SINGLE PLY ROOFING
RECYCLING SCOPING STUDY

SINGLE PLY ROOFING ASSOCIATION

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Axionconsulting™
Innovative resource recovery

SPRA
Single Ply Roofing Association

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GLOSSARY

BREEAM	Building Research Establishment Environmental Assessment Method
CPE	Chlorinated Polyethylene
CSR	Corporate Social Responsibility
EPDM	Ethylene Propylene Diene Terpolymer
EVA	Ethylene Vinyl Acetate
FPO	Flexible Polyolefin
PVC	Polyvinyl Chloride
PIB	Polyisobutylene
SPRA	Single Ply Roofing Association
TPE	Thermoplastic Polyolefin Elastomer

GLOSSARY

Axion Consulting would like to thank Jim Hooker, Technical Director at SPRA for his input to this project and the SPRA members that kindly gave their time to be interviewed.

- Axter
- Bauder
- Breyer Group
- BriggsAmasco
- CCM Europe
- Danosa UK
- Delomac Roofing
- FK Construction
- Icopal
- IKO Polymeric
- Langley Waterproofing Systems
- Metclad Contracts
- Protan UK
- Renolit Cramlington
- SIG Design & Technology
- SIKA
- Single Ply Services
- Soprema UK

1. EXECUTIVE SUMMARY

The Single Ply Roofing Association (SPRA) represents the UK's single ply roofing industry and as part of its sustainability commitment is interested in investigating the potential to establish a collection and recycling scheme for single ply roofing waste. Axion Consulting was commissioned by SPRA to investigate potential volumes of single ply roofing waste, establish current waste management practices within the sector and ascertain the interest from roofing manufacturers and contractors in a collection and recycling scheme being set up.

It is estimated that a total of 5.08 million m2 of single ply roofing membrane was sold in the UK in 2015 based on figures provided by nine out of twelve SPRA manufacturer members interviewed for this project. The SPRA estimates the total UK market to be in the region of 6.5 million m2, with their membership representing at least 80% of these sales. The 5.08 million m2 of single ply roofing sold in the UK in 2015 equates to approximately 8,480 tonnes of material. Due to the longevity of the product this is not likely to be overlaid or removed until at least 2040. There is a lack of information regarding historic sales data to assess how much single ply waste is currently arising. In addition to this there is a lack of data regarding the number of projects in which new roofing is overlaid on top of the old membrane (with or without additional insulation) and the number of projects in which the entire aged membrane is removed.

The study has estimated a typical level of waste generation during roofing projects, both new and refurbishment, to be approximately 3%. This equates to approximately 152,000 m2 or 254 tonnes of off-cut material being potentially available each year for recycling. Waste membrane will also be generated through production activities, damaged or faulty materials and from training activities; so, total waste volumes will be greater than this estimate.

There are currently a variety of waste management routes and practices in the UK sector. Production waste, damaged goods and waste from training activities can be recycled and in some instances used within new single ply roofing products. Installation off-cuts and end-of-life roofing membrane are typically collected from construction sites and disposed of to landfill.

From the discussions held with SPRA members there is a real interest in recycling within the sector, from both roofing manufacturers and contractors. There is support for a collection and recycling scheme to be established for roofing waste in the UK, to help divert waste from landfill, support corporate sustainability objectives and provide sales and marketing benefits. A number of barriers and challenges were identified in relation to a collection and recycling scheme being set up. These were focused on financial implications, a lack of available material and the need for buy in and support from the whole supply chain and stakeholders.

Information was gathered from SPRA members on how a collection and recycling scheme could be operated, making use of the existing logistics and supply networks. A reverse logistics/backhaul mechanism is one option, so that waste roofing membrane can be returned through the distribution and supply infrastructure. Other options include collection directly from construction sites where the waste is generated. Axion's experience and knowledge of schemes operating in other sectors is that both these options should be feasible and provide an effective way of collecting waste roofing for recycling.

Collected and recovered waste single ply membranes could potentially be used in a number of products and end market applications. Production waste, damaged products and waste from training activities will be relatively clean material and there should be opportunities to incorporate this material back into single ply roofing products. For installation off-cuts and stripped membrane waste there are several end markets that currently use recycled plastics, such as products for traffic management and equestrian surfacing, which are potential outlets for this waste material.

With regard to recommended next steps a key area for the single ply roofing sector is to capture, record and report more comprehensive data, in terms of the amounts and types of single ply roofing used on different projects and the levels of waste generated. A key part of this will be establishing volumes and construction of products, composed of different polymer types. This data can be used to help assess the commercial viability of a collection and recycling scheme for waste membranes. A pilot scheme should be developed, trialling a number of collection routes and

Based on average weight of 1.67 kg/m2. See Section 4.2.

mechanisms to evaluate how such a scheme could be rolled out and operated on a larger scale. There is also a need to undertake more work and trials to identify and secure end markets and outlets for waste membranes.

There is certainly an opportunity to improve the current waste management practices of the UK single ply roofing sector. The manufacturers interviewed are aware that volumes of old roofing in particular will increase as rapid sector growth in the 1990's and the 8,480 tonnes-plus currently installed each year reach end of life and they are keen to ensure that systems are in place to deal with this material. There is interest and enthusiasm from both roofing manufacturers and contractors for a collection and recycling scheme to be established and Axion recommends this opportunity is pursued by the SPRA and its members.

2. INTRODUCTION

1.1.BACKGROUND

The Single Ply Roofing Association (SPRA) is the trade association representing the UK's single ply roofing industry. Its membership covers the whole supply chain from manufacturers, distributors and contractors. SPRA's objectives are to promote single ply roofing systems, to ensure high standards of products and application, to provide help and guidance to users and specifiers and to promote employment and training opportunities in the sector.

Single ply is a complete roof system created from strong and flexible membranes, composed primarily of synthetic polymer. Products can be homogenous or reinforced with glass fibre or polyester. There are a number of membrane types including polyvinyl chloride (PVC), ethylene vinyl acetate (EVA), flexible polyolefin (FPO), thermoplastic polyolefin elastomer (TPE) and ethylene propylene diene monomer (EPDM).

As part of its sustainability commitment, SPRA is interested in investigating the potential to establish a collection and recycling scheme for single ply roofing waste in the UK.

Many of the SPRA manufacturing members are already part of the Roof Collect system for the recycling of single ply roofing which operates across Continental Europe and are interested in investigating the feasibility of operating a similar system in the UK.

Against this background SPRA commissioned Axion Consulting to undertake a scoping study to investigate potential volumes of single ply roofing waste available for recycling, establish current waste management practices within the sector and gauge the interest within the sector to establish a collection and recycling scheme for single ply roofing waste.

1.2. AIMS AND OBJECTIVES

The overall purpose of the scoping study is to:

- Better understand the volumes of single ply roofing waste generated; and
- Establish how a collection and recycling scheme for the roofing sector could be set up and established.

The key objectives of the study are to:

- Establish the end of life volumes of single ply roofing waste;
- Understand the current waste management routes and practices for pre- and post-consumer roofing waste;
- Gain an understanding of the single ply roofing supply chain and logistics network;
- Investigate how a collection and recycling scheme could be established and operated for the single ply roofing sector;
- Identify potential outlets for single ply roofing waste; and
- Identify manufacturers and contractors interested in participating in a collection and recycling scheme.

3. METHODOLOGY

Axion Consulting used the following methods to undertake the scoping study for SPRA.

3.1.TELEPHONE INTERVIEWS WITH MANUFACTURERS AND CONTRACTORS

A key part of the study involved telephone interviews with a selection of manufacturers and contractors. A list of SPRA member companies was agreed with SPRA and a 'prompt sheet' devised to help guide and steer the discussions. A copy of the prompt sheets used for the interviews with manufacturers and contractors can be found in Appendices A and B. Interviews typically took place with the Technical Manager or Technical Director of the company.

The interviews were designed to gather information on:

- Volumes of end of life product generated;
- Types of waste arising;
- Types of roofing projects undertaken;
- Current waste management practices and costs;
- Interest in becoming involved in a collection and recycling scheme for single ply roofing materials;
- Key drivers for this interest;
- Any perceived barriers and challenges, plus ideas for how these could potentially be overcome;
- How the current supply chain and logistics network operates and potential opportunities to backhaul waste; and
- Willingness of SPRA members to participate in a trial collection and recycling scheme.

Interviews were held with twelve manufacturers and six contractors and all responses were recorded.

3.2. RESEARCH TO IDENTIFY OUTLETS FOR SINGLE PLY ROOFING WASTE

Desk based research was undertaken by Axion Consulting to identify potential outlets for single ply roofing waste. This involved both internet research and discussions with companies within the plastics recycling and products sector. The objective was to identify outlets for roofing waste and to understand how the material would need to be presented, how it would be recycled, financial and technical considerations and end market applications.

4. FINDINGS

The responses given by the telephone interviews with manufacturers and contractors and the additional desk-based research have been analysed and the following key findings established. All responses and data have been summarised and anonymised for the purposes of this report.

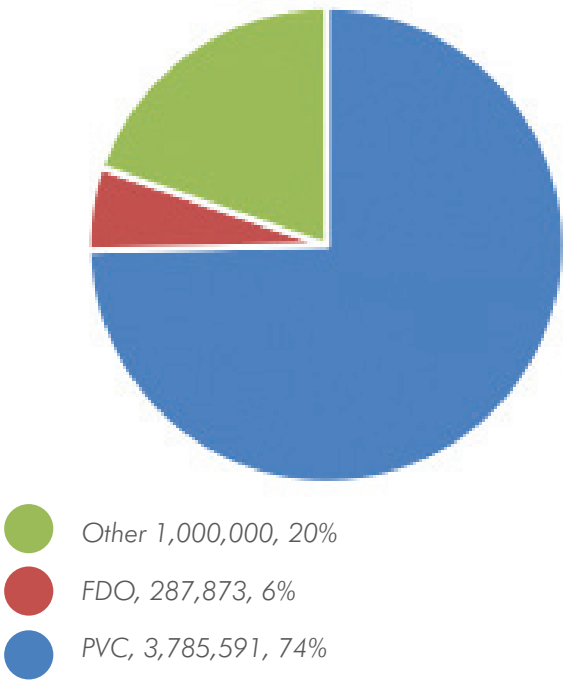
4.1.VOLUME OF SINGLE PLY MEMBRANE SOLD ON THE UK MARKET IN 2015

Manufacturers interviewed were asked to provide data of UK sales of single ply membrane for 2015. Of the twelve companies interviewed nine manufacturers supplied sales data. Sales data was recorded in m2.

According to the data provided sales of single ply membrane for 2015 from these nine companies are estimated to be approximately 5,080,000 m2. SPRA estimates that the total UK market of single ply membrane is in the region of 6.5 million m2. From the data provided by the nine SPRA manufacturer members, this would equate to their sales making up nearly 80% of the total UK sales.

As shown in Figure 1, approximately 74% of the membrane sold was PVC, 6% was FPO and other materials (principally EPDM) accounted for approximately 20%. This data is based on the nine manufacturing members that provided sales data for this study.

Figure 1 Single ply membrane sold in UK in m2, 2015 broken down by polymer type



4.2. ESTIMATED WEIGHT OF WASTE MATERIAL ARISING

One of the key objectives of the study was to estimate the amount of waste membrane arising, in order to assess the viability of a collection and recycling scheme.

Single ply roofing is sold in m2, but waste material is estimated in kilogrammes or tonnes. In order to convert m2 to kilogrammes, manufacturers were asked to supply the weight of material per m2. This varies according to thickness and type of material, with weights quoted ranging from 1.2kg/m2 to 2.2kg/m2. The average of all the weights provided was 1.67kg/m2.

Axion used this average weight per m2 to calculate the approximate weight of the material placed on the market and from that estimate the weight of waste that arises from single ply roofing projects.

Based on the above calculation, the total weight of single ply membrane supplied in the UK in 2015 by the manufacturers interviewed was estimated to be approximately 8,480,000 kg (8,480 tonnes).

4.2.1. WEIGHT PER TYPE OF WASTE

There are a number of types of waste arising from the single ply roofing sector that could potentially be available for recycling:

- Production/manufacturing waste: manufacturers will generate some production waste as part of normal manufacturing practices;
- Damaged or faulty membrane: this can be produced by either a manufacturer or contractor;
- Training waste: this material is produced as a result of training activities;
- Installation off-cuts: this material is produced by contractors during a project and is typically clean and free from adhesives; and
- Post-consumer stripped membrane waste: this material is generated by contractors during refurbishment projects.

In the following section Axion has assessed the volumes of each of these types of waste arising in the UK. There is further discussion of the types of waste and current waste management practices in Section 4.4

4.2.1.1. MANUFACTURING WASTE

Only one of the manufacturers interviewed manufactures their single ply membrane in the UK. This manufacturer currently recycles their manufacturing waste into new products.

4.2.1.2. TRAINING WASTE

All companies produce training waste as they run regular training courses for the sector. The waste generated from training activities could not be quantified by the manufacturers as it is not currently measured and monitored. There could be a significant volume of this type of membrane waste potentially available for recycling. Most manufacturers stated that it is technically feasible to recycle training waste, however as most of them are based abroad, the logistics of shipping smaller volumes back is challenging. Therefore, the feedback received from the manufacturers suggests that this material is usually landfilled.

4.2.1.3. INSTALLATION OFF-CUTS

In order to assess the off-cut waste potentially available for recycling, contractors and manufacturers interviewed were asked how much material was typically wasted on a per job or project basis.

Responses received from manufacturers and contractors varied greatly with regard to this question. This can only partly be ascribed to the effect of project size on rates (i.e larger jobs tend to have smaller percentage wastage rates). Estimates ranged from 1% to 12%, with an average of 3%. The scatter graph in Figure 2 shows the large variation in estimated percentage of installation off-cut waste.

The average estimate of contractor off-cut waste of 3% was applied to the manufacturer sales data to calculate expected area and weight of off-cuts from membranes arising in the UK in 2015. As shown in Table 1, approximately 152,000 m2 or 254,000 kg of single ply roofing off-cut waste arose from projects undertaken by the companies interviewed by Axion in the UK in 2015.

Figure 2 Variation in estimated percentage of installation off-cut waste

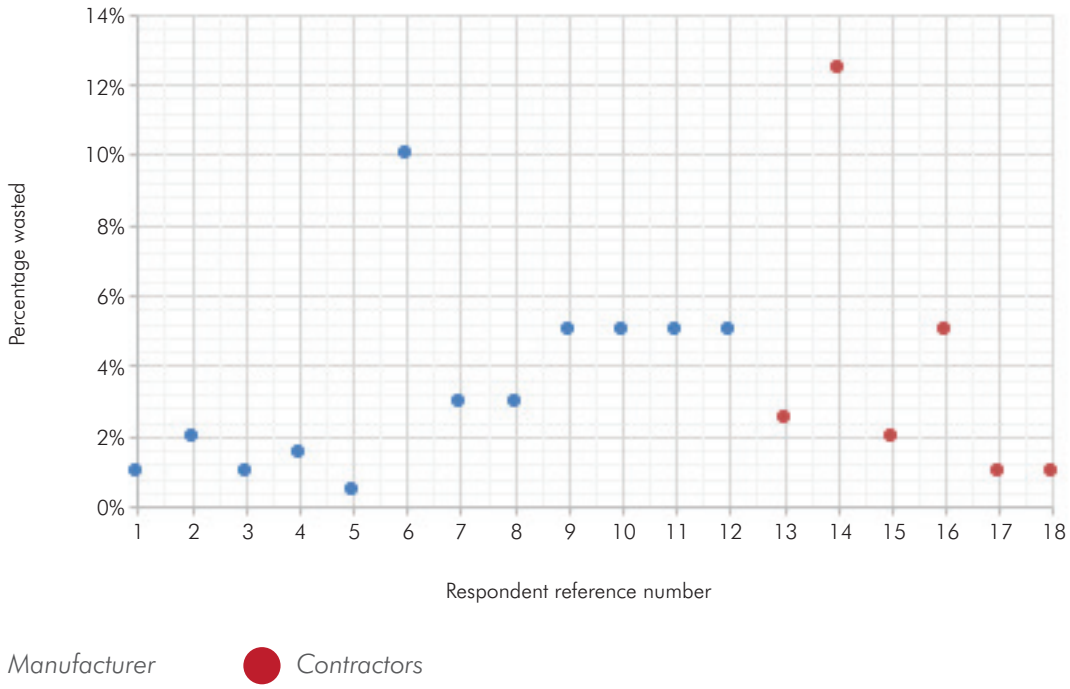


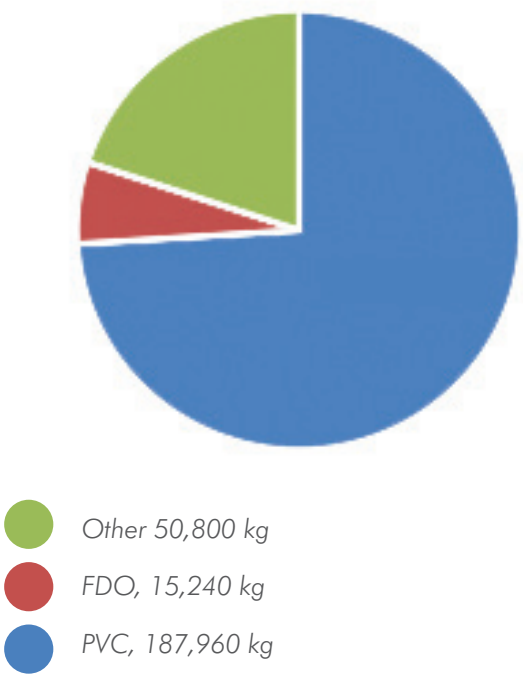
Table 1 Estimated m2 and weight of off-cuts arising

Placed on the market		Percentage waste	Off-cut waste	
m^2	kg (based on 1.67kg/m^2)		m^2	kg
5,080,000m^2	8,480,000 kg	3%	152,000m^2	254,000 kg

It should be noted that this off-cut material is a mix of different membrane types.

Figure 3 shows the split of off-cuts potentially available for recycling by product type, assuming that 74% is PVC, 6% is FPO and 20% is EPDM and a mix of other product types.

Figure 3 Amount of single ply roofing off-cuts by type



4.2.1.4. STRIPPED MEMBRANE WASTE

In order to assess the volume of stripped membrane waste potentially available for recycling manufacturers and contractors were asked to provide the following information:

- Historic sales data to assess the volume of roofing coming to the end of its life and potentially available for recycling in the near future;
- The percentage of roofing supplied for new build projects and compared to the percentage for refurbishment projects; and
- The percentage of refurbishment projects that are strip and renew compared to the percentage of overlay projects.

None of the manufacturers interviewed were able to provide historic sales data to assess the volume of roofing coming to the end of its life within the next five years. Single ply roofing is a very long lasting product with durability in the range of 25-40 years. Therefore, it is reasonable to assume that a significant proportion of the membrane installed in 2015 in the UK is unlikely to reach end of life until at least 2040.

According to SPRA, the earliest projects that used single ply membrane in the UK will soon be 40 years old and already well beyond service life estimates provided in certification when installed. If not already overlaid or replaced, these will require action soon. However, there appears to be no readily available data regarding historic sales and so it is difficult to assess the volume of roofing likely to be ready to be replaced in the near future. Information provided by the manufacturers interviewed suggests that sales of membrane have increased significantly in the last ten years and therefore there is likely to be an increasing amount of material available for recycling in the future.

According to feedback from manufacturers and contractors approximately 70% to 85% of the projects they supplied membrane to in 2015 were new build projects. Of the 15% to 30% of projects that were refurbishment projects, the large majority appear to be overlay applications, whereby new membrane is placed on top of the existing roofing material, often with additional insulation between the two layers. Most manufacturers said that in more than 90% of refurbishment projects the new membrane was laid on top of old membrane.

There is not enough information available at present to give an accurate estimate of old membrane that will be available for recycling in the near future.

4.3. TYPES OF PROJECT

Manufacturers and contractors were asked about the type of projects or jobs they normally worked on. In addition, respondents were asked to provide information on the type of membrane used, to understand the types and volumes of waste typically generated on different types of project.

4.3.1. MANUFACTURERS

Of the twelve manufacturers Axion spoke with, six reported that over 70% of their UK sales are for new roofing projects. With regard to refurbishment projects, all manufacturers responded that the majority of material supplied is for overlay projects rather than strip and renew projects. The proportion of material sold for strip and renew projects is fairly small at 3% to 10% of total sales.

4.3.2. CONTRACTORS

From the six contractors Axion held interviews with, two of the companies specialised in new roof projects only. The other four contractors reported that the majority

http://www.spra.co.uk/sustainability/durability

of their work was new roofing projects (greater than 60%) but refurbishment projects are also undertaken for clients.

Refurbishment projects are typically carried out using a variety of methods; a) strip a small section of the roof out and replace it with new material; b) repair small areas of the roof; and c) completely overlay a new roof on top of old roofing material. Removing an entire roof can be expensive and there are also risks associated with the building not being protected and water tight while the old roof is being removed and the new roof laid.

The majority of the contractors stated they only use PVC roofing (four out of six contractors). Two of the contractors reported they primarily use PVC products but also use TPE and ethylene propylene diene monomer (EDPM) for more specialist projects such as green roofs or when a roof needs enhanced strength and robustness. All the contractors Axion spoke to used SIKA Sanifil products, with a number of other products being mentioned including SIKA Trocal, IKO and Bauder, with Bauder being mainly used for green roof projects.

Figure 4 Single ply roofing installation

4.4. CURRENT WASTE MANAGEMENT PRACTICES

The next part of the interviews with manufacturers and contractors focused on understanding the types of waste produced and the current waste management practices for these waste streams.

As outlined in Section 4.2 there are a number of types of single ply roofing waste in relation to how the waste material is generated:

- Production waste;
- Damaged or faulty membrane;
- Training waste;
- Installation off-cuts; and
- Post-consumer stripped membrane waste.

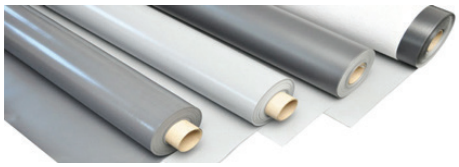
Each type of waste will have its own characteristics and waste management practices, which are outlined in the following two sections.

4.4.1.MANUFACTURERS

Axion spoke with twelve manufacturers; one of these manufacturers is UK based, with the other eleven companies being based in mainland Europe, specifically Germany, Scandinavia and the Netherlands. Single ply membrane manufacturers produce waste at different stages of their production process.

Four of the manufacturers commented that their production waste can be reground or re-used in some products. This will depend on what stage of the manufacturing process the waste was generated, for example if the waste arises early on in the process then there is the opportunity for the material to be incorporated back into the same product.

Figure 5 Single ply roofing products



For off-cut waste generated at the end of the production process, manufacturers reported there are a number of options. Off-cuts can be used to produce different products such as damp proofing or cut down to make strapping materials. Some manufacturers sell off-cut material to contractors for use on smaller size projects and others use it for training activities.

Manufacturers responded that damaged or faulty membrane is sometimes produced at manufacturing facilities. This material may have a defective section, which can be removed and the remaining material used for strapping. Materials are also sometimes returned to manufacturers by contractors due to faults, this material can be treated in the same way.

Manufacturers also generate waste products from training activities. Most of the companies interviewed responded that their training waste is currently landfilled. One manufacturer stated that their material is granulated and incorporated into new products.

4.4.2. CONTRACTORS

Contractors produce both installation off-cut waste and post-consumer waste, which is material stripped and removed from an existing roof.

Off-cuts are generated on both new and refurbishment roofing projects. This waste material is typically clean and free from adhesives and contaminants. The amount of off-cuts produced depends on the type and scale of the project being delivered, for example irregular shaped buildings/roofs will generate higher quantities or off-cuts. The responses from the contractors were that off-cuts were typically 1% to 12% of the total material used on a project. Contractors did comment that larger sized off-cuts can be potentially used for strapping or kept for future smaller refurbishment projects.

Figure 6 Installing single ply roofing

Stripped post-consumer waste membrane is generated from refurbishment projects by contractors. This material can be difficult to separate from underlying insulation materials or roof coverings, particularly if it was originally installed using adhesives. The waste material will also be dirty, contaminated and UV damaged (on its upper surface), due to it being in place for many years.

Occasionally contractors will receive faulty or damaged products from manufacturers. Depending on the type and scale of the faults or damage, contractors reported they sometimes try to repair the material themselves on site or alternatively the material will be returned to the manufacturer.

Axion asked the six contractors about their current waste management practices, to gain an understanding of how the waste is handled and managed. All the contractors responded that off-cut and stripped membrane waste is disposed of in waste skips that are located on site and provided by the main construction contractor. It was noted that sometimes a main contractor will provide a segregated skip for certain recyclable waste materials. Although the most common practice is for a mixed construction waste skip to be used. The cost of disposal is covered by the main contractor and therefore client, so the roofing contractor is not incurring any disposal or waste management costs. These costs will obviously vary depending on the waste management company and location and will be based on a cost per tonne rate. On smaller projects the roofing contractor will be responsible for making its own waste management arrangements, probably through using a small skip for waste collection and the material will be disposed of to landfill.

Figure 7 Construction site waste collection

4.5. INDUSTRY VIEWS ON A COLLECTION AND RECYCLING SCHEME

Part of the purpose of the interviews with manufacturers and contractors was to investigate whether there was interest in participating in a pilot collection and recycling scheme, as well as exploring the key drivers for companies committing to recycling and sustainability initiatives. Axion was also interested in finding out if there were perceived barriers and challenges that would need to be overcome in the single ply roofing supply chain.

4.5.1. MANUFACTURERS

4.5.1.1. KEY DRIVERS

All twelve of the manufacturers that participated in the study stated they were interested in being involved in a pilot collection and recycling scheme. One manufacturer felt more could be done with waste minimisation, through contractors ordering bespoke lengths of rolls of membrane for specific projects.

There was a variety of reasons for manufacturers wishing to be involved in a scheme. One manufacturer would like to reduce waste being disposed of to landfill, whilst another stated they wanted to take corporate responsibility for the products they manufacture and having a solution in place for end of life products would help them achieve this. Two manufacturers commented there is growing demand from main construction

contractors to handle and manage site waste in a more sustainable manner, with requirements to produce Site Waste Management Plans. For example, Balfour Beatty require an environmental policy being in place for waste produced on site.

Other reasons given were customer satisfaction, 'green' credentials and marketing opportunities. It was commented that although green credentials are not a major factor, it can contribute to making and achieving sales. A number of the manufacturers mentioned they are members of VinylPlus , the PVC industry's commitment to sustainability in the value chain, and would like to participate in a recycling initiative as part of that.

If a collection and recycling scheme was piloted and established, there would need to be improved data collection and reporting within the single ply roofing sector. All the manufacturers responded positively by saying they would support an initiative by collecting and reporting data on the type of roofing materials used, amount of material installed, percentage of wastage, etc. An option is to use the existing field inspection reports which are produced initially by the manufacturer and then passed on to the contractor. Four of the manufacturers interviewed confirmed that additional data recording could be easily done through this reporting mechanism, with a few modifications made to the existing report. Although there was a general consensus that more data collection and reporting could be achieved, questions were raised by a number of the manufacturers as to whether this would produce a true and accurate reflection of actual waste volumes. The reasons being that skips are changed, replaced and emptied frequently on busy construction sites and therefore it could be difficult to accurately record data. Therefore, it will be necessary to capture data from roof level rather than waste collection points. Others commented that contractors may feel obliged to give the 'right' answer and also that the field inspection report is often completed once the roofing contractor has left the site, so there would need to be a way of ensuring accurate and complete data is recorded. The manufacturers recognised this as an important step for the SPRA membership to take and it should be discussed and agreed within the association.

4.5.1.2.RECYCLING OFF-CUTS

The manufacturers were asked about their ability to recycle clean, off-cut waste and whether it was technically feasible to incorporate this material in new single ply roofing membrane. Five out of the twelve companies responded that this should be achievable. One of the manufacturer's commented that they have equipment to recover PVC from installation waste and would be willing to trial this and explore how it could be established on a commercial scale.

The other manufacturers felt it was technically viable to recycle off-cut waste and use the material in new single ply roofing products but it may not be financially viable. The reasons being the costs associated with transporting relatively small quantities of material to manufacturing facilities in mainland Europe. Comments were made that identifying and establishing UK-based outlets would be a more sensible approach.

There were concerns from some manufacturers around the technical challenges involved in recycling installation waste back into single ply roofing products. Reasons given were the material will have been exposed to the elements (sunlight, rain, temperature variation) which would impact on the physical properties of the material, as well as material compatibility issues and contamination from other substances or materials such as adhesives. Two of the manufacturers commented a better option may be to use the recovered material in other products, such as roofing grade products for example damp course proofing which have lower specifications and requirements, but not back into single ply roofing applications.

A chemical recycling process was mentioned by one of the manufacturers, the Vinyl Loop process which recovers the material into its constituent parts, which can then be used in a range of applications.

4.5.1.3.BARRIERS AND CHALLENGES

Two key barriers were identified by the manufacturers Axion interviewed; cost and a lack of buy in from stakeholders. All the manufacturers responded that any collection and recycling scheme would need to make both commercial and environmental sense. One manufacturer commented that if there were additional costs to be incurred as a result of a scheme, then these should be factored in to the costs of a project right from the beginning. Two of the companies felt there must not be any additional costs associated with a scheme. Comments were also made about recognising the different types of costs, for example labour costs may be higher due to handling waste materials and keeping roofing materials separate from general mixed waste.

The majority of manufacturers highlighted that a successful collection and recycling scheme would need buy in from both the contractor and client. It was noted

[4]http://www.vinylplus.eu/

that most clients are keen to support recycling initiatives, which is a positive starting point. Manufacturers felt that encouraging fitters to separate roofing waste may be challenging but with clear and improved communication on sites this could be achievable. One of the manufacturers commented that a recycling scheme would need to be led by contractors, but with the co-operation and buy in of the whole supply chain.

It was recognised that a collection and recycling scheme would need all SPRA members to work together. Also, that it would be important to ensure appropriate controls were put into place to prevent abuse of the scheme by non-SPRA members.

4.5.2. CONTRACTORS

4.5.2.1. KEY DRIVERS

All the six contractors interviewed by Axion were positive about a collection and recycling scheme for single ply roofing waste and said they would participate in a scheme if it was available. Most of the contractors commented that having a scheme in place to recycle the waste roofing membrane would help them to win and secure more work with clients. The BREEAM accreditation scheme was mentioned, which is a method of assessing the sustainability of master-planning projects, infrastructure and buildings. Recycling of construction waste can count towards BREEAM accreditation points. A further example given was large construction contractors such as Morgan Sindall Group or Lovell have strong Corporate Social Responsibility (CSR) policies and prefer to work with contractors that can demonstrate construction waste is recycled.

4.5.2.2. BARRIERS AND CHALLENGES

The contractors interviewed also identified two key barriers to establishing a collection and recycling scheme; a lack of volume of waste material available and an absence of buy-in from stakeholders.

Three of the contractors commented there may not be a sufficient amount of single ply roofing material available to justify the costs associated with collections from construction sites. A suggestion was made that bulking up waste at a contractor's depot may improve the logistics and economics of the scheme.

Four out of the six contractors stressed the importance of buy-in from stakeholders across the whole industry and supply chain. They felt that manufacturers, suppliers, contractors and industry bodies would need to work together to make a scheme an industry-wide initiative.

Two of the contractors commented they would support a scheme led by a trade body such as SPRA.

One respondent said it might be challenging to get fitters to change their habits and participate in a scheme initially, although they recognised that people adapt to new practices over time and a lot of fitters are already supportive of recycling. A suggestion was made that recycling practices could be included in a fitter's induction process, so they understand how to use a service and why it is important and beneficial. A further suggestion was for distributors and suppliers to promote the service to installation teams and fitters. It was also commented that having a main construction contractor such as Lovell, supporting a scheme would help to encourage recycling on construction sites. Without the support of the main contractor finding space for additional collection containers and site infrastructure may not be established.

4.6. LOGISTICS AND OPPORTUNITIES FOR A COLLECTION SCHEME

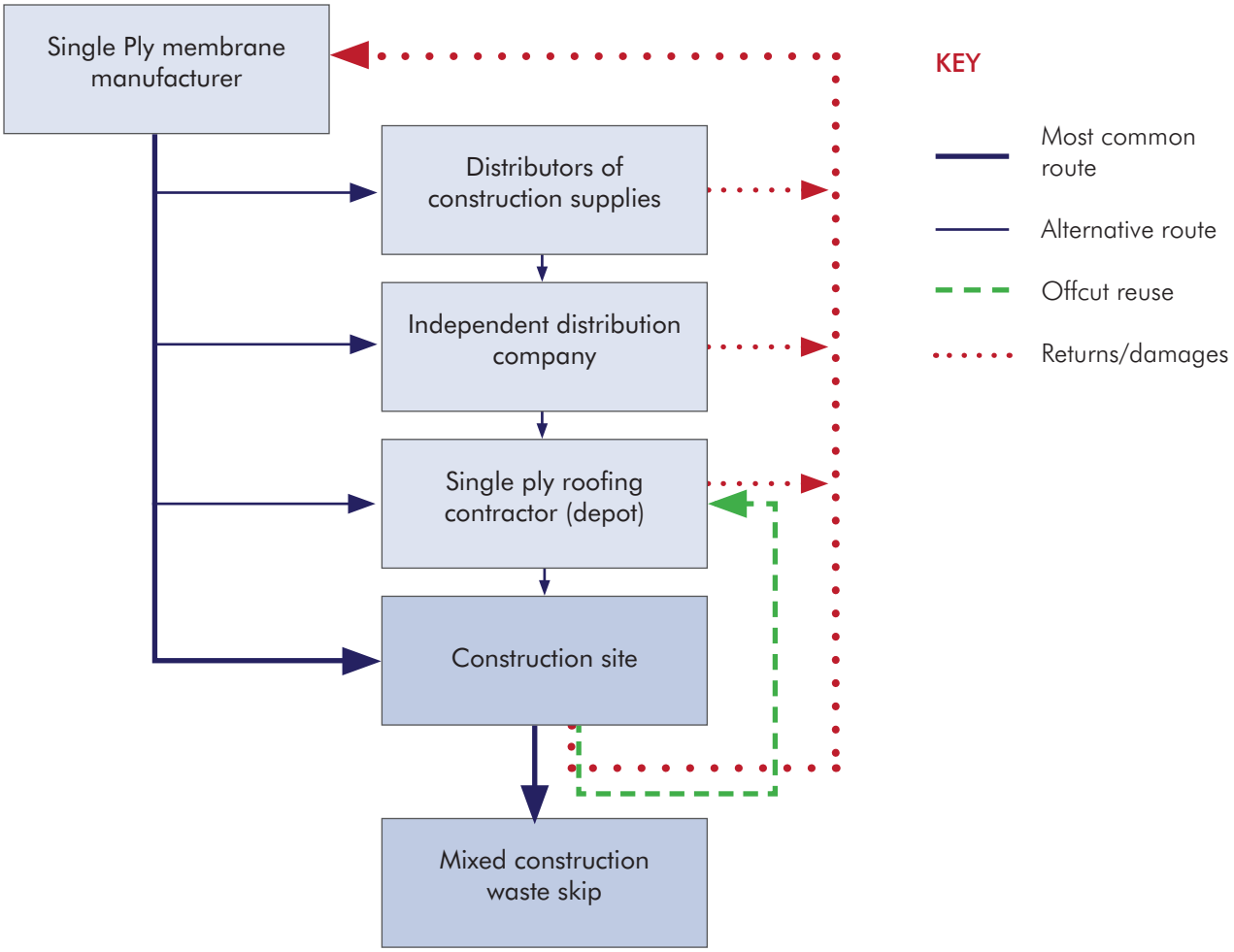
Manufacturers and contractors were asked to outline their current supply chain and logistics network. The purpose of this part of the interviews was to both understand current practices and explore whether there were opportunities to utilise backhaul and reverse logistics in the single ply roofing sector. This technique is used successfully in many other sectors as a cost effective and efficient way of collecting waste materials from points of waste production.

Figure 8 shows the current supply chain for single ply roofing, including the key stages and flows of materials. (see next page)

[5] http://www.vinyloop.com/en

[6] http://www.breeam.com/

Figure 8 Single ply roofing supply chain



4.6.1.MANUFACTURERS

From the twelve manufacturers Axion interviewed, five said their roofing products are stocked and sold by a roofing materials supplier, with branches across the UK, for example Rinus Roofing Supplies, Alltype Roofing Supplies and Jewsons. One manufacturer commented that they use a third party that specialises in construction materials to deliver their products. The other manufacturers use their own fleet of vehicles to distribute and deliver their products.

In terms of opportunities to utilise the existing supply chain and network for waste collection, many of the manufacturers interviewed identified existing suppliers and distributors as a potential mechanism for collecting and transporting waste roofing materials. The point was made that a cost benefit analysis would be needed to evaluate the opportunity fully and determine if it made commercial sense.

Two of the manufacturer's suggested that contractors could return small volumes of waste roofing to the distribution centres, allowing small quantities of waste material to be bulked up prior to collection. One manufacturer questioned whether contractors would be willing to do this, as it could involve separating waste material on site and making a special journey to drop off the material at a collection point. Although they did recognise if the contractor was already visiting the distributor then this would appear to be a sensible option. Other issues raised were that contractors may not be willing to apply and pay for a waste carrier's license, which would be required , and also that working with distributors and suppliers may not be feasible as not all manufacturers work with all distributors.

A number of the manufacturers that participated in the interviews suggested that an effective collection mechanism for waste roofing would be to use bulk bags and/or returnable stillages, which could be collected from construction sites or from contractor's depots.

Using contractor's facilities would allow material to be collected from several projects and sites and be bulked up, so that collection occurs when a sufficient amount of material has been generated.

One manufacturer commented that in addition to roofing membrane waste, a collection scheme could also accept plastic bags the rolls of membrane are delivered in. It was thought there may be some income to be generated from the sales of this fairly clean plastic waste stream (likely to be polythene), which could be off-set against the costs of operating the scheme.

4.6.2. CONTRACTORS

The contractors Axion interviewed confirmed that single ply roofing membrane is supplied and delivered in rolls. The majority of products are supplied directly from the manufacturer to the project site, although material is sometimes delivered to a contractor's depot.

Of the six contractors that participated in the study, four thought there were opportunities to work with the supply chain and distribution network to collect roofing waste materials. The other two contractors questioned whether this would be an option, as deliveries are sometimes undertaken by an external haulage company.

The contractors were asked for their views of how a collection scheme could be operated. The majority of contractors identified the Kingspan recycling service as a good model of a supplier-led take-back scheme. This scheme collects insulation off-cuts in bulk bags, allowing the material to be separated from general mixed waste. The bags are then collected by Kingspan when a delivery is made to the site.

The contractors recognised that a collection and recycling scheme would need to be flexible to allow for different types and sizes of roofing projects. Two of the contractors suggested their installation off-cuts could be easily manually handled and returned to their depots. The other four contractors felt it would be preferable for the waste roofing to be collected from site, although it would be possible to return the material to their depots. For those sites with a limited amount of space, collection bins could be used with a timed collection and a 'wait and load' skip service, whereby a skip is delivered to site at a scheduled time, the skip is loaded with waste and then removed.

The contractors were asked about what type of collection container could be used. The majority of contractors answered that large bulk bags and skips would be preferable, as it was thought that bins might be too small for some off-cut materials. One contractor suggested the membrane manufacturers could supply bulk bags for collecting waste materials in at the same time as supplying and delivering new products.

[7] https://www.gov.uk/waste-carrier-or-broker-registration

[8] http://blog.kingspaninsulation.co.uk/waste-take-back-scheme/

5. POTENTIAL OUTLETS FOR SINGLE PLY MEMBRANE WASTE

Part of the scoping study involved Axion identifying potential outlets for PVC and FPO single ply roofing membrane, as these are the most commonly used products. PVC membrane is supplied in a number of formats; unreinforced, polyester reinforced, glass fibre reinforced and felt-backed membrane.

Axion approached a number of companies to establish whether end of life single ply roofing membrane could be utilised in their recycling and manufacturing processes. Companies producing traffic management products, acoustic barrier matting products and equestrian surfaces were contacted. All of these currently use recycled polymers as a product or use waste plastics as part of their manufacturing process.

Traffic management products, such as traffic cones, provide measures and solutions to slow and control the speed of vehicles. The traffic management product sector is a large user of all types of flexible post-consumer PVC including flooring and cable waste. Axion talked to the traffic cone manufacturer Melba Swintex based in Bury, Manchester and they expressed interest in the unreinforced PVC, both aged/post-consumer material and off-cuts. They would be willing to accept relatively small volumes of material, possibly a few tonnes at a time although they would prefer larger loads. They would accept the material delivered in bulk bags on pallets and ideally the material should be cut into as small strips as possible.

Figure 9 Traffic management products

A manufacturer of acoustic barrier matting was also contacted, WSBL in Bury. These products minimise noise, combat vibration and can be used on walls, floors and ceilings. Again, this company was particularly interested in unreinforced PVC material, either as an off-cut or post-consumer material. They would require a minimum of 10 tonnes of material and for it to be supplied in bulk bags.

Both companies commented the polyester and glass fibre reinforced membrane would cause technical issues with their recycling and manufacturing processes. The polyester, which is present as a scrim, tends to wrap around blades as the material is cut and therefore quickly blunts the equipment used for size reduction. Polyester also 'fluffs up' in the extruder, causing blockages in the filter.

There is some positive interest from both of these companies but practical trials will be needed to investigate and evaluate the technical and commercial viability. Both of these end markets are relatively small scale however the likely volumes of single ply roofing waste available for recycling will not be huge, so the markets should have sufficient capacity to accept and handle this waste stream.

The equestrian surfaces market is a further possible outlet for collected waste roofing membrane. This market produces specialist resilient surfaces for use in horse riding and training environments. The sector is already a large user of recycled flexible PVC waste and is used by the RoofCollect initiative in Germany.

6. CONCLUSIONS

Axion has undertaken a scoping study of the potential to establish a collection and recycling scheme for single ply roofing waste material. The study has also established estimates for the amount of single ply roofing sold in the UK and the current levels of waste generated by the sector.

It is estimated that a total of 5.08 million m2 (equivalent to 8,480 tonnes) of single ply roofing membrane is sold in the UK per annum by the nine manufacturers who provided data for this study. The SPRA estimate the total market for UK sales of single ply membrane is 6.5 million m2; the nine SPRA members that shared data can be seen to represent nearly 80% of the UK market for sales of single ply roofing membrane.

Contractors were able to estimate the percentage of single ply roofing that is wasted and on average this is thought to be approximately 3%, although obviously varies on type and size of project. Using this as a basis an estimate was made as to the total amount of single ply roofing membrane off-cuts generated as waste in the UK; 152,000 m2 or 254 tonnes. This estimate is for off-cut material only as it is not possible to estimate volumes for the other types of membrane waste (including production waste, waste from training activities and stripped membrane waste) due to a lack of data. So, the overall tonnage of waste roofing produced will be higher than this figure once the other sources of waste are taken into consideration.

It was clear from the interviews held with manufacturers and contractors that there is a lack of robust and accurate data, particularly in terms of type of products used and waste generation, but also historical sales data.

The single ply roofing sectors works on a variety of projects including new roofing schemes and refurbishment projects. The majority of UK sales of membrane are for new roofing applications and this was validated by the contractors, with a number specialising in new projects only and the other companies estimating that new projects account for more than 60% of their work.

Waste is generated by the sector at various stages of the supply chain. This starts with the manufacturing process with production waste being generated or damaged or faulty products. Waste is also produced from training activities. Contractors then generate waste as a result of both installation off-cuts and post-consumer/ used roofing being removed and replaced on existing buildings and structures.

There are a variety of waste management routes and practices for the single ply roofing membrane. Production waste, damaged products and training waste can often be recycled and used within new single ply roofing products. Installation and post-consumer waste is typically collected at the construction site, using waste skips provided by the main construction contractor. Sometimes there is provision for separate skips for recyclable materials, but often roofing waste is disposed of with mixed general waste. The cost of this disposal is normally borne by the main construction contractor and ultimately client.

There is definitely a real interest in recycling within the sector, from both manufacturers and contractors. All eighteen of the companies interviewed supported a collection and recycling scheme being established within the industry. The reasons given for supporting recycling include wishing to divert waste from landfill, corporate responsibility, sales and marketing benefits and green credentials. Both manufacturers and contractors highlighted the influence of major construction contractors and that they expect and encourage recycling of on-site construction waste.

A number of barriers and challenges to establishing a recycling scheme were identified; financial implications, a lack of volume of available material and the need for buy in from the whole supply chain and stakeholders. The manufacturers and contractors did not feel these barriers could not be overcome, with a number of useful suggestions being made. For example, working with suppliers and distributors to promote the scheme and ensuring fitters have a clear understanding of how to participate in a scheme and the benefits of doing so.

Information was obtained on how a collection and recycling scheme could be operated within the sector, making use of existing logistics and supply networks. There is some support for a reverse logistics/backhaul mechanism to be used, so that waste roofing can be returned to distributors and manufacturers. Another option is for the waste to be collected from either construction sites, contractor's depots or distribution/ supplier facilities. There was clearly support for

collections from construction sites using preferably bulk bags. Suggestions were also made for bulking up waste at contractor's depots so that larger volumes would be available for collection.

Based on Axion's knowledge and experience of developing and managing collection and recycling schemes in other industry sectors, it is likely that a variety of mechanisms might be needed, to allow for different practices, types and sizes of projects. Axion suggests that a network of drop-off facilities at distributors and suppliers would be an efficient method of collecting off-cuts of single ply membrane. Contractors could be supplied with collection sacks to use on site, which could be dropped off when they are visiting suppliers/ distributors for new supplies and the material bulked up reading for collection. Collections from larger construction sites should also be a viable mechanism, with contractors being supplied with bulk bags to fill up with off-cuts and stripped membrane waste, which can then be collected directly from sites.

In terms of using the single ply roofing waste back into roofing products, some of the manufacturers felt this would be technically feasible, particularly for installation off-cuts that should be relatively clean. One manufacturer has existing equipment to recycle PVC off-cuts and is interested in exploring this further. Other manufacturers commented there would be technical challenges in recycling this waste stream, due to both contamination and the post-consumer material being exposed to the elements and resulting changes in physical properties. One issue to note is that the majority of manufacturers are not based in the UK, which could increase transport costs for shipping waste material back to manufacturing plants.

Axion investigated other outlets for single ply roofing waste, including acoustic barrier matting and traffic calming products. There is some initial interest from manufacturers in the unreinforced PVC membrane. This will require further investigation to fully explore the opportunity.

The key conclusion from this study is that there is an opportunity to improve the waste management practices of the single ply roofing sector. There is potential to trial a collection and recycling scheme for single ply roofing membrane waste. The support and interest shown by the manufacturers and contractors is encouraging. There are a number of areas that will need to be investigated further including better data collection so a more accurate picture of waste roofing types and volumes can be established. There will be a need to secure the buy in and co-operation of all stages of the supply chain, from manufacturers, suppliers, main construction contractors, roofing contractors and fitters.

7. RECOMMENDATIONS AND NEXT STEPS

Axion makes the following recommendations to SPRA:

- Set up a more comprehensive data collection system to enable a more robust and accurate picture of current waste types and volumes to be established. The existing field inspection reports appear to be a logical route for collecting this data. The current report will need to be modified to capture and record the required data. The data will then need to be collated and passed to a central body such as the SPRA. It will also be important to identify geographical areas where the highest volumes of roofing waste are generated;

- Annual reporting of sales data and types of project undertaken by SPRA members. This will allow forecasts to be made of future volumes of single ply membrane waste, allowing for more robust planning to take place for the development of recycling initiatives;

- A pilot collection and recycling scheme to evaluate a range of collection mechanisms, monitor volumes of recyclable waste and participation by the sector. A pilot scheme should include a number of different collection methods including backhaul, collection from construction sites and contractor depots and drop-off facilities at supplier and distributor facilities. The scheme should also explore promotional, communication and educational activities, to ensure good levels of participation can be achieved;

- Recycling trials to evaluate options for using roofing waste in single ply roofing products. This should include different types of roofing waste being trialled by a manufacturer to determine if it is technically feasible; and

- Recycling trials with other product manufacturers. This should include providing samples of waste for preliminary assessment, followed by trials to evaluate the use of roofing waste in a number of applications.

In terms of next steps to drive this work forward Axion suggests:

- SPRA recommends modifications to the existing field investigation reports to enable better quality data to be collected. Key data to be recorded and collated includes:
    - Number of projects using different methods of laying roofing membrane;
    - Types of roofing material used;
    - Amount, type and percentage of waste generated per project; and
    - Geographical location of projects.

- Once a revised field inspection report has been agreed, it's use should be trialled with a selection of SPRA members for a period of time, for example three months, to test the data capture, collection and reporting systems;

- Roll out of more comprehensive data capture and reporting system with all SPRA members, through the field inspection reports following the trial period;

- Deliver a trial collection scheme for installation off-cut and post-consumer waste using:
    - Take-back collection from construction sites using an external haulage contractor;
    - Take-back collection from construction sites using a manufacturer's own transport fleet; and
    - Take-back collection from contractor's depots.

- Deliver trials to evaluate the use of off-cuts in single ply roofing products with both UK and European manufacturers; and

- Deliver trials to evaluate the use of off-cuts and post-consumer waste with recyclers and end users in the UK.

APPENDIX A SPRA SURVEY - MANUFACTURERS

SURVEY AIMS

To conduct a scoping study to better understand the volumes of post-consumer singly ply roofing waste in the UK and establish how a collection scheme for the roofing sector might work.

SURVEY

1. GENERAL INFORMATION

1.1. Contact details	
Name	
Position	
Company name	
Email	
Telephone	

1.2.What types of single ply roofing do you manufacture or distribute?	
CPE - Chlorinated polyethylene	
EPDM - Ethylene Propylene Diene Terpolymer	
FPO - Flexible Polyolefin	
PVC - Polyvinyl chloride	
PIB – Polyisobutylene	
EVA Ethylene Vinyl Acetate	

2. VOLUME OF MATERIAL SUPPLIED

2.1. Do you manufacture the single ply roofing in the UK?	
If yes, how much post-manufacturing waste do you generate at your site?	
What is your current disposal method for your manufacturing waste? Is any material currently recycled?	

2.2.How much PVC roofing did you supply in 2015?				
Thickness (membrane only)				
Standard glass reinforced				
Standard polyester reinforced				
Fleece backed				
Unreinforced				

2.3.What is the average weight of your products per square meter?				
Thickness (membrane only)				
Standard glass reinforced				
Standard polyester reinforced				
Fleece backed				
Unreinforced				

2.4.On average, what percentage of roofing supplied is for strip and renew contracts and what percentage is for overlay contracts?
Strip and renew contracts ..... % Overlay contracts ..... %

3. FUTURE WASTE ARISING

3.1. We would like to get a picture of volumes that will reach end of life in 5-yearly blocks arising from the market 20 years ago. To get a very rough estimate we would need your company's sales during those 1990s. Would you be willing to provide this data?

4. RETURNS AND DAMAGES

4.1. Do you receive returned material that is damaged or faulty?	
4.2. How much was returned in 2015?	
4.3. Where was this returned to? How was it disposed of?	

5. DISTRIBUTION

1.1. What volume of your products are sold/distributed?	
Direct to contractor (i.e. you are sole distributor)	
Via a multi-branch roofing merchant	

6. WASTE VOLUMES

6.1. On average, what percentage of the material supplied is offcut waste? E.g. 5% for strip and renew, 3% for overlay.	
6.2. What is the current disposal route for installation waste and stripped roofing waste?	

7. RECYCLING SERVICE

7.1. SPRA would like to trial a recycling scheme for single ply roofing waste, would you be interested in partnering on this project? What are your main drivers to take part?	
7.2. Would you be willing to modify field inspection reports to include recording information on e.g. site waste provision and whether existing was removed at refurbishment?	

7. RECYCLING SERVICE (continued)

7.3. Do you believe it is feasible to recycle clean offcut waste into a material that could be used as recycled content in new single ply roofing? Why?	
7.4. Do you see any opportunity to work with distributors or fitters to provide a drop off point/collection service or locations for bulking up waste?	
7.5. Do you foresee any potential barriers/ challenges?	
7.6. We would like to source samples of different types of single ply roofing (clean offcuts, manufacturing offcuts, training waste, waste material from strip and renew contracts), would you be able to send samples of this waste material to us?	
7.7. Please can you supply new and aged (end-of-life) samples of the different single ply roofing that you supply?	

APPENDIX B SPRA SURVEY - CONTRACTORS

SURVEY AIMS

Conduct a scoping study to better understand the volumes of post-consumer singly ply roofing waste in the UK and establish how a collection scheme for the roofing sector might work.

SURVEY

1. GENERAL INFORMATION

1.1. Contact details	
Name	
Position	
Company name	
Email	
Telephone	

1.2. What kinds of roofing do you use?	
1.3. Approximately, how much of each roofing do you use annually?	
1.4. Which distributors or suppliers do you regularly buy material from?	
1.5. How is it delivered? E.g. Is it delivered directly to site or to your depot?	
1.6. What % of your jobs are:	New ..... % Overlay ..... % Strip and re-new ..... %

2. WASTE VOLUMES

2.1. Which of the following single ply roofing wastes do you produce?	
Installation waste	
Post-consumer roofing waste (stripped membrane)	
Other	

2.2. Do you know/ Can you estimate what volume of waste you produced in 2015?				
Training waste				
Installation waste (Can you estimate new product waste rates for say <500m2 and >500m2 jobs?)				
Post-consumer roofing waste (stripped membrane)				
Other				

2.3. What % of offcut waste is generated on an average job? E.g. 5%for strip and renew, 3% for overlay.	
2.4. Are wastage rates generally higher or lower in refurbishment compared to new-built?	

3. WASTE MANAGEMENT

3.1. What is your current disposal method for your roofing waste? Is any material currently recycled? Are skips provided at larger jobs for your roofing waste? If skips are not provided how do you dispose of waste? E.g. we hire our own skip. We take waste back to our depot?	
3.2. Do you run training sessions? How do you dispose of the waste from the session? E.g. we hire our own skip.	

continued on next page

3. WASTE MANAGEMENT (continued)

3.3. How much per tonne does your current disposal method cost you?	
3.4. How often do you have to separate membrane waste from other waste e.g. insulation?	
3.5. How easy would it be to remove extraneous fittings (trims, peel-stops etc.) from waste?	
3.6. Can you describe what the waste material looks like when you carry out a strip and renew job? Is there any adhesive or other non-roofing material stuck to it?	
3.7. Do you have space to store waste at your depot? E.g. on a pallet? Do you have a forklift at your site?	
3.8. Please can you send a sample of installation waste and post-consumer waste?	

4. RECYCLING FOR SINGLE PLY ROOFING

4.1. SPRA would like to trial a recycling scheme for single ply roofing waste. Would you use a recycling service if it was available?	
4.2. What would incentivise you to use a recycling service?	

4. RECYCLING FOR SINGLE PLY ROOFING (continued)

4.3. Would your clients be more likely to use your services if the waste material was recycled?	
4.4. Do you see any opportunity to work with suppliers or distributors as a drop off point/ collection service or locations for bulking up waste?	
4.5. Do you foresee any potential barriers/ challenges?	
4.6. Would you be interested in taking part in a trial to recycle you of your single ply roofing waste?	

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