is finding ways to reduce waste where possible, reuse what can be salvaged, and recycle more and more with sophisticated as well as effective sorting and recovery technologies." Other priorities include encouraging industries to make use of waste generated in other sectors, and managing waste efficiently at local, national and global levels. The document also refers to the high recycling targets which the EU has set itself, based on the European Commission's 2008 Waste Framework Directive.

The Consolidation Group, in line with the feedback provided by the VOICES Advisory Board, found that many of the VOICES outcomes clearly legitimised these current priorities in European research and innovation policy. Other key outcomes, however, suggested new priorities which could be incorporated into the priorities of future European research and innovation.

7.2.1 VOICES outcomes in line with current EU research priorities

Many of the key VOICES outcomes legitimise current EU priorities on the topic of 'Urban Waste'. Much of what was relevant of these findings related to awareness: confirmation that in many areas, citizens do have significant knowledge of the challenges facing waste disposal in Europe, and agree with current EU research priorities. These outcomes can be summarised as follows.

Citizens across the focus groups expressed a need for **less packaging**. On the whole, they believe products are over-packaged in an attempt to make them more appealing to consumers, using more material than the minimum necessary to ensure hygiene and protection of the product. European citizens also expressed a need for **more efficient packaging materials**. They want to see research carried out into more effective types of 100% biodegradable packaging, and plastics that can be fully recycled without loss of quality. This fits with the EU priorities of reducing waste on the manufacturing level, and finding ways to recycle more.

The focus group participants want urban waste to be **easier to recycle and reuse**, in more efficient ways. They look to European research to come up with innovative ways to recycle and reuse products, taking the recycling process into account both in the way the products are manufactured and in their disposal or reuse. This is in line with EU priorities to find ways to reuse and recycle more using sophisticated technologies.

In terms of policy measures, European citizens want **manufacturers to be regulated more heavily**, taking responsibility for the lifespan and recycling of their products. They are aware that many products are designed to have a limited lifespan. Manufacturers could in fact produce longer life products, but choose to make their products become redundant after a certain period of time in order to encourage the consumer to buy new products. Citizens want to see an end to this planned obsolescence. Again, this supports current EU priorities of encouraging industries to take action to reduce waste.

Another policy point which came up in the focus groups relates to recycling points, where citizens take their waste to be recycled. In general, citizens across the EU feel that **more recycle points are needed**, at locations which will be more convenient for the general public to reach. This supports the EU's focus on recycling targets as stated in the 2008 Waste Framework Directive.

[16] Waste as a Resource – EU research, Luxembourg: Publications Office of the European Union, 2012, http://bookshop.europa.eu/en/eu-research-pbKI3012899/

A final point which came out of the focus groups that legitimises current research priorities is on the subject of waste incineration. Focus group participants in general called for **more waste to be incinerated to produce heat and energy**. They would like to see European research focusing as much as possible on innovations which make the incineration process more efficient. The EU's current priority on using sophisticated technology to improve waste management is already working towards this goal.

7.2.2 VOICES outcomes suggesting innovative ways to strengthen EU research

The VOICES outcomes underlined some issues which are not sufficiently accounted for by current EU priorities on the topic of 'Urban Waste', and which could be used to strengthen European research and innovation. These elements, which constitute the core of the VOICES contribution to RRI and strong suggestions for better social innovation in the field, can be summarised as follows.

One aspect of the waste management process which focus group participants emphasised heavily in consultations across the EU was the issue of recycling and household convenience. European citizens feel **convenience in the household is crucial**. The VOICES outcomes pointed to a clear need for devices to facilitate sorting and compacting in the home (along the lines of "smart bins"), or technology which allows waste to be used as a resource in the household.

In terms of waste management policy, one key outcome from VOICES is that **European citizens want more incentives to separate their waste**. Consultations across the EU found that citizens feel that a lot of effort is required to dispose of their waste properly. They see other individuals and organisations benefitting financially from waste, and they would like to see more deposit systems and reward schemes in place to ensure that the general public also has a direct incentive to separate and dispose of waste correctly.

In order to do so, citizens suggested ideas which could be developed through scientific research, by creating new technologies or adapting already existing ones. For example, they would like to have machines in their houses that automatically sort or dispose of waste, or smart bins and containers, that can inform about waste and correct or inappropriate separation. They would also like a barcode recognition system (or other systems) which can detect whether or not waste has been properly separated and disposed of, linked to some kind of 'credit system', bringing advantages to citizens in terms of taxes, incentives, etc.

VOICES focus group participants emphasised that they feel **education and communication are crucial** to improve management of urban waste as a resource. The consultations found that citizens are largely unaware of the waste management process, and would feel more engaged in the process if knowledge was more widespread. Citizens across Europe stated specifically that they would feel more motivated to dispose of waste correctly if they knew exactly what happened once they had sorted and thrown it away.

One final conclusion of the VOICES consultations which can strengthen future EU research directions is the citizens' emphatic confirmation that **technology can be a motivation to recycle in itself**. Citizens frequently stated they feel that technology can help to empower people in the recycling process. Subsequently, they assigned high priority to ideas using chips, electronic tags and apps to facilitate the waste disposal process, and lead Europe towards a 'zero waste society'.

7.3 Impact

The most direct impact of VOICES is the fact that the outcomes have been used to influence the direction of the European Union's research and innovation policy. The work of the Consolidation Group, which met in June 2013 at the European Commission in Brussels, was to take the VOICES outcomes and ensure that the needs and priorities expressed by the citizens are reflected as much as possible in the upcoming Horizon 2020 work programme, which funds research and innovation projects on the topic of 'Urban Waste'. Projects co-financed by this work programme will therefore be working to address the needs, concerns and ideas of citizens drawn out by VOICES consultations. This process is therefore a model of Responsible Research and Innovation in action, and a demonstration of how RRI can be integrated into a large-scale funding programme, ensuring coherent implementation of RRI across Europe.

As such, the VOICES process also has a very significant impact as a pilot project. By refining, implementing and evaluating a methodology which is capable of gathering and analysing citizens' hopes, concerns and perceived opportunities about a complex topic related to research, VOICES sets a precedent for other consultations with similar objectives. VOICES has shown what factors are necessary for such a consultation to be effective, and the project tools have been designed to be adaptable for use on a local, regional or national as well as European level, and on a vast range of subject areas of societal concern. Consultations using VOICES methods can also have a wide range of objectives in terms of how the results are used.

A significant related impact is the fact that VOICES was a strong tool in terms of capacity building. By bringing science centres and museums together with academic experts in consultation methodologies and focus group participant recruitment companies, VOICES established key hubs of expertise across the European Union. These hubs now have the skills and experience to carry out similar consultations in the future, continuing to contribute to the RRI process on a local, national and European level where required.

One interesting finding of the VOICES consultations was that the focus groups themselves actually trigger public engagement on the part of the participants. When reflecting on the experience of taking part in a VOICES focus group, European citizens frequently expressed a feeling of engagement. They often enjoyed the experience, found it interesting to share experiences and knowledge on the topic of urban waste as a resource, and felt more motivated to manage waste correctly as a result. Science centres and museums, as institutions of informal education, can harness and maximise this impact in terms of public engagement.

The effects of the impacts mentioned in this section are all multiplied by the way the project is disseminated and the coverage it receives from the media and other stakeholders. The wide range of dissemination activities around the VOICES project and the strong confirmation from the European Commission in the project's validity are both crucial in ensuring that the impact of VOICES will be multiplied, reaching researchers, policymakers, academics, industry and other stakeholders across the field of research and innovation.

8. Reflections and future research

Embarking on such a large-scale consultation with such a direct impact on research policy was a groundbreaking move by the European Commission, showing a strong commitment to the concept of Responsible Research and Innovation. As mentioned above, the impact of such an undertaking stretches beyond what was conceived of at the beginning of the project.

Looking back at the project, it should be noted that it is important with such a consultation process to be clear in advance about the expected outcomes. In the case of VOICES, the consultations were clearly aimed at identifying and collecting citizens' ideas which would influence part of the priorities of a specific EU work programme for research and innovation. One misconception about VOICES could be that it was inviting citizens to identify problems in the waste management process and directly come up with new innovations in order to solve these problems. This may well be a by-product of the work of the VOICES consultations, and it is true that the methodology involves participants identifying and prioritising solutions, but the ultimate objective was for citizens to identify ideas (not only those linked to existing problems) to feed into analysis and influence research priorities. The success of the project can clearly be judged on these terms.

That said, participants in the VOICES consultations did come up with a number of significant creative innovations. Thanks to the structure of the focus group, these innovative ideas were also assigned priority by each group, validating the importance of each idea in the eyes of European citizens.

The analysis of the VOICES consultation outcomes also brought up a number of questions which could form the basis of future research into European attitudes towards urban waste as a resource and the concept of a 'zero waste society'. Several such questions are raised when looking at the focus group data across groups of linked countries. For example, a trend can be perceived that European countries around the Mediterranean tend to favour the use of incentives, deposit systems and reward schemes as a way to motivate people to dispose of waste correctly, more than other member states. Furthermore, in EU member states which belonged to the former Soviet Union, various participants expressed nostalgia for the values of society under that regime. Such trends reflect local cultural, social and economic factors and should be further studied in order to be able to foster more region-specific policymaking in European research.

The VOICES data also invites further analysis in relation to age groups. Although VOICES focus groups were clearly structured by age groups, no major trends related to this were drawn out in the current analysis. Nevertheless, further analysis of the attitudes of each of these groups could lead to interesting conclusions regarding urban waste, particularly with a view to the opinions of future generations. Since Youth will be the focus of one of the upcoming European Years promoted by the European Commission, this could prove a particularly relevant moment to look into such an issue.

A number of broader findings of the VOICES consultations also invite further research. For example, participants in VOICES focus groups emphatically supported the regulatory role of legislative bodies like the European Commission, calling for more regulation in waste management. This does not appear to be in line with the trend currently perceived in Europe calling for less regulation from EU institutions. Another example was a perceived mistrust from citizens in countries considered leaders in waste management (highest-ranking countries in the 27 EU member states of Municipal Solid Waste Recycling) regarding their own countries' policies, facilities and systems for waste disposal. This attitude was perceived in consultations in many of the countries which are ranked at the top of Eurostat's 2010 listing of the percentage of Municipal Solid Waste recycled. Participants often expressed similar levels of mistrust of waste disposal management in their country as those in countries which rank lower on the same listing (and therefore do not have such well-developed recycling systems and facilities). Further research could draw interesting conclusions on this matter.

An interesting analysis could also be performed to look at the terms which participants came up with to describe their innovative ideas. Participants across Europe coined a number of phrases such as 'smart bins', 'zero-waste marketing' and 'zero-waste behaviour' which could be interesting concepts to explore in more depth and apply to future research and innovations.

The fact that the VOICES consultation resulted in an impact and a set of potential future opportunities for more research and analysis is further confirmation of its value as not just a consultative tool but also a framework within which RRI can be fostered and advanced. We look forward with great anticipation to the outcomes of future initiatives which follow the precedent set by VOICES.

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VOICES, CITIZEN PARTICIPATION IN SOCIAL INNOVATION

VOICES is a Europe-wide citizen consultation process, led by Ecsite, the European network of science centres and museums, which helps set the agenda for the environmental research dimension of Horizon 2020 - the European Union's strategy to advance research and innovation.

VOICES represents a valuable insight on methods and procedure for engaging citizen participation to inform Europe's Responsible Research and Innovation framework. Focus groups, academic analyses of public consultations and dissemination of results will lead to an effective method through which to consult the public on science and technology related issues.

VOICES is engaging citizens in 27 EU countries through science centres and museums - all of which are expert, impartial and powerful partners in public engagement with science as members of Ecsite.

One thousand European citizens have joined VOICES focus group discussions on innovative uses and solutions for urban waste. The outcomes of this European consultation process are presented in the VOICES Reports Collection.

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