



# CIRCULAR FOAM

## Customer Experience Report Deliverable 2.4

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## Technical References

<b>Project Acronym</b>	<b>CIRCULAR FOAM</b>
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## Executive Summary

Customer experience survey concerning the sustainability of metal panels was pursued with the following main outcomes:

1. Quality and cost are both considered ahead of sustainability, despite the growing need for reused / recycled materials.
2. The pursuit of reused / recycled materials is currently being led by companies, though many believe that the EU will lead soon with legislation and regulations.
3. Quality is the deciding factor to either reuse or recycle materials. While most prefer reuse, if materials are of poor quality, then they will choose to recycle instead.
4. Material passports are seen as a key need within the industry to supply assembly/disassembly manuals, show end-of-life impact and include product specifications.
5. Respondents find the circular panel design positive but need reassurance that this will easily integrate into their existing processes, as well as being easy to install.

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## 1 Introduction

### **Brief:**

Kingspan is interested in the topic of sustainability in relation to the end-of-life dismantling of buildings. Research is required to capture insights on the handling/ repurposing/ recycling of products (such as wall/roofing panels) from those involved in this process – inclusive of specialist contractors and specifiers.

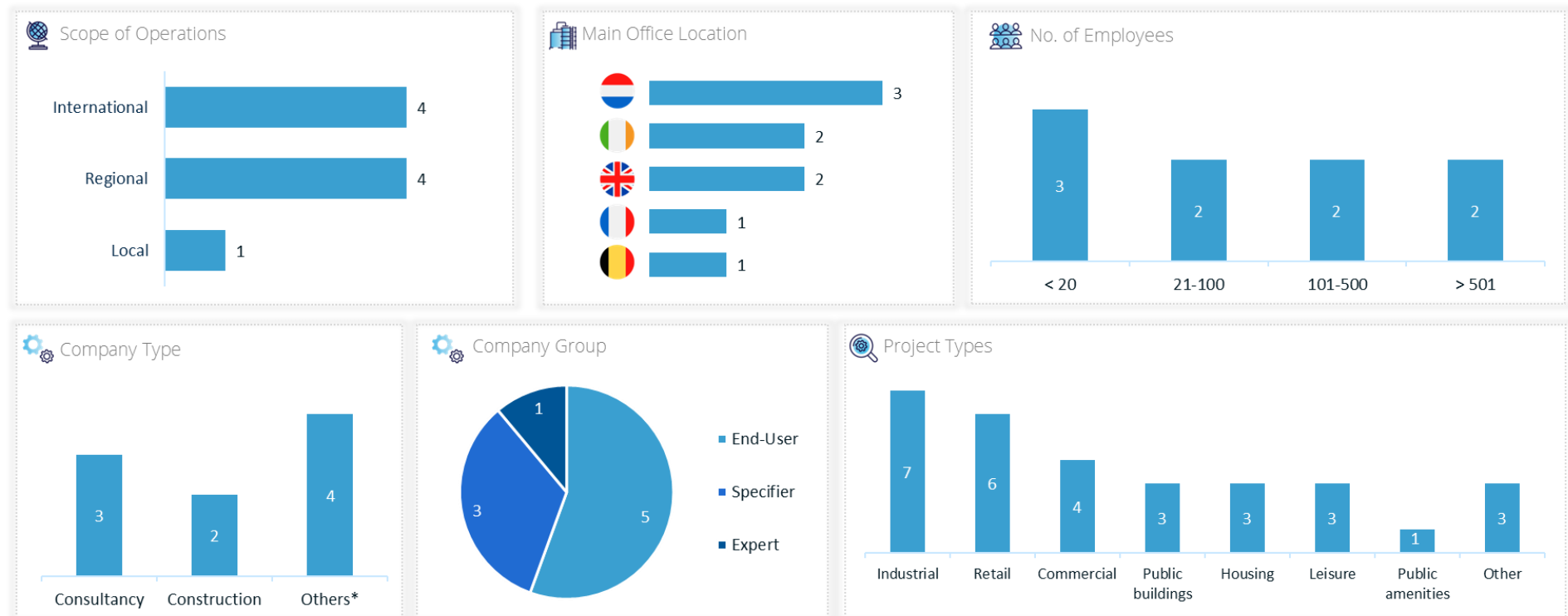
### **Methodology:**

The brief and methodology employed was developed by the three-person Kingspan project management team which consisted of the Head of Customer Experience, Head of Marketing (West) and the IKON Analytical Manager. Further internal input was gathered from the Sustainability & R&D teams and external input from the WP2 consortium members. The survey itself was conducted by B2B International. The approach taken was to have in-depth interviews with stakeholders across different functions and geographical locations. Under direction from the Kingspan project management team, B2B conducted the interviews with respondents between the 4<sup>th</sup> September and 17<sup>th</sup> November 2023.

Nine experts across a range of company areas and functions were interviewed as part of this process. It should be noted that many companies would not take part, either because they felt they had insufficient knowledge of the area to give a meaningful contribution, or they were simply not interested in being interviewed. The respondents have been anonymised but an overview of the background of the companies contacted is given in table 1.

Deliverable 2.2 - Prototype of improved metal panels / envelopes from the CIRCULAR FOAM project formed the basis of the discussion for the circular design aspect. Additionally, respondents were asked their opinion on topics relevant to other aspects of the Circular Foam project; namely, material design, their attitude towards digital tools, waste collection and treatment. The key learnings and respondent observations will be considered during Design for Circularity.

**Table 1. Details of respondents involved in the interview.**



\*Others include: demolition, real estate, non-profit and architect.



## 2 Sustainability: A Deep Dive on Drivers & Needs

Respondents associate sustainability with environmental sustainability. They are working towards net zero ambitions and want to be a credible and transparent partner for their clients.

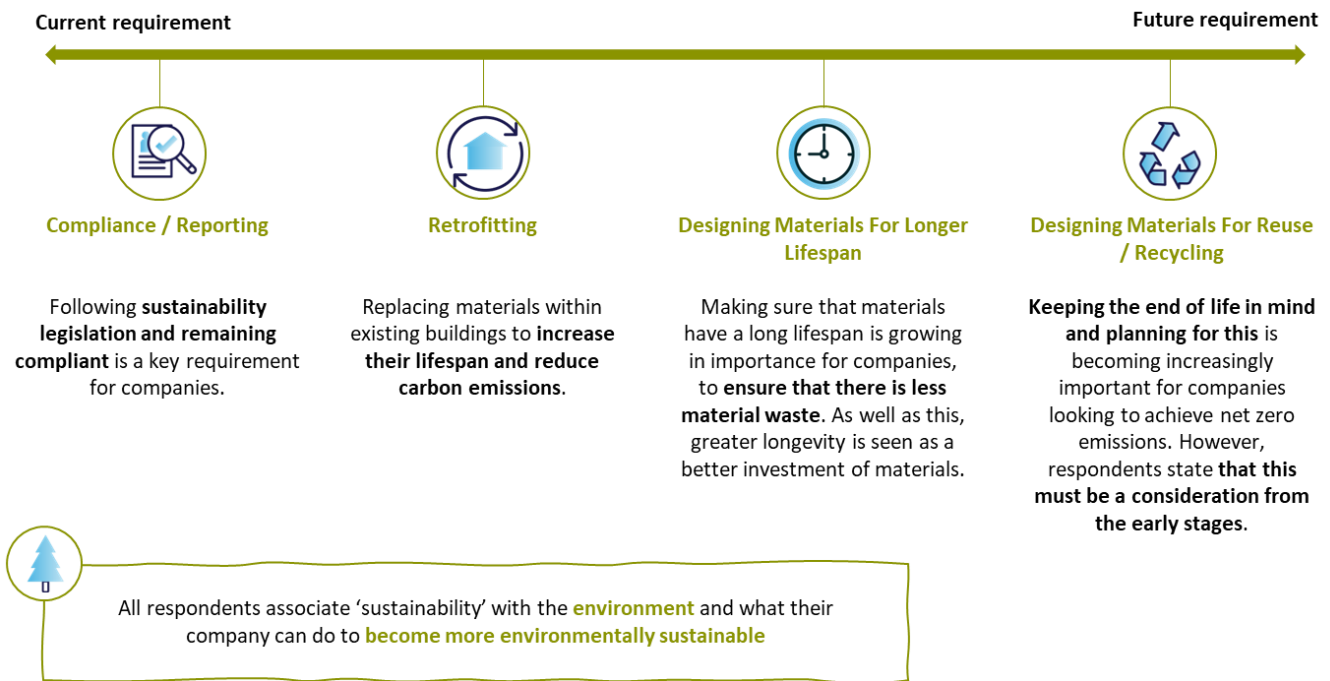


Figure 1. Current and future requirements as seen by respondents.

### Key points from respondents regarding sustainability:

- **“Sustainability in a couple of words, means circularity, and project & customer access.** We would look for a reuse or recycle materials. We prefer reuse, but if that is not possible, then recycling.”
- **“It means you build something that you can do longer with.** It is about the quality of the stuff you want; you want a good quality so you can use it longer. **We approach the buildings and in all our work we use the things that have a higher quality, so it can be used longer.”**
- **“I think there is a lot of movement towards circular economy, where carbon emissions kind of stole the limelight for a while.** People are starting to think of, ‘how is this material made,’ and ‘where did it come from,’ and ‘what happens to you after it is used’. I think there is just better awareness across industry of those kinds of considerations now that there would not have been before, and obviously we would want to be part of that and setting a good example.”
- **“Sustainability is a broader area which takes into consideration energy efficiency, wellness, environmental pollution and also circularity now,** which is under this umbrella.”

The transition to sustainability comes with many associated challenges. Cost implications are mentioned by the majority of respondents.





Companies are unable to make the shift to sustainable materials without first having the cost and quality of products remain consistent, if not improved.

**1. Cost implications:**

- Respondents agree that the price of sustainable materials (reused, recycled or produced in a sustainable manner) is greater than virgin materials.
- Cost will be a large barrier to greater uptake as businesses look to enhance profits and reduce risk.

**2. Material Quality:**

- There are concerns that the quality of reused or recycled materials will not be as strong as virgin materials.
- Additionally, some believe that the current panels are not capable of being recycled or reused as they were not designed for this, with their end-of-life quality not strong enough.

**3. Lack of Information & Guidance:**

- There is a lack of direction in the market, with various regulations and changing practices between markets.
- Respondents would like more guided direction and clear information from one source. Many believe that the EU will lead this synthesis of direction.

**4. Logistics:**

- Separating materials to be sent to different locations is seen as a challenge, particularly with composite materials.
- Additionally, some mention that these practices must be kept at the local-level due to the negative impact of transport. By transporting materials long distances, they would undo the positive of reusing / recycling.

**5. Others:**

- Overcoming the misconceptions of reusing / recycling materials for greater uptake in the market.
- Further sustainability practices such as electrification of fleets & using renewable energy.

Currently, organisations are leading the charge towards sustainability and circular economy, while waiting for more direction and leadership from governments to cross the finish line. European governments are gathering speed and beginning to legislate on the circular economy, with many expecting the EU to synthesise policies and lead the way in the near future. Other countries are seen to be lagging when compared to Europe. This includes the UK, who are perceived to be behind the pack and lacking direction. All 7 EU respondents believe that there will be more regulation in the near-medium future. Both UK respondents did not believe that more regulation would be introduced soon.

Reporting is believed to be the main form of new regulation incoming. Respondents believe that they will need to provide more evidence of their ESG commitments, and the materials used in projects. Environmental Product Declarations are seen to be increasing in importance, with legislation expected to make this consistent across nations.

### 3 The End-To-End Process: From Design to Disassembly

Respondents were asked as to their opinions on circular processes; from design through to end-of-life. Their considerations are given in Figure 2 below. It should be noted that panel reuse (as opposed to recycling) was raised by a number of the respondents and is included in the discussion that follows.

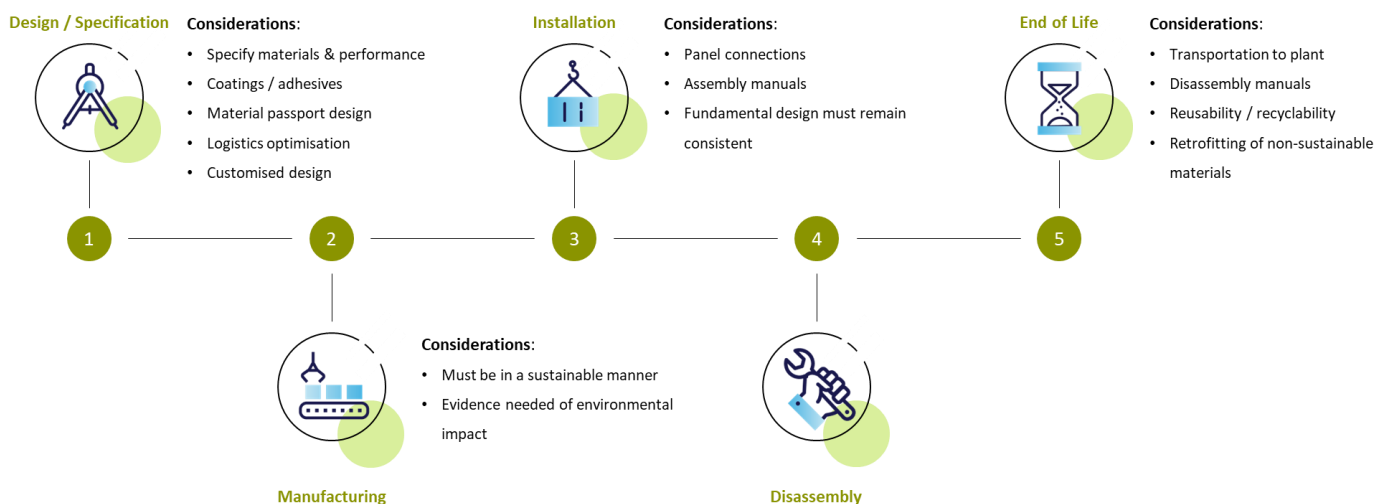


Figure 2. End-to-end panel process considerations.

#### 3.1 Design & specification

There are 5 key considerations during the design of reusable / recyclable panels as set out by the respondents:

- **Specify materials & performance:** Making decisions on the materials to be used within the panel is crucial as these must be reliable and guarantee longevity.
- **Coatings / sealants:** Respondents mention the need for reliable sealants & coatings to be used on the panel so that they are correctly fit, and durable for various weather conditions. These key components must remain reliable and not have their performance impacted to make the panel easier to dismantle.
- **Material passport design:** When specifying materials, these should be correctly tracked & captured through a material passport. This allows companies to easily access the product information to assess how it should be handled, what the composition is, and to see evidence of any sustainability credentials.
- **Customised design:** One respondent mentions the need for adjustable panel design as they are unable to use standard panels in their design. However, many believe that standardisation will become more prevalent in the near-future as a result of legislation.
- **Logistics Optimisation:** A major challenge during the transportation of materials for reuse and recycling is the bulky design of panels that means more transports must be used. Designing panels with end-of-life transportation in mind will assist later in the panel's lifecycle and further enhance the environmental impact.

#### Key points from respondents regarding design and specification of circular panels:

- “When we need to use or when we want to make components to be reusable, **we have to ask for adjustable panels according to our design**. This is very important for us now because we cannot use the old or the standard panels in our design. **It is very important to ask the manufacturer to make the panels according to our design to be reusable.**”
- “The important issue of the panels is the coating or if they are solar-resistant... **it is very important that the coating is still resistant, or that it is quite easy to re-coat the panel.**”
- “**If we can optimise panel length in the transportation to site on a full truckload** then obviously it will have some impact on the carbon footprint.”
- “You have to deal with the user of the building and the one is who is going to demolish the project at the end and reuse the materials because **the biggest problem is how it can take a long time from designing to reuse the materials of a building.**”

### 3.2 Installation

Respondents noted there are 3 key considerations during the installation of reusable / recyclable panels:

- **Panel connections:** When being installed, panels must be connected to one other reliably without performance sacrifices. Reused / recycled materials should not compromise the connectivity of these panels, with some concerned that they will be poorer quality due to the materials and being designed for easier disassembly.
- **Assembly manuals:** Instructions on how to properly install the panels is a key need for respondents, particularly in construction, who would benefit from clear direction to avoid any damages and ensure that it will be applicable for reuse / recycling when the building is disassembled.
- **Consistent design:** The design of reusable / recyclable panels cannot deviate massively from existing panel designs. This will help increase uptake of sustainable solutions as they can easily be integrated into existing processes.

#### Key points from respondents regarding installation of circular panels:

- “**We need silicone in between the panels to make sure that they are airtight, and that does bring some implications by tearing the thing apart that the panels have the possibility of being separated from each other.** By using the silicone in between, we need to think of options to get it torn down at the end of the life cycle.”
- “Knowing that they can be disassembled in the typical way that they are installed means that **we do not install them differently than we would normally do.**”
- “**It could have an impact if you changed the design of the product fundamentally**, but that's not what we aim for. **We aim for very smooth integration.** So that means that what we carry internally is like the concept of same norm, same prices at worst.”
- “We have to get them out at the end-of-life span, and **we have to determine how we can loosen it at the end and if we have to make a digital design** where we store the design for disassembly knowledge.”

### 3.3 Disassembly

During the interview, respondents were shown the scheme below, outlining a simplified disassembly process, and asked for their opinions.

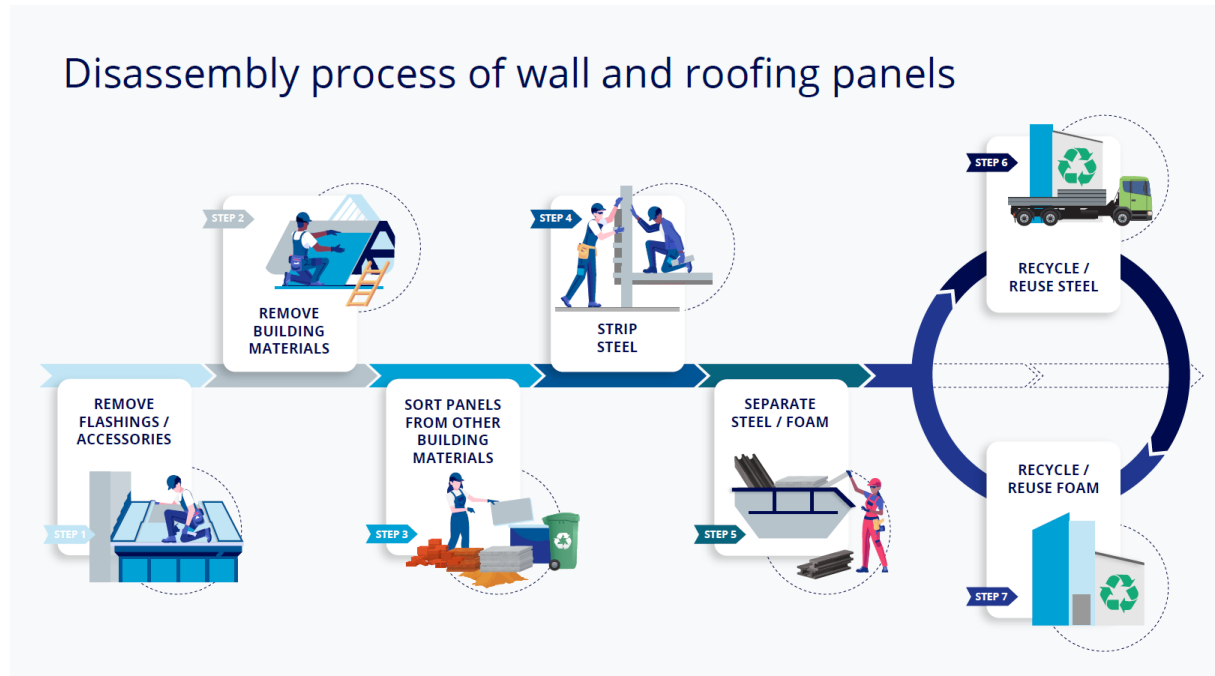


Figure 3. Scheme outlining the deconstruction and disassembly of panels for recycling at end of life.

#### Key points from respondents regarding disassembly of circular panels (as given in Figure 3):

- **“These stages do represent the disassembly process.** If we were trying to remove the panel, we would try to move the sheet intact. If the sheets are in good condition, they will be palletted and strapped as a bundle. **If the sheets are not in good condition, we would just put the sheet and everything with it into a skip,** we would not try to separate the steel and the foam, and it would just go as mixed waste through to one of the third-party disposal sites. Regarding if I think there are any stages that should be removed from the slide you have just shown me, **I do not know of any company that would strip the steel from the foam on site. I do not think there are any stages missing that you have shown me.** I think if the panel is in fair condition, it is enough if it is palletted and wrapped.”
- “I know that when the panels are taken away from us, we are involved with the removal of the materials, but **we do not get involved with stripping the steel.** We get involved in removing the accessories and sorting the panels from other building materials, but **we do not separate the steel from the foam, and we do not recycle or reuse the foam.** All of that is done by a company that we have been using for the last couple of years.”
- “I wonder what would happen to the accessories. If it is not part of the recycling process at the end, **what happens to the flashings and accessories in step one?**”
- **“For me there is a difference between the reuse and the recycling.** It is a different process. With the reuse, you can use again as it is. With the recycling, you need to machine the material and then recreate it again. **I would add between step six and seven another two.**”

- “If you say you also have it about reuse process, then **you do not need to strip the steel off the panel. You use the whole panel again.**”

As can be seen from the above quotes, many of the respondents suggested changes and additions to the scheme. In particular, more than half of respondents suggest additional steps or changes to be adapted in the process. These suggestions are summarised in Figure 4 below.

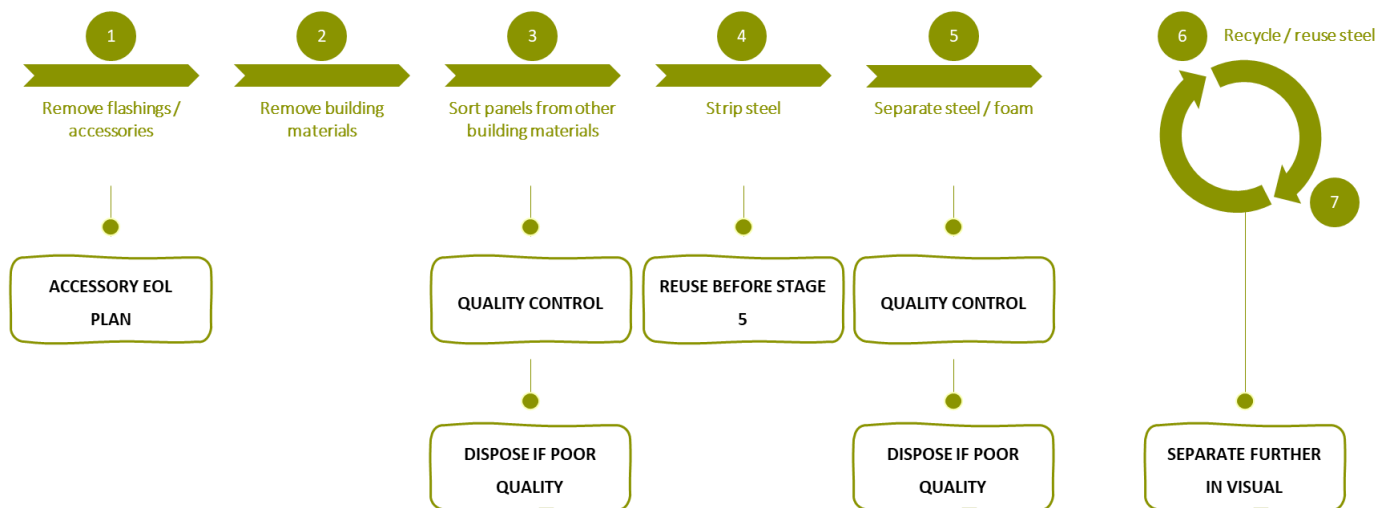


Figure 4. Additional steps / changes to disassembly scheme as suggested by respondents.

Other suggestions include: disassembly guide, detection of composites and confirming where steps take place.

**In general, respondents agree that step 4 is the point at which the process must be conducted at a separate plant as they would lack the capabilities to strip steel and separate foam on site.**

- There were different opinions on whether quality checks should happen onsite or at the plant to correctly determine whether the panel is suitable for reuse, or better to be recycled.

### 3.4 End of Life

The majority of respondents suggest using trucks to transport materials, with space optimisation & localisation the greatest challenges:

**Localisation:** To make sure that transporting the materials does not negatively impact the environment, projects are kept to a local level to minimise carbon footprint.

**Space optimisation:** Foam panels are seen to be light, yet bulky – meaning that optimising space is hard to reduce the number of trucks being used to transport.

Respondents made the following points:

- “Thinking about the materials that there are in Belgium, **we need the transport to be local, and this is our priority to use local materials...** we have to use the truck to use environmentally

friendly transport... **We calculate the transport stage of the materials and our life cycle assessment."**

- "The one question is always how many trucks you are going to have and space optimization, logistics optimization... **If the blocks are bigger, you are transporting more waste emptiness."**

Quality is the most important factor to respondents when deciding if a product should be recycled or reused. Once quality and cost have been weighed to decide if a panel should be reused / recycled – the quality determines the outcome. For a panel to be reused, respondents must be reassured and provided evidence that it meets the appropriate conditions.

**Lifecycle assessments are seen as a key way of determining product quality to establish the end outcome.**

This is seen as critical to ensure health & safety needs are being met and to avoid unnecessary risk. If the materials are not reliable for reuse, then they will be recycled.

Respondents: Reuse versus recycle. Condition of the panel is one of the main considerations.

- **"It would be the condition of the panel.** A lot of the panels that we take down are from factories and if they are in good condition, we would try to sell it again or reuse it ourselves. But it is in bad condition or a bad state, it just has to go for disposal. **It really is all about the condition of the panel."**
- **"It is to do with the actual state of the panel when it is removed.** If it is in fairly good condition we may recycle it and bring it back to our office as we can store up to thirty or forty panels that are of good condition that we can then use as temporary panels in factories, where they do not want to spend a lot of money to put a temporary wall up so that we can break through to do our work and then take it down again and take it away. Other than that, **if they are really bad then we send them away to be disposed of."**

Respondents were clearly sceptical about the reuse and recycling of panels and panel foam:

- **"It is very difficult to reuse the steel and the foam** that is used in our existing building because the old system is to build their materials on the construction site, so **it is difficult to disassemble all the elements of materials and reuse them in the future. "**
- "A construction calculation needs to be done with a reused project product and how we do this is a challenge... **the construction calculation firms do not want to use the reused materials;** they only want to use new materials because then they know which rules they can apply."
- **"I do not know for sure that the core of the panels is recyclable, you can burn it, but that is not recycling, they sometimes call it thermal recycling.** Only the steel can be recycled, but that is only a very small amount... I know there are some companies who are busy with reusing foam, but I do not know if that is a very environmentally friendly method."
- "The reuse of the naked foam is pretty limited. **You can only use it then as an insulation slab under a concrete floor."**

Others did see possible avenues for foam reuse:

- “If you are able to reuse it and either mix it up with new panels or instead of concrete, **I do not see why there is any reason why we could not use it.**”

Overall, the respondents do not appear to have given much consideration to foam recovery, outside of panel reuse.

### 3.5 Health & safety considerations

The majority report no changes to health & safety policies due to reusable / recyclable panels, though some do suggest factors to consider. This supports the approach taken in deliverable 2.2 (Prototype metal panel): that circular panel design and installation practices should remain as close as possible to current methodologies.

- **“We need to use the panels that are easy to install and easy to transport at the construction site ... we should consider the safety inside the construction site. If we think about the new components on new materials, we should think about how can we build or install the components or panels inside the building to be safe for the employees inside the construction site.”**
- **“Working with these materials and the possibility of contaminant of these materials in foam** for example. I think that is the most important one we should do something about it. **If there is a new product with recycled contents, then there is not any contaminant in that foam.”**
- **“What we do on the day-to-day basis is the guys on site have their personal protection gear with them.** We protect the eyes, the ears and the mouth when they are cutting off panels and that is basically it. In all honesty (again it depends on the instructions around future panels from recycled material), **I do not think there would be an awful lot of a difference.”**
- **There are no specific health and safety measures we have taken or are planning to take** regarding equipment, education, training or changes in practice.

One respondent in particular had worked extensively with hazardous materials and developing ways of separating them without endangering workers:

- **“We work with asbestos.** We have R&D that we worked on for quite a long time and then we have a plant that we have operated as a demo plant to treat asbestos. **There are some safeties and regulations in place which we are obviously following** but when we did this, we had to push the limits quite far up.  
**You had a huge number of toxic materials** such as oils, hydrocarbons, waste containers of plenty of different batteries and other materials, which are all mixed up because of the explosion, as well as a lot of asbestos. **We had to devise the process of separating the different materials that would make sure they did not endanger any workers.** We worked with pressurised cabins, we worked with all the overall safety equipment, the masks, etc., everything you can action to make sure that the people are protected.”

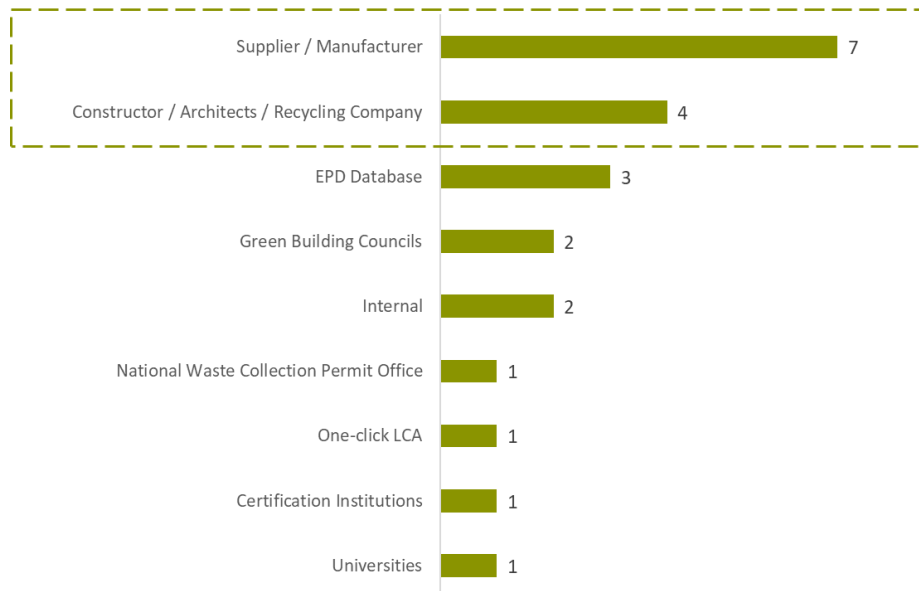
A summary of the main health and safety points raised by the respondents is given below.

- **Panel Design:** Designing panels to be easier to transport and install could substantially reduce accidents. Using smaller components for transportation and reducing the amount of large equipment to install materials will enhance health & safety processes.
- **Toxic materials:** Respondents mention the current challenge of overcoming asbestos and other harmful materials when dismantling / demolishing existing buildings. While this challenge will not persist, they need support to recycle / reuse materials that may have been contaminated.
- **Material Regulation:** More regulations on the materials that can be used in building materials is a key consideration for future health & safety. Regulating the chemicals and contaminants within foam and reporting these transparently via a **material passport** will be crucial for building processes.
- **Manufacturing Site:** Pre-site manufacturing / pre-fabrication of materials is seen to enhance health & safety processes as there is less training required for workers to assemble these themselves. With less happening on-site, respondents believe the risk of accidents will decrease.



## 4 Tools & information sources

The respondents were asked their opinion on where they would go first to source information on materials and components. The majority choose to go to suppliers or manufacturers for information, before validating this with other professionals.



**Figure 5. Preferred information sources for respondents.**

6 out of 7 respondents that consult with the supplier will also verify this with another source. Four verify with constructors / architects / recycling companies due to their experience.

### 4.1 Material passports / Digital Product Passports

Material passports can be used to solve the information currently missing for the reuse & recycling of building materials. Key areas where the respondents saw value being added were:

#### Material specification:

- Breakdown of materials within the product
- Breakdown of recycled content within product
- Lifecycle of materials from manufacturing to usage

#### End-of-Life impact:

- Impact of reusing / recycling material in KPIs, e.g., carbon reduction
- Value assessment of materials over time

**Manuals:**

- Assembly manuals to support installation
- Disassembly manuals to support dismantling / demolition
- End of life plan for materials

A material passport combines the information currently missing from products and condenses this into an easily accessible location.

Some respondents believe that this is already being adopted by some manufacturers and anticipate that this will continue to increase in prevalence.

**Key observations from respondents:**

- **“I think we need to understand more, what is the end-of-life plan for those products? What happens to them so that we can make an assessment of that. At the minute sometimes it is like end-of-life is part of this product as a feature, but in terms of what end of life means or what the process is, does that mean instead of going to landfill, it goes somewhere else, or does it mean that it's reused or broken down?”**
- **“The recycling percentage.** This is very important for us because when we test the project and the building secularity feature in our software, **we have to put the exact number of the recycled content.”**
- **“We need to calculate the environmental impacts of all products.** If that is easily accessed, the EPDs are quite necessary for our business. Also, **deconstruction manuals would be very nice** if a company can say; ‘okay, if you use our products, this is the way to construct it, but this is also the way to deconstruct it.’”
- **“Once you select a product, then you know there is a depreciation and then it still has some value. The residual value is something which is really missing in the market because it allows for the company itself to value this material more.”**

## 5 Circular panel design – respondent opinions

Under task 2.2, deliverable 2.3, Kingspan outlined a circular panel concept. A slide showing this concept was shown to the respondents during the interview to gauge their opinions.

### Proposed Circular Panel Design:



**Figure 6. (a) Concept circular panel summary slide (taken from deliverable 2.3), shown to respondents during interview process. (b) Respondents scoring of the panel in terms of overall appeal of the design (5 – highest to 1 – lowest).**

Overall, respondents were split over whether they found the new panel design appealing and they had important points of clarification before the design can be adopted.

### Respondents: positive opinions on outline circular panel design:

- **“It is probably a bit easier to fix and attach to the wall or the roof.** I like the fact that it is easier to fix and easier to install. It could be easier to take off as it probably has less weight in it, so it is probably less cost for disposal as well.”
- **“I think in terms of logistics, it could be easily transported or maybe you can transport more in the same truck,** so the truckload will be better.”
- **“They thought about how we can recycle the tape or how can we stick the tape but also recycle the panel, that is good. I think it is a good first step. Most of the time the suppliers of these materials or other materials just supply the information of the product and forget the information on how can we put the product into the building and how we deal with the connections to other building materials.** The connections between the facade and the roof and the facade and the floor are more important than just a panel.”
- **“There are not an awful lot of changes to the panel shape / panel form.** It would work out.”

**Respondents: mixed / negative opinions:**

- **“The option before is thicker, so does that mean there is any kind of performance limitation or change to performance?** Because often even we would not be specifying in particular materials, but it would be like a performance specification in terms of air tightness.”
- **“What is missing is how the panel is placed into a building or its connections.** They are the most challenging connection and not only the panel, so maybe that's a lack of information.”
- **“The thing that pops out now is you need four fasteners in a row instead of three in the past, so that would be that would be less beneficial.** I think it will have impact on the installation. The design mainly will not be changed an awful lot, recycling or reuse will not change; it is just on the installation because you simply need one more fastener per row... **it is almost 25% extra labour**, and you just have to bear in mind that on an average roof you probably put in 25,000 fasteners so that is going to be 30,000 or 32,000, the impact is quite massive.”
- **“Perform 100% recycled resources: I doubt if they can,** but if they say they can, I hope they do.”

**Table 2. Summary of positive and negative aspects of the proposed circular panel design from respondents.**

Positive appeal	Mixed/negative appeal
<b>“QR Code/Bar-Coding”</b> – Ability to access information (via Material and digital product passports) are important to respondents as evidence of the sustainability credentials as well as to contain (dis)assembly instructions.	<b>“Fasteners”</b> – There is some confusion as to the impact of more fasteners on the installation and disassembly process, potentially increasing labour.
<b>“Minimal Changes”</b> – Respondents do not want the fundamental design of panels to change so that it can be easily integrated into existing processes.	<b>“Flattened Profile”</b> – There are questions about the performance of the circular panel due to this flattened profile – with reassurance needed that quality is maintained and it will not negatively impact installation. Some also believe that this will aid with space optimisation during transport, and potentially lighten the panel’s weight.
<b>“Recyclable Side Tape”</b> – The consideration of side tape is impressive to respondents who believe that this can be overlooked and not considered.	<b>“100% Recycled Sources”</b> – There are doubts that this is true, with evidence required to convince respondents.

Key takeaways from the respondent feedback.

- **It is important that the panel has minimal changes and is easily installed.** While many comment that it appears to be very similar to the original panel (in a positive way), they question the impact of the flatter design and extra fasteners on the performance and installation.
- **A material passport is important to show evidence of sustainability claims** such as 100% recycled foam.
- **The recyclable side tape was only mentioned by one respondent**, however they believed this showed commitment and thought.

This feedback will be assessed in detail and taken into consideration during WP6 – particularly task 6.4 (Design for recycling).

## 6 Conclusions & Recommendations

**Five key headline points were highlighted by the customer experience survey:**

1. Quality and cost are both considered ahead of sustainability, despite the growing need for reused / recycled materials.
2. The pursuit of reused / recycled materials is currently being led by companies, though many believe that the EU will lead soon with legislation and regulations.
3. Quality is the deciding factor to either reuse or recycle materials. While most prefer reuse, if materials are of poor quality, then they will choose to recycle instead.
4. Material passports are seen as a key need within the industry to supply assembly/disassembly manuals, show end-of-life impact and include product specifications.
5. Respondents find the circular panel design positive but need reassurance that this will easily integrate into their existing processes, as well as being easy to install.

## 6.1 Recommendations:

The results of the survey were analysed to determine the best approach going forward. The SAVE framework – a widely employed marketing mix approach (Wani, 2013) – was applied to the gathered data. Unlike the 4Ps method, the SAVE framework broadens the focus to include the needs of the customer. An example of the matrix is given in Figure 7 below while summary results of the SAVE analysis are given in Figure 8.



**Figure 7. The SAVE framework**

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Wani, T., 2013. From 4Ps to SAVE: A Theoretical Analysis of Various Marketing Mix Models. Business Sciences International Research Journal 1, 540. <https://doi.org/10.2139/ssrn.2288578>



Figure 8. Summary of SAVE analysis applied to customer survey results.

