



Bonneagar Iompair Éireann
Transport Infrastructure Ireland

TII Circular Economy Plan

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Arup

TII Standards Training 2022
5th May 2022

TII Circular Economy Plan

Standards Roadshow

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Agenda

- Introduction
- Circular Economy Policy and Strategy
- Circular Economy Action Plan
- Circular Economy Template Plans for Projects
- Pilot Projects
- Next Steps

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Transport Infrastructure Ireland

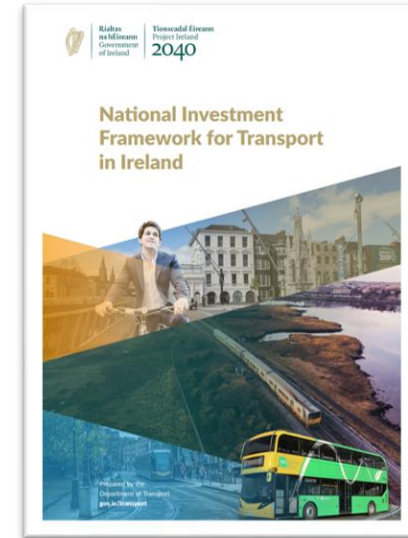
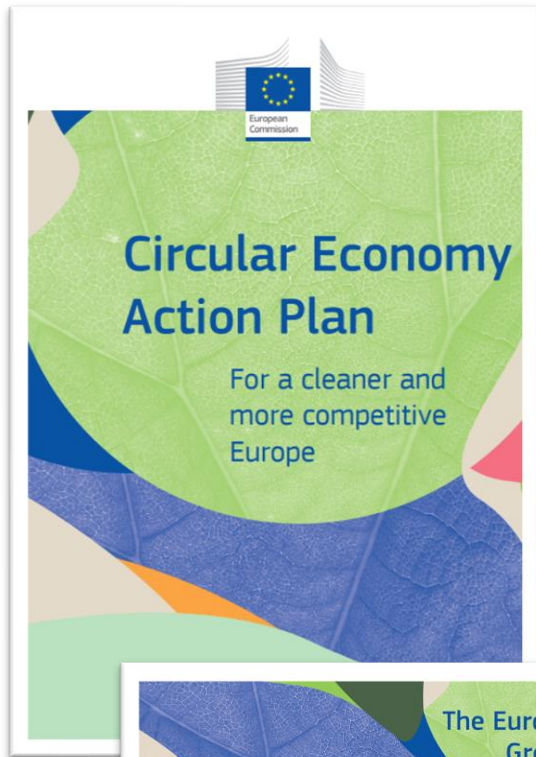
Introduction

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The Importance of Circular Economy

To Ireland and the European Union



National Investment Framework for Transport in Ireland Intervention Hierarchy



9R Categorisation of Circular Economy

Reflects International Experience



R0. Implement Regenerative design principles to add value. Make the asset redundant by making its function unnecessary. For example compact growth reduces demand for transport and makes active travel and public transport easier to provide eliminating the need for private cars when compared with dispersed growth.

R1. Make the asset use more intensive. (eg by delivering the demand for transport in shared vehicles and in particular buses).

R2. Increase efficiency in asset manufacture or use through design for deconstruction or consuming fewer natural resources and materials.

R0 Regenerative Design and Refusing the Asset
R1 Rethink

R2 Reduce and Design for Deconstruction



R3 Reuse

R4 Repair
R5 Refurbish
R6 Remanufacture
R7 Repurpose

R8 Recycling

R9 Recover

R9. Incineration of material with energy recovery

R3. Reuse by another asset or organisation of discarded asset which is still in good condition and fulfils its original function

R4. Repair and re-manufacture of defective asset which is still in good condition and fulfils its original function

R5. Restore an old asset and bring it up to date

R6. Use parts of discarded asset in a new asset with the same function

R7. Use discarded asset or its parts in a new asset with a different function

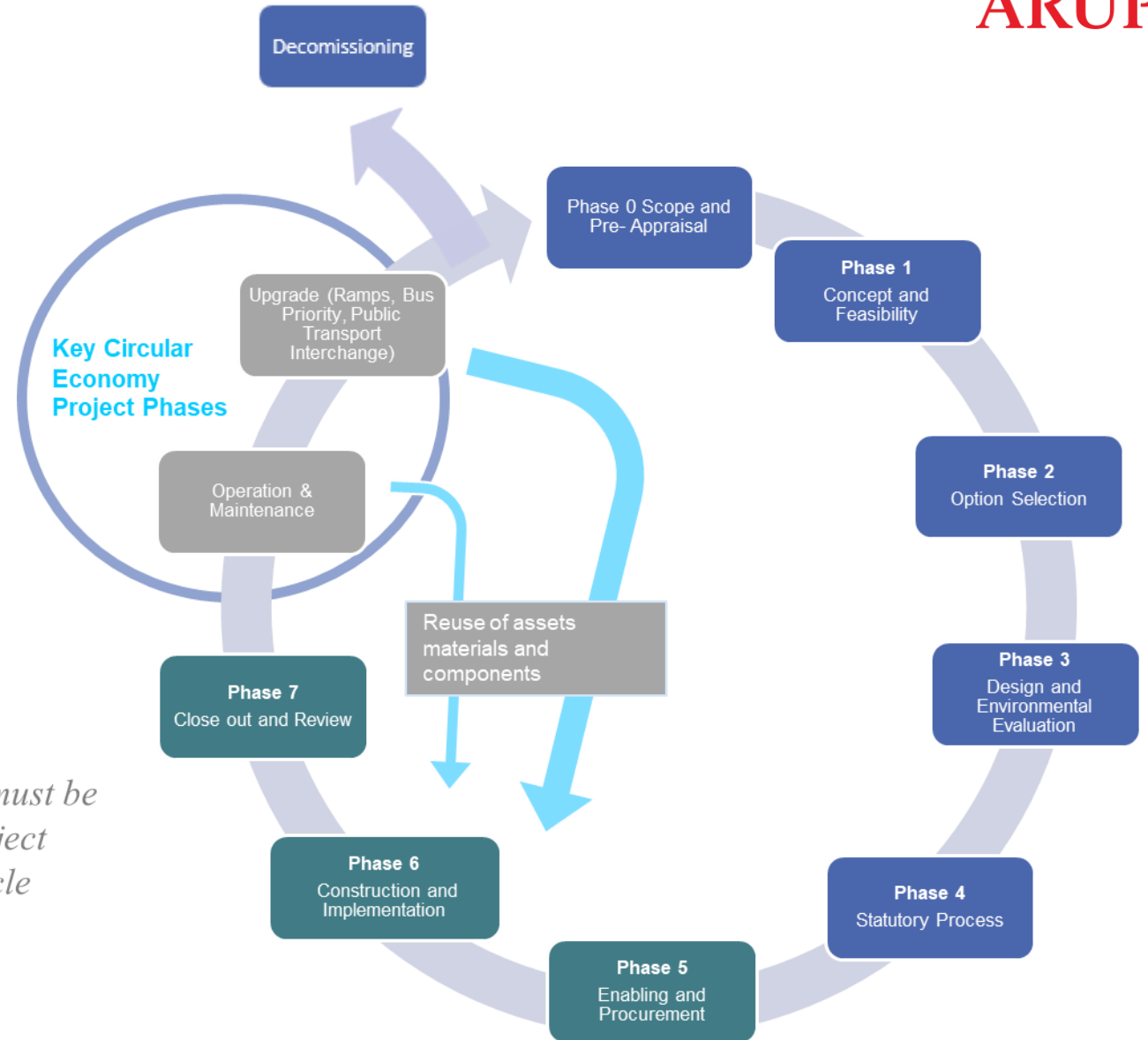
R8. Process materials to obtain the same (high grade) or lower (low grade) quality

Circular Economy in TII

“an economy that is restorative and regenerative by design, and which aims to keep assets, components and materials at their highest utility and value at all times”

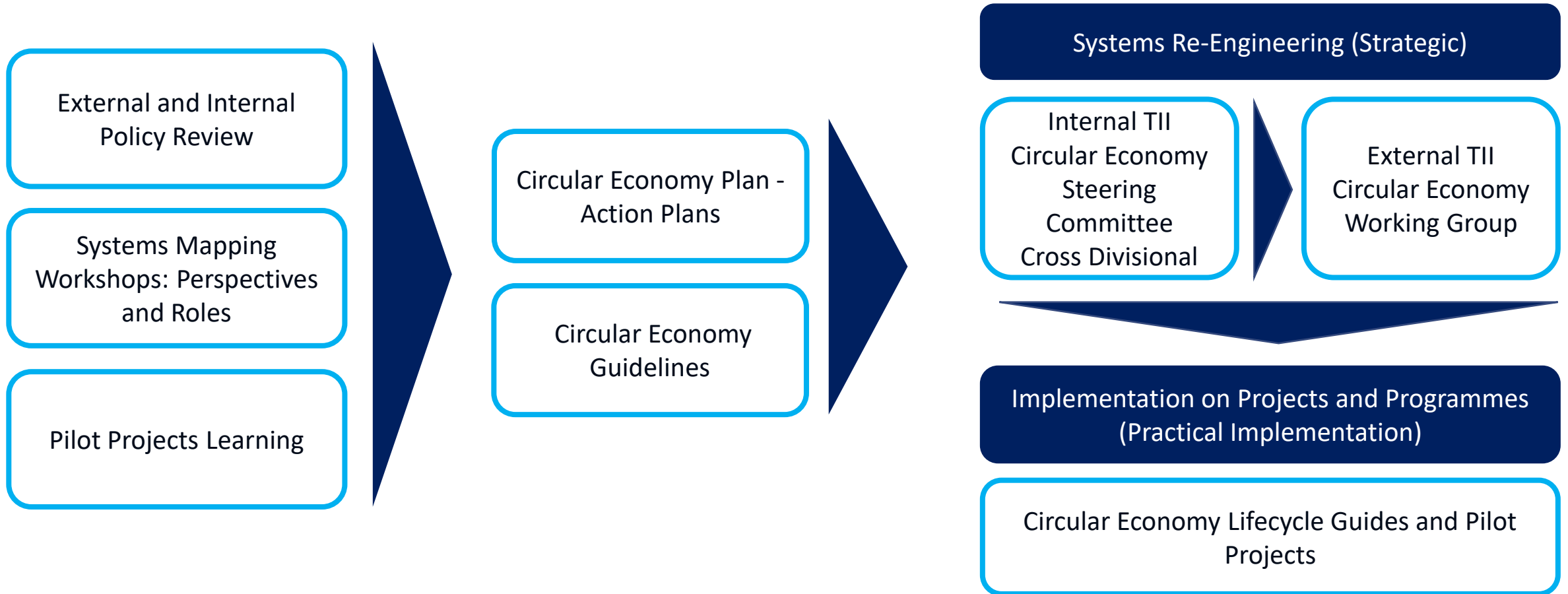
“sweating of assets and re-engineering of business systems”

“Circular Economy must be considered at all project phases, and a life cycle approach taken”



TII Circular Economy Plan

Creation and Implementation



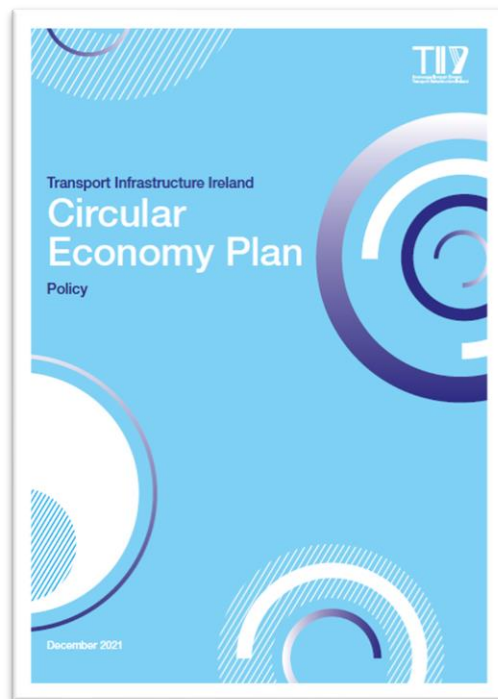
Circular Economy Policy & Strategy

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TII Circular Economy Policy

Guiding Principles



Creating value through:

- Optimisation of asset use
- Driving down embodied carbon and
- Re-engineering of business systems

TII will adopt a circular economy approach throughout all activities, programmes and projects it undertakes and sponsors



Re-engineering of Systems

Ensure asset optimisation is considered at outset of projects. Implement layers design concept, to enable design for deconstruction and ease of maintenance to lengthen asset life.



Asset Management

TII as an asset management organisation through mindset change and re-engineering.



Procurement

The use of whole life costing in procurement, taking account of environmental and social criteria.



Collaboration

TII will engage with the supply chain and other agencies to influence UN SDG implementation and vice versa.



Life Cycle Assessment

Consider operation and maintenance at the early project phases. Use new/ appropriate models which strike a balance between economic and social costs.



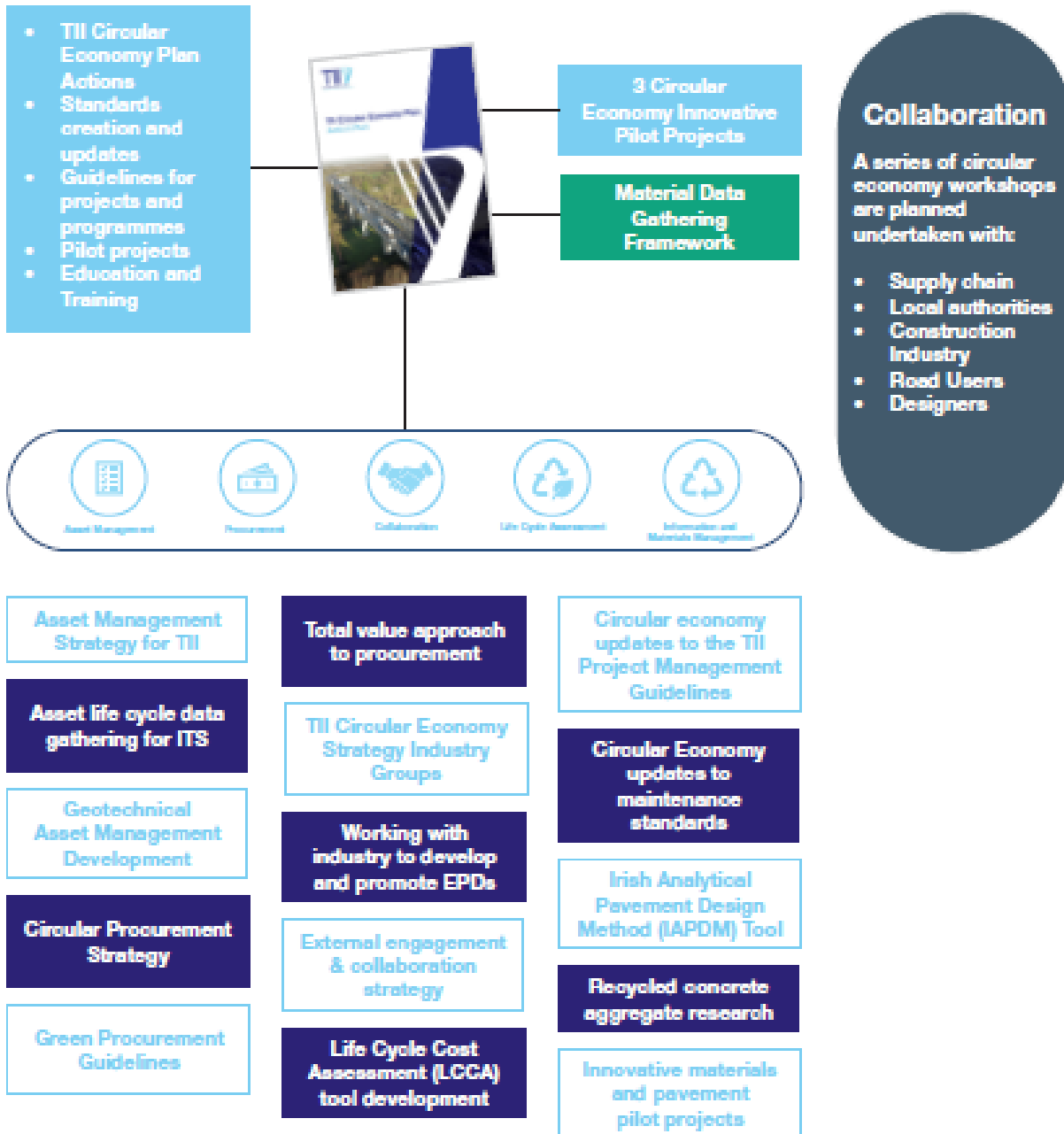
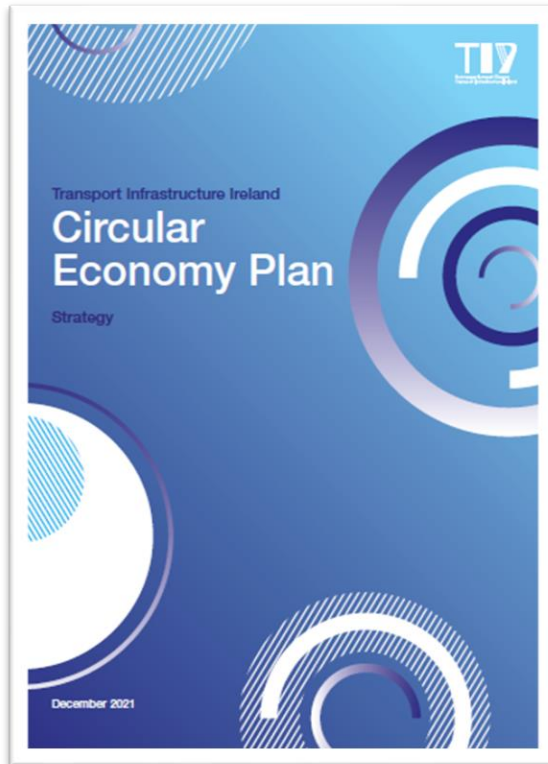
Information and Materials Management

Gather asset management data to inform timing of (re) design, investments/ divestments etc. Material passport-type data gathering for assets, components and materials

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TII Circular Economy Strategy

TII Approach



Circular Economy Action Plan

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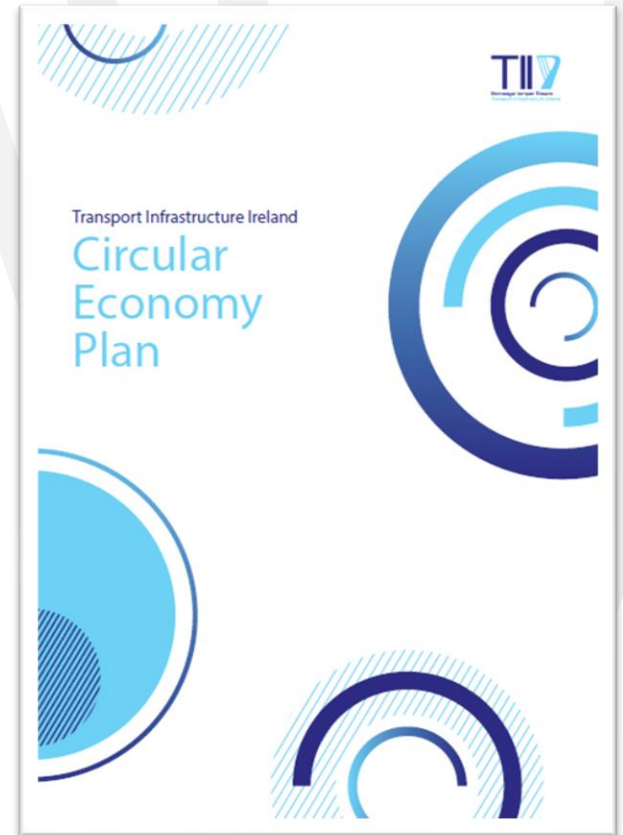
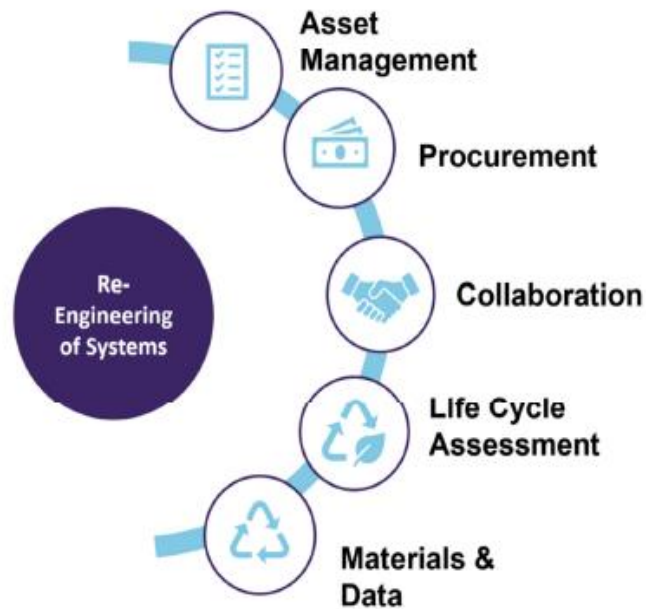


Circular Economy Action Plan

An economy which is restoration and regenerative by design and which aims to keep assets components and materials at their highest utility and value at all times.

Sweating of Assets

Taking a life cycle approach to all assets



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TII Action Plan

Theme Headings



Re-engineering of Systems

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The use of whole life costing in procurement, taking account of environmental and social criteria.



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TII can engage with the supply chain and other agencies to influence UN SDG implementation and vice versa.



Life Cycle Assessment





Consider operation and maintenance at the early project phases. Use new/ appropriate models which strike a balance between economic and social costs.



Information and Materials Management

Gather asset management data to inform timing of (re) design, investments/ divestments etc. Material passport-type data gathering for assets, components and materials

Interventions

Description	
 Regulatory	Political and Legal instruments such as policy, regulations, Article 27 and 28 determinations, licences and permits, contracts and planning permissions
 Economic (fiscal)	Financial incentives such as taxes, grants and loans etc
 Technical	Such as standards updates, new standards or specifications, material passports, warranties, environmental impact assessment reports
 Collaboration / Facilitation	Industry group facilitation, training, education, support, networking and platforms etc.

Circular Economy Action Plan



Materials & Data

Update standards for optimisation and reuse

Implementation of Circular Economy Plans for all projects

Guidelines on carbon accounting by construction asset approach

Procurement

Circular criteria for non CWMF procurements

PCRs and EPDs development for key TII materials

Social and Environmental indicators to be developed

Life Cycle Assessment

Update PMGs for a life cycle approach

Decommissioning Management Plans development

Supply chain engagement strategy

Asset Management

Guides for Geospatially linked as built

Obtain life duration, DfD and attachment data for assets

Deterioration rate and discounting research by asset

Collaboration

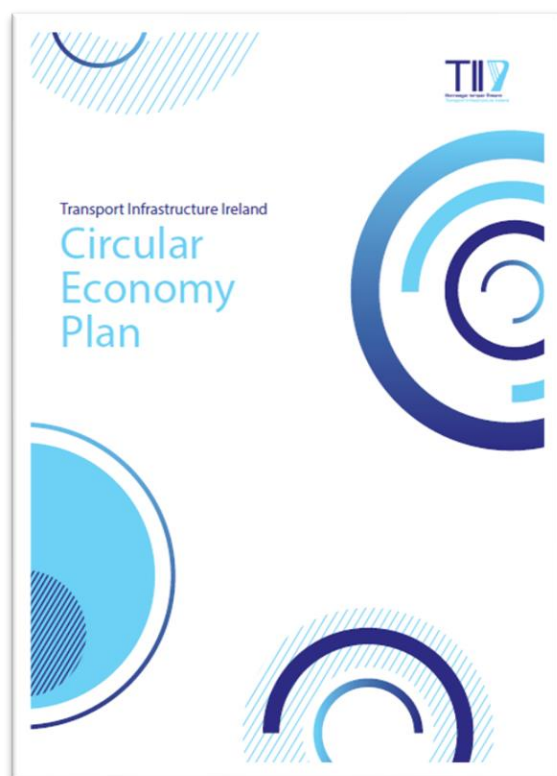
TII Cross Divisional CE Implementation Group

CE Industry and Stakeholder Implementation Working Group

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Circular Economy Action Plan

Actions being Finalised



Circular Economy Plan – Material and Data Actions

M1. Update Standards for Optimisation and Materials Reuse	MA1.1 MA1.2 MA1.3
M2. Align QC Testing and Compliance with CE Principles	MA2.1 MA2.2 MA2.3
M3. Provide guidance framework to demonstrate material CE benefits	MA3.1 MA3.2 MA3.3
M4. Consult and advise on regulatory compliance methodologies	MA4.1 MA4.2
M5. Develop guidance for material process platforms	MA5.1 MA5.2 MA5.3

Circular Economy Plan - Procurement Actions

P1. Enable regenerative design and circular economy principles through: <ul style="list-style-type: none"> Procurement Strategy Tendering Contract Delivery 	PA1.1. # PA1.2. # PA1.3. C PA1.4. # PA1.5. #
P2. Engage with the Supply Chain and Develop Mutually Beneficial and Sustainable Solutions for Circular Procurement	PA 2.1 F PA 2.2 F PA 2.3. I PA 2.4. I
P3. Develop Procurement Models that Balance Social, Environmental and Economic Costs	PA3.1. E PA3.2. C PA3.3. V PA3.4. # PA3.5. F PA3.6. I

Circular Economy Plan – Life Cycle Assessment Actions

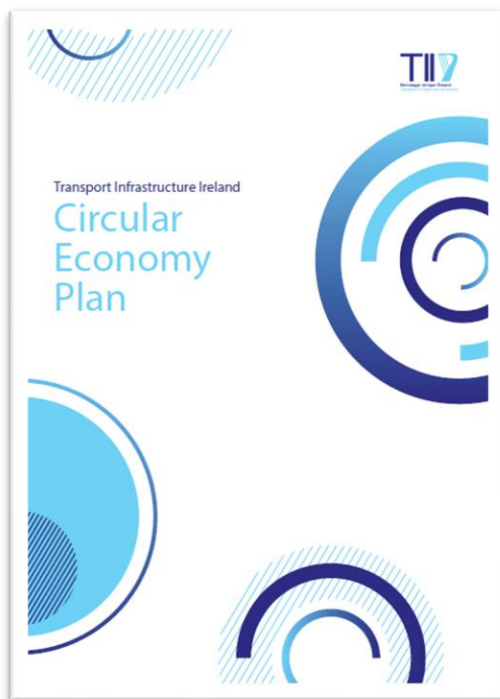
L1 Embed LCA in Procurement (TII focus)	LA1.1 LA1.2 LA1.3 LA1.4 LA1.5 LA1.6 LA1.7 LA1.8 LA1.9 LA1.10 LA1.11 LA1.12 LA1.13 LA1.14 LA1.15 LA1.16 LA1.17 LA1.18 LA1.19 LA1.20 LA1.21 LA1.22 LA1.23 LA1.24 LA1.25 LA1.26 LA1.27 LA1.28 LA1.29 LA1.30 LA1.31 LA1.32 LA1.33 LA1.34 LA1.35 LA1.36 LA1.37 LA1.38 LA1.39 LA1.40 LA1.41 LA1.42 LA1.43 LA1.44 LA1.45 LA1.46 LA1.47 LA1.48 LA1.49 LA1.50 LA1.51 LA1.52 LA1.53 LA1.54 LA1.55 LA1.56 LA1.57 LA1.58 LA1.59 LA1.60 LA1.61 LA1.62 LA1.63 LA1.64 LA1.65 LA1.66 LA1.67 LA1.68 LA1.69 LA1.70 LA1.71 LA1.72 LA1.73 LA1.74 LA1.75 LA1.76 LA1.77 LA1.78 LA1.79 LA1.80 LA1.81 LA1.82 LA1.83 LA1.84 LA1.85 LA1.86 LA1.87 LA1.88 LA1.89 LA1.90 LA1.91 LA1.92 LA1.93 LA1.94 LA1.95 LA1.96 LA1.97 LA1.98 LA1.99 LA1.100
L2 Normalise EPDs in procurement (supply chain focus)	LA2.1 LA2.2 LA2.3 LA2.4 LA2.5 LA2.6 LA2.7 LA2.8 LA2.9 LA2.10 LA2.11 LA2.12 LA2.13 LA2.14 LA2.15 LA2.16 LA2.17 LA2.18 LA2.19 LA2.20 LA2.21 LA2.22 LA2.23 LA2.24 LA2.25 LA2.26 LA2.27 LA2.28 LA2.29 LA2.30 LA2.31 LA2.32 LA2.33 LA2.34 LA2.35 LA2.36 LA2.37 LA2.38 LA2.39 LA2.40 LA2.41 LA2.42 LA2.43 LA2.44 LA2.45 LA2.46 LA2.47 LA2.48 LA2.49 LA2.50 LA2.51 LA2.52 LA2.53 LA2.54 LA2.55 LA2.56 LA2.57 LA2.58 LA2.59 LA2.60 LA2.61 LA2.62 LA2.63 LA2.64 LA2.65 LA2.66 LA2.67 LA2.68 LA2.69 LA2.70 LA2.71 LA2.72 LA2.73 LA2.74 LA2.75 LA2.76 LA2.77 LA2.78 LA2.79 LA2.80 LA2.81 LA2.82 LA2.83 LA2.84 LA2.85 LA2.86 LA2.87 LA2.88 LA2.89 LA2.90 LA2.91 LA2.92 LA2.93 LA2.94 LA2.95 LA2.96 LA2.97 LA2.98 LA2.99 LA2.100
L3 Reduce life cycle and supply chain impacts	LA3.1 LA3.2 LA3.3 LA3.4 LA3.5 LA3.6 LA3.7 LA3.8 LA3.9 LA3.10 LA3.11 LA3.12 LA3.13 LA3.14 LA3.15 LA3.16 LA3.17 LA3.18 LA3.19 LA3.20 LA3.21 LA3.22 LA3.23 LA3.24 LA3.25 LA3.26 LA3.27 LA3.28 LA3.29 LA3.30 LA3.31 LA3.32 LA3.33 LA3.34 LA3.35 LA3.36 LA3.37 LA3.38 LA3.39 LA3.40 LA3.41 LA3.42 LA3.43 LA3.44 LA3.45 LA3.46 LA3.47 LA3.48 LA3.49 LA3.50 LA3.51 LA3.52 LA3.53 LA3.54 LA3.55 LA3.56 LA3.57 LA3.58 LA3.59 LA3.60 LA3.61 LA3.62 LA3.63 LA3.64 LA3.65 LA3.66 LA3.67 LA3.68 LA3.69 LA3.70 LA3.71 LA3.72 LA3.73 LA3.74 LA3.75 LA3.76 LA3.77 LA3.78 LA3.79 LA3.80 LA3.81 LA3.82 LA3.83 LA3.84 LA3.85 LA3.86 LA3.87 LA3.88 LA3.89 LA3.90 LA3.91 LA3.92 LA3.93 LA3.94 LA3.95 LA3.96 LA3.97 LA3.98 LA3.99 LA3.100








Circular Economy Plan – Asset Management Actions

A1. Provide guidance to support geospatially linked digital inventory for new and refurbished assets provided to TII	AA1.1 AA1.2 AA1.3 AA1.4
A2. Gather life duration data	AA2.1 AA2.2 AA2.3 AA2.4 AA2.5
A3. Enable life cycle costing	AA3.1 AA3.2 AA3.3 AA3.4 AA3.5 AA3.6 AA3.7

Circular Economy Action Plan

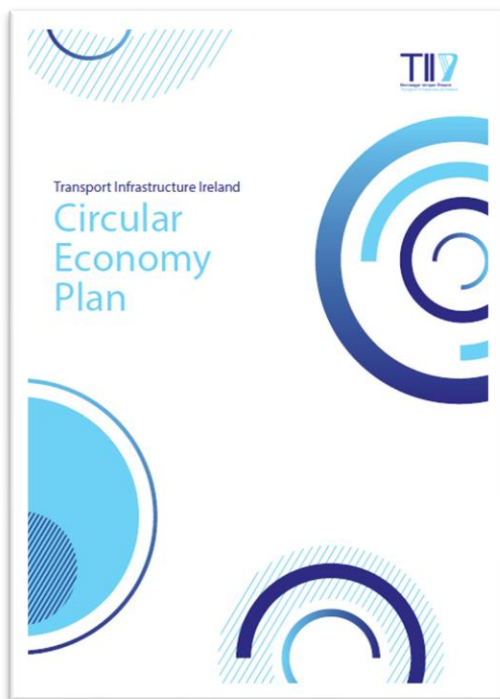
Collaboration










Sector		Potential Actions
	Government	Key role in development of strategies and their implementation. They have the necessary instruments, capacity and long-term perspective.
	TII, Road and Rail Agencies	A driving force as the client for construction and operation of road, light rail and Metro networks. TII have additional influence as the author of standards implemented across the construction industry.
	Customers and Users	Their participation is important even if their direct involvement in building strategies is difficult to manage. However, they also are agents of change.
	Industry	A driving force since suppliers and construction contractors can assist with implementation through pilot projects, new products and services or business models. They can typically contribute more quickly to the implementation of measures requiring the support of public authorities.
	PPP Concessionaires	A driving force as they can assist with implementation through the life cycle of transportation assets during the PPP duration.
	Standards Agencies	An enabler as standards enable circular strategies, circular business models, recycled content, design life durations, modular construction and design for deconstruction.
	Regulators	An enabler as regulators can ensure that there are clear and rapid pathways for achieving circularity without the risk of environmental pollution. This can be enabled through streamlined and transparent regulatory processes.

Circular Economy Action Plan

Collaboration



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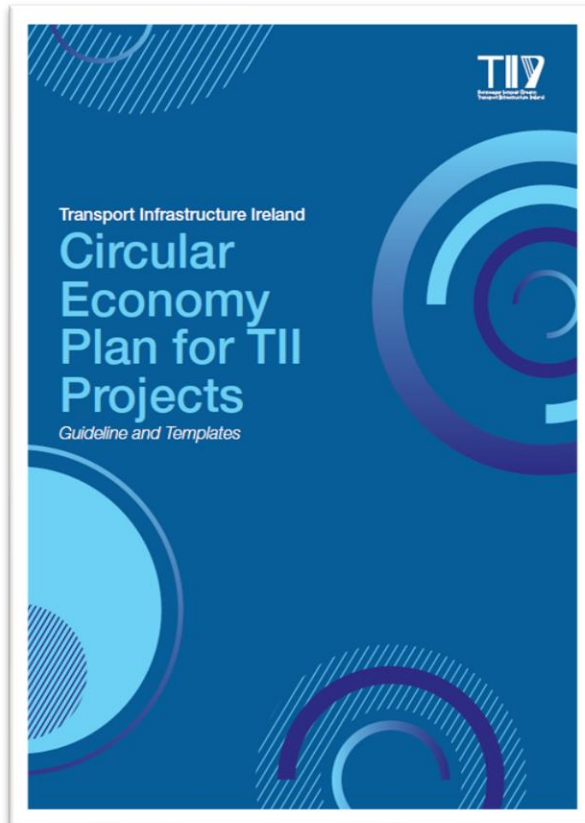
Circular Economy Plan for Projects

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Circular Economy Template Plans for Projects

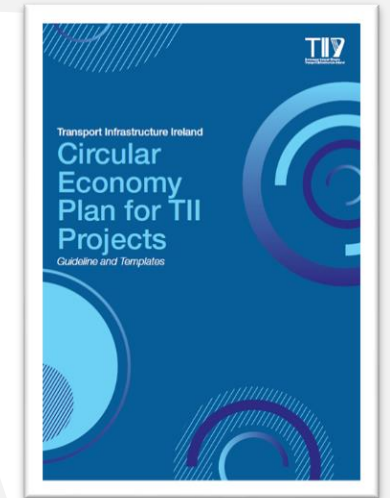
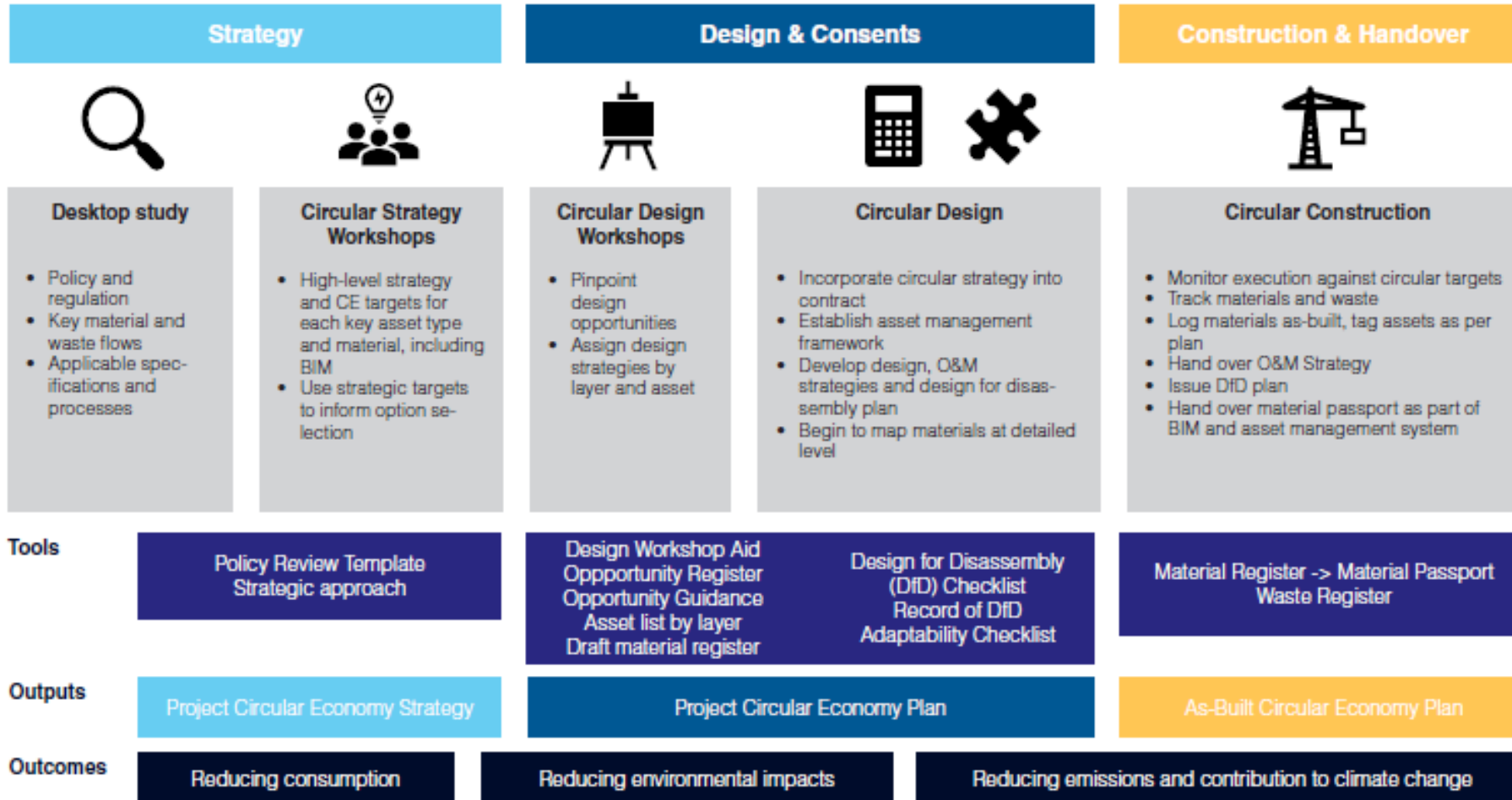
Plan Objectives



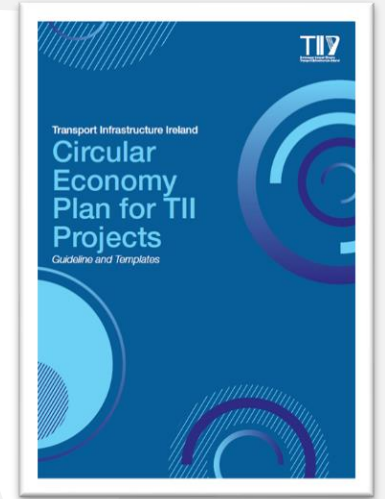
Macro-objectives	Plan aims
<p>Designing out waste and resource use to protect existing material stocks and the environment</p>	<ul style="list-style-type: none"> • Minimise the quantities of materials used • Minimise the quantities of other resources used (e.g. water) • Specify and source materials and other resources responsibly and sustainably • Optimise design to support lean and circular flows • Minimise environmental impacts over the lifecycle of assets. • Design out construction, demolition, excavation and municipal waste. • Manage demolition, excavation, construction waste • Minimise total greenhouse gas emissions over the lifecycle of assets. • Understand material and waste flows;
<p>Keeping assets, components and materials at their highest value at all times</p>	<ul style="list-style-type: none"> • Understanding appropriate design strategy and designing for disassembly of each group of assets on the project including for longevity, adaptability, flexibility, reusability or recoverability. This can mean: <ul style="list-style-type: none"> • Avoiding use of materials which will prevent design for deconstruction, including scarce, hazardous or some polymer-based materials; • Use of mechanical and reversible connections; • Ensure ease of removal of asset/component/material in useful; • Ease of access for maintenance during life, where required. • Gathering, retention and availability of data regarding the built asset, its components, materials, maintenance and end of use requirements. (eg Asset tagging and permanent markings on connections). • Extend long-term material utility • Protect existing technical-functional value and economic value. 7 • Understanding of processes for reuse, recycling and any required associated processing associated with demolition excavation, construction and municipal wastes; and • Understand the life cycle of assets in the context of the project and the wider transport system; • Optimising life cycle cost and whole life value of assets.
<p>Regenerative or restorative design</p>	<ul style="list-style-type: none"> • Designing using a whole transport systems approach. • Creating resilient systems which integrate societal needs with nature.

Circular Economy Template Plans for Projects

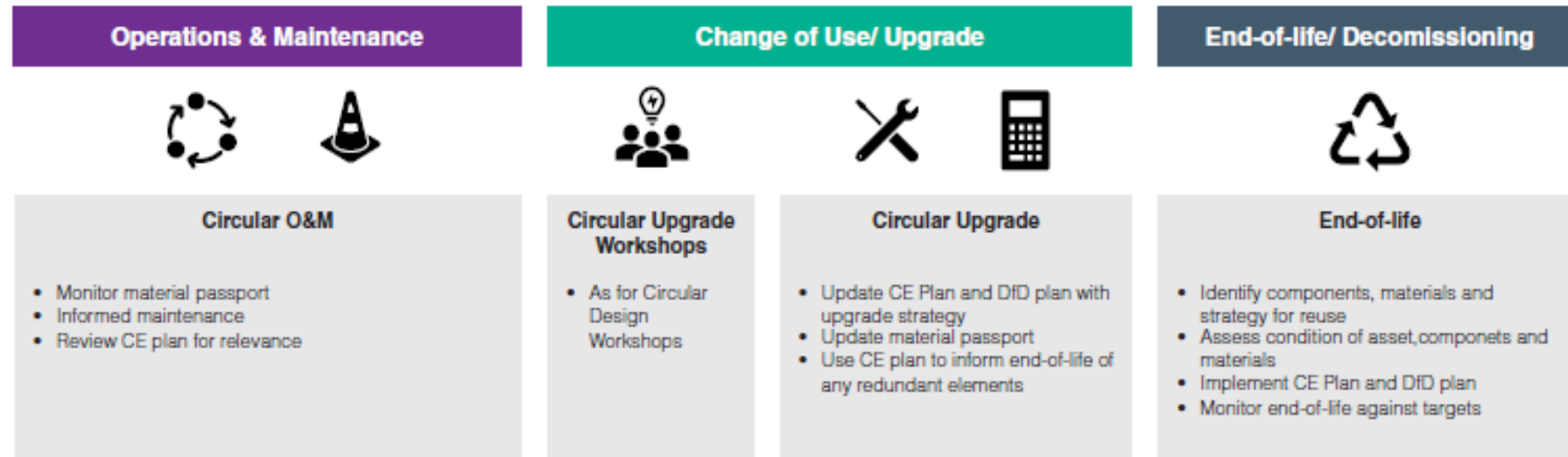
Circular Economy Plan - Compulsory Stages



Circular Economy Template Plans for Projects



Circular Economy Plan - Optional Stages



Tools

Material Register -> Material Passport
 Opportunity Register
 Circular targets from strategic approach

Outputs

Up-to-date Circular Economy Plan Up-to-date Circular Economy Plan End-of-life Circular Economy Plan

Outcomes

Reducing consumption Reducing environmental impacts Reducing emissions and contribution to climate change

Circular Pilot Projects

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TII Circular Economy N4 Road Pilot (Route Selection)

Outcomes

Reduce demand on new road through increasing urban permeability and active travel



Earthworks volumes better understood and optimized



Saving of virgin asphalt and greater reuse of existing layers



Reuse of materials for nature based solutions



Recommendations and Next Steps

- Findings incorporated into Guideline Circular Economy Plans for Projects
- Updates to PAG/ PMGs
- Material flow analysis for projects at an early stage
- The project is an example of building as little as possible and early planning for material sourcing. It's a worked example – it needs to be the standard way a designer approaches a project

TII Circular Economy N4 Road Pilot (Route Selection)

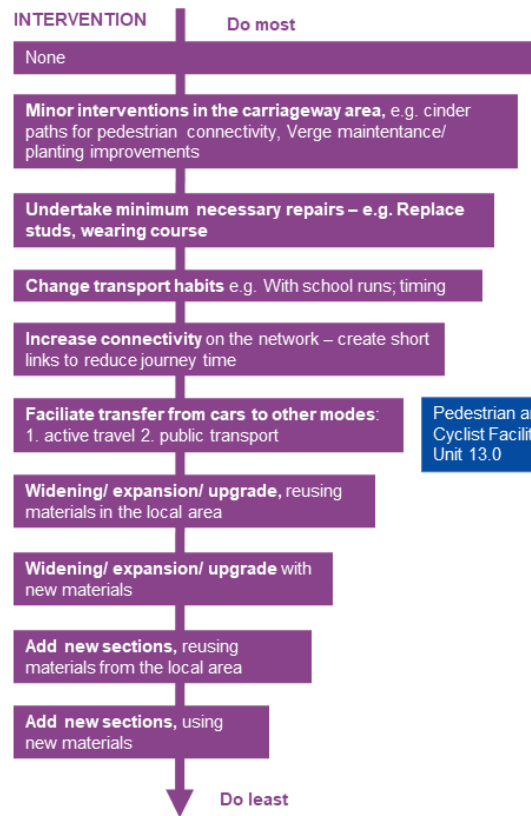
NIFTI intervention hierarchy in practice

Hierarchy of Carriageway Intervention TII N4 Carrick-on-Shannon to Dromod Circular Economy Pilot

CHALLENGE

- None
- Need for pedestrian access on verge. Need for maintenance/landscaping that better supports biodiversity.
- Keep the carriageway in good condition.
- Delays and capacity issues
- Carriageway intervention is still necessary after transferring as much traffic as possible to other modes.
- The widening/expansion/upgrade is not enough on its own.

Increasing circularity



TII PAG DELIVERABLE / SECTION

- None
- Strategic Assessment Report (SAR)- PAG Unit 2.1
- Project Brief (PB) – PAG Unit 3.0
- Options Appraisal Report (OAR)
Cost Benefit Analysis (CBA)
Multi Criteria Analysis (MCA)
Project Appraisal Balance Sheet (PABS)
- According to:
 - Unit 4.0 – Alternatives, including Management Option, for best possible delivery with existing infrastructure
 - Unit 5.0- Transport Modelling Overview
 - Unit 6.0 - Cost Benefit Analysis Overview
 - Unit 7.0 – Multi Criteria Analysis
- Preliminary and Final Business Case - PAG Unit 8.0

National Investment Framework for Transport in Ireland Modal Hierarchy



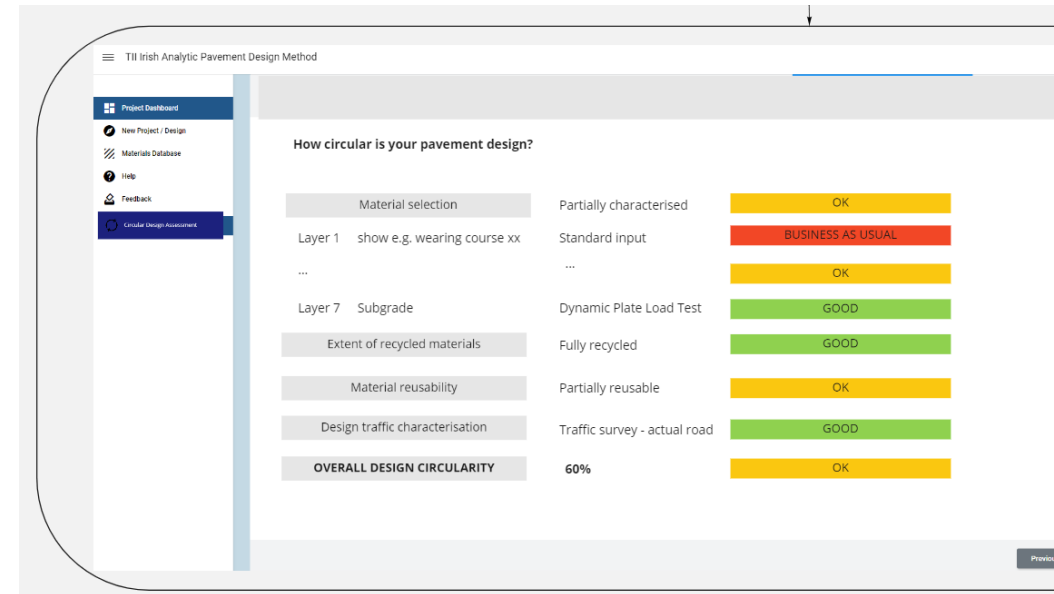
National Investment Framework for Transport in Ireland Intervention Hierarchy



TII Circular Economy Pilot Project- IAPDM Tool

Performance Based Pavement Design Tool

- Ability to reduce, reuse or repurpose materials required a fundamental change to design methodology
- Performance related rather than empirical approach is the basis of Irish Analytic Pavement Design Method (IAPDM)
- Considers site specific local pavement materials, environmental, deterioration modelling and traffic loading conditions .
- Circularity scorecard and carbon calculations within the IAPDM tool



Length	11,200	m
Width	14	m
Area	156,800	m ²
Thickness saved	0.03	m
Volume saved	4,704	m ³
Mass saved	11,290	t
Cost of AC32 40/60 (2019)	€ 178	per m ³
Value of material saved	€ 834,960	
Embodied Carbon saved	600,607	kgCO₂

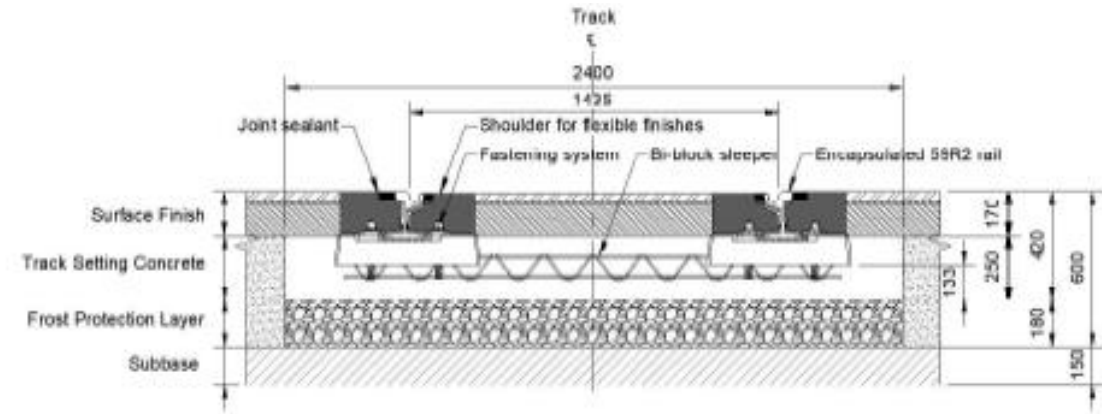
€800,000 saving along the 11 km Pilot

Through enabling much higher proportion of second life and local materials **supply chain resilience** is increased

Circular Luas Pilot Project

Luas Finglas

- Design for Deconstruction of track formation to ISO 20887:2020. Carbon calculations for approach
- Optimise reuse of excavated material using a hierarchy approach
- Carbon sequestration potential calculations using reused excavated material in landscaping
- Sharing of assets between TII and other agencies such as local authorities



Life cycle approach to track formation normalised using Design for Deconstruction checklists.

Next Steps

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Next Steps

Concepts

Circular Economy Policy

Circular Economy Strategy

Circular Economy Action Plan

- Procurement
- Asset Management
- Life Cycle Assessment
- Materials
- Collaboration

Guidance and Proof of Concept

Practical Guidance

- CE Plans for Projects
- CE Guide for Roads
- CE Guide for Light Rail

Pilot Projects

- IAPDM
- Luas Finglas
- N4 Route Selection

Next Steps

- Usable lifecycle circular guides for PMs
- Training and delivery to staff
- Integration of circular life cycle approaches in PMGs
- Pilot Projects:
 - Greenways
 - Luas Red Line Fleet
 - Luas Upgrades
- Metrolink



Thank you