SUPPORTING THE CIRCULAR ECONOMY TRANSITION IN THE IRISH CONSTRUCTION SECTOR

THE NEED TO UNDERSTAND AND EMBED CIRCULAR ECONOMY PRINCIPLES

A VIEW FROM PRACTITIONERS IN THE SECTOR

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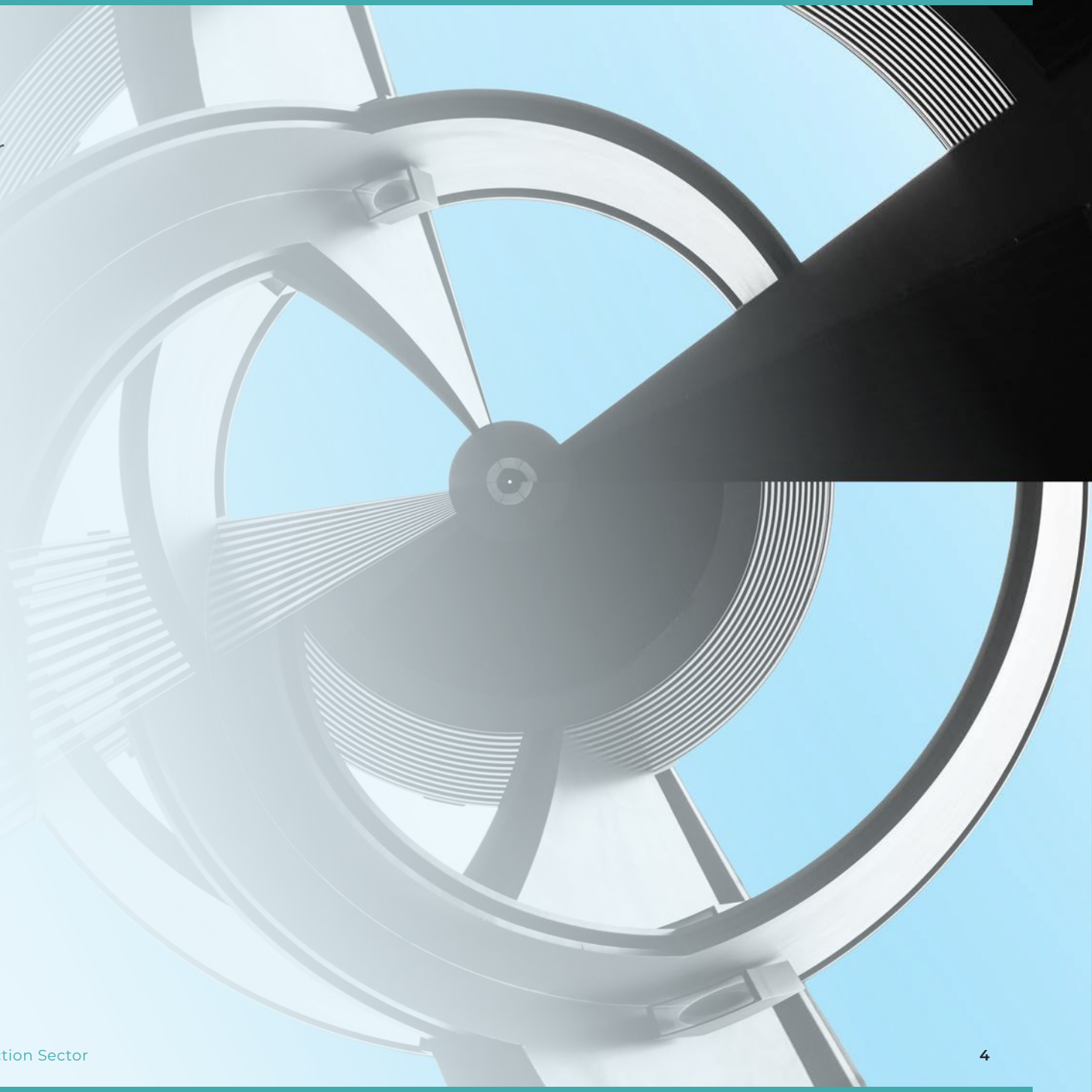
PURPOSE

The purpose of this document is to set out a sectoral perspective on why the Irish construction sector needs to understand and embed circular economy principles and to provide initial recommendations for all in the sector, be they from industry, government departments and agencies, local authorities, NGOs, academia, or others to start the process of bringing circular economy thinking into the mainstream of construction and demolition practice across buildings and infrastructure.

These recommendations have been drawn up on the understanding that the adoption of circular economy practice in the Irish construction sector, while advancing, is at a very early stage and that much work is needed to adapt to this new way of thinking. This publication endeavours to bring an initial vision, encourage innovation, critical thinking and look to adopting best practice for the next generation. Such change will also be required not only in relation to circular practice but also in parallel and complementary areas such as Modern Methods of Construction, Digital Delivery, Sustainability and Design for Manufacture Assembly and Disassembly.

Much work is being done at EU and government level to bring about change in this area and many policies and directives are evolving or changing so that it is highly likely that this guidance will have to be updated over the coming years. Consequently, this publication should be seen for what it is: a set of recommendations to be considered by Government in the development of a statutory Circular Economy Roadmap for the construction sector, in line with the requirements of the Circular Economy Act 2022. It is also a call to action for the industry and we expect it to be followed by many collaborative and forward thinking initiatives



Chair of the Construction Sector Innovation and Digital Delivery SubGroup

Since I was appointed Chair of the Construction Sector Innovation and Digital Delivery SubGroup in September 2020, I am proud to be part of a body that is championing the delivery of a more productive and environmentally sustainable Irish construction sector, which is fundamental to the Ireland achieving the objectives of the National Development Plan 2040.

KPMG/Future Analytics examined the productivity of the Irish construction industry and in June 2020 they recommended a significant number of innovation actions, seven of which have been prioritised for implementation by the Construction Sector Group Innovation and Digital Adoption SubGroup.

We are now looking at a future more collaborative, productive, agile and environmentally sustainable construction sector greatly upskilled and enabled by innovation and digitisation.

Included in the seven priorities are digitisation of the planning permission process which is now almost complete, development of a Construction Technology Centre by Enterprise Ireland, the Centre of Excellence for Build Digital including the full suite of Building Information Modelling (BIM), promotion of Modern Methods of Construction and a more focused approach to Construction Applied Research through the establishment of Construct Innovate, the development of a National Construction Technology Centre (CTC) and Demonstration Centre, with a National Construction Skillnet to be optimised and future significant innovation funding sources to be explored and mobilised. All of these actions embed sustainability and climate action as part of their mission.

The Irish construction sector is undergoing a transformation with a focus on upskilling, productivity, digitalisation and offsite manufacturing. These technologies are pivotal in creating a more efficient and eco-friendly industry. Emphasising durability and adaptability, key attributes of circular economy practice, the aim is for the sector to design and build or retrofit long-lasting structures while maintaining a digital record of materials and maintenance. Life cycle assessments are crucial for understanding the interplay between material choices, carbon reduction, and adaptability. The key to sustainability lies in demonstrating the commercial viability and business case for these changes, ensuring a resourceful and a construction life cycle with much reduced waste.

In collaboration with DECC, we gave the CS Innovation and Digital Delivery Subgroup Sustainability and Climate Action Consultative Committee the task of developing guidance for ***Supporting the Circular Economy Transition in the Irish Construction Sector - The Need to Understand and Embed Circular Economy Principles.*** This work has been undertaken by over 40 expert practitioners from across the construction sector within both the public and private sectors.

It is a privilege to work with industry experts with such a wealth of knowledge, and also the vision and passion to deliver a future with zero waste in construction, the embedding of the principles of the circular economy across the construction sector and a cleaner environment. I would like to extend my sincere thanks to the team who have worked hard to produce this excellent report.

PJ Rudden
Chair of the Construction Sector Innovation and Digital Delivery SubGroup

PREFACE

This document and the recommendations it contains have been prepared for the Department of Environment, Climate and Communications (DECC) by the Sustainability and Climate Action Consultative Committee of the CSG Innovation and Digital Adoption Subgroup which is mandated to deliver crucial actions to improve productivity and sustainability in the construction sector. We call on DECC to ensure that this document is used as a key input to the formulation of the statutory Circular Economy Roadmap for the Construction Sector (CERCS), in line with the provisions of the Circular Economy Act 2022.

A well-functioning building and construction sector is fundamentally important for all modern economies. It shapes the built environment and delivers the structures and services that are essential to meet the needs of society. This ability to shape our environment brings with it impacts on the natural environment, and today the sector recognises its responsibility to continue to meet the needs of society but with significantly less impact on the natural world.

It is not surprising given the scale of construction activity in Ireland that, according to the Irish Green Building Council (IGBC), construction and demolition projects are also responsible for about 50% of all material extraction, 33% of potable water usage and 50% of the total waste (by weight) generated in Ireland. According to the EPA National Waste Statistics Summary Report for 2021, 82% of C&D resources and waste was backfilled, 10% was sent for disposal, with only 8% being recycled. This presents serious environmental challenges during the entire lifecycle of buildings and infrastructure, especially during the operational and end-of-life stages. It is concerning to note that the EPA Demolition Waste Statistics for Ireland, released on 10th August 2023 with the Latest Reference Year 2021, indicates that the quantity of Construction and Demolition (C&D) waste generated and collected in Ireland in 2021 increased to 9 million tonnes from 8.2 million tonnes in 2020, an increase of 10%.

Like all sectors of our economy, the construction industry faces urgent pressure to transition from the prevailing linear model to a circular economy approach. Embracing circular economy thinking entails extending the life of components, materials, and products through practices such as reuse, repair, recycling, remanufacture, maintenance and refurbishment. While circular economy concepts have proven successful in various sectors like electrical equipment, their application in the construction industry is relatively recent and has primarily focused on waste prevention and material management. Opportunities are presented to designers of buildings, infrastructure, and construction products to increase circularity through designing out waste, design for adaptability and design for disassembly and reuse. New business models will be required to bring about the changes required to reduce resource consumption.

Despite the challenges, the construction sector holds immense potential to implement circular economy strategies, particularly through embracing eco-friendly products and technologies, resource management, reducing extraction of raw materials, design for circularity and incorporating sustainability criteria in procurement. Nonetheless, the sector's project-based institutional practices and market mechanisms often hinder the seamless integration of circular economy principles. With numerous stakeholders contributing to the environmental impacts and costs throughout the supply chain, both government and businesses can lead in guiding and supporting a circular economy transition within the construction industry through relevant guidelines and policy interventions.

While the 2021 Resource and Waste Management Best Practice Guidelines have embedded circular economy principles, this current support document, aims to inform both industry decision-making and policymaking in Ireland. It is the first step in envisioning a thriving Irish construction sector that meets the needs of society, while fully embracing circular economy principles that maintain products, components, and materials at their highest use and value throughout their lifecycle. Consequently, it aims to outline most of

the currently understood necessary actions required to replace the linear construction sector economy, characterised by a take-make-dispose approach, with a circular one that focuses on reducing the extraction of natural resources, recovery retention, refurbishment, remanufacturing, and reutilisation. Our future built environment and infrastructure must be designed to facilitate the reuse and adaptation of materials. Organisations should find value in reusing, recovering and remanufacturing products or salvaging parts and materials to bring benefit to clients and end users, leading to successes in the wider environment of sustainable buildings, cities, and infrastructure.

Working with a group of experts from industry, government departments and agencies, local authorities, NGOs, academia, and others who possess extensive knowledge and construction sector expertise has been a privilege. My sincere thanks is extended to the dedicated team that has diligently crafted this excellent guidance document and a full list of contributors is set out in the Acknowledgements section.

Looking ahead, the construction sector is poised for transformation, driven by early moves to digitalisation and offsite manufacturing, which promise greater productivity, new skills, reduced carbon footprint, support of circularity and expanded business opportunities. Embracing these technologies is instrumental in creating a resourceful and more productive construction sector. Designing durable and adaptable buildings and infrastructure will lead to longer functioning lifespans and maintaining a digital memory of their composition and maintenance will facilitate end-of-life decisions on materials' reuse, recycling, or recovery. Holistic life cycle assessments will underpin the interplay between material choices, carbon reduction, durability, and adaptability, ultimately leading to more sustainable outcomes.

These recommendations, when carried through into the CERCS, will be helpful to all participants and practitioners in the Irish design, manufacturing, construction, demolition and resource and waste management, built environment asset management sectors and to educators as it provides guidance for the transition from current practice to circular practice and sets out the actions required in the education, value chain, research and development, digital delivery areas to achieve this transition.

It will also be valuable to policy makers in highlighting the many aspects of policy and regulation which need to be addressed to eliminate many roadblocks and certain barriers, and to support the transition of the construction sector to the circular economy model.

It is also anticipated that this document will be followed by CircularBuild, an EPA-funded project, which aims at developing and designing the National Circular Built Environment Roadmap to 2040. The project lead, the Irish Green Building Council, in collaboration with Atlantic Technological University, Technological University Dublin and the University of Galway, will be broadly dedicated in defining and exploiting Circularity in the Irish Construction sector, an engaging process, with stakeholders from different backgrounds and expertise in the four key circular areas of the Construction sector. This will be carried out through dedicated workshops and a public consultation process, before the roadmap is prepared, and launched.

The successful implementation and embedding of circular economy principles into the Irish construction sector necessitate unprecedented collaboration across value chains and government departments. This document's development has been characterised by a highly collaborative process that transcends traditional silos and incorporates key stakeholders from central and local government, government agencies, NGOs, academia, and the construction industry. Drawing on best practices from both national and international contexts, the document encompasses key initiatives essential for driving the construction sector circular economy vision.

David Browne
Chairperson
Construction Sector Circular Economy Group

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BY-PRODUCT

substance or object, resulting from a production process, the primary aim of which is not the production of that item fulfilling the following points:

a. Further use of the substance or object is certain;

b. The substance or object can be used directly without any further processing other than normal industrial practice;

c. The substance or object is produced as an integral part of a production process;

d. Further use is lawful, i.e., the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.[53]

CIRCULAR ECONOMY

Where the value [54] of products, materials and resources is maintained in the economy at the highest possible value for as long as possible, and the generation of waste minimised, making an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy.[55]

Circular Economy and Miscellaneous Provisions Act 2022: "circular economy" means an economic model and the policies and practices which give effect to that model in which:

(a) production and distribution processes in respect of goods, products and materials are designed so as to minimise the consumption of raw materials associated with the production and use of those goods, products and materials;

(b) the delivery of services is designed so as to reduce the consumption of raw materials;

(c) goods, products and materials are kept in use for as long as possible thereby further reducing the consumption of raw materials and impacts harmful to the environment;

(d) the maximum economic value is extracted from goods, products, and materials by the persons using them, and

(e) goods, products and materials are recovered and regenerated at the end of their useful life.

PRODUCTION RESIDUE

A material that is not deliberately produced in a production process but may or may not be a waste.

RECYCLING

Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations in Ireland.

RESOURCES

Defined by UNEP and OECD as the naturally occurring assets that provide use benefits through the provision of raw materials and energy used in economic activity (or that may provide such benefits one day) and that are subject primarily to quantitative depletion through human use. They are subdivided into four categories: mineral and energy resources, soil resources, water resources and biological resources. Resources for a business are more inclusive than just materials and equipment, including also (for example) human resources. This CWA uses "*resources*" to have this breadth of interpretation.[56] These categories all form a subset of the 'external environment'.

This larger system they exist within has strict replenishment rates, interdependencies/knock-on effects within multiple subsystems. i.e. Earth systems can replenish resources annually but where extraction exceeds these limits there can be significant cascading effects causing potentially severe impacts on multiple policy agendas- including circularity.

SELECTIVE DEMOLITION

Removal of materials from a demolition site in a pre-defined sequence in order to maximize recovery and recycling performance.[57]

WASTE

Any substance or object which the holder discards or intends or is required to discard.[58]

1 Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (Text with EEA relevance), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098

2 It should be noted that "value" is not limited to financial value, and may also include social, cultural, historic, aesthetic etc.

3 Closing the loop - An EU action plan for the Circular Economy https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0614

4 CEN "Industrial Symbiosis: Core Elements and Implementation Approaches" December 2018, https://www.cencenelec.eu/media/CEN-CENELEC/CWAs/RI/cwa17354_2018.pdf

5 EU Guidelines for waste audits

6 Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (Text with EEA relevance) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098

LIFE CYCLE ASSESSMENT (LCA)
LCA is a technique to assess the environmental aspects and potential impacts associated with a product, process, building, development, or service, based on I.S. EN ISO 15978. The assessment involves compiling an inventory of relevant energy and material inputs and environmental releases; evaluating the potential environmental impacts associated with those inputs and releases. Undertaking an LCA can help to inform design decisions in the construction sector to promote less environmentally damaging practices. The term "lifecycle assessment" is interchangeable with the term "whole life cycle analysis".

LIFE-CYCLE COSTING
Life cycle cost (LCC) is an approach that assesses the total cost of an asset over its life cycle including initial capital costs, maintenance costs, operating costs and the asset's residual value at the end of its life.[59]

WASTE HIERARCHY
The waste hierarchy applies as a priority order in waste prevention and management legislation and policy. It is the cornerstone of EU waste policies and legislation and is laid down in the EU waste framework directive. Its aim is twofold:

- to minimise adverse impacts of the generation and management of waste; and
- to improve resource efficiency.

The hierarchy is generally depicted in the form of an inverted pyramid with the most preferred options at the upper end and disposal at the bottom as the last-resort solution to managing waste, from the most preferred being prevention to the least preferred being disposal to landfill or incineration without energy recovery.[60]

PRE-DEMOLITION REPORT
A Pre-Demolition report also known as an Audit should be undertaken on buildings prior to renovation, refurbishment or demolition. It should identify items and materials that can be reused either within the existing building or in another building, materials that can be sent for recycling and also materials that cannot be recycled. The report should outline details as to how to develop a methodology for undertaking this. The WAPCE commitment re bringing circularity / C&D waste within the framework of statutory planning guidelines should contain provide for this.

The purpose is to identify, prior to commencement of soft strip of the building, demolition materials that can be reused or recycled. This will allow tender documents for the works to instruct a Contractor what to do with individual materials so as to maximise their reuse and recycling.

BIM MODELLING
Modelling a building using computer software known as Building Information Modelling (BIM) will produce a 3D digital version of the building. It is particularly useful when constructing a new building where all elements of the building can be modelled in advance of physical construction.

It can also be a very useful tool when identifying materials within the building that could be reused or recycled as part of a renovation project if they are to be removed from the building. Currently most commercially available BIM software does not allow separate identification of materials that are to be demolished or removed from the building and it is up to Designers to use different methods to identify materials for recycling or reuse.

SUSTAINABLE
Causing, or made in a way that causes, little or no damage to the environment and therefore able to continue for a long time.

CASCADING
The sequential and consecutive use of resources.[61]

CLIENT
The employer, tenant or other person commissioning a development of any type.

7 Overview on life cycle methodologies and economic feasibility for nZEBs; Sesana &Salvalai; 2013

8 CEN "Industrial Symbiosis: Core Elements and Implementation Approaches" December 2018, https:/ti/tiwww.cencenelec.eu/timedia/tiCEN-CENELEC/tiCWAs/tiRI/ticwa17354_2018.pdf

9 The Circular Economy and Cascading: Towards a Framework; https://www.researchgate.net/publication/340867805_The_Circular_Economy_and_Cascading_Towards_a_Framework

GUIDING CONSIDERATIONS FOR THE DEVELOPMENT OF THE CIRCULAR ECONOMY IN THE CONSTRUCTION SECTOR

1. The Circular Economy Act and Circular Economy Strategy provide the primary legislative and policy codes to support the circular economy transition in the Irish construction sector. Other areas can support the transition – including, inter alia, public procurement, planning and building control.

2. The design and construction of buildings is regulated under the Building Control Acts 1990 to 2014, in order to ensure the safety of people within the built environment.

3. The requirements of the Building Regulations are performance based with no requirement to use any particular technology. Technical Guidance Documents (TGDs) accompany each part of the Building Regulations indicating how the requirements of that part can be achieved in practice for common, non-complex buildings. Where the details in any given TGD are followed, this provides prima facia evidence of compliance with the relevant part of the Building Regulations. Alternative means of compliance are possible, but it will be the responsibility of the designer/builder/owner to ensure compliance.

4. Consideration should be given to the requirements of the Construction Products Regulation (CPR). Products which are harmonised under this regulation include the vast majority of construction products used in forming the fabric of a building (structural steel, timber, masonry, cement, aggregates, windows & doors etc). It is not possible for a member state to enact any requirements which exceed what is detailed in the harmonised product standards for these products. This could mean that product level Environmental Product Declarations (EPDs) cannot be made compulsory in Irish legislation or in public procurement.

5. The revision of the CPR is currently being negotiated by the European Commission, European Council and European Parliament. One of the drivers for the revision of this legislation is to allow for environmental characteristics to be a compulsory declaration, when a manufacturer is placing products on the European market.

6. In parallel, a technical review of the existing harmonised EN standards is being carried out in a process referred to as the CPR Acquis. The conclusion of this will see the European Commission issue updated mandates to the standardisation bodies to update/develop new product standards to take account of the requirements of the revised CPR. These revised product level standards may provide improved guidance in relation to the re-use of construction products, and detail the mandatory environmental characteristics which must be declared.

7. For the time being, there are no harmonised technical specifications that define essential characteristics under Basic Works Requirement No. 7. But the work in the CPR Acquis Process is progressing, meaning that we may rather soon see new standardisation requests providing the necessary basis for the definition of such essential characteristics related to environmental sustainability, both in new and revised harmonised technical specifications. It is of great importance that potential candidate Notified Bodies offer their expertise and insights to ensure that the future framework for the declaration of environmental sustainability of construction products will work in practice.

OUR VISION FOR THE BUILT ENVIRONMENT

Executive Summary: Our vision for the built environment
Our vision is a circular built environment in Ireland by 2050 where the built environment takes a Cradle-to-Cradle Life Cycle approach to:

- minimise its negative environmental impacts across its whole life cycle, from the extraction of raw materials to construction, use/occupation, repair/refurbishment, and finally to the demolition and/or recovery and disposal of end-of-life components and materials.

- maximise its positive environmental impacts across its whole life cycle such as enhancing ecosystems and biodiversity, through regenerative design that uses systems thinking to emulate natural processes (e.g., biomimicry).

IN THE SHORT-TERM (BY 2025)

For large projects over 1,000 square metres, planning authorities should stipulate a Circular Economy Planning Statement at planning stage covering circularity principles including design for adaptability, pre-demolition audit and design for disassembly. Planning authorities should pilot the use of Circular Economy Planning Statement on a range of projects from mid-2024 to inform the stipulation of a requirement from mid-2025 onwards.

The CERCS should ensure that circularity is embedded at the earlier phase in a development project including pre-planning, design or pre-demolition. Government should fully implement the recommendation set out in the Waste Action Plan for a Circular Economy (WAPCE) to bring C&D waste within the framework of statutory planning guidelines.

The CERCS should also support the use of pre-development feasibility studies to be carried out to assess feasibility of land and buildings reuse, provided clear justifications for any demolition works including lifecycle assessment of demolition materials and a design-phase resource and waste management plan, to drive built asset reuse and the creation of a market and availability of reuse materials for design, specification, and costing.

All relevant education offerings from upskilling CPD and apprenticeships to secondary school, undergraduate, and post graduate degrees will include core modules on circularity in addition to other areas of climate breakdown that allows multidisciplinary interconnectedness in the response of built environment professionals.

Each of the Construction Industry Council organisations, the RIAI, CIF, SCSI, ACEI, Engineers Ireland, and Building Materials Federation (BMF) to provide resources (e.g., using existing documentation such as the WGBC Circular Economy for the Built Environment Playbook and developing bespoke playbooks, toolkits etc for Ireland), and mandate circularity CPD for their members.

All relevant value chain actors involved in design, specification, procurement, and costing will have reviewed and updated their organisational strategies and business models to embed green procurement, including Life Cycle Analysis (LCA) and circularity in operations.

A clear chain of Qualified Resource Managers (RM) with expertise in waste and resource management on site to implement circularity throughout each phase who can work together i.e., design team champion working in collaboration with the construction site champion etc. These 'Champions' would have to undergo CPD or training to ensure a consistency of knowledge and competency across the value chain.

Established metrics, building on established circularity criteria, in place to be used to measure specific, measurable, and achievable goals for all building and infrastructure design proposals to feed into the statutory reuse reporting obligations. This will support the requirements of the Circular Economy sectoral roadmap provisions of the Circular Economy Act 2022 which states that such roadmaps shall have targets for reductions in material resource consumption, and increases in the use of re-usable products or materials.

In addition to harnessing existing funding from organisations such as EPA, the government, venture capital and philanthropic funds will work together with the Centres of Excellence (such as BuildDigital, Construct Innovate, Circular Economy Research Group, Build360 etc) to establish research and development funding for projects to advance circularity in design, spec, procurement & cost on topics such as lessons learned from other countries (e.g. Netherlands, Scandinavia), case studies on reuse of built assets and materials, new and innovative materials and technologies, digital delivery, etc.

Government to support research and development, testing, and timely certification of additional products and materials which have circular characteristics and/or low carbon (which may include, for example, straw, mycelium, hemp, timber) to increase their credibility and widespread use, and to give the sector confidence and assurance to design & specify these materials.

IN THE MEDIUM-TERM (BY 2030)

Obligations and requirements under the Government's Circular Economy Strategy (including CERCS) and Green Procurement strategy and action plan will be implemented within the required timeframe. Any requirements under the climate action plan relating to green procurement be actioned as required.

A review by the State, including by all relevant government departments and agencies, of the administration of regulations and standards to supports circularity, e.g., updating regulations or standards where relevant, or provision of additional funding for implementation e.g., to the EPA to deal promptly with applications for By-Product and End-of-waste decisions to allow for safe, legal, reuse of construction products and materials as well as supporting optimum use of local regenerative materials.

IN THE LONGER-TERM (BY 2050)

All actors involved in the design, specification, procurement, and costing of built environment projects will be fully conversant in the circular economy principles which underpin these guidelines and their practical application.

Policy, regulations, and standards will fully support circular design, specification, and costing, especially construction, maintenance, procurement, and financial regulations.

AUDIENCE AND AIMS

The report has two primary audiences:

- **practitioners and industry in undertaking their work;**
- **policymakers, particularly in DECC and those responsible for bringing forward the CERCS, to give them pointers to where policy reform or other supports are needed.**

The document also aims to describe the sector's ambitions for the move to Circular Economy best practice, and identify which stakeholders have a role in delivering this ambition. It is to set out the current position of the Irish construction industry as it now stands in relation to the adoption of Circular Economy practice for construction and demolition and identify the challenges to moving to a Circular Economy including the current policy context and what legislation/ policy has an impact on moving from "as is" to achieving the ambition. Finally, it is looking towards solutions, what further research is needed to assist harnessing these proposals, what policy reform is necessary and what can practitioners/industry and other stakeholders can do in the short term, medium term and long-term.

As set out above, it is intended that this document will be a key input to the development of the CERCS and will be followed by CircularBuild, an EPA-funded project, which aims at developing and designing the National Circular Built Environment Roadmap to 2040.

This report is set within a wide matrix of policy drivers – including legislation, regulations, voluntary guidelines, and statements of policy – which shape activity in the fields of construction and the built environment to bring benefits to the built environment including increased competitiveness, promotion of innovation, economic growth, and reduction in greenhouse gases.

The policy context of this report includes Ireland's international obligations, such as Ireland's commitments from the Paris Climate Agreement, and European policy instruments including (but not limited to) fields such as the European Green Deal, the European Circular Economy Action Plan, Fit for 55, the Waste Framework Directive, New European Bauhaus, Construction Products Regulation[10] and Eco design directive.[11]

The design, location, use, re-use, and occupation of our buildings, infrastructure and the built environment is driven by a domestic suite of legislation, regulation, policies, and statements under the remit of a range of departments. Further, a range of agencies across government are tasked with issues of environmental sustainability such as the delivery of the National Climate Action Plan 2023, the Waste Action Plan for a Circular Economy, the Whole of Government Circular Economy Strategy 2022 – 2023 'Living More, Using Less', national and regional development plans, the forthcoming National Waste Management Plan for a Circular Economy and the implementation of regulations on construction processes and manufacturing. Beyond these, environmental policies also affect wider plans and policies including, for example, Housing for All, the National Marine Planning Framework, the National Planning Framework, the National Energy Security Strategy, and the National Development Plan.

Ireland has a legally binding commitment to achieve a 51% reduction in GHG emissions by 2030.[12] Significant emission reduction opportunities can be achieved by extending the life of existing buildings – whether residential or commercial, or publicly owned and occupied buildings – by ensuring that existing buildings can be retrofitted to ensure their continued use.

Published in 2020, Ireland's national Long Term Renovation Strategy (LTRS) outlines Ireland's existing building renovation policies which are set out in a range of policy documents, most notably the Climate Action Plan and the National Energy and Climate Plan, which in turn were developed in line with the targets of the EU's Green Deal and Renovation Wave. Construction and Demolition Waste Management Protocol (guidelines on CDW management) and guidelines on pre-demolition audits are provided in the Directive. The circular transformation of the construction sector is covered under the Circular Economy Action Plan.

The EU also published an EU Construction & Demolition Waste Management Protocol in 2016[13] which aims to:

- Improved resource and waste identification, source separation and collection;
- Improved resource and waste logistics;
- Improved resource and waste processing;
- Quality management;
- Appropriate policy and framework conditions.

Best practices for Pre-demolition Audits ensuring high-quality Raw materials Project (PARADE) is a pre-demolition guidance package to provide a base for preparing individual member states protocols.[14] Pre-demolition audit basic principles guide was also produced by the PARADE project to assist practitioners with the process.[15]

The EU Waste Framework Directive (Directive 2008/98/EC) set the basic concepts and definitions related to waste management, such as definitions of waste, recycling, and recovery. It also included definitions for when waste ceases to

10 The European Green Deal Communication, the Circular Economy action plan and the Renovation Wave Communication highlighted the role of the CPR as part of efforts towards energy- and resource-efficient buildings and renovations, and in addressing the sustainability of construction products. The proposal for a revised Energy Performance of buildings Directive highlighted the importance of the life cycle GHG emissions of buildings and building materials to calculate the Global Warming Potential of new buildings as of 2030. Also, both the European Parliament and the Council have called for actions to promote circularity of construction products, to address barriers in the single market for construction products and contribute to the objectives of the European Green Deal and the Circular Economy action plan.

11 The European Green Deal Communication, the Circular Economy action plan and the Renovation Wave Communication highlighted the role of the CPR as part of efforts towards energy- and resource-efficient buildings and renovations, and in addressing the sustainability of construction products. The proposal for a revised Energy Performance of buildings Directive highlighted the importance of the life cycle GHG emissions of buildings and building materials to calculate the Global Warming Potential of new buildings as of 2030. Also, both the European Parliament and the Council have called for actions to promote circularity of construction products, to address barriers in the single market for construction products and contribute to the objectives of the European Green Deal and the Circular Economy action plan.

12 Ireland's Long-term Strategy on Greenhouse Gas Emissions Reduction: https://assets.gov.ie/255743/35b2ae1b-effe-48af-aaf3-156dc5b01ee6.pdf

13 EU Construction & Demolition Waste Management Protocol: https://ec.europa.eu/docsroom/documents/20509/attachments/1/translations/en/renditions/native

14 https://single-market-economy.ec.europa.eu/news/eu-construction-and-demolition-waste-protocol-2018-09-18_en

15 https://www.europeandemolition.org/communication/news/the-parade-project-presented-the-report-pre-demolition-audit-basic-principles

be waste and becomes a secondary raw material (end-of-waste criteria) and how to distinguish between waste and by-product. The Directive, enacted in Ireland under the Waste Directive Regulations 2011 (S.I. No. 126 of 2011), requires Member States to apply the waste hierarchy to keep materials out of the waste stream, promote reuse and preparation for reuse activities, and establish resource and waste management planning procedures to track material flows and rates.

The policy context for reform

The next iteration of the Whole-of-Government Circular Economy Strategy (due for publication by end-2023) will include sectoral targets in relation to Construction and Demolition (C&D) Waste, set out in detail in the CERCS.

The Climate Action Plan 2023 targets a significant reduction in embodied emissions in the built environment and achieving net zero carbon. Circular construction will be a necessary element to help achieve these objectives.

The current Programme for Government states that "we will mandate the inclusion of green criteria in all procurements using public funds, to be completed within 36 months." In pursuance of the Programme for Government commitment, DECC published a draft GPP Strategy and Action Plan for public consultation in September 2023, and will be publishing the final version in Q1 2024.

Reducing the material footprint of the built environment and reducing levels of construction and demolition resource and waste would directly support both SDG 11. 'Make cities and human settlements inclusive, safe, resilient and sustainable' and SDG 12. 'Ensure sustainable consumption and production pattern'. A goal of this report is to stimulate a sector and stakeholder specific roadmap (or series of roadmaps) to achieving the Sustainable Development Goals (in light of the most recent available science) for built environment professionals.

Further development of the EU Taxonomy in relation to Circular Economy will incentivise investment in circular construction. Domestically, NSAI has published a collection of Standard Recommendations to guide the efforts of professionals in the retrofit sector including for heat pump systems, conventional water-based heating systems, thermal solar systems and solar photovoltaic micro-generators for dwellings.

In line with the 2020 Circular Economy Action Plan,[16] the European Commission will propose minimum mandatory Green Public Procurement (GPP) criteria and targets in sectoral legislation and phase in compulsory reporting to monitor the uptake of GPP. In terms of EU sectoral legislation, the Construction Products Regulation support and require increased application of circular construction. The EPA plans to update and expand its Office Buildings criteria set once the EU criteria have been published.

Transport Infrastructure Ireland (TII)s purpose is to provide sustainable transport infrastructure and services, delivering a better quality of life, supporting economic growth and respecting the environment. TII published its Circular Economy Policy and Strategy in September 2023. These are a means of implementing circular principles to achieve TIIs Statement of Strategy goals, with a particular focus on the following goals:

*"**Existing Infrastructure** - Operate, maintain and extend the life of national roads and light railway infrastructure to ensure the safety and efficiency of our transport networks, ensure appropriate management of environmental resources and contribute to the transition to a low- carbon and climate-resilient society.*

***New Infrastructure** - Deliver national road, light railway, metro and Active Travel infrastructure, contributing to compact growth, sustainable mobility, enhanced regional accessibility and the transition to a low-carbon future.*

16 European Commission, Circular economy action plan, https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

Services *- Operate TII's light rail, tolling and traffic control systems and contribute to the electrification and digitalisation of transport, benefiting our customers and contributing to sustainable mobility and decarbonisation of transport."* [17]

TII projects under the National Development Plan 2021-2030 will also play an important role in achieving national carbon reduction targets. TII has published over 500 technical standards for road, light rail and greenway construction and operation in Ireland. These are being updated as part of implementation of TIIs Circular Economy policy and strategy including increased use of recycled content and warm mix asphalt in lieu of hot mixes, thereby significantly reducing carbon during production and from road users. [18]

[17] Transport Infrastructure Ireland, https://www.tii.ie/sustainability/

[18] TII Publications technical documentation relating to National Road, Greenway and Light Rail schemes: https://www.tiipublications.ie/

BAGGOT PLAZA

Full Refurbishment and Extension of 1970s Office Building

Location
Baggot Street, Dublin 2

Architects
RKD Architects

Date
2013-2016

Area
17,000 sq m

BAGGOT PLAZA

Full Refurbishment and Extension of 1970s Office Building

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Date
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Area
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1.

2.

Originally constructed in the 1970s as an 8,500 sq m three -block office building over six-seven storeys, Baggot Plaza is in a prime location close to Dublin's Grand Canal commercial district.

The client sought to thoroughly modernise the building through refurbishment and extension. RKD Architects developed a design which included retaining the original structural concrete frame, floors and cores and extending the building to increase the building's floor area to 17,000 sq m, for which planning permission was granted in March 2015. RKD led a multidisciplinary design team to deliver this complex redevelopment project in budget and on time within a challenging 15-month construction schedule. The main contractor for the construction works was John Sisk and Son.

3.

The redevelopment kept the shell and core of the original building with its three- block arrangement. The existing concrete structure was retained and extended, with flexible design proposals adapting to the constraints of a mass concrete frame. The entire building was re-clad externally with the introduction of red sandstone to the primary Baggot Street elevation and coloured horizontal tile cladding to the remaining façades.

The re-use of the existing structure was marginal due to the existing floor-to-floor height of 3.37 metres. However, because it was possible to remove a 100mm screed on all floors and replace this with a raised access floor system and, through careful planning of air conditioning and other services above ceiling level, a successful transformation of the building was

1. Baggot Street façade - Original building prior to refurbishment. Image: RKD Architects

2. Baggot Street façade - Building after completion of refurbishment Image: RKD Architects

3. Retained concrete superstructure and cores. Image source: John Sisk and Son

BAGGOT PLAZA

achieved. It was possible to reuse existing stairwells as they still complied with current Building Regulations requirements.

Numerous office buildings constructed from the 1960s to the early 1980s are, however, not suitable for refurbishment due to floor-to-floor heights that cannot accommodate current service requirements, and many have been demolished.

Cost studies carried out at design stage by the project quantity surveyors demonstrated a budget saving of approximately 40% of the capital cost by proceeding with the refurbishment option rather than a full demolition and new build option.

Design modifications enabled the connection of the two building entrances from Baggot Street and Fleming Place. These entrances were then connected via a new internal 'street', which in turn connects each of the three existing blocks and provides opportunities for future multi- tenancy within the building if required. In June 2016, the entire building was handed over to the tenant on a 25-year lease. In January 2017 the project achieved LEED Gold certification.

4. Retained columns, beams, and floor slabs with screed to be removed
Image source: John Sisk and Son

5. Fleming Place façade - Building after completion of refurbishment
Image: RKD Architects

ECONOMIC RATIONALE FOR CIRCULAR ECONOMY PRINCIPLES IN CONSTRUCTION

Prepared by KPMG Future Analytics.

"There is only one planet Earth, yet by 2050, the world will be consuming as if there were three."

"Greenhouse gas emissions from material extraction, manufacturing of construction products, construction and renovation of buildings are estimated at 5-12% of total national GHG [greenhouse gas] emissions. Greater material efficiency could save 80% of those emissions." [19]

Ireland's construction sector has a role to play in combatting the global climate emergency. With responsibility for almost two thirds of Ireland's waste tonnage in 2021, it is vital that construction and demolition transition from a linear "take make waste" economic model to a circular approach, where materials are reused and upcycled to reduce our reliance on raw material extraction.

The construction sector must pay a substantial upfront cost to transition from a linear to a circular approach. The long-term financial, economic, and social benefits of that transition will make that initial cost well worth paying.

Where are we now?

Ireland generated 9 million tonnes of construction & demolition (C&D) waste in 2021, almost two thirds of all waste produced in Ireland.[20] This represents a 10% increase from the 8.2 million tonnes created in 2020, a figure suppressed by the impact of the pandemic. As Ireland continues to work towards its strategic infrastructure and housing development ambitions, there is a risk that the amount of waste generation continues to grow.

[19] A new Circular Economy Action Plan, European Commission, 2020

[20] https://www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics/construction--demolition/

The good news is that 93% of this waste is reused or recycled in some way, according to statistics compiled by the Environmental Protection Agency. However, there is plenty more to do. The construction industry must work to reduce the volume of waste it creates in the first place through changes to design and fabrication processes. There is also the challenge of treating and separating the more than 600,000 tonnes of C&D waste that ends up in landfill.

Benefits of becoming circular

Taking the construction sector from a linear economic model of "take make waste" to a circular model brings with it a range of benefits to the construction sector itself and to the wider economy. These benefits include reductions in materials costs and supply chain risks, lower maintenance costs for occupiers, and less damage to the natural environment.

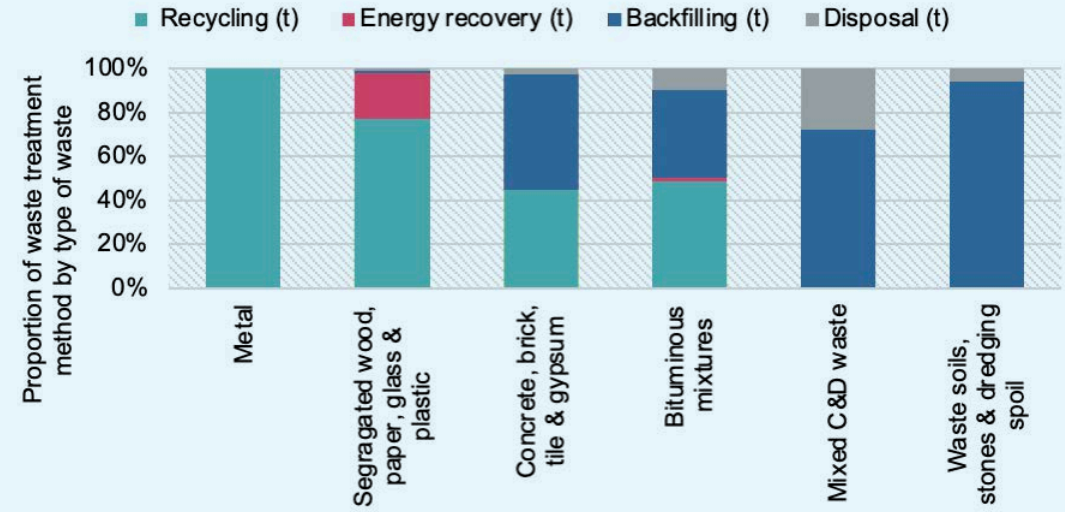
Benefits to construction industry

Transitioning to circular economy principles will help the construction industry produce less waste. With less waste, construction firms will need to buy fewer materials and components. This will lead to a reduction in materials costs and in the cost of delivering and storing those materials, as well as lower costs for transporting and processing waste.

By reducing the volume of material used, the construction sector can also reduce the amount of greenhouse gases it emits, a key objective for the sector as Ireland works towards its Net Zero ambitions.

For example, aluminium building facades can be recovered and recycled. Recycled aluminium requires 95% less energy to produce than the same mass of virgin aluminium, with a corresponding reduction in CO2 emissions from energy generation.[23]

Quantity of C&D waste managed in Ireland compared with CSO construction index [21]



Waste treatment method by type of C&D waste [22]

[21] https://www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics/construction--demolition/

[22] Image source: KPMG

[23] https://recycling.world-aluminium.org/review/sustainability/

The transition to a circular economy will also bring greater resilience to the supply chain. As things stand, construction firms face risks when acquiring materials. There may be disruption at extraction sites, for example due to poor weather or labour disputes. Any number of issues can delay global shipping, from a global pandemic to a container ship blocking the Suez Canal. And political changes can make it more challenging or more expensive to import materials from other countries.

By contrast, moving towards circular economy practices will help the construction industry keep control of its own supply chain. Materials and components can be reused and recycled within Ireland, bypassing the risk inherent in importing from overseas. This will contribute towards greater supply chain and pricing certainty for construction firms.

Benefits to others

As well as benefiting the construction industry, transitioning to a circular construction economy will bring benefits to the wider economy.

Firstly, by reducing the rate at which we extract non-renewable natural resources such as clay, sand, and stone, the construction industry can reduce the disruption it causes to the landscape and habitat, helping to limit biodiversity loss.

Secondly, by designing buildings to extend their useful life, construction firms can reduce repair, maintenance, and moving costs for occupiers. If we design buildings to be flexible, they can accommodate a range of different uses, rather than falling vacant should there be a fall in demand for their specific purpose.

Finally, moving to a more circular economy will require substantial innovation in building design, production, and disassembly processes. This innovation will help to boost economic growth and create jobs in sectors such as manufacturing, recycling, and waste. For example, research by Tellus in the US [24] shows that waste disposal generates only 0.1 jobs per 1,000 tonnes, while recycling processing creates two jobs per 1,000 tonnes.

Costs of becoming circular

While there are many benefits of moving to a more circular construction industry, the transition brings with it many costs too.

The buildings we construct today simply were not designed with circularity in mind. Redesigning buildings to use recovered components or recycled materials, for greater flexibility in use, and for straightforward disassembly requires significant upfront investment in design and testing.

There will also be costs associated with the transportation, processing, and storage of reusable components or recyclable materials. The construction sector will have to invest in solutions for retrieving valuable components from demolition sites, processing those materials, and storing them until they can be used.

By contrast, it is important to note the cost of doing nothing. If the construction sector retains its current “extract, use, dispose” model, it will face rising and uncertain materials costs as we deplete the earth’s natural resources. Construction firms will continue to pay for components and materials than end up wasted due to inefficient design. And there will be costs to the environment, as resource extraction impinges on natural landscapes and habitats.

[24] Tellus, More Jobs, Less Pollution - Growing the Recycle Economy in the US, 2013

Cost/benefit comparison

The transitional costs of moving from a linear to a circular construction sector will be significant. However, over the longer term, the financial, economic, and social benefits from making these changes will outweigh those costs.

It is important for the construction sector to take a long-term view. The cost to move to a circular construction sector is high, but the cost of doing nothing and the forgone benefits if the sector does not act swiftly is higher still. With the benefits of becoming circular accumulating every year, the sooner the industry changes the better.

Global context

It is important that the Irish construction sector takes steps to become more circular. It is also important that Irish firms remain competitive, particularly in comparison to overseas firms. If Irish firms invest in becoming more circular while overseas firms do not, there is a risk that they become less financially competitive. It is critical that regulatory requirements for circularity are applied equally stringently to firms based overseas as they are to indigenous companies. The EU Construction Products Regulation goes some way to addressing this, applying the same requirements equally across the EU.

It is also vital that Ireland develops the capacity to extract valuable components and materials from the demolition process domestically, rather than outsourcing the process to other countries. At present, 96% of C&D waste undergoes final treatment in Ireland with just 4% exported abroad. Maintaining or improving this ratio is important both for reducing transport emissions and for ensuring Ireland benefits from the value extracted from these materials.

Conclusion

The construction sector must pay substantial upfront costs to transition from a linear to a circular approach, including a complete change in the philosophy of how we design and construct buildings.

However, the long-term benefits of this transition are substantial and widespread. Moving to a circular construction economy will reduce materials costs as businesses waste less of what they buy. It will contribute to greater resilience and certainty for construction firms, as they retain greater control over the supply chain and their materials costs. Finally, it will bring environmental benefits as we reduce the negative impact that resource extraction has on Ireland's natural landscape and biodiversity.

What is our vision for circularity?

A useful and detailed definition of the circular economy has been provided by the Ellen MacArthur Foundation:

"A systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution. It is based on three principles, driven by design: eliminate waste and pollution, circulate products and materials (at their highest value), and regenerate nature. It is underpinned by a transition to renewable energy and materials.

Transitioning to a circular economy entails decoupling economic activity from the consumption of finite resources. This represents a systemic shift that builds long-term resilience, generates business and economic opportunities, and provides environmental and societal benefits." [25]

What is a circular economy in the built environment?

According to the EPA, in the circular economy system, we use less raw material, we design products for long-life and recyclability, we share products, we use them for longer and we reuse and repair things before we recycle or throw them away.[26] The European Parliament further describes a circular economy as: "a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended. In practice, it implies reducing waste to a minimum. When a product reaches the end of its life, its materials are kept within the economy wherever possible. These can be productively used again and again, thereby creating further value." [27]

A circular economy is a systemic approach to economic development designed to benefit businesses, society, and the environment. In contrast to the "take make waste" linear economy, a circular economy is based on three principles i.e. (1) to design out waste and pollution, (2) keeping the products and materials in use at the highest value level possible, and, (3) to regenerate natural systems.[28]

A circular economy for buildings, infrastructure and the built environment can be characterised by two broad principles:

1. Making our existing building and infrastructure stock more circular, through renovation, adaptation etc. In simple terms maximising the existing asset value and extending the functional life;
2. Designing new buildings and infrastructure to be as circular as possible.

This is achieved as follows: [29]

- The smaller the loop (activity-wise and geographically), the more profitable and resource efficient it is.
- Loops have no beginning and no end.
- The speed of the circular flows is crucial: The efficiency of managing stock in the circular economy increases with a decreasing flow speed.
- Continued ownership is cost-effective: Reuse, repair and remanufacture without a change of ownership saves double transaction.
- A circular economy needs functioning markets.

[25] EMF, Finding a Common Language – The Circular Economy Glossary https://ellenmacarthurfoundation.org/news/finding-a-common-language-circular-economy-glossary-launched

[26] EPA Ireland, "What is the circular economy?" https://www.epa.ie/environment-and-you/circular-economy/

[27] European Parliament, "Circular economy: definition, importance and benefits" May 2023 https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits

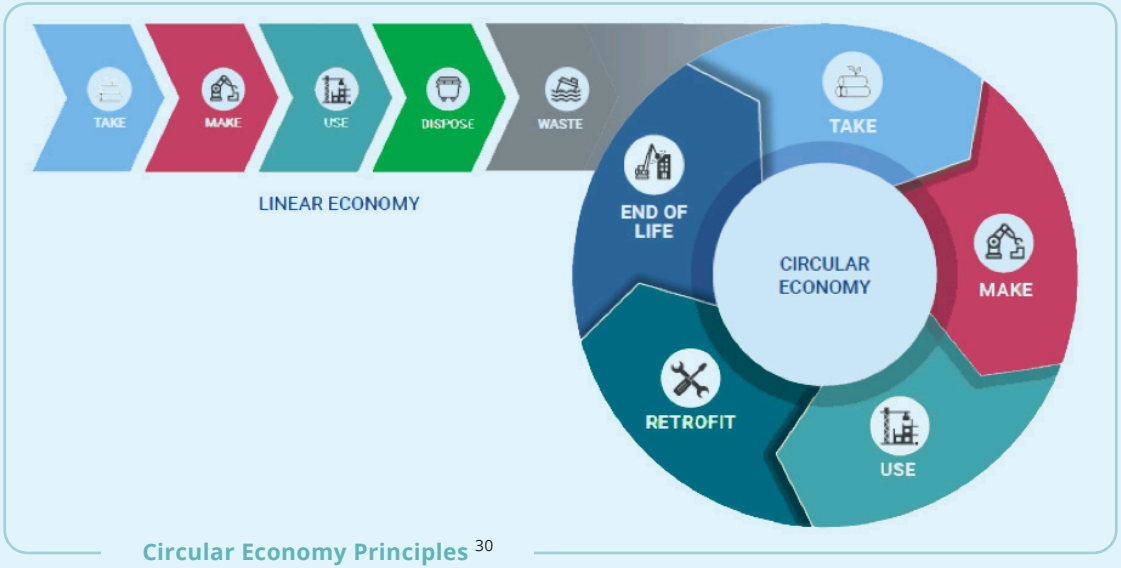
[28] Ellen Mac Arthur Foundation, "What is a Circular Economy?" https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview.

[29] McDonough.com, "Cradle to Cradle," William McDonough & Michael Braungart, 2002. https://mcdonough.com/cradle-to-cradle/

The construction and built environment should be stewarded by well-trained network of professionals working within a supportive policy and regulatory environment to design out waste, and build zero-waste buildings and infrastructure that are sensibly located and designed in a manner to deal with increased climatic/weather variability such as increased rainfall or extreme wind levels, that perfectly serve their purpose, that are flexible, adaptable and durable and that enhance the lives and experiences of those that use them and the nature environment. In constructing them we must make considered material choices to reuse for as long as possible materials and components, to use renewable materials and energy to allow for environmental sustainability and to design out and to reduce raw material resources, reduce consumption and prevent waste from design stage. Examining life cycles may make recirculation easier, ensure minimal loss of material resources and maximise the overall number of use-lives for any given material, including potentially indefinite reuse.

Embracing circular principles means resources are kept in use for as long as possible, creating a closed-loop system that minimises waste and maximizes the value of resources, so that that future construction and infrastructure activities and materials we choose are re-usable, repairable and recyclable. The selected resources and materials should remove toxicity from our built environment, minimise import of materials, focus on locally sourced materials and use reversable connections between buildings, infrastructure and the built environment to facilitate reuse.

Cascading is another key principle of the circular economy and its subset - the bioeconomy. Cascading opens up the possibility of future life phases in different sectors which could be at a higher value, treating materials as an asset which could produce revenue when no longer viable within the sector e.g., pulp and furniture.



Circular Economy Principles [30]

All stakeholders should fully embrace circular design processes and procurement at the earliest possible stage of the design of any building, infrastructure or built environment construction project. The Government of Ireland, as the country's largest construction client should seek to use the widest range of policy and regulatory options available to it. These include public procurement, waste and circular economy regulation, the planning system, and building standards. Circularity should influence all the stages of the life cycle, from tendering through procurement, design, planning, building, maintenance, use and re-use.

These principles should extend through the life of all design and construction activity through designing for circular use, retrofitting and renovations. An example of small changes which can easily be implemented is for stacking or packaging materials from deliveries to site, such as pallets, remain the responsibility of the producer as an incentive for them to adopt a more circular approach, including, for example, reusable pallets that they collect and re-use multiple times.

30 WGBC, "The Circular Built Environment Playbook," 2023. https://worldgbc.org/article/circular-built-environment-playbook/

MIESIAN PLAZA

Refurbishment and Extension of 1960s and 1970s Office Buildings

Location
50-58 Baggot Street, Dublin 2

Architects
STW Architects

Date
2013-2018

Area
21,800 sq m

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Area
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The complex of three office buildings on Baggot Street is a Dublin Landmark recognised, as much for their transition from Georgian Dublin to higher development as for their international flair.

Designed between 1968 – 1972 and 1973 – 1975 by Ronald Tallon of Scott Tallon Walker Architects as a high-end corporate headquarters, the complex is now refurbished to provide Grade A office accommodation of the highest modern standard.

With its superbly crafted solid bronze cladding and curtain wall glazing, the buildings are unique to Dublin City. The central public Plaza unifies the development and creates an all too rare sense of place on Baggot Street. The building is listed on the Dublin City Council Record of Protected Structures.

The retrofit of existing office building stock is crucial to achieving carbon emissions reduction goals while also preserving the cultural value of our mid-century modern building heritage.

The redevelopment provides ultra-modern buildings with flexible, Grade A office accommodation that are energy efficient and have the highest sustainability credentials.

The project has been awarded a LEED Platinum Rating v4 for the building Core & Shell works, the first building to receive this accreditation in Ireland and only the 11th in Europe. The US Green Building Council took a particular interest in the project as an example of how to successfully refurbish iconic modern movement buildings.

The single most effective energy conservation method employed in Miesian Plaza was the decision to upgrade the façade's thermal performance, all while maintaining the existing aesthetic. Additional design features included green roofs, rainwater reuse, reclaimed heat energy, sustainable material use, and smart-building technologies.

The development provides 28,000m2 gross internal area, including basements and 20,345m2 or 219,000 sq. ft. of total net lettable accommodation.

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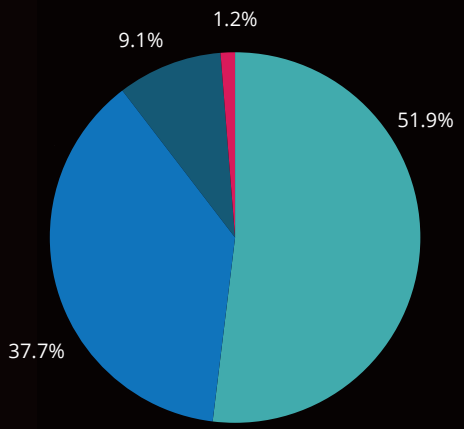
1. Bank of Ireland - Original buildings before refurbishment

2. Miesian Plaza - Buildings after completion of refurbishment
Images: STW Architects

MIESIAN PLAZA



Retrofitting an existing building meant that embodied carbon associated with constructing a new structure could be avoided. Retaining the concrete structure saved an estimated 5,955 tonnes of embodied carbon. (213 kgCO2e/ m2)

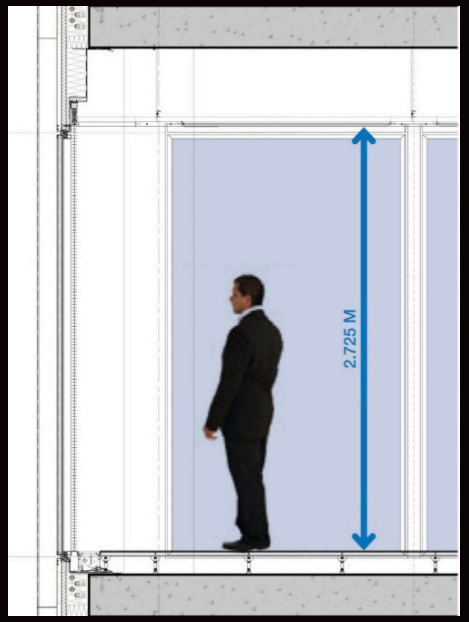
The existing acceptable floor-to-floor heights and the possibility of removal of the non-structural 100mm screed on all floors allowed for a successful transformation of the building and the introduction of raised access floors.

The necessary interventions included accommodation of the larger stairs and an increased number of lifts and sanitary facilities to meet the current standards. However, these modifications were limited to a minimum. The retained part of the fabric of each block was propped with temporary steelwork during the deconstruction.

The largest of the three blocks was extended by one bay (80m long by 6.5m deep) along the length of the building to the northeast. The building's façade on this elevation was carefully removed, refurbished, and reinstated in its new location.

Remodelling of the existing bronze façades was a key driver in achieving the environmental goals. All the panels were disassembled by the curtain wall and asbestos specialists, who encapsulated and removed the exposed harmful substances. The frames were then bar-coded and transported to a workshop in Architectural Aluminium Factory, where the glazing was taken out, the frames cleaned from the remaining Asbestos Containing Materials (ACMs), shot-blasted and repatinated.

A restored, thermally broken system with new high-performance double glazing incorporating a solar control coating and



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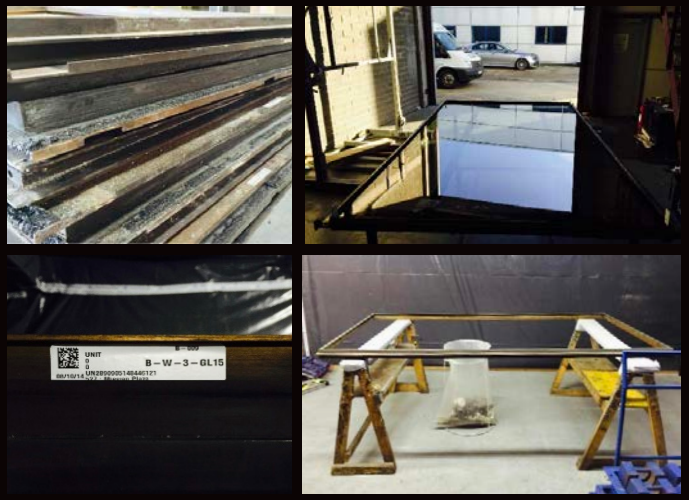
3. The existing acceptable floor-to-floor heights

4. Retained concrete structure during the removal of non-structural screed.
Images: STW Architects

MIESIAN PLAZA

internal motorised blinds were installed back on the facade. These changes dramatically enhanced energy efficiency while preserving the building's architectural character.

In addition to retaining the existing structure, some finishes, such as granite, were reused internally and for the plaza paving. Circularity was prioritised during demolition, with over 75% of waste diverted from landfill.



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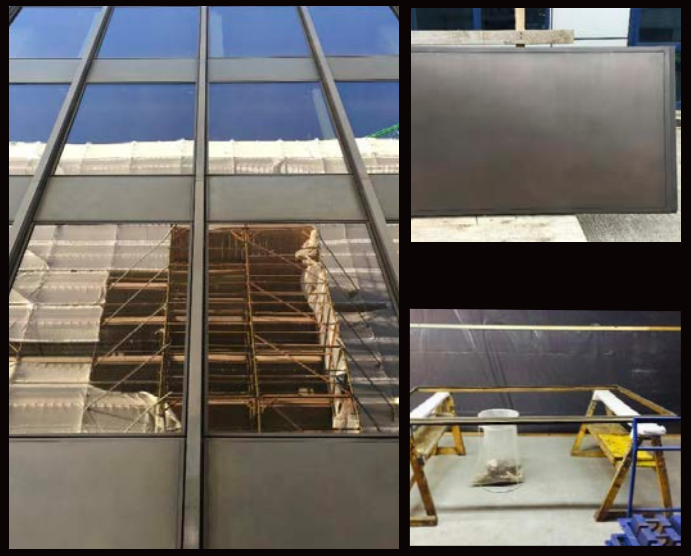

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5. Façade during renovation

6. Façade during renovation

7. Façade after renovation

8. Selection and matching of reclaimed stone slabs

9. Segregation of materials

Images: STW Architects

MIESIAN PLAZA

The refurbishment project demonstrates a successful conversion of a 1970s iconic modern building into a Grade A 21st Century office with the highest sustainable credentials.

By adapting and restoring the mid-century structures, STW created a future-proof design that maintains and preserves the architectural heritage of the city.

10. Baggot Street façades - Building after completion of refurbishment
Image: STW Architects

DESIGN FOR CIRCULARITY

Design is creation with intention: Everything that surrounds us has been designed by someone: the clothes we wear, the buildings we live in, even the way we get our food. The Montreal Design Declaration defines design as "the application of intent: the process through which we create the material, spatial, visual and experiential environments in a world made ever more malleable by advances in technology and materials, and increasingly vulnerable to the effects of unleashed global development." [31]

Put another way, design is the way we create products, services, and systems, and is the mechanism by which we shape the material environment around us to meet our needs and desires.

Crucially, when something is designed, important decisions are made that impact how it is manufactured, how it is used, and what happens when it is no longer needed or wanted. It is exceedingly difficult to go back and undo the effects of those decisions if they are later found to produce undesirable consequences.

The Whole of Government Circular Economy Strategy 2022 - 2023 Living More, Using Less report commits to significantly reduce Ireland's circularity gap, in both absolute terms and in comparison, with other EU Member States, so that Ireland's circularity rate is above the EU average by 2030.[32]

What does embedding circular economy principles in the built environment do?

IMPROVES	REDUCES
Keeping products, materials, components, and buildings in use, at their highest or optimum value, for as long as possible.	Harm to the natural environment, atmosphere, biodiversity, habitats, flora, and fauna. Generation of waste in construction and demolition.
Circular business models e.g., reuse, sharing, remanufacturing, leasing, take-back, product-as-a-service etc.	Use and extraction of raw virgin materials, generation of waste in construction and demolition.
By-product opportunities for construction and demolition residual resources.	Generation of waste in construction and demolition.
Recycling/recovery of construction waste into secondary products.	Use and extraction of raw virgin materials.
Circular design tools and resources.	Green House Gas (GHG) emissions that cause climate change.
Design in layers (Shearing/Brand model: Site, Structure, Skin, Service, Space, Stuff).	Other harmful chemicals & gasses e.g., ozone depleting, per- and poly-fluoroalkylated substances (PFAS), etc.
EU Level(s) Macro Objective 2: Resource efficient and circular material life cycles.	Consumption (and wasting) of materials, energy, and potable water.
Lessons learned from other countries, research, and organisations.	Generation of waste in construction, operation, and demolition.
Circular design and specification principles.	Use of hybrids and composites materials that are inseparable at end-of-life, particularly where technical or synthetic materials have been combined with biological materials.

[31] Design Declaration, "Montreal Design Declaration," Design Declaration Summit, 2017. http://www.designdeclaration.org/declaration/.

[32] Whole of Government Circular Economy Strategy 2022 – 2023 'Living More, Using Less' https://www.gov.ie/en/publication/b542d-whole-of-government-circular-economy-strategy-2022-2023-living-more-using-less/

Where are we now? Challenges to the delivery of our vision

EDUCATION AND TRAINING

The need to change behaviours within those currently working in the sector through workplace training and education to ensure applied understanding of these principles.

BIM (Building Information Modelling), circularity, and sustainable design need to be fully embedded into all third-level education for architecture, engineering, construction, buildings and infrastructure operations and maintenance, and cost management students (all levels) so there is currently a lack of mandatory education curricula in these critical topics for all third-level students studying in these sectors. While there is some knowledge, expertise, and awareness across personnel in the built environment on issues such as BIM, circularity and sustainable design there remains a lack of mandatory CPD programmes for current professionals.

Significant variability exists in the system and future built environment professionals will need to prepare for the possibility that their working assumptions (such as those underpinning weather modelling) will likely change more across the lifetime of a building than for previous generations of built environment professionals.

There is a wide misconception in industry that circularity is only about recycling, e.g. recovering and re-using aggregates rather than a more fundamental way of design thinking and change to business models.

Due to the relative lack of applied circularity experience, there may be a challenge in finding sufficiently qualified and experienced people to teach both students and professionals in the short-term.

The current pace of new standards, and policy and guidance change for practitioners can be overwhelming and there is a need for structured CPD education on these topics to support them.

REGULATION AND STANDARDS

Many pieces of legislation and technical guidance documents do not yet include principles of circular design and sustainability. The complexity of updating these policies is made difficult as policy ownership is split across government departments and agencies, and there is a need for industry to work with government to embed circular economy principles across policy as a matter of urgency.

Policy and regulation should reflect the fact that all new buildings and infrastructure should be designed with adaptability/circularity at their core.

Incremental change of standards, policies, product and sustainability certification and guidance to reflect circularity, sustainability and other issues can create unique difficulty for designers and specifiers of materials and components, and all stakeholder practitioners, in the sector. As a result, greater participation is required by stakeholders from the circular economy in the development of standards.

The lack of knowledge and research into new or innovative materials, such as suspended floor tiles, precast flooring etc. needs to be addressed, and technology and products 'de-risked' prior to certification, to increase the range of options for designers and specifiers.

General application of the WFD and Waste Management Act, and by-product and end-of-waste application bottlenecks.

Existing operation of standards may, in some cases preclude some recycled and reused materials and components due to concerns about potential lower quality, wear and tear, poor construction and maintenance performance.

Until recently, generally a lack of Circular Economy legislation and supporting statutory strategies or roadmaps to actively encourage circularity along with lack of penalties and incentives which encourage and favour circularity.

Use of other regulatory or legislative codes (as listed above) to drive circular practices in the construction sector.

Where are we now? Challenges to the delivery of our vision

VALUE CHAIN

There is a lack of knowledge, understanding and often unwillingness amongst design teams and clients about how best to integrate circularity into design and responsibility is often overlooked or pushed onto the incorrect team.

Contractors are generally not involved in the design process early enough to support the construction projects' sustainability objectives and provide expertise in buildability, disassembly, deconstruction, and innovation in design.

There is a need to change the culture of design for demolition. Clients, design teams, contractors and the supply chain should all be supported to deconstruct carefully for reuse at highest value particularly through the procurement process. The development of the CERCS by DECC will be an important opportunity for effecting this cultural change.

There can be serious difficulty in justifying reuse of retained structures and cores of existing buildings as a viable design option due to non-compliance of materials, components and dimensions with current standards and regulations.

Clients will need to become the prime driver of what is considered of value and to direct the work carried out by the contractor, placing a greater value on disassembly as opposed to demolition and reuse of materials and assemblies, utilising best practices to incentivise stakeholders.

Limited incentives exist where quality of materials or existing building environment are fully considered which leads to a mindset of freely discarding materials at construction and demolition stages without assessing the quality of the materials.

There is little or no physical infrastructure (buildings, yards, depots) and an almost complete absence of takeback schemes in Ireland to collect, provide information on available stock, store and process materials and products for a circular construction economy and a corresponding lack of volume of product to support business to develop in this area meaning that circular design and specification options are extremely limited. The CERCS should examine policy options for creating supportive market conditions for this.

Circular design and construction, ideally requires material and component production to be adjacent to construction locations and there is a current very significant lack of manufacturing or extraction facilities for circular production in Ireland.

Manufacturers and suppliers do not currently provide enough data to allow people to procure and specify based on circular criteria.

Increasing demand for product data and certification will incur significant financial costs on the manufacturing and supply chain for investment in new facilities, equipment, systems training, R&D, design and product certification to provide products.

The design, specification and presentation of most components and assemblies are not currently aligned with circular economy principles.

Very fragmented silos in the value chain - there is a lack of cohesive strategies and frameworks that facilitate effective collaboration, hindering the seamless integration of circular principles throughout the value chain.

Component and assembly manufacturers, suppliers and producers generally do not currently have a full understanding of the benefits which circular thinking can provide for their business.

Some fears exist that the circular economy sourced materials and components may be unsafe and not long lasting because materials have been subject to wear and tear in their previous life and are less resilient and durable and not compliant with current standards.

DIGITAL DELIVERY

Lack of good quality asset data for buildings and built environment which by using digital systems and skills, seriously impedes meaningful life cycle assessments as part of the design and specification process.

Centralisation of re-use data does not exist to be enabled by BIM or other digital asset platforms to provide timely information to designers and specifiers.

There is a lack of good quality data across all aspects of the Irish built environment, from road and rail infrastructure to town planning to material and component availability, to circular economy design. There is an opportunity for this to be comprehensively developed through the use of BIM or other digital asset platforms.

OPERA SQUARE

Regeneration of a site within the city centre that has been vacant for decades into a modern day world class mixed-use development.

Location
Limerick City

Area
48,709 sq m

OPERA SQUARE

Regeneration of a site within the city centre that has been vacant for decades into a modern day world class mixed-use development.

Location
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Area
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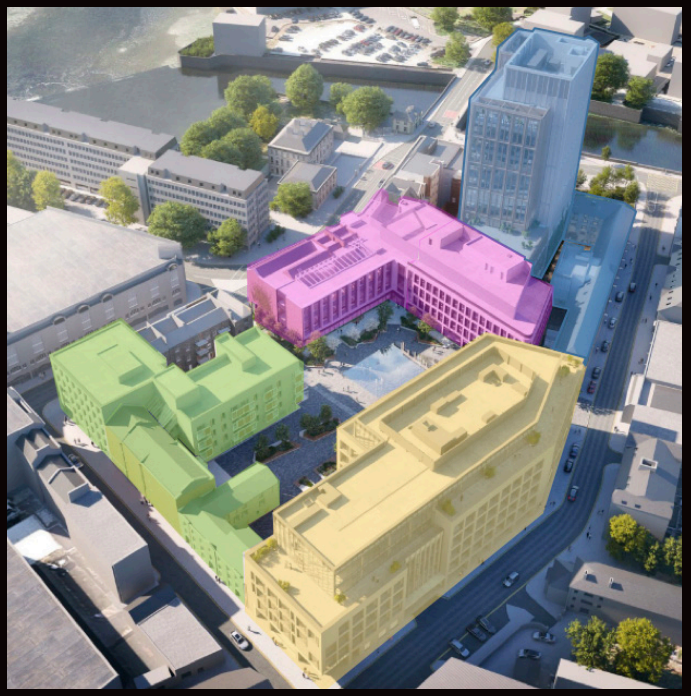
The Opera Site is a brownfield site located in the heart of Limerick City Centre in the functional area of Limerick City and County Council.

The project is key strategic project as part of the Limerick 2030 Vision: An Economic and Spatial Plan for Limerick. As such a key objective of the project is the restoration and regeneration of a site within the city centre that has been vacant for decades into a modern day world class mixed-use development.

The project is under development by Limerick Twenty Thirty DAC (LTT), a dynamic property development company established as a special purpose vehicle of Limerick City and County Council. The project value is estimated at €300m providing 500 construction jobs during development and 2,500 jobs during operation.



1.

The development consists of the following specific Parcels:

- One Opera Square, which is a 14,000m2 6-storey office, retail and restaurant;
- Hotel, which is 4,700m2 consisting of 110 rooms, a restaurant;
- A new 4,410m2 City Library, living room and café;
- Four Opera Square, which is a 2,580m2 5- storey office (flexspace);
- Parcel 3B: 6 * 1 bedroom Georgian apartments and retail;
- 14-storey Landmark office building of 12,300m2;
- Refurbishment of the Granary (2,715m2) into offices and a restaurant;
- 8,000m2 basement for 155 car spaces and 495 bike spaces;
- New public realm space for the City Centre of 5,700m2, complete with a Mirror Pool – Iconic Feature.

Circular/Sustainability Initiatives in bullet points.
Demolition and Enabling Contract:

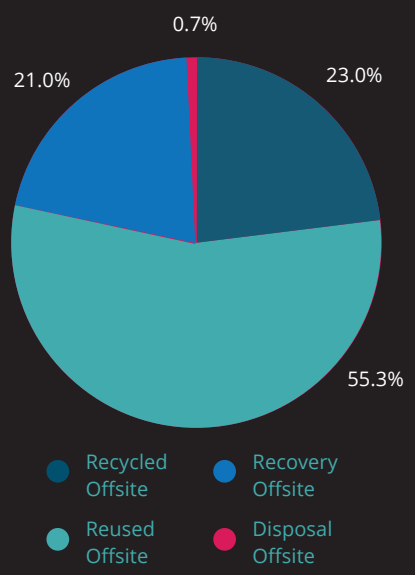
- LTT in collaboration with Atlantic Technological University (ATU) and Regional Waste Management Planning Office - Southern (RWMPO-Southern) appointed RPS to undertake a Pre-Demolition Audit, the largest of its kind ever undertaken in Ireland.
- Pre-Demolition audit identified quantities of material available for reuse throughout the project.
- Sisk as main contractor segregated items for reuse both onsite and offsite as per image below.

2.

1. The development consists of specific Parcels.

2. The main contractor segregated items for reuse both onsite and offsite
Image source: Limerick Twenty Thirty

OPERA SQUARE



Results

- 99.3% of all construction and demolition material was diverted from landfill.
- Onsite recovery (15,000 tonnes): classification of crushed concrete material as 6F2 for future haulage road build up and piling mat layer.
- Onsite reuse – Cobbled stones and doorcases from historic elements stored onsite for reuse in future public realm and Library project.
- Offsite Reuse (900 tonnes):
  - Natural Stone reused throughout Limerick City and County Council stone wall projects;
  - Old clay bricks reused in the construction of the Canal Harbour buildings in Limerick City;
  - Palisade fence panels – reused and erected at Richmond Rugby Club;
  - Concern, Finucane memorial – stone reuse.
- In collaboration with Sisk, the design was changed to a post tensioned slab design saving approximately 1,950 tonnes of reinforcement and 2,100 tonnes of concrete.
- Ground Granulated Blast furnace Slag (GGBS) is a by product of iron manufacturing and is a recycled material. Project Opera has seen the use of GGBS in the concrete of soft piles (approx. 70%), capping beam (approx. 70%) and floor slabs (approx. 20%).
- Sisk reused 800 linear metres of 3 metre high hoarding from Contract A to Contract B. All timber for hoarding is FSC Certified.
- All Sisk generators on site are powered off HVO, lowering carbon emissions from generators by up to 90%. Particularly important when tower cranes are stood and in operation.
- Sisk welfare site office is powered off mains electricity, all

3.

4.

5.

3. Natural Stone reused throughout stone wall projects

4. Old clay bricks reused in construction of the Canal buildings

5. Concern, Finucane memorial – stone reuse

Images source: Limerick Twenty Thirty

OPERA SQUARE

Construction Contracts

LTT have looked to build on the successes from the Circular Economy work undertaken in Contract A and were successful in achieving grant aid funding from the EPA's "*Green Enterprise – Innovation for a Circular Economy*" programme. This project titled **CE-Con Research Project**, is a collaboration between the Irish Green Building Council, the Build 360 research group in the Atlantic Technological University, the RWMPO-Southern and ourselves Limerick Twenty Thirty as the property developer.

The work packages will explore circular economy opportunities during the demolition and enabling works (retrospectively), design, pre-construction, construction, and operational phases of the project in close collaboration with the supply chain. The outputs will include a suite of 'Demonstrator Opera Briefs' that will inform subsequent projects in the overall Limerick Twenty Thirty plan and furthermore will be developed with evidence based case study information as industry guidance for the wider construction sector to inform upcoming Govt Project 2040 projects.

The output will also be the piloting of a circular economy literacy learning pathway with supply chain partners using a triple A approach – Awareness, Action and Attitude.

A Demonstrator Circularity Playbook for Industry will also be an output.

This is an EPA funded project and as part of this project, a 2 year Opera Project Circular Economy specific Masters student will insitu onsite. The student will have a 3 days per week presence onsite with a clear Circular Economy brief that is driven by Atlantic Technological University research Masters.

Based upon the success of previous Circular Economy initiatives, LTT have been approached by a number of private developers and different Local Authorities throughout Ireland to gain an understanding for the methods and benefits of incorporating a Pre-Demolition Audit within the Built Environment and identifying reuse, recovery locations using Opera Square as a tangible example. Following a request from the Irish Green Building Council (IGBC), LTT and the RWMPO-Southern presented the Opera Square – Enabling and Demolition Contract as a lighthouse demonstrator for their Routes to Circularity Programme. LTT will continue to promote the benefits to the Built Environment of utilising the Circular Economy approach to Construction & Demolition projects.

LTT commissioned a lessons learned report to understand and identify means by which reuse potentials can be improved upon throughout our wider portfolio of projects. As a result of these findings, LTT intended on including the requirement to make resource efficiency a key tenet of delivery into the contract documents for all participants appointed to deliver services, including design. This will ensure that all future enabling & demolition projects include the requirement to undertake a Pre-Demolition Audit with a site specific Material Management Plan where the likely demand and potential locations for these materials are clearly understood.

Regulation and Standards

RECOMMENDATIONS	RESPONSIBILITY	TIMELINE
Implement the WAPCE commitment in relation to bringing circularity and C&D waste within the framework of statutory planning guidelines (e.g. future iteration of S. 28 Development Management Guidelines).	Department of the Environment, Climate and Communications; Department of Housing, Local Government and Heritage; Professional bodies and industry leaders.	2025
Review planning legislation and best practice in the context of circular economy and design principles, and provide clear guidance for integration into development plans of the impact of density, infrastructure ratios, building typologies, development mix, car parking provision nature based solutions and demolition on resource consumption.		
The commitment of the Programme for Government and Housing for All - a New Housing Plan for Ireland (Action 25.3) to reinstate the BRAB should include members with expertise in circularity, and that circularity should form a central part of its remit.		
In developing the CERCS, DECC should consider institutional options for oversight for delivering CE targets.		
Incentivise the re-use of existing buildings to the greatest extent possible.		
The development of circularity strategies should remain material neutral based on performance and outcome.		
Delivery at a European level for recycled materials content, Environmental Product Declaration (EPD) etc.		
A national construction & demolition use hierarchy be developed as an output to set out preferred options for management of C&D resources and wastes. CERCS to set out targets for reused/secondary materials in construction, and requiring Life Cycle Assessments with all planning application submissions, with additional requirements for buildings of 1,000 sq m and over in line with the current EPBD.	Department of the Environment, Climate and Communications.	2025
Appropriate State bodies to collaborate with industry for development of deliverable exemplar design and case studies and providing guidance to industry showing implementing circular economy principles in case study projects.	Environmental Protection Agency (EPA); Professional bodies and industry leaders.	2025
Through circular economy strategy governance arrangements, better communication of policy and regulation from policymakers in advance of proposals to consider amending standards.	Relevant government departments; Professional bodies and industry leaders.	2025

Regulation and Standards

RECOMMENDATIONS	RESPONSIBILITY	TIMELINE
Ongoing review of policies, standards and guidelines to be undertaken as feasible to increase circular design principles in concrete, steel and other material value chains in Ireland. This includes TII, NSAI and Department of Housing, Local Government and Heritage publications. It also includes European Standards adopted as Irish Standards.	Department of Housing, Local Government and Heritage; NSAI; Transport Infrastructure Ireland (TII).	2025
Continuation of programme of fire safety regulations by a cross department/industry representative working group under Department of Agriculture, Food & the Marine and clarity on permission for multistorey timber frame buildings & high-rise mass timber buildings.	Department of Housing, Local Government and Heritage; Department of Agriculture, Food & the Marine.	2025
Supporting circular uses of construction and demolition resources and waste through national by-product and end-of-waste decisions for multiple types of building products/ materials and greatly increase resources at the EPA to deal with these applications.	EPA.	2025
CERCS should consider options to enable local authorities take a long-term view and seek clear information on the end-of-life of built assets/components, and reuse scenarios (current and potential future use) and developing storage facilities for large quantities of high-quality construction materials for reuse.	Department of the Environment, Climate and Communications / Department of Housing, Local Government and Heritage; Local government.	2030
Introduction of regulations applicable to re-used / second-hand products and materials, including process with the goal of reusing products including, major building elements such as precast flooring, facades, suspended flooring etc. (As these products are covered by the Construction Products Regulation, as such there are harmonised rules in place when making such products available on the market. This recommendation needs to be considered in the light of the measures that could legally be taken, without infringing European legislation).	EPA, and other agencies as appropriate.	2025

Education and Training

RECOMMENDATIONS	RESPONSIBILITY	TIMELINE
Provide funding to resource participation of national experts in standardisation of strategic interest with a view to integrating Irish needs and propagating knowledge nationally.	Government; Professional bodies and industry leaders; Providers of CPD and training.	2025
Develop and build on existing circular economy design guidelines for designers and professionals with a focus on applied practice in delivery and implementation:	Professional bodies and industry leaders; Providers of CPD and training.	2025
1.Provide practical workbooks and training modules for designers and professionals designed in collaboration between industry and third-level institutions;		
2.Each professional membership organisation (RIAI, Engineers Ireland, SCSI etc) should collaborate to develop a suite of cross-professional Circular Economy Guidelines to embed circular economy principles;		
3.Provide exemplar models of applied principles of design, specification and construction of sustainable and circular buildings and infrastructure.		
Compilation by industry and third-level educational establishments of existing CPD as a resource and to identify gaps in training needs, then develop and publish a comprehensive suite of learning modules that cover all aspects of circularity, for example, DASBE.	Industry publications; Researchers.	2025
Educating trainers in third-level and throughout education about the principles of the circular economy.	Third-level institutions and training bodies.	2025
Programme alignment with existing EU initiatives to deliver general awareness of Circular Economy across society including general public communications campaign, teaching at primary and secondary School Level and other initiatives.	Third-level institutions and industry bodies; Providers of CPD and training.	2025
Structured, programme of thematic CPD events for all professional bodies to support circular construction.		
Develop a suite of Circular CPD Learning and Training modules to be delivered by RIAI, CIF and other consultant professional membership organisations, including the Irish Planning Institute aiming to upskill the construction sector workforce based on examples of best practice.		

Education and Training

RECOMMENDATIONS	RESPONSIBILITY	TIMELINE
Academia and industry to collaborate further on a range of applied pilot circular economy projects.	Third-level institutions and industry bodies.	2025
Simplify circular economy objectives to assist in making conceptual framework easier for successful adoption and ownership.	Third-level institutions and industry bodies; Providers of CPD and training.	2025
Educate all industry members both at third-level and throughout their careers, about circular economy in the built environment and the benefits of creating a regenerative built environment that prioritises retention and refurbishment over demolition and rebuilding, where material resources can be recirculated.	Third-level institutions; Employers.	2025
Develop existing good practice through the creation of basic level training of circular economy principles to local authorities, and roll out successful industry/education/local government pilot training courses nationwide.	Institute of Public Administration; Local authorities.	2025
Government agencies, third-level institutions, professional membership organisations to publish a set of actions for each sector - education, design, construction, maintenance, operation, and client by 2030, actioned in the Circular Built Environment Roadmap.	Government, third-level institutions; Professional membership organisations.	2025
Educate designers on the end-of-life process.	Industry bodies; Providers of CPD.	2025
Pilot projects to enable and support mainstreaming of circular economy design and specification.	Design practitioners and clients.	2025
Educate all sectors through examples of worked projects.	Design practitioners and clients; Training providers.	2025

Research & Development

RECOMMENDATIONS	RESPONSIBILITY	TIMELINE
Ensure that the necessary financial and resource support is given to successful programmes such as Construct Innovate, Ireland's National Research Centre for Construction Technology and Innovation, in its role of making Ireland a global research and innovation leader for sustainable construction and built environment technology.	Government; Third-Level institutions and professional representative bodies.	2025
Better co-ordination to develop a programme of applied research and development for the construction sector in relation to best practice, circularity and sustainable targets.	Third-level institutions and professional representative bodies.	2025
Develop pilot projects, building on initiatives such as the CE-Con Project, a collaboration between IGBC, ATU, Limerick Twenty Thirty and the Southern Waste Region, that will lead the way for circular economy design and circularity to become mainstream as soon as possible.	Third-Level institutions; Industry bodies; Providers of CPD; Government departments and agencies.	2025
Promote research in sustainable and deconstruction design principles to align waste reduction and material re-use.	Construction material manufacturers; Design professionals.	2025
Development of the proper management of indigenous bio-based materials industry.	Relevant government agencies; Third-Level institutions and professional representative bodies.	2030
Manufacturers to research existing products and assemblies to explore how they might be disassembled and reused rather than discarded.	Construction material manufacturers; Design professionals; Clientxs/Procurement agencies.	2025
Promote research into domestic bio-based materials – e.g., mass timber, hemp, etc. to assess current levels and set a realistic self-sufficiency target in building materials.	Construction material manufacturers; Design professionals.	2025
Further research and development into reuse potential, including driving demand, resource mapping, safety, testing, and certification of reused products and materials, and business models for reuse.	Government; Third-Level institutions and industry; representative bodies.	2025
More research into cleaning, decontamination and preparation for reuse.	Government; Third-Level institutions and industry bodies; Waste management sector.	2025

Research & Development

RECOMMENDATIONS	RESPONSIBILITY	TIMELINE
State supports for manufacturers to explore how materials and equipment could be disassembled and re-used at the end of life to include circularity principles in the manufacturing and installation stages to reuse or recover materials more effectively.	Government; Construction material manufacturers.	2025
Development of multidisciplinary roadmaps that provide concrete actions/cross linkages to facilitate better systems-level responses across Government and Society.	Government departments and agencies; Industry representative bodies.	2025

Value Chain

RECOMMENDATIONS	RESPONSIBILITY	TIMELINE
Encourage a greater awareness of the value and finite availability of materials and resources by price incentives and restrict non-circular activity in the form of a 'resource tax'.	Regulatory agencies; Department of Finance.	2025
Targets for 2030, develop a new approach, building on EU Levels model for architectural and engineering design and specification process including designing for adaptability and deconstruction.	Design teams.	2030
Base designs (or elements of design) on the range of available construction materials.	Construction material manufacturers; Design professionals; Clients/Procurement agencies.	2030
Involving the construction contractor earlier in the design process to promote integration and collaboration in the design and build process.	Design teams.	2030
Early circular procurement and research of construction material options, to secure supply and to explore alternative material options available.	Construction material manufacturers; Design professionals; Clients/Procurement agencies.	2030
Reform of material warranties in the context of material re-use.		
Adopt material, component and equipment leasing instead of purchasing. Schiphol Airport has successfully implemented this strategy, and the lessons learned from this initiative should form the basis of future research.	Construction material manufacturers; Design professionals; Clients/Procurement agencies.	2025
Engagement at EU level for further adoption of existing waste coding system to facilitate reuse and circularity. A universal and standard coding system must be introduced across the EU to facilitate tracking of material use, waste generation, with a project-based targeting system.	Regulatory agencies.	2030
Setting targets by 2030, as is currently the case in the UK's Construction Sector Deal, referred to in the ZAW Report of February 2020, providing for the construction sector deliverable targets.	Government; Regulatory agencies.	2030
Promotion of collaboration between planners, suppliers, operators, maintenance contractors and demolition/waste providers to provide a whole life cycle.	Industry bodies; Providers of CPD.	2025

Value Chain

RECOMMENDATIONS	RESPONSIBILITY	TIMELINE
Engage with maintenance teams to understand all of their requirements to avoid demolition. Focus on planned preventative maintenance and its alignment with product-as-service models.	Design teams; Construction teams; Client/Procurement agencies.	2025
Use of new financial disclosures regulations to engage with the supply chain and look for greater adoption and embedment of Circular Economy practices.	Government; Regulatory agencies.	2030
Maintain awareness of developments at EU level to support circular economy performance metrics certification for all construction products to drive up the number of certified materials (for example, asking for EPDs HPDs, C2C etc.).	Industry bodies; Design teams; Construction teams; Client/Procurement agencies.	2030
National register for all built assets, including current occupation, date constructed, dates renovated, and BER if available, updated on a five-year cycle.	Government; Regulatory agencies.	2025
Research into innovation and development of prestressed stone structures and brick.	Construction material manufacturers; Design professionals; Clients/Procurement agencies.	2025

Digital Delivery

RECOMMENDATIONS	RESPONSIBILITY	TIMELINE
Creation of Material Passports and building logbooks to include all the materials that are included in a product or construction during its life cycle to facilitate circularity decisions in supply chain management, and promotion of the use of digital material passports for tagging and tracking along the full lifecycle of a product, material or system. Use of BIM for material passports, component and assembly labelling and identification.	Construction material manufacturers; Clients/Procurement agencies.	2030
Adoption of material exchange platforms as already existing in other EU countries.	Construction material manufacturers; Clients/Procurement agencies.	2025
Develop material reuse 'Market Place' (such as IGBC Excess Materials Exchange) to include for storage and distribution of materials.		
Utilisation of BIM across, cost, programme, sustainability, and operations so that it may be used as a tool to implement circularity across the industry for various projects.	CPD and training providers; Industry professional bodies.	2030
Develop building information modelling and building information management process to support a circular built environment.	Government; Procurement agencies.	2025
Public sector to lead and mandate BIM levels/management in procurement.		
Ensure that the necessary financial and resource support is given to projects such as the Build Digital Project in its role to transform the Irish construction and built environment sectors by enabling all stakeholders, particularly SMEs, clients, and suppliers, to develop, maintain, and continuously improve their capabilities as digitally enabled, standards-based, agile, collaborative, and sustainable participants in the delivery of Project Ireland 2040.	Government; Third-Level institutions; professional representative bodies.	2025
Co-ordination of digital delivery education effort/findings/information both between educational institutions and between them and the industry.	Industry bodies; Providers of CPD.	2025
Use of digital tools and plug-ins to advance Revit models e.g., specifications, carbon assessment, etc.	Industry bodies.	2025

Sector-Specific Recommendations

RECOMMENDATIONS	RESPONSIBILITY	TIMELINE
Designing and specifying to reduce Construction and Demolition Waste by up to 95% (excluding soil and stones and backfilling) and significantly increasing recycling offsite.	Designers and contractors.	2025
Built asset maintenance, refurbishment, and repair strategies should form part of the overall procurement process.	Procurement agencies; Occupiers; Professional bodies.	2030
Coding or use of materials passports of construction materials, components, and assemblies to facilitate deconstruction and re-use.	BuildDigital; Construction material manufacturers.	2030
Consideration of material and component leasing instead of purchasing.	Clients / Procurement agencies.	2025
Develop a Circularity Rating (similar to a BER Rating) to demonstrate the circularity of a built asset to promote circularity/sustainability assessments and decisions.	Industry.	2030

PEARSE SQUARE

Example of Domestic Project Recycling

Location
Pearse Square, Dublin 2

Architects
RKD Architects

Date
2011-2022

Area
50 sq m

PEARSE SQUARE

Example of Domestic Project Recycling

Location
Pearse Square, Dublin 2

Architects
RKD Architects

Date
2011-2022

Area
50 sq m

This is an example of component and assembly re-use on a domestic project.

RKD Architect's client was carrying out the renovation of an 1840s terraced house at Pearse Square in Dublin2. This project involved the full refurbishment of the terraced house upgrading of its roof and wall insulation to enable the successful installation of an air-to-water heat pump based heating system.

Part of the project included the renovation of a single storey garage to the rear of the property into a work from home studio. While working on another domestic project at the same time, the builder was required to remove a set of double doors with side glazing from that project. The builder offered the assembly to our client. This was checked for suitability and incorporated in the garden façade of the studio building.

1.

1. Renovation of an 1840s terraced house at Pearse Square in Dublin2
Image: RKD Architects

WHO WILL DO THIS?

Delivering circular economy principles in construction and the built environment requires engagement across a wide range of stakeholders from government, institutes of education, professional bodies and training providers, industry and regulators.

SECTOR	RESPONSIBLE BODY
Public procurement agencies, including local authorities	ESB Eirgrid and ESB Networks Enterprise Ireland Gas Networks Ireland Heritage Council Health Service Executive (HSE) Irish Rail Irish Water National and Regional Roads Offices Office of Government Procurement Office of Public Works Tailte Éireann Teagasc Department of Finance Local Government Operational Procurement Centre (LGOPC) Transport Infrastructure Ireland (TII)
Public Sector – including policy makers, delivery bodies and regulators	Department of Agriculture, Food and the Marine Department of Education Department of Enterprise, Trade and Employment Department of Environment, Climate and Communications Department of Health Department of Housing, Local Government and Heritage Department of Public Expenditure and Reform Department of Rural and Community Development Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media Department of Transport Legislators and regulators Planning departments Environmental Protection Agency National Standards Authority of Ireland (NSAI) Sustainable Energy Authority of Ireland (SEAI) An Bord Pleanala Regional and Local Authorities Local Authority Services National Training Group Irish Green Building Council (IGBC)

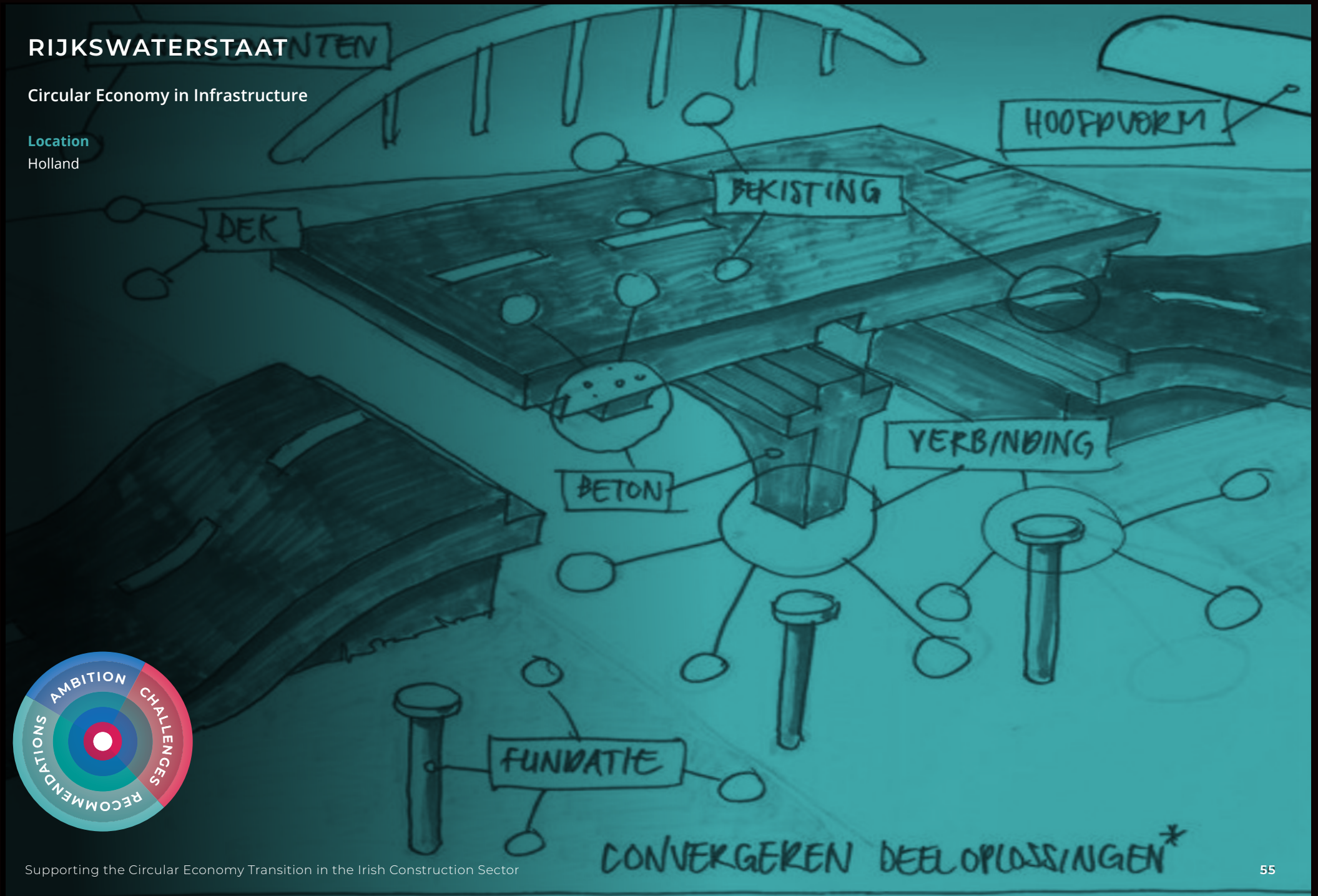
SECTOR	RESPONSIBLE BODY
Industry and professional representative organisations	Association of Consulting Engineers of Ireland (ACEI) IGBC The Royal Institute of the Architects of Ireland (RIAI) Society of Chartered Surveyors Ireland (SCSI) Engineers Ireland Irish Planning Institute Property Industry Ireland Community Resources Network Network Ireland Irish Concrete Federation Chartered Institute of Building Circular service providers, IGBC Estate agents, property surveyors and building surveyors
Professional service providers	Design teams Grant providers Investors, funds, and fund managers Grant providers Mortgage and fund managers Licensed Waste Operators Planning consultants Procurement team Project managers Procurement team Project managers Property managers Quarries and earthworks hauliers Quantity surveying team Quarries and earthworks hauliers Recycling and manufacturers Suppliers and manufacturers

SECTOR	RESPONSIBLE BODY
Research and training Institutes	Circuléire Construction Industry Technology Alliance Construct Innovate Construction Centre of Excellence Digital Academy for the Sustainable Built Environment (DASBE) Material exchange platforms e.g., Excess Materials Exchange, Rotor DC, Wrpp It, etc Material passport platforms Materials testing laboratories Second and Third-Level Institutions Sectoral NGOs and Charities Sectoral researchers (Academic and Industry) The Rediscovery Centre Research groups, including Timber Engineering Research Group (TERG) in the University of Galway and the Bio- and Circular Economies Research Group (Bio-CERG) in TU Dublin Build Digital

RIJKSWATERSTAAT

Circular Economy in Infrastructure

Location
Holland



RIJKSWATERSTAAT

Circular Economy in Infrastructure

Location
Holland

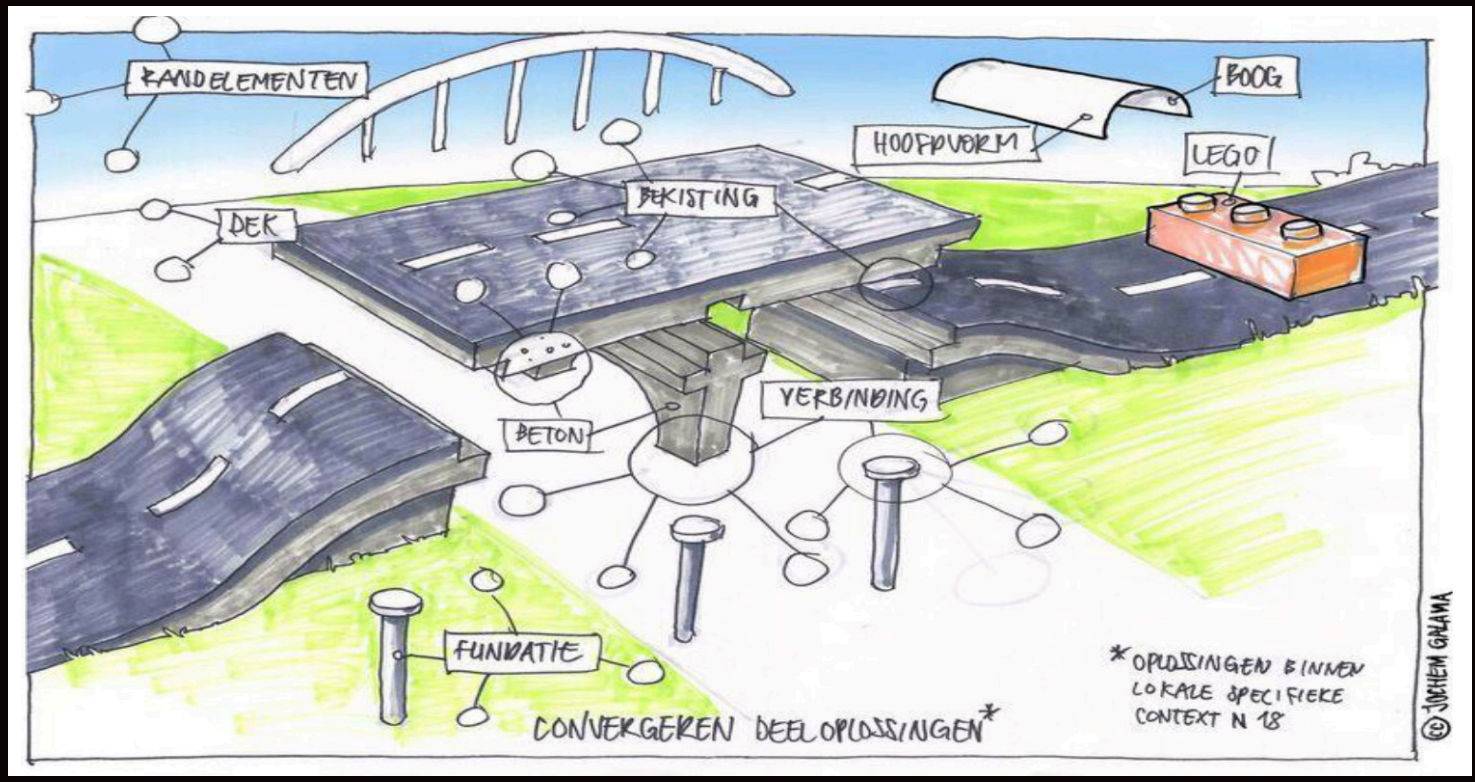
Rijkswaterstaat is the Dutch government agency responsible for public infrastructure works and water management. They have their Circular Economy Programme 2030 which involve a number of measures to reach circularity and climate neutrality.

These include;

- Modular design for disassembly
- Less material being used
- Overall aims include a 50% reduction on virgin materials by 2030 and no waste by 2050
- Energy and climate neutrality by 2030.

The main focus of the circular programme is;

- Preservation and re-use of materials
- Circular design – build and maintain
- Data systems – Materials passports
- Circular Procurement



SECTORAL GUIDANCE

Implementing the principles of the circular economy in constructing the built environment requires reform of policy and regulations, development in training, research, the harnessing of digital delivery to support circularity and greater collaboration between stakeholders at all points in the construction process.

The following phase provide greater detail about where we see the sector now, what our vision is for fully embedded circular economy thinking within the sector, and the targeted reforms which we believe should be undertaken to achieve the vision set out at the start of this report.

We highlight eight critical junctures in the development of the built environment where specific reforms are needed to fully embed circular economy principles into the development of infrastructure and buildings.

1. DESIGN
2. PROCUREMENT
3. MANUFACTURING OF CONSTRUCTION PRODUCTS
4. PLANNING
5. CONSTRUCTION
6. OPERATIONS AND USE
7. RE-USE AND RETROFIT
8. DISASSEMBLY AND RECOVERY

DESIGN

What is our ambition?

To create a genuine circular economy in the Irish Construction industry we need to change current practices and set ambitions for circular practice. The principles of circular practice apply as much to the design of Ireland's physical economic and social infrastructure, as to its public and private building stock.

Recommendations

As set out in table, Government needs to raise public awareness about the benefits of circular economy principles. By educating the public about responsible consumption, repair culture, and sustainable choices, communities can drive behaviour change. The CERCS should contain measures to ensure the whole life design of a project so that these principles are "baked-in" at the earliest stages of design.

Designers will need to reorganise their design process around the principles set out in Section 2 of EU Level(s) headings of holistic sustainable design which specifically deals with circularity.

- **DESIGN IN LAYERS**
- **LEVELS 2.1: BOQS MATERIALS & LIFESPANS**
- **LEVELS 2.2: C&D WASTE AND MATERIALS**
- **LEVELS 2.3: DESIGN FOR ADAPTABILITY AND RENOVATION**
- **LEVELS 2.4 DESIGN FOR DECONSTRUCTION, REUSE AND RECYCLING**

From Current Practice	To Circular Practice
Demolition.	Building reuse and repurposing; Recirculation of materials at end-of-use life.
Building lifespan of 30 to 50 years followed by demolition.	Planning for buildings that can be adapted over time with minimal intervention with a primary emphasis on re-use.
Financing for minimum viable single expendable lifecycle with no reporting of environmental impacts.	Financing for maximisation of asset utility and minimisation of environmental impact over multiple use lives of the built asset; Annual reporting of ESR including carbon footprint of built assets.
Design for cost minimisation.	Design for maximising long-term economic value and containing overall environmental impacts consistent with the UN Sustainable Development Goals.
Design focus on initial use including space and services.	Designing for flexibility, repurposing, and upgrading.
Design focus on current project.	Designing for multiple use lives.
Using virgin raw materials.	Reusing original structure, components and materials and adopting secondary products where possible for refurbishment to ensure a verifiable net reduction in resource depletion over multiple use lives.
Use of Composite materials	Building in layers that are removable and reusable; Offsite fabrication and onsite assembly of prefabricated components and assemblies that can be removed and used elsewhere.
Reducing waste.	Reusing material and reassessing waste as a resource.
Consuming natural resources: energy, water, materials, increasing atmospheric carbon levels.	Harvesting natural resources: including energy, water, materials; sequestering atmospheric carbon, increasing biodiversity, promoting human wellbeing.
Outsourcing waste disposal: land fill and wastewater treatment.	Treating waste as a resource and dealing with waste generated either on site, or at the off-site location with the lowest overall environmental impact.
Design based on the current take, make, waste approach.	Facilitating material reuse and recertification systems.
Measure cost and time.	Measure performance and quality.
Using global environment and reducing biodiversity.	Restoring global environment and promoting biodiversity.
Consideration of carbon footprint.	Mandatory carbon reduction towards net zero operational emissions.
Limited circular options.	Vibrant circular economy in construction materials, components, built assets and infrastructure.

This section is intended as direction when undertaking public or private sector construction projects.

DESIGN IN LAYERS

1. Issue guidance to client organisations to consider a building as a series of layers & use layers to guide design as follows:
   a. Stuff;
   b. Space;
   c. Services;
   d. Skin;
   e. Structure;
   f. Site;
   g. (society).[33]
2. Design to retain value of materials and components in buildings.
3. Components should be screwed or bolted together. Avoid gluing or sticking materials together. This makes it easier to disassemble and helps to retain a materials value at the buildings end of life. Use BIM / Material passports to facilitate the recording and storing of deconstruction instructions.
4. Design to make it easier to replace and upgrade components and services. This will reduce life cycle maintenance costs.

RECOMMENDATIONS FOR ALIGNMENT WITH LEVELS 2.1: BILL OF QUANTITIES, MATERIALS AND LIFESPANS

1. Consider buildings as a lifetime asset rather than a project lifecycle.
2. Use Whole Life Cycle Analysis and Life Cycle Costing to determine the most efficient long-term cost of a building including operational costs.
3. Incorporate Stage D of the WLCA process to measure circularity (Cradle to Cradle).
4. Establish 'Building Product Circulation Hierarchy' with the most circular and lowest carbon products being the priority products for specification: IGBC to provide guidance with this.
5. Design 'Buildings as Material Banks' (BAMB). This is achieved by developing and integrating two complementary value adding frameworks, (1) materials passports and (2) reversible building design.[34]
6. Factoring in replacement rates and maintenance in the design process is key to establishing accurate WLCA and LCC. This can be done in the object properties in BIM.
7. Design for adaptive re-use to extend the lifespan of a building.
8. Consider alternative procurement routes which treat buildings as a service so that the buildings or infrastructure will be designed to maximise circularity and to minimise life cycle costs and carbon content.

RECOMMENDATIONS FOR ALIGNMENT WITH LEVELS 2.2: C&D WASTE AND MATERIALS

1. Design out waste on site by using standardised dimensions to avoid off cuts.
2. Minimise replacement rates of components to make them last as long as possible (Whole Life Cycle Approach).
3. Instruct a 'Renovation and Refurbishment First' policy and avoid demolition to reduce waste and carbon emissions. This approach will significantly increase circularity and reduce carbon emissions.
4. An example of reducing material waste and maintaining material value would be to use lime mortar in masonry construction to enable easier recovery and reuse of masonry units. This would have to be incentivised through benefit and penalty schemes, led by public sector example.

[33] How Buildings Learn: What Happens After They're Built https://sb.longnow.org/SB_homepage/Home.html

[34] https://cordis.europa.eu/project/id/642384

RECOMMENDATIONS FOR ALIGNMENT WITH LEVELS 2.3: DESIGN FOR ADAPTABILITY AND RENOVATION

1. Design for future change including:
   a. Loose fit;
   b. Alternative scenario planning;
   c. Simple plan form;
   d. Independent layers.
2. Use flexible and demountable components.
3. Collaborate with operations and maintenance teams to simplify designs for renovation and adaption.
4. Design regenerative built environment that prioritises retention and refurbishment over demolition and rebuilding, designing buildings and infrastructure that can be adapted, reconstructed, and deconstructed to extend their life and that allow components and materials to be salvaged for recirculation, reuse or recycling.
5. Design for adaptive re-use to extend the lifespan of a building e.g., Georgian terrace buildings are well known for their multi-functional uses through the ages.
6. Consider floor to floor heights, core design and universal design in buildings to enable future adaptability.
7. Design services to be easily removeable, deconstructed and upgradeable to enable future adaptability.

RECOMMENDATIONS FOR ALIGNMENT WITH LEVELS 2.4: DESIGN FOR DECONSTRUCTION, REUSE AND RECYCLING

1. Embed DfMAD (Design for Manufacture and Assembly/ Disassembly) and MMC (Modern Methods of Construction) which are designed to encourage circular and low carbon principles as the norm for construction projects.
2. Design based on modular (standardised) measurements so that components can be easily re-used on other projects.
3. By 2030 require designers of new architectural, engineering and infrastructure projects to:
   a. Ensure they are future proof and will last;
   b. Demonstrate how they will adapt to potential changes in use and to climate change;
   c. Design and specify out waste for new buildings, refurbishment projects and infrastructure by designing for better resource efficiency and for deconstruction and disassembly, efficient manufacturing processes, extending the life of buildings, disassembly for reuse and reducing surplus materials;
   d. Demonstrate how they will be maintained over the long term so that major renewal such as façade replacement will not adversely impact occupants and how different layers of the development have been designed to be disassembled cost effectively to support recovery and reuse of the building's systems, components and parts as and when they need to be replaced;
   e. Interact with manufacturers and suppliers to work with them to provide materials, products and systems that minimise waste, can be assembled to support disassembly and retain value at the end of their life;
   f. Be based on regenerative and nature-based solutions as the mainstream design approach.

PROCUREMENT

What is our ambition?
That by 2030, circular economy principles and practices are included by default within the procurement processes for all built environment assets at all lifecycle phases, and these processes drive increased circularity and a reduction in the resource intensity of the built environment.

That procurement practitioners will have access to comprehensive and sufficiently detailed guidance/guidelines in relation to maximising circularity for all life cycle phases, and both upstream circular design decisions and pro-circular incentives, regulation and standards enable that circular procurement.

The current situation
Procurement is undertaken currently to facilitate the linear economy. The lowest price tender is often the successful one. It does not take into account the total life cycle cost or external costs such as environmental or social costs.

Procurement is purely transactional and short term focussed. Procurement methods are conservative and highly restrictive with little scope for variance.

Circularity is not considered at all in the procurement process and in Ireland we are one of the least circular countries in Europe.

It is important to consider differences within private procurement and public procurement and so the approach to both would need to differ, for example, as the EU operates as a single market, discriminating in favour of local suppliers by a public contracting authority may be seen as a breach of Article 76 of Directive 2014/24/EU (and national Regulations), and more particularly Article 56 of the Treaty of the Functioning of the EU.

What are the current challenges to delivering this vision?
The nature of the construction industry is highly fragmented. There are low barriers to entry and little spending on R&D. Consequently, procurement, particularly in the private sector, can be informal with the primary emphasis on lowest cost and maximum margins. This downward pressure on prices all the way through the value chain leads to lower quality, more adversarial interactions and negatively affect the lifetime cost of an asset.

WHAT ARE OUR PROPOSED SOLUTIONS?

1. Move from a project life cycle (short term focussed) to an asset life cycle (long term value focussed);
2. Close the loop - create closed-loop systems where materials are continuously cycled within the economy. This includes developing circular supply chains, establishing take-back programs for products, and supporting industries that rely on recycled materials. Justification as to the selection of potential products can be used to ensure that consideration of the history of a product built into the process;
3. Procurement is the function by which the circular economy can initially be implemented. It needs careful consideration;
4. State procurement to lead in the establishment of circular procurement in order to help to create the circular economy;
5. Consult with experts from countries with more mature circular economies in order to learn current best practices and how to avoid their past mistakes;
6. Move from short term business cases to long term value creation; [35]
7. Focus on Total Cost of Ownership (TCO) and Total Cost of Use (TCU);
8. Implement Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) on all public projects;
9. Experiment with different procurement methods such as Competitive Dialogue. Strike the right balance between competition and collaboration;
10. Establish Award Criteria that assesses and rewards circular performance;
11. Transition from technical specifications to functional specifications; [36]
12. In civil engineering, undertake functional assessments at business case stage to establish if (a) a project is required and (b) what is the most circular way to deliver it;
13. Refocus procurement to purchase functions rather than material, e.g. light as a service, lift movements rather than lift cars;
14. Develop consistent metrics to measure circularity. If something cannot be measured, it cannot be managed, but measuring circularity is difficult. Using programmes such as Circular IQ will help to put rigour on the process and avoid 'green washing';
15. Use internationally recognised standards such as those developed by ISO, IEC, CEN and CENELAC;
16. Shift towards more 'bio-based procurement'. Bio based procurement does not always coincide with circular use, however when bio-based procurement is combined with circular procurement it leads to highly circular & sustainable, low carbon solutions; [37]
17. Develop long term contracts or performance agreements that reward lower TCO / LCC.

RECOMMENDATIONS FOR PROCUREMENT POLICY	TIMELINE
LCA and LCC to be undertaken in all new major public projects.	2025
Education on circular procurement to be undertaken throughout the public sector.	2025
Undertake test projects to experiment with alternative procurement to facilitate circular delivery of projects and monitor result.	2025
Develop award criteria for the awarding of circular commissions for both design teams and project delivery proposals.	2025
Develop long term performance agreements that incentivise lower TCO / LCC.	2025

[35] Circular Procurement in 8 steps; van Oppen, Croon & de Vroe; p33

[36] Circular Procurement in 8 steps; van Oppen, Croon & de Vroe; p36

[37] Circular Procurement in 8 steps; van Oppen, Croon & de Vroe; p38

MANUFACTURING OF CONSTRUCTION PRODUCTS

Summary

A wide range of construction products and materials are needed to construct buildings, infrastructure, and the built environment. While some products are made here in Ireland, many are imported. Reducing the importation of construction products and materials has the potential to create enable a more circular indigenous construction materials sector. reduce overall carbon emissions and improve the circularity of the construction sector and make it more robust.

In simple terms manufacturing construction products requires four key elements:

- suitable raw materials;
- skilled workforce;
- energy/heat;
- facilities and investment.

To transition for the construction materials manufacturing businesses to become more circular, each of these elements must be examined:

- **suitable raw materials:** Are they local? Can less raw material be used? How much waste is produced? Can other sources of raw materials be identified?
- **skilled workforce:** Do we have the necessary skills, or are new skills and training needed?
- **energy/heat:** How efficient is the manufacturing process? How much energy/heat is required? How much is or could be renewable? Is it sourced locally?
- **facilities and investment:** Is funding or investment in new facilities needed? What supports are currently available? What supports should be available?

CIRCULÉIRE - The National Platform for Circular Manufacturing in Ireland [38] ran a series of Circular Economy Innovation Workshops during 2023 on different sectors including 'construction and the built environment' with a focus on developing a National Centre of Excellence.

What is our ambition?

- Narrowing resource loops (reducing the input of resources) by reusing buildings and refusing the use of products (i.e., prevention) when possible, intensifying the use of products or reducing the use of materials through more efficient manufacturing or efficiency in using them;
- Slowing down or elongating resource loops (longer and high value use of materials and products) by reuse, repair, and remanufacturing of products;
- Closing the loops (reducing loss of materials through waste) by recycling and recovering energy from materials when all the previous options are no longer possible;
- Minimising waste produced per functional unit of product produced. Manufacturing products for construction purposes include a diverse range of items (insulation materials, precast walls, cements, and timber beams). Manufacturers should, if they have not already, consider setting measurable KPIs to reduce the production of waste year on year as a percentage of their production output.
- Development of a publicly available large database of EPDs for construction products that will provide transparency and ease the life-cycle assessments, life-cycle costing and indoor air quality assessments; [39]
- Creation of a metric or scoring system for buildings, which would be made available on a public database.

[38] National Platform for Circular Manufacturing in Ireland https://circuleire.ie/

[39] The EC have committed to creating a system to ensure credibility of such a system for the internal market.

Where are we now?

In Ireland under current waste legislation, certain rules apply to the use and classification of secondary materials. The EPA is preparing guidance on reuse which shall include a chapter dedicated to the construction and demolition sector. This should serve as a useful tool to support industry in determining their legislative requirements in this regard.

A by-product is a material which is produced as an indirect consequence of a production process i.e., the main aim of the production process was not to produce that material. Construction and/or demolition can be considered as a production process from which by-products can be produced. In order to be considered a by-product, certain conditions as set out in Regulation 27 of the European Union (Waste Directive) Regulations 2011-2020 must be fulfilled. A by-product must be notified to the EPA on a single-case base for determination, or if associated European level criteria or National criteria exist, it must be registered on the EPA website.

If a material is discarded or intended to be discarded, then it is considered a waste. To be able to reuse a waste material, it must be reclassified as a product by achieving end-of-waste status. End-of-waste status can be achieved through compliance with European level criteria or National criteria, where published, or on a single-case basis through application to the EPA for a decision under Regulation 28 of the European Union (Waste Directive) Regulations 2011-2020. An overarching requirement of end-of-waste is that a waste authorisation is in place to control the waste treatment (recovery) process that results in the reclassification of waste to non-waste.

The uptake and engagement on the by-product (Regulation 27) and end-of-waste (Regulation 28) regulatory provisions has gathered significant pace in recent years. This is evidence of a clear ambition within many industries to identify practical solutions to support the circular economy. The majority of applications and notifications received by the EPA relate to construction-based waste and materials. In 2022, the EPA commenced a more strategic approach of developing national by-products [40] and end-of-waste criteria [41] for the construction-based materials, including greenfield soil and stone, site-won asphalt and recycled aggregates. These criteria will ultimately eliminate the need for multiple single-case decisions for those materials.

What are the current challenges?

Achieving these goals requires stakeholders, including construction professionals, to overcome the following challenges:

We need to consider how businesses involved in manufacturing construction materials quantify or account for the longer-term value of the resources they put on the market. Both business and consumers need to know that they can track the value and how they are rewarded for that value. We need better information to answer whether their customers are interested in or aware of the differences or benefits of more circular production.

One of the challenges includes difficulties in putting innovative, circular products on the Irish market. There needs to be a clear pathway for manufacturers of innovative, circular products to help them launch new products in Ireland. Required certification and other alternative routes to put innovative products on the market must be clearly defined. The current construction product certification including Agrément certification does not cover the sustainability and circularity of the certified product. This is due to the lack of sustainability requirements in the current version of the Construction Product Regulation (CPR). The CPR is in the process of revision to add environmental sustainability clauses. Environmental Product Declarations may go some way to addressing those issues; however, they are voluntary.

[40] By-products Regulation 27, https://www.epa.ie/our-services/licensing/waste/by-products-regulation-27/

[41] End-of-waste criteria in Ireland, Levels of end-of-waste criteria, https://www.epa.ie/our-services/licensing/waste/end-of-waste-art-28/end-of-waste-criteria-in-ireland/

Many new solutions and innovations still need to be developed for high-quality recycling and reuse of materials, sustainable production, and service-life extension of materials. While the EPA have excluded structural applications from the scope of the National decision end-of-waste decision for recycled aggregates, they have stated that they would however support and steer industry to build on the criteria already developed to establish national-criteria for structural uses.

We need to find measures to overcome the reluctance of companies to provide more sustainable manufacturing processes due to their lack of knowledge or additional upfront manufacturing cost, and in parallel develop a market demand for these products.

There needs to be more regulations to encourage or force manufacturers to declare the environmental impacts and circularity performance of their products. Currently, there is no requirement to provide third-party verified environmental performance metrics. This can lead to confusion among businesses about which construction material products are genuinely circular. Producers who take the bold steps and initiatives to publish an EPD openly are not necessarily rewarded with more business, so they might be disincentivised. This is particularly relevant in markets with no existing EPDs. Producing one sets the benchmark and gives competitors opportunities to improve. Forced declaration might be a solution, but further supports would be required to aid smaller businesses beyond those already provided by Enterprise Ireland.[42] We note, however, that new regulation such as revision of the CPR and the Ecodesign of Sustainable Products Regulation is coming.[43] Construction Product Regulation will be continuously revised to make sustainable products the norm in the EU and boost circular business models. Green Public Procurement will also support use of sustainable products.

There are opportunities to promote bio-based materials such as hemp. Current issues with the Department of Health licensing of hemp production need reform. Farmers want to grow hemp but are currently restricted by both licensing rules and lack of processing facilities. For example, there is a potential launch and use of hemp insulation in Ireland in coming years, and while some hemp is available for sale here, further research and development is needed to launch a product with Hemp sourced in Ireland at scale. Hemp is not the only bio-based material with potential. Others include jute, wood fibre, sheep wool, willow, bamboo, hemp, cellulose, cork board, timber frame straw panelised systems, bio based insulating lime boards and natural insulating plasters for heritage buildings. Some of which are in a more mature phase of development.

The lack of fire testing and certification facilities in Ireland means delays in getting new products to market. The current challenges with achieving combustibility classification for bio-based insulations needs more research and development in order to provide an opportunity for this to be used at scale domestically. Additionally, we need more competence in this area, beginning at an educational level. If fire concerns are restricting the potential use of a sustainable material, it is paramount that we, in the construction sector, all develop a better understanding of it. It should be mandatory learning. This should be addressed by Construct Innovate, which was established last year to bring testing facilities and universities together.[44]

What are our proposed solutions?

Manufacturing construction products can generally be seen as a series of internal economies within the construction sector. Many manufacturers are already very efficient and have very little waste arising within their own production facilities. Much of construction waste arises later in the supply chain and on construction sites. Each producer should endeavour to control what they can as a starting point by, for example, setting annualised targets on waste reduction. This might eventually be in the form of publicly published waste data but beginning with internal reporting and measurement. Grants should then be offered to those manufacturers to develop innovative processes that first minimise waste, and, secondly,

[42] Enterprise Ireland: GreenStart: https://www.enterprise-ireland.com/en/Productivity/Build-a-green-sustainable-Business/GreenStart

[43] Revision of the Construction Products Regulation https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2022)739243#:~:text=On%2030%20March%202022%2C%20the,and%20boosting%20circular%20business%20models.

[44] Construct Innovate: Ireland's National Research Centre for Construction Technology and Innovation https://constructinnovate.ie/

maximise the use of any remaining construction and demolition resources and waste internally. Local support networks should be encouraged to develop creative solutions that could then see one manufacturer's waste become another manufacturer's raw material; for example, timber processing waste into insulation materials.

Bio-based materials are, one of a number of product solutions, which require particular attention as their impact extends beyond the circular economy. Bio-based building materials have potential to reduce the embodied carbon footprint of new buildings and refurbishments. The production of such materials must be subject to robust assessment under e.g., the WWF GWPbio biogenic assessment tool (with all advanced data profiles completed), or similar, to ensure that any carbon savings are verifiable and auditable.[45] The impacts on land use, land use change and forestry (LULUCF) should also be included in such an assessment. This will also enable the quantification of any biogenic carbon capture and storage possible as a result of the switch to bio-based building materials use. Given the dynamics of the economic impacts, any biogenic carbon advantage will need to be mapped for each bio-based material for the years from 2025 to 2050 compared to their decarbonising competitor materials over the same period to inform the economic cost-benefit and the carbon cost-benefit that may accrue in any switch from mineral to bio-based building material use.

In order to fully co-ordinate and facilitate the development of new sustainable products to meet the need of a decarbonised construction industry, Enterprise Ireland should be tasked with setting up a sustainable construction products division, linked to the existing Innovation Hubs across higher education, to identify and support high potential low carbon or carbon negative products which would have export potential. The service would include support with achieving product certification, EPDs and voluntary circular economy certification.

This would incorporate and promote existing supports which currently need to be more widely known.

Mapping resource flows is critical to identifying new raw material opportunities or more circular flows for existing materials in the construction sector and beyond.

EPA: The EPA to support and steer industry to build on the national end-of-waste criteria for recycled aggregates to establish national criteria for recycled aggregates for structural uses. The EPA guide for understanding End-of-Waste (EoW), by-products and waste regulation webpage has lots of useful information, including links to decisions made to date by the EPA for construction related products / materials.[46]
Industry to set up an industry led quality assurance scheme, as exists in other member states, to streamline the process of quality management, certification against technical standards and compliance with end-of-waste criteria. Industry also to lead on the development of national end-of-waste criteria for recycled aggregates for structural uses.
Local Authorities: CERCS should consider how the local government sector can use the existing network of civic amenity sites to provide depots for storing reused products, or allow testing of soil or stones for safe reuse.
Department of Housing: To enable greater uptake in reuse, provide additional guidance on the use of Part D3 (c) of the Second Schedule to the Building Regulations.
DECC / OGP: To ensure environmental impact indicators (e.g., Levels(s)) are incorporated into the public procurement process. Contractors: To engage in a new certified deconstruction scheme to provide assurance of safety, ensuring non-contamination of segregated wastes.
Manufacturers: To provide take-back schemes for repair and recertification of their products for reuse.
Design Professionals: To engage in applying Level(s) indicators from the early design stage and understand how they can be applied in design. Designers integrate circularity into designs that contractors then deliver. It is not the contractor's responsibility to create circularity out of a linear design.

[45] Biogenic Carbon Footprint Calculator for Harvested Wood Products https://www.worldwildlife.org/projects/biogenic-carbon-footprint-calculator-for-harvested-wood-products

[46] https://www.epa.ie/our-services/licensing/waste/end-of-waste-art-28/

Industrial Symbiosis

Industrial symbiosis refers to the practice of an industry or organisation using the waste or by-products from another. This could take the form of using waste heat, energy, water, or materials. The industrial park at Kalundborg in Denmark, where sixteen organisations share twenty different resource streams, is a good example. Each year they save tens of thousands of tonnes of C02 and raw materials, and millions of litres of potable water through these exchanges.[47]

Industrial symbiosis is something that could be applied within the construction sector and further stimulation and awareness of its merits are needed in the Irish economy. In fact, it is already taking place with the use of imported ground granulated blast furnace slag (GGBS), a waste product from the steel industry, for use in concrete.

The cement industry is working with partners and customers to maximise the value of discarded resources by returning them to the cement manufacturing process. The unique features of the cement factories, the fact they are transforming raw materials at high temperatures into an essential construction material. Given the huge scale of the industry here in Ireland, there is significant further opportunity for suitable materials to be cycled back in the cement manufacturing process.

Combining waste heat capture with district heating systems is another example. South Dublin Council and Codema initiated a project in 2021 that would capture the waste heat from a data centre and use it to heat buildings belong to the council, TUDublin, and some homes in the adjacent surrounding area in Tallaght.[48]

[47] CEN, 2018. CEN Workshop Agreement: Industrial Symbiosis, Core Elements and Implementation Approaches.. p. Ref. No.:CWA 17354:2018:7. EPA, By-products Regulation 27: https://www.epa.ie/our-services/licensing/waste/by-products-regulation-27/

[48] COdema, Tallaght District Heating Scheme, https://www.codema.ie/projects/local-projects/tallaght-district-heating-scheme/

RECOMMENDATIONS	TIMELINE
Industry working groups should be established working with the Department of Housing, Local Government and Heritage; The Department of Environment, , and others to develop detailed solutions to deliver all of the above, with a focus on:	2025
• Reform of the national implementation of the EU waste framework;	2025
• Building Regulations – Subject to the review of the CPR legislation and product level standards review of the CPR Acquis, limiting environmental impacts (determination of LCA, LCC, IAQ (for example, through Level(s) or HPI));	2025
• Consider Whole Life Value on Infrastructure projects.	2025
Start with the Level(s) framework, particularly the Macro objective – Resources and Circularity and integrate indicators 2.1-2.4 into the early design stage of projects onwards. The manuals and checklists provide an easy entry into how circularity can be integrated from the early feasibility stage.	2025
Designers to use the Regenerate Tool or the Ellen MacArthur Circular Buildings Toolkit develop with Arupor the London Mayor's Office template for the preparation of Circular Planning Statements to create circularity statements for their projects to create a structured approach to the key circularity indicators.	2025
Train design staff in the development of Resource & Waste Management Plans through Enterprise Ireland or similar training providers.	2025
Train all construction site operators in EU protocols for waste segregation to avoid contamination.	2025
Promote green, sustainable products to clients and procurement agencies in design.	2025
Establish environmental impact indicators, and identify which areas for constant improvement in circular economy principles.	2025
Implement GPP and provide guidance on circularity particularly Level(s) indicators 2.1 -2.4 for integration from early CWMF stages.	2030
Designers, manufacturers and contractors will need to work together to collaborate on how buildings can be easily disassembled to allow reuse of all components.	2030
Certification that reusable construction elements and materials are 'fit for purpose' will be required to encourage the widespread adoption of these circular practices.	2030
Manufacturers need to transition to long-term leasing of their products or provide a maintenance service on their products to maintain them in operational condition.	2050

PLANNING

The planning system in Ireland refers to the framework of laws, regulations, policies, and procedures that govern land use and development. It is administered by the Department of Housing, Local Government, and Heritage and is implemented by local authorities, regional assemblies, and An Bord Pleanala, with an oversight role for the Office of the Planning Regulator in ensuring that policy at regional and local levels is consistent with national policy. Generally, the planning system aims to ensure that development occurs in a coordinated and sustainable manner, taking into account factors such as environmental protection, infrastructure provision, economic development, and the overall well-being of communities.

For the circular economy the whole-life cycle information associated with an application and the capture of the digital analysis undertaken to supplement a digital portfolio can provide valuable information on the built environment such as urban resource mapping which should be centralised and accessible by all.

What is our ambition for embedding circular economy principles in planning?

The delivery of ambitious circular economy goals and strategies can be supported through the various stages of the planning process and its impact on the way urban and regional development is approached at every scale. The key ambitions for supporting the delivery of circular economy principles through the planning system are as follows:

Resource Efficiency: Circulatory statements for planning should be required to encourage designing for durability, repairability, and disassembly, as well as promoting the reuse, recycling, and recovery of materials.

Digitisation: Information provided under planning applications should be harvested to ultimately create comprehensive digital databases of the built environment, and this should be accessible to all interested parties.

Waste Prevention: Use the EPA Best Practice Guidelines for the Preparation of Resource and Waste management plan for construction and demolition projects. [49]

What are the current challenges to achieving this ambition?

1. Circular waste management considerations are not currently mandatory in planning applications.
2. There is not a sufficient requirement for robust justification for demolition.
3. There is a paucity of physical and e-infrastructure for holistic data collection and collating from planning applications.

What are our proposed solutions?

Guidance: Provide guidance to local authorities to support the delivery of circular economy objectives through the planning system. This could include, for example, inclusion of circularity principles within the scope of statutory planning guidelines.

Integrated Planning Approaches: Incorporate circular economy principles into urban and regional development plans, addressing land use, waste management, transportation, and infrastructure. Promote cross-sectoral collaboration to integrate circular principles across different planning domains, such as urban planning, transportation planning, and waste management.

Demolition: For existing planning permissions, it should be acknowledged that the term demolition is an umbrella definition–

[49] https://www.epa.ie/publications/circular-economy/resources/CDWasteGuidelines.pdf

this is in line with the BS6187: 2011 Code of practice for demolition. This clear acknowledgement will assist and clarify the transition with existing and new planning permissions.

Waste Management and Infrastructure: Use the forward planning process to deliver sufficient treatment capacity including recycling and resource recovery infrastructure to facilitate the separation and processing of materials for reuse and recycling. The CERCS should make clear recommendations for stakeholders, including planning authorities on how to reflect circularity in the areas of forward planning and development management processes. To support this, a guidance document could be developed to showcase best practice.

Community Engagement: CERCS should consider how the development plans process can incorporate policies/objectives to support circularity in design and construction and in the development of circular business models in the construction sector which in turn will influence planning applications i.e. applications could be required demonstrate how they are delivering on the Local Authority sustainability targets or Climate Action Plan targets, as appropriate.

Continuous Monitoring and Evaluation: Regularly monitor and evaluate the outcomes and impacts of circular economy strategies. Inform planning approaches based on lessons learned and emerging best practices through implementation of the CERCS.

By employing these solutions and strategies, planners can effectively integrate circular economy principles into their decision-making processes and contribute to building more sustainable, resource-efficient, and resilient communities.

RECOMMENDATIONS	TIMELINE
Bring circularity / C&D waste within the framework of statutory planning guidelines.	2025
Where appropriate, planning permissions granted to include compliance with the RWMP as a standard condition of planning. The level of detail presented in the RWMP should be reflective of the scale and complexity of the project (in accordance with the EPA Best Practice Guidance).	2025
Include materials report, site investigation and pre-demolition audits as a planning condition.	2025
LCAs to be included as a condition of planning permission for all new planning applications for all developments in excess of 1,000 sq m, in line with the Energy Performance of Building Directive.	2025 / 2030
Applicants to provide survey information in a GIS compliant format; Centralisation of all data gathering with a singular resource with a layered and filter approach to data access.	2025
Consider developing national protocol for digital twins starting with public buildings.	2025
CERCS to explore potential for regional and local authority development plans to incorporate policies/ objectives to support circularity in design and construction which in turn will influence planning applications.	2030

CONSTRUCTION

The environment in which construction of new buildings and infrastructure takes place is significantly more complex than in the past - and there is potential that embedding circularity may bring more complexity and uncertainty. Contractors will align their tenders to the client's design team's scope, so clients and their design teams will have to be highly accurate and detailed in the procurement process.

Within construction there is a need to focus on the preparation of Resource Management Plans, material logistics, site layout and management, supply chain engagement and on-site training to deliver the EU Circular Economy within the construction sector.

Wider thinking about embedding principles of circularity into construction means reducing potential emissions from the machinery used for the purpose of construction, with sites connected to the grid to allow for EV vehicles.

What is our ambition for embedding circular economy principles in construction?

- Clients and their design teams will make the right choices when selecting how to construct their built asset and support contractor involvement and innovation;
- The transportation of resources and waste from construction sites should be kept to a minimum by ensuring that as much construction and demolition material can be processed on site for re-use. The planning system and local authorities should be aligned and support this concept;
- Primary legislation, regulations and construction standards will work together to ensure that all construction and demolition waste and resources are reused in the construction process or recycled/ recovered and are banned from landfill, with the onus on the Client to ensure that this is planned and implemented during the design and construction process;
- A manufacturing eco-system will exist whereby all construction by-products, residues, resources and waste can be processed to be reused within the construction process;
- The Construction Works Management Framework has been reformed as per the NDP;
- There will be robust and effective standards based on international benchmarks to support the reuse of secondary construction products, and the focus of government policy across all agencies will be aligned to ensure that new recycling processes can be quickly approved and certified;
- The insurance industry supports the use of construction by-products and innovative solutions;
- An integrated supply chain with open-source information on environmental performance;
- All construction sites will have access to the national grid to allow the use of electrical vehicles on site, including the use of HVO as an alternative to diesel in machinery, with site accommodation powered by renewables;
- A scalable network of fuel depots will be implemented to support alternative fuel use in heavy plants and equipment;
- Open-source access to Product Performance Declarations such as EPDs;
- Grants for SMEs to implement upskilling and certification such as ISO 14001 in a meaningful way onsite;
- Government funding allocated to provide additional training for Local Authority Staff who are working on small-scale projects for upskilling the engineering staff who are managing/designing these projects.

What are the challenges to achieving this ambition?

It is recommended that the Constructions Works Management Framework be reviewed and updated to embed circularity, and that the OGP receive additional resourcing and assistance for the delivery of their Medium Term Strategy [50] in alignment with the following:

- Whole life cycle costing;
- Whole Life Value;
- Quality in Award of contract – quantitative criteria;
- Insurance, liability and indemnity;
- Risk Management;
- Digitalisation and modern methods of construction (MMOC);
- Green Public Procurement;
- Inappropriate requirements in green procurement.

[50] Office of Government Procurement: https://www.gov.ie/en/organisation/office-of-government-procurement/

Secondary construction products, such as crushed concrete, require robust testing criteria to determine if reuse on-site is feasible. Local Authority noise restrictions can sometimes prohibit onsite crushers where reuse of concrete is possible.

There is no national testing centre dedicated to the testing of new innovative products and materials, and the certification and inspection system is underfunded and under-resourced.

Adapting procurement methods to align with circular economy goals necessitates client-driven decisions and the support of their design teams. Clients should determine how their constructed asset can maintain performance throughout its lifecycle and define how this performance is measured. Understanding the link between sustainability, performance, green procurement, and project scope is crucial. Environmental performance relies on measurable metrics, which must be outlined by the client and design team.

This should occur during the project's early stages, prior to construction, within the business case and design phase. The contract functions as the project's operational guide, while the scope outlines work descriptions, features, and performance criteria. Detailed documents, including material specifications, work requirements, and systems needed, are pivotal for effective green procurement.

RECOMMENDATIONS	TIMELINE
Reform of the Construction Works Management Framework, including the procurement process and public works contract, recognising the need to train procurers who need to understand that procurement of a circular building starts before the site is acquired and brief developed not at tender stage for the contractor.	2030
Formal CPD training in sustainability including LCC, LCA, Article 27 & 28 and circularity to be a mandatory requirement for all CIF companies & accredited through the attainment of a digital badge or similar.	2024
Engage experts from more developed circular economies to share their experience in CPD.	2025
Appointment of a circularity officer in all CIF affiliated companies.	2027
Engage with material suppliers to pilot 'take back schemes' from site waste products to recycle e.g., plasterboard, insulation, timber, wiring etc.	2027
All contractors to sign up the IGBC Construction Materials Exchange (CMEX) platform and integrate it with procurement, estimating and contract management functions within contractor organisations	2027
Encourage contractors to attain ISO 14001 and integrate circular principles into this management system.	2027
Use pre-demolition audits in order to identify materials in demolition projects that can be recycled or down cycled.	2027
All built drawings to be in the form of a digital twin BIM model. All EPDS to be included with components. The model should operate as a 'material bank' identifying the materials that can be used in other projects at its end of life.	2027
Effectively fund and resource the Office of Government Procurement.	2025
Introduce whole life cycle costing, with resource Whole Life Value and carbon budgeting.	2030
Research into implications in relation to liability, indemnity, and insurance as it relates to the mechanisms of the implementation of circular economy principles in the construction sector will be important.	2025
Collaborative forms of contract designed to avoid disputes and incentivise innovative performance. Circularity during construction requires contracts that rewards innovation	2025
Clear definition of a Design Scope of Services, Standard of Design and clear identification of design responsibility in the Contract documents, Bill of Quantities and Specifications.	2030
Effective risk management.	2025
Integration of early contractor involvement in the design process.	2025

OPERATIONS AND USE OF INFRASTRUCTURE AND THE BUILT ENVIRONMENT

Once constructed, the way in which occupiers can operate and use buildings and physical infrastructure provides an opportunity to embed principles of the circular economy into the built environment. Our ambition is that buildings should be constructed, designed and located in a network of infrastructure, so that their running costs can contribute to extending their life-cycle and options for occupation and use.

Improving the use of buildings

- Greater engagement with potential occupiers of buildings in the design phase with greater consideration given to how buildings are to be used and operated at the earliest project stages. Appointment of operators early in the design process to allow for integration of sustainable facilities management practices early in a project.
- Appointment of operators early in the design process can also allow for integration of their requirements into overall brief requirements. Consideration should be given to allow operators and procurers to enhance their collective ability to deliver circularity objectives e.g. 'green partnerships'.

Behavioural Change:

- Enhancing the concept of networks of infrastructure so that individual infrastructure projects are not seen as working in isolation, but can achieve greater circularity outcomes by being designed and used as a network of inter-connecting projects.
- Buildings as living labs and learning environments to nudge behaviour change by occupiers.

Recommendations

DESIGN PHASE

- Maximising the potential to use solar energy through building orientation, window size, and heat recovery ventilation systems.
- Digital technologies such as building information modelling (BIM) and digital twins can be used for planning, designing, constructing, and managing property. Through more direct collaboration with stakeholders, facilities managers can use technology such as BIM to identify performance and use patterns and the costs of maintenance.
- Technology and parametric modelling can permit facilities managers to make real-time changes for multiple users. Different models can be discussed with the design team.
- Design can also be optimised for the total cost of ownership. Typically, the cost of repair is multiple times the cost of monitoring the performance of buildings to avoid a defect occurring in the first place. Better planning, forecasting, speed and quality of maintenance when hardware has been designed to be easy to upgrade, together with long-term collaborations between stakeholders, can further reduce these costs.

OPERATIONS PHASE

- Consideration of implementing a system of Soft Landings [51] whereby there is a process for a gradual handover of a new or refurbished building, where a period of professional aftercare by the project team is a client requirement, planned for and carried out from project inception onwards, and for up to three years post-completion.
- Strategies for fit out and replacement of furniture and fittings around longevity, reuse, take back schemes. Use of modular partitions that can be easily reconfigured rather than demolished.
- Harnessing technological innovation in intelligent buildings to help promote the circular economy in building to improve the ability and speed with which occupiers can self-diagnose some maintenance requirements by using sensor technology integrated into BACS (Building Automation and Control Systems).
- Embed circular principles at a neighbourhood scale by integrating waste management into the circular economy; for example, waste collection companies can specialise in processing waste such as textiles, plastics, paper and organic materials. The case study of van Gansewinkel in Rotterdam which operates a circularity centre collecting waste for re-use and recycling should be explored further in Ireland. [52]
- The following waste reduction programmes are important to help move to zero waste buildings:
  - source separation of resources and waste to derive maximum potential resuse;
  - infrastructure for waste reduction and education of occupants;
  - use of local digestors and clean technologies for organic waste streams, including black and grey water;
  - collecting and re-using rainwater locally; and
  - making buildings biodiversity-friendly.
- monitoring and continuous improvement can entail:
  - BIM to monitor building health throughout its lifecycle.
- closing the following loops on site, where possible, will also help:
  - organic waste can be dealt with by bio digestion, heat recovery, mineral extraction, using compost as input for on-site food production or general soil enrichment; on-site food production improves user engagement and education;
  - greywater can be recycled for toilets or landscaping;
  - heat recovery through geothermal heat pumps and extracting heat from waste and cooking;
  - sorting and pre-processing resources and waste on the site to maximise recycling or reuse and educate users;
  - use of less resource intensive solutions such as nature-based solutions including landscaping for biodiversity and species protection which reduce the need to use commercial fertilisers;
  - using renewables where possible, such as combined photovoltaics and solar hot water, small-scale bio digestion and battery storage of electricity for emergency back-up, reduces the need to use other fuels, which are typically fossil fuel-based; and
  - 3D printing for on-site manufacturing or remanufacturing will be possible in the future, cutting down on transport costs and emissions.

[51] https://www.designingbuildings.co.uk/wiki/Soft_landings

[52] Van Gansewinkel: Rotterdam organisations join forces in Circularity Center https://www.wendelgroup.com/sites/default/files/2014-april-04-rotterdam-organisations-join-forces-in-circularity-center.pdf

BEHAVIOURAL

- Regularly conduct sustainability audits through collaboration between all stakeholders in the design and operation of buildings to understand what is and is not working when it comes to reducing the carbon footprint (including matters such as conservation of water, reduction of waste) of company facilities. A circularity audit, followed by meaningful changes to the way in which the buildings are used will help occupiers analyse current sustainability efforts and find areas for improvement to achieve targets and a plan.
- Circular facilities management policies and guidelines to be implemented in organisations to help occupiers know what and how to recycle workplace resources from paper, and cans, to large e-waste such as old computers and batteries, with specific tasks assigned to colleagues to champion participation in building-wide recycling programme.
- Wellbeing at work is vital for productivity and staff retention. Current trends include changes in space use, such as activity-based work (ABW) stations and decreasing the space per person, which reduces the physical resources required per staff member, thereby reducing the environmental footprint. However, ABW layouts can simultaneously reduce opportunities for social interaction and collegiality, thereby reducing social sustainability.
- Commercial space providers should also consider access to childcare and other user amenities; further measures which have a proven track record in success may include the following: [53]
  - Decentralised access to heating and lighting controls increases productivity as users manage their own environments.
  - Natural ventilation and access to green space is related to good indoor air quality and wellbeing, improving productivity by more than 11%.
  - Natural daylight and views increase productivity by 23%, and having windows that can be opened, 18% thereby improving the usefulness of the building itself.
  - Collective goals and incentives to achieve performance targets result in greater levels of teamwork and outputs.
  - Designing for function by focusing lights on working areas is more economic than ambient lighting.
  - Enhancing existing tools such as LEED, WELL etc in ensuring behavioural incentives can be offered, such as shower facilities for cyclists.

[53] Circular economy: role of facilities manager - Virtuous circle: https://www.isurv.com/info/390/features/11568/circular_economy_role_of_facilities_manager

RE-USE AND RETROFIT OF BUILDINGS AND INFRASTRUCTURE

Synchronising & Identifying Shared Strategic Outcomes

As noted in the previous section, initial stakeholders involved in the design of new buildings or infrastructure are often not involved in ongoing operations. This absence has the potential to negatively impact the optimisation of circular economy principles once the building is in use. Owing to this absence of a long-term vested interest, the opportunity to optimise circular economy principles may not be fully capitalised on as it does not form part of their client's brief.

Cost & Budget Constraints

There is a challenge to gaining buy-in from all stakeholders to factor whole life cycle costings and circular economies at the outset of design and planning. Planning and design can often place a greater focus on aesthetics and space optimisation rather than the use of materials and building systems which offer greater flexibility in lending themselves to optimising circular economy potential.

Knowledge and perception

The reuse of building components and mechanical and electrical parts is often perceived as achieving upfront savings which, in the eyes of the occupiers, may have an impact on the quality and safety of both the building and its component parts, thereby carrying additional risk. Moreover, there can be an ingrained perception that building systems may fail owing to the reuse of parts which can increase the perceived risk profile of the building. This perceived risk profile may extend to encompass the insurance of the building, with insurance providers potentially also deeming reuse as increasing the risk profile of the building.

Retrofitting & Conservation

Challenges result in devising solutions which capitalise on potential for circular economies owing to existing building structure, age, building regulations and if a building or any of its features are protected.

What is our ambition?

As noted in the policy context of this report, Ireland's national Long Term Renovation Strategy (LTRS) outlines Ireland's existing building renovation policies which are set out in a range of policy documents, most notably the Climate Action Plan and the National Energy and Climate Plan, which in turn were developed in line with the targets of the EU's Green Deal and Renovation Wave.

What are the challenges?

Many of the changes required to reuse and retrofit buildings and infrastructure of all types involve a significant initial outlay, and Government support should particularly assist SMEs and those without resources to undertake major refurbishments to make the necessary transition to extend the life and use of their buildings.

Every renovation project is different and unique, dependent on the use, nature and age of any particular building or piece of infrastructure – which makes it difficult to aggregate projects into a size that funds or banks will accept or that could be securitised by financial institutions. With each project being undertaken in isolation, there is a lack of coherent oversight of how Ireland's building stock is, and should be, renovated.

What are our proposed solutions?

Dublin Chamber has proposed that Government should consider a tax credit for SMEs that have undertaken and completed three items from an approved list (or 'Sustainable Business Register'), to significantly reduce GHG emissions or otherwise improve

sustainability of its operations. For the purpose of this report, items on the list could for example include: retrofit and energy efficiency measures; circular supply chain guarantees; effective waste management practices; circular economy measures; and adoption of low-emissions transport. [54]

Eco-certifications and Third-Party Environmental ratings: There are many established rating schemes used for commercial buildings in Ireland, including are LEED and BREEAM, and Home Performance Index for residential properties. Level(s) can be applied to civil infrastructure projects. These ratings can act as a baseline or a benchmark for comparing investments and performance to inform decision-making. They can also demonstrate that a building goes above and beyond mere compliance with regulations (potentially standing out from, and above the competition) and could be used as a marketing tool to attract investors and tenants for (circular) renovation.

Direct Reuse: Resources are directly reused for the same purpose, where possible. This includes some repair, which by extension, may include refurbishment. Direct reuse is considered for doors, windows, pillars, fences, cut stone and other masonry structures when used for the same purpose, on the basis of forthcoming EPA guidance.

Pre-Demolition Audit (Including An Audit Of Haz Materials): Pre-demolition audit presumes demolition will take place. It should be incorporated into the pre-construction audit report. As identified within the EPA Resource and Waste management guidance, pred-demolition audits should be developed in line with EU requirements.

Resource & Waste Management Plan: Prepared in accordance with the EPA Guidance.[55] The EPA best practice examples provide a useful tool in the delivery of this goal. [56]

What are the challenges?

Cost & Time: There is a need for the client to lead the decision-making process and value allocation in relation to how buildings are demolished/disassembled Currently, demolishing a building is a cost factor and currently, demolition is seen as a cheaper and quicker form of reuse of the land on which the building stood. Developers and clients may require full-scale demolition completed as quickly as possible to focus on delivery of a new building and thereby achieve occupation (and therefore a return on investment) quickly. Time and cost are strong drivers for selecting a certain method of demolition.

Building Resources: As natural building resources are limited, use of virgin materials is often prioritised. Secondary replacement products should be procured to reduce carbon tonnage and climate and environmental impacts.

Insulation Materials are difficult currently to recycle, reuse and deconstruct and may cause difficulties in the demolition phase. It is vital that older insulation products inflated with Ozone depleting substances and/or F-gases are destroyed safely and without losses to atmosphere as part of any demolition process in accordance with EU F-gasses Regulations.

54 Dublin Chamber, Sustainability: https://www.dublinchamber.ie/Influencing/Policy-Priorities/Sustainability

55 Government of Ireland, Construction and Demolition (C&D) Waste https://www.gov.ie/en/publication/c305a-construction-and-demolition-cd-waste/

56 EPA, Best practice guidelines for the preparation of resource & waste management plans for construction & demolition projects: https://www.epa.ie/publications/circular-economy/resources/construction--demolition-guidelines.php

RECOMMENDATIONS	TIMELINE
Government should produce Pre-Demolition Audit Protocol.	2025
BIM Methodology/Technology & Governance should be considered mandatory for all construction and demolition projects.	2025
Government should provide grant-aided training for BIM for SMEs.	2025
Undertake a building census for the Irish building stock development as well as the material stock and flows –based on the Dutch Model already in place.	2030
Consider an Extended Producer Responsibility (EPR) scheme for insulating materials, as there are many difficulties dealing with these materials in a demolition phase.	2030
Retrofit methods and materials should also align with circularity principles. High embodied carbon insulation which is difficult to reuse or recycle (such as polyurethane) should be phased out.	2030

TREASURY BUILDING

Renovation & Extension

Location
Grand Canal Street Lower, Dublin 2

Architects
Allford Hall Monaghan Morris Architects

Structural Engineer
CORA Consulting Engineers

Date
December 2024

Area
21,724 sq m

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The building was originally constructed in 1946 as Boland's Bakery a four storey steel framed building clad with brick. In 1986, in was renovated and extended by one floor and an entrance atrium was added. In 2022, Planning Permission was granted for a further vertical extension of two stories and a horizontal extension of the atrium space.

As part of the proposed works, the existing steel structure was required to be strengthened and modified. Additional steelwork was also required and some steelwork that was no longer required in its original location was carefully removed and sent directly to the Steel Fabricator to be altered before it was returned to the building. The processing of this reclaimed and reused steel followed the procedures in SCI Publication P427 which outlined testing and certifying of the materials to allowed it to be certified as CE marked and returned to the building as new steelwork. The Embodied Carbon of reclaimed steel is approximately 50kgCO2e/m2 versus new Blast Furnace Steel of 2,450kgCO2e/m2.

All of the existing Raised Access Floor tiles in the building were also lifted, sorted, cleaned and stored for reuse on new pedestals. Damaged or cut tiles were discarded with that equating to approximately 5% of the total.

Reinforced concrete that was removed from the building as part of the modifications was crushed, screened and graded and sent for reuse as Recycled Aggregates in unbound applications

SELECTIVE DEMOLITION

What is our ambition?

To enable and encourage informed sustainable selective demolition practices by treating buildings and infrastructure as material banks. The implementation of a circular economy culture by utilising selective disassembly techniques and strategies to maximise the reuse and recycling of materials at their highest economic value, with the ultimate objective of achieving a zero-waste goal.

What does best practice look like?

Design For Selective Demolition: Design for partial or full selective demolition considering reuse within the project of materials generated or an external reuse or recycling. Development design teams should receive specialist demolition advices as early as possible to inform potential for circular economy opportunities in selective demolition methodology, etc. Design to consider the full life cycle of the project and include reuse options for next project and to take account of easy disassembly at the end of life. Design should consider whether renovation is a more circular and sustainable option than demolition.

BIM Methodology & Governance to be considered for all new projects, renovations and additions. It allows construction managers to create a virtual project model that can be analysed and modified before any physical work begins. The application of BIM also captures all building materials used in the construction – this will in turn inform future reuse and recycling, while creating a culture of buildings as material banks.

Prepare A Pre-Demolition Audit
(including an audit of hazardous materials)
As identified within the EPA Best Practice Guidelines for the preparation of resource & waste management plans for construction & demolition projects [57] pre-demolition audits should be developed in line with current legislation. The pre-demolition audit will identify materials for reuse and recycling. A material inventory for the project can be established and material flows can be tracked from demolition.

Prepare a Resource & Waste Management Plan in accordance with the EPA Guidance.[58] This should include both building fabric and materials to be excavated. Excavated materials should be assessed and classified for potential reuse or recovery potential. Where contamination is identified it should be delineated and assessed for appropriate treatment on or offsite. This should be carried out by a qualified and experienced environmental professional following recognised standards such as the EPA Code of Practice [59] and BS10175. Material volumes should be quantified in the RWMP and tracked throughout the project. A project closure report should be submitted to the appropriate authority at the end of the construction phase.

Direct Reuse: Resources are directly reused for the same purpose, where possible. This includes some repair, which by extension, may include refurbishment.

Measuring the material flows from a selective demolition and construction project is an effective measure. All materials generated through a demolition and construction project are documented along with their destination (i.e. reuse, by-product, recycling, waste etc). This also allows Ireland track progress against EU waste reduction targets at the site of generation as opposed to relying on waste facility statistics which will become less meaningful as reuse and recycling rates increase.

Purpose built recycling facilities should be used where on-site product production is not possible due to space, time and environmental constraints where environmental and quality controls are easily monitored and the market is established and effective as is the norm across Europe.

[57] https://www.epa.ie/publications/circular-economy/resources/CDWasteGuidelines.pdf

[58] EPA, Best Practice Guidelines for the preparation of resource & waste management plans for construction & demolition projects: https://www.epa.ie/publications/circular-economy/resources/CDWasteGuidelines.pdf

[59] https://www.epa.ie/our-services/compliance--enforcement/waste/contaminated-land/

What are the challenges to the delivery of best practice?

Improving Quality Secondary Materials: Quality secondary materials must be produced to ensure no adverse environmental, health or structural impacts. Material specifiers and designers need to have confidence in secondary materials.

Lack of competency in relation to the preparation of pre-demolition audits, pre-development studies that incorporate whole lifecycle assessment and circularity.

Over Reliance On Backfilling: Ireland relies on backfilling to deal with 82% of demolition wastes.[60] Materials which could be reused or recycled are backfilled into former quarries or agricultural lands hence taking them out of circulation. This is a low economic but potentially high environmental cost as the embodied carbon of materials is lost.

Current Status of the Industry

In the demolition sector project safety is the first priority. Prevention sits at the top of hierarchy so the first question that should be asked is whether demolition can be avoided. If demolition is agreed, reuse must then be considered as the first priority. The direct reuse on the development site is generally the first port of call and then direct reuse off-site is the second option for consideration. In some cases the materials may only be suitable to be directed for recycling off-site or disposal to landfill.

A recent OECD report on the circular economy in Ireland stated that Ireland needs to *"Make the legislative and regulatory framework fit for the circular economy by making regulation conducive to ecodesign, repair, reuse and remanufacturing; streamlining regulatory processes for reusing material considered as waste through end-of-waste and by-product processes; broadening extended producer responsibility (EPR) to new waste streams and improving existing EPR schemes to facilitate reuse; mandating Resource and Waste Management Plans, which are currently recommended on a voluntary basis, for all construction and demolition projects; and ensuring that circular criteria are included alongside green criteria in GPP"* [61]

The EPA published a National end-of-waste decision for recycled aggregates, production of recycled aggregates on the 17th October 2023 and registration is open for companies to use this now. Various stakeholders will need to work together to ensure that product standards, product certification, waste enforcement and materials specifications are aligned to accommodate and promote use of recycled aggregates in appropriate uses.

Raised access flooring (RAF) is a material that should be considered for direct reuse as an expensive and high carbon content material.

Consistency in approach around the use of crushers on the projects sites needs to be addressed by the local government sector. Some local authorities require permits while others do not; similarly, some local authorities permit the reuse of the material on site while others do not.

Currently there is difficulty with building control and fire certification when reusing materials or using secondary products and suitable harmonised product standards are in development to allow for their reuse/recycling without increased risk. Appropriate upskilling and training for this sector in the safe specification and use of recycled products will be required when suitable certification processes have been implemented to ensure risk-free reuse of harmonised construction products.

Current practices tend to move towards requiring demolition and removal as soon as possible. So tender proposals are generally decided on cost and time, but this needs to change whilst the project has to remain viable. All development projects should have to demonstrate that they include circular economy practices

[60] EPA: https://www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics/construction--demolition/

[61] https://www.oecd-ilibrary.org/sites/7d25e0bb-en/index.html?itemId=/content/publication/7d25e0bb-en.

as a minimum not unlike that requested in the Circular Planning statements in London. Demolish to segregate at the highest value is what is required to ensure that a project is more circular and a minimum reuse on site target based on the total tonnage of material produced in demolition phase. Tracking of material flows and rate will allow this to be measured and assessed.

There are few outlets available for contaminated or hazardous construction materials and therefore the country is reliant on export which is expensive and is not circular. Hazardous products must be permanently excluded from the material supply chain and are not suitable for recycling or reuse.

Public Fixed price contracts are a big issue when it comes to try and implement circular economy practices as they do not encourage time for demolition for reuse. All Public Projects should demonstrate an element of circularity and this should be included in the Capital Works Management Framework.

In the education sector cost per square metre is the standard cost metric, and, for example, selective demolition is recorded as an additional and abnormal cost rather as a standard cost.

The demolition sector should be encouraged to move away from backfill and landfill of construction materials where they are suitable for reuse or recycling and the introduction of regulations to include a landfill levy per tonne should be considered at a rate similar to the UK of £3.25/tonne.

Tax incentives on demolition should be considered to tweaking tax terms of plant depreciation for recycling and recovery infrastructure possibly a higher annual depreciation rate.

RECOMMENDATIONS: GOVERNMENT	TIMELINE
Government produce "A Pre-Demolition Audit Protocol" in 2025 and this could be undertaken by the EPA and Local authorities under CEP fund.	2025
Consider grant aiding training or an accelerator programme for circularity that would incorporate digitalization for SMEs.	2025
Consider implementing a building census and building logbooks for the Irish building development stock as well as the material stock and flows. NB: Digital Building Logbooks are mandatory under EPBD 2023, precise details are currently awaited from the Commission which are to be developed under Delegated Acts.	2025
Government to consider introducing a tax on virgin aggregates to encourage use of secondary aggregates, following the delivery of other measures to increase the overall circularity of the sector.	2030
Government and Local Government to consider updated training for building regulation and fire certification teams on materials reuse and secondary products when the CPR Acquis process is complete for structural and fire resisting materials.	2025
Appropriate training and educational bodies to consider training of certifiers for assigning recertification of raised access flooring.	2025
Consideration of tax incentives for demolition such as for recycling/ recovery plant a higher depreciation rate could be avenue for incentivisation.	2025
Introduce a backfill/landfill levy for construction and demolition materials at a rate similar to the UK of £3.25/tonne to encourage backfill/landfill diversion where reuse or recycling is possible.	2025
Provide guidance on reuse to support industry in determining their legislative requirements and encourage reuse and resource efficiency and ensure that all new buildings are designed for adaptability and deconstruction.	2025

RECOMMENDATIONS: PUBLIC SECTOR/LOCAL GOVERNMENT	TIMELINE
The public sector should lead by example and mandate maximum circularity for the procurement of all public projects, including the reuse of existing structures where possible, use of reclaimed and recycled materials and design for disassembly.	2025
A review of the national over reliance on backfill and export as waste solutions should be undertaken. Reuse and recycling should be encouraged above backfilling through a range of incentives.	2025
Consideration should be given to demonstrating circular economy practices in all developments/ tenders from.	2025
Update the Capital Works Management Framework to include the demonstration of circularity potential by adding a column to page 14 main project processes.	2025
A minimum reuse on site target of 15% for all demolition projects based on the total tonnage of material produced in demolition phase should be investigated.	2025
The demolition industry must be enabled to reuse/recycle on-site where possible, for use directly on-site or directly off site particularly for selectively demolished single stream material. The liberalisation of the market will encourage the demolition industry to invoke circular economy practices and create a more sustainable culture. Furthermore, enabling the demolition industry to maximise reuse/recycling will potentially reduce unnecessary lorry movements but where there are site and space constraints and any other barriers this will also enable the recycling industry to develop in tandem to cover all potential avenues to circularity.	2025
Local Government Sector to have a consistent approach in terms of mobile crushing permits and reuse permissions on the development sites.	2025
Government and Local Government to consider ongoing training for building regulation and fire certification teams, as well as designers and builders on materials reuse and secondary products.	2025
Government to consider training of certifiers for assigning recertification of raised access flooring.	2025

RECOMMENDATIONS: INDUSTRY	TIMELINE
Requirement for on-site separation of materials on site to allow the materials to be reused or recycled at the highest possible value.	2025
Production or high-quality recycled materials through adhering to legislative requirements and follow international best practice from countries with established recycling markets (e.g. through a quality production protocol).	2025
Provide accurate data on material flows and rates using electronic recording systems.	2025
Standardise site investigation and material characterisation reports for excavated materials to ensure that materials are assessed in terms of their reuse potential, not just the landfill waste classification as currently used by many consultants by 2025.	2025

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