CIRCUIT

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Using policy to power circular construction

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Contents

Acknowledgments

The *Circular Construction in Regenerative Cities* report presents the key learnings, tools, methodologies and recommendations generated by the Circular Construction in Regenerative Cities (CIRCuIT) project from 2019 to 2023 across the cities of Copenhagen, Hamburg, London and Vantaa/ Helsinki region.

This report was produced by members of the 31 partner organisations that were involved throughout. It shares a body of work that was made possible thanks to the time and expertise provided by numerous individuals who helped to support the project across its lifespan. This includes local decision makers and built environment stakeholders from each of the CIRCuIT cities, as well as the European Commission's Horizon 2020 programme.

All of the resources presented in this report, along with the accompanying technical report, are available at circuit-project.eu/post/latest-circuit-reports-and-publications.

Glossary of terms

Adaptive Reuse
The process of reusing a structure or building for a purpose other than the original purpose for which it was built or designed.

Business as Usual (BAU)
Shorthand for the continuation of current conventional construction process practices as if the intervention under consideration were not to happen. Usually used as a benchmark to compare interventions.

Circularity Indicator
A piece of information that can be used to measure performance within the built environment to guide decision making and enable the industry to communicate their circular economy actions in a consistent way.

Design for Adaptability (DfA)
An approach to planning, designing, and constructing a building so it can be easily maintained, modified and used in different ways or for multiple purposes throughout its lifetime, extending its practical and economic life cycle.

Design for Disassembly (DfD)
Approach to the design of a product or constructed asset that facilitates disassembly at the end of its useful life in such a way that enables components, materials, and parts to be reused, recycled or, in some other way, diverted from the waste stream.

Downcycling
A form of recycling that repurposes materials into a substance of lower value than the original.

Life Cycle Assessment (LCA)
A methodology developed to assess the environmental impacts of a building, component or material. The assessment compiles and evaluates the inputs and outputs of the material system throughout its life cycle and assesses the relevant environmental impact.

Life Cycle Cost Analysis (LCC)
An analysis of all the costs that will be incurred during the lifetime of the product, work or service. LCC may also include the cost of externalities such as environmental degradation or greenhouse gas emissions.

Meanwhile Use
A range of strategies to make under-utilised spaces and places productive, both economically and socially, often for a shorter length of time until a long-term use for the space is determined.

Pre-demolition Audits (PDAs)
A systematic and comprehensive assessment conducted before the demolition or deconstruction of a building or structure which results in the inventory of materials and components arising from the building. The reusability and recyclability of the materials can also be assessed during this process.

Pre-redevelopment Audits (PRAs)

A systematic evaluation conducted before the redevelopment or repurposing of a property or site, typically with the aim of assessing and addressing potential environmental contamination and regulatory compliance issues. The potential to reuse or incorporate existing structures on site into the new plans can also be assessed during this process.

Recovery

The process of systematically and intentionally collecting, salvaging and reusing materials from a building or construction site to extend their life cycle and reduce waste.

Recycling

Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes.

Return on Investment (ROI)

The quantifiable returns and advantages derived from embracing specific construction methods. This encompasses financial gains, environmental benefits and enhanced social value resulting from the project's design choices.

Reuse

The repeated use of a product or component for its intended purpose without significant modification.

Transformation

In architecture transformation is used as an umbrella term to refer to a wide range of potential changes to a building from a subtle change of appearance to a complete change of use.

Upcycling

A form of recycling that repurposes waste, products or materials into a substance of higher value than the original.

Urban Mining

The process of recovering and reusing the raw materials that are already in the environment, cities or everyday products, in the resource cycle.

Introducing the CIRCuIT project

The way we currently build our cities is wasteful and inefficient with resources extracted, manufactured into components, and constructed into buildings only to be demolished and discarded as waste well before the end of their useful life.

Estimates suggest that 11% of global emissions are linked to manufacturing construction materials such as steel, cement and glass[1]. In the EU alone, the built environment accounts for 36% of carbon emissions, 40% of material use and 50% of landfill waste[2].

Accommodating for the expected population growth within cities will mean constructing additional buildings and infrastructure equivalent to a city the size of Milan (1.5 million people) every week until 2050[3]. There is, therefore, an urgent need to transition from a linear construction model to a more sustainable and regenerative one based on circular economy principles.

In a circular model, rather than continuing the traditional take-make-consume-dispose process, building material loops are closed through reuse, sharing, leasing, repair, refurbishment, upcycling or recycling. This radical reimagining of construction considers how the lifespan and reusability of entire buildings can be maximised at the very start of the design process and thereby ensures that usable materials are not discarded as waste.

Cities hold the keys to this transition. Working collaboratively with industry, they can find new ways of confronting the climate impact of construction and develop a new urban agenda. This also gives rise to co-benefits as embedding circular principles also supports wider policy goals such as net zero targets, climate resilience and adaptation in cities.

Further, this regenerative approach has economic and social benefits as more adaptable and flexible cities are better able to serve the changing needs and interests of residents and circular solutions often also bring cost savings over a building's life cycle.

It is, therefore, crucial that cities and their stakeholders have the support, resources and tools needed to create change and drive circular construction practices locally.

Turning theory into practice

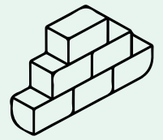
Many circular construction techniques, tools and approaches have been developed and tested around Europe, but circular practices are yet to be scaled up effectively to a city or regional level. To explore how the circular economy can be effectively embedded in cities across Europe, and bridge the gap between theory, practice and policy, CIRCuIT – Circular Construction in Regenerative Cities – was established.

CIRCuIT was a collaborative project funded by the European Commission's Horizon 2020 programme. The project involved 31 partners across the entire built environment supply chain in Copenhagen, Hamburg, Helsinki Region and London.

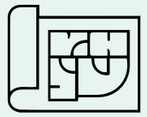
1 Global Status Report for Buildings and Construction 2019 | IEA
2 Internal Market, Industry, Entrepreneurship and SMEs | European Commission
3 Circular economy in cities: Opportunity & benefit factsheets | Ellen Macarthur Foundation

The project's goal was to support the mainstreaming of circular construction practices in the built environment focusing on three key thematic areas:

Transformation and building life cycle extension



Urban mining and material reuse



Design for disassembly and adaptability

Over the course of the project three key results emerged:

1. It is beneficial: Circular practices can improve both the financial and environmental outcomes of construction projects. As part of the project, 36 demonstrators were developed that provide evidence of the carbon and economic implications of adapting conventional construction methods to more circular approaches. The results show that the environmental benefits are great: in all three thematic areas there can be significant carbon emissions reductions and resource savings. Cost benefits are also evident within the context of a circular approach and have been explored in the business cases within chapters 1, 2 and 3. Shifting to circular practices requires use of long-term thinking and seeing buildings as investments to be examined by legislation, integrated collaborations, and new financial models.

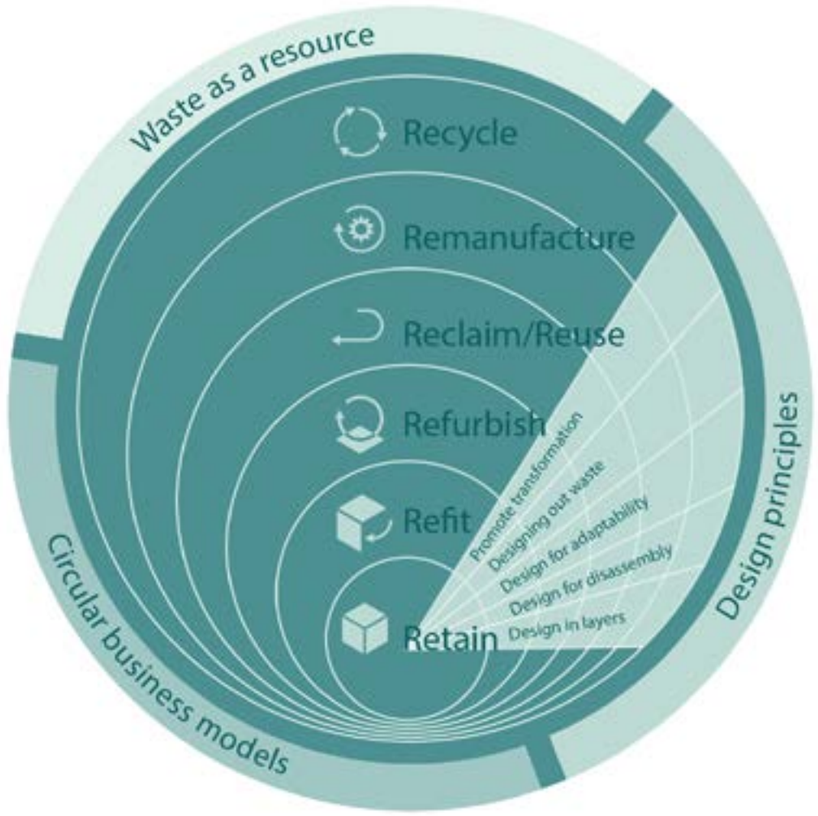
2. It can be done: Real changes are possible by defining a common agenda and applying tools that enable cities to work smarter given the same resources. CIRCuIT has developed tools that can help cities and their stakeholders embed circular economy practices, such as the transformation tool which supports the identification of buildings at risk of demolition, or the dialogue tool which ensures that conversations about circularity start early in the planning process. The CIRCuIT project also developed adaptable procurement requirements in collaboration with the construction industry (see chapter 5). Each of these tools will help to create changes within the landscape, processes, and behaviours.

3. It has scale-up potential: Circular practices are achievable at a building, neighbourhood, city or even country level. To generate the maximum impact of circular construction practices, each of the cities in the CIRCuIT project developed roadmaps that illustrated how best practices could be effectively embedded into city policy (chapters 3 and 5). The project also created working proof of concepts for digital tools such as the Material Reuse Portal that support the delivery of material exchange work and thereby enable increased uptake and the scaling of benefits (see chapter 6).

A call to action

Cities now have the opportunity to connect an ambitious circular economy transition to their sustainability goals. However, to achieve success, cities must also work with professionals from across the entire built environment value chain, from urban planners to material manufacturers, from demolition specialists to residents, and urge them to come together and transform the sector using circular economy principles.

Changing the way that the industry designs, constructs and transforms buildings and infrastructure is critical in the fight against the climate crisis. Thanks to the wide array of tools, case studies and datasets developed by the CIRCuIT project, stakeholders across the value chain are better equipped to turn ideas into reality.



Principles of circular construction

The Handbook to Building a Circular Economy, David Cheshire, AECOM, 2021

Chapter 1: Extending the lives of buildings through transformation and refurbishment

Transformation and refurbishment of existing buildings is the first principle of circular construction. Applying a transformation-first approach will be key to meeting climate targets. Reducing the instances of demolition can keep resources that have already been refined in use for longer, reducing the need for new materials.

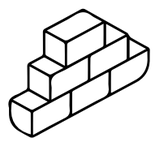
Key findings:

- Methodologies to identify buildings at risk of demolition
- Policy drivers to encourage decision makers and built environment professionals to extend the lives of existing buildings
- 12 demonstrator projects showcasing design transformation strategies.
- 10 business cases for building transformation.

Chapter 2: Increasing the reuse and recycling of building materials

Reusing and recycling building materials is a highly effective way to reduce the resource use and carbon intensity of the built environment by closing material loops. But many challenges are preventing cities from adopting this circular construction approach including issues with cost, adoption and the demolition process.

The CIRCuIT project explored these challenges and suggested ways to embed practical solutions on how cities and the building sector both build and demolish, from policies to Pre-Demolition Audits.

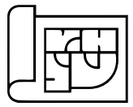


Key findings:

- Recommendations to increase the reuse and recycling of building materials
- Recommendations for embedding pre-demolition audits (PDA) in city policy
- Methodology for developing an optimised PDA
- 12 demonstrators illustrating material reuse and recycling techniques
- 9 business cases for driving the reuse and recycling of building materials.

Chapter 3: Futureproofing cities: designing for disassembly and adaptability

Design for disassembly (DfD) and design for adaptability (DfA) are two construction approaches that can help cities meet their future housing and infrastructure needs while ensuring circular economy principles are adopted. Currently, the technical solutions needed to adopt these approaches exist but take up throughout the construction industry is low. The CIRCuIT project explored what DfD and DfA looks like in practice, how these approaches can be embedded in cities, and how the environmental and economic benefits of DfD and DfA can be calculated to help increase adoption.



Key findings:

- Methodology for assessing the return on investment (ROI) for DfD and DfA across three areas: monetary cost, carbon use and material use
- Methodology to assess whether a DfD or DfA concept is likely to be scaled up across a city
- Roadmaps for DfD and DfA for Copenhagen, Hamburg, London and Vantaa
- 12 DfD and DfA demonstrator projects
- 7 business cases for DfD and DfA approaches.

Chapter 4: Data and indicators for a circular built environment

A consistent and comprehensive approach to data collection, analysis and management is fundamental for a city to accelerate circularity in its built environment. As part of the CIRCuIT project, partners explored the data available in cities, how data capture can be improved and which indicators are key to supporting circularity.

Key findings:

- Two methodologies and template for carrying out a circularity data mapping exercise and assessment of accessible data in a city
- Set of data templates to improve the capture and sharing of data relating to components, spaces, buildings and areas
- Recommendations to help a city address gaps or weaknesses in their data
- Set of 37 indicators that focus on circularity at a city, building and materials level.

Chapter 5: Using policy to power circular construction

Two significant areas where cities can support a transition towards circular construction is through their planning and procurement policies. To help decision makers take effective action in these areas, the CIRCuIT project developed practical guidance on policy interventions, working with developers, criteria for public tenders and city-level circular economy strategies.

Key findings:

- Policy interventions to embed circular approaches in cities
- Checklist to support circular construction dialogue with developers on city projects
- Recommended circular economy criteria for public sector tenders
- Circularity policy roadmaps for Copenhagen, Hamburg, London and Vantaa

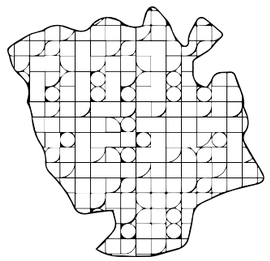
Chapter 6: Supporting circular construction with online tools

If cities are to increasingly transition to circular construction, it's critical that decision makers and built environment professionals have access to tools that can help them turn circular construction theory into practice. As a result, CIRCuIT's project partners developed five online tools to improve professional knowledge, increase acceptance of this way of building and ultimately, accelerate adoption of circular construction.

Key findings:

- Material Reuse Portal
- Circularity Dashboard
- Circularity Atlas
- Citizen Engagement Portal
- Circular Economy Wiki.

Overview of the four CIRCuIT cities

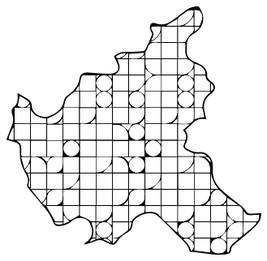


Copenhagen

Copenhagen is internationally renowned for its innovative approach to the climate and the environment. It has a reputation as the world's best city for cyclists. It is a living showcase for Danish architecture. But, most important of all, Copenhagen is a good place to live.

None of this came about by chance. It is the result of years of planning and development based on the needs of Copenhageners – everybody who lives in, uses, visits, works with or runs a business in the city. It is based on the life between the buildings.

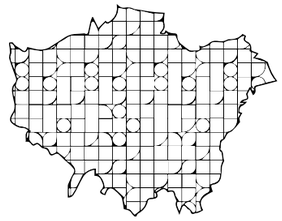
Copenhagen sets ambitious climate goals, aiming to be the world's first carbon neutral capital. It will achieve this through a city-wide transition toward sustainable energy supply, building retrofits, circular waste management, sustainable public infrastructure and mobility, as well as other key initiatives to support the transition.



Hamburg

The Free and Hanseatic City of Hamburg is one of the 16 states of the German federation and the second largest city in Germany. As a member of Eurocities and the City Science Initiative, Hamburg supports European cities and regions, facilitating knowledge sharing across networks, forums and workshops.

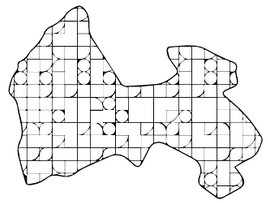
It is currently delivering several EU-funded Interreg and Horizon 2020 projects on urban development, circular economy and smart city elements, harnessing the power of innovation to progress towards its circular goal. In addition, in recent years Hamburg has set up ambitious climate transition targets in line with its industrial composition and socio-economic prospects, and it has introduced sectorial targets, including carbon reduction targets for each sector.



London

London is the engine of the UK economy, accounting for more than a fifth of the country's economic output. Over many centuries London has evolved, resulting in an extraordinary web of distinctive residential streets, squares, markets, parks, offices and industrial and creative spaces.

London aspires to be a zero carbon, zero waste city, and to transition to a low carbon circular economy. This is part of a wider strategy promoting 'Good Growth', which is about working to rebalance development in London towards more genuinely affordable homes, to deliver a more socially integrated and sustainable city.



Vantaa/Helsinki Region

One of three cities in Helsinki metropolitan area, the city of Vantaa is the fourth biggest city in Finland. It has a total area of 240.35 km^2 and a population of 223,000, rising by 2,400 citizens every year. The population is expected to reach over 300,000 by 2050.

Vantaa has a new comprehensive environmental programme called the Roadmap to Resource Wisdom 2030. It focuses on the circular economy and Vantaa's ambition to be carbon neutral by 2030. The circular economy goals consist of reusing materials (including during a demolition), establishing circular economy as part of planning and execution and improving the model for circular economy areas.

Why policymakers must take action

Global construction is centred in cities. By 2050, an additional 2.5 billion people are projected to live in cities, and as urban populations grows, the need for new buildings and infrastructure will intensify. Cities have a growing responsibility to mitigate construction's role in the climate crisis.

Cities are uniquely positioned to promote and support the transition from a linear to circular economy, particularly in construction and urban development. While some cities have already taken up the challenge to start working with circular economy principles to minimise their impacts, an understanding of how to holistically implement circular solutions often remains blurry.

The CIRCuIT project developed specific lessons related to circular construction in cities – such as Transformation (Chapter 1), Urban mining (Chapter 2) and Design for Dissasembly and Adaptability (Chapter 3) approaches. Now these learnings need to be translated into clear recommendations for action.

Two significant areas of influence for cities are through their planning and procurement policies. For example, by leveraging procurement power, cities can set the level of ambition for the entire city providing a strong signal of confidence for the sector or specific solutions. Cities can also use procurement requirements to bolster their own climate priorities, targets and strategies through clauses that address embodied carbon or city regeneration, among others.

Embedding circular strategies into planning policies helps to scale up action and introduces a much larger portion of the supply chain to circular solutions. However, all policy changes need to be supported by open dialogue, a factor that CIRCuIT explored through developing a dialogue tool.

This chapter outlines a range of different policy mechanisms to drive circular construction, a dialogue tool to guide productive conversations between developers and cities and illustrates the roadmaps CIRCuIT cities developed to put these into actions.

While some cities have already taken up the challenge to start working with circular economy principles to minimise their impacts, an understanding of how to holistically implement circular solutions often remains blurry.

Barriers to circular action in cities

The CIRCuIT project identified specific barriers to circular action in cities that city decision makers must consider when outlining their change making mechanisms. Addressing these barriers can help policy makers design effective interventions.

Regulatory barriers: Failure of a policy to be clearly defined, aligned and/or enforced across national, municipal and local hierarchies. When these various layers do not enforce each other (or contradict each other) this can lead to confusion. Regulatory barriers can also include overreach of regulations, like energy efficiency, that inadvertently make circular solutions more difficult.

Market barriers: Failure of the market based on communication and access. This can happen when there isn't a common language to define needs (for example missing standards and data). Businesses can have trouble accessing the market due to missing or unaligned standards as well as lack of communal infrastructure needed to support the market – for example material storage and exchange depots.

Economic barriers: The current financial system values new materials and conventional construction far above circular approaches. In some regions, such as the UK, retrofits are taxed at a higher rate than new construction. This means it is often financially impractical to pursue circular construction as incentives are not currently provided for circular economy approaches. Where incentives are available, they are not divided equitably along the supply chain to further drive circular construction. Upskilling built environment professionals to enable uptake of new approaches can also be prohibitively expensive.

Process barriers: The conventional construction process can sometimes be a barrier. Barriers can include the large multidisciplinary teams on projects and comparatively low margins on budget. Circular activities that prolong the construction period are unlikely to be successful – they cost the investor more both in terms of running the construction site and 'missed' rent while the building isn't operational.

Social barriers: Uptake of circular construction practices requires behavioural change. Lack of knowledge, interest or awareness of construction techniques can stall progress, as can the perception that any change is inevitably more expensive. In addition, construction does not have a collaborative culture people can harness to easily break through these cultural barriers .

Circular activities that prolong the construction period are unlikely to be successful – they cost the investor more both in terms of running the construction site and 'missed' rent while the building isn't operational.

Embedding urban development policies

City administrations can harness a range of policy interventions to further circular action and overcome barriers to circularity. Adopting new circularity-related regulations can require significant changes both in terms of process and cultural expectations. Transitioning towards a circular approach to construction means changing what and where cities build, how spaces are developed and how materials are made, recycled and used.

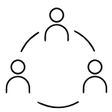
Policies can be adjusted to align with local stakeholders' capabilities and the varying levels of support from national governments. For example, they can be supported by integrating non-regulatory practices, such as developer dialogue tools (page 5-12), which help develop open circularity conversations between cities and industry.

> **For the full list of policy interventions, and the specific recommendations for interventions in each of the four CIRCuIT cities, please see 7.1 Circular economy in urban planning at circuit-project.eu/post/latest-circuit-reports-and-publications**

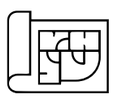
Policy recommendations are presented in three key areas of circularity action: transformation and life cycle extension, urban mining and material reuse and design for disassembly and adaptability. They cover five types of policy instruments:

Legislative and regulatory: Policy interventions relating to requirements for planning or demolition, licences and permitting, data reporting and design requirements.

Economic and fiscal: Relating to taxes or levies on certain behaviours, as well as subsidies or investments from the city.



Agreement and incentive-based: Interventions related to collaborative actions and agreements between parties. Can also include pledges, commitments and voluntary certification schemes.



Strategy, roadmap and information-based: Interventions that support direction and knowledge, written roadmaps and guidelines or eco-labelling, widespread use of best practice case studies.

Knowledge and innovation: These tackle more systematic knowledge gaps through upskilling and training, curriculum changes and stakeholder engagement.

Policy interventions to embed circularity in cities

Transition to circular construction requires system change. This means it can be beneficial to implement a range of policy interventions that reinforce each other. For example, if there's a legal requirement to increase the use of reused and recycled materials (legislative/ regulatory instruments) this could be supported by a primary materials tax (economic instrument) and pilots to determine best practice (knowledge/innovation instruments).

Life cycle extension and transformation drivers

Encourage planning authorities to prioritise reuse of assets in strategy and culture – Changing perceptions of the value of existing buildings from strictly cultural to environmental due to the sunk carbon costs in all planning authority operations.

Strategy and roadmaps

Ensure zoning and planning regulations do not restrict refurbishment – Reviewing requirements and removing certain elements (e.g. stringent energy efficiency requirements, densification blockers) that make it harder to maintain existing buildings.

Legislative/ regulatory

Require demolition and rebuild vs. retrofit carbon assessment of site before issuing demolition or new development permit – Assessments can reveal which intervention is more effective from a carbon perspective. Ensure the scope is considered too – emissions saved in the next 10 years are more impactful than those saved in 60 years.

Legislative/ regulatory

Urban mining drivers

Require a minimum time between demolition permitting and demolition activity – Time is a very valuable resource in construction. Requiring a minimum amount of time between permitting and demolition means reusable and recyclable materials are more likely to find a useful second life. Time delays can also be enforced for projects that choose to demolish rather than deconstruct and reuse materials so there is no time benefit to conventional, non-circular demolition practices.

Legislative/ regulatory

Require a pre-demolition audit before issuing a demolition permit or approving a new development permit including how waste will be minimised – Pre-demolition audits ensure the material on site is catalogued and assessed for reuse or recyclability. Requiring this step means all projects must consider what to do with the buildings on their existing site.

Legislative/ regulatory

Set requirements (%) for amount of material (waste) reused/recycled in demolition permit – Ensures a baseline level of reusable materials in the city market.

Legislative/ regulatory

Require waste hauler to be licenced and identified in the demolition or new development permit – Ensures material reuse and recycling is traceable and second uses can be verified.

Legislative/ regulatory

Require buildings meeting specific criteria to be deconstructed, not mechanically demolished – Certain building types that include specific desirable building materials (e.g. single family homes built with old growth timber) should be required to be deconstructed carefully to allow for maximum material reuse of high value materials.

Legislative/ regulatory

Make pre-demolition audit information public – Pre-demolition audits are a great source of city-level data on material flows. Making the granular data publicly accessible means better predictions and smoother secondary reuse markets are possible.

Knowledge and innovation

Set requirements (%) for number of reclaimed/recycled materials incorporated in new development permit – Ensures a baseline of secondary material demand to drive the secondary reuse markets.

Legislative/ regulatory

Ban use of certain (non-circular) materials – Helps ensure effective urban mining is possible in the future.

Legislative/ regulatory

Design for disassembly and adaptability drivers

Set requirements that short life span buildings should be modular or prefabricated – If use cases for the building are limited to the short term require modular and demountable structures be considered.

Legislative/ regulatory

Set disassembly targets for shorter lifespan or higher reuse potential buildings or elements.

Legislative/ regulatory

Multiple circularity solution drivers

Articulate clear planning strategy that centres circular and regenerative solutions – Establishing public goals and priorities can help the local supply chain adapt and better meet the near-future needs of the city.

Strategy and roadmaps

Allow larger development areas where certain circularity approaches are applied (e.g. % reused materials, % existing building maintained) – Provide an indirect financial incentive by allowing more square metres of development as reward for exemplary circular practices.

Agreements/ incentive

Provide a 'fast-lane' permitting process where certain circularity approaches are applied (e.g. % reused materials, % existing building maintained) – Provide an indirect financial incentive by allowing construction to proceed more quickly as reward for exemplary circular practices.

Agreements/ incentive

Reduce permitting fees where certain environmental criteria are met (e.g. retention of existing building, reuse %, carbon footprint, green building rating scheme) – Provide a direct financial incentive by allowing construction to proceed more quickly as reward for exemplary circular practices.

Economic/fiscal

Support innovative pilot projects – The city can support exciting new projects in the area, blazing a trail for other circular work.

Economic/fiscal

Train city staff and supply chains – Policy implementation will happen much more smoothly if the people on both sides of the table understand circular construction. The city can support training initiatives, especially for smaller businesses who may not have the resources to develop this knowledge on their own.

Agreements/ incentive

Supporting circular economy policies: In dialogue with developers

Relevant and well-developed policies cannot be created, or enforced appropriately, without the support of the local construction sector. Working to establish an open and supportive communication channel between city officials and developers is key to achieving sustainability and circularity goals. This seven-part check list can support this dialogue.

1. Give developers a vision

Developers say they often feel confused about a city's direction on the circular economy. This can lead to business-as-usual practices.

To tackle this, cities need to prioritise their circular goals and communicate them clearly to urban planners and developers. They also need to ensure that these goals relate to existing agendas, such as an overarching objective of becoming carbon neutral.

Developing and sharing a circular economy strategy and roadmap for a city's built environment will also help create a clear vision for developers.

2. Provide a clear overview of the planning process

A city's planning process can appear complicated. Developers may not know when and how to introduce circular economy initiatives.

A good way a city can help overcome this problem is by visualising all the stages of their planning process. At each stage there should be easy-to-understand information about what is expected from a developer and which city officials will work with them.

It's important each stage should also clearly explain what a developer can do to help embed circular economy principles in their project.

3. Talk about circularity as early as possible

To increase the probability of circular approaches being adopted, it's critical city officials speak as early as possible to developers about them.

These conversations must start before demolition of existing structures and a developer submits their planning application.

This can be done by organising sustainability kick-off meetings with developers, consultants and all relevant city officials.

4. Identify common circular interests and goals

A developer may have a different objective or perspective than a city on the circular economy, or they may believe circular objectives and requirements are out of reach.

To increase the chance of circular activities being adopted, cities should work with developers to identify common sustainable interests and goals, such as reusing components from demolished buildings.

City officials should continue to work with and support the developer to ensure that any common objectives are achieved.

5. Discuss incentives for developers to adopt circular practices

Circular construction is not yet a top priority for most developers. To change this, municipalities and developers should agree incentives, which could include:

- Developers being exempt from certain regulations if they adopt circular approaches. For example on energy demands, material longevity or documentation requirements.
- Developers being allowed to increase the floor area offered by a building if it is constructed in a way that meets specific circular targets.

6. Establish channels for communicating policy change and circular economy knowledge

For a developer to be in a strong position to implement circular economy approaches, it's important they have a good knowledge of a city's planning process and circular construction practices.

To do this, a city should establish an official channel, such as an online forum, they can use to communicate planning process changes and knowledge about building sustainably and the circular economy.

A city should also set up an internal network for urban planners and other city officials engaged with the circular economy agenda. The officials could use this network to ensure their planning practices are aligned in a way that increases adoption of circular practices.

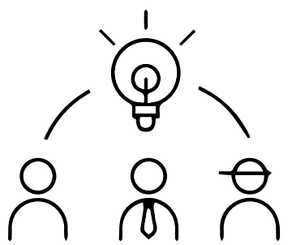
7. Use circular economy data and best practice to drive action

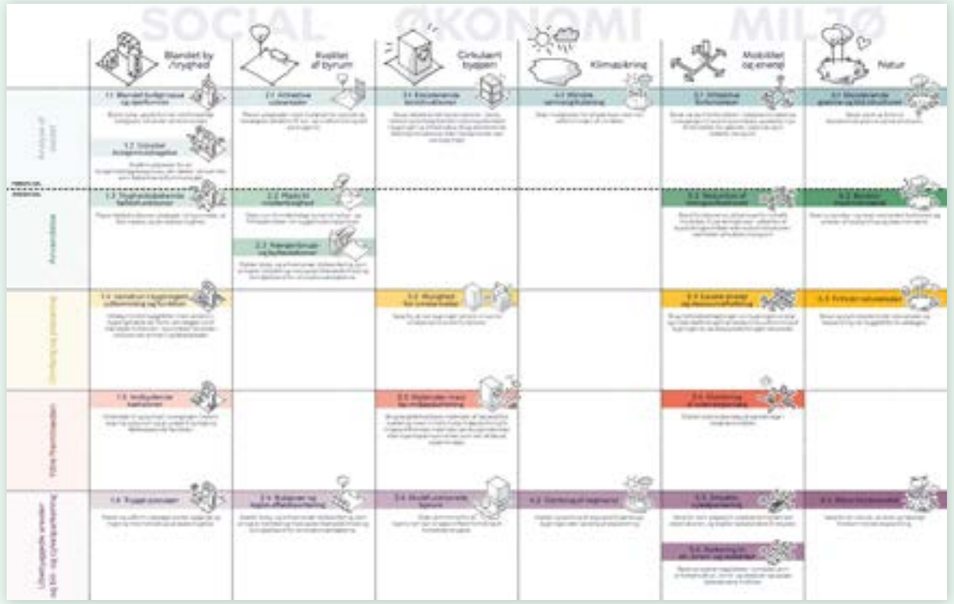
Hard evidence and best practice often play a key role in changing behaviour.

Cities should collect data on circular construction initiatives and the environmental, economic and social benefits they deliver. Also, they should create a catalogue of best practice building projects that have used circular economy principles.

Share data and case studies with developers, urban planners and other built environment stakeholders to increase their knowledge and encourage similar action.

If a city is unsure how best to do this, or generally lacks knowledge about the circular economy, it should consider hiring a circular construction expert to support city officials and local developers.





The Copenhagen Sustainability Tool (CST) in action

A Copenhagen Sustainability Tool (CST) was developed to improve dialogue on sustainability between the planner and developer. The CST is a discussion tool that helps the city planner effectively communicate the city's strategies on environmental, social and economic sustainability and options for the developer to support these priorities. The planner, developer and consultants use the tool to choose 3-5 of the most relevant initiatives and assess how to integrate them into the final development plan. This plan is then submitted to the city council including outcomes of the dialogue. The tool will be updated to focus on CO_2 reduction and material reuse and recycling as key initiatives for dialogue.

Embedding circularity: Using public procurement

Incorporating circular economy principles into public procurement has potential for large-scale positive impact. In Europe, public procurement accounts for approximately 14% of GDP. This means the demolition, renovation and construction of a city's own buildings are a great opportunity to lead by example, promote, trial and normalise circular construction.

Current procurement practices are generally optimised to minimise short-term financial cost. This doesn't capture the long-term financial and environmental benefits circular practices can deliver. Circular economy solutions are innovative – and municipalities must adapt and incorporate new developments into procurement practices. Even in cases when sustainability and circularity goals are named priorities, there can be issues seeing requirements carried through to the final product.

This is for a few reasons:

- When circular economy criteria are outlined in public sector tenders, they tend to feature 'soft' wording (like 'striving for' sustainability) rather than hard targets. There are no consequences for missing these targets.
- Without defined circularity targets to hit, there can be different interpretations of what a circular approach looks like. This makes it difficult for a city to assess proposals and identify the best one for a project.
- Existing sustainability construction standards, such as DGNB or BREEAM, are sometimes used in public procurement tenders to encourage sustainable and circular economy practices. However, not all the criteria in these standards are prioritised and enforced to the same extent. Circularity criteria is often less prominent, leading to mixed circular outcomes for a project.

To help city governments overcome these issues, CIRCuIT partners developed a set of circular economy criteria that any city can include in their tenders for public demolition, renovation and construction projects. When applying this criteria cities should consider these points:

- Procurement criteria is most effective when formulated as minimum requirements in the tender document, rather than as award criteria, to ensure implementation in a project. This way circular economy strategies will be incorporated in all bidders' proposals while price, quality and additional sustainability factors will remain the competitive elements of the bid.
- The highest priorities should be maintenance, repair, refurbishment, renovation and transformation of buildings to achieve circular economy. This means procurement criteria should place more emphasis on them.
- Municipalities should select criteria relevant to the stage of the project. Some criteria will be useful in tenders for a concept development, while others will be useful for execution of a demolition project.

> **For the full list of criteria and a complete discussion of the procurement work please see D7.4 Recommendations: Criteria for public tenders on construction at circuit-project.eu/post/latest-circuit-reports-and-publications**

Recommended circular economy criteria for public sector tenders

Renovation

Avoiding demolition through investigating transformation opportunities can extend the life of the building, and promote life cycle value creation. It also reduces resource use and the developers' carbon footprint while potentially safe guarding the cultural value of existing buildings.

Require a screening of potential new use in the transformation –-This requires study of each building in terms of condition, location, local plan and spatial structure. Design of different transformation scenarios and recommendations for project to select should be provided.

Project development stage

Require a feasibility study of vertical extension potential in renovation projects –- The vertical extensions can be used to meet carbon footprint targets. This requires a study of each building for condition, location, local plan and spatial structure.

Design stage

Require LCA and LCC calculations for comparison of different renovation and transformation scenarios Decisions on which renovation or transformation strategy should be chosen should always consider the potential savings on carbon footprint. Some CO_2 -limits may be set by legislation or by the city. LCA and LCC calculations and their comparison should be required for different scenarios to make an informed decision for project execution. A light version of LCA and LCC can be required in the design stage of the project. The in-depth LCA and LCC can be required before the execution stage.

Execution (construction) stage

Demolition

Requiring circular economy criteria for the demolition stage can help reduce demolition waste by extending the life cycle of existing materials. This can inturn reduce natural resource use and energy consumption, due to no virgin material excavation and processing.

Require a pre-demolition audit – Require the timeframe of the audit and a list of stakeholders participating. Ensure you provide a template to allow for comparable and detailed reporting.

Execution (demolition) stage

Require training certification from demolition personnel – Require reference to specific training for demolition personnel.

Execution (demolition) stage

Require a plan for storage of recovered elements –- Require a plan on-site or off-site for recovered material before demolition starts. Preferably on-site storage to prevent transportation.

Execution (demolition) stage

Require a plan for material reuse –-Require assessment of potential reuse of material after recovery. Ideally, this should happen before demolition to prevent long-term storage and transportation.

Execution (demolition) stage

Construction

Requiring circular economy criteria for the construction phase can help future proof buildings requiring considerations for future reusability and adaptability. In the next iterations of the building this can reduce on site waste creation and reduces the need for new materials by supporting reuse.

Require a plan for potential future uses of the project
Ask project teams to outline potential future uses for the project – this can be a change of use for the building, future retrofit or building relocation.

Project development stage Design stage

Require an outline of estimated life span for each building layer
Ask project teams to estimate the life span of different building layers (structure, façade, building services, space and stuff).

Design stage

Require a DfA and DfD approach for each building layer based on potential future uses and lifespan
Ask project teams to outline what DfA and DfD can be applied to each building layer based on potential future use and the expected life span.

Design stage

Require a LCA of DfD and DfA strategies and their potential impact on cost and carbon
Ask the project team to conduct a LCA on at least three DfD and DfA strategies applied and realised to different building layers and compare against not applying it.

Design stage

How to embed best practice in policy: City Policy Roadmaps

Despite cities embracing the task of incorporating circular economy principles, the sequence of implementation and integration into existing workflows can remain tricky. The four CIRCuIT cities each reviewed the wide range of circular recommendations developed by the project and considered these alongside their city's needs, environmental priorities and ambition. The result is four circularity strategy roadmaps all developed from a different and unique perspective. The sequence of actions and pace of change can support similar action in other cities where the context may be similar.

> **For the full roadmap descriptions see D7.6 Implementation of Circular approaches into city planning at circuit-project.eu/post/latest-circuit-reports-and-publications**

Copenhagen City Policy Roadmap

In Copenhagen the aim of the roadmap was to influence action at the municipal level taking findings from different areas of CIRCuIT and compiling them into the new Copenhagen Climate Plan 2035 as well as into the municipality's own building stock.

TARGET	WHO					WHEN						IMPACT
Target: Implementation of an improved dialogue tool for sustainability in local planning process	Urban Plans section in the City of Copenhagen	Climate and City Development Department	Council for Sustainable Construction	National stakeholder	External Consultant	Now	6 months	1 year	2 years	3 years	Future	Expected impact/value added
Theme 1: Select a relevant approach												
1.1 Review the processes and standard procedures in local planning to understand potential for sustainability improvements	●					●						Identification of how CST can contribute to local planning work and the opportunities to integrate CO_2-saving measures. In turn, the purpose and use of a sustainability tool will be sharpened.
1.2 Identify the needs in local planning processes and define the use of sustainability dialogue tool	●						●					Ensure that the selected tool will be relevant, operational and usable in local planning work.
1.3 Specify the focus areas of the dialogue tool	●						●					The focus and aim of the tool will be specified (e.g. by prioritising indicators) making it more intuitive, simple and user-friendly.
1.5 Secure financing and the mandate and responsibility for implementing the dialogue tool	●						●	●				Governance around the tool is defined and expectations are aligned, ensuring more effective implementation in the municipality.
Theme 2: Improve the current CST												
2.1 Revise the local planning procedure to ensure CST can be implemented as early in the process as possible	●					●						The tool is implemented early in the local planning process, before critical decisions are made. This gives better results in implementing sustainability and circular economy in local plans.
2.2 Reduce the number of initiatives featured in CST	●					●						The tool is easier to understand and use and so is more effective.
2.3 Align CST with the new local planning regulation	●					●						The tool reflects the updates in local planning regulation, strengthening the argument for its widespread implementation.
2.4 Connect CST with supporting tools, such as CO_2 calculation tool, transformations tool or biofactor tool	●				●		●					The tool is supplemented with quantitative data on the sustainability of different alternatives. This allows more evidence-based decision making leading to more sustainable choices.
2.5 Conduct necessary communication and education activities internally in Copenhagen Municipality	●							●	●			The tool is supplemented with quantitative data on the sustainability of different alternatives. This allows more evidence-based decision making leading to more sustainable choices.
Theme 3: Implement a nationwide CST tool												
3.1 Establish relations with relevant partners to contribute to a nationwide sustainability tool	●		●	●	●		●					Cooperation with relevant actors is established.
3.2 Transfer the lessons learned (e.g. the needs of municipalities) identified from local planning into the nationwide tool	●						●					The knowledge and experience of the City of Copenhagen, as well as municipal needs, are reflected in the national tool. This increases the feeling of ownership and makes it locally relevant. It also ensures compliance with local legislation.
3.3 Ensure alignment of the tool with national and local regulations	●		●	●	●			●				The tool is aligned with other legislation and processes in urban planning work at national level. This helps develop the area in a circular direction by identifying relevant indicators, tendencies and ways to enter into dialogue about circular economy in local planning work.
3.4 Conduct necessary communication and education activities internally in Copenhagen Municipality about the nationwide sustainability dialogue tool	●								●			Awareness and feeling of ownership of the tool is secured in the municipality.

Hamburg City Policy Roadmap

Roadmap development in Hamburg focused on development of the physical infrastructure needed for urban mining drawing from CIRCuIT learnings on urban mining and PDAs.

TARGET	WHO										WHEN							IMPACT
	Demolition company	Recycling companies	City cleaning	Manufacturers	FHH (BSW and BUKEA)	ORPUD / LIG	(Construction) planner	Facilities operators	External operator	Legal advisor	Now	1 year	2 years	3 years	4 years	5 years	Future	Expected impact/value added
Theme I: Intermediate storage for the reuse of building products and parts																		Establishment of a material hub in Hamburg with public sector participation to create a local market for re-using building products
1.1 Clarify the function					●			●			●							Better marketing than non-waste, more throughput
1.2 Legal clarification on the handling of re-use components and materials, on the term product/waste and landfilling					●			●		●	●							Temporary, flexibly rentable warehouses prevent vacancies and running costs. These will probably only work if re-use components are not traded as waste (no permits required)
1.3 Prioritise particularly suitable/in demand components/ materials for reuse	●	●		●	●			●					●					Increases the throughput of the warehouse, reduces disposal costs in the event of non-switching
1.4 Determine the useful life of the area			●		●			●			●	●	●	●		●	●	
1.5 Analyse requirements and needs for the area depending on materials	●	●			●		●	●			●							
1.6 Determine structural requirements for storage		●	●		●			●			●							
1.7 Logistical requirements for storage space		●						●	●		●							
1.8 Perform market analysis	●	●			●			●			●	●	●	●		●	●	Inclusion of further components, gradual expansion/adaptation of the offer
1.9 Location scouting					●	●					●							
1.10 Perform inventory analysis of selected properties					●	●	●					●						As little reconstruction as possible
1.11 Optional: tender for planning competition					●													
1.12 Invitation to tender for necessary structural measures, refurbishment or upgrading of technical equipment							●					●						
1.13 Find an operator					●							●						
1.14 Optional: Tender for the operation of a component exchange								●										
1.15 Determine the type and operation of a platform and data collection of incoming and outgoing products and materials								●	●			●						Digital warehouse logistics, online shop with connection to existing platforms
1.16 Material acquisition								●					●	●				
1.17 Marketing of components to planners / architects / dealers								●						●				Increases the throughput of mediated components

TARGET	WHO										WHEN							IMPACT
	Demolition company	Recycling companies	City cleaning	Manufacturers	FHH (BSW and BUKEA)	ORPUD / LIG	(Construction) planner	Facilities operators	External operator	Legal advisor	Now	1 year	2 years	3 years	4 years	5 years	Future	Expected impact/value added
Theme II: Intermediate raw material storage for recycling																		Establishment of an interim storage facility for recycled building materials to collect raw materials and prepare them for return to the industry. If necessary, integration into existing recycling yards or separate collection point for product-specific raw material collection
2.1 Legal clarification on handling the term product/ waste and on landfilling			●		●					●	●							
2.2 Determine useful life			●		●			●			●	●	●	●		●	●	
2.3 Identify required permits and authorizations			●	●	●		●	●		●	●							
2.4 Obtain necessary permits and authorizations			●				●					●						
2.5 Analyze requirements and needs for the area depending on materials			●		●		●				●	●		●				
2.6 Define structural requirements for storage facilities			●				●	●			●							
2.7 Define logistical requirements for storage space, handling, equipment			●					●			●							
2.8 Receipt of products: formulate acceptance and quality and quantity check. Create product data sheets (component catalogue)				●				●				●						Acceptance prices should be at least 25% below those of the material recycling of the local recycling companies (extra expenditure in removal, loading and transport)
Compensation is only necessary for components that would otherwise be recycled in scrap																		
2.9 Market analysis (ongoing)	●	●		●	●			●			●	●	●	●	●	●	●	
2.10 Scout for location			●		●	●					●							
2.11 Perform inventory analysis of selected properties					●						●							
2.12 Invitation to tender for necessary structural measures, new construction, refurbishment or equipment upgrade							●					●						
2.13 Optional: tender for planning competition					●							●						
2.14 Plan structural measures							●	●				●						
2.15 Find an operator					●						●							
2.16 Optional: tender for the operation of a component exchange					●						●							
2.17 Marketing, communication, involvement of associations					●			●				●						

TARGET	WHO										WHEN							IMPACT
	Demolition company	Recycling companies	City cleaning	Manufacturers	FHH (BSW and BUKEA)	ORPUD / LIG	(Construction) planner	Facilities operators	External operator	Legal advisor	Now	1 year	2 years	3 years	4 years	5 years	Future	Expected impact/value added
Theme III: Bulk material, Soil handling, Urban processing																		Bulk materials are handled close to the construction site, shortening transport routes. Flexible infrastructure exists for the reuse and recycling of bulk materials
3.1 Understand process, identify competences and contact process participants	●	●	●		●						●							
3.2 Analyze material flows and perform quantity analysis		●	●	●							●							
3.3 Market analysis and product development		●	●	●							●							
3.4 Decide which type of facility should be considered		●	●								●							
3.5 Identify project management or project sponsor			●		●		●				●							
3.6 Analyze area requirements and needs		●	●				●				●							
3.7 Define logistical requirements for storage space		●	●				●				●							
3.8 Identify required permits and authorizations		●	●		●		●				●							
3.9 Find suitable areas in terms of identified requirements, considering the ownership situation		●	●		●	●			●		●							
3.10 Determine a suitable operator		●	●		●		●		●		●							
3.11 Engineer a concrete implementation concept		●	●						●			●						
3.12 Obtain necessary approvals and permits		●	●		●		●		●	●		●						
3.13 Implement in the usual construction process	●	●	●	●								●						

London City Policy Roadmap

The London roadmap focused on incorporating CIRCuIT findings on streamlining data, pre-demolition audits and establishing the data frameworks of material passports into the existing circular economy statement policy that exists in the city.

TARGET	WHO		WHEN								IMPACT
	City Government	ReLondon	Policy Guidance 1	London Plan Policy Cycle 1	Policy Guidance 2	London Plan Policy Cycle 2					Expected impact/value added
Theme 1: Leveraging CE Statement data for city-level material flow											Improves city-level data capturing infrastructure and indicator monitoring
Connect CE Statement data flow to existing data infrastructure	●		●								
Assess suitability of planned PLD for CE Statement data sharing	●			●							
Update CE Statement template to streamline CE Statement data sharing	●					●					
Integrate CE Statement template data into PLD	●					●					
Assess city-level indicators that can be measured with CE Statement template data		●	●								
Identify city-level indicators that can influence policy priorities		●			●						
Theme 2: Leveraging Pre-Demolition Audits to drive retention and reuse											Improves data capture on availability of secondary materials to inform material pipeline
Collect input and establish consensus from industry and relevant stakeholders on change to CE Statement template to include retention and PDA standardisation.	●		●								
Update CE Statement template to include retention and PDA standardisation	●			●							
Support development of city-wide material exchange portal	●		●		●						
Update policy to require submission of PDA and CE targets at pre-application stage	●					●					
Link CE Statement template PDA data to city-wide material exchange portal	●						●		●		
Update policy to require CE Statement template PDA data to be uploaded onto the city-wide material exchange portal	●									●	
Collect input and establish consensus from industry and relevant stakeholders on the inclusion of required reuse and recycled % of materials into new build to drive secondary reuse market	●								●		
Creation of best practice guide to CE Statement – how to incorporate PDA findings into CE targets		●	●								
Support development of city-wide material exchange portal		●	●		●						

TARGET	WHO		WHEN								IMPACT
	City Government	ReLondon		Policy Guidance 1		London Plan Policy Cycle 1		Policy Guidance 2		London Plan Policy Cycle 2	Expected impact/value added
Theme 3: Establishing demand signal with the Bill of Materials											Improves data capture on demand of materials to inform material flow pipeline
Collect input and establish consensus from industry and relevant stakeholders on the level of detail and input needed to make BoM useful as demand signal on material exchange platform	●		●								
Update CE statement template BoM section according to stakeholder engagement findings	●			●							
Support development of city-wide material exchange portal	●		●		●						
Establish connection between the CE Statement template BoM data and the city-wide material exchange portal	●										
Link CE Statement template BoM data to city-wide material exchange portal	●										
Update policy to require CE Statement template BoM data to be uploaded onto the city-wide material exchange portal	●										
Support development of city-wide material exchange portal		●	●		●		●				
Theme 4: Embedding materials passports											Futureproof is incoming material data for improved secondary material recovery
Collect input and establish consensus from industry and relevant stakeholders on use of material passports – settling on agreed framework for London/UK	●		●		●						
Update policy to require Material passports provided on completion for 20% of FFE	●					●				●	
Update policy to require Material passports provided on completion for 80% of FFE	●										
Support upskilling of LAs and SMEs on new topics such as material passports		●	●		●						
Theme 5: Broadening the scope of applicable developments.											Establishes broad base of understanding and application of CE Statement policy to gather more comprehensive city-wide dataset and improved compliance
Support further training and upskilling staff to take on the additional assessment of the new CE Statements	●		●		●						
Include language that outlines the CE Statement requirements used by LAs for non-referrable major application	●					●				●	
Convene LA working group to achieve consensus on the requirements for CE Statements non-referrable major applications		●	●		●						
Commitment from all interested LAs to apply CE Statement requirements to all major works in their boroughs		●			●						
Support further training and upskilling of staff and built environment stakeholders to take on the additional assessment of the new CE Statements						●					
Convene LA working group to achieve consensus on the evolution of requirements for CE Statement's non-referrable major applications		●									

Vantaa City Policy Roadmap

In Vantaa the roadmap focused on integrating best practice findings from CIRCuIT into the existing 'Resource Wisdom' strategy document.

TARGET	WHO		WHEN							IMPACT
Target: Circular economy aspects are implemented in planning.	City zoning	Building inspection	Now	1 year	2 years	3 years	4 years	5 years	Future	Expected impact/value added
Theme 1: Incorporate circular economy aspects into the plans. Encourage renovation and adaptive reuse through urban planning and zoning measures										
1.1 Investigate the legislative prerequisites for increasing the flexibility of zoning plans	●			●						
1.2 Add circular economy themes to the planning report template	●		●							
1.3 Create a guideline and an assessment model to encourage additional construction in connection with renovation. Compare the impacts of demolition to preservation in zoning processes	●	●	●	●	●					
Theme 2: Enhance collaboration between the city and private sector to support circular economy pilots in Vantaa.										
2.1 Choose the first pilot(s)			●							
2.2 Carry out the pilot(s)				●	●					
2.3 Set up the operating model						●	●			
Theme 3: Enhance collaboration between urban planning and building inspection to promote circular economy. Allocate resources for coordinating circular economy in planning and building inspection.										
3.1 Add circularity to kick off-meetings' agenda	●	●	●							
3.2 Circularity in planning and building inspection is business as usual	●	●		●						

Further reading

For further information about these outputs and the work behind them, please read the following reports, which were published by members of CIRCuIT partner organisations during the lifetime of the project.

- D7.1 Circular economy in urban planning and building permits – possibilities and limitations
- D7.3 Recommendations: Instruments for the dialogues with developers
- D7.4 Recommendations: Criteria for public tenders on construction
- D7.5 How to implement the EU guideline for pre-demolition audits
- D7.6 Implementation of Circular approaches into city planning

All these reports can be downloaded at circuit-project.eu/post/latest-circuit-reports-and-publications

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Janus zum Brock, Hamburg University of Technology
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Karolina Bäckman, GXN
Kimmo Nekkula, The City of Vantaa
Mahsa Doostdar, Hamburg University of Technology
Mathias Peitersen, The City of Copenhagen
Philipp Wendt, The City of Hamburg
Pia Kohrs, The City of Hamburg
Rachel Singer, ReLondon
Rune Andersen, Technical University of Denmark
Silke Bainbridge-Nott, Otto Wulff
Simon Gühlstorf, Otto Dörner
Tessa Devreese, ReLondon
Tiina Haaspuro, Helsinki Region Environmental Services Authority
Uta Mense, The City of Hamburg

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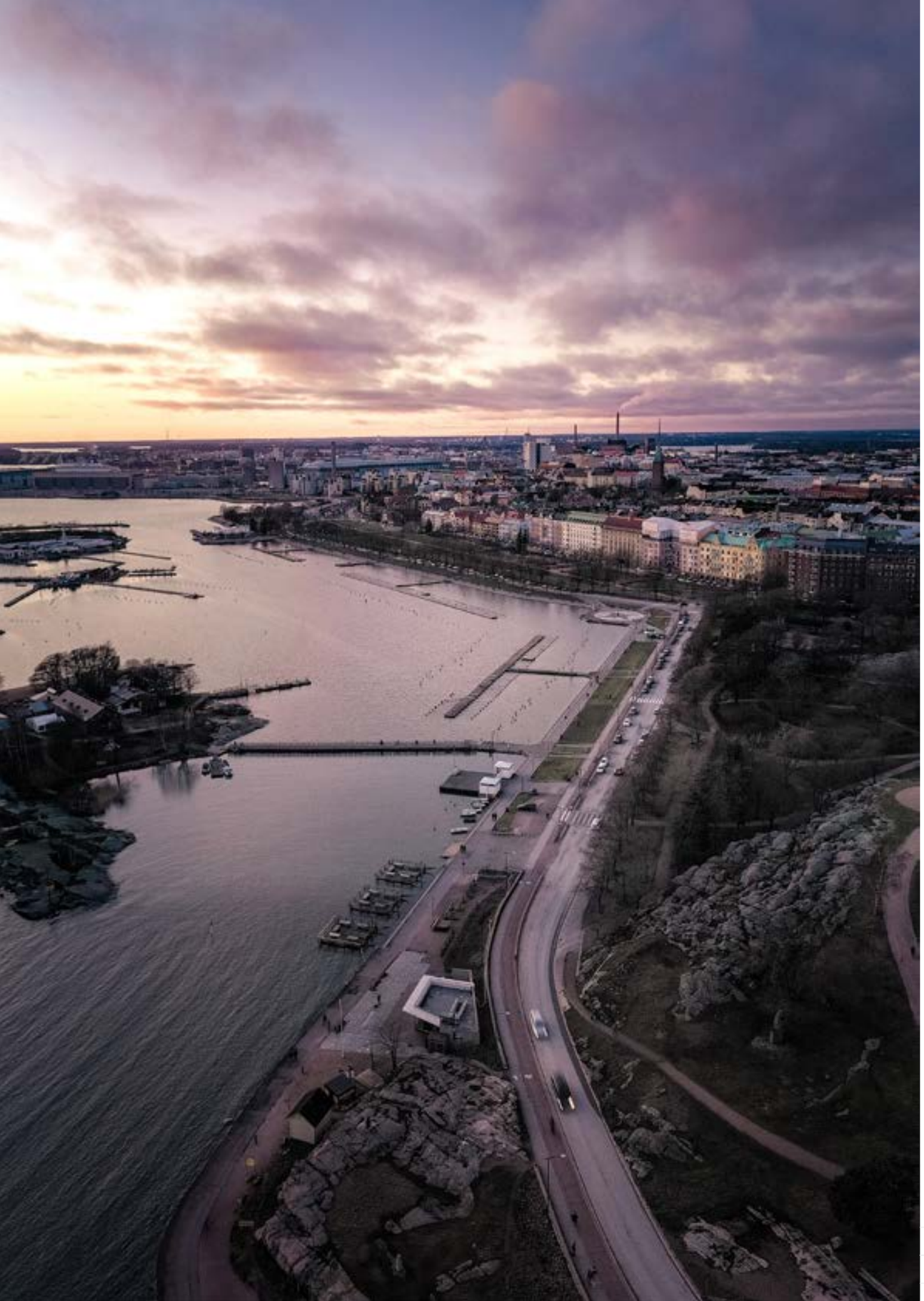

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