



CIRCULAR FOAM

Consumer Survey

Assessment of consumer awareness and attitudes towards circular solutions for products with polyurethane foam in Germany, the Netherlands, and Poland

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Introduction

The present report summarizes the results of the consumer survey commissioned for work package 1 in the European Horizon 2020 project “CIRCULAR FOAM - Systemic expansion of territorial CIRCULAR Ecosystems for end-of-life FOAM”. It is intended to offer insights into consumer attitudes, preferences and sustainable behaviour by providing a systematic study commissioned by WP1 specifically for the CIRCULAR FOAM project and its thematic scope.

The CIRCULAR FOAM project aims to introduce several improvements to the existing material cycle and build a new, sustainable, circular ecosystem for rigid polyurethane foam. The research objective of the survey was to determine the level of societal awareness regarding circular economy solutions in Germany, the Netherlands, and Poland. The analyses were conducted to gain a deeper understanding of potential consumers' awareness and attitudes towards recycled polyurethane, including their willingness to make purchasing choices for products and devices made using recycled polyurethane foam.

The data was obtained in a two-step research process, using the principle of methodological triangulation. As a first step, a nomothetic approach (quantitative research) was employed, using the Computer Assisted Web Interview (CAWI) method to obtain an overview of the problem under study on a national level for the three countries. In addition to the quantitative research and as the second step, we used qualitative research by means of focus groups on the regional level to help answer complex questions and give insights into attitudes, arguments, preferences and associations with the given topic. This report is structured accordingly: In the first chapter, it presents the results from the quantitative CAWI survey, followed by the qualitative survey results in the second chapter. It closes with the conclusion in chapter 3.

1 Quantitative research: CAWI survey

The quantitative CAWI survey was carried out from 29 April to 9 May, 2023 by the Polish company Korporacja Badawcza Pretendent that was commissioned by the Circular Foam project consortium member Wrocław University of Economics and Business. The survey was incorporated into an omnibus survey and encompassed five main questions and additional demographic questions.

1.1 Demographic data

The demographic questions covered the following aspects, some of which are shown in diagrams below:

- Gender
- Age
- Education
- Status in labor market
- Type of building they live in
- Home ownership
- Number of people in household
- Income
- Region
- Rural/ urban place of residence



The group of respondents from Germany consisted of 1002 people with the following composition:

- 514 female (51.3%)
- 486 male (48.5%)
- 2 diverse/ no answer (0.2%)

The group of respondents from the Netherlands consisted of 1008 people with the following composition:

- 526 female (52.2%)
- 477 male (47.3%)
- 5 diverse/ no answer (0.5%)

The group of respondents from Poland consisted of 1001 people with the following composition:

- 662 female (66.1%)
- 337 male (33.7%)
- 2 diverse/ no answer (0.2%)

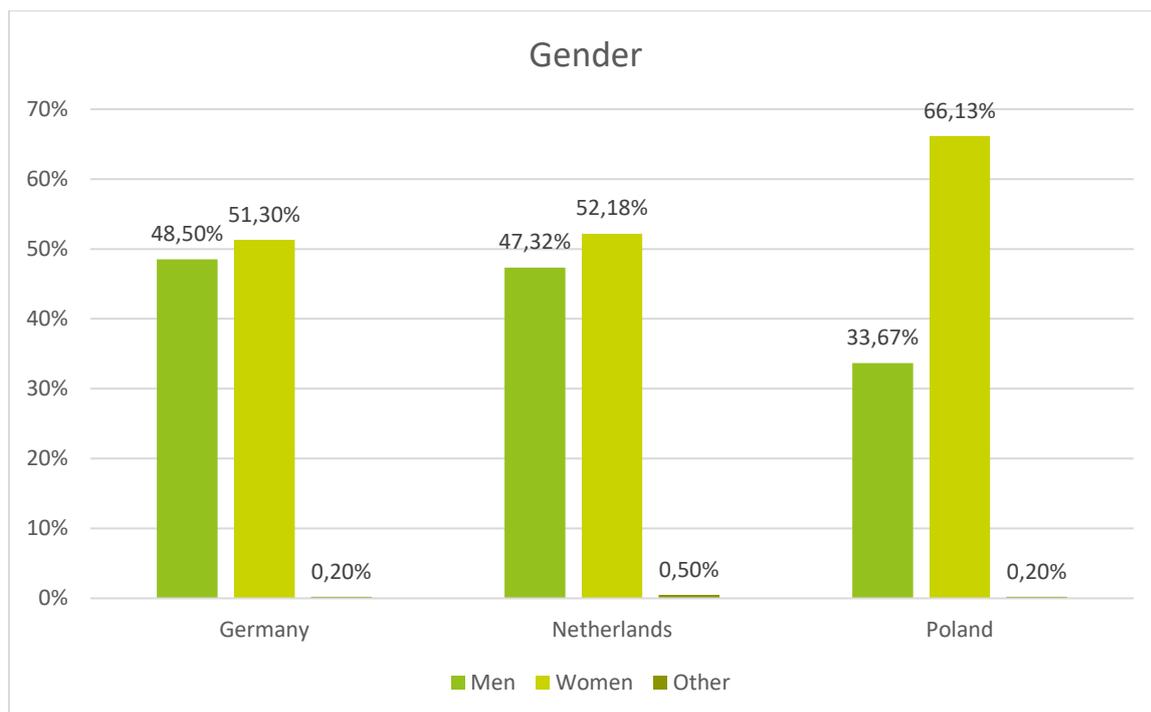


FIGURE 1: GENDER COMPOSITION

It is apparent in figure 1 that the sample does not align with the overall population statistics in the countries, especially in the case of Poland, where the female population represented 51.54% and the male population 48.46% of the total population in 2023. The other two country samples are closer to the actual gender ratio in the respective populations: In the Netherlands, 49.67% of all residents were male and 50.33% female in 2023. The German population was composed of 49.38% men and 50.63% women (UN 2024).

The age groups show that the 26-35 year-olds were represented the most in Germany and the Netherlands with around 30%, while in Poland, the age group from 36-45 yrs. is higher in number. In all three countries, the age group of 60 and above is by far the smallest in the sample.

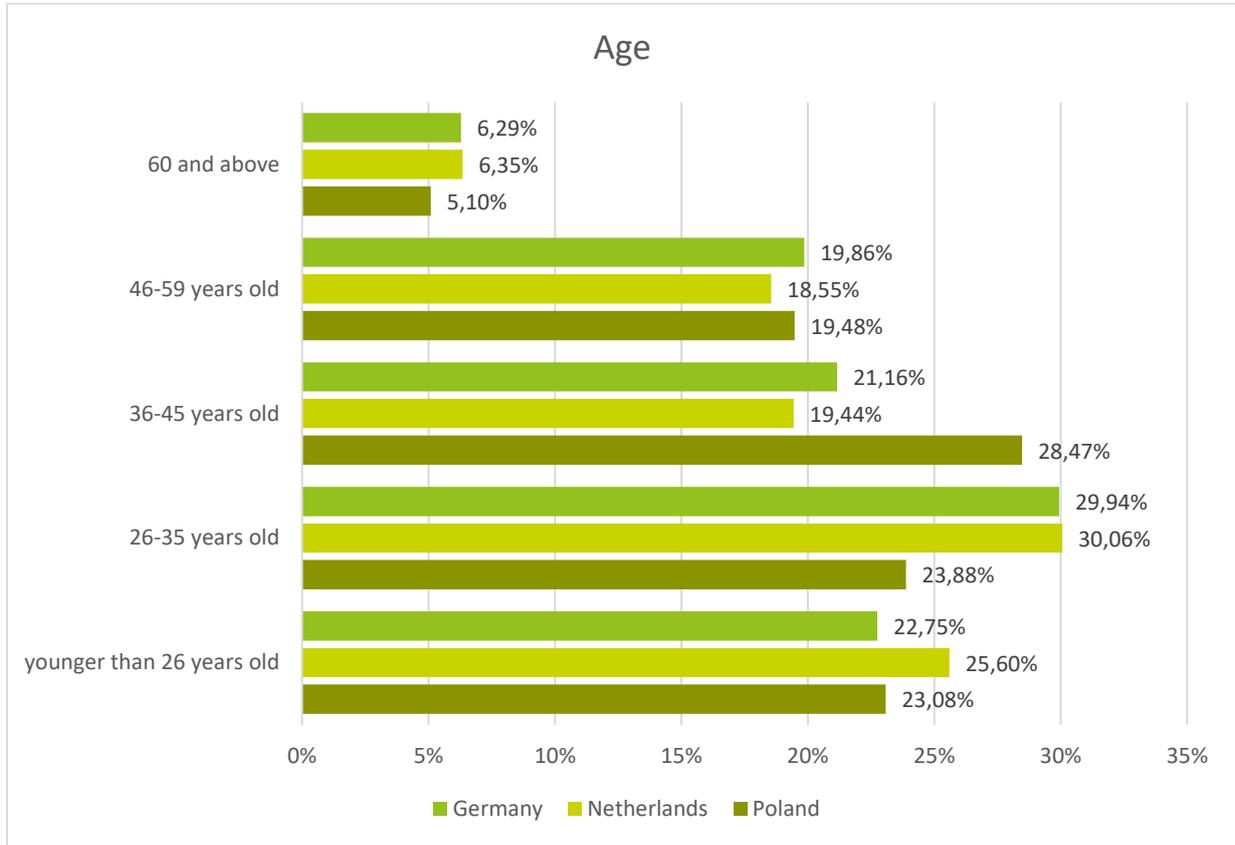


FIGURE 2: AGE DISTRIBUTION

The job status is very similar across the countries. In all three national surveys, over 60% of respondents have indicated to be professionally active, while another rounded 15-20% are active but looking for other work. The share of people not professionally active and not looking for work is below 10% in each survey (see figure 3).

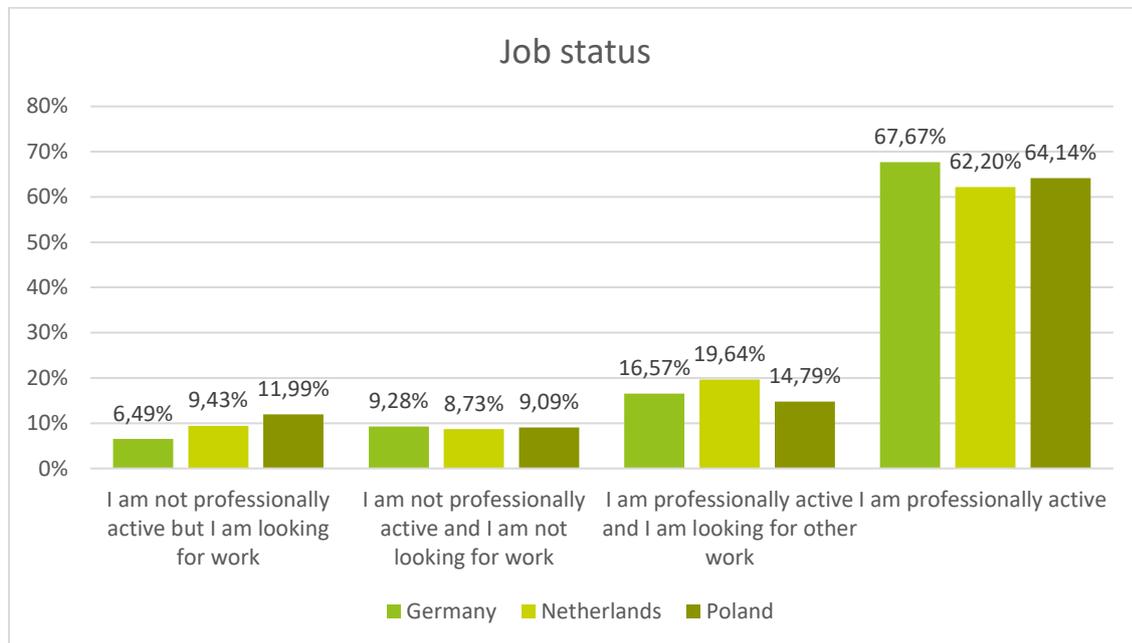


FIGURE 3: JOB STATUS

When asked for the type of building the respondents live in, the results show large differences between the countries. What stands out is the high proportion of people living in single-family homes in the Netherlands with 71.93%. For Germany, the representation of this type of home is much lower and nearly balanced out with multi-family homes with up to four units. In Poland, the single-family home is also most common but closely followed by multi-family homes with more than five units - and below 10% of homes up to four units.

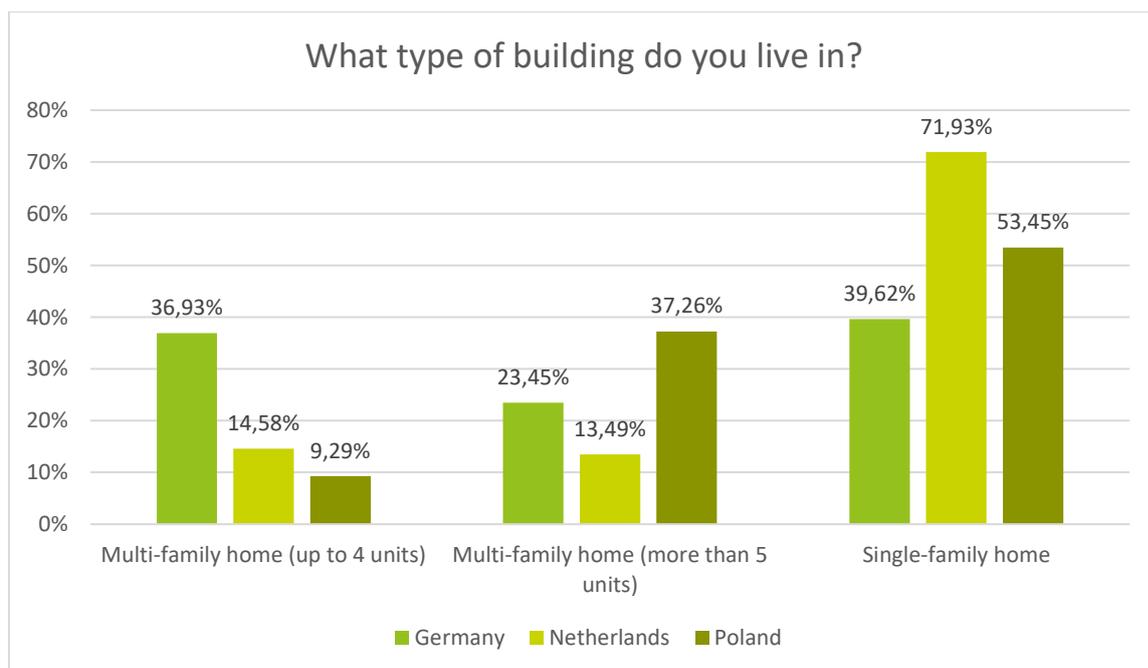


FIGURE 4: TYPE OF BUILDING

Homeownership is also lowest in the German survey with only 42.52% compared to a much higher percentage of 65.77% in the Netherlands and 70.83% in Poland.

These figures are lower than the official homeownership rates in the total populations of the three countries with Poland at 87.2%, the Netherlands at 70.6% and Germany at 46.7% but show a similar tendency (eurostat 2023).

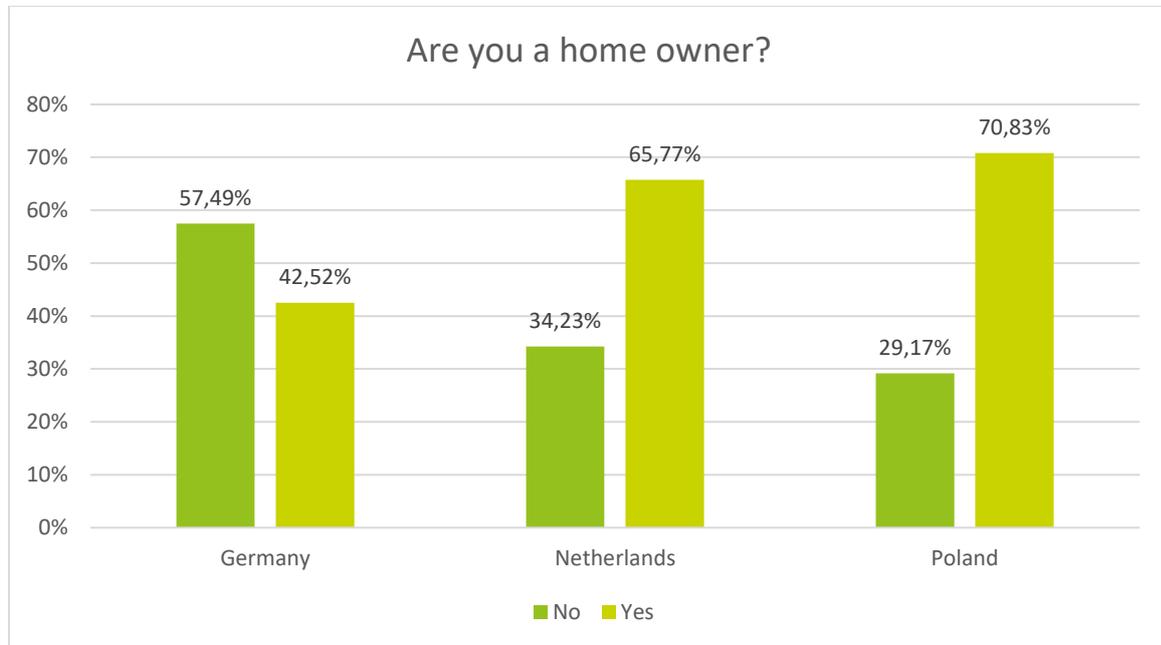


FIGURE 5: HOMEOWNERSHIP

Most striking when looking at the number of people living in the respondents' households is the very low share of one-person-households in Poland with only 5.59% and at the same time a relatively high share of four- and five-person households. The Dutch respondents are also more likely to live in a group of four but most common is a two-person household, which also applies to the German participants.

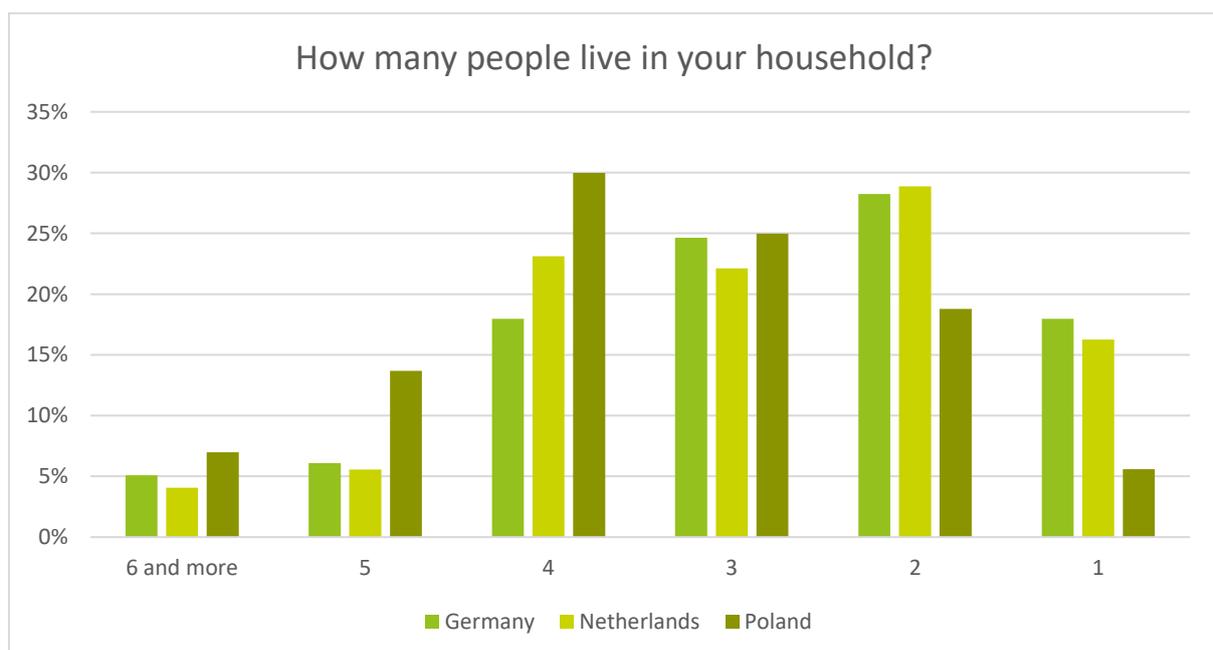


FIGURE 6: NUMBER OF PEOPLE IN HOUSEHOLD

In the Netherlands, a particularly high number of people live in a village with close to 30% of respondents, followed by medium-sized cities between 50,000 to 150,000 residents. For both Germany and Poland, small cities of up to 50,000 people are more prevalent as the place of residence. The results also show a rather high number of Germans who live in a village, while in comparison, a noticeable share of Polish participants live in larger cities from 150,000 to 500,000 residents.

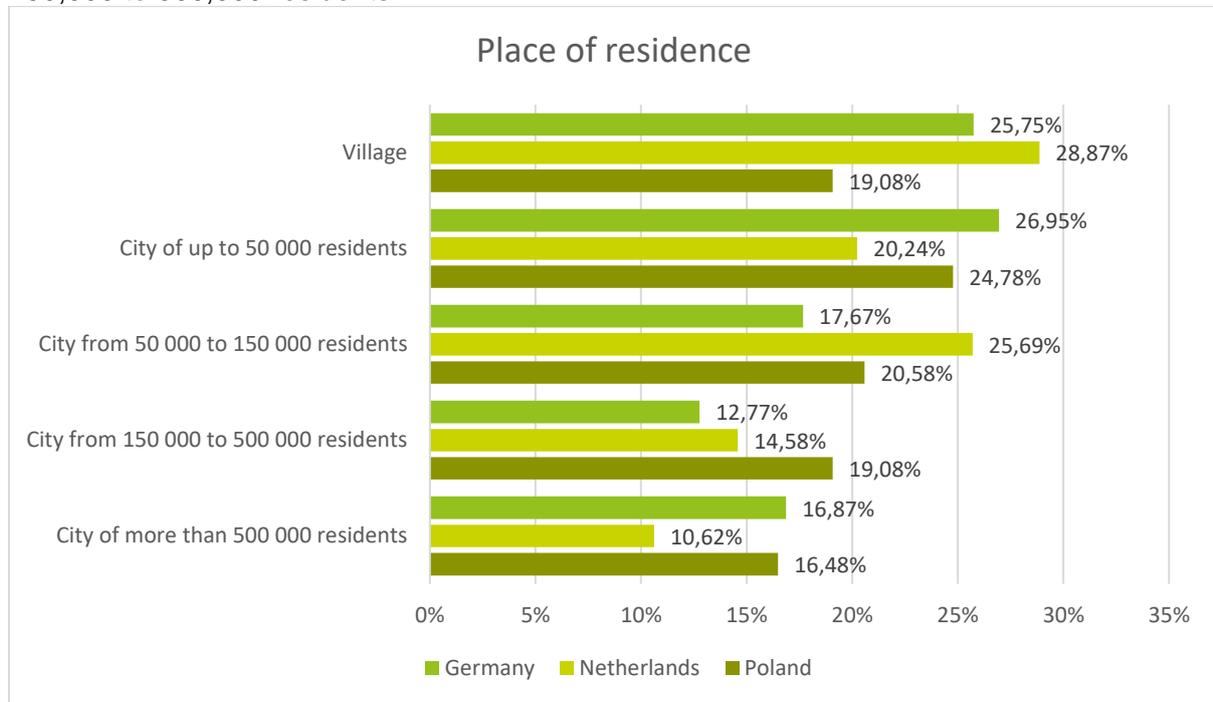


FIGURE 7: PLACE OF RESIDENCE

1.2 Results

The respondents answered the following five questions in the survey:

- How familiar are you with the concept of *circular economy*?
- Who should be responsible for advancing recycling solutions of plastic waste?
- Hard foam made out of a plastic called Polyurethane (PU) is used for insulation. Could you name a product in which PU is integrated?
- What factors would convince you to choose a refrigerator with recycled PU plastic?
- What factors would convince you to choose house insulation products with recycled PU plastic?

The following diagrams show the aggregated results for the five survey items for the three countries.

1.2.1 Familiarity with circular economy

The first question in the survey asked respondents to indicate their familiarity with the concept of circular economy. They were asked to choose a number on a scale of 1 (no familiarity) to 7 (high familiarity). The following diagram shows the combined results for the three national surveys:

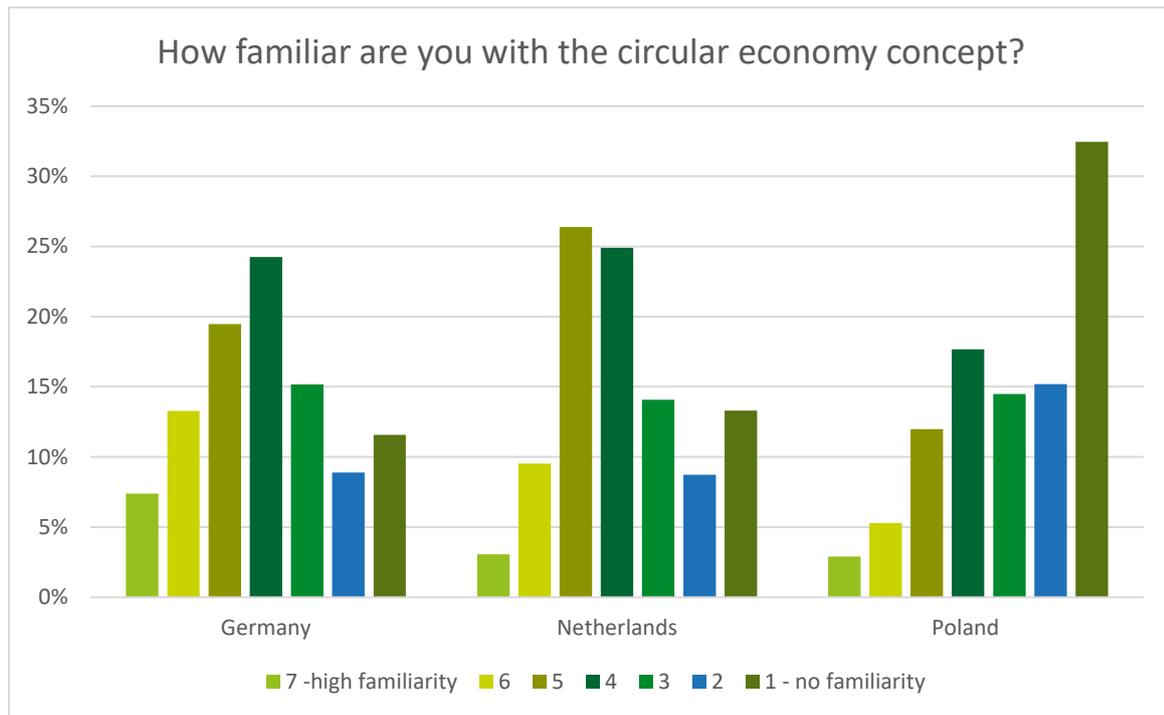


FIGURE 8: FAMILIARITY WITH CIRCULAR ECONOMY CONCEPT

The figure shows that circular economy as a concept is well-known in the German and in the Dutch sample group, whereas in Poland, a striking majority have responded with the lowest available scale value (1 – no familiarity).

It is important to note that the way the question is asked in the three different languages can have a different effect on the answer. A representative German study by the forsa Institute for Social Research and Statistical Analysis in 2021 showed that only a minority of respondents (13 %) say that they have heard or read about the term “circular economy”, while a majority of respondents (61 %) say they have heard or read about the German equivalent term “Kreislaufwirtschaft”.

As we have already pointed out in Del. 1.1, the Regional Readiness Report, the German term of “Kreislaufwirtschaft” - which is the common translation for circular economy - is well known and based on broad public support. However, this term may imply a strong association with the topics of waste, waste disposal and waste separation. The English term of “circular economy” is often used to indicate a much broader approach – for example, encompassing waste avoidance, reduction, circular design and the whole life cycle of a product, among others (DKE 2022). The terms are often used as synonyms, however, and this makes it hard to know what people understand by each of them and if they associate different meanings with them.

In the present survey, we asked for the German term.¹ Therefore, the results align with the forsa results, showing that people are rather familiar with it.

In Dutch, the terms in national language and English do not differ strongly (“circular economy” in English vs. “circulaire economie” in Dutch), so that it can be suspected that the above-mentioned differing associations as with the German case are not as relevant here.²

¹ German wording: *Wie vertraut sind Sie mit dem Konzept der Kreislaufwirtschaft?*

² Dutch wording: *In hoeverre bent u bekend met het concept van de circulaire economie?*

The Polish version of the question uses the English term but includes several translations or synonyms in Polish language in parentheses. Against this background, the high unfamiliarity becomes even more striking as there is explanatory information included in the question.³

1.2.2 Responsibility for recycling solutions

The second question presented the participants with a question concerning the responsibility for developing plastic waste recycling solutions, giving four options: government⁴, science, business, and consumers. The following ranking questions have been answered along the scale of 1 = most responsible to 4 = least responsible. The diagrams are sorted according to rank 1.

Germany

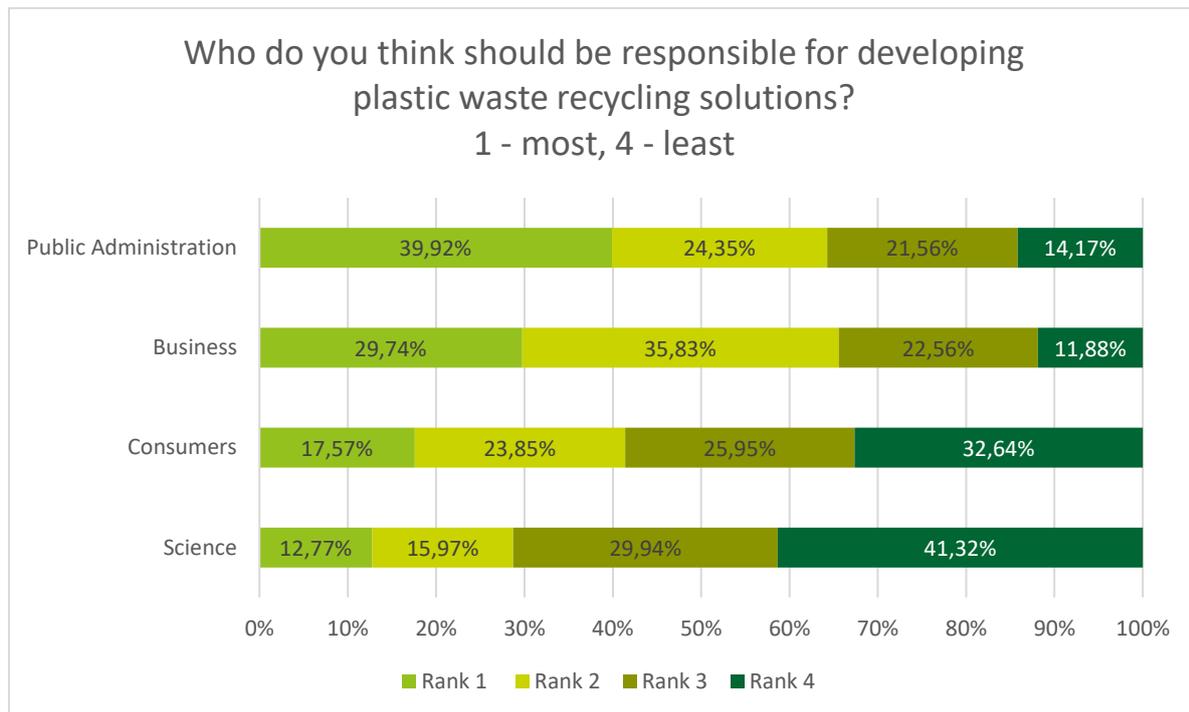


FIGURE 9: RESPONSIBILITY FOR RECYCLING SOLUTIONS (DE)

³ Polish wording: *Jak bardzo jest Pani/Pan zaznajomiony/a z koncepcją circular economy (ekonomia cyrkularna gospodarka cyrkularna gospodarka obiegu zamkniętego GOZ)?*

⁴ In the three native-language questionnaires, there is a deviation of the translation of one of the answer options: Apart from science, business and consumers, “government” was given as fourth option in the German and Dutch questionnaires, while the Polish questionnaire asked for “public administration”.

German wording: *Regierung, Wissenschaft, Wirtschaft, Verbraucher*innen.*

Dutch wording: *Overheid, Wetenschap, Bedrijven, Consumenten.*

Polish wording: *Administracja publiczna, Nauka, Biznes, Konsumentci.*

Netherlands

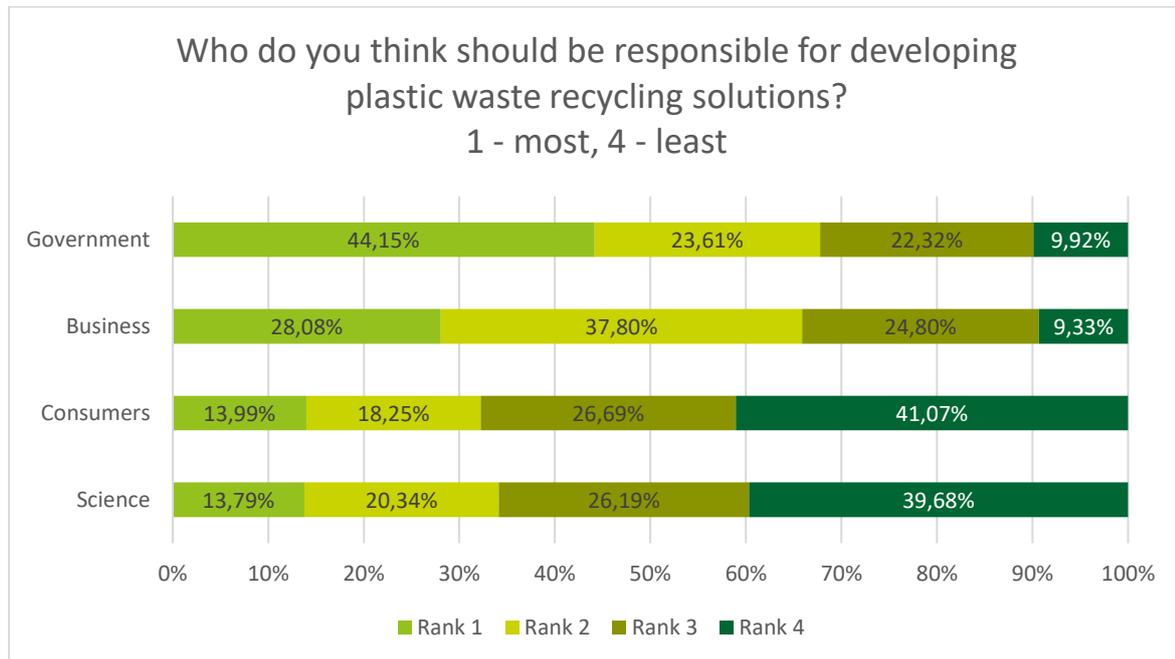


FIGURE 10: RESPONSIBILITY FOR RECYCLING SOLUTIONS (NL)

Poland

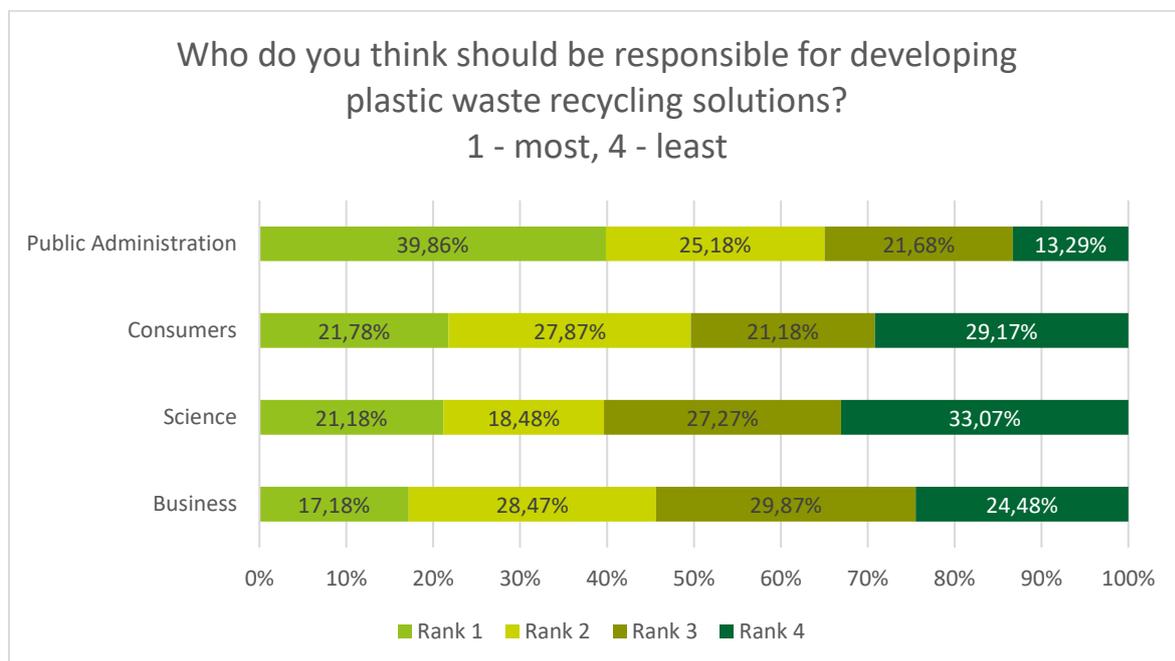


FIGURE 11: RESPONSIBILITY FOR RECYCLING SOLUTIONS (PL)

Looking at the three aggregated rankings, it is apparent that the government/ public administration is seen on rank 1, i.e. as most responsible for developing plastic waste recycling solutions, in all three countries. Both in the Netherlands and Germany, business has been placed on rank 2 by more than one third of all participants. What is interesting here is that in contrast, business is on the lowest rank in the Polish survey. However, when taking

a closer look, it becomes clear that it is not the category that was ranked in fourth place by most people but instead science has the highest percentage of votes for rank 4.

1.2.3 Open question: Products with PU

The next survey item inquired about products containing PU by means of an open text question⁵. The data analysis was conducted by developing a coding system and applying it to the three national data sets. This way, it was not necessary to translate all answers (1000 for each country) into English first but instead, we were able to group answers according to the following code set:

1 - building materials (includes building materials for insulation, doors and windows, insulating materials, including construction, sealing, assembly, and walls)

2 - refrigerators (includes freezers)

3 - I don't know (includes “I prefer not to answer”, “I have no idea”, “no”, “yes”, “I don't understand”, and any answer that repeats the words in the question without further specification such as hard foam/ foam, polyurethane/ PU/ PUR, plastic, or insulation)

4 - incorrect answer (answers that are clearly wrong, e.g. Styrofoam)

5 - PU products that are not hard foam (such as mattresses, which contain PU soft foam)

6 - Other products with PU hard foam (that do not belong in categories 1 and 2, e.g. boilers)

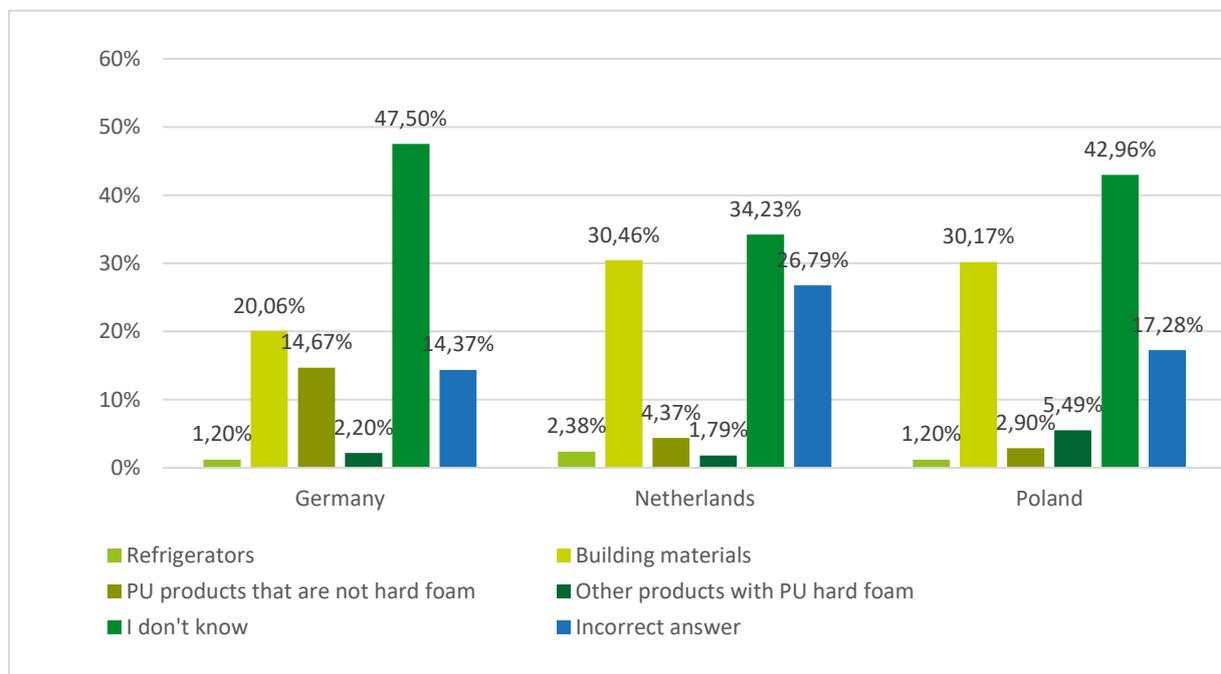


FIGURE 129: OPEN QUESTION: PRODUCTS WITH PU - TOTAL RESULTS OF CATEGORIZED ANSWERS IN THE THREE COUNTRY SAMPLES

⁵ Wording of the question: Hard foam made out of a plastic called Polyurethane (PU) is used for insulation. Could you name a product in which PU is integrated?

The diagram shows the prevailing lack of knowledge among the inhabitants of all three countries regarding products that contain PU hard foam. The highest percentage of such respondents was recorded in Germany and the lowest in the Netherlands. When combining the incorrect answers with the results for “I don’t know”, they add up to around 60% of answers in all three countries (61.87% for Germany, 61.02% for the Netherlands and 60.24% for Poland), showing that overall awareness is low. People more familiar with the topic most often indicated construction materials. In Germany, products containing PU that are not hard foam accounted for almost 15% of the answers, while building materials were (correctly) named less frequently than in the other two national surveys. Other products containing hard foam (e.g. boilers) were indicated as well in all three countries, with Poland showing the highest percentage in this category with 5.49%. What should be emphasized is a very small percentage of people (regardless of the country) who indicated refrigerators as products containing hard foam.

Germany

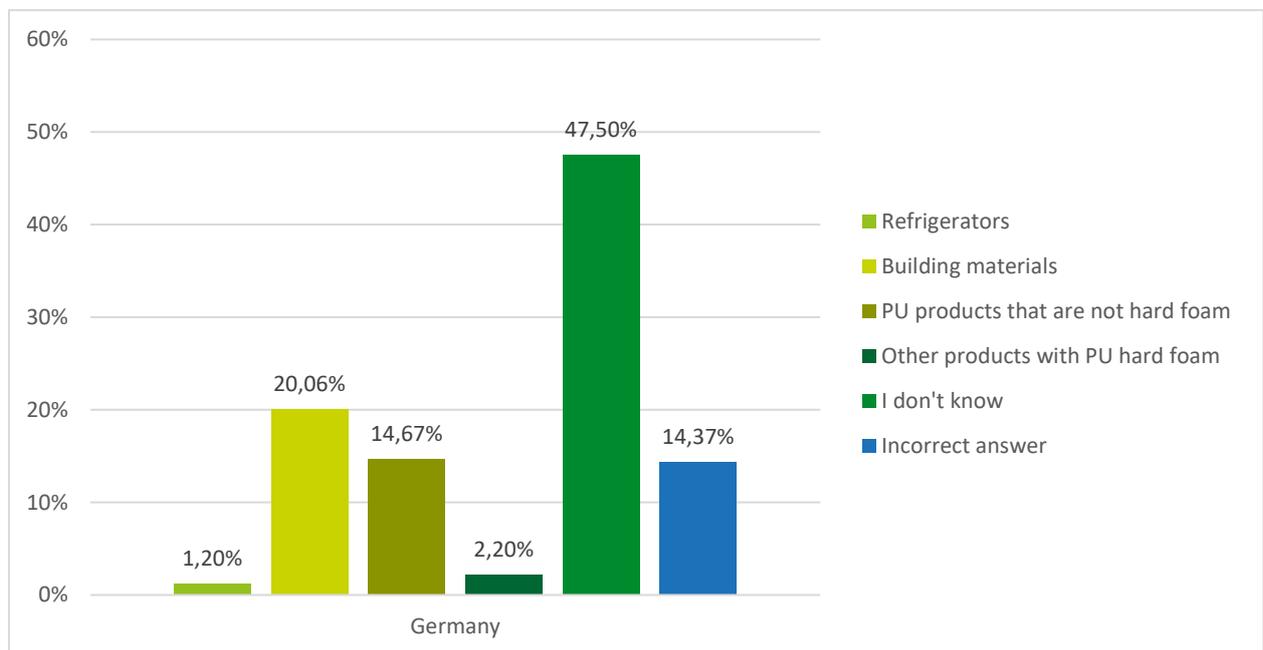


FIGURE 13: OPEN QUESTION: PRODUCTS WITH PU (GERMANY)

Netherlands

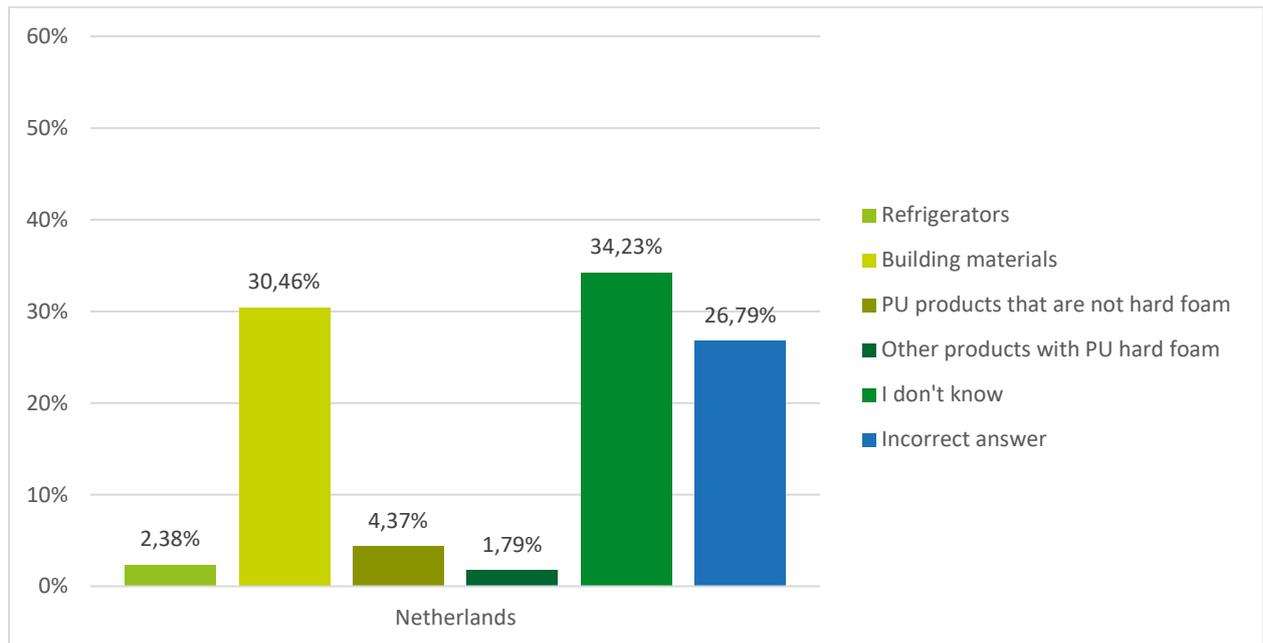


FIGURE 14: OPEN QUESTION: PRODUCTS WITH PU (NETHERLANDS)

Poland

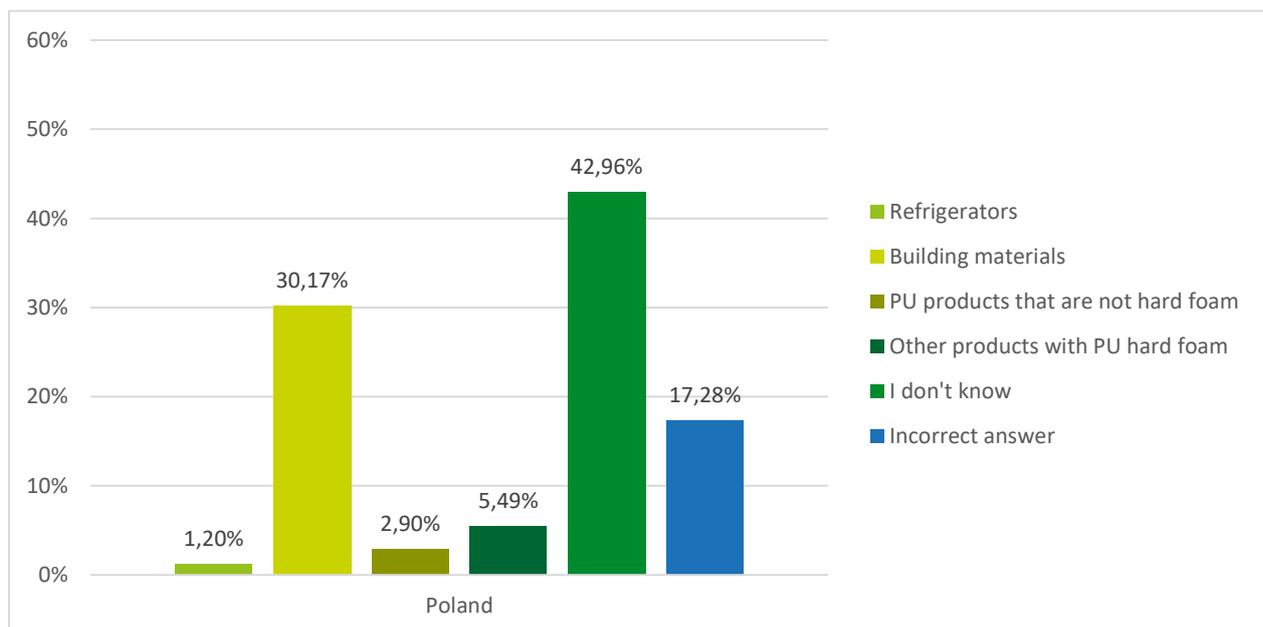


FIGURE 15: OPEN QUESTION: PRODUCTS WITH PU (POLAND)

Interim question

Before proceeding to the next question items, participants were asked an obligatory interim question:

“Are there factors that would convince you to choose products/services with recovered (recycled) PU plastic?”

The respondents who disagreed were not able to continue the survey and were not included in the analysis of the survey. Therefore, all respondents who submitted complete questionnaires had previously answered this question with “yes”.

1.2.4 Purchasing factors: Refrigerators

Another ranking question was asked to identify purchasing factors for refrigerators with recycled PU. A scale from 1 (most important) to 7 (least important) was applied to seven answer options. The diagrams below show the aggregated data for each national survey.

Germany

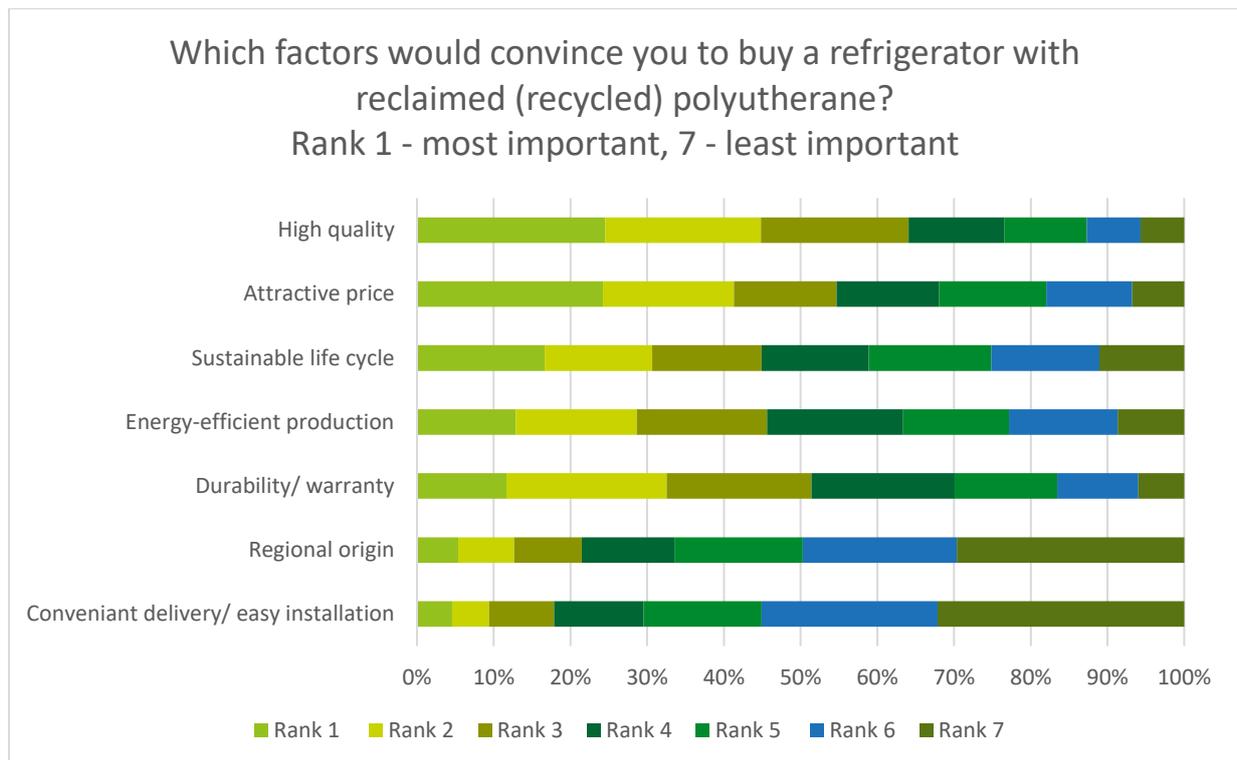


FIGURE 16: PURCHASE CRITERIA RANKING – REFRIGERATORS (DE)

Netherlands

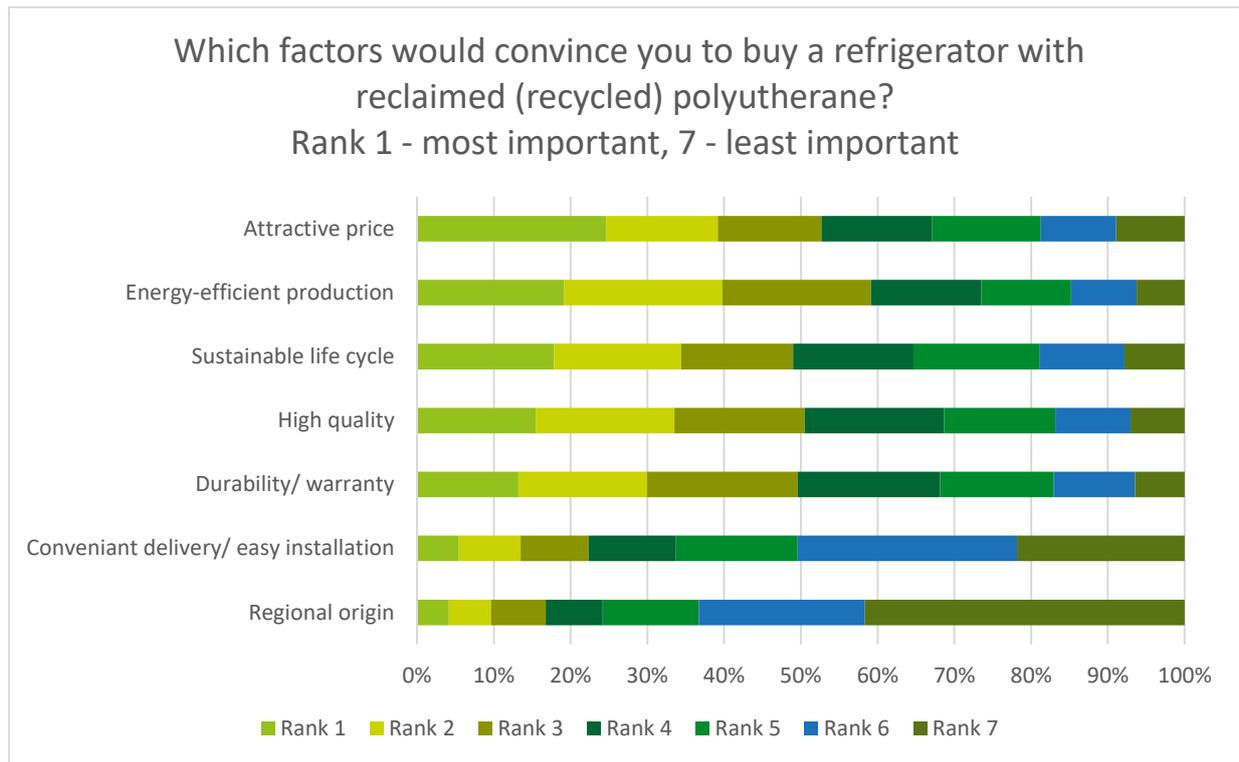


FIGURE 17: PURCHASE CRITERIA RANKING – REFRIGERATORS (NL)

Poland

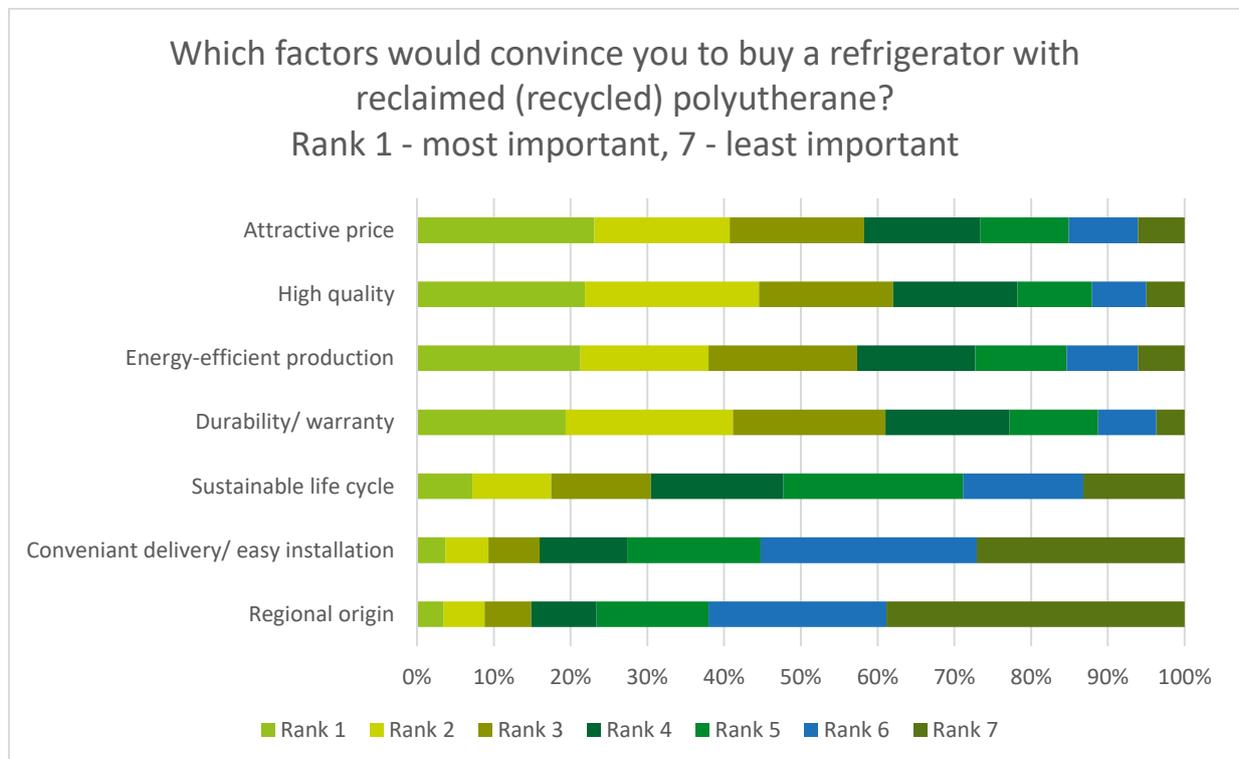


FIGURE 18: PURCHASE CRITERIA RANKING – REFRIGERATORS (PL)

The factor of attractive price is rated as the most important in both the Netherlands and Poland. In Germany, it is in second place. When combining the first two ranks, “high quality”, which is considered most important in Germany, has a higher value in Poland than the price. The same is true for durability/ warranty in the Polish survey. When looking beyond the top position in the diagram row, durability/ warranty is also deemed more important in Germany since a lot of respondents have placed it on rank 2 (20.86%).

Energy-efficient production is rated strikingly high, especially in the Netherlands. It can be questioned whether some of these answers may also refer to “energy-efficiency” referring to the device in use and not to the circumstances of production. However, looking at the next section on insulation material, the same factor will appear in the middle ranks of the diagrams as well. Energy-efficiency in the use phase of insulation material can rather be ascribed indirectly to the effect it has on heating and seems less likely to be a relevant factor. Therefore, while it cannot be ruled out that there has been some room for misunderstanding, we conclude that there is indeed a higher interest in an energy-efficient production of the products. Also, it should be noted that the question refers to refrigerators with *recycled* PU – when a customer is asked to think about the purchase of a product with these properties in comparison to a conventional product, factors such as energy-efficient production may become more important. The relatively high ranking of the factor of sustainable life cycle may also be due to similar reasons.

In all three countries, regional origin and convenient delivery/ easy installation were indicated by far as the two least important factors.

1.2.5 Purchasing factors: Insulation material

The following survey question is very similar in formulation to the previous one and asked for the application example of insulation material containing recycled PU. The categories were the same as for the refrigerator question and the respondents were given the same seven-step rating scale. The diagrams below show the aggregated rankings for each national survey.

Germany

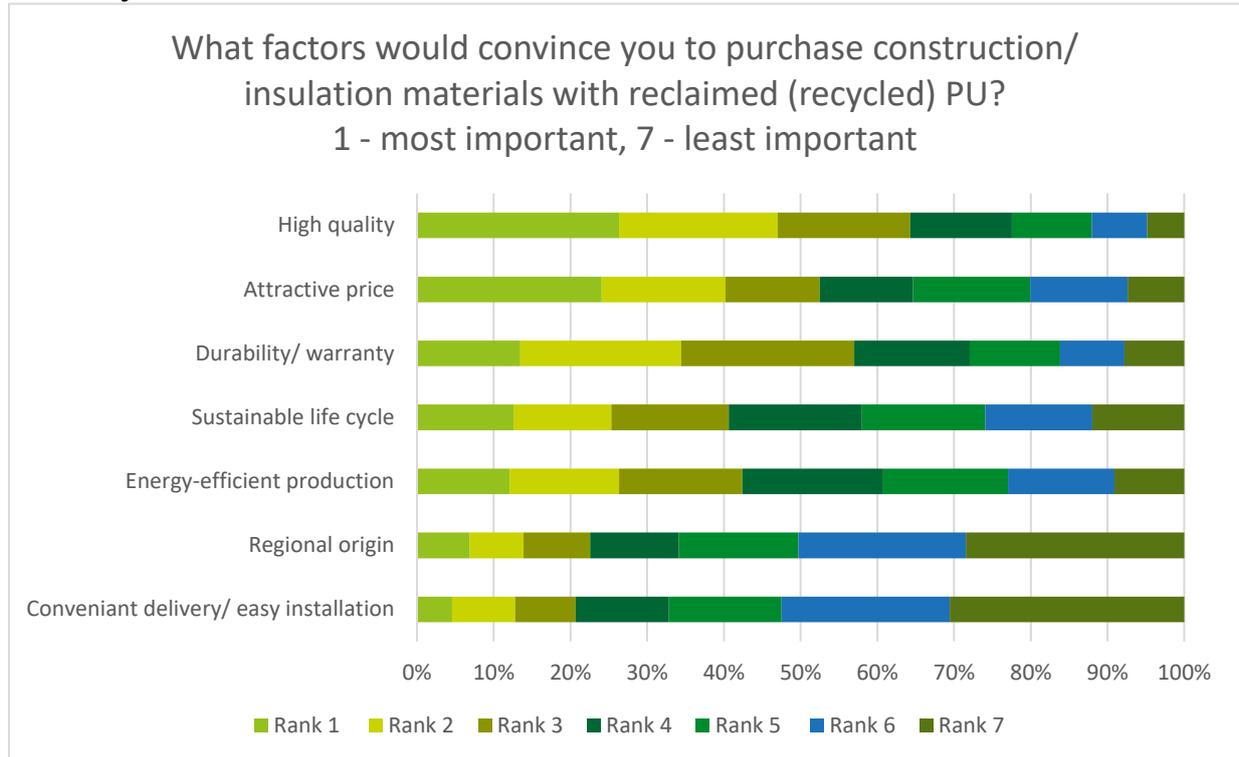


FIGURE 19: PURCHASE CRITERIA RANKING - INSULATION MATERIAL (DE)

Netherlands

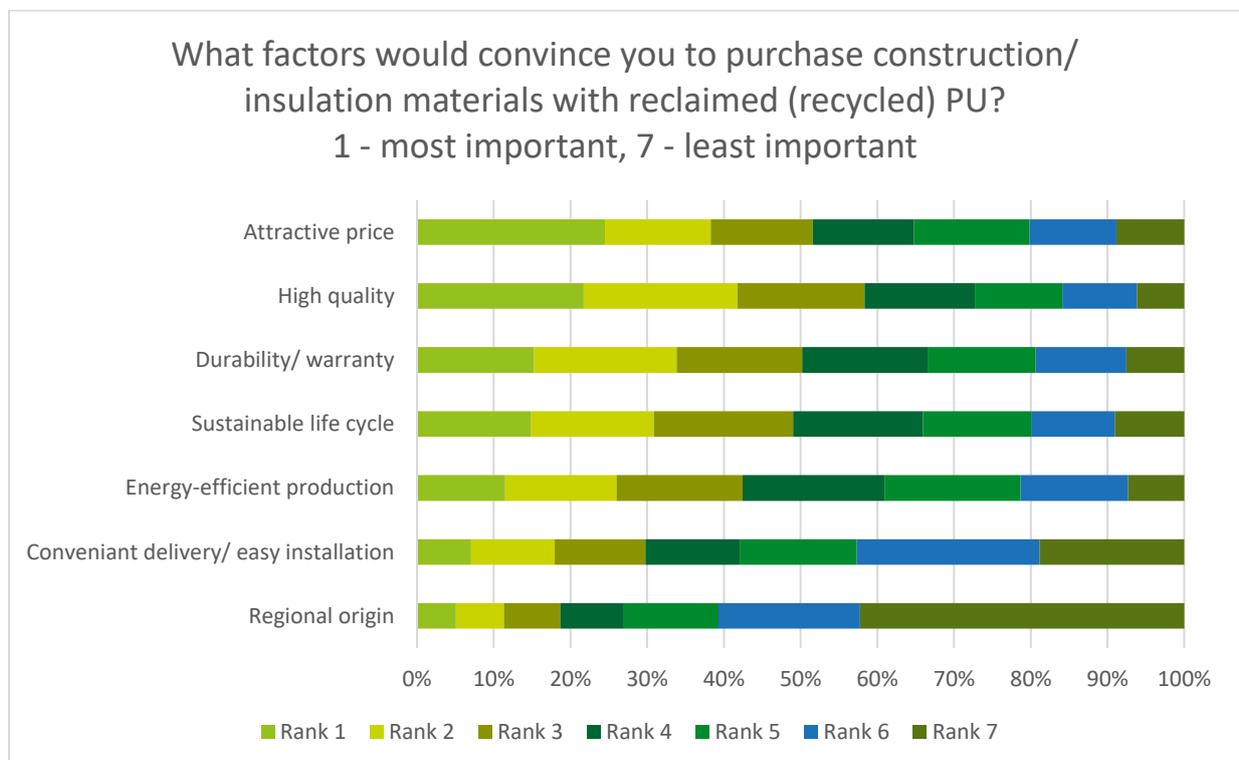


FIGURE 20: PURCHASE CRITERIA RANKING - INSULATION MATERIAL (NL)

Poland

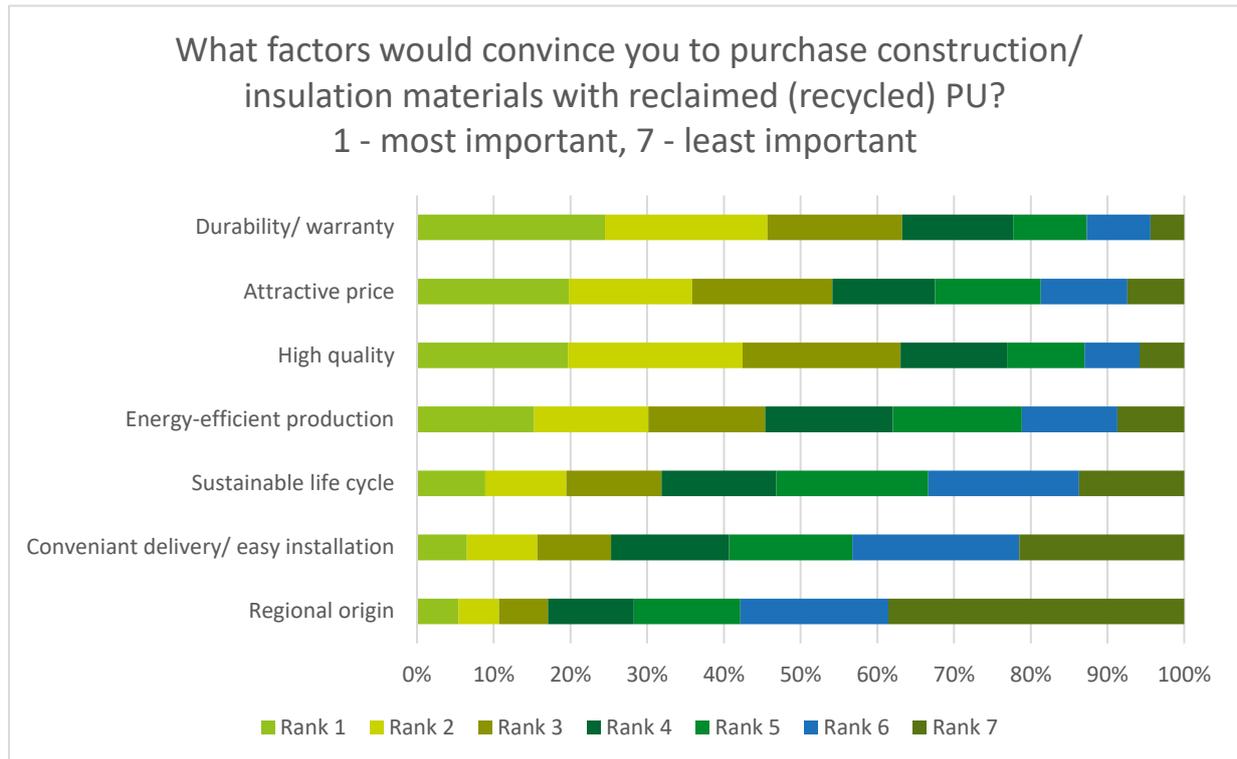


FIGURE 21: PURCHASE CRITERIA RANKING - INSULTATION MATERIAL (PL)

For rank 1, we see three different factors in the diagrams: Attractive price in the Netherlands, durability/ warranty in Poland and high quality in Germany. These answers share the top three positions in varying order in all countries. In the Netherlands, when paying attention to the first two ranks and combining the two, high quality comes out at the top. The combined ranks 1 and 2 from the Polish cohort also result in a higher percentage for high quality than attractive price. For both countries, regional origin is by far the least important factor, while in Germany, convenient delivery is the lowest ranked factor.

1.2.5.1 Combined results: Purchase criteria for refrigerators and insulation material of all three country samples

The following figures 22 and 23 show the combined data from the three countries for the two survey items (mean for Germany, the Netherlands, and Poland), again ranked by first position.

1.2.5.1.1 Combined results for purchase of refrigerators (mean for DE, NL, PL)

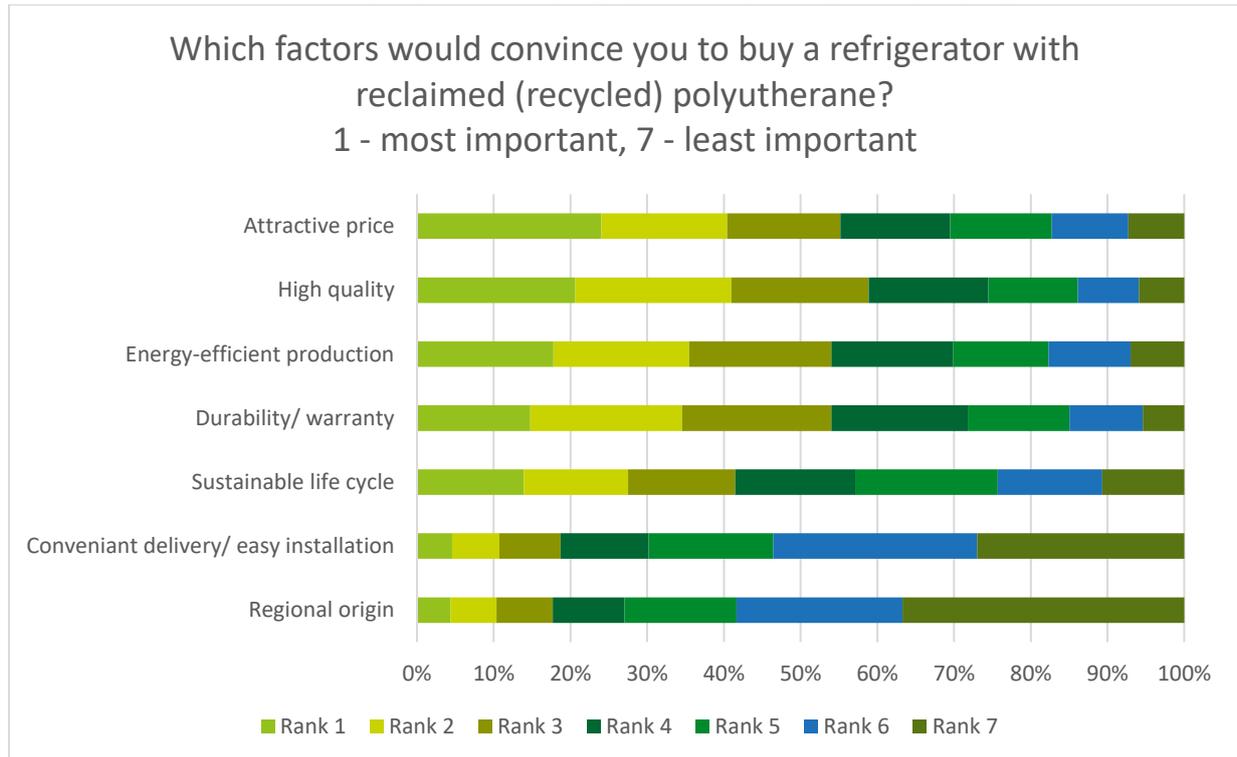


FIGURE 22: PURCHASE CRITERIA RANKING - COMBINED RESULTS FOR REFRIGERATORS (MEAN FOR NL, PL, DE)

1.2.5.1.2 Combined results for purchase of insulation material (mean for DE, NL, PL)

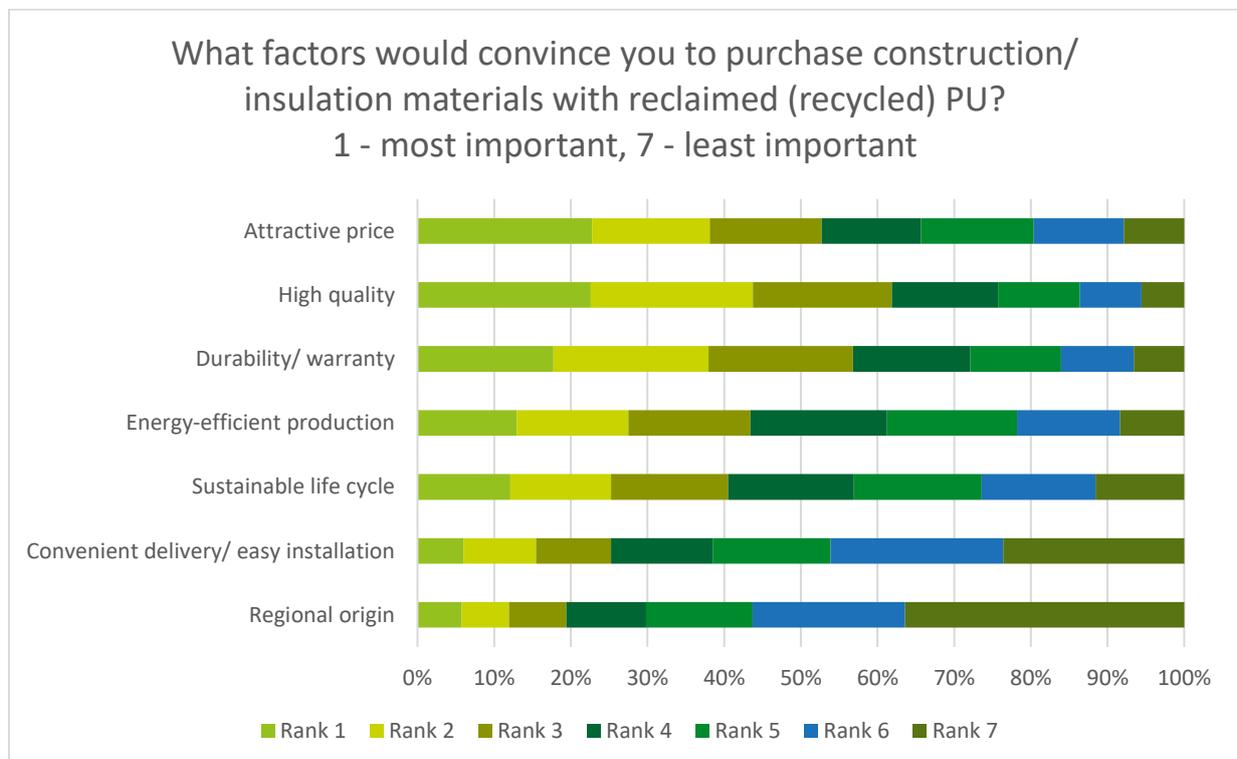


FIGURE 23: PURCHASE CRITERIA RANKING - COMBINED RESULTS FOR INSULATION MATERIAL (MEAN FOR NL, PL, DE)

When comparing the results for the ranking of purchasing factors for refrigerators and insulation material, the most striking differences can be seen when the results for all three countries are combined in one diagram. For both product groups, the factor “attractive price” is ranked the highest, while “high quality” is in second place. However, the factor of energy-efficient production is the third most important factor for refrigerators, but switches place with durability/ warranty when looking at insulation material. This makes durability/ warranty the third most important factor for the purchase of insulation material.

This is underlined when looking back into each countries’ data and comparing each data set for refrigerators and insulation. In the German data (figures 15 & 18), the first two and last two ranks stay the same regardless of the product. The center three factors are those that differ: the factors of durability/ warranty are much more important for insulation material (rank 3) than for refrigerators (rank 5). In Poland, durability/ warranty are even ranked as the most important factors for insulation material (figure 17), while it is only on rank 4 when asked the same question with regard to refrigerators (figure 14). The Dutch respondents have ranked the durability factor third most important for insulation material (figure 16). In contrast to refrigerators (figure 13), high quality is also considered more important for insulation material (rank 4 vs. 2). Both energy-efficient production and sustainable life cycle are not considered as important for insulation material as for a refrigerator purchase.

Across the board, convenient delivery/ easy installation and regional origin share the last two ranks in each data set, regardless of the product. In Germany, regional origin is on rank 6, convenient delivery on rank 7 for both product groups, while for all other countries, it is the other way around. In all three countries, these aspects have the lowest influence on purchasing decisions. This is interesting especially with regard to refrigerators, when taking into account their size and weight. While insulation material is most likely purchased within a larger construction project that requires the respective transportation possibilities, refrigerators are rather purchased by the individual consumer in everyday situations.

2 Qualitative research: Focus Group Interviews

The focus group study is intended to generate a more nuanced and in-depth knowledge on the topics of interest. Focus Group Interviews (FGIs) represent a qualitative research methodology that convenes a limited group of participants, typically ranging from 6 to 10 individuals⁶. The purpose of these gatherings is to engage in focused discussions on predetermined topics, facilitated by a trained moderator who guides the conversation with the aim of extracting insights, opinions, and perceptions from the participants.

Throughout the course of FGIs, careful consideration is given to the selection of participants with rigorous criteria employed to align their characteristics with the research objectives. The moderator's role is pivotal, involving skilful direction of the discussion to ensure equitable participation and adherence to the established research objectives. Open-ended and probing questions are strategically utilized to encourage participants to articulate their thoughts and share personal experiences.

The dynamics within the group setting are crucial in FGIs, providing an environment conducive to exploring diverse perspectives and dynamic reactions among participants. The data generated from these interviews is inherently qualitative, and the subsequent analysis involves identifying patterns, themes, and insights derived from the rich discussions.

The study commissioned for the project aimed to determine the level of societal awareness regarding circular economy solutions and to gain a deeper understanding of potential consumers' attitudes towards recycled polyurethane, including devices and products among respondents with varying levels of familiarity with the subject. The recruitment process was conducted by questionnaire which asked the potential participants to indicate their familiarity with products containing polyurethane foam, their openness to the issues of ecology and recycling, and their willingness to separate/ recycle items including examples such as large appliances, furniture or building materials.

The respondents needed to meet certain prerequisites and attitudes to take part in the focus groups:

- Participants were consumers familiar with products containing polyurethane foam and their applications (not deep knowledge but rather an awareness).
- Participants had to be open to the issues of ecology and recycling (these were important/ very important issues for them).

The focus group interviews (FGIs) were conducted between May and June 2023 across three European regions: Upper Silesia in Poland, Greater Amsterdam in the Netherlands, and Rheinisches Revier in Germany. A total of six focus groups, consisting of 5-8 participants from diverse age groups and mixed gender, were conducted in order to ensure a comprehensive understanding of attitudes across the different age brackets. The age brackets were 20-39 years (younger generation) and 40-60 years (older generation). Each region hosted two focus groups, carefully chosen by a survey company to reflect the population of the given country in respect to: sex, level of education, place of residence (city, village), income, and work situation.

Qualitative data were collected using semi-structured focus group interviews (with open questions), using a video conference platform, allowing for geographically diverse participation while ensuring the safety and convenience of the respondents. During the

⁶ Gawlik, K. (2018). Focus Group Interviews. In: Ciesielska, M., Jemielniak, D. (eds) *Qualitative Methodologies in Organization Studies*. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-65442-3_5

interviews of up to two hours, participants engaged in discussions facilitated by trained moderators, exploring their awareness of ecological and environmental concerns and recycling initiatives. All interviews were performed by an external company, most in the presence of one of the members of WP1, and were audio-recorded for future reference.

The following **guiding questions** were given to the interviewers in advance by the WP1 team:

1. In the past, when you replaced large household items such as your refrigerator, did you dispose of the items in a way that allowed them to be recycled? Was it important to you? Where did you return the item to, or who removed the item to take it for recycling?
2. When buying a new refrigerator, do you consider taking back and recycling your old refrigerator? Is it important to you? If so, why?
3. What incentives would make you return your old refrigerator so that it may be recycled?
4. What would motivate you to buy a refrigerator containing recycled PU versus a standard refrigerator with non-recycled PU foam? Is it important to you? If so, why? Would you be willing to spend more on a refrigerator containing recycled PU?
5. How much more would you be willing to spend when purchasing products that contain polyurethane (PU) hard foam, such as refrigerators, knowing the PU foam is fully recyclable? (0-100%)
6. In the past, during the construction/renovation of a house/apartment, have you disposed of used building materials in a way that allowed for their recycling? Was it important to you? Where did you return the material to, or who removed the material to take it for recycling?
7. What would motivate you to buy construction material containing recycled PU versus a standard material with non-recycled PU foam? Is it important to you? If so, why? Would you be willing to spend more on construction material containing recycled PU?
8. When building/renovating a house/apartment, are you willing/ ready to segregate removed products with PU foam? Is it important to you? If so, why?
9. What would encourage you to segregate foams in your construction waste?
10. How much more would you be willing to spend purchasing PU products, e.g., home insulation (insulation panels, spray foam), knowing they are fully recyclable? (0-100%).

Photos were provided by the research team to illustrate the two examples of PU in use. These were employed later by the moderator in the conversation when talking about refrigerators and insulation material respectively. The moderator also took some notes in a PowerPoint presentation, for example when collecting the group's associations with PU.

The conversations were started with a question regarding the respondents' own experiences and attitudes related to ecology and environmentally friendly behaviors. Next, their familiarity with polyurethane foam and its applications was discussed, followed by two discussion blocks on the specific products in question (refrigerators and construction materials),

including purchase decisions and willingness to engage in separation and recycling efforts. The last part of the group discussion pertained to closed-loop material cycles, including responsibilities and measures to be taken to close the loop.

This report is structured along the five following sections for each focus group:

- *General approach to ecology and pro-environmental behaviours*
- *Knowledge and perception of polyurethane foam, awareness of its applications*
- *Polyurethane foam in refrigerators and freezers*
- *Polyurethane foam in construction insulation materials*
- *Perception of closed-loop material cycles - meaning and practical actions*

2.1 Limitations

After the first conducted focus group, the research team had the opportunity to give feedback to the moderator. The first group discussion that took place was the German younger group. Here, it was noted that although the moderator of Polish origin was fluent in German, sometimes he had unclear wording (e.g. when asking about products that are already recycled or that are recyclable after use). He was asked to improve this in the upcoming second group.

Also, in some cases, the moderator asked a leading question, i.e. pointing towards the answer, such as: “Are PU foams a good, ecological solution?” which was answered by one respondent by saying: “If you ask the question like this, then probably not.” The research team gave the feedback that such questions should be avoided.

The moderator added some questions on regulations and responsibility that were not prompted by the research team in advance. This led to some interesting discussions so that it was suggested to repeat these questions in the second group (also for comparability).

The final question by the moderator asked if there was anything else the respondents would like to add that could be important. This led to surprisingly many reactions, so we also commended this a good question to repeat in the second group.

In the Polish interviews, there was some inconsistency in asking respondents about their personal background (not asking everyone about specific place of residence, family status, type of housing, place/position of work).

A lack of encouragement for all respondents to answer was noted as well. As a result, the survey was dominated by statements from a few people, while a few respondents rarely spoke. There were also technical problems during the meeting (no audio, the moderator was unable to share photos at the first meeting, which were then shared by a member of the research team).

For the Dutch group, it has been noted that the interviewer’s command of Dutch was also not ideal but most of the time understandable. The interviewer did not read out the questions as prepared but a little bit of interpretation, changing order. As a result, the questions asked to one group were not identical to the other group.

The interviewer said that PU foam is in fact recyclable at this very stage of technology, which is an abridged information since the process is not established yet. This did not have much impact on the answers though.

The company has reported the results in a text document for all six focus groups. For the report at hand, the WP1 authors have modified the summaries and added citations as well as their own observations. The overall conclusions across all FGs were drawn by the research team.

2.2 Results

2.2.1 Summary of FGI Group 1, Poland

2.2.1.1 *General approach to ecology and pro-environmental behaviors*

In terms of their own experiences related to ecology and environmentally friendly behaviors, respondents mentioned:

- Using water filters instead of buying single-use bottles
- Reducing meat consumption
- Limiting the use of disposable bags/ products
- Purchasing products in durable packaging
- Minimizing food waste
- Using apps to reduce food waste
- Reducing clothing purchases
- Buying eco-friendly products

2.2.1.2 *Knowledge and perception of polyurethane foam, awareness of its applications*

Familiarity and perception of polyurethane foam, awareness of its scale and applications, and associations regarding its usage:

- Used in renovations
- Used for insulation/ sealing/ soundproofing
- Difficult to dispose of
- Good insulator, better than wool and Styrofoam, more efficient, and reduces heat consumption at home
- Associations with "something chemical" (harmful, dangerous product)

2.2.1.3 *Polyurethane foam in refrigerators and freezers*

Respondents lack knowledge of the interior of refrigerators and were surprised that foam is used as part of the refrigerator. They do not think about recycling foam from the inside but rather from external parts. Respondents hope that it can be further used in the recycling process. Respondents do not know if foam from discarded refrigerators is recycled; during replacement, it's important for the seller to simply take the refrigerator. Respondents don't

consider the further recycling process. Recycling is not a determining factor for their purchase. When choosing a refrigerator, respondents emphasize electricity consumption/ appearance/ functionality. They indicate that refrigerator purchases are rare, so they don't focus on recycling aspects. Respondents indicate a low awareness of refrigerator recycling possibilities. Given the same price and quality, respondents would gladly choose a refrigerator with recycling components. However, if a new refrigerator with recycled parts is more expensive, respondents state they wouldn't choose it. Instead, they prefer redirecting their daily actions to areas where they have an impact, like reducing plastic consumption.

2.2.1.4 Polyurethane foam in construction insulation materials

The generally positive perception of construction materials based on recycled foam was similar to refrigerators. Respondents are not willing to spend more on recycled products compared to non-recycled ones. The main difference relevant to the project is waste collection and segregation for reuse: Respondents indicated that the procedures for donating used household appliances (refrigerators) are clear and generally known (such as that the refrigerator is picked up by the store when buying a new refrigerator, and you can also bring it to the Municipal Waste Selective Collection Center yourself). On the other hand, there are no regulations or guidelines on how to deal with construction waste containing PUR foam, so it ends up in mixed construction waste. Polish respondents suggested possible solutions such as setting up dedicated containers for this type of waste at DIY stores or at the Municipal Waste Selective Collection Center.

2.2.1.5 Perception of closed-loop material cycles - meaning and practical actions

According to respondents, the responsibility for introducing recycled products should primarily lie with manufacturers. Respondents believe that legal regulations mandating recycling in the production process should be introduced, leading to a closed-loop system. Respondents suggested that information about recycled elements should be visible on products, which could be a significant factor influencing purchasing decisions. Respondents also pointed out, alongside systemic actions, that educating society is a way to build environmental awareness.

2.2.2 Summary of FGI Group 2, Poland

2.2.2.1 General approach to ecology and pro-environmental behaviors

Based on their own experiences in the field of ecology and pro-environmental behaviors, respondents pointed out:

- Waste segregation
- Replacement of home furnaces
- Purchase of biodegradable products
- Electricity conservation
- Disposal of used items for recycling
- Purchase of energy-efficient appliances
- Purchase of eco-friendly clothing

2.2.2.2 Knowledge and perception of polyurethane foam, awareness of its applications

When asked for familiarity and perception of polyurethane foam, awareness of its scale and applications, as well as feelings regarding the use of polyurethane foam, the participants mentioned:

- Used in door installation
- As a sealant, for insulation and home insulation
- Versatile usage, practical
- Chemical composition, not very natural
- Produced from chemical components

2.2.2.3 Polyurethane foam in refrigerators and freezers

Most respondents are unfamiliar with the details of refrigerator construction. According to the respondents, refrigerators involve processes and chemical components. Respondents willingly recycle used refrigerators if they are sure they will be further recycled. When purchasing a refrigerator, respondents do not consider whether it can be recycled after use.

When buying a refrigerator, respondents would gladly choose one with foam made from recycled materials, provided the quality remains the same. It's important that the components of the refrigerator are marked as coming from recycling and that the foam can be reused. Respondents expect information from manufacturers on how to recycle it. They generally believe that foam-containing refrigerators should be cheaper (given that some of its materials have already been processed). According to the respondents, recycling foam should be cheaper than producing it from scratch. Respondents are not willing to pay more for recycled products. They would be more willing to buy a refrigerator with recycled components if they receive added value, like an icebox, longer warranty, or additional services.

2.2.2.4 Polyurethane foam in insulation materials for construction

The overall positive perception of construction materials based on recycled foam is similar to that of refrigerators. The key difference lies in waste collection and segregation for reuse. Respondents would prefer to buy products containing recycled foam if they are both cheaper and of good quality. Quality is often more important than price, as these are products used for a longer time and are harder to replace. Respondents would be willing to pay up to 10% more for recycled products, but they indicated that it's a waste to overpay if the quality is the same.

2.2.2.5 Perception of closed-loop material circulation - meaning and practical actions

According to the respondents, there is no single main group responsible for the closed-loop process of polyurethane foam. They pointed to both manufacturers and distributors. In the respondents' opinion, retail chains and manufacturers should provide information to consumers about products made from recycled materials using various communication channels. Respondents want to see the recycling process (how parts can be reused). Besides systemic actions, respondents also pointed to societal education as a way to build environmental awareness.

Summary of FGI

2.2.3 Summary of FGI Group 1, Germany

2.2.3.1 *General approach to ecology and pro-environmental behaviors*

Listed pro-environmental actions include:

- Waste sorting / facilitating recycling
- Choosing cycling over driving
- Composting plant waste
- Growing flowers and nectar-producing plants beneficial to bees in gardens or pots
- Cultivating personal herb and vegetable gardens
- Reducing packaging during shopping, especially plastic and disposable materials
- Purchasing regional products to support local businesses and reduce supply chain length

Actions considered unacceptable, annoying, or harmful to the environment:

- Excessive and unnecessary packaging, e.g., using plastic to package bananas
- Throwing trash and waste on the street or into nature
- Large amounts of plastic and film discarded after even small renovation or painting tasks
- Generally, the pattern of discarding whole products or significant parts and replacing them with new ones, instead of repairing and prolonging the product life cycle, thus excessively shortening the product cycle and lifespan (both for small, everyday use items and larger ones like appliances or cars)

In summary: Among the respondents, there is an established sensitivity to environmental issues and willingness to engage in behaviors that help protect the environment. However, this mainly applies to things and aspects that they are well-informed about — those that are widely communicated and highlighted.

2.2.3.2 *Knowledge and perception of polyurethane foam, awareness of its applications*

Awareness of the widespread presence of polyurethane foam in our surroundings was high. The study participants mentioned the following applications/ places where polyurethane foam is used:

- Thermal insulation - generally
- Soundproofing, sound-absorbing panels (pyramids)
- Applied with a "gun" for sealing and filling holes, gaps (e.g., around windows and doors)
- Thermal insulation in refrigerators

- Dishwashing sponges

2.2.3.3 *Polyurethane foam in refrigerators and freezers*

In the general perception, when choosing and purchasing a refrigerator, people don't think about its unseen interior and polyurethane foam. Some didn't even know that it's there. When discussing recycled foam vs. regular foam, participants admitted that in the actual buying situation, they wouldn't consider foam as a deciding factor for choosing a device model. When buying a refrigerator, factors like functionality, aesthetics, price, and the combination of ecology and finance, i.e., energy efficiency class, matter.

The type of foam used in the insulation of the refrigerator should be indicated on the product label and preferably communicated by the seller. In general, participants expressed openness and a positive attitude towards products with foam made from recycling and fully recyclable foam. With a generally pro-environmental approach to life, they would gladly buy such products to have a clear conscience and a sense of less environmental burden. However, it was noted that the type of foam is secondary at the moment of purchase.

Fully recycled polyurethane foam did not raise concerns about its quality or durability. On the contrary, it was seen as more ecologically desirable. Participants did not require additional incentives to choose it, rather they pointed to a lack of information and awareness on the topic. Importantly, they expressed concerns that products with such foam might be much more expensive, similar to many other eco-friendly products. Considering consumer choices, especially for relatively expensive appliances and the rapidly rising costs of living and household maintenance, price can be a barrier in choosing equipment, potentially overshadowing positive (albeit less measurable) ecological feelings. It was suggested that first of all, all appliances should be replaced with those featuring more environmentally-friendly foam. However, consumers should not bear the cost of such technological changes. Expectations were that manufacturers and distributors should be motivated or even obliged (through fines or incentives, legal systems) to offer more environmentally-friendly refrigerators.

As potential incentives for purchase and involvement in the disposal of appliances containing polyurethane foam, financial benefits were indicated. Respondents mentioned vouchers or discounts for specific amounts of money or other products from the same manufacturer or distributor. Also, willingness to invest time, energy, and money in potentially delivering an old refrigerator to a dedicated waste collection point was limited by a calculated approach based on the real costs involved and concerns about excessive environmental impact due to the distance of transportation. Therefore, it would be best to return the appliance to the distributor upon purchase, and points for independent disposal (e.g., when not purchasing a new refrigerator) should be available in easily accessible places like supermarkets.

2.2.3.4 *Polyurethane foam in insulation materials for construction*

In the case of building materials, polyurethane foam—used for insulation and filling spaces—was better known and recognized compared to refrigerators. Even if participants didn't work with it personally, almost everyone had encountered it somewhere, whether in their homes or in construction waste, sometimes even being disposed of illegally.

The overall positive perception of construction materials based on recycled foam was similar to that of refrigerators. The main difference is related to waste collection and segregation, which plays a significant role in the project. Participants saw the responsibility lying with both material-selling companies and those working with the materials. The first issue is that

companies should be required to guarantee proper dismantling and disposal of foam. The second issue is facilitating segregation and creating a comfortable and not logistically challenging waste collection system for individual consumers. There was no consensus on whether an additional container should be added to the municipal waste segregation system or whether dedicated foam collection channels were necessary. What was clear is that participants would engage in such segregation, but they expect it to be straightforward and not overly demanding. In the case of disposing of building materials and post-renovation waste containing polyurethane foam, one solution could be to transport them to a construction materials store.

2.2.3.5 Perception of closed-loop material circulation - meaning and practical actions

The closed-loop material circulation system dedicated to polyurethane foam was deemed necessary and practically indispensable to ensure the most efficient recycling cycle—returning old foam for processing. Problems and concerns raised included:

- The costs of both purchasing and potential dedicated disposal
- Convenience, waste collection logistics (both in terms of the action of collecting, for example, removed or otherwise dismantled building materials, as well as the way they are sorted, collected, and transported)
- The universality and effectiveness of such a system—participants suggested organizing it to ensure global operation and the elimination of entities (primarily on the side of manufacturers, distributors, construction companies, and recycling companies, rather than consumers) that discard waste outside the closed loop.
- In pursuit of the effectiveness of the last proposal, legal measures, subsidy systems, and even stricter penalties for the "industry" operating outside the system were suggested. This could create a comfortable and cost-free waste collection system for polyurethane foam and possibly an educational campaign. However, the key seems to be the introduction of a system on a global and "top-down" level (primarily by authorities and institutions). Then, consumers would face neither difficulties nor significant barriers to joining such a system. Consumer education alone, especially in selected segments or countries and markets, will not yield measurable results according to the group members.

2.2.4 Summary of FGI Group 2, Germany

2.2.4.1 General approach to ecology and pro-environmental behaviors

As their own pro-environmental actions, participants mentioned:

- Improving thermal insulation of homes/apartments - replacing windows with triple glazing
- New, more energy-efficient heating systems
- Installation of solar panels
- Reducing car and plane travel

- Less packaging means less waste - tendency to avoid excessively packaged products
- Boycott of Nestle products
- Not always choosing the cheapest items, as they might be produced using child or exploitative labor and in environmentally harmful ways, often imported from China, resulting in long transportation distances
- Avoiding polyurethane foams, replacing them with cork (sprayed cork)

Actions considered unacceptable, annoying, or environmentally harmful included:

- Fruits in packaging
- Packaging and general litter in forests and streets, not disposed of properly in garbage bins
- Cigarette butts in sewer grates, lying on playgrounds or streets
- Too many single-use products
- Eco-friendly products are too expensive, there should be affordable options to motivate environmentally friendly choices
- Not all products labeled as "organic" (Bio) are genuinely organic, there's a need to verify the source and credibility of the label
- Too long supply chains, difficulty in finding locally produced items, unnecessary environmental burden due to individual transportation and excessive packaging

In summary, older respondents exhibited pro-environmental attitudes similar to younger ones, but it was noticeable that older individuals were more concerned with whether their actions resulted in the elimination of old appliances, such as household appliances, and how these appliances were recycled. There was also a lack of trust in information that lacked substantiated data and verifiable guarantees of proper disposal by recycling companies (acknowledgment of regulatory measures, control, and transparent procedures). Furthermore, older participants were more cautious in evaluating the overall benefits of recycling or environmental actions, emphasizing the importance of concrete benefits during recycling processes.

2.2.4.2 Knowledge and perception of polyurethane foam, awareness of its applications

- Refrigerators – known as a method for mounting the compressor (embedded in foam) and for insulation (however, overall awareness of PU foam in refrigerators was low)
- Mattresses, cushions
- Car seats and various automotive linings, widely used in the automotive industry
- Soundproofing, acoustic insulation
- Concerning mounting foam, it was seen as a convenience for installation work but potentially compromising the quality, solidity, and durability of the installation. This might benefit the installer but raise concerns for the client or resident.

2.2.4.3 Polyurethane foam in refrigerators and freezers

From the perspective of a refrigerator buyer, the type of foam used was deemed irrelevant. Additionally, most participants explicitly stated that even with knowledge about PU foam, they would not factor it into their refrigerator purchase decisions. They also would not pay extra for such foam. Some participants, considering PU foam challenging to recycle, expressed a preference for knowing that a refrigerator does not contain PU foam. (This is another insight indicating that a pro-eco message needs to be supported by significant and comprehensible benefits.) The information that a refrigerator's foam is 100% recycled material was not a decisive factor in the purchase. Firstly, there is relatively little foam compared to the overall appliance, and secondly, there is a lack of knowledge to positively assess such information. However, participants indicated that knowing what percentage of the entire refrigerator is made from recycled materials could influence their decisions. This insight could be more persuasive without necessitating 100% recycling; a substantial portion would suffice. It was emphasized that there is no willingness to pay a higher price for appliances with recycling materials. While participants are willing to pay for ecological considerations when they are tangible, they also want assurance of the benefits. Participants would also value knowing that their discarded appliances are properly recycled.

When it comes to handing over appliances to a distributor, a specialized waste collection company, or even having them collected by city cleaning services, respondents generally assumed that everything is properly disposed of, although some weren't entirely certain. Respondents associated with the "industry" assured, however, that there are traceable documents and procedures in place in this regard.

As factors that could further encourage the choice of a fridge with 100% recycled foam, the following were indicated:

- Providing information with relevant statistics, calculations, and benefit assessments - to have a point of reference and comparison
- Information about whether the fridge and/or just the foam within it is CO₂ neutral
- Currently, consumers lack sufficient knowledge about foams and the specifics of issues and possibilities related to their disposal and processing, which hinders them from making purchasing choices rationally based on information about the type of foam in a product. While the younger group might somewhat rely on emotional-level information (without willingness to pay extra), the older group needs accurate information from trustworthy sources to make informed decisions.

2.2.4.4 Polyurethane foam in building insulation materials

In this group, PU foam in construction materials was spontaneously discussed at the beginning of the conversation. The strongest focus was on spray foam used in tubes. Discussing products like sandwich panels or boards was more challenging. The perception of PU foam as a construction material was predominantly negative - older participants associated it with the trend of using less durable and more environmentally polluting materials. The discussion focused on disposal methods and places. Demolition, construction, and disposal companies have established procedures for waste separation and sorting. For individuals, returning waste to distributors or specific waste disposal facilities (labeled as special waste in Germany) was seen as a proper way of disposing waste. Since there was an overall agreement that recycled and eco-friendly items should be cheaper, the discussion did not delve into how much extra participants would be willing to pay for recycled foam.

Additionally, concerns emerged about whether foam made entirely from recycled materials would be as good as the "original, new" version. For products built into a house, which lasts for decades, there were concerns about using products that are perceived as less durable, such as those made from recycled materials. Consequently, some participants expressed a willingness to pay extra for foam that is not from recycled sources, to ensure its quality and durability.

2.2.4.5 Perception of closed-loop material systems - meaning and practical actions

The closed-loop material system dedicated to polyurethane foam was not enthusiastically received. There were several questions regarding the overall rationale behind a recycling system, which, according to participants' knowledge and estimates, might not be balanced in terms of financial and environmental aspects. Concerns arose that straightforward disposal of PU, such as incineration and producing new foam, might have a lower environmental impact than processing old foam into new, necessitating a complex system of waste separation and collection to acquire the raw material. To view 100% recycled PU foam more favorably, this group would require data and calculations demonstrating that the closed-loop system for PU foam would balance CO₂ emissions, water footprints, logistical chains, and the potential introduction of harmful chemicals into the environment. Older participants are generally less responsive to slogans and require reliable information; they exhibit a high level of curiosity and skepticism. Both groups share a willingness to engage in pro-environmental actions but require rational acceptance of new ideas, and communication strategies need to address this aspect. This group, in particular, is averse to products that do not guarantee long-term usage and durability, which are crucial factors for reducing environmental burdens. Effective communication strategies will need to address this group's specific concerns, backed by trustworthy information. This group also expressed hesitation about paying extra for products with 100% recycled foam, while fearing that the planned recycling system might drive up costs for consumers.

2.2.5 Summary of FGI Group 1, Netherlands

2.2.5.1 General approach to ecology and pro-environmental behaviors

As their own pro-environmental actions, participants mentioned:

- Waste segregation,
- Recycling,
- Not using plastic bags,
- Buying second-hand items,
- Reducing airplane travel, using public transportation instead of cars,
- Limiting meat consumption,
- Buying from circular shops,
- Buying fewer clothes but of higher quality,
- Energy conservation

Actions considered unacceptable, annoying, or environmentally harmful included:

- Products unnecessarily packaged in plastic,
- Traveling by airplane or car,
- Online shopping,
- Buying disposable items

In summary, respondents are fairly well acquainted with the topic of ecology and environmentally friendly actions. They understand what actions benefit the environment and what do not. Some of their actions, like waste segregation, are influenced by external regulations in the region where they live, such as Amsterdam.

2.2.5.2 Knowledge and perception of polyurethane foam, awareness of its applications:

Awareness of the widespread presence of polyurethane foam in the environment was average. Participants listed the following applications/places where polyurethane foam is used:

- Insulation,
- Automotive parts,
- Appliances,
- Construction,
- Mattresses,
- Clothing industry

2.2.5.3 Polyurethane foam in refrigerators and freezers

Most people were unaware that polyurethane foam is used in refrigerators and freezers, but they acknowledged its lightweight and insulating properties. However, nobody knew that such foam can be separated for recycling. Regarding replacing refrigerators, participants only considered doing so if their existing unit broke down. When purchasing a new refrigerator, energy efficiency class and availability were the primary considerations. The longevity of the appliance was also a common concern, as they aimed to buy something that would last for years. The type of polyurethane foam used in a refrigerator would not influence their decision to purchase a new unit. Overall, participants were positively inclined toward products with recycled or recyclable polyurethane foam. They would be willing to buy such products as long as they matched the quality and longevity of the basic version. They would also consider purchasing such a product if it were comparable in quality but cheaper. However, participants indicated that they would expect products with recycled polyurethane foam to be cheaper, as manufacturers would save on the cost of new foam.

2.2.5.4 Polyurethane foam in building insulation materials

For building materials, polyurethane foam was better known and associated more positively than in the case of refrigerators. Participants were aware that it is a lightweight and effective insulating material. They recognized that proper home insulation could have positive environmental effects through energy savings. Regarding the use of polyurethane foam in

construction, some responsibility was attributed to builders and authorities issuing construction permits. They should be aware of the materials they use and their environmental impact. Participants saw the potential for separating foam for recycling, but it should be easy and not create excessive mess. They would also like to know the environmental impact of such an action. If it were mandated by local regulations, they would comply. Participants saw the possibility of using recycled polyurethane foam, but they would need to know the environmental impact. They also preferred such materials to be as durable as regular foam and cheaper.

2.2.5.5 Perception of closed-loop material systems - meaning and practical actions

Participants recognized the need for recycling and agreed that environmentally friendly actions are necessary. However, they were not entirely willing to pay more, especially since they believed they would still need to pay some tax for pro-environmental actions. They viewed significant influence and responsibility on the part of governing bodies to enact laws that promote the environment. Buyers often focus on price and quality, and manufacturers seek profit. With predefined regulations, manufacturers can adapt their practices. Nevertheless, participants suggested it would be more effective to ask producers if they are willing to accept lower profits for using recycled materials rather than asking consumers if they are willing to pay more. Currently, most participants lack information about polyurethane foams and their recycling to provide more comprehensive answers in this area. Consequently, their responses were mainly driven by practical considerations.

2.2.6 Summary of FGI Group 2, Netherlands

2.2.6.1 General approach to ecology and pro-environmental behaviors

Respondents mentioned the following as their own pro-environmental actions:

- Using less plastic,
- Cleaning up loose plastic waste,
- Returning deposit bottles to the store,
- Using bicycles and public transportation instead of cars,
- Waste segregation,
- Buying products like clothes and furniture made from durable materials

Actions considered unacceptable, annoying, or environmentally harmful included:

- Recycling that doesn't work when all waste goes to the same landfill,
- Lack of options to buy local products without using a car

In summary, respondents are fairly well-versed in the topic of ecology and environmental protection actions. They strive to have a positive impact on the environment in their lives and pay attention to the quality of purchased products.

2.2.6.2 Knowledge and perception of polyurethane foam, awareness of its applications:

Awareness of the widespread presence of polyurethane foam in the environment was average. Participants listed the following applications/places where polyurethane foam is used:

- Packaging,
- Insulation,
- Construction materials,
- Furniture,
- Showers,
- Floors,
- Mattresses

2.2.6.3 Polyurethane foam in refrigerators and freezers

Most participants were unaware that polyurethane foam is used in refrigerators and freezers, but they mentioned that it makes sense as an insulating material. Some thought that this foam was only present in newer refrigerators. Participants didn't know about the possibility of separating and recycling foam. Some participants mentioned replacing refrigerators due to renovations or moving and wanting a new one for the new place. When purchasing a refrigerator, participants considered energy efficiency class and how well it would fit the new home. Most participants prioritized energy efficiency class over the materials the refrigerator was made of, partly due to limited knowledge on the topic. Participants also believed that the responsibility for separating materials for recycling lies with landfill sites or the entities collecting the appliances. For the group, knowing that a refrigerator contains foam made from recycled materials isn't sufficient; they would prefer more information about the type of recycling, its location, and whether it genuinely has a positive environmental impact. Nonetheless, they would be willing to purchase such a refrigerator if its durability, energy efficiency class, quality, and price was comparable. Reluctance to pay extra for recycled materials was expressed, especially since it pertains only to a part of the refrigerator.

2.2.6.4 Polyurethane foam in building insulation materials

For building materials, polyurethane foam was widely known. Participants were aware that it is a lightweight and effective insulating material. They deemed polyurethane foam suitable for insulation if it could be recycled in the future, making it a good building material. However, participants believed they lacked sufficient knowledge to fully discuss the use of regular and recycled polyurethane foam in construction, particularly regarding their durability. Participants saw the potential for separating foam for further recycling, but they currently lack clarity and awareness. They would need more information on how the foam would be recycled, whether the carbon footprint of such a process would be lower than the current gain from recycling, and how to separate polyurethane foam from other materials. Participants also considered using recycled polyurethane foam but insisted that they'd want to know the real environmental impact. Furthermore, they thought that building or renovation teams, rather than individuals, should handle such matters.

2.2.6.5 Perception of closed-loop material systems - meaning and practical actions

Despite their enthusiasm for ecology and pro-environmental actions, participants realized that their individual roles were rather limited. They believed that manufacturers and large corporations should place greater emphasis on recycling and environmental actions to ensure that the products consumers receive are of better quality. The group felt that governing bodies should influence producers rather than consumers. Moreover, they thought that products made from recycled materials should be cheaper for consumers, and the cost should be borne by the manufacturers. The carbon footprint was often discussed, both in terms of recycling and purchases. The presence of an "eco-friendly" label doesn't necessarily mean a lower carbon footprint, and participants would prefer more information about this aspect rather than just recycling information. Participants mainly focused on the durability of the products they purchased, intending to buy fewer items that would last for years, regardless of the type of foam used.

2.3 Synopsis of all focus groups

The focus group study was conducted to generate a more nuanced and in-depth knowledge on the level of societal awareness regarding circular economy solutions. The qualitative group discussions allowed us to gain a deeper understanding of potential consumers' attitudes towards recycled polyurethane. The following synopsis sums up these insights by employing exemplary quotes from the groups that illustrate the different attitudes.

The **knowledge and perception** of PU foam including its applications was varied among the participants. They were most familiar with polyurethane foam in the shape of spray foam that is used for small home renovations. Apart from this, most were able to name some possible applications of the material but stated that they do not give much thought in everyday life to the insulation material e.g. inside cooling appliances.

The focus group conversations revealed that there is not enough **transparency** concerning recycling. Some participants expressed the need for more information on how the foam would be recycled and on its ecological impact, such as this person from a Dutch group struggling to prioritize different factors: "I have very little knowledge about this, I would like to know how big the impact on the environment is and what is actually better for the environment: using it longer, energy label, recycling?" Another participant added that they "need to be sure that the overall environmental footprint is reduced", while a respondent from a Polish group admits lacking awareness of the problem: "Someone would have to influence my awareness, as of today I don't feel an incentive to buy recycled foam products, because I am not aware that I am making consumer choices that are detrimental to the environment".

Greenwashing is seen as a problem by a participant in a Dutch focus group, suggesting distrust in the accuracy of information about ecological impact: "Information that something is environmentally friendly must truly mean that, now anyone can claim it without it being true." Another Polish respondent also asked for more details and "open communication" on the recycling process to make a purchase decision for a product with recycled foam, "because the creation of such foam can use massive amounts of potable water or energy", highlighting the potential detrimental impact on the environment by the recycling process. In the older German focus group compared to the younger German group, there was more knowledge but also scepticism regarding the recycling and environmental impact. Even without certain knowledge about recycling procedures for PU foam, suspicions were voiced about the needed energy input and ecological impact of the recycled products. When asked if it would be a plus or minus for their decision if the PU foam in a refrigerator in the store is made from 100% old PU foam, one respondent answered: "That's something you don't think about. Who knows what chemical processes have been used to turn the PU foam from solid to liquid?"

That doesn't work just with water, you have to add some chemicals." Later, this person described it as "greenwashing" when PU foam that is recycled is advertised without disclaiming "what is behind all that, how much water, how much energy, what chemicals are used. (...) Recycled – okay, but recycled how?" All of these quotes imply the need for more knowledge to make informed purchasing decisions, especially regarding the sustainable life-cycle and recycling process of the products.

Participants across all groups have expressed **reluctance to pay extra** for a refrigerator with recycled PU and have stated that recycled material should not be more expensive than the original. In several groups, people have even demanded that the recycled products should be cheaper than those with conventional material as it is being reused and no new material is needed, assuming that manufacturers would save on the cost of new foam. One Polish respondent, referring to recycled PU foam, commented, "Why should I pay more for something that is not new?" For the Polish respondents, the environmental features of a refrigerator are not the most important, except for low power consumption during use. Other important features are the durability, functionality of the refrigerator and its design as shown by this statement of one respondent: "If I have to pay more I'd rather pay for an ice cube maker than for the fact that the refrigerator has recycled parts". Another respondent commented: "I want to use the refrigerator for years and for its energy class to be the highest." For both German focus groups, energy efficiency is the most important factor when buying a refrigerator. Also, the design and appearance of a refrigerator is considered. Similarly, the Dutch respondents did not express willingness to pay more for recycled products, "recycled should be cheaper, not more expensive". Another participant said: "It feels good if it's recycled, but price is more important." They also show concerns about the financial burden given the small size of their country: "Why would I pay more if no one else does? Why the Netherlands only, we are 18 million people".

However, regarding pricing for recycled products, there have also been statements especially from the Dutch groups referring to the concept of the **level playing field**: "It should be the opposite - higher taxes on virgin or environmentally unfriendly products for both producers and consumers." Another respondent also called for "true pricing" that includes the environmental impact, saying "the government has a leading role in this." A respondent from the younger Polish group supported this view by saying: "The consumer cannot pay more for something that is recycled, because it is not worth it to him. To make it worthwhile for him, the purchase price must be lower than products whose components are not recycled. So, there must be a system of financial subsidies for producers who use recycled components or penalties for those who do not."

The younger German group welcomed the idea of recycled PU foam in a refrigerator but worried about the price, expecting it to become more expensive while showing a willingness to pay more for the recycled product if price difference was not too high. The following dialogue underlines that this group shows an **intrinsic motivation** for buying recycled items:

Mod.: "How could you motivate a consumer to pay attention to which products they buy? You know already that products become more expensive, not cheaper, when they are recycled, so you have to pay extra. What could you offer people to motivate them?"

Person A: "Maybe offer items cheaper and make them more attractive."

Person B: "I think it is also a lot about the added value: as a mom, it reassures me when I know there is less rubbish, so my daughter will have the opportunity to stand on the same green planet as I did – I like that and I don't need a monetary factor."

Mod.: "So the fact alone that it is recycled and that there is a system like that is a bonus in itself?" (Person B agrees)

Person C: “I agree, normally you should not have to motivate people because with logical thinking it is preferable. But maybe I would do it the same way as [Person A] stated and offer it cheaper in the beginning so that people can see that it makes no difference at all. And after that you can still readjust it. Just to offer people a cautious approach.”

Person D: “I see it totally different [...]: Regarding the masses, I know for sure that people can only be motivated monetarily to do anything. That is why if there is no discount, I would start by working with vouchers for other products of the same manufacturer.”

One respondent in the older German group said that assuming the refrigerator would look the same, was made largely from recycled materials including recycled PU foam and was also energy efficient, “then I would see more benefits and an additional price would be justified”. If it only contained PU foam “recycled from old, bad PU foam”, that alone would not be a convincing argument to him. Much in the same vein, another respondent added it would be important to know “that it is worth recycling at the bottom line” to be willing to pay more: “It needs to be within reasonable bounds but I would do it.” Apart from other factors being more relevant as a purchase criterion, some people expressed an even **higher expectation** for recycled products, including higher rates of recycled material in the product and alternatives to the original material as shown in the following dialogue in the older German group:

Person A: “Just because a refrigerator has only recycled PU foam in it, that's not a purchase criterion for me. Instead, the entire refrigerator should consist of a certain percentage of recycled materials.”
(...)

Moderator: “What else could be a decision factor?”

Person B: “Produce them without the PU foam.”

Person A: “Produce them in a CO₂ neutral way – I think, if the PU foam is recycled, the CO₂ balance is already ruined.”

In several groups, the **environmental impact** made by everyday consumption choices was estimated higher than the purchase of a refrigerator, as explained by this person from the older German group:

“(...) The purchase of such large appliances is so rare that I think I can achieve much more through daily things like buying organic products or from regional producers than saying I have bought a refrigerator but if it breaks in 10 or 15 years, it is not so dramatic for the environment because there is recycled PU foam inside. I think that too little is achieved with such a one-time decision to really care about it much.”

The purchase of a refrigerator containing recycled PU is compared to other consumption decisions, which are attributed a stronger positive effect, as confirmed by a Polish respondent from the younger group: “I don't buy a fridge to worry about what will happen to it because I buy it for years. Things I use or buy more frequently have a greater impact on the environment, and that's what I focus on.” Other Polish respondents indicated similar concerns as expressed by this respondent: “The ecology and recycling aspect is irrelevant to me if I buy something once every 30 years. The most important thing is quality and durability. I have a sense of impact on the environment if I segregate garbage every day rather than making environmentally friendly purchasing choices twice in my life.”

Many of the statements made about purchasing refrigerators with recycled PU are also true for products in the area of **construction material**. Additionally, some respondents,

especially in the older German group, have expressed concerns regarding the durability of recycled PU foam for insulation material in construction. This does not pertain to refrigerators as the moderator points out in this cited passage:

Person A: "I would be afraid that the recycled construction foam has not had the chance to prove itself over the years and then maybe later it turns out that it is not so effective or solid or becomes porous faster."

Moderator: "You have not expressed such fears with refrigerators."

Person D: "Yes, but listen, the refrigerator will be broken anyway after 10 or 15 years. If I build a house and use the material - if it is broken after 10 years, that would be bad."

This shows the perceived differences between the two products and their requirements. A refrigerator has a shorter use phase than PU foam for construction which makes the participants more concerned about the material's endurance over time.

3 Conclusion

By collecting both qualitative and quantitative data, we have not only gained representative information on consumers' preferences but also insights into argumentation patterns. The combination of the two components has produced a richer and more comprehensive understanding of our research interest.

The survey has shown that PU is rather unknown. If respondents are familiar with it, it is mostly the case for spray foam - a product used by individuals in their homes, not necessarily requiring professional knowledge.

The respondents have overall expressed that there is not enough transparency regarding the production and recycling processes connected to the material. They show partial mistrust against companies' communication about their procedures and environmental impact ("greenwashing").

It has become clear in both the CAWI survey and the focus groups that price is the most important purchase criterion for both products. While this may not be surprising to be top priority, the focus groups can shed more light on the differentiated thoughts and arguments that may play a role. It seems to depend very much on the benefits the product may have for the individual; for example, personal valorisation of a more environmentally friendly choice of product. Opinions range from the attitude that the consumer should not bear the extra cost for recycled materials over the willingness to spend more but "not too much" to the position that recycled materials should in fact be cheaper. Also, ideas for vouchers and other incentives have been discussed by the respondents to enhance the willingness to buy recycled products. Other participants, however, have pointed out that they may be willing to spend a little more on products with recycled parts (5-10% in a Dutch group, 10-15% in a German group, none in the Polish sample). In the case of the refrigerator, some participants have indicated that they expect a larger percentage of the product to be recycled, i.e. not only the insulation foam but also other plastics. It has even been mentioned that there should be an alternative to PU foam altogether built into the appliances. The discussions show that the willingness to pay an additional amount is dependent on a number of factors.

The CAWI survey has also shown that the factor of durability/ warranty is more important with regard to insulation material than for refrigerators when asking for purchasing criteria

(see chapter 1.2.5). The qualitative survey can give some insight into possible arguments behind this data. The durability is considered much more important for the purchase of insulation material because it is expected to be in use for a much longer time. Refrigerators may be replaced after 10-15 years, while the use phase of construction material amounts to several decades. Some respondents lack trust that the new material possesses the same qualities as the conventional material.

In view of the fact that most respondents were reluctant to pay more for recycled products, it seems consequential that most groups stated that the main responsibility for introducing recycled materials should lie with the manufacturers and large corporations, adding that governing bodies should introduce regulations concerning environmentally friendly practices and influence producers rather than consumers. Acknowledging that buyers often focus on price and quality, and manufacturers seek profit, most respondents felt that only through legal regulations for recycling can manufacturers adapt their practices to create a closed-loop system and place greater emphasis on recycling and environmental actions. This is largely congruent with the representative survey results in chapter 1.2.2 which show that the respondents see the government/ public administration as the most responsible entity for developing plastic waste recycling solutions in all three countries.

Additional Sources

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