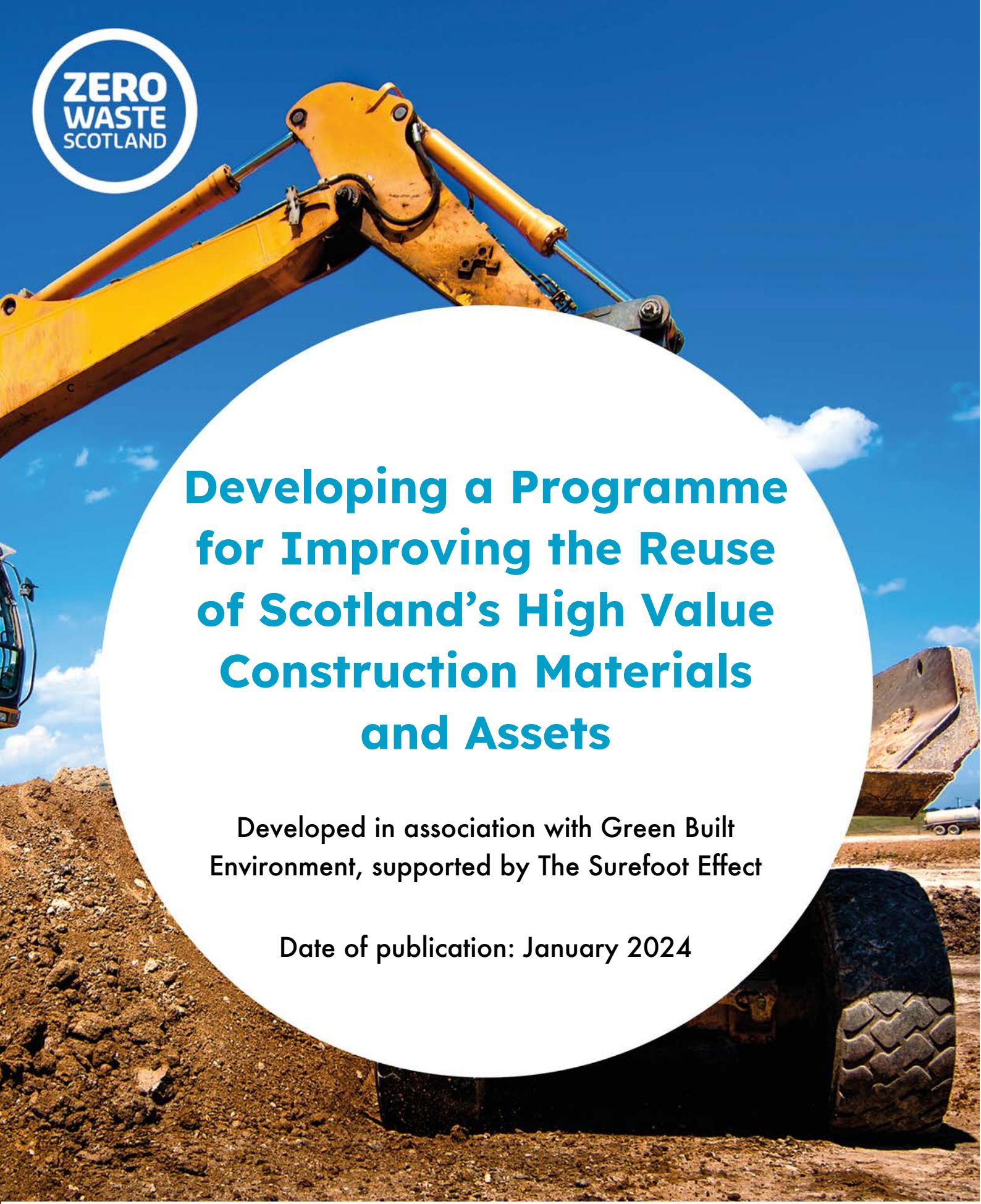

Developing a Programme for Improving the Reuse of Scotland's High Value Construction Materials and Assets

Developed in association with Green Built Environment, supported by The Surefoot Effect

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Contents

Executive Summary

The construction sector is the largest consumer of natural resources and contributor to waste in Scotland, accounting for at least 50% of overall waste arisings (tonnes) annually[1]. Imports of goods and services in the Scottish construction sector total a value of approximately £2bn[2],with a significant proportion of this spend – estimated to be in the region of £520m – attributed to building materials used in housebuilding[3]. A fundamental change is needed in the way construction materials are designed for use, maintained over their in-use phase, and managed for both recovery and potential redeployment at the end of their lifecycle, for a truly circular construction sector to be realised.

Scottish Government's consultation in 2022, 'Delivering Scotland's Circular Economy: A Route Map to 2025 and beyond'[4], has acknowledged this need and proposed a series of actions to support embedding circular construction practices that reduce resource demand, reduce waste arisings and emissions, and encourage reuse. On this basis, Zero Waste Scotland commissioned and supported the facilitation of a series of stakeholder engagement workshops between June and October 2022, designed to gather views and insight from the construction industry in Scotland and to potentially help shape and inform any future programme for reuse of high value construction materials and assets in Scotland.

This report presents an overview of the stakeholder feedback collected during these engagement sessions, in response to a series of questions designed to gather information on specific sector requirements, the barriers and enablers, and priority actions needed, to develop and implement a programme for reuse.

Enabling the adoption and implementation of circular practices within Scotland's construction sector is critical to reducing its climate change impact and demand for increasingly finite material resources. From engagement with the sector, it was possible to identify three key themes that could underpin future actions taken by policymakers to support and inform the development of a programme for reuse of high value and high carbon materials and assets in Scotland. These included 1) a clear legislative landscape; 2) agreement on the technical requirements that would be needed to drive the change required; and 3) enabling market conditions to facilitate increased adoption of circular practice within the sector.

Each of the three themes and their associated priority actions, are summarised in Table 1:

[1] https://www.sepa.org.uk/environment/waste/waste-data/
[2] Zero Waste Scotland, 2020, Embodied Carbon in construction – setting the scene for Scotland
[3] Scotland's Construction and Housing Industry: Workforce, Imports and Housing Demand, 2018
[4] Delivering Scotland's circular economy: A Route Map to 2025 and beyond

Table 1: Priority actions

Priority Actions
1. **Legislative landscape**: It is essential to provide clarity and certainty over the legislative landscape that businesses in the sector will operate within if or when a programme for reuse is implemented. This will require: • agreeing and defining **mandatory** aspects of **building standards**, and **planning and demolition procedures** to avoid needless demolition of existing buildings and enable **prioritisation of refurbishment**. • establishing agreed assessment frameworks for **planning and building approvals** that account for **embodied carbon** and adoption of **circular economy** practices. 2. **Technical requirements**: Reaching agreement and consensus on the technical requirements necessary for enabling and increasing the circular practices within Scotland's built environment is critical. Moving forward, critical next steps include: • **establishing universally accepted technical requirements** that can be applied at all stages of building design and construction. A focus on the **measurement of embodied carbon for both existing and new building stock** was one of the design aspects that featured prominently throughout all of the discourse with stakeholders. • **embedding circular economy** construction in the school, college, and university curriculum, and in the professional practice registration process to drive progressive change in perception and value of the underlying practises and principles. 3. **Market conditions**: Creating the right 'playing field' is needed to enhance the adoption of circular practices within the sector, this was outlined by stakeholders as involving: • use of **appropriate and equitable fiscal and financial measures** to enable the sector to adapt; and in doing so ensure public sector organisations are **equipped, resourced, and educated** to enable the prioritisation and adoption of circular practices when commissioning projects.

- prioritisation of circular practices and embodied carbon assessment within **procurement frameworks** to determine project commissioning outcomes.

An urgency for the need of a suite of reinforcing priority measures for reuse was keenly expressed by industry stakeholders. Acknowledging business and fiscal drivers, evidence presented in this report suggests that until legislative change is implemented to support circular practises as financially preferable, sectoral change may not escalate at the desired rate to meet reduced consumption by 2025 and beyond. The sector is willing to engage with its development on a collaborative basis to ensure feasible opportunities for reuse of high value construction materials and assets in Scotland are realised in the very near future.

Key Terms and Glossary of Definitions

Key Term	Definition
BAMB	Buildings as materials banks
BREEAM	Building Research Establishment Environmental Assessment Method, founded by the Building Research Establishment (BRE) in the UK in 1990 and uses licensed assessors to give accreditation.[5]
BIM	Building Information Modelling
C&D	Construction and Demolition
CDW	Construction and Demolition Waste
CE	Circular Economy
LCA	Life Cycle Assessment
LEED	Leadership in Energy and Environmental Design, developed by the U.S. Green Building Council (USGBC). LEED requires the building's design team collect data to be processed by the USGBC[6]
EC	Embodied Carbon
EPD	Environmental Product Declaration, which aims to report objective, comparable and third-party verified data about products and services' environmental performances from a lifecycle perspective[7]
EPR	Extended Producer Responsibility
Reuse	For the purposes of this project the definition of Reuse used by the UK Green Building Council (UKGBC) for their Circularity Working Group[8] was adopted. This definition is referenced from the International Standard ISO 20887:2020, Sustainability in buildings and civil engineering works[9]
LA's	Local Authorities

[5] https://bregroup.com/products/breeam/
[6] https://www.usgbc.org/leed
[7] https://www.environdec.com/all-about-epds/the-epd
[8] https://www.ukgbc.org/news/defining-Reuse-why-adopting-iso-definitions-will-help-encourage-circularity/#_ftn4
[9] https://www.iso.org/standard/69370.html

Materials Bank	Repositories or stockpiles of valuable materials that might be recovered. If those materials replace primary resources used during the construction, operation or refurbishment of buildings and their parts, the need for primary resource mining, for example, of rare earth elements, can be eliminated[10]
Materials Passport	Digital data sets which describe characteristics of materials and components in products and systems, giving them value for present use, recovery and future reuse[11]
MEAT	Most economically advantageous tender
NZPSBS	Net Zero Public Sector Buildings Standard
Pre-Demolition Audits	Also referred to as pre-redevelopment audits, are surveys undertaken on existing buildings, structures and hard-standing surfaces prior to demolition or major redevelopment.[12]
SG	Scottish Government
Tier 1 Contractors	Main contractors with a direct commercial relationship with a client
Tier 2 Contractors	Typically, subcontractors to Tier 1 Contractors, and tend to be the larger commercial building firms that take on major projects for public and corporate clients.
WMF	Waste Management Framework
WEEE	Waste Electrical and Electronic Equipment

[10] https://www.designingbuildings.co.uk/wiki/Material_banks
[11] https://www.watermangroup.com/news/kick-starting-the-circular-economy-pioneering-use-of-materials-passports-at-londons edenica/#:~:text=Materials%20Passports%20are%20digital%20data,use%2C%20recovery%20and%20future%20reuse.
[12] https://www.sweco.co.uk/services/buildings-urban/pre-demolition-audits/

1. Introduction

1.1 The Current Landscape

The UK policy and regulation landscape has, for decades, targeted reducing greenhouse gas emissions from the construction sector by focusing on operational aspects of a building, such as the heating and utilities-based energy consumed during the buildings lifetime. Conversely, attention on embodied carbon emissions associated with the construction, maintenance and decommissioning of buildings has remained a largely voluntary act, as embodied emissions remain unregulated in the UK[13].

As steps have been taken to reduce the lifetime operational emissions of our buildings, the importance of embodied carbon to a building's whole life cycle impact has increased. It will only continue to increase as further energy efficiency measures and the decarbonisation of the national grid is delivered through UK policy. Embodied carbon is now, on average, 50% of a building's whole life carbon, and is mainly emitted before the building is commissioned or used - that is 50% of a buildings greenhouse gas impacts occurring at the pre-construction stage as opposed to over the 60-year lifetime of the building - at a time when we least need these impacts to happen[14]. This situation heightens the desire for improved understanding and valorisation of embodied carbon emissions associated with extraction, manufacture and processing of materials used in the built environment.

In the UK, since 2016, the combined effect of forty different regulations targeting improved performance of waste management practices in the construction sector has resulted in a Construction and Demolition (C&D) recovery rate of 91%, equating to 60.2Mt of non-hazardous waste materials.[15] However, the majority of this high weight recovery rate can be attributed to recycling of low carbon value materials and assets such as soil and stone, and as a result reuse levels within the sector remain low. Ultimately, this has not led to an increased impact on the overall waste carbon footprint of the sector in the UK as reuse potential has not been realised for the non soil and stone waste fractions. Nor has it impacted upon resource usage, with slow adoption of

[13] UK Green Building Council, 2021, Net Zero Whole Life Carbon Roadmap: A Pathway to Net Zero for the UK Built Environment

[14] Lützkendorf, T. and Balouktsi, M., 2022. Embodied carbon emissions in buildings: explanations, interpretations, recommendations. Buildings and Cities, 3(1), pp.964–973. DOI: http://doi.org/10.5334/bc.257

[15] Lou E CW, Lee A, Welfle AJ, Abdullahi AL, 2021, Testing the Nexus between C&D waste management strategies & GHG emission performances: The case of UK student accommodation refurbishment projects, Journal of Building Engineering, v34

alternative means of design and construction that result in lower materials usage and lower wastage levels, such as those outlined in BREEAM[16].

Studies have highlighted that achieving high levels of performance against targets such as those defined by the European Commission's Waste Directive, or the criteria of building certification schemes such as BREEAM and LEED[17], will not guarantee a low emission waste management strategy either. Due to the bespoke nature of waste material arisings and potential for reuse opportunities across the built environment, assessing waste management strategies using standardised performance benchmarking tools becomes highly complicated and challenging[18].

1.2 The Future

Despite high material recovery rates, fluctuations in Construction and Demolition (C&D) waste arisings are likely to persist with changing economic activity, as has been demonstrated in the wake of the COVID-19 pandemic[19]. Whilst these fluctuations can significantly impact tonnages of waste arisings in the near future, the high recycling rate for Construction and Demolition (C&D) waste, combined with its relatively low carbon value means they do not necessarily lead to increased national waste carbon impacts, and relates to soil and stones comprising the majority of construction waste being recycled.[20]

Coupled with demand to meet Scottish (weight-based) waste reduction targets by 2025; and the additional disruption faced by the sector in supply chains, increasing material prices, and challenges in the labour market[21], conserving and prolonging the useful life of construction materials and assets has become a key component of future strategic planning. This has been keenly recognised in recently published consultations in Scotland, including the Circular Economy Bill[22]; Delivering Scotland's circular economy: A route map to 2025 and beyond [23], and the Fourth National Planning Framework[24].

[16] https://files.bregroup.com/breeam/technicalmanuals/BREEAMUK2014SchemeDocument/
[17] Scofield JH, 2009, Do LEED-certified buildings save energy? Not really..., Energy and Buildings, 41, pp1386-1390
[18] Lou E CW, Lee A, Welfle A, 2017, Greenhouse gases (GHG) performance of refurbishment projects – Lessons from UK higher education student accommodation case studies, 154, pp309-317
[19] Constructionline, https://www.constructionline.co.uk/insights/news/covid-19-infographic/
[20] Pratt K, Lenaghan M, 2017, The Carbon Footprint of Scotland's Waste, Zero Waste Scotland
[21] Findlay K, 2021, Scottish Construction Now
[22] https://consult.gov.scot/environment-forestry/scotlands-circular-economy-legislation/
[23] https://www.gov.scot/publications/consultation-delivering-scotlands-circular-economy-route-map-2025-beyond/pages/13/
[24] https://www.gov.scot/publications/draft-fourth-national-planning-framework-analysis-responses-consultation-exercise-analysis-report/

1.3 Aims and Objectives

Zero Waste Scotland (ZWS) commissioned Green Built Environment (GBE) to design and facilitate a series of stakeholder engagement workshops with a representative group of experts and practitioners associated with the Scottish construction sector. The aim of these workshops (supported by The SureFoot Effect) was to gather evidence centred on improving collective understanding of the feasibility and potential for increased material and asset reuse in the construction and demolition sector. To achieve this aim, the following set of objectives were developed to help design and deliver the workshops:

1. Collate the perspectives of the invited stakeholders to develop a long list of the requirements stakeholders believe will influence their ability to implement reuse practices across the sector.
2. Identify barriers and enablers for implementing reuse and circular practices relevant to their role(s) within the sector.
3. Generate a short list of priority actions for implementing reuse within the sector, identifying who should be involved in their delivery, and when these can be achieved by.

The stakeholders included representatives from a broad range of organisations involved in waste management, reuse and construction from the business, academic and public sectors. An overview of the participating stakeholders can be found in Table 2 in Section 2.1.

Whilst the focus of the project was on reuse, it was important to consider this practice within the broader context of the circular economy and the waste hierarchy. Preventing or reducing material use in the first instance was viewed as a key action, in addition to other practices such as remanufacturing and recycling – the latter of which has already been highlighted to contribute greatly to Scotland achieving its European Union construction and demolition waste reduction target.

1.4 Links to Delivering Scotland's Circular Economy

The purpose of the project was to support work on the Scottish Government's recently published consultation: 'Delivering Scotland's circular economy: A route map to 2025 and beyond'. The consultation focuses on several priority areas and highlights the government's ambition to move towards a circular economy and tackle the climate emergency.

One of the priority areas included in the consultation is focused on construction and outlines Scottish Government's aim for embedding circular construction practices within the industry that reduce resource needs, reduce waste and carbon, and encourage refurbishment and reuse. Within this priority area, a series of proposed actions have been put forward, one of which is the

coordination of a Scottish Programme for Reuse of Construction Materials and Assets. This programme would be developed to overcome the challenges of supply, geography and specification currently faced in Scotland and provide a platform for companies within the industry to source used materials.

2. Methodology

As with all of the actions put forward in the consultation under the priority area of embedding circular economy practices within Scotland's construction sector, they have been designed with the underlying aims of achieving improved collaboration between Government and Industry; incentivising sustainable construction practices; promoting best practice; and improving understanding of how and where waste is generated.

This project was developed with these aims in mind and included the delivery of three stakeholder engagement events. An inception meeting was held in August 2022 to set the scene with participants and was followed by two further workshops in October 2022. In order to maximise the reach of the project and the level of participation from industry, all of the events were conducted online.

The initial inception meeting offered invited industry stakeholders the opportunity to define the best approach for meaningful engagement with the workshop programme. The two subsequent workshops focused on capturing the specific requirements that would make reuse a viable action for the sector. In doing so, stakeholders were able to highlight collaboratively where opportunities, barriers and enablers existed for implementing feasible and high value actions. This list of stakeholder requirements enabled opportunities, barriers, and associated enablers to developing a Construction and Demolition (C&D) waste reuse programme to be identified.

2.1 Participants

Participants at each of the workshops represented a broad range of construction and demolition roles. These roles were considered during the design stage of each of the workshops, resulting in the following groupings being developed: Builders and Developers; Designers; Energy and Infrastructure; Public Procurement; Research and Associations, and Waste and Reuse.

Details of the roles represented at each of the workshops, the number of attendees and their groupings are shown in Table 2.

Adopting this grouping format aimed to ensure discussion was focused on specific issues relevant to the different industry sectors; and allow for differentiation in terms of priorities and/ or barriers on a sectoral basis.

Table 2: List of participants from across industry and attendance levels

Industry grouping	Sector role	Attendance (Totals)		
		Inception meeting (26)	Workshop 1: Opportunities, Barriers & Enablers (27)	Workshop 2: Implementation (27)
Builders and Developers	• Tier 1 contractor • Developer • Home Builder	8	5	8
Designers	• Architect • Housing Association	2	4	1
Energy and Infrastructure	• Engineer • Infrastructure • Regulator	1	4	3
Public Procurement	• Local Authority • Public Authority	1	3	2
Research and Associations	• Industry body & membership organisation • Centre of Expertise • Academic • Consultant	10	7	5
Waste and Reuse	• Business (with construction reuse focus) • Demolition contractor	4	4	8

2.2 Format of Inception Meeting and Workshops

Over the three sessions, participants were asked to respond to four specific questions sequentially:

1. Stakeholder Requirements: from the perspective of their role within the sector, what requirements did they have which would influence reuse activity?
2. Barriers: what are the perceived barriers to those requirements being met?
3. Enablers: what would incentivise or open opportunities to overcome barriers and encourage reuse activities?
4. Implementation: what actions are needed to deliver on the above, who would be responsible for those actions, and when should they be prioritised?

Further details of the formats and summaries of the reported outcomes from each of the engagement sessions are provided in section 3.

For the purposes of this project, the definition of reuse was taken from the UK Green Building Council's (UKGBC) research with the Circularity Working Group[25]:

> "Reuse: use of products or components more than once for the same or other purposes without reprocessing. Note: reprocessing does not include preparation for re-use, such as removal of connectors, cleaning, trimming, stripping of coatings, packaging, etc."

This definition is referenced from the International Standard ISO 20887:2020, Sustainability in buildings and civil engineering works[26], and it was chosen because it is tailored to the built environment. It emphasises that:

- components can be reused multiple times, not just once
- the use can be for other purposes, not just the original purpose
- preparation and repair are a valid part of the Reuse process.

2.3 Participant Engagement

Summary reports were prepared for the inception meeting and each of the workshops, and these were distributed to stakeholders who participated in the events. This supported participants ability to feed in throughout the process and consider their input retrospectively, and in advance of the next workshop.

This final report presents an overview of the project, with additional reference made to key information from the separate workshop summary reports. The recommendations consider the combined outcomes of all the workshops and supporting research, building an evidence base that will support and inform the development of a programme for reuse of high value and high carbon construction materials and assets in Scotland.

The evidence generated by the participating stakeholders includes a very broad range of issues, often with subtle nuances, and to prevent loss of insight, certain parts of this final report quote the feedback at length.

[25] https://www.ukgbc.org/news/defining-Reuse-why-adopting-iso-definitions-will-help-encourage-circularity/#_ftn4
[26] https://www.iso.org/standard/69370.html

3. Findings from Stakeholder Engagement

Summarised findings, and identified themes and priorities, arising from the inception meeting and the two workshops are outlined briefly below in sections 3.1, 3.2 and 3.3, respectively.

3.1 Initial Themes Identified during Inception Meeting

The inception meeting aimed to inform the agenda for the subsequent workshop programme as part of an iterative collaborative process. There were three breakout sessions focused on the proposed workshop agenda:

1. Stakeholder Requirements
2. Opportunities (Barriers & Enablers)*
3. Implementation

*Barriers and Enablers are listed separately in the Methodology (refer to Section 2.2) but were addressed in the discussions around requirements. The feedback offered by participants was categorised under the headings listed below:

- Circular Economy
- Collaboration
- Data
- Design
- Drivers
- Extended Producer Responsibility (EPR)
- Legislation
- Market
- Planning
- Quality Control
- Value
- Waste

These discussion points generated a diverse and range of issues. The circular economy (CE) seemed to be recognised as a more pertinent issue than carbon. This is perhaps reflective of the commitment by the UK Government to move to a circular economy following the publication of the Circular Economy Package (CEP) in 202[27], and visibility of organisations such as the Ellen McArthur

[27] https://www.gov.uk/government/publications/circular-economy-package-policy-statement/circular-economy-package-policy-statement#circular-economy-package

Foundation who support transition to a circular economy through publishing practical tools such as the circular procurement framework for cities[28]. Collaboration across all parts of the C&D sector is broadly accepted as essential to achieve the types of changes anticipated and the importance of robust, relevant, and real-time data was recognised.

Emerging extended producer responsibility (EPR) policy and regulations means that, for the first time, there will be the expectation that manufacturers have some ongoing responsibility for their products. Participants saw quality control as critical to de-risk the reuse of materials and recognised that the non-financial values for reuse must be considered beyond simple cost-benefit analysis.

Analysis of the discussion identified eight key themes. These provided the first framework for discussion to be taken forward into the subsequent engagement workshop. The eight key themes are listed in Table 3 alongside a corresponding description.

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Table 3: Key Themes identified by stakeholders during inception meeting

Theme	Description
1. Legislation & Planning	All aspects of government regulations and policy that act as the "sticks and carrots" to mandate or encourage reuse activities.
2. Economics	Cost implications, whether for the supply of reused materials or associated processing and admin costs.
3. Market & Infrastructure	Recognises that reuse will have to operate within the supply and demand framework of the free market, including procurement frameworks, and also within the constraints of logistics and resource availability which are often global in nature.

[28] https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview#principles

4. Business Model	Recognises that businesses will have their own drivers for using (or not) reused materials, including issues such as Corporate Social Responsibility.
5. Information & Reporting	All aspects of data gathering and sharing, including material provenance and tracking.
6. Technical & Design	A broad group of issues relevant to the making process of buildings, including quality control and certification of components.
7. Social & Cultural	Recognises that cultural changes will be required to drive change in the sector, and that broader social impacts should also be considered.
8. Performance & Sustainability	Recognises that reuse will not always be a "good" outcome by default, with the need to assess performance against a broad range of non-financial values and sustainability.

3.2 Stakeholder Requirements, Barriers & Enablers

Whilst the eight themes identified in the inception meeting were used as the basis for discussion in Workshop 1, to set a high level of ambition, participants were posed the following scenario:

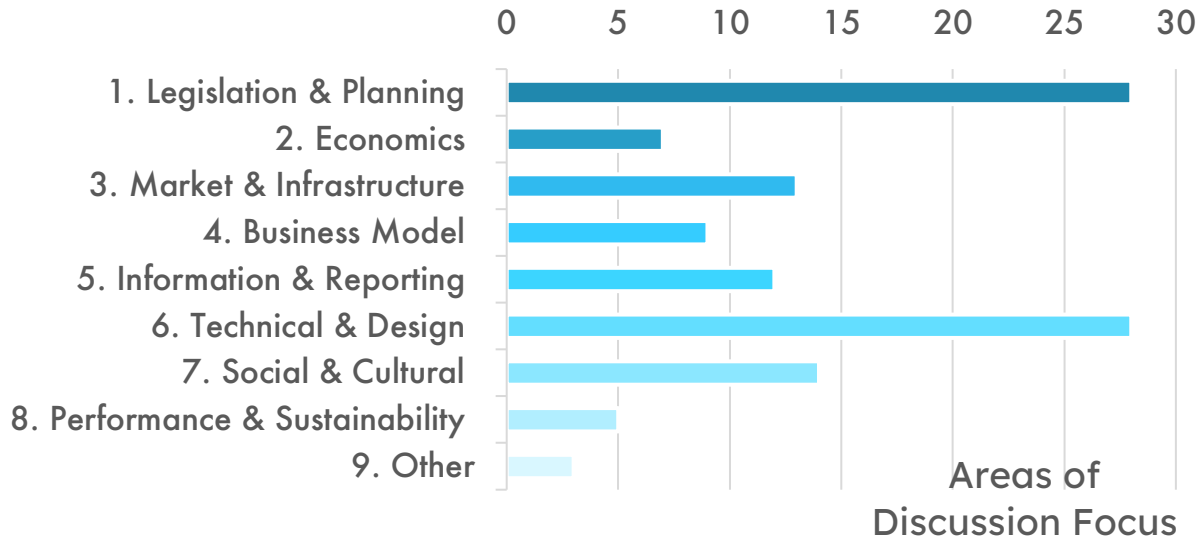
> Q. In order to not send any materials from the construction process to landfill, with regard to reuse:
>
> - What would need to change in your sector?
> - What do you need from others in the supply chain?

The breakout sessions were organised to allow separate discussion about each of the three specific areas being addressed at the workshop:

1. Stakeholder Requirements
2. Barriers
3. Enablers

Figure 1 captures the frequency with which different thematic areas were discussed during the workshop on barriers and enablers. Change in legislation and planning, as well as changes in technical and design areas were the most frequently discussed topics across the different industry sector clusters.

Figure 1: Workshop 1 Discussion Points - 'Barriers, Enablers & Requirements session' (number of points per theme as per Table 3)



3.2.1 Requirements

The requirements proposed by participants in their industry cluster groups are described below (grouped by theme). Themed areas of discussion focus, and key words are in highlighted in bold.

Legislation & Planning: Most of the industry groups discussed some aspect of embodied carbon, and circular economy as being a priority issue for the Legislation and Policy theme, some making specific reference to the Circular Economy (CE) Bill. These also crossed over into the Information theme with the perceived need to better define and collate data on these issues. Those with expertise in waste were looking for a degree of regulation of embodied carbon within legislation and planning processes. Both the builders and public group were looking for the planning process to adopt implementation of CE practises and policies. Designers were seeking stricter policy on retrofit/refurbishment to avoid unnecessary cases of demolition. This was supported by the research cluster groups requirement for mandatory requirements on the use of recycled content in construction.

Economics: The focus of the group discussions related to cost, whether to businesses or consumers, and how reuse could be incentivised through either taxes or the market. The public cluster group sought incentivisation by tax breaks similar to those currently available for the private sector. Waste experts considered whether demolition contractors need to be financially incentivised to become deconstruction contractors and store materials, which touches on the logistics of supply chain and the barriers discussed below.

> "How can this be achieved if storage / transport costs and the chance of a future profit does not outweigh scrap/recycling value?... Business rates relief on storage yards?"

Market & Infrastructure: Many of the comments under the theme of the Market were about the supply chain, and whether it could support reuse. As well as the development of markets for secondary materials, it was proposed that suppliers of new materials may play a role, such as if Scottish quarries could take back stone to renew and resell as secondary stone.

> "Development of secondary material supply chain - must ensure that materials can be transported, stored, and passed on to someone else in a way that they remain high quality."

Business Model: There were only a few comments made on the theme of Business and these covered a range of issues without a specific focus. There was reference to increasing designer and developer awareness of secondary materials by waste experts, and suggestion to have collaborative project planning across public sector agencies to maximise the opportunity to share high volume materials across different projects by those in the research cluster. Designers proposed a kind of EPR that could feed into a second-hand market for refurbished products, similar to market and infrastructure suggestions using stone as an example.

> "Require manufacturers to take back products and refresh for re-use with new warranty."

Information & Reporting: The need to review how waste data is classified and reported on was flagged under Information by four of the clusters, and the need for standardised methods for measuring embodied carbon. This covered a range of issues such as the provenance of materials and how open and available pre-demolition audits could feed directly into material banks. As noted above these requirements also crossed over into how legislation would set benchmarks and support key parties such as insurers.

> "Reporting on provenance of reuse in the sector to inform key stakeholders."

Technical & Design: Whilst there was no one specific focal point, the builders, energy, and the research cluster group considered the need for deconstruction procedures and skills to be developed as to whether reuse is an option on a site. This was framed with a need for potentially wasted materials generated as a direct consequence of works undertaken on-site, which have the potential to be re-used and are also referred to as site won materials, to be of a suitable and recognised standard and quality to meet client demand.

> "Development of these [deconstruction procedures] by demolition firms and construction companies (e.g., lifting timber floor to put insulation under and then re-laying) to ensure they can

> deconstruct safely and effectively. Deconstruction skills training may be required."

There was a requirement for public sector projects to have more certainty on all aspects of a building project, including waste, to understand what could be diverted from landfill and repurposed. This was echoed by clusters in a call for early involvement in projects from all disciplines in embedding circularity. This is a thread linking the information and reporting and legislation themes above, legislative support to have multiple disciplines involved from an early stage, mapping out the potential for reuse in an open and standardised way that warrants trust from clients.

Social & Cultural: These discussions focused on changing perceptions about reuse versus new materials, both in the industry and with publics, whilst continuing to emphasise the need for early collaboration between designers and builder. A spotlight was made on procurement incorporating CE practises, and education on this was considered a priority to frame reuse as a professional approach. The ethics of discarding salvageable items, such as kitchens or whitegoods, was addressed by the potential of supporting local residents to salvage items from buildings being demolished in their area.

> "Make it socially acceptable (and/ or legal?) to allow local people to take elements of buildings being locally taken down."

Performance & Sustainability: Building reuse into briefs from the start continued to be raised by participants, reflecting on how both new and proposed developments could respond to a site's existing resources. Participants sought ways to provide assurance of performance for reused materials and suggested low risk applications of secondary materials could be mandated.

3.2.2 Barriers

Just under half of the requirements put forward by stakeholders included a comment on barriers. These touched upon a range of interconnected themes, which are described below, and include specific points raised by the stakeholders.

Business drivers: cost and time remain the main drivers for clients, which creates challenges when presenting the adoption of circular practices at the design and planning stage. Clients may not see the value in circular practises where this requires additional time, which in turn costs them more money. Stakeholders indicated that more strategic planning was required, within the public sector for example, to enable circular practices to become more widely understood and an integral part of review and planning of existing and new building stock, respectively.

> "Client lack of experience/ understanding."

> "...requires a shift in perception in understanding the long-term benefits."

Procurement: This theme leads on from the previous point raised around business drivers, where procurement tends to be conservative in approach; and is limited by **time constraints** that do not support the implementation of new practices by procurement professionals. The view from industry representatives was that the current approaches taken promote a lower cost model, which work against the circular economy and opportunities for investment.

> "Current lowest cost procurement ethos often works against CE initiatives and investment therein."

> "Supplier qualification and strategic procurement that considers reuse and recycled material as part of sustainability policy and product offering and weights accordingly in awards and partnerships."

Materials data and tracking: Developing standardised and legislated approaches to material data collection and tracking were viewed as critical pathways for embedding and improving opportunities for reuse and circular practices more widely across industry. Feedback indicated that this will require investment to support the growing need for appropriate resource to catalogue, schedule and store materials and assets.

> "Legislation to drive data generation; public or private ownership of platform."

> "BIM becoming industry resource and it relies on material data."

Performance and standards: Feedback from stakeholders highlighted the importance of more joined up thinking and collaboration needed to tackle the lack of a clear standalone benchmarking and certification system for reuse materials and assets. Existing regulatory barriers (around import and export of materials into and from Scotland, respectively), and difficulty in standardising circular practice definitions and material classification act as ongoing barriers across the supply and value chain.

> "Public sector needs to present demands clearly to supply chain. This relates to point on clarity around building planning and standards; and what the building performance expectations are."

> "Net Zero Public Building Standard - currently voluntary - when is it going to be mandatory? It provides a benchmark for Local Authorities to use that has been led by Scottish Government. We need to move beyond aspiration to mandated targets,..."

> "Warrantees, fear of product failure and liability has always driven new build. We need a shift in perspective around refurbished products/ materials. Standards around refurbished materials needs to be driver."

3.2.3 Enablers

About a third of the requirements included suggestions for enablers. Stakeholder comments again highlighted several thematic reference points, which have been listed below.

Education and skills: Improving awareness and understanding of reuse potential and circular practices across the supply and value chain would benefit from rollout of a wider educational programme. Supporting this would be guidance and showcasing of best practice exemplars that can engage and be accessed by both the demand and supply side.

Legislation: Government's role through legislation was again cited as a key enabler for promoting and empowering stakeholders to engage in the field of circular economy within the construction sector. Collaborative and shared working between industry and government is needed to reach agreement on numerous issues, including, for example, material certification and mandating of best practice standards.

> "Mandatory requirement for Life Cycle Assessment to be carried out at planning stage (this should become the business-as-usual approach). This will inform materials specification and building design. This approach is currently only driven by clients looking to achieve 'excellent' standards in building performance certification i.e., BREEAM."

> "Role for government for setting up pilot projects for example with public buildings to showcase for examples of pre demolition audits to show others how it is done."

Fiscal measures: Many of the comments offered were directed at the existing challenges posed by VAT, and how these could be overcome through alternative mechanisms that incentivise reuse over new and promote refurbishment of existing building stock.

> "VAT not the best driver - financial incentives/tax break for leading on innovation that is climate focused."

> "Taxation on the extraction of raw materials"

Material data and tracking: A range of comments were gathered from stakeholders citing the development of collective storage facilities (hubs), as part of a centralised approach to resource management and cultivating circular

innovation within the sector. Appropriate internal management of these facilities was deemed a prerequisite for these sites to go ahead – something that could be backed by Scottish Government.

Furthermore, these sites could allow for testing of the suitability of materials and assets identified for reuse. This point was particularly pertinent throughout the stakeholder events for the Energy Infrastructure industry group representatives.

Perception and Value: Although the challenge remains in changing existing mindsets, there was belief from stakeholders that change is already happening within the sector. Furthermore, similar work is required to accelerate progress in areas such as the second-hand market, ensuring materials and assets are tested to recognised standards.

> "Cross discipline working and sharing of best practice - lots of good guidelines exist and needed to be shared in use, not replicated and waste time."

> "Supply needs to be met by demand; second hand products need to be incentivised from a client perspective."

3.2.4 Priorities

Participants were asked to consider where their priorities would be in terms of the developed list of requirements. This revealed a sense of urgency across the stakeholder groups, and across the discussion topics.

Material data and tracking was viewed as a high priority by groups representing Builders and Developers, Designers, and Public Authorities. Established protocols for reporting of reuse material data, and knowledge of its provenance was viewed as necessary to improve and inform understanding of key aspects of its availability, performance (linked to embodied carbon) and suitability.

The issue of performance was also reflected by the Builders and Developers group when discussing requirements at the design and planning stage of a building. Defining what the minimum standards and requirements for circularity, including reuse of materials, at all stages of a building's lifecycle, was viewed as an essential immediate next step. Progress on this issue would require government to implement legislation that outlines mandatory standards and regulations for building design, construction, refurbishment, and demolition.

Enhancing education, skills and awareness on the issue of circular economy in the construction sector was viewed as a key action for increasing the potential for reuse and circular practices. Both the Research and Centres of Expertise groups highlighted the value of existing technical knowledge on this subject and the need for improved dissemination through training to key stakeholders, in particular public sector procurement.

This training would be supplemented and further enhanced by reaching agreement on benchmarking and certification schemes for reuse materials – two priority areas identified by representatives from Local Authority, Designers and Architects roles – enabling both improved collaboration at the design stage of a building and shift in value and perception around the issue of reuse.

Whilst this was a useful part of the workshop process, at this stage it did not provide any definitive indication of what the top priorities should be. Questions around priority were revisited in the second workshop, as part of the discussion on Implementation, where particular focus was drawn to the question on "when" actions should be implemented (see below).

3.2.5 Focussing discussion

As noted above, numerous requirements were identified by stakeholders, with associated links to barriers and enablers also highlighted. This presented a very broad and diverse range of issues, with many subtle nuances based on the experience of the sectoral expert and their viewpoint. This also highlights the importance of having cross sectoral engagement to capture the differing potential insight relating to future changes in legislation or subsequent supply chain dynamics. At this stage of the engagement process, categorisation of the issues raised remained a challenge and required refocusing the structure of the subsequent workshop.

Given the focus of the next workshop was on Implementation (Workshop 2), the themes were reviewed in the context of what type of actions would typically be relevant to each theme. This resulted in the themes being grouped under three main topic headings: 1. Legislation; 2. Technical; and 3. Market. The main points to be addressed in the second workshop were grouped under each of these topic heading as follows:

1. Legislation

- 1.1 Embodied carbon and circular economy
- 1.2 Retrofit versus demolition
- 1.3 Taxes, levies, and VAT
- 1.4 Extended producer responsibility

2. Technical

- 2.1 Material data and tracking
- 2.2 Materials performance and standards
- 2.3 Project brief and contract process
- 2.4 Education, skills, guidelines and protocols

3. Market

- 3.1 Supply chain
- 3.2 Business drivers
- 3.3 Public and private procurement

3.3 Exploring Implementation

During the final workshop where implementation was addressed, participants worked in their industry clusters to identify issues affecting implementation. These issues were then identified as a high or low priority by the participants and the prominent issues emerging from the discourse are listed below in **Table 4** (in no particular order, all were considered high priority issues). Some points made by participants have been expanded in retrospect for clarity:

Table 4: List of prominent issues identified by Stakeholders

	Prominent issues relating to Implementation identified in Workshop 2
1	Requirement to consider the maintenance and whole-life impacts of assets, not just end-of-life, across all metrics but especially the cost and the practicalities of building management, as these have more immediate relevance to building owners. (i.e., a highly maintained building or aspect (material/equipment) would result in an extended life of said 'asset', keeping it in use for longer. It could also potentially lead to a better quality 'asset' more fit for reuse in a second life scenario.)
2	Embodied carbon and the circular economy is widely endorsed as needing mandatory actions within construction and demolition (and associated industries and supply chains).
3	Extensive networks of existing players, protocols and guidelines exist and if these were better coordinated and consolidated this would avoid repetition of work streams and potentially highlight actions which already have broad support for quick implementation.
4	Presumption in favour of retention of building and reuse of materials locally will also support placemaking and heritage conservation.
5	Procurement must change requirements and weighting of briefs and tenders to ensure Embodied Carbon (EC)/ Circular Economy (CE) principles become standard practice and do not fall off at the last hurdle when cost wins out.
6	The principles of Extended Producer Responsibility (EPR) have relevance beyond just the producer and require consideration for the expansion of repair/ refurbish capacity and servitisation of components.

7 Both the storage and logistics of reuse materials and assets are often considered as obstacles but lots of items are already being stored by various organisations (e.g., Design & Build contractors) and logistics need has no more impact than for new products.

8 This is a mixed economy with no one-size-fits-all solutions so flexible and inclusive systems are needed to support the different industries associated with construction, conservation, retention, and demolition.

9 Specification and certification processes are interrelated, are heavily influenced by insurance and risk, but are often subject to personal working habits of those responsible (e.g., engineers self-certifying reused items). So the main requirement is a consistent approach to what performance standards will be acceptable in all (or at least most) projects.

10 Start with "soft sticks" which get people used to dealing with new issues, such as reporting on EC/CE or trial of reused materials, which can transition to "hard sticks" for mandatory implementation as momentum builds.

3.4 Outcomes Recommended by Stakeholders

Recommended outcomes suggested by stakeholders are summarised below. For a full list of all discussion points please refer to the data tables in Appendix A.

3.4.1 Legislation

Participants identified the need for mandatory target setting for embodied carbon. They acknowledged that some funding mechanisms are already asking for these targets, but they are looking for consistency across all organisations so that the same targets are being applied. Aligned with mandatory targets there was a desire for construction (conservation, demolition and associated industries) to be included in the CE bill.

At a local authority level, in relation to design or planning, a certified or approved list of key circular products or services would ideally be readily available to support behaviour change within the field. Consideration of the local context was also important in the support of retrofitting over demolition, with the suggestion of a framework like that for listing buildings to support reuse of materials and assets. There was also an acknowledgement for the need to increase maintenance budgets to avoid demolition due to under investment in building infrastructure. There was discussion amongst some attendees in relation to the application of extended producer responsibility within C&D, with consideration of adapting from the consumer space to construction as

information to accompany building components through their lifecycle - i.e., Building Information Modelling (BIM), material passports. This followed in the technical discussion where legislation is required to support the changes in technical practise:

> "Increased use of modelling (BIM), Life Cycle Assessment (LCA), compliance testing, etc., and make sure this is applied consistently over the lifespan of a building. Operational and technical information needs to be part of all handovers."

There was a perceived lack of action by the Scottish Government in relation to VAT charge on materials for retrofit or reuse that is not applied to new builds, as the un-devolved tax and vat breaks are not currently favouring retrofit. For an example of levies influencing the capture of virgin materials over reuse, gypsum extraction was cited. This is an area over which the UK Government hold power, and despite Scottish Government support in this area, they do not have the powers to make change as this is not a devolved mater.

> "...this needs (to be?) resolved - the tax and vat breaks should be favouring retrofit."

3.4.2 Technical

The responses put forward by industry representatives suggested action required would need a broad yet coordinated approach, with key legislative support measure. Collaboration across all disciplines and stages of a project could be supported by mandatory legislation to require input and circular practises from all parties involved in a build process,

Future thinking approaches could be taken to design for maintenance and repair, design consideration that considers end of life disassembly and reuse as part of its brief, but also on how the construction will impact upon maintenance of a building.

> "...how materials are layered and installed impact how readily a building can be maintained during its life..."

Standards stipulation that a brief or specification should have a defined quantity or percentage of recycled material included was suggested, but this relies on participants expectation of standardised assessment of quality of reuse materials to prevent a reduction in performance. Creating a system using pre-demolition audits that shows the value of the materials if recovered correctly, and a call for this to be in one place so a wider range of people can see their value. This relates also to the openness asked for during the technical discussion, knowing what materials are used during the repair and maintenance during building life:

> "The notion of a digital thread/data base embedded into the building. It allows the end user/specifier to see that they are getting what they asked for…"

Technical and legislative discussions both highlight an opportunity to introduce a mandatory requirement for Life Cycle Assessment (LCA) at the planning stage to inform materials specification and building design as this approach is currently perceived to only be driven by clients looking to achieve 'Excellent' standards in building performance certification i.e., BREEAM.

There is a need for education and transformation in the industry, with cross discipline working and sharing of best practice at all levels and reference to good guides and tools already existing that could be utilised rather than reinvented, something that may require legislative support to instigate. Training opportunities could help produce benchmarking studies of example cases to understand the life cycle (cost/carbon) benefits of new products versus retrofit.

> "…lots of good guidelines exist and needed to be shared in use, not replicated and waste time."

> "…apprenticeships to collaborate on retro fit rather than starting again…"

3.4.3 Market

Supply Chain and Business drivers were themes throughout roughly two thirds of the market discussions. This could be interpreted as a focus on the basic demands of doing business – the logistics of sourcing products for a building project and the **costs** of doing so.

Participants suggested financial incentives to support the growth of the supply chain and to help with the creation of new CE supportive industries, as well as to bolster existing innovation. Barriers woven through the planning process, and the time lags that can come before construction, were also cited as counter to circular practises that could be rapidly amended:

> "conditions normally include approval of final material selection, wording could add 'can include reused materials'."

The other Subtopics, about procurement processes and perception, also highlighted the important financial drivers behind business decisions that may drive using 'new' over 'site won' or secondary materials. The most economically advantageous process was presented as driving public procurement, with an identified need to re address the importance of quality or longevity of a build and its component parts:

> "....price dominates public procurement process - inclusion of CE meaningless unless given weight - if quality was given equal weight to finance it would shift this."

The discussions pointed to shifting perception, both within the industry but also with clients and the public, to framing reuse as a sound business decision. Increasing trust in quality assurance processes and supporting procurement teams to make informed choices, whilst acknowledging not all solutions will be the same for each build, was highlighted:

> "Market needs to open for new materials/products to become available; can be difficult to understand the extent of reused materials available...."

> "Certification scheme (such as Forest Stewardship Council etc.) for reused products to improve market awareness..."

> "A driver linked to general new material reduction (not bogged down in carbon reduction). A simple metric like 70% reduction of virgin material on this retrofit. Something a procurement team can understand and get behind."

3.5 Who is Responsible?

Feedback provided clear evidence that stakeholders are expecting and anticipating the Scottish Government and Public Sector organisations to take the lead on the issue of embedding circularity within the construction sector. This does not mean these identified organisations should be solely responsible for relevant actions as many are collaborative in nature, the stakeholders recognised they play a role in this change.

During the programme of workshops, the question of who is best placed to take responsibility was considered in a range of ways, but for this summary we will use the headings from Workshop 2, that is:

- Government
- Supply Chain
- Individual Organisations

3.5.1 Government

Stakeholders are expecting and anticipating government, and public sector organisations, to take the lead with a sense of urgency (expectation of action by 2025). Suggested actions for Government included:

- Legislation, especially planning and building approvals and the inclusion of construction and demolition in the Circular Economy Bill.

- Liaising with stakeholders to development of guidelines or protocols, or support/endorsement of those already produced.
- Further research of specific fields such as developing an evidence base on the reuse potential of existing and future building stock.
- Resourcing and directing public organisations to implement best practice in their operations.
- Financial/ fiscal or other support for innovative business or third sector actions.

This does not mean government is considered solely responsible for these actions, many rely on collaboration for effective implementation, but they are unequivocally areas where formal and legal structures are required. Both the UK Government and Scottish Government are mandating actions on reuse, often as part of Circular Economy models, and the Scottish Government's draft Circular Economy Bill [29] was frequently referenced as important during discussion. Barriers currently in place, such as in planning processes where materials are stipulated at submission, could be addressed to officiate a flexibility when site won materials are identified in a demolition audit.

An example of local level action in the UK is The Greater London Authority London Plan Guidance for Circular Economy Statements[30] , which defines guidelines to re-use and/or recycle materials arising from demolition and remediation works. It outlines assessing how much waste a project is expected to generate, and how and where the waste will be managed in accordance with the waste hierarchy; materials, components and products to be disassembled and re-used at the end of their useful life. It also advises managing as much waste as possible on site with easily accessible storage space and collection systems to support re-use and recycling.

At an international level the Italian Institute for Innovation and Transparency in Public Procurement and Environmental Compatibility (ITACA) Protocol[31] been adopted by many Regions in Italy (e.g., Piedmont; Liguria; Tuscany; Marche; Lazio; Apulia; Basilicata; Campania; Veneto; Friuli, etc.). Most ITACA Protocol requirements are applied in tenders, incentive programs and public housing. It assesses the level of energy and environmental sustainability of buildings and implementation of circular strategies and expects the reuse of existing structures (60-100% of envelopes), and materials/components (30-50% of the total of envelope and internal floors).

[29] https://www.gov.scot/publications/delivering-scotlands-circular-economy-consultation-proposals-circular-economy-bill/
[30] https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/london-plan-guidance/circular-economy-statement-guidance
[31] https://www.itaca.org/valutazione_sostenibilita.asp

In Canada, the Green Demolition Bylaw in Vancouver[32] law covers all homes pre-1950, which account for around 70% of demolitions[33]. It encourages the reuse of demolition materials, through the requirement for a $14,650 deposit, paid when applying for a demolition permit. There is a sliding scale for return of the deposit depending on the recycling rate achieved; 75% of the waste (measured by weight) must be reused or recycled for full return of the deposit and there is guidance given on salvaging and reusing materials.

In the US, the Washington Residential Deconstruction Permit (Salvage Permitting Ordinance) has been in place since 2009[34]. To qualify for a residential deconstruction permit, there is a requirement to both reuse a minimum of 20% of the building materials, and to recycle or reuse a minimum of 50% of the building materials (by weight and excluding asphalt, brick, and concrete). A Waste Diversion Plan must also be submitted with the permit application and plans, and when deconstruction is complete to record the actual rates of reused and recycled materials.

Such examples outline real world approaches that the Scottish government could take into consideration when establishing agreed assessment frameworks for planning and building across Scotland. Supporting local authorities as they move to circular practises in planning, as well as financially incentivise recycling and reuse on sites, and creating a potential revenue stream (as per the example in Canada) in line with priority action 1 outlined in the executive summary of this report.

3.5.2 Supply Chain

Suggested actions from participants relating to the Supply Chain included:

- Establish processes to identify and share details of material availability, starting with pre-demolition audits through to stockpiling in material banks.
- Establish processes for tagging materials with accurate data to support a range of other actions, ranging from BIM databases to operational handbooks.
- Cross-discipline working and early involvement in projects.
- Networking across whole sector to share best practice.
- Standard Operating Protocols for certification and specification of reuse materials.

[32] https://bylaws.vancouver.ca/11023c.pdf
[33] https://vancouver.ca/home-property-development/demolition-permit-with-recycling-requirements.aspx
[34] http://www.seattle.gov/sdci/permits/permits-we-issue-(a-z)/demolition-permit--building

Participants were less able to identify who else should be leading on implementing change and acknowledge there may be aspects of the supply chain that are being overlooked in the stakeholder discussion. However, connectivity is a theme here, as the supply chain may also be working towards similar adaptations to support a circular economy but perhaps the spaces to implement change together, in parallel have not been explored.

It could be said that the supply chain is the primary area where policy gets put into practice, individuals can promote or reduce the impact of any proposed intervention as 'middle actors' influence the sector specific ecosystem they service[35]. The Built Environment has a complex supply chain involving diverse groups of stakeholders, ranging from local tradespeople and designers to global certification schemes and multinational corporate manufacturers. To ensure broad and rapid uptake of new practices, it will be essential that all stakeholders are engaged. Many of the points tagged with supply chain were about collaborative working and agreeing consistent frameworks such as in the Buildings as Materials Banks (BAMB) [36]and other models for material hubs.

3.5.3 Individual Organisations

Note: the question in Workshop 2 referred to individual businesses rather than organisations but in this summary, we want to emphasise this includes non-business stakeholders.

Suggested actions for individual businesses & organisations included:

- Including circular economy and reuse criteria for procurement or supplier processes.
- In-house training and awareness programmes.
- Consider whole life costs including management and maintenance not just construction and end-of-life.
- Establishing their own material banks.

Given the stated aim of the workshops was to gather stakeholder requirements it is unsurprising that responsibility was most often directed at "others" rather than at the individual organisations represented. The theme of business model had only 2 high priority items from Workshop 1, and as noted above for Workshop 2 only 9% of short-term priorities were for individual business.

However, there were examples of where individual organisations are implementing schemes that support reuse, even if they are sometimes being done for purely pragmatic reasons. Recognising there are valuable resources in the materials that otherwise would have been considered waste is central to this,

[35] https://iuk.ktn-uk.org/events/local-net-zero-targets-behaviour-change/
[36] https://www.bamb2020.eu/

changing perception and practise within construction and demolition as 'site won'[37] materials are generated during works.

Whilst applicable at all scales, the impact was most obvious for organisations that own or manage large estates, including public buildings, such as schools and hospitals, but also privately owned buildings such as offices and retail parks, where salvaging materials for reuse, as part of their repairs and maintenance programme, had obvious cost and logistical benefits.

An example of this approach was the refurbishment of an existing building by the University of Cambridge as the base for the Cambridge Institute for Sustainability Leadership. It was originally a telephone exchange built in the 1930's, converted into offices in the 1990's. The University decided to retrofit the building to ultra-low carbon standards, achieving the Passivhaus EnerPHit standard for refurbishment, BREEAM Outstanding rating, and the WELL-Building Gold Standard.

The project adopted circular economy principles with the aim to change the way ISG designs, procures and installs products, systems and materials, so at end of use they could be reused, repurposed or recycled at their highest value, without causing adverse environmental impact at cost neutral or less. Examples of circular economy principles applied during the project included the reuse of structural steel (such as that used to support a solar panel installation on the roof), light fittings and a reception desk. All items were sourced from other buildings and reused in the Entopia building and were remodelled or recertified with the support of the original manufacturers. Three key "takeaways" were noted from this project.

1. Materials are available, you just need to put the effort in to find them.
2. Ask the original manufacturer (to help the reuse process).
3. It is easier to introduce reused materials than you may think.

3.5.4 When should actions be implemented?

Participants showed a strong requirement for action in the short term. The project brief defined three timeframes for implementation:

- Short-term (by 2025)
- Medium-term (by 2030)
- Long-term (by 2045)

Questions about priority were considered in both workshops, what emerged was a range of issues where short to medium term action was suggested.

[37] https://www.zerowastescotland.org.uk/construction/maximising-reuse

It was clear that stakeholders are expecting actions across a broad range of issues by 2025. Discussion did not discern the appropriate order to implement these interventions, but acknowledged the complexities of how they may intersect. Data tables from the prioritisation process can be seen in Appendix B.

From Workshop 2, Sub-topics for short-term implementation included:

- Embodied carbon and circular economy
- Retrofit versus demolition
- Taxes, levies and VAT - for actions related to VAT and taxes
- Education, skills, guidelines and protocols
- Business Drivers
- Public and private procurement

Actions listed under these sub-topic areas have therefore been considered as the more immediate priorities for addressing implementation.

There was an even split between short- and long-term for:

- Material Data and Tracking
- Material Performance and Standards
- Project brief and contract process
- Supply Chain
- Perception and value

That means the only sub-topic not directly tagged with a Short- or Medium-Term timeframe was:

- Extended Producer Responsibility

There was only one action tagged as Long Term, which was about bringing embodied carbon into the scope for carbon offset funds, and this is logically linked to the net-zero framework and its target date of 2045.

4. Recommendations

4.1 Stakeholder Expectations

The stakeholders who participated in the workshops expressed an interest for continuing engagement in this process; other stakeholders who we spoke to during the research but were unable to attend the workshops were also keen to be involved in any future events.

The level of enthusiasm is perhaps best summed up with this quote from one of the participants provided in their feedback on the Inception Meeting:

> "Probably the first workshop with an agenda to actually achieve something. Feel stronger about having attended this workshop than any other I've attended. Let's get it done this time."

The main point is that all stakeholders are expecting action soon (by 2025). There was an expectation on the implementation of mandatory actions on embodied carbon and circular economy in the planning and/ or building approval process. This assertion was made in the conclusion of the InFutUReWood[38] report (Appendix C):

> "Deconstruction Plans are likely to become legally required in the future and finding a coherent standard is considered as an important area for future research."

Hence any programme for reuse should be developed in the knowledge that stakeholders are expecting strong actions in the immediate future, primarily from Scottish Government, and have demonstrated their willingness to engage with the process and be proactive in its implementation.

4.2 Priority Actions

Categories of 'priority issues' became apparent during discussion with this representative group of stakeholders. The timeline over which actions should be taken was not completed for all topics during the workshops, however, stakeholders focussed on short- and medium-term implementation of prioritised actions areas, and a desire to move with urgency across these areas. The priority actions are listed below.

1. Embodied carbon and circular economy
2. Retrofit versus demolition
3. Taxes, levies and VAT
4. Education, skills, guidelines and protocols

[38] https://www.infuturewood.info/

5. Business Drivers
6. Public and private procurement

Hence it is reasonable to assert that there are priority actions across all the sub-topics. Some brief comments on these issues follow.

4.2.1 Embodied carbon and circular economy

There is clear expectation that some sort of assessment metrics for embodied carbon and circular economy will be included in planning and/ or building approvals by 2025. Numerous examples of places in the UK and globally where this is already being trialled were provided, such as The Greater London Authority London Plan Guidance for circular economy Statements (guidelines)[39] for major developments in London. In Scotland the Net Zero Public Sector Buildings Standard[40] (NZPSBS) provides a solid basis for developing this. There is no clear consensus on whether these should include mandatory or voluntary targets, but agreement that the sector should be recording actual outcomes for all new projects as this will help inform future benchmarks. To record that data an agreed assessment framework is needed and Government legislation to require monitoring and reporting of embodied carbon in all buildings, and a requirement for circular economy design in all buildings.

4.2.2 Retention versus demolition

Linked to the issue of reuse is the bigger question about refurbishment in preference to demolition of buildings generally. This is the "reuse" of building assets, rather than reuse of individual materials and components. This was not discussed at length in the Workshops as the project focus was on reuse of materials, but it was flagged numerous times by Stakeholders.

It is an issue which is getting widespread coverage in the media, both the construction media and the mainstream. Examples include the current high-profile case of the proposed demolition of the Marks & Spencer building on Oxford Street in London, the decision of which is now being reviewed by the UK Government[41]. In Scotland there is the proposed demolition of the Wynford Estate in Glasgow, which is being opposed by Friends of the Earth on the basis it goes against Glasgow City Council's climate change commitments[42]. By comparison, similar buildings at the Woodside Estate in Glasgow were recently retained and refurbished to a high energy efficiency standard[43]. Another

[39] https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/london-plan-guidance/circular-economy-statement-guidance
[40] https://www.scottishfuturestrust.org.uk/page/net-zero-public-sector-buildings-standard
[41] https://www.standard.co.uk/business/marks-and-spencer-oxford-street-store-london-michael-gove-b1036397.html
[42] https://www.glasgowtimes.co.uk/news/viralnews/22774602.climate-activists-slam-plans-glasgow-wyndford-flats-demolition/
[43] https://www.collectivearchitecture.com/projects/woodside-multi-storey-flats

example of what is possible is the AMP Capital building in Sydney, what has been described as the city's first skyscraper, was fully redeveloped and extended, but retained 68% of the buildings structural frame[44].

The workshops flagged two issues that relate to this, which are not often considered in the discussion about reuse:

- Heritage: how could the existing heritage listing and planning framework be adapted to set the presumption in favour of retention for all buildings within certain criteria?
- Placemaking: what role could retention play in this emerging strand of urban design and planning policy?

This was the approach taken for a recent article in the Architects Journal, where it was suggested that the equivalent of Category C Heritage listing was applied to all existing buildings with regard to proposed demolition. The author noted that that there are currently no laws to protect buildings from needless demolition except those that are heritage listed, and that "we lose around 50,000 buildings a year because of this"[45]. The Entopia building detailed above, further demonstrates the value in retention vs demolition and how this approach could potentially be applied for all buildings within an amended planning framework.

Regarding the reuse of materials, implementation of such a policy could reduce the quantity of materials becoming available, although the biggest change could be for structural elements such as concrete which cannot be readily reused. Such a policy would also have the potential to support development of material hubs, on the assumption that some sort of pre-demolition audit would be part of the assessment process when considering any application for demolition, and the salvaging of materials for reuse could be a condition of consent.

Note that the planning approval and building warrant application processes already ask questions about whether a project includes demolition, and that sector already has a process for requiring pre-demolition surveys for Asbestos. This process/mechanism could be utilised for the requirement for a full deconstruction survey.

4.2.3 Taxes, Levies and VAT

There are previously published suggested actions[46] relating to the imbalance of how VAT is applied to new-build construction compared to alterations and additions. This directly influences decisions about retention versus demolition for buildings as a whole. Similar questions are now being raised about reuse of

[44] https://www.youtube.com/watch?v=eBJYcc71ptc
[45] https://www.architectsjournal.co.uk/news/opinion/could-a-grade-iii-listing-for-buildings-halt-the-uks-tide-of-demolition
[46] https://www.constructionforum.scot/our-work/the-construction-recovery-plan

materials which come under the category of second-hand goods for HMRC (HM Revenue and Customs) purposes[47]. How the tax system generally can encourage and support innovative business practices is also worthy of further consideration. It is noted that only some taxes are devolved matters so this will require UK-wide action. Levies are mentioned regarding the existing aggregates levy and waste disposal charges.

4.2.4 Extended Producer Responsibility

The concept of Extended Producer Responsibility (EPR) was developed in the 1990's by Thomas Lindhqvist[48], but only in recent years has it started to enter the mainstream in terms of government regulations or industry practice. At the moment, SEPA is reviewing proposed implementation of EPR in Scotland for packaging. The Waste Electrical And Electronic Equipment scheme[49] (WEEE) is also a variant of EPR. Its role to date in Construction has been minimal, which probably accounts for its relative lack of priority for most of the stakeholders, but in the Workshop discussions it was flagged several times by the Research and Waste industry clusters.

The concept of EPR fits well with the circular economy as it emphasises how resources should be managed beyond the lifespan of a product. In the construction industry this is complicated by the relatively long time frames typically involved (compared to packaging or WEEE items, for example). However, some building components do get replaced on a regular basis, what is sometimes referred to as the "shearing layers" that reflect the cycles of building use, repair, and upgrades. Things like light fittings and mechanical equipment tend to get replaced regularly, especially in commercial buildings. In houses, bathrooms and kitchens are replaced every 10-15 years on average. Windows tend to be replaced on a longer timeframe, perhaps every 15-20 years, but the need to upgrade windows to meet net-zero energy efficiency standards is likely to see a significant quantity of new windows being installed over the next 10-20 years.

In summary, consideration should be given now to how Construction materials can be included in emerging EPR regulations.

4.2.5 Material Data and Tracking

The data currently available about the quantities and types of reuse in Scotland is very limited, as was highlighted in section 4.2. Data that is available comes mostly from the waste management framework and is of limited relevance to

[47] https://www.gov.uk/vat-margin-schemes
[48] Lindhqvist, T. (2000). Extended Producer Responsibility in Cleaner Production: Policy Principle to Promote Environmental Improvements of Product Systems. IIIEE Dissertation 2000:2. Lund: IIIEE, Lund University.
[49] https://www.sepa.org.uk/regulations/waste/waste-electrical-and-electronic-equipment-weee/

reuse, due to the insufficiency of the existing metrics and measurement categories used.

The InFutUReWood report (Appendix C – summary details of the report), although focused on the reuse of timber, closely mirrors the outcomes generated from this stakeholder engagement process. The report outlines that all buildings will have certain items suitable for reuse and that the care with which demolition is undertaken can significantly impact reuse potential. They infer that protocols for the certification and quality control could be readily developed but that data compilation on reuse in the market needs to be much more detailed than it is currently. The report also presented the expectation that Pre-Demolition Audits or similar will become standard practice, and that standard assessment methods will be necessary to support this.

The key point is that there is no framework to capture data on construction material and asset reuse potential. A potential example of this type of framework in action could be the Green Demolition Bylaw from Vancouver[50]. The supply of new materials can be monitored through industrial production data. Anecdotally, it is known that certain level of reuse is already happening but there is no central resource to log that data and if we want to monitor reuse there is need to put a system in place.

Material tracking is a more substantial issue as this would apply to all construction materials, whether new or reused. This links to the idea of a Materials Passport, with automatic digital logging of data via BIM (Building Information Management) models or similar, links to EPD (Environmental Product Declarations) or other manufacturer's information, and transfer of this information to owners and operator handbooks, etc. Whilst Material Data collection is a manageable task, Materials Tracking will require a whole of industry approach.

4.2.6 Material Performance and Standards

A potential barrier raised in relation to reuse being undertaken at scale is the lack of agreed performance standards by comparison to new products, whether that is by legally binding certification schemes or covered by industry best practice. Designers and contractors rely on these standards when specifying materials, and compliance can be linked to building approval, insurance and finance policies. Hence it is critical that:

50 https://bylaws.vancouver.ca/11023c.pdf

- Standards and/or protocols are developed that allow the certification of reuse materials
- Organisations that require certification adopt a more flexible approach to what materials will be acceptable.

For example, the InFutUReWood project has included the development of methods for assessing the structural capacity of reclaimed timber, and the International Standards Organisation are developing standards for reuse of sustainability of materials as part of ISO 20887. There is also reference in the discussion points from the Workshops to self-certification of materials by engineers.

Whilst action on these tasks will require a whole of industry approach, the main focus will be on those large stakeholder groups involved in developing standards and protocols/a testing process, or who have influence in the procurement, property development and investment sector.

4.2.7 Project Brief and Contract Process

When it comes to an individual construction project, the brief and the type of contractual arrangement between client, designer and contractors are the fundamental drivers for what will eventually get built. If they provide clear direction about the client's attitude towards reuse of materials the designers and contractors will seek to deliver the best quality and most cost-effective outcome they can, within whatever constraints might exist (such as Performance Standards).

This is in the direct control of all clients; for Public Sector organisations, the government can take steps to ensure policies that support reuse are included, notwithstanding funder constraints.

Note this applies to all projects whether refurbishment or new-build. For demolition projects where no immediate redevelopment is proposed it would provide for the recovery of items for reuse.

4.2.8 Education, skills, guidelines and protocols

Actions will be limited by the level of skills and experience that the people working "at the coal face" have to draw on. Mixed levels of understanding of circular practises were suggested to cut across all career stages and so there is an action in relation to education. Young people coming into the profession over the next few years will start with different expectations and will need informed leadership on what is possible. Hence inclusion of sustainable construction (and quality assurance of those standards) in the school, college, university

curriculum, and in the professional practice registration process, should be considered an urgent priority.

4.2.9 Supply Chain

This covers a broad range of issues for how reuse materials are made available in the supply chain. Tasks identified in relation to Supply Chain from Section 3.4 "Who is Responsible" include the following.

- Establish processes to identify and share details of material availability, starting with pre-demolition audits through to stockpiling in material banks.
- Establish processes for tagging materials with accurate data to support a range of other actions, ranging from BIM databases to operational handbooks.
- Cross-discipline working and early involvement in projects.
- Networking across whole sector to share best practice.
- Protocols for certification and specification of reuse materials.

To maximise the outcome a whole of industry approach is required, but it can start with individual organisations. There are already many businesses running their own material banks for specific materials, with Move On Wood[51] and Glasgow Wood[52] being two examples in Scotland of social enterprises dealing in reuse of timber. Cleveland Steel[53] sell[54] salvaged steel, especially redundant oil pipelines but including standard structural sections, and Paint360 collect and reprocess leftover paint. Government support for these types of businesses would help the industry develop.

- Establish processes for tagging materials with accurate data to support a range of other actions, ranging from BIM databases to operational handbooks.
- Cross-discipline working and early involvement in projects.
- Networking across whole sector to share best practice.
- Protocols for certification and specification of reuse materials.

There was also anecdotal evidence from the Workshops that organisations with large estate departments, such as the NHS, already practice reuse programme for their own use in-house. The premise is simple: if they have a large stock of similar buildings then components salvaged from one building can be used for repair of another.

[51] https://moveonwood.org.uk/
[52] https://glasgowwood.org.uk/
[53] https://cleveland-steel.com/
[54] https://www.paint360.co.uk/

Another reference was to Tier 1 Contractors running Design & Build contracts, where surplus materials from previous projects can be allocated to new projects in lieu of the specific product. Hence allowing and encouraging this type of reuse model could be included in Procurement frameworks.

There is also the potential to develop material hubs or material sharing networks. There are several sharing networks in Europe such as the RotorDC,[55] tagged as a Deconstruction and Consulting cooperative based in Brussels. There is also the Construction Material Exchange[56] (now inoperative) that was operated by Resource Efficient Scotland, noted on the ZWS website as being launched in 2012.[57] During this research we have not identified any such network that is operating effectively at high capacity, but they have developed the type of frameworks necessary.

4.2.10 Business Drivers

This acknowledges that for reuse to be taken up at scale in the open market it will need to be supported by other business drivers. This could include both stick and carrots for issues around:

- Mandatory requirement in procurement and supply contracts
- Taking a market-leadership role
- Corporate reporting on CSR and sustainability issues including Scope 3 emissions
- Access to "green" finance for business development
- Promoting sustainable consumption models
- Better value for resource management using their own material stockpiles
- Developing new products or services to supply emerging market demand

These are primarily for individual businesses to act on but could be supported by government policy and/ or with financial support through funding schemes by the Scottish Enterprise or the Scottish National Investment Bank.

4.2.11 Public and Private Procurement

This is similar to the Project Brief and Contract Process (see above) in that it can be implemented on a project-by-project basis and is under the direct control of the client. Again, this comes with caveats, especially that most public procurement has to be undertaken in compliance with formal policies and frameworks. Large corporations can also have similar procurement frameworks.

[55] https://rotordc.com/
[56] https://cme.resourceefficientscotland.com/
[57] https://www.zerowastescotland.org.uk/content/construction-support-material-management-and-building-material-reuse

Hence action in this area may need to be taken by senior management to ensure procurement frameworks support reuse, allowing (or mandating) project managers to adopt this on individual projects.

The key outcome of this must be that reuse and related embodied carbon or circular economy outcomes have genuine influence on how commissions are awarded. One view commonly expressed in the Workshops was that even when such metrics were included in current tender processes they held little weight, with most contracts awarded on the basis of most economically advantageous tender (MEAT). The same criticism was made for other environmental and social impacts, including reference to formal government policies for the Just Transition and Community Wealth building, how that would translate in to the tender process where financial cost is heavily weighted in decision making or subsequent procurement practises.

4.2.12 Perception and Value

In the introduction to Workshop 2, the consultant team used this quote from Maarten Gielen and Lionel Devlieger, the founders of RotorDC (mentioned in Supply Chain above):

> "We see this as a pilot project, research, testing methods for the professionalisation of reuse. Architects sometimes don't understand the power they have. They are diverting huge streams of money towards new materials when they specify and there are social, environmental and economic consequences of those decisions."

Helping all stakeholders "understand the power they have" is essential if reuse is to become mainstream practice.

There are standalone tasks that can support changes in social expectations. One example from the Workshops was to arrange an Awards programme for good examples of reuse across the sector. But many of the suggestions linked cultural changes to other more practical actions. The other Priority Actions listed above all include examples of how perception and/or value of reuse can be changed.

- Assessment metrics that value embodied carbon and circular economy benefits
- Presumption in favour of retention over redevelopment
- Changes to the tax system to provide financial incentives for reuse
- Collating data on reuse that helps to quantify its value to the economy
- Developing standard that equates the performance of reuse with new material
- Making specific allowance for reuse in project briefs and contracts
- Including embodied carbon and circular economy in relevant educational curriculum
- Supporting and raising the profile of existing material hubs and networks

- Including circular economy outcomes in corporate reporting
- Ensuring procurement frameworks give genuine weight to reuse and related benefits

4.3 Further Actions

Based on the data generated during this research project, an extensive list of priority actions has been generated. It is important to note that many of the actions are interlinked and do not lend themselves to defining standalone policies. Cross-discipline working was identified in several of the workshop discussions and is a core tenant of sustainable development generally.

At the macro level, reuse is best considered as part of a broader strategy for embodied carbon and a circular economy, as it can capture items of high carbon and financial value. Optimising reuse potential across the whole sector may not have a big impact on reducing waste quantities, given the relatively small proportion of the waste streams it draws from, but could help ensure high value, high carbon materials are salvaged. If retention and retrofit or refurbishment of existing buildings is promoted over demolition these waste streams will be reduced. Mineral waste streams can also be redistributed, stone and brick can be repurposed on site or for other projects and soil, can be reused either on-site as fill, or for stabilising soils using hydraulic binders, manufacturing quality soils by adding 'green' compost, or in re-mediating brownfield land in-situ[58]. A strong case has been generated through this engagement to highlight the high carbon opportunities that reuse, and retention of materials (through refurbishment) and assets offers, but there are other considerations around material security, protecting natural capital too. It has been noted that none of these issues or approaches can be treated in isolation and require a holistic view to be taken. Pertinent to this point, is the need for further action to be taken in establishing a recognised mandatory framework to support this transition for the industry.

The industry is also experiencing change in best practice. There is a small, but growing, reference pool on reuse in construction – UKGBC guidelines were only published in 2019. There are many drivers for this shift, as captured succinctly by the InFutRUseWood report (Summary of InFutRUseWood - Appendix C) which states that, when the project commenced in March 2019, reuse was:

> "a rather novel research area for timber buildings, but this period of three years saw many changes. Increasing concern for climate change could have been expected, but shortages of building materials caused by the Covid-19 pandemic and political events

[58] https://www.zerowastescotland.org.uk/construction/maximising-reuse

encouraged many to take an interest in the reuse and circularity of wood products."

Further collaboration on the development of policy to support the implementation of these actions is recommended.

5. Conclusion

This project was commissioned by Zero Waste Scotland to inform work supporting Scottish Government's consultation on "Delivering Scotland's Circular Economy: A Route Map for 2025 and Beyond". Reuse has been identified as an important part of the circular economy model, and this project focused on identifying feasible opportunities for reuse of high carbon and high value construction materials and assets in Scotland. Whilst the starting point was to consider and evidence how construction materials and assets could be removed from the waste stream through increased reuse, the outcome of this work has been to collaboratively identify a series of priority actions to facilitate this process.

The circular economy requires working across traditional boundaries for policy and industry, of being open to seeing resources in multiple ways. Implementation systems to embrace the circular economy are rapidly emerging in the Construction sector, so that actions which only a few years ago would have been considered improbable are now being taken seriously. In the context of reducing Construction waste, which is consistently the largest waste stream in Scotland, the potential for reuse of materials is modest compared to the much greater potential for reuse of assets through the retention and refurbishment of buildings rather than demolition and redevelopment.

The response from stakeholders made clear that significant action is expected and anticipated in the immediate future by government. The workshop discussions and the research identified many barriers and enablers, with positive examples of where actions are already being taken detailed. In terms of setting priorities, industry indicated an urgency for implementation of priority actions in the short-term. The majority view from industry representatives was that Scottish Government is the critical partner responsible for mobilising the actions necessary in the short-term, but with reference made to instances where the supply chain and individual organisations could take the lead through supported partnership working and market leading practices. It was acknowledged that many of the required actions are collaborative in nature.

The research project has provided a solid base of information from stakeholders to inform the development of a programme for reuse, along with affirmation that the need for such a programme is widely regarded as urgent and that it is something the sector is willing to engage with on a collaborative basis.

6. Appendices

A. Workshop 2 Data Table

Please note that this table is data (pre analysis format). It may contain note format text as within the original data table, collated during workshop, minor edits have been made to the original table for readability in this context.

Cluster	Topic	What	Who	Stakeholder	When
BUILDERS	1.1	Housing - 2024/25 Regs in England may be incorporating embodied carbon targets. This approach is supported. Need clarity on measurement approach. RICS professional statement/Certified measurement tools to be used.	Government		Short (2025)
BUILDERS	1.1	Needs Building regs inclusion in Warrant for CEC targets. If Recycled product requirements are also incorporated within Regs, this needs to be balanced with recycled products. Issues with evidencing delivery of both need to be developed.	Government		Short (2025)
DESIGNERS	1.1	briefing councillors/planners on local planning committees on CE - included in hustings on most recent elections (London does have a CE process)	Government	RIAS actively pushing this	Short (2025)
DESIGNERS	1.1	include construction in the CE bill	Government		Short (2025)
PUBLIC	1.1	LEIP Phase 3 (to be announced at Xmas) and their new 7 criteria, one of which included embodied energy and carbon is tied to funding. NZPSBS - currently voluntary - when is it going to be mandatory? It provides a benchmark for LA's to use that has been led by SG. We need to move beyond aspiration to mandated targets, removes wiggle room and arguments around capex	Government		Short (2025)
PUBLIC	1.1	Mandatory target setting for embodied carbon. Some funding mechanisms are already asking for these targets but this needs to be across the piece. Consistency across all organisations so that	Government	Building Control & Planning Department	Short (2025)

		the same targets are being applied.			
PUBLIC	1.1	When will Building Control and Planning be the mechanism that can enforce all the above targets. Resources within LA to resource the skills/enforcement etc to achieve such targets noted above devolved and national gov will need to this is enabled	Government	Skills Development Scotland/ Higher Education institutes	Short (2025)
WASTE	1.1	List of Key Circular product/service to be selected at the point of planning and or design.	Government	ALl project stakeholder defined by Govt	Short (2025)
WASTE	1.1	Mandatory asset tagging (Material Passports) that identify what an asset is, where it came from and how to reuse it.	Supply Chain	Supplier, Procurement teams, specifier	Short (2025)
DESIGNERS	1.2	local context: one size does not fit all - how can planning regulations allow for local context - a more circular place-based approach	Government		Short (2025)
DESIGNERS	1.2	support for councils to challenge/enforce retention of buildings proposed for demolition	Government		Short (2025)
PUBLIC	1.2	LA banned from building new when there is empty stock?	Government	SG/Planning	Short (2025)
PUBLIC	1.2	LA demolition driven by financial burden of having empty buildings in the stock. Banning new build before existing housing stock are assessed for circularity potential.	Other	A combination of public sector/ individual business/ Government to develop and introduce protocols for review of existing building stock prior to new build going ahead.	Short (2025)
RESEARCH	1.2	Engage with and learn from Nordic countries examples! Bringing a degree of standardisation and unity (current cross-ministerial working group on this topic - coordinated	Government	ZWS / BSD/ ScotGovt engagement with NSCF	Short (2025)

		by Matti Kuittenen Finland Ministry of Environment, looking at policy best practice across region)			
RESEARCH	1.2	Local authorities already doing this - looking at stabilising communities rather than building new and displacing - Renfrewshire council doing this (pilots are happening) Look at pilots we have already - lots of good work at the moment but it needs pulled together and looked at as a whole rather than lots of individual projects - more of a cross Scotland programme approach	Government		Short (2025)
WASTE	1.2	Vast majority of demolition due to under-investment in the building infrastructure. Increased maintenance budgets.	Government		Short (2025)
BUILDERS	1.3	VAT break on refurbished projects/ Recycled projects. Need to maintain profitability for private sector.	Government		Short (2025)
PUBLIC	1.3	VAT not the best driver - financial incentives/tax break for leading on innovation that is climate focused. Virgin aggregate levy increase? Change the dynamics on material extraction via taxation i.e it's easier to extract gypsum that reuse it - it's a reusable material. Taxation in Scotland is a devolved issue	Government		Short (2025)
WASTE	1.3	Scrap VAT for the construction sector	Government		Short (2025)
WASTE	1.3	Tax for use of raw materials	Government		Short (2025)
WASTE	1.4	Asset lifecycle should be defined with a route to keeping the asset in use for the life of the building	Supply Chain	Procurement Teams	Short (2025)
PUBLIC	1.5	Warrantees, fear of product failure and liability has always driven new build. We need a shift in perspective around refurbished products/ materials. Standards around refurbished materials needs to be driver.	Government		Short (2025)

WASTE	1.5	Taxation on the extraction of raw materials	Government	Short (2025)
BUILDERS	2.1	Defining what the min standard is.	Supply Chain	Short (2025)
BUILDERS	2.1	No. of materials are set up for single use. Can't use materials that will not do the job. Lifecycle analysis to become mandatory.	Supply Chain	Short (2025)
DESIGNERS	2.1	BIM becoming industry resource and it relies on material data. BIM coordinator will have increasingly important role in running projects.	Supply Chain	Short (2025)
DESIGNERS	2.1	Retrofit now often using digital inputs from drones etc and so is readily transferrable to BIM - its already happening, there are items available in the market	Supply Chain	Short (2025)
PUBLIC	2.1	All building stock within public sector accounted for in continuous review and assessment procedures	Government	Short (2025)
PUBLIC	2.1	Increased use of modelling (BIM), LCA, compliance testing, etc., and make sure this is applied consistently over the lifespan of a building. Operational and technical information needs to be part of all handovers.	Government	Short (2025)
PUBLIC	2.1	QR codes on building components that could support continuity of performance	Supply Chain	Short (2025)
RESEARCH	2.1	There is Scotland construction materials exchange - they need to be better connected, better communicated and better funded - also role for coordinating related initiatives (e.g. 2 separate projects trying to set up Glasgow material hubs)	Government	Short (2025)
WASTE	2.1	Material Passports	Government	Short (2025)
BUILDERS	2.2	Benchmarking studies of example cases to understand life-cycle (cost/carbon) benefits of new products/retrofit	Other	Short (2025)

PUBLIC	2.2	Develop list of materials/ assets with performance characteristics related to refurb/ reuse potential. This exists for new materials but needs to be addressed for materials gathered through building deconstruction. Standards created should relate to durability/ longevity of materials being recirculated into construction (under warranty, for example, and guarantees accompanying these materials).			Short (2025)
RESEARCH	2.2	How can we get the same assurance for reused materials that we have with virgin material - this could be a project on all materials groups in terms of grading - there has been work done on this around timber - but we need to do this on other materials groups Does the timescales, costs and testing around this make it prohibitive - what materials don't require this? End of waste certs for reuse - process needs to be easier especially when the materials is not being used directly but is being reprocessed as part of a higher value material	Supply Chain	New enterprises that make it their business to address the challenges for specific material groups, add value, make acceptable to widest possible part of the market (gathering materials, testing, recertification)	Short (2025)
WASTE	2.2	Durability assessment of de-constructed construction units	Government		Short (2025)
WASTE	2.2	EPD/LCA data that is based on a common platform	Government		Short (2025)
WASTE	2.2	Standards stipulation that specification should have a defined qty of recycled material included without reducing performance	Supply Chain	Trade bodies and Technical Authorities	Short (2025)
BUILDERS	2.3	Designing for disassembly/deconstruction built into design brief	Individual Business		Short (2025)
DESIGNERS	2.3	Client handbook: include in standard documents	Supply Chain	RIAS	Short (2025)
DESIGNERS	2.3	Post occupancy evaluation	Supply Chain	RIAS	Short (2025)

RESEARCH	2.3	Designing for appropriate longevity; able to cope with changes in use, environment, and technology. Designing for flexibility and adaptability down the line, to minimise the need for future deep retrofit. Consider how the use case may change down the line, and how that might be accommodated without structural alteration.	Individual Business	Architects, designers, and those commissioning new buildings	Short (2025)
WASTE	2.3	Technology Roadmaps to manage obsolescence better and build in resilience to systems	Supply Chain	Manufacturers	Short (2025)
BUILDERS	2.4	Should this be supplier led, how best can we reuse existing products.	Supply Chain		Short (2025)
DESIGNERS	2.4	Cross discipline working and sharing of best practice - lots of good guidelines exist and needed to be shared in use, not replicated and waste time	Supply Chain	RIAS, RICS, ACE, LETI, ACAN, SEDA	Short (2025)
DESIGNERS	2.4	Include CE in learning outcomes in architecture education	Supply Chain	Universities, ARB, APEAS P3	Short (2025)
DESIGNERS	2.4	Identify which disciplines best to lead in different parts e.g. architects on design strategies, building surveyors on EC			Short (2025)
RESEARCH	2.4	Designing with secondary components	Other	RIAS/RIBA, universities, students	Short (2025)
RESEARCH	2.4	Lack of skills around ability properly understand existing buildings as usable materials - training around deconstruction Embedding in curriculum - sustainable principles (UoS) - we should be doing this around reuse - We are covering this with further education but need to change attitudes in other generations Big role for ZWS - make existing CPD materials (for City of Glasgow College) available to the industry Wider CPD of the industry focused on those who are preventing delivery on this			Short (2025)
RESEARCH	2.5	More collaboration around all the supply chain			Short (2025)

WASTE	2.5	As there are fast track routes for patents of sustainable products, it should have options of fast track certification of construction materials that have recycled content, are circular and low carbon	Government	Certification bodies, UKAS accredited houses	Short (2025)
BUILDERS	3.1	Supply needs to be met by demand, second hand products need to be incentivised from a client perspective	Other		Short (2025)
DESIGNERS	3.1	Planning Conditions: Difficult to include specific elements in planning approval because of time lag before construction - conditions normally include approval of final material selection, wording could add "can include reused materials"	Government	councils, RTPI	Short (2025)
DESIGNERS	3.1	self-certified materials: Varying attitudes by engineers/architects to use of Reused materials where self-certifying is required - need practice notes, sharing of best practice	Supply Chain	RIAS, RICS, ACE - forum	Short (2025)
PUBLIC	3.1	Taxation/ levies that would push the supply chain to store more material/ assets that would then be available for reuse/ refurbishment projects.	Government		Short (2025)
PUBLIC	3.1	Way of identifying emerging needs to supply chain - increase demand for CLT and triple glazed windows	Other	LA needs to highlight the demand to supply chain and what asks are coming.	Short (2025)
PUBLIC	3.1	Provide information on waste produced from materials provided to market	Supply Chain		Short (2025)
BUILDERS	3.2	Greater commercial emphasis to fund projects which provide a positive environmental/social impact, i.e. leadership can drive these types of projects	Individual Business		Short (2025)
BUILDERS	3.2	Legislation will only get stricter, therefore requires some anticipation of the market, i.e. getting 'ahead of the curve' in terms of environmental targets/mandates etc	Individual Business		Short (2025)

DESIGNERS	3.2	Design & Build - use materials left over from other projects - this can increase the quality of outcome as cheaper that buying lesser quality new products - materials already stockpiled in their yards	Individual Business	protocol developed by RIAS?	Short (2025)
DESIGNERS	3.2	Stockpiling materials that would not otherwise be sold e.g. brick seconds from Ibstock	Individual Business		Short (2025)
PUBLIC	3.2	Identifying emerging needs both individually and collectively as public sector organisations.	Other	SFT - already engaging with LA and there needs to be a transfer of information gathered with the supply chain.	Short (2025)
RESEARCH	3.2	mandating the use of recycled materials/ reuse in products firstly in public sector procurement (is this in the NZPSBS)	Government	SFT	Short (2025)
WASTE	3.2	A driver linked to general new material reduction (not bogged down in carbon reduction). A simple metric like 70% reduction of virgin material on this retrofit. Something a procurement team can understand and get behind.	Government	Procurement teams, suppliers	Short (2025)
BUILDERS	3.3	Briefs to need to specify use of reused materials/ avoiding use of materials	Individual Business		Short (2025)
DESIGNERS	3.3	MEAT - most economically advantageous process - Scotland is worst offender in that price dominates public procurement process - inclusion of CE meaningless unless given weight - if quality was given equal weight to finance it would shift this	Government	Minister for Community wealth building	Short (2025)
PUBLIC	3.3	Performance based project delivery indicators need to be established to ensure longer term success of building	Government	Public and private sector both need to meet the same standards to ensure transparency on environmental requirements	Short (2025)

RESEARCH	3.3	Invest in and test new ideas through demonstrator projects - network of collaborators, engagement with insurers and standards authorities, investors, space/equipment/skills, capturing impact, publicity	Supply Chain		Short (2025)
WASTE	3.3	Current lowest cost procurement ethos often works against CE initiatives and investment therein	Government		Short (2025)
PUBLIC	3.4	Value of role within public sector dealing with QA of the building performance/ building standards needs reigniting. Build quality has suffered as a result of not having this oversight.	Other	Clerk of works specifically responsible for building control and regulation need to be factored in to achieve the required standards. Institute of Clerk of Works - can these institutes bring value and benefit.	Short (2025)
RESEARCH	3.4	Circular Building Awards (might want to borrow/copy French equivalent - https://boosterdureemploi.immo/en/circular-building-awards/)! Competition that gathers case studies of material reuse - raises profile and provides library of cases for planners/private sector to refer to	Supply Chain	ZWS run the competition?	Short (2025)
WASTE	3.4	Incentivising the use of reuse products across projects beyond cost	Government	individual builders	Short (2025)
BUILDERS	3.5	Taking advantage of third sector	Supply Chain		Short (2025)
RESEARCH	3.5	Form a lobbying group / interest group / trade association as voice for businesses pushing reuse/remanufacturing etc - clear messaging and clear signposts to information	Supply Chain	Is this ZWS or another agency?	Short (2025)
WASTE	3.5	Embodied carbon targets	Government		Short (2025)

BUILDERS	1.1	Need to comprehensive EPDs across suppliers. Currently manufactures not always doing this. Can be a challenge for SMEs to fund this. EPDs for re used materials may be required (carbon passports?), as carbon associated with the recovery process should be identified.	Government		Medium (2030)
RESEARCH	1.1	Regulating Embodied Carbon in Scotland's Buildings - March 2022 report for ZWS proposals for staged regulations align with Part Z (endorsed by over 200 companies) - In England Both of these are broadly the same approach to align England and Scotland as best as possible Consider comparable policies or requirements for largest projects to GLA London Plan SI7 policy (likely require longer consultation time)	Government	Building standards/ Scot Gov work with DLUHC to ensure consistency across UK (bearing in mind 2023 consultation on approach in England)	Medium (2030)
RESEARCH	1.1	Role for government for setting up pilot projects for example with public buildings to showcase for examples of pre demolition audits to show others how it is done	Government		Medium (2030)
RESEARCH	1.1	Staged adoption - learn from example projects and implement over time (e.g. following approach with GLA Circular Economy Statements in London). e.g. introducing requirement for largest projects applying NZPSBS to also undertake CE statements)	Government		Medium (2030)
WASTE	1.1	Recycle & Reuse Content would need to be mandated by Govt Legislation for to gain buy in by all manufacturers for electrical products , especially wire and cable as high percentage of products come from low cost countries who service the current market. Also would need to be international standards for electrical compliance and specification	Government		Medium (2030)

BUILDERS	1.2	Could planning legislation promote re use as opposed to heavy redevelopment, similar to Listing approach. Needs to be a reasonable framework which is appropriately managed - more resource	Government		Medium (2030)
BUILDERS	1.2	Housing - perhaps some type of minimum recycled content should be stipulated. Perhaps could be restrictions in place on land purchases - e.g., noting that existed buildings need to be retained.	Government		Medium (2030)
BUILDERS	1.2	Quality of material and certainty of supply and quantity is important. if this is legislated, how is this policed. Need some sort of evidence associated with planning application justifying why not refurb/repurpose.	Government		Medium (2030)
DESIGNERS	1.2	relate to placemaking programme - cultural value of many historic buildings contributes to this	Government		Medium (2030)
WASTE	1.2	Designs of new buildings should incorporate future retrofit that aligns with technology roadmaps from manufactured to allow future technologies to be easily adopted	Supply Chain	Manufacturers / Designers / System Designer	Medium (2030)
BUILDERS	1.3	Could there be a carbon tax on producers. This would encourage consideration of local/reused materials.	Government		Medium (2030)
DESIGNERS	1.3	tenure: financial support for private owners in mixed tenure buildings, otherwise whole-building retrofit gets blocked	Other	financial but also legal	Medium (2030)
WASTE	1.3	Store of all recovered assets in central repositories. Incentives put in place for re-use of the products/materials	Government		Medium (2030)
WASTE	1.4	Cost could be built into the products to allow for future processing at end of life.	Government		Medium (2030)
BUILDERS	2.1	Certification - EPDS. Supply chain - Can they look at lifespan of the material.	Government	Suppliers, manufacturers	Medium (2030)

BUILDERS	2.1	Standardisation - Are all on a level playing field.	Government	Government, industry bodies, contractors/consultants	Medium (2030)
DESIGNERS	2.1	Links to maintenance (see below) about knowing what materials are used during repair and maintenance during building life, not just end of life	Supply Chain		Medium (2030)
RESEARCH	2.1	Pre demolition audits - mandatory Building materials tracking in the BIM models Creating BAMB's Creating a connected ecosystems of BAMB so not in isolation and done at a wider scale ZWS are already on a lot of this through their demolition guidance - make mandatory	Government	Government policy to drive data generation	Medium (2030)
RESEARCH	2.1	Create a system that allows the value to see pre demolition audits etc all in one place so a wider range of people can see the value in the waste	Supply Chain	Could be public or private owned database?	Medium (2030)
BUILDERS	2.2	Tracking Element - still have its integrity.	Supply Chain		Medium (2030)
DESIGNERS	2.2	Design for maintenance and repair - how materials are layered and installed impact how readily a building can be maintained during its life - this is more important than design for end-of-life disassembly/reuse	Supply Chain		Medium (2030)
DESIGNERS	2.2	Quality control is increasingly recognised as very important e.g. Passivhaus has made us aware how important quality of construction and components is	Supply Chain		Medium (2030)
DESIGNERS	2.2	Retrofit design needs to allow for ongoing maintenance and repair e.g. external wall insulation can often seal in the windows, obstructing future changes	Supply Chain		Medium (2030)
BUILDERS	2.3	Does structure need to be retained and re-used - e.g hotel into flats.	Individual Business		Medium (2030)
WASTE	2.3	Design for Dis-assembly Design brief standard.	Government	All players in the value chain	Medium (2030)

WASTE	2.3	The notion of a digital thread/data base embedded into the building. It allows the end user/specifier to see that they are getting what they asked for.	Government	All players in the value chain	Medium (2030)
BUILDERS	2.4	Pushed through schools, apprenticeships to collaborate on retro fit rather than starting again. Reviews on how to reuse materials on current building of a certain age.	Government		Medium (2030)
RESEARCH	2.4	Issues with planners/ specifiers and clients who demand a certain specification - education required here	Supply Chain		Medium (2030)
BUILDERS	3.1	Government involvement to mandate % of reused/recycled materials? Other programmes to encourage supply chains to take ownership of takeback/circular economy etc.	Government		Medium (2030)
BUILDERS	3.1	Market needs to open for new materials/products to become available; can be difficult to understand the extent of reused materials available. Certification scheme (such as FSC etc.) for reused products to improve market awareness	Supply Chain		Medium (2030)
DESIGNERS	3.1	Mechanical/electrical components have particular challenges - need for people who can service and repair - could come under EPR. Possible consideration of a different business model for M&E components (e.g. PSS)	Supply Chain	Large property owners would be interested eg HA's	Medium (2030)
RESEARCH	3.1	Database of available materials	Government	Legislation to drive data generation; public or private ownership of platform	Medium (2030)
RESEARCH	3.1	There is not a big enough supply chain to cope with a big increase in demand - financial incentives to support the growth of the supply chain - help with the creation of new industries and bolster the existing innovation support landscape will all help	Government		Medium (2030)

		but the timelines in a lot of these things need to be accelerated			
WASTE	3.1	Supplier qualification and strategic procurement that considers reuse and recycled material as part of sustainability policy and product offering and weights accordingly in awards and partnerships	Supply Chain	Manufacturer and Distribution	Medium (2030)
BUILDERS	3.4	Cost issues may result in cutback of scope/deliverables, e.g. often environmental management is the first to go; requires a shift in perception in understanding the long-term benefits.	Other		Medium (2030)
BUILDERS	3.4	Culture change towards retrofit/reuse, showcasing of best practice examples	Other		Medium (2030)
RESEARCH	1.3	bring embodied carbon into the scope for local or national carbon offset funds as is already the case for operational carbon in some LAs e.g. London boroughs	Government		Long (2045)
PUBLIC	1.1	Mandating of embodied carbon target setting Voluntary means exist already.	Government		
PUBLIC	1.1	A national implementation strategy for the shift in materials etc. across Scotland - think the uptake of CLT from Europe limited by the cost to get it to Scotland, yet we have the resources and the technology in Scotland to produce it domestically, but there isn't currently the demand to justify a shift from posts and decking to mass CLT manufacture - also there's a tree planting issue - we aren't currently planting at the rate needed to replace trees if there is the predicted increased uptake of timber use in the UK.			
PUBLIC	1.1	Market challenges to meet targets i.e. affordability or			

		availability of skills and materials in supply chains		
DESIGNERS	1.2	How do you apply ideas such as long life / loose fit to existing buildings. Deconstruction benchmark - what era of buildings are the most valuable to designers - we are finding that 30' / 40s buildings are the most valuable - socially culturally and technically.	Government	
PUBLIC	1.2	Access to funding driven by the prioritisation of a refurb/reuse		SFT
RESEARCH	1.2	Need proposals to inform planning process, national planning framework and process - need to be clear what intention of NPF4 policy is		
WASTE	1.2	Design for dis-assembly. Requirement for planning.	Government	
RESEARCH	1.3	VAT charge on materials on retrofit and not applied to new build - this is managed by Westminster - this needs resolved -the tax and vat breaks should be favouring retrofit There is no push from Scot gov for change in this area	Government	
PUBLIC	1.4	this would be influenced by the bigger issues above		
RESEARCH	1.4	this only goes as far as consumer products & packaging and not applied to construction materials and this should be the case where possible - it is noted the difficulty of doing this within construction due to the length of time	Government	
RESEARCH	1.4	How to translate EPR for building lifespan? Adapt in construction to be about info to accompany building / building components through their lifecycle - i.e. BIM, material passports	Supply Chain	
DESIGNERS	1.5	soils: distinguish between soils and other waste	Government	
DESIGNERS	1.5	soils: needs to inform how we design sites	Supply Chain	designers: architects, engineers, landscape architects

RESEARCH	1.5	Public procurement rules to be adapted (will discuss in section 3) - public procurement based on a percentage of recycled or reused materials from a national database or circular products?	Government	
WASTE	1.5	Lowest cost tendering drives wrong behaviours	Government	
PUBLIC	2.2	Use of virgin materials more fiscally unattractive		
PUBLIC	2.3	Mandatory requirement for LCA to be carried out at planning stage (this should become the BAU approach). This will inform materials specification and building design. This approach is currently only driven by clients looking to achieve 'Excellent' standards in building performance certification i.e. BREEAM.	Government	
PUBLIC	2.3	Financial retention needs to be linked to building performance and construction quality.		
PUBLIC	2.3	Realistic construction programmes to meet the standards public sector is attempting to meet.		
PUBLIC	2.4	Efficiencies of transferability of knowledge/ skills within organisation hierarchies needs to be improved. Leadership are tasked with meeting targets and are informed, and more junior roles are at a knowledge development stage. Middle/ project delivery roles are overwhelmed with responsibilities to meet the asks and require further support to deliver this increased demand.	Government	
PUBLIC	2.4	Bespoke guidance/ protocols to account for the geographical variance in Scotland.	Other	Local Authorities
WASTE	2.4	Needs a specific training programme that directs behaviour	Individual Business	
PUBLIC	3.1	Market can only align and respond to the demand coming from the clients.		
PUBLIC	3.1	Value of skills in construction		

RESEARCH	3.1	Create commercial incentives for stockists to pass on business where supply/demand mismatches - e.g. client approaches stockist too early, pass business on to stockist who can take time lag until project on site (currently no incentive to pass on business, instead just speculatively accept or refuse business)		
WASTE	3.1	Supply chain can offer more re-use and recycled content only if it is valued by procurers. Ability to de-construct and dis-assemble exists but budget to pay for such effort doesn't		
DESIGNERS	3.2	Design & Build - how reused materials go into procurement process	Supply Chain	add to procurement framework / KPI
PUBLIC	3.2	Funding security and support need to be ensured to support smaller more vulnerable businesses investing in solutions.	Other	Range of funding organisations
PUBLIC	3.2	Public sector needs to present demands clearly to supply chain. This relates to point on clarity around building planning and standards; and what the building performance expectations are.	Other	
RESEARCH	3.2	Access to capital, financial forecasting - support for new businesses		
RESEARCH	3.2	Shared spaces for new businesses, equipment, testing		
WASTE	3.2	Cost		
WASTE	3.2	Embodied carbon targets		
BUILDERS	3.3	Appreciation of a mixed economy of new build/reuse or refurb; at early stages need to assess long term impacts of solutions. Not all cases will require the same solution	Individual Business	
PUBLIC	3.3	Demonstrating value for money as overarching goal of public procurement is too ambiguous. More clarity needed around scope of design and specifications used during tendering process.		

DESIGNERS	3.4	Emphasise maintenance etc for mid-life as important, not just end of life, as this is more relevant to owners - easier sell to clients and appreciate benefit of some extra costs	Individual Business	Plus planning and/or regulatory support/drivers
RESEARCH	3.4	Creating value statement for financial benefit of recycled or reuse of materials		
RESEARCH	3.4	Main stream consumer engagement to change perception of what circular means - full campaign nationally		
RESEARCH	3.5	Skills - we are losing skills for repair and maintenance of old buildings - we need to work to keep this alive	Supply Chain	

B Data Action Tables

Workshop 1 Findings tables: What actions are needed?

Analysis of the discussion points culminated with a broad range of actions proposed by the stakeholders, categorised here as Priority Items, with 71 in total. Against each item, a short description of what action would be appropriate has been provided, based on issues flagged in the discussion points.

These are listed below categorised under the 12 Sub-topics that were used for Workshop 2.

1. Embodied carbon and circular economy
2. Retrofit versus demolition
3. Taxes, levies and VAT
4. Extended Producer Responsibility
5. Material Data and Tracking
6. Material Performance and Standards
7. Project brief and contract process
8. Education, skills, guidelines and protocols
9. Supply Chain
10. Business Drivers
11. Public and private procurement
12. Perception and value

This is not a definitive list and many of the actions cross over between Topics. However, this will provide a framework which allows for better understanding of the types of action required, as well as linking them directly to the discussion points made by the Stakeholders.

1 Embodied carbon and circular economy

Priority Item	Action
Building Regulations	include embodied carbon and circular economy in building regulations (see also: assessment frameworks)
Circular Economy Bill	include construction in circular economy bill
Embodied Carbon	formalise and expand references to embodied carbon in relevant legislation and policies
LEIP P3	review how LEIP P3 could include reuse as part of embodied carbon and circular economy targets
Life Cycle Assessment	develop standard framework for life cycle assessments and include in procurement
Mandatory, Staged or Voluntary	review which actions would be best implemented on mandatory, staged or voluntary basis
NPF4 (National Planning Framework 4)	review how NPF4 could include reuse as part of embodied carbon and circular economy targets
NZPSB	review how NZPSB could include reuse as part of embodied carbon and circular economy targets
Planning Approval	include reuse and other embodied carbon and circular economy in planning approvals (see also: assessment frameworks)

2 Retrofit versus demolition

Priority Item	Action
Heritage Listing	consider how the heritage listing framework could be extended to encourage refurbishment rather than demolition (see also: retention v redevelop)
Placemaking	consider how the evolving framework for placemaking could encourage refurbishment rather than demolition (see also: retention v redevelop)

Retention V Redevelop	develop standard assessment framework for reviewing impacts of retention/refurbishment v demolition/redevelopment

3 Taxes, levies and VAT - for actions related to VAT and taxes

Priority Item	Action
Carbon Tax/Offset	define how carbon tax and carbon offsets would interlink with embodied carbon and circular economy issues (see also: assessment frameworks)
Devolved Matters	review which actions could be implemented under devolved matters or where coordination or lobbying with UK national government will be required
Levies	review how levies could be applied to waste and virgin materials to provide financial incentives for reuse
Taxes	review opportunities for the tax system to support retention and reuse
VAT	review how VAT could be applied to reuse and construction materials and processes generally to provide financial incentives for reuse

4 Extended Producer Responsibility

Priority Item	Action
Extended Producer Responsibility	ensure EPR includes construction sector materials and components where relevant
Post Occupancy Evaluation	encourage greater use of post occupancy evaluation and include actual outcomes for relevant criteria e.g. targets for reuse, application of design-for strategies (see also: facilities management)

5 Material Data and Tracking

Priority Item	Action
Assessment Frameworks	develop standard assessment framework for embodied carbon and circular economy to be applied consistently across all relevant systems
BIM	ensure all BIM-related frameworks include relevant carbon and circular economy issues (see also: assessment frameworks)
Environmental Product Declarations	ensure EPD framework is based on consistent and accurate data but which is also flexible to allow for bespoke supply chain impacts (see also: assessment frameworks)
Material Passport	work with the supply chain to define consistent criteria for material passports
Material Tagging	work with the supply chain to define how all materials, whether new or reused, could be tagged to support a range of actions
Single Use	research into whether single-use items have undue impact on waste in the sector
Soils	separate soils from other waste data to recognise that it does not have any manufactured value
Transparency	ensure all data related to reuse and other circular economy outcomes, including availability of materials and the assessment criteria, are open access
Waste Data	collate waste data to enable separation of construction, demolition and excavation generation source, and to track what recovery actions relate to these separate streams

6 Material Performance and Standards

Priority Item	Action
BREEAM	coordinate with BREEAM and similar building certification schemes to learn from and to include relevant carbon and circular economy issues (see also: assessment frameworks)
Certification	liaise with relevant organisations for the development of certification frameworks that will support and ameliorate reuse and other circular economy outcomes e.g. fast track, self-certification
Durability	include durability and life span information is relevant assessment (see also: assessment frameworks)
Mixed Economy	review actions to ensure they can be implemented in flexible ways to suit context e.g. regional variations, sector specific needs
New And Unused Materials	treat new but unused materials similarly to reused materials for relevant actions
Quality Assurance	ensure quality assurance is integrated into relevant aspects of the reuse process and is given adequate weigh in procurement
Risk Management	liaise with relevant organisations to risk management related to reuse does not pose unnecessary constraints e.g. insurance (see also: standards)
Standards	liaise with relevant organisations for the development of standards related to reuse and other circular economy outcomes (see also: certification + assessment frameworks)

7 Project brief and contract process

Priority Item	Action
Clerk Of Works	review the role of clerk of works and how they could support the implementation of reuse and other circular economy outcomes (see also: quality assurance)
Cross Discipline Work	encourage cross discipline working in briefs, contracts and procurement

Design-For Strategies	emphasise design-for strategies in professional practice and consider how they could be included in planning or building approvals
Facilities Management	encourage facilities management during the operational life of a building include embodied carbon and circular economy criteria, such as in operation manuals and post occupancy evaluation
Maintenance	review areas where ongoing building maintenance can impact outcomes e.g. prevent demolition by neglect, demonstrate cost benefit to owner, facilitate future disassembly and reuse
Mid-Life Benefits	ensure impacts during the operational life of a building, not just construction and end-of-life, are considered at relevant stages, especially where this will demonstrate better value to property owners

8 Education, skills, guidelines, and protocols

Priority Item	Action
Best Practice	collate and promote examples of best practice
Curriculum	include embodied carbon and circular economy in curriculum for university and trade qualifications
Pilot Projects	work with large estate owners, public or private, to run pilot projects
Trade Network	establish an industry-wide trade network to coordinate actions on embodied carbon and circular economy, including identifying which disciplines should lead on different actions
Training And Resources	ensure adequate training and resources are provided to all personnel involved in assessment and management of embodied carbon and circular economy actions, including recovery or legal action for non-compliance
Transferable Skills	research to identify transferable skills within all sectors that would be relevant to reuse and other circular economy outcomes

9 Supply Chain

Priority Item	Action
Appropriate Reuse Materials	research on what materials are most appropriate for reuse and flag their availability in recovered material
Cost Competitive	research which high carbon/high value items would benefit from financial incentives to encourage reuse
Material Banks	support the development of material banks by public and private organisations
Pre-Demolition Audit	encourage greater use of pre-demolition audits and ensure data is made available to material banks
Remanufacture	research how reprocessing/remanufacture of reuse materials can be supported and how cost impacts can be ameliorated e.g. through Scottish Institute of Remanufacture
Supply Demand Mismatch	Research how issues around the mismatch of supply and demand could be managed, including geographic location, extended timeframes between recovery and use, and timeframe between planning approval and final material selection at construction.
Waste Management	review waste management strategies to better enable reuse

10 Business Drivers

Priority Item	Action
Builders	building sector should identify drivers and opportunities to promote reuse irrespective of carbon and circular economy benefits
Certainty Of Future Direction	identify areas of legislation or policy or sector development where certainty of future direction would encourage business innovation e.g. technology route map
Clients	client sector should identify drivers and opportunities to promote reuse irrespective of carbon and circular economy benefits
Support Emerging Business	provide financial or other support to support existing reuse business or networks and encourage the development of new ones, whether public or private

Third Sector	third sector should identify drivers and opportunities to promote reuse irrespective of carbon and circular economy benefits

11 Public and private procurement

Priority Item	Action
Design & Build Contracts	review design & build contracts to identify how they could encourage reuse and other circular economy outcomes
Mixed Tenure	research specific issues related to mixed tenure properties
Most Economically Advantageous Tender	Review procurement frameworks based on most economically advantageous tender (MEAT) that weight cost over environmental and social outcome, including link to Community Wealth Building.
Procurement	encourage procurement frameworks whether public or private provide genuine incentives for reuse and other circular economy outcomes, and that these are carried through to the award of the contract and construction
Product-Service Systems	ensure product-service system (PSS) benefits can be included in relevant assessment and procurement processes (see also: assessment frameworks)
Public Estate	review opportunities for the public estate to implement and promote innovation and best practice

12 Perception and value

Priority Item	Action
Awards Programme	launch national awards programme for circular economy products
Awareness Raising	range of awareness raising programmes for circular economy at targeted audiences

Climate Literacy	include embodied carbon and circular economy in climate literacy programmes and ensure these are rolled out to all parts of the industry
Community Salvage	encourage and facilitate communities to adopt informal salvage schemes in the local area
Manufactured Capital	include manufactured capital (value) as part of assessment frameworks where relevant

Stakeholder Requirements

The following stakeholder requirements have been grouped by the eight key themes collaboratively generated with stakeholders during the inception meeting.

Most of the clusters discussed some aspect of embodied carbon and circular economy as being a priority issue for the Legislation and Policy theme, some making specific reference to the Circular Economy Bill (Note: the Scottish Government recently ran a public consultation on this concurrently with the Route Map to 2025 which is the basis for this workshop programme). These also crossed over into the Information theme with the perceived need to better define and collate data on these issues. The comments include:

Table 13 Legislation & Planning

Theme	Cluster	Requirement
Legislation and policy	BUILDERS	Requirements for **planning process** to adopt implementation of CE statements
	DESIGNERS	**Stricter policy** on retrofit/refurb of buildings, avoiding cases of unnecessary demolition
	PUBLIC	Requirements for **planning process** to adopt implementation of CE statements
	RESEARCH	**Mandatory requirements** on the use of recycled content in construction
	WASTE	**Regulation** of embodied carbon

Table 14 Economics and Finance

The obvious focal point here was cost, whether to the business or the consumer, and how reuse could be incentivised through either taxes or the market.

Theme	Cluster	Requirement
Economic and Finance	ENERGY	Lowest cost to consumers
	PUBLIC	Incentivisation through tax breaks for the public sector. This is seen more in the private sector and should be introduced for public organisations.
	WASTE	Demolition contractors need to be financially incentivised to become deconstruction contractors and store materials. How can this be achieved if storage / transport costs and the chance of a future profit does not outweigh scrap/recycling value? Business rates relief on storage yards?

Table 15 Market & Infrastructure

Many of the comments under the theme of the Market were about the supply chain, and whether or not it could support reuse.

Theme	Cluster	Requirement
Market and Infrastructure	DESIGNERS	Supply chain must be able to support reuse
	ENERGY	Markets for secondary materials
	RESEARCH	Development of secondary material supply chain - must ensure that materials can be transported, stored, and passed on to someone else in a way that they remain high quality.
	RESEARCH	Can we get suppliers of new materials to also take on supplying secondary materials. For instance, can local Scottish quarries do more of taking back, renewing and reselling secondary stone?

Table 16 Business Model

There were only a few comments made on the theme of Business and these covered a range of issues without a specific focus.

Theme	Cluster	Requirement
Business Model	DESIGNERS	Require manufacturers to take back products and refresh for re-use with new warranty (creating a second hand market)
	RESEARCH	SEPA involvement engendering a shift in attitude, towards enabling and promoting new ways of thinking
	RESEARCH	Collaborative project planning across public sector agencies - TS/SW/LA within defined geographical boundaries to maximise the opportunity to share high volume materials across different projects
	WASTE	Designer/developer awareness of secondary material suppliers

Table 17 Information & Reporting

The need to review how waste data is classified and reported on was flagged under Information by four of the clusters. This covered a range of issues such as the provenance of materials and how pre-demolition audits could feed directly into material banks, and as noted above crossed over into how Legislation would set benchmarks. The comments included:

Theme	Cluster	Requirement
Information & Reporting	BUILDERS	Reporting on provenance of reuse in the sector to inform key stakeholders (for example insurers)
	DESIGNERS	Better categorisation of CDW
	PUBLIC	Reporting on provenance of reuse in the sector to inform key stakeholders (for example insurers)
	WASTE	Pre-demo audits into a material reuse portal - visible and available
	WASTE	Standard methods for measuring embodied carbon

	BUILDERS	Post-completion of project to outline what CE practices have been implemented.

Table 18 Technical & Design

The theme of Technical and Design had the most comments, covering a broad range of issues from which no specific focal point can be defined. The following summary includes a point from each of the clusters.

Theme	Cluster	Requirement
Technical & Design	BUILDERS	Interrogation of whether reuse is an option on site/ quality must be equivalent of new/ meet client demand
	DESIGNERS	Early involvement by all disciplines in the process
	ENERGY	Secondary materials need to be suitable and of a recognised standard/ quality
	PUBLIC	Public sector projects need more clarity and certainty on all aspects of a building project, including waste - understanding what was diverted from landfill and repurposed
	RESEARCH	Deconstruction procedures/ skills - Development of these by demolition firms and construction companies (e.g. lifting timber floor to put insulation under and then re-laying) to ensure they can deconstruct safely and effectively. Deconstruction skills training may be required.
	WASTE	Routes to assess performance according to building standards of de-constructed materials

Table 19 Social & Cultural

These focused on changing perceptions about reuse versus new materials, both in the industry and the general public, ranging from high level activities within procurement through to how locals should feel comfortable about recovering items from buildings being demolished in their area.

Theme	Cluster	Requirement
Social & Cultural	BUILDERS	Move away from new-is-best approach to enhance adoption of CE practices
	DESIGNERS	Reused materials must be considered as well performing/not "cheap" or poor quality
	PUBLIC	Broader education piece needed to overcome go to approach adopted for new-is-best
	RESEARCH	Collaboration & Exchange - earlier engagement between contractors and designers
	RESEARCH	We must stop selling circularity to the public as a school project - professionalise the message!
	RESEARCH	Make it socially acceptable (and/ or legal?) to allow local people to take elements of buildings being locally taken down. Such as kitchens, white goods, lights etc.
	BUILDERS	Move away from new-is-best approach to enhance adoption of CE practices

Table 20 Performance & Sustainability

There were only a few comments related to performance and these tended to focus on how to provide assurance of performance for reused materials.

Theme	Cluster	Requirement
Performance & Sustainability	BUILDERS	KPIs and measurement of benefits of reuse to enhance awareness of reuse amongst key stakeholders.
	DESIGNERS	Build into briefs - which should include how new and existing development responds to the site's existing resources
	WASTE	Attack low hanging fruit on the risk curve. Use of secondary materials in low-risk applications mandated?

C. InFutRUseWood Report (Summary)

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InFutUReWood is a European project supported under the umbrella of ERA-NET Cofund Forest Value, of which the UK Forest Commissioners is one of the contributing partners. The acronym stands for "Innovative Design for the Future – Use and Reuse of Wood (Building) Components, and their summary report was published in March 2022, compiled by a collaboration of eight European academic organisations including Edinburgh Napier University (ENU). Offsite Solutions Scotland is also a partner of the project, and through them BE-ST (formerly the Construction Scotland Innovation Centre). We were informed about the project by Marlene Cramer from ENU who was one of the report authors.

The report is not yet published on the project website but other details of their work can be referenced there.[59]

The Abstract for the report states:

> "The InFutUReWood project aimed to answer the question: "How should we build today to be able to circulate tomorrow?" It started in March 2019 and ended March 2022, covering both the design of new buildings, and the reuse of timber from buildings already at the end of their life. At that time, the subject was a rather novel research area for timber buildings, but this period of three years saw many changes. Increasing concern for climate change could have been expected, but shortages of building materials caused by the Covid-19 pandemic and political events encouraged many to take an interest in the reuse and circularity of wood products."

In Section 4. Inventory, deconstruction, and quality of recovered wood, the report states:

> "All buildings, irrespective of type, potentially contain useful quantities of wood products that could either be reused or recycled, rather than burned for energy. However, in practice the demolition methods used, which in turn are dictated by inter alia the economics of the demolition process and the lack of a market for recovered wood, result in the wood being significantly

[59] Publications - InFutUReWood

damaged and the dimensions reduced. This in turn, naturally affects the market potential. In other words, we have a vicious circle to contend with. In addition, the initial design, as well as maintenance, affects the condition of the wood contained in buildings. Design and poor maintenance often lead to fungal decay, making reuse impracticable.

To quantity the amount of wood embodied in buildings, we can use different approaches, based on the available statistical sources and computed material intensity coefficients. Nevertheless, even where access to statistical data is good, there are often gaps in the data, or simply the data is missing, making it difficult to create accurate models, especially when information and statistics about demolitions is lacking. It might be fruitful in the future to explore alternative methods and approaches to modelling the outflow of wood, such as those based on GIS (Global Imaging System).

Having material of suitable quality for reuse or recycling is imperative, and to determine what is of good enough quality requires criteria against which to assess it. We created a set of criteria as part of WP4, which has been tested against recovered wood obtained from a waste management company. Further validation should now take place to assess the validity of the criteria and determine if any further amendments are necessary.

We developed a materials flow model, based on an input calculated from statistical data and output based on mathematical functions representing building survival probability. Whist the model is functional, it requires development to improve accuracy and to predict the volumes and quality of individual wood products."

And the Conclusion in Section 8 of the report states:

"The project has developed three methods to plan and optimize a primary design for deconstruction and reuse, rather than demolition: one qualitative method to assess and improve an existing design, one assessment tool producing a ReBuilding Index adapted to industry needs, and one Decision Matrix to be used by designers. Cases studies carried out with manufacturers show that timber building designs exist that are relatively well adapted for deconstruction and reuse already today. Simple changes in design are sometimes enough to augment the reuse potential of a

> building. There are many possible ways to structure guidelines for deconstruction and reuse of a building (Deconstruction Plans) and no standard is yet established. Deconstruction Plans are likely to become legally required in the future and finding a coherent standard is considered as an important area for future research."

Once again, these points closely mirror the outcomes of the workshops and our research such as:

- All buildings will have some items suitable for Reuse.
- The care with which demolition is undertaken can significantly impact Reuse potential.
- Protocols for the certification and quality control can be fairly readily developed.
- Data compilation on Reuse in the market needs to be much more detailed than currently.
- Expectation that Pre-Demolition Audits or similar will become standard practice.
- Standard assessment methods are necessary to support this.


ZERO
WASTE
SCOTLAND