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Evidence Synthesis Report 8

Ireland's Urban Bioeconomy – Opportunities for Climate Action

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Rialtas na hÉireann
Government of Ireland

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3. Office of Evidence and Assessment
4. Office of Radiation Protection and Environmental Monitoring
5. Office of Communications and Corporate Services

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EPA RESEARCH PROGRAMME 2021–2030

Ireland's Urban Bioeconomy – Opportunities for Climate Action

(FTP-2024-07)

EPA Research Evidence Synthesis Report

Independent scientific research funded by the Environmental Protection Agency

Prepared by the Rediscovery Centre

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ACKNOWLEDGEMENTS

This report is published as part of the EPA Research Programme 2021–2030. The EPA Research Programme is a Government of Ireland initiative funded by the Department of Climate, Energy and the Environment. It is administered by the Environmental Protection Agency, which has the statutory function of co-ordinating and promoting environmental research. This research study was funded under the EPA Research Fast-Track to Policy funding scheme, which is designed to support short-term, evidence-based research studies where an urgent policy need is demonstrated.

The authors would like to acknowledge the members of the project steering committee, namely Conor McGovern, Darren Byrne, Evan Carey and Laura Broomfield (Department of Climate, Energy and the Environment), Catriona Power (Enterprise Ireland) and Joanne O'Rourke (Dublin City Council). The authors would also like to acknowledge the support of the Research Project Manager on behalf of the EPA, namely Niamh McCormack.

DISCLAIMER

This report is based on research carried out/data from 1 November 2024 to 30 June 2025. More recent data may have become available since the research was completed.

The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

EPA RESEARCH PROGRAMME 2021–2030
Published by the Environmental Protection Agency, Ireland

ISBN: 978-1-80009-XXX-X February 2026

Price: Free Online version

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Executive Summary

This Fast-Track to Policy research project identifies opportunities for urban circular bioeconomy development to inform policy updates for Ireland's Bioeconomy Action Plan and Climate Action Plan, and EU and Irish bioeconomy strategies.

Both the circular economy and the bioeconomy are central to delivering a climate-neutral and resource-efficient economy as part of the European Green Deal. Increasing circularity within the economic system is common to both the circular economy and the bioeconomy, with integration of circular economy principles into the bioeconomy being a priority for improving bio-resource efficiency.

Cities and urbanised areas have high levels of biological resource consumption and generation owing to the density and scale of people and businesses. The EU Bioeconomy Strategy 2018 recognises the importance of urban circular bioeconomy development in the context of increasing urbanisation, stating that "cities should become major bioeconomy hubs"; however, the potential contribution of Ireland's cities and urbanised areas to the bioeconomy remains underexploited.

The revised EU Bioeconomy Strategy should continue to support the development of cities as major circular bioeconomy hubs and increase financial support for EU cities in every Member State to draft urban circular bioeconomy strategies as an integral aspect of local bioeconomy development and climate action. At the national level, the Irish Government's strategic policy objectives for the bioeconomy should recognise the importance of cities and urbanised areas for bioeconomy development and support the development of an urban circular bioeconomy strategy for at least one Irish pilot city.

Local authorities that manage urban areas must be supported to deliver circular bioeconomy-related actions within all designated decarbonising zones and to coordinate such actions with circular economy strategies that have food and construction as recommended focus areas.

The Circularity Gap Report Ireland, commissioned by the then Department of the Environment, Climate and Communications (now the Department of Climate, Energy and the Environment), assessed Ireland's circularity baseline and carbon profile. Urban circular bioeconomy opportunities are considered within the context of five target circular economy areas (as depicted in Figure ES.1) identified as having the potential to reduce Ireland's carbon emissions by up to 32%. A summary of recommendations under each target is presented below.

- **A circular built environment.** The aim in this area is to increase the use of bio-based construction and retrofitting materials to replace carbon-intensive materials and consequently reduce embodied and operational carbon emissions in the built environment. Funding model options to reduce the green premium of bio-based construction materials include a government fund, a public–private partnership model similar to Peatland Finance Ireland and a philanthropic fund supported by industry. Several policy actions for accelerating the use of bio-based construction and retrofitting materials to replace carbon-intensive materials are presented in the Irish Green Building Council's 2025 publication *Building a Circular Ireland – A Roadmap for a Resource Efficient Circular Built Environment*.
- **Circular food systems.** There are two key opportunities in this area. On the production side, with regard to urban food growing, Ireland has among the lowest numbers of community gardens and allotments in the EU. As part of regional biodistrict development, implementing the Planning and Development Act 2024 requirement for local authorities to provide allotments and community gardens and membership of the Organic Cities Network Europe would support urban and peri-urban agriculture and citizen uptake of organic and regional food products. On the waste side, residential and commercial food waste generation remains high in Ireland, with a significant proportion of this disposed of as part of general waste. The EU HOOP project toolkit could be used to reduce food waste and improve organic waste segregation and capture from households and businesses in urban areas.

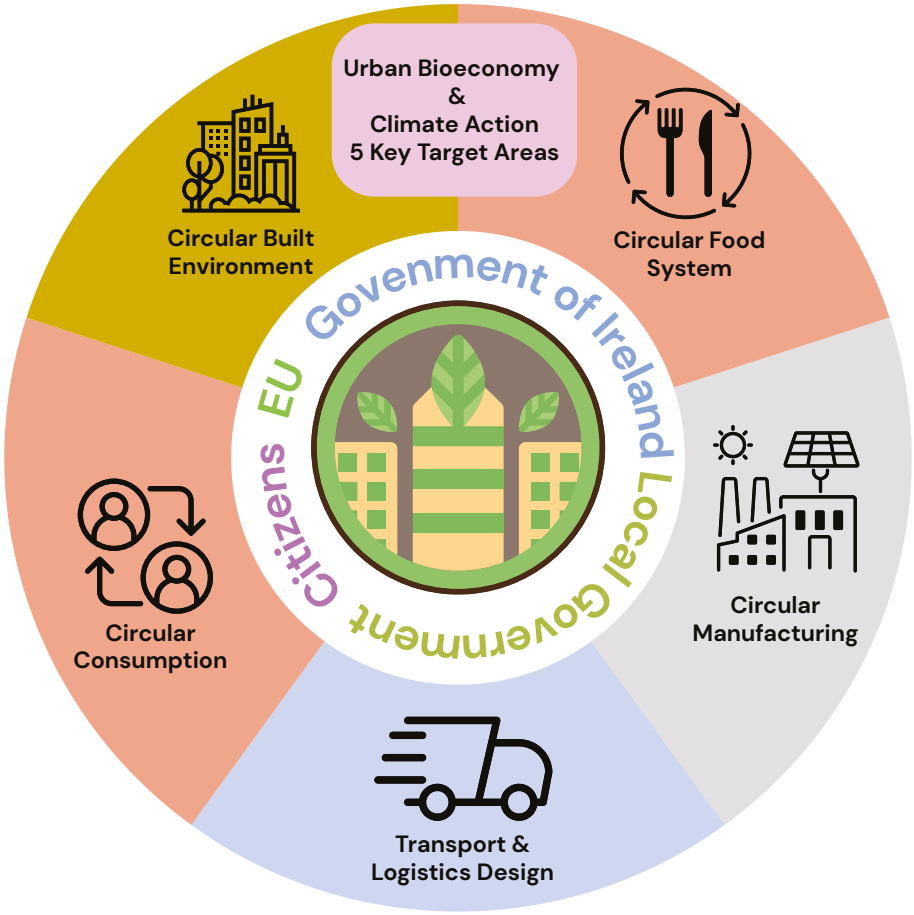

Figure ES.1. Target circular economy areas for urban circular bioeconomy opportunities. Figure designed with Canva.

- **Circular manufacturing.** Bioeconomy manufacturing facilities need to maximise the use of on-site renewable energy and resource efficiency measures, such as energy and water meters. Enterprise Ireland, the Sustainable Energy Authority of Ireland and CIRCULÉIRE offer a range of relevant supports to manufacturers. Crucially, bio-product design must adopt circularity as a core principle. The application of industrial symbiosis tools by bio-industrial networks as part of a national industrial symbiosis programme would support efficient bio-resource flows among businesses. Such an initiative should build on learnings from the previous SMILE resource exchange programme supported by the EPA and regional waste management offices.
- **Transport and logistics redesign.** National and regional supply chain development can be informed by the EU City Logistics in Living Laboratories project, which has produced a range of strategies, actions and tools for zero-emission logistics. As part of the process, transport emissions within bioeconomy supply chains can be assessed using existing tools, for example the Vehicle Energy Consumption Calculation Tool, and mitigated by the incentivised use of relatively small light-weight vehicles, electric vehicles and low-carbon fuels where appropriate.
- **Circular consumption.** Circular.ie, the Government of Ireland digital platform and resource hub funded by the Department of Climate, Energy and the Environment and powered by the Rediscovery Centre, provides an excellent opportunity for the promotion of sufficiency lifestyles and local, circular bio-based products via an urban circular bioeconomy communications plan that celebrates urban and rural linkages. The communication plan can be informed by the BioBeo education programme and the EU HOOP project toolkit, which provide a range of public engagement resources for boosting citizen awareness of the urban circular bioeconomy.

1 Introduction

1.1 Project Aims and Scope

This Fast-Track to Policy research project mapped the landscape and opportunities for circular bioeconomy development in Ireland's urban context to mitigate climate change. The research findings are to inform policy updates to Ireland's Bioeconomy Action Plan and Climate Action Plan, and EU and Irish bioeconomy strategies.

The report:

- addresses the role of the circular economy, the bioeconomy and urbanised areas in climate change mitigation (Chapter 2);
- presents a state-of-play review of the urban circular bioeconomy in Ireland (Chapter 3);
- summarises urban and circular bioeconomy case studies that illustrate best practice approaches that could be rapidly deployed in Ireland.

An assessment of the rural bioeconomy is beyond the scope of this report; however, urban–rural linkages are considered an important aspect of urban and circular bioeconomy development.

1.2 Ireland's Climate Change Mitigation Obligations

Greenhouse gas (GHG) emissions generated by fossil fuel combustion and other sources are warming the planet and driving climate change. The Government of Ireland declared a climate emergency in 2019, and the Climate Action and Low Carbon Development (Amendment) Act 2021 provides the governance framework for achieving GHG emission mitigation targets, namely a 51% reduction by the end of 2030 relative to 2018 levels and net zero by 2050. Local authorities (LAs) (county and city councils) manage urbanised areas, and they are obliged to prepare LA climate action plans every 5 years, in line with the governance framework, and to identify decarbonising zones (DZs) as demonstration sites for targeted, innovative measures. Climate action regional offices are working with LAs to deliver climate action plans at the regional and local levels.

Three 5-year carbon budgets for the period 2021–2035 are the cornerstone of the governance framework. The Climate Change Advisory Council has highlighted the need for transformational change to meet the emission reduction target of 6.3% year on year under the proposed carbon budgets to 2040 (CCAC, 2024). Sectoral emission ceilings have been applied to the energy; industrial processes; agriculture; waste; and land use, land use change and forestry sectors. The governance framework also includes the Climate Action Plan 2024, Ireland's National Long-term Strategy on Greenhouse Gas Emissions Reduction 2024, the National Adaptation Framework 2024 and sectoral adaptation plans for 2019.

Ireland's Climate Change Assessment: Synthesis Report (Thorne *et al*., 2023) states that Ireland is not on course to meet its 2030 and 2050 GHG emission reduction targets. Annual carbon budget reviews for 2021 and 2022 indicate that 47% of emissions covered by Ireland's first carbon budget (2021–2025) have been emitted within 40% of the budget's time frame. Greater emphasis on systemic transformation is needed, along with more effective implementation of improved policies. Consideration of alternative economic models is noted as a key aspect of achieving systemic change and addressing indirect drivers of emissions (Thorne *et al*., 2023).

The climate change and resource challenges Ireland faces are driven by the dominant linear (take–make–waste) economic model, which is founded on global regional wealth inequalities and cheap materials relative to human labour, resulting in large amounts of waste generation (EMF, 2013; Sariatli, 2017). Fundamental take–make–waste characteristics of the linear economy include non-renewable material extraction, large-scale production of short-life products, high levels of consumption and large amounts of waste, which are managed by landfill, incineration and recycling. Business bears few of the costs of environmental damage, and subsidised non-renewable fossil fuels have enabled the linear economy model to become dominant while driving GHG emissions and global warming. Resource extraction and processing account for about 50% of total global GHG emissions,

and most biodiversity loss and water stress (IRP, 2019). Ireland's small, open, highly globalised free-market economy currently ranks third on the Index of Economic Freedom (https://www.heritage.org/index/). In this context, enabling alternative economic model development to meet climate change challenges requires systemic transformation driven by a range of legal, economic, cultural, technological and skills interventions (Circle Economy, 2024; Joint Committee on Environment and Climate Action, 2024).

2 Urban Bioeconomy and Climate Change Mitigation – Literature Review

Key findings

- Urban and circular bioeconomy development is important for climate action given the high levels of biomass consumption and production concentrated in densely populated urban areas and increasing levels of urbanisation.
- The circular use of biomass in urban areas can stimulate the national bioeconomy, and urban-derived biomass can contribute to bioeconomy material flows.
- Key circular economy target areas for climate change mitigation are a circular built environment; circular food systems; circular manufacturing; transport and logistics redesign; and circular consumption.

2.1 Circular Economy and Climate Change Mitigation

The EU launched the European Green Deal in 2019 to deliver a climate-neutral and resource-efficient economy. Resource efficiency has significant potential to mitigate climate change (Hatfield-Dodds *et al*., 2017). Over recent years, the circular economy concept has gained significant international and national traction among policymakers, legislators, businesses and consumers as a means of delivering resource efficiency and decoupling consumption from environmental damage (Geissdoerfer *et al*., 2017). The Circular Economy Action Plan (CEAP) is a cornerstone of the European Green Deal. At the national level, the EPA-led Circular Economy Programme 2021–2027 is driving Ireland's shift to a circular economy. Despite growing interest, there is no universally accepted definition of a circular economy, which presents challenges for policymakers. Under Ireland's Circular Economy and Miscellaneous Provisions Act 2022, a circular economy refers to an economic model in which goods, products and services are designed for longevity, reuse and recovery, with a view to reducing raw material consumption. The EU definition takes a systems perspective (https://eur-lex.europa.eu/EN/legal-content/glossary/circular-economy.html), and the definition proposed by Kirchherr *et al*. (2017) considers the role of the circular economy in sustainable development and social equity.

The circular material use rate (CMUR), reported by Eurostat, is a key national circular economy metric that reflects the ratio of material recycled to material consumed. Unfortunately, Ireland's CMUR has been consistently low, being only 2.3% in 2023 (Eurostat, 2023). Ireland aims to achieve a CMUR above the EU average (currently 11.9%) by 2030 (DECC, 2021). Following a critical analysis, McCarthy *et al*. (2024) found limitations to the CMUR approach, including a lack of direct accounting for GHG emissions, reuse, repair and waste prevention activities. Better integration of energy–climate mitigation modelling and circular economy analytical tools (e.g. material flow analysis) would capture the contribution of materials' circularity to climate change mitigation (Lima *et al*., 2023). The Horizon Europe CON2STRUCT project (Oikonomou *et al*., 2023) aims to bridge this gap by integrating key circular economy concepts with the Integrated MARKAL-EFOM System climate model to develop a new circular climate mitigation framework, with a focus on the construction sector as a test area.

There is significant potential for a circular economy to mitigate climate change, but Corvellec *et al*. (2022) highlight some problems, such as an oversimplification of cyclical systems, the resource efficiency rebound effect (i.e. reduced costs can increase consumption), challenges with connecting waste streams and secondary resources to production, biophysical limits to economic growth, and assumptions around a new consumption culture and neglect of circular economy impact assessments on society and the environment. Corvellac *et al*. (2022) conclude that effective, inclusive and transparent circular economy development must challenge neoliberal norms such as eliminating price controls, deregulating capital markets and lowering trade barriers. Standards such as organisational guidance frameworks (Flynn and Hacking, 2019) and transdisciplinary research to

inform cross-sectoral circular economy development might offer a transition pathway. The European Environment Agency (EEA) notes that, despite the importance of a circular economy for reducing GHG emissions through material flow efficiency, circular economy actions are underrepresented in national climate policies and reporting because of their cross-sectoral nature and the challenge of quantifying impacts (EEA, 2024). This report responds to the first and second of the EEA's recommendations, namely to raise awareness and break silos and to identify circular economy measures with high GHG reduction potential. Specifically, the report raises the profile of bioeconomy development in urban areas and identifies urban circular bioeconomy opportunities for climate change mitigation.

2.2 Bioeconomy – Biomass, Circularity and the Urban Perspective

Similar to the circular economy, there is no single widely accepted definition of the bioeconomy. The updated definition included in the EU Bioeconomy Strategy 2018 (EC, 2018) refers to economic sectors that currently rely on biological resources, along with future increased dependency on such resources and ecosystem services. Increasing dependency on biological resources is driven by the core bioeconomy aim to replace fossil carbon with biogenic carbon and substitute fossil fuel-derived products and high-emission materials with renewable biomass alternatives. Developing resource-efficient technologies and driving a transition to a sustainable society will also be necessary (Lewandowski *et al*., 2018).

2.2.1 Biomass and climate change mitigation

Biomass is "the fuel of the bioeconomy and a key component of its value chain", with EU trends in biomass supply and demand increasing from both primary domestic production and secondary sources (Avitabile *et al*., 2023). Biomass is organic material of biological origin that can potentially be carbon-neutral when compared with the release of carbon from fossil fuels (Lewandowski *et al*., 2018). In relation to climate change mitigation, products and materials derived from wood, for example, can be used as alternatives to concrete and steel products with higher carbon footprints (Hetemäki and Kangas, 2022). The substitution effect is dependent however on the lifetime of and GHG emissions from the product used for substitution (EEA, 2023).

Biomass is the main source of renewable energy in the EU, accounting for 56% of gross final EU renewable energy consumption in 2021 (EEA, 2023). However, it should be noted that the non-renewable extraction and burning of biomass at rates exceeding regrowth (Ghilardi *et al*., 2016) or depleting natural capital (Chiesura and de Groot, 2003) does not mitigate GHG emissions. Application of a natural capital approach to bioeconomy decision-making can support sustainable land use by capturing the many values and services of ecosystems along with the bioeconomy impacts and dependencies on such ecosystems (Neill *et al*., 2020). Strong sustainability can be delivered through a circular bioeconomy if Ireland's critical natural capital (Ekins *et al*., 2003) is well defined, broadly accepted as vital for human welfare and recognised as non-exchangeable with other forms of capital. Quantifying the climate change mitigation potential of biomass, bioenergy and bio-based products, and related policy development, requires a holistic assessment of land use dynamics, displaced fossil fuels and energy system feedback within the supply chain (Diaoglou *et al*., 2019).

The three main sources of urban biomass in Ireland are obtained from the segregation of municipal solid waste (e.g. paper, cardboard, natural fibre textiles, food waste and green waste (https://www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics/municipal/)), municipal sewage sludge and urban wood biomass (Li *et al*., 2017), including timber in wood products, structures and buildings.

2.2.2 Circular bioeconomy

The circular bioeconomy is the melding of the circular economy and the bioeconomy to achieve efficient and circular bio-resource management (Tan and Lamers, 2021). In the context of the bioeconomy, circularity refers to both the cycle of technical materials and a regenerative cycle of materials to support ecosystem restoration and function (EEA, 2018; EMF, 2019). Stegmann *et al*. (2020) define a circular bioeconomy as "the sustainable, resource-efficient valorisation of biomass in integrated, multi-output production chains (e.g. biorefineries) while also making use of residues

and wastes and optimizing the value of biomass over time via cascading". Cascading biomass use is a key approach that prioritises higher value material use over energy. Holden *et al*. (2023) provide a framework (for biocircularity) to assess the contribution of a material, product, process or system to a sustainable, circular economy. The development of biocircularity metrics (e.g. the index recently proposed by Zhang *et al*. (2024)) is also important for assessing the circular bioeconomy's socio-economic and environmental impacts (D'Amato *et al*., 2020). Such metrics should help to optimise the cascading use of biomass (Gursel *et al*., 2023) and identify aspects of the circular bioeconomy that are important for climate change mitigation and GHG emission reporting.

2.2.3 Urban circular bioeconomy development

Urbanisation in the EU is expected to increase to about 85% in 2050 (EC, 2025). Given that modern cities are major consumers of goods produced beyond their boundaries, measures targeting urban areas have significant potential to reduce supply chain emissions, and a consumption-based approach is recommended for urban GHG emission accounting (Del Borghi *et al*., 2022).

The EU Bioeconomy Strategy 2018 recognises the importance of urban bioeconomy development within the context of increasing urbanisation, stating that "cities should become major bioeconomy hubs" (EC, 2018). The strategy includes an action to develop the urban bioeconomy through pilots in 5–10 cities through Horizon Europe, with a view to then extending the programme to 30 cities. Financial support to develop, implement and monitor urban circular bioeconomy strategies is focused on valorising biowaste, supporting the use of bio-products and diversifying sources of biomass. As a leading example, a material flow analysis for the Buiksloterham neighbourhood in Amsterdam led to an ambitious circular economy strategy for the whole city, with targets to reduce the use of virgin materials by 50% by 2030 and to achieve full circularity by 2050 (www.metabolic.nl).

To date, bioeconomy development in Ireland has focused on diversifying the agricultural sector, given that 65% of land is under some form of agricultural practice that collectively accounts for 38% of territorial GHG emissions (Circle Economy, 2024). The urban perspective is vitally important, however, given that 46% of the Irish population lives in cities and given the high per-capita consumption level in Ireland (Circle Economy, 2024). Sekabira *et al*. (2023) assert that the "circular bioeconomy can serve as a bridge to both urban and farming communities", so, despite the focus of this report on the urban bioeconomy, the circular bioeconomy must always be viewed in the wider geographical context. In fact, it has been stated more firmly that urban circular bioeconomy development can strengthen the urban to rural linkage and help meet rural regeneration goals (Philip and Winickoff, 2018).

Urban bioeconomy development also ties in with the Circular Cities and Regions Initiative (CCRI) under the EU CEAP. Effective urban circular bioeconomy frameworks that balance economic growth with environmental stewardship need stakeholder participation, collaborative central and local government support, public–private partnerships, integration of ecosystem services, and the adoption of decentralised and localised strategies to increase resource efficiency and resilience in urban systems (Paes *et al*., 2024). A proposed framework for informing the development of urban centres as hubs for the circular bioeconomy in Ireland is presented in Figure 2.1 and Appendix 1. This framework is built on the concept of the interaction between rural and urban environments, namely that they are contrasting but co-dependent places with complex, dynamic systems where people, wildlife, habitats, green spaces, buildings, infrastructure, transport networks, businesses and community facilities co-exist in different ways.

Looking at the role of urban centres in the circular bioeconomy, the proposed framework incorporates aspects of previously developed frameworks for urban centres' roles in circular bioeconomy development, including 10 central urban challenges noted by Raymond *et al*. (2017) with the addition of ecosystems, biodiversity and ecosystem services, which are overlaid with eight categories for grouping drivers, barriers, strategies, practices and indicators (Paes *et al*., 2022) (Figure 2.1). Key considerations relevant to the Irish context are also collated under these eight categories (Appendix 1).

The Circularity Gap Report Ireland (Circle Economy, 2024) identified five target circular economy

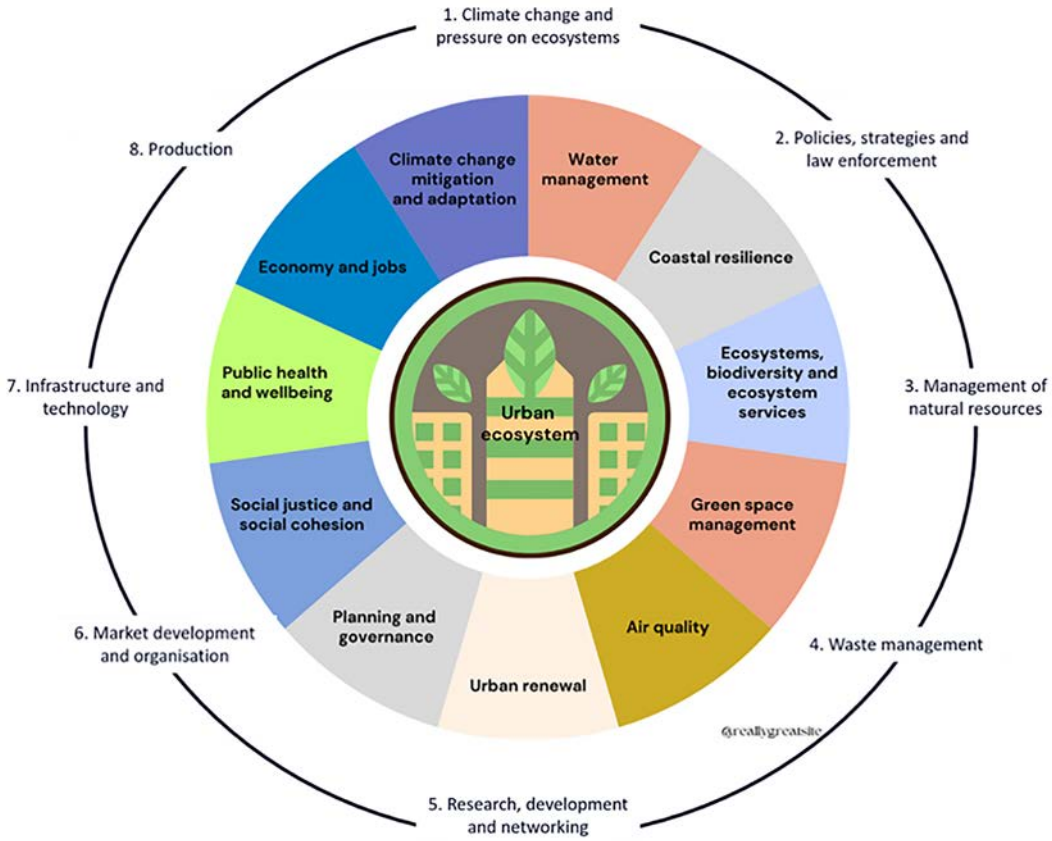

Figure 2.1. Framework for informing the development of urban centres (typically, but not necessarily, cities) as hubs for the circular bioeconomy in Ireland (see also Appendix 1). Figure designed with Canva.

pathways that have the potential to reduce Ireland's carbon emissions by up to 32%, namely a circular built environment, circular food systems, circular manufacturing, transport and logistics redesign, and circular consumption. Labour shortages and skills gaps across the circular economy and bioeconomy are noted as key cross-sectoral barriers to the transition to a circular economy and bioeconomy. Table 2.1 presents urban circular bioeconomy opportunities for climate change mitigation within the context of the five target areas identified in Ireland's Circularity Gap Report (Circle Economy, 2024).

Table 2.1. Circular economy target areas for urban circular bioeconomy development and climate action

Target area	Climate challenge in Ireland	Urban context	Urban circular bioeconomy opportunities for climate change mitigation
Circular built environment	Built environment and construction account for 37% of Ireland's national emissions (14% embodied carbon; 23% operational emissions) (IGBC, 2025). Retrofit target of 500,000 homes in Ireland by 2030 (Government of Ireland, 2024).	Building density is high.	Accelerate the use of bio-based construction and retrofitting materials to replace carbon-intensive materials (e.g. cement, concrete, steel) (Hertwich *et al*., 2019; Ding *et al*. 2022; Bošković and Radivojević, 2023; EEA, 2023; Daly and Barril, 2024a,b).
Circular food systems	Annual food waste per person (145 kg) in Ireland is higher than the EU average. In 2023, 169,864 tonnes of biodegradable municipal waste were disposed of in landfill, representing 32.6% of all municipal waste sent to landfill (EPA, 2025a). Landfilling such organic wastes generates significant GHG emissions (Nordhal *et al*., 2020). Urban areas typically depend on long, complex food supply chains (Spillane *et al*., 2024).	Levels of food consumption and food waste generation are high. Ireland has among the lowest numbers of community gardens and allotments in the EU (Community Gardens Ireland, 2023).	Reduce food waste (Mohareb *et al*., 2018). Improve the segregation and capture of organic waste and its diversion from landfill (Zero Waste Europe, 2024). Increase urban and peri-urban agriculture as part of biodistrict development, with a focus on agro-ecology and local food value chains, events and markets (Kulak *et al*., 2013). Integrate urban wastewater treatment as part of nutrient recovery (Aryampa *et al*., 2025).
Circular manufacturing	In 2023, emissions from manufacturing combustion accounted for 7.6% of Ireland's total GHG emissions (www.epa.ie). Manufacturing in Ireland represents 20% and 17% of the country's material and carbon footprint, respectively (Circle Economy, 2024).	Urban-based manufacturing facilities are typically located in peripheral industrial estates.	Embed renewable energy within circular manufacturing (Posen *et al*., 2017). Boost industrial symbiosis, i.e. the association between manufacturing facilities in which waste or by-products of one sector can become feedstocks in another (Bijon *et al*., 2022).
Transport and mobility redesign	The number of heavy-duty, largely diesel-fuelled vehicles in use increased by 177% between 1990 and 2023. Commercial transport emissions require decoupling from economic activity via sustainable planning and electrification (EPA, 2025b).	Urban-based businesses are within circular bioeconomy supply chains.	Develop national and regional circular bioeconomy value and supply chains (Beames *et al*., 2021). Apply the Vehicle Energy Consumption Calculation Tool to assess transport-related GHG emissions and promote the use of zero-emission alternatives (Middela *et al*., 2024).
Circular consumption	In 2023, Ireland's actual individual consumption per capita (goods and services consumed by households) was 94%, meaning it ranked 7th out of 27 Member States. High rates of material consumption are a driver of increasing waste levels and GHG emissions.	Urban-oriented campaigns are important for reducing overall consumption and bioeconomy market development owing to the higher population densities of urban areas.	Promote sufficiency lifestyles and local, circular bio-based products (Circle Economy, 2024). Embed green public procurement in the public sector.

3 Ireland's Urban Circular Bioeconomy – State-of-play Review

Key findings

- Nearly 70% of Ireland's population lives in urbanised areas.
- Significant improvements in the reduction, segregation and capture of household and commercial organic waste are needed.
- Cork City, Galway City and Dublin City have dedicated LAs currently involved in green city initiatives that could incorporate circular bioeconomy actions.
- Some LA DZs provide an opportunity for trialling urban circular bioeconomy actions.
- There is a lack of support for urban circular bioeconomy development in current policies.

3.1 The Characteristics of Urbanised Areas and Local Authority Decarbonising Zones in Ireland

According to Census 2022, 46.3% of Ireland's population lives in cities, with 22.3% living in towns and suburbs. The Local Government Act 2001 redesignated the three county boroughs of Dublin, Cork and Galway as administrative cities, with the city status of Kilkenny retained under the Local Government Bill 2000, in keeping with local long-established civic tradition. Limerick and Waterford were redesignated as cities within a "city and county" administrative unit. Dublin City, Cork City and Galway City have dedicated LAs, with populations of 588,233, 222,333 and 83,456, respectively. Of the 49 built-up areas/towns with a population of 10,000 or more, 33 were in Leinster, 11 in Munster, 3 in Connacht and 2 in Ulster (Republic of Ireland) (CSO, 2023).

The EPA undertakes regular municipal waste characterisation studies to assess the composition of household and commercial waste. The most recent study, conducted in 2022, found that organic waste collected in organic waste ("brown") bins accounted for 11%, or 197,518 tonnes, of all managed household waste (EPA, 2024). The study also found that about two-thirds of household organic waste is placed in the general waste ("black") bin. With improved segregation, there is potential, therefore, to capture approximately 592,554 tonnes of organic waste in brown bins from municipal households per annum, with food waste prevention remaining the top priority. With regard to commercial waste, 60,000 tonnes of organic waste was collected from brown bins, with 161,600 and 11,250 tonnes of organic waste incorrectly placed in the general waste black bin and recycling "green" bin, respectively (www.epa.ie). Based on data gathered from these municipal waste characterisation studies, there is potential to capture approximately 825,404 tonnes of municipal organic waste per annum with improved segregation. A wider EU study of the current rate of capture (2021–2022) and potential generation of biowaste (food and garden) reports that there is potential to increase municipal biowaste capture in Ireland from 66 to 235 kg per person per year (Zero Waste Europe, 2024).

Dún Laoghaire–Rathdown County Council and Fingal County Council are signatories of the Circular Cities Declaration, which sets out commitment from European cities and regions to encourage the transition from a linear to a circular economy. In addition, Cork City is one of eight European cities and regions taking part in the Frugal Cities Through Energy Efficiency and Low-tech Communities EU Interreg project. The Climate Action Plan 2024 also notes the selection of Cork City and Dublin City for the EU Climate-Neutral and Smart Cities Mission, which earmarks both cities as hubs for creative climate action solutions. Furthermore, Galway City is receiving funding to demonstrate methods for rapid retrofitting and decarbonisation of the existing housing stock as part of the EU Mission Pilot Cities Programme (OECD, 2025).

As required under the Climate Action Plan 2024, LAs have identified DZs as trial areas for the development of local climate mitigation and adaptation measures. Appendix 2 lists the DZs under each LA as potential research and development areas for urban circular bioeconomy initiatives. DZs within the Midland counties of Laois (Portlaoise DZ), Offaly

(Tullamore DZ), Westmeath (Mullingar DZ) and Longford (Longford Town DZ) could be tied in with just transition initiatives to promote their development as circular bioeconomy hubs.

Regional assemblies and LAs are clearly integral to the implementation of circular bioeconomy initiatives in urbanised areas within and beyond DZs, given their responsibility for, inter alia, strategic economic and spatial planning, building regulations and infrastructure, community gardens, economic and enterprise development, and parks/public land management. The National Waste Management Plan for a Circular Economy 2024–2030 also notes that LAs are one of the main actors in driving green public procurement and behaviour change towards circular practices within businesses and households.

3.2 Key National and EU Policies Relevant to Climate Action via Urban Circular Bioeconomy Development and Implementation

3.2.1 Programme for Government

The Programme for Government (PfG) 2025 requires each LA to create a circular economy strategy focused on waste reduction, with an emphasis on food and construction waste. PfG 2025 also includes commitments to promote the circular economy via support for repair and refurbishment enterprises, infrastructure, public procurement and producer responsibility schemes, and to develop Ireland's bioeconomy via a "coordinated approach that harnesses Ireland's natural resources and competitive advantage" (Department of the Taoiseach, 2025).

3.2.2 National Spatial Strategy 2002–2020 and National Planning Framework

Spatial planning plays a crucial role in transitioning cities towards circular development by enabling circular resource management, delivering circular infrastructure and generating demand for circular activities (Williams, 2020). The National Spatial Strategy for Ireland 2002–2020 aimed to improve the balance of social, economic and physical development across Ireland via a network of gateways and hubs; however, it was deemed unsuccessful, mainly owing to implementation failures linked to governance shortcomings, including the non-alignment of the strategy with local government reforms (Ó'Riordáin and Van Egeraat, 2016). There was no reference to a circular economy or bioeconomy in the National Spatial Strategy; however, the subsequently drafted National Planning Framework (NPF) 2018–2024 includes a commitment to support the development of sustainable supply chains in the bioeconomy and the first revision of the NPF includes National Policy Objective 67, namely to "Support the circular and bio economy including in particular through greater efficiency in land and materials management, promoting the sustainable re-use and refurbishment of existing buildings and structures, while conserving cultural and natural heritage, the greater use of renewable resources and by reducing the rate of land use change from urban sprawl and new development" (Government of Ireland, 2025).

The Urban Regeneration and Development Fund supports actions to achieve the target of 40% of new housing being built within existing towns, villages and cities on infill or brownfield sites, along with investments for addressing building vacancy and dereliction. The Climate Change Advisory Council notes that poor economic incentives for urban brownfield/infill development need to be addressed to achieve this target and limit further urban sprawl. The EU Bioeconomy Strategy 2018 encourages the use of urban brownfield sites for biomass sourcing and circular bioeconomy business development; however, the current focus on infill and brownfield sites for housing development potentially limits such urban circular bioeconomy activities to existing publicly owned and/or rezoned land.

The NPF has adopted a region-focused strategy to ensure an approximate 50:50 distribution of growth between the Eastern and Midland Region and the Southern and Northern and Western Regions. This regional approach corresponds well with the current cluster approach to collaborative circular bioeconomy development in Ireland. Furthermore, the focus of the NPF on existing urbanised areas for growth highlights the need for increased focus on the urban aspect of the circular bioeconomy. Between them, the cities of Dublin, Cork, Limerick, Galway and Waterford are targeted for 50% of overall national growth, with Ireland's large and smaller towns, villages and rural areas accommodating the other 50% of growth. The towns of Sligo, Athlone, Letterkenny and Drogheda are earmarked in the NPF as regionally and

strategically important. These particular urbanised areas provide opportunities for circular bioeconomy hub development.

3.2.3 Ireland's Climate Action Plan 2025

There is no specific reference to the urban bioeconomy or urban circular bioeconomy in the Climate Action Plan 2025; however, urban development and overarching circular and bioeconomy development are considered within the context of climate change mitigation and adaptation. The plan notes that urban development is a key driver of biodiversity loss, along with noting the importance of the Urban Regeneration and Development Fund for mobilising climate action. The Climate Action Plan 2025 includes an action to establish a DZ advisory group. The National Mirror Group to support the cities of Cork, Galway and Dublin under the EU Climate-Neutral and Smart Cities Mission has the potential to contribute to urban circular bioeconomy development.

3.2.4 EU and national circular economy development and waste management

The second EU CEAP, adopted by the European Commission in 2020 as a key aspect of the European Green Deal, identifies seven key product value chains, five of which are highly relevant to urban circular bioeconomy development (packaging; plastics; textiles; construction and buildings; and food, water and nutrients). The CEAP also includes a specific action to develop a policy framework for bio-based plastics as a key product value chain. As part of the CEAP, the Waste Framework Directive (Directive 2008/98/EC) was amended in 2018 to include minimum operating requirements for extended producer responsibility schemes; strengthened rules on waste prevention; new municipal waste recycling targets; separate collection of household textiles, hazardous waste and biowaste; and examples of incentives to apply the waste hierarchy.

Waste management with the aim of preventing waste and improving resource management is the foundation of a circular economy (Tsai *et al*., 2020). In particular, waste management regulations arising from EU directives determine material classification and flow management within the circular economy. For example, the EU Waste Framework Directive has established the by-product concept, which has been transposed into Irish law through Regulation 27 of the European Communities (Waste Directive) Regulations 2011. According to this regulation, only a production residue can be considered a potential by-product, and material producers must assess and demonstrate whether a production residue is a by-product or a waste based on further use, suitability as a secondary resource, and environmental and health impacts (https://www.epa.ie/our-services/licensing/waste/by-products-regulation-27/).

Urban initiatives are noted in the CEAP as important for making circularity work for people, regions and cities. Such initiatives include the European Urban Initiative, the Intelligent Cities Challenge and the CCRI. The Western Development Commission and the Southern Region Waste Planning Authority are noted as Irish stakeholders in the CCRI. The forthcoming revised EU Bioeconomy Strategy and Action Plan are also noted in the CEAP as central to supporting the sustainable and circular bio-based sector and ensuring the sustainability of renewable bio-based materials. A new EU Circular Economy Act, a pillar of the forthcoming Clean Industrial Deal expected in 2026, presents an opportunity to improve circular economy and bioeconomy policy coherence and enable delivery of a sustainable circular bioeconomy.

At the national level, Ireland's Whole of Government Circular Economy Strategy 2022–2023 is currently being revised for publication in 2026. The current strategy notes the need for further coherent, cross-sectoral policy development to realise the bioeconomy objective of supporting Ireland's transition to a carbon-neutral and circular economy. Ireland's National Waste Management Plan for a Circular Economy 2024–2030 replaced the three existing regional plans and recognises the waste sector as central to the national transition to a circular economy. The replacement of the EPA-led National Waste Prevention Programme with the Circular Economy Programme 2021–2027 also reflects a pivot away from a focus on waste management thinking to a focus on a circular system that minimises waste. The EPA Circular Economy Programme refers to the bioeconomy as being important for realising the economic aspects of circularity.

Sustainable food use, including food waste prevention and improved capture, plays an important role in the

recovery of nutrients and secondary raw materials from urban biowaste. Ireland's National Food Waste Prevention Roadmap 2023–2025 supports the United Nations Sustainable Development Goal (Target 12.3) to reduce food waste by 50% by 2030. Major challenges remain in achieving this target according to Ireland's Sustainable Development Report 2024 (Sachs *et al*., 2025).The current voluntary approach to measuring and reporting food waste, such as under the EPA Food Waste Charter for businesses, will be reviewed in view of EU targets to reduce food waste and emerging policy and regulation developments. Emphasis on the cascading EU Food Use Hierarchy is critical, with actions in order of priority being prevention, redistribution, valorisation of by-products, nutrient recovery and energy recovery to disposal.

3.2.5 EU and national bioeconomy development

The EU Bioeconomy Strategy Progress Report 2022 found that actions are on track to deliver the main objectives of the EU Bioeconomy Strategy (EC, 2022); however, for the purposes of this report a summary update of key activities under specifically urban-related actions is considered. The most relevant activities fall under Action 2.2 – "Pilot actions to support local bioeconomy development (rural, coastal, urban) via Commission instruments and programmes":

- **Activity 2.2.3** – "Develop urban bioeconomies through piloting circular bioeconomy cities through Horizon Europe" – has been addressed with some success, as detailed in Appendix 3, which summarises relevant EU Framework Programme funding in Ireland.
- **Activity 2.2.3.1** – "Support a pilot group of European cities to launch, finance, implement and assess their urban circular bio-based economy strategies and projects for the production of safe, sustainable and valuable bio-based products from urban biowaste and wastewater" – is being addressed through the CCRI (https://research-and-innovation.ec.europa.eu).
- **Activity 2.2.5.2** – "H2020 [Horizon 2020] funds supporting projects developing urban living labs" – was addressed by the creation of living labs for urban food systems transformation as part of implementing the Food 2030 Policy Framework in city region food systems (some project examples are presented in Appendix 3).

The European Commission's Knowledge Centre for the Bioeconomy provides a useful up-to-date dashboard of national bioeconomy strategies (https://knowledge4policy.ec.europa.eu/bioeconomy/bioeconomy-strategy_en).

In Ireland, the National Policy Statement on the Bioeconomy 2018 uses the current EU Bioeconomy Strategy bioeconomy description and includes seven key actions for the development of an effective and sustainable bioeconomy in Ireland, all of which influence the urban circular bioeconomy. The Bioeconomy Implementation and Development Group tracks the progress of the National Policy Statement on the Bioeconomy and has produced two progress reports to date, in 2019 and 2023. The Bioeconomy Implementation and Development Group also established the Irish Bioeconomy Forum in 2021, is a coordinating partner of the Irish Bioeconomy Network and oversees monitoring of Ireland's Bioeconomy Action Plan. The dashboard includes 18 other national bioeconomy-related strategies and 13 bioeconomy sectors, highlighting the cross-cutting nature of the bioeconomy and the need for robust policy coherence. Ireland's National Biodiversity Action Plan and Common Agricultural Policy Strategic Plan are notable omissions from the list of bioeconomy-related strategies on the dashboard. The National Biodiversity Action Plan is central to the development of natural capital accounting as a tool for protecting natural capital and regenerating ecosystems, as noted in Ireland's Bioeconomy Action Plan 2023–2025. The Common Agricultural Policy Strategic Plan includes objectives relevant to bioeconomy development and the protection and enhancement of ecosystem services. The noted development of bioeconomy indicators and monitoring systems in Ireland could be informed by the EU Bioeconomy Monitoring System (Patani *et al*., 2024).

The EU Bioeconomy Strategy was updated by the European Commission in 2025. The Department of Climate, Energy and the Environment (DCEE) and the Department of Agriculture, Food and the Marine (DAFM) will lead on the following update of Ireland's National Policy Statement on the Bioeconomy in 2026. Ireland's Bioeconomy Action Plan 2023–2025 includes 33 actions across seven pillars with the aim of realising the vision of the National Policy Statement on the Bioeconomy 2018. Specifically, the urban-related actions in the Bioeconomy Action Plan are as follows: (1) Action 4.1, develop bioeconomy demonstration

Table 3.1. Additional key EU policies, initiatives and legislation relevant to urban circular bioeconomy opportunities for climate action

Target area	Additional key EU policies, initiatives and legislation
Circular built environment	New European Bauhaus, EU Taxonomy for Sustainable Activities, EU Carbon Removal Certification Framework, EU Construction Products Regulation, EU Energy Performance of Buildings Directive, EU Corporate Sustainability Reporting Directive, EU Biodiversity Strategy for 2030
Circular food systems	Farm to Fork Strategy, EU Waste Framework Directive, EU Biodiversity Strategy for 2030, EU Common Agricultural Policy, EU Landfill Directive
Circular manufacturing	EU Renewable Energy Directive, EU Clean Industrial Deal, EU Corporate Sustainability Reporting Directive, EU Single-use Plastics Directive, EU Packaging Regulations, EU Ecodesign for Sustainable Products Regulation
Transport and mobility redesign	European Green Deal emission standards for heavy-duty vehicles
Circular consumption	European Care Strategy, EU One Health approach, EU Public Procurement Framework

initiatives (agriculture, food, forestry and the marine pillar), requiring the establishment of demonstrator initiatives to engage local communities, primary producers and enterprises, lead by DCEE and Uisce Éireann; and (2) Action 5.1, advance bioeconomy governance in cities, regional assemblies and LAs (communities, regions and cities pillar), requiring integration into the NPF, cities, regional assemblies, LAs and partnerships to address climate action, the green economy and economic development. See Table 3.1 for additional key EU policies, initiatives and legislation relevant to the urban circular bioeconomy target areas for climate action.

A recent review by O'Riordan *et al*. (2025) of circular economy and bioeconomy governance in Ireland sets out a number of recommendations for improving policy coherence, capacity building, regulation, stakeholder engagement, data management and knowledge sharing. The authors note, inter alia, the importance of upcoming revised circular economy and bioeconomy strategies for delivering a roadmap for improved policy coherence, underpinned by a high-level, cross-governmental circular economy working group that includes bioeconomy professionals (O'Riordan *et al*., 2025).

3.2.6 Urban bioeconomy and climate action – research and development

Appendix 3 presents key bioeconomy and circular economy research and development projects and initiatives (national and EU, 2015 to present) relevant to urbanised areas and the five key target areas for climate action: a circular built environment, circular food systems, circular manufacturing, transport and logistics redesign, and circular consumption. All circular and bioeconomy research and development is relevant, either directly or indirectly, to urban bioeconomy and climate action; however, the intention is to signpost key projects and initiatives over the past decade that consider the urban perspective specifically, or that are highly relevant to urban areas and relate closely to the five key target areas for climate action.

4 Urban Circular Bioeconomy for Climate Action – Case Studies

The purpose of presenting these case studies is to provide bioeconomy and climate action policymakers with examples of urban bioeconomy initiatives from different jurisdictions in order to illustrate opportunities for circular bioeconomy development and climate action in Irish towns and cities. One concise case study is provided for each of the five target areas identified in the literature review, namely a circular built environment, circular food systems, circular manufacturing, transport and logistics redesign, and circular consumption.

The case study selection criteria were:

- an ongoing or complete EU-based project led by an institution based outside Ireland;
- strong relevance to urbanised areas;
- a focus on urban areas of similar size to Irish cities or the general urban perspective;
- representative of a circular bioeconomy with a focus on the cascading use of biomass and optimising the value of bio-based products, materials or resources over time.

4.1 Circular Built Environment: Built by Nature – Accelerating the Timber Building Transformation (Ongoing Since 2021)

Within the context of increasing levels of urbanisation and associated building needs, the increased use of timber and other bio-based construction materials could lead to a significant reduction in embodied carbon levels, an increase in long-term carbon sequestration in buildings and the development of sustainable forestry models. Built by Nature (BbN) demonstrates how an innovative grant-making network of investors, foresters, developers, asset owners, designers, cities, insurers and governments can drive the sustainable use of timber and other bio-based materials as alternatives to concrete and steel in the building sector via a connect–enable–amplify model. BbN was founded by the Laudes Foundation in 2021, a philanthropic initiative of the Brenninkmeijer family business managed by a voluntary board and an investment committee, with the latter approving grants in excess of €500,000 (www.laudesfoundation.org). The LTPP Foundation and the IKEA Foundation are also key funding partners for the BbN funds. BbN currently has 5 experienced volunteer board members and 14 staff members working to offer an inclusive platform for collaboration and knowledge sharing along with grant funding to support solution delivery. BbN is incorporated in the Netherlands as a foundation with *Algemeen Nut Beogende Instelling* status (non-profit). Partners include Bauhaus Earth, Cities4Forests, the Climate Smart Forest Economy Program, the European Institute of Innovation and Technology Climate-KIC, the Climate Neutral Cities Alliance and the Centre for Natural Material Innovation. Local BbN networks are active in the Netherlands, the UK, Spain, Italy and Germany.

The BbN Prize supports projects that demonstrate responsible timber construction. The BbN From Forest to Frame challenge awarded grants to support 12- to 16-month projects to improve transparency along bio-based construction value chains by extending the life of existing buildings, accounting for the whole life cycle, ensuring sustainable forest management, maximising the storage potential of wood and promoting a timber-building bioeconomy. The grants awarded include Facilitating Change Through Sharing Value Chain Stories; Innovative Mapping and Processes to Advance Construction Timber Transparency; and From Tree to Panel – Data for Accurate and Transparent Assessment Construction-stored Carbon Monetisation.

Ireland has the infrastructure to implement the BbN approach with little modification. The Irish Green Building Council (IGBC), a non-profit organisation providing leadership across the built environment value chain, is a company limited by guarantee and a registered charity approved by the Charities Regulator. The IGBC is primarily funded through membership fees and national project grants from organisations such as the Sustainable Energy Authority of Ireland, the EPA and Enterprise Ireland via Construct Innovate. Additionally, it has secured international project

funding from sources including the Laudes Foundation, the IKEA Foundation and various European initiatives.

Recommended actions for accelerating the development of the bioeconomy for construction are set out in section 7.3.1 of *Building a Circular Ireland – A Roadmap for a Resource Efficient Circular Built Environment* (IGBC, 2025), which could be built on to enable the IGBC to implement the BbN connect–enable–amplify model as follows:

- Connect: the IGBC brings together a broad range of Irish construction and forestry stakeholders and has the potential to convene collaborations that positively shape the timber construction sector and increase the use of Irish timber. In 2024, the IGBC was appointed to the DAFM Timber in Construction Steering Group and Cement and Construction Sector Decarbonisation Working Group. The Timber in Construction Steering Group aims to review building regulations, develop standards for mass timber in Irish construction and work towards removing barriers to timber construction above 11 metres.
- Enable: the IGBC does not currently have a grant-making fund dedicated to addressing key barriers to timber construction in Ireland. Funding models open to private and public organisations are needed in Ireland to de-risk innovative bio-based construction projects by covering the additional capital cost. Funding model options include a government fund, a public–private partnership model similar to Peatland Finance Ireland or a philanthropic fund supported by industry.
- Amplify: the IGBC has the network and communication systems in place to disseminate information relating to timber construction and bio-based construction materials best practice.

4.2 Circular Food System: Organic City (Bio-Stadt) Bonn, Germany – Organic Cities Network Europe (2015 to Present)

The Organic Cities Network Europe, established in 2015, fosters organic agriculture and organic food as part of the overarching EU Common Agricultural Policy Network. Organic cities promote bioeconomy and climate action by focusing on renewable resources, reducing waste, fostering bio-based industries and reducing the application of synthetic nitrogen fertilisers. The network currently consists of nine European cities and municipalities and two research institutes. In addition to the Organic Cities Network Europe, 33 German cities have formed an alliance under the name Biostädte.

Organic farming is promoted in the member cities, municipalities and districts, with a view to supporting the transformation of agricultural and food systems. As at January 2025, an estimated 17% of Germany's population lived in organic cities. The city of Bonn has been an organic city since 2019 and has the following goals: to provide more organic food in childcare centres, schools and public facilities; to gradually convert the city's agricultural land to organic farming land (approximately 20% of the city's agricultural land is leased to organic farms); to provide information and undertake educational work on the subject of organic farming and organic food; and to undertake public relations work and run campaigns for Bonn residents by networking with stakeholders.

Bonn hosts events and raises awareness of the many benefits of organic food. The "Bonn isst gut" campaign and the annual sustainability festival "Bonn – Rundum nachhaltig" are particularly noteworthy. A network of central and local government departments and public and private sector organisations is maintained to promote cooperation and the implementation of joint projects and events. This network is central to the acquisition of funding. There are also links to the International Federation of Organic Agriculture Movements (IFOAM) and United Nations organisations such as the United Nations Convention to Combat Desertification. The Organic Cities Network also overlaps with biodistricts as defined in the EU Organic Action Plan. IFOAM Organics Europe led a European Parliament session titled "Biodistricts: An opportunity for rural revitalization and sustainable, organic public procurement" to showcase successful biodistrict initiatives.

A digital organic and/or regional shopping guide and interactive map for the urban, peri-urban and wider Bonn region connects organic producers with citizens by providing the locations of organic farms, farm shops, organic markets, low-packaging shops and delivery boxes. In contrast to organic products, regional products are typically not labelled, given the lack of a definition for regionality; therefore, the

shopping guide makes it easier to source locally and regionally produced products.

Under the European Green Deal's Farm to Fork Strategy, the European Commission has set a target of "at least 25% of the EU's agricultural land under organic farming and a significant increase in organic aquaculture by 2030" (EC, 2020). There has been significant growth in organic farming in Ireland since 2021, and the aim is for 10% of land to be under organic farming by 2030. Membership of the Organic Cities Network Europe would support Ireland's National Organic Strategy 2024–2030 by building demand for domestically produced organic products and enable achievement of the target for public sector bodies to spend a minimum of 10% on organic food by value under its Green Public Procurement Strategy and Action Plan 2024–2027. The Organic Cities Network Europe would also drive green procurement in the private sector and support compliance with the EU Corporate Sustainability Reporting Directive.

Currently, there is no Irish member of the Organic Cities Network Europe. Membership of the Organic Cities Network Europe is open to all cities, regions and municipalities that share the stated vision and mission. The first step to membership is the submission of a formal declaration of intent by the board or council of the city, town or municipality. An application to the Organic Cities Network Europe would require significant commitment from a regional assembly and at least one LA. Prospective members can engage with the network by beginning a policy working process. Prospective members should have a council decision to focus on organic food and agriculture; intend to achieve agreed goals; intend to implement projects, activities and measures; and name a responsible contact department and a contact person.

4.3 Circular Manufacturing: Securing Local Supply Chains via the Development of New Methods to Assess the Circularity and Symbiosis of the Bio-based Industrial Ecosystem (2024–2026)

The EU Horizon Europe project "Securing local supply chains via the development of new methods to assess the circularity and symbiosis of the bio-based industrial ecosystem" (SYMBA) brings together a consortium of nine partners from five EU countries (Italy, Spain, Belgium, the Netherlands and Germany) to deliver resource efficiency as part of circular bio-based industrial value chains. The project is developing a novel AI-driven industrial symbiosis tool tailored to local and regional bio-based ecosystems and replicable across the EU. The project is led by the consulting firm ENCO and supported by a range of organisations experienced in resource optimisation, including Novamont, Climate-KIC, CIRCE, Centexbel, AIMPLAS, ICLEI Europe, Bio Base Europe Pilot Plant and Cetaqua (https://www.symbaproject.eu).

Industrial symbiosis stands as one of the most effective strategies for addressing resource limitations and environmental degradation. Unlike traditional waste management approaches, industrial symbiosis fosters a closed-loop system that maximises resource efficiency, reduces waste and minimises pollution. However, despite its immense potential, only 0.1% of the 26 million EU enterprises are currently active in this transformative field, largely due to historical access to inexpensive and abundant resources.

The SYMBA approach is aligned with the EU Bioeconomy Strategy and involves:

- the creation and validation of a new industrial symbiosis methodology for the bio-based sector, starting from existing knowledge and lessons learned from SYMBA consortium partners;
- the development of criteria to select regional hubs;
- an AI database including monitoring tools, a waste relation matrix, and networking and collaboration with ongoing EU and local networks;
- the identification and mapping of ongoing industrial symbiosis projects and best practices;
- the review of EU, national and regional policies to address regulatory challenges;
- the engagement with stakeholders to build innovative frameworks for assessing and implementing industrial symbiosis;
- the evaluation of environmental, social and economic impacts using the SYMBA approach;
- the demonstration of solutions in regional hubs to showcase adaptability and success;
- the facilitation of knowledge sharing through events, forums and training sessions.

The project ultimately aims to repurpose materials that would otherwise be discarded as valuable secondary raw materials. The approach is projected to increase

productivity through waste recovery, resulting in cost savings of €1.24 billion annually. Additionally, the SYMBA project's focus on energy efficiency will reduce GHG emissions. The first SYMBA Bootcamp, facilitated by Climate-KIC, took place in May 2025, with a focus on how local, regional and national policies can enable the implementation and scaling up of industrial symbiosis practices. Outputs will inform the development of policy briefs to support policymakers and decision-making within public authorities.

CIRCULÉIRE's Thematic Working Group Industrial Symbiosis Synthesis Report 2020 provides insights into the industrial symbiosis landscape in Ireland (CIRCULÉIRE and International Synergies, 2020). The key recommendations for fostering industrial symbiosis in Ireland relate to technologies, end-of-waste management, networks and data. The overarching recommendation is to establish a facilitated industrial symbiosis programme comprising a government owner or sponsor, a national coordinating body for delivery and an innovation/research partner. In relation to a circular bioeconomy, the Irish Bioeconomy Forum, led by DCEE and DAFM, is developing a bio-industrial network for the purpose of examining bio-based opportunities in Ireland. Such a network would be well placed to apply tools developed by the SYMBA project and build on learnings from the SMILE Resource Exchange, a previous industrial symbiosis programme implemented in Ireland.

4.4 Transport Redesign: CITYLAB – Incubating Zero-emission Logistics in Living Laboratories (2015–2018)

Innovative urban and regional transport management is an important aspect of minimising carbon emissions in circular bioeconomy supply chains. With regard to the urban context, the CITYLAB project developed a range of strategies, actions and tools for zero-emission logistics in "living labs" located in Rotterdam/Amsterdam (the Netherlands), Brussels (Belgium), London (UK), Oslo (Norway), Paris (France), Rome (Italy) and Southampton (UK). Citizens, governments, industry and research partners worked collaboratively to develop policies, regulations and actions to address four key target areas: highly fragmented last-mile deliveries in city centres; inefficient deliveries to regular recipients of large deliveries (e.g. businesses and public administrations); urban waste management and recycling; and logistics sprawl. Potentially impactful solutions were tested in each living lab and upscaling opportunities were evaluated (https://civitas.eu/projects/citylab).

Each participating city implemented one or more freight measures during the project:

- Amsterdam: city-centre micro-hubs and cycle freight deliveries;
- Rotterdam: improving mobility through implementation of the Urban Traffic Plan 2017–2030;
- Brussels: increasing vehicle loading by utilising spare capacity;
- London: growth of consolidation and electric vehicle use;
- Oslo: common logistics functions for shopping centres;
- Paris: logistics hotels to counter logistics sprawl;
- Rome: integration of direct and reverse logistics flows;
- Southampton: joint procurement and consolidation for large public institutions.

Key learnings from the CITYLAB project can inform urban transport management within bioeconomy supply chains:

- Minor business model changes, such as including the price of a common logistics function in the rental of a facility rather than implementing the cost afterwards, can have a significant impact.
- Robust stakeholder collaboration and clear political will and support from local government play a major role in building partnerships and securing funding for initiatives. Public sector involvement, often across municipal agencies, and the capacity of LAs to implement policy measures are very important for successful implementation.
- Pilot and field surveys/studies are useful for raising awareness and increasing participation among end users

The CITYLAB *City Logistics Living Lab Handbook* provides a range of resources and guidance for setting up and managing a city logistics living lab (CIVITAS, 2023).

4.5 Circular Consumption – Building Circular Bioeconomy Awareness among Citizens: HOOP – Vitalise Europe's Urban Bioeconomy (2021–2025)

In light of the EU Bioeconomy Strategy vision for cities as major circular bioeconomy hubs, the EU Horizon 2020 HOOP project supported the development of large-scale urban circular bioeconomy initiatives in eight lighthouse cities and regions, namely Albano Laziale (Italy), Almere (The Netherlands), Bergen (Norway), Kuopio (Finland), Münster (Germany), Murcia (Spain), Greater Porto (Portugal) and Western Macedonia (Greece).

The project secured an approximate total investment of around €120 million in urban circular bioeconomy initiatives across the eight lighthouse cities and delivered project development assistance for the production of bio-based materials such as fertilisers and bio-plastics from urban biowaste and wastewater in each city, with a focus on cross-cutting technological innovation, regulation, market development, public procurement and stakeholder engagement. The multidisciplinary project development assistance approach used to identify and address key project development challenges was central to coordinating investment with project strategies and action plans. In relation to circular bioeconomy public procurement, open market consultations were found to be important for competition and balancing innovation, cost efficiency and risk.

Stakeholder engagement activities, ranging from small co-creation meetings to conferences, were coordinated via open and collaborative HOOP Biowaste Clubs. Stakeholder engagement via the clubs was noted as a key enabler of the successful collaboration needed to advance the various urban circular bioeconomy initiatives. A citizen science approach was also key for project development, with more than 1500 citizen scientists engaged via group training sessions and the HOOP Trainers app. This approach provided vital information on citizen perspectives on urban biowaste and acceptance of circular bio-based products. Citizen science interventions are recommended for data collection, awareness raising and driving behavioural change around circular bioeconomy initiatives. The outcome reports of the HOOP citizen science interventions show how a citizen science approach can improve urban biowaste segregation and collection and public awareness of circular bio-based products. Initiatives in Almere (the Netherlands), Kuopio (Finland) and Münster (Germany), in particular, reported improvements in biowaste quality as a result of specific citizen engagement activities.

The HOOP Toolkit provides a range of resources to support urban circular bioeconomy development in the broader cities and regions network, with a focus on economic viability and circular performance. As of February 2025, the HOOP Network of Cities and Regions had about 130 European members. Free membership is open to authorised representatives of cities and regions and waste management and wastewater treatment companies interested in sharing knowledge about urban circular bioeconomy initiatives. The toolkit includes multiple resources:

- The HOOP Urban Circular Bioeconomy Hub online platform hosts all HOOP Toolkit resources, signposts users to additional supports and facilitates project evaluation and knowledge sharing among cities, regions, researchers, project developers and policymakers. Specialised support on technical, financial and procurement issues can also be requested via the hub.
- The HOOP Circularity Label tool is an evaluation tool for LAs and waste managers to assess and enhance the performance of current bio-circular measures.
- The HOOP Project Maturity Level evaluates the maturity level of projects with a view to mobilising green financing and implementation funding.
- The HOOP Circular Valuation Method is a clear and simple method for companies and public bodies to assess whether circular projects are financially attractive.
- The Virtual Academy provides a range of resources to support urban circular bioeconomy projects, including handbooks, manuals, factsheets and videos.

Circular Bioeconomy Cluster is a member of the HOOP Network of Cities and Regions and supports the CircBioCityWaste project (2022–2026), which aims to develop an integrated biorefinery for valorising anaerobically digested sludge from municipal

organic waste, wastewater treatment sludge and dairy-processing waste. The application of the HOOP Toolkit to LA DZs can help to raise awareness of the bioeconomy, reduce food waste and improve the segregation and capture of municipal organic waste from homes and businesses. The toolkit can also inform the development of LA circular economy strategies, as required under PfG 2025.

5 Policy Recommendations

5.1 Strategic Recommendations

- Cities and urbanised areas consume and generate large amounts of biological resources. The revised EU Bioeconomy Strategy should therefore continue to support the development of cities as major circular bioeconomy hubs in order to ensure the long-term competitiveness of the EU bioeconomy and increase the resource-efficient and sustainable circular use of biological resources. Increased financial support for EU cities to draft urban circular bioeconomy strategies, informed by material flow analysis, is needed to extend this initiative to cities in every Member State as an integral aspect of local bioeconomy development and climate action. Coordination of the urban circular bioeconomy strategies with the CCRI could help to improve circular economy and bioeconomy policy coherence and implementation. **Key stakeholders: DCEE, DAFM, the Department of Housing, Local Government and Heritage (DHLGH).**

- The contribution of Ireland's cities and urbanised areas to the bioeconomy remains underexploited. The Irish Government's strategic policy objectives for the bioeconomy should recognise the importance of cities and urbanised areas for bioeconomy development and support the development of an urban circular bioeconomy strategy for at least one pilot Irish city. Irish cities already engaged in circular and green networks, such as Cork and Galway, with dedicated LAs provide opportunities for the development of such strategies and pilot circular bioeconomy hubs. Such a pilot strategy would serve as a city-wide, long-term demonstration initiative of circular economy and bioeconomy actions, within the context of wider regional activities, and promote positive urban–rural linkages, drive circular bioeconomy development and motivate national climate action. **Key stakeholders: DCEE, DAFM, DHLGH, regional assemblies, LAs.**

- LAs should be supported to deliver circular bioeconomy-related actions within all designated LA DZs and coordinate actions with LA circular economy strategies, which have food and construction as recommended focus areas. In addition, research should be funded to develop and monitor the role of the circular bioeconomy in LA DZs, with a focus on food, organic waste, construction and natural capital (e.g. Ballymun – Ringsend, Balbriggan, Cork City, Galway City, Tullamore). **Key stakeholders: DCEE, DAFM, DHLGH.**

- Improved circular economy and bioeconomy policy coherence and governance at the EU and national levels can strengthen the mutual aim of systemic economic change. Urban circular bioeconomy development, and broader bioeconomy development and climate action, would benefit from improved circular economy, bioeconomy, climate action, biodiversity and water management policy coherence, which could also be used to leverage the synergies and co-benefits of related measures to secure public and private funding from a variety of programmes and sources. **Key stakeholders: DCEE, DAFM.**

- The integration of existing circular economy and bioeconomy actions with GHG emission reporting is needed to address the underrepresentation of such actions in climate policies and reporting. Urban-focused measures have significant potential to reduce supply chain emissions, and a consumption-based approach is recommended for urban GHG emission accounting. **Key stakeholders: EPA, Climate Change Advisory Council.**

5.2 Bioeconomy and Climate Action Plan Recommendations

5.2.1 Circular built environment

- Reducing the costs/green premium of bio-based construction materials will increase their use and

accelerate the replacement of carbon-intensive materials such as concrete and cement. Funding model options include a government fund, a public–private partnership model similar to Peatland Finance Ireland or a philanthropic fund supported by industry (see the BbN case study in section 4.1). A range of policy actions to accelerate the use of bio-based construction and retrofitting materials to replace carbon-intensive materials are presented in *Building a Circular Ireland – A Roadmap for a Resource Efficient Circular Built Environment* (Actions G1–G14) (IGBC, 2025). **Key stakeholders: IGBC, Construction Industry Federation, Timber in Construction Steering Group.**

- Of these actions, the priorities are as follows:
  - Action G4: introduce a multi-annual fund (€30 million per annum) open to all supply, production and demand stakeholders to kickstart support for farmers, the development of production facilities and the development of pilot projects to build capacity in the industry.
  - Action G5: develop an infrastructure of "eco-park" business clusters and collection hubs that combine bioeconomy processing and cluster companies to maximise value extraction from agricultural products for food, chemicals and construction materials.
  - Action G6: support construction projects with new capital funding using innovative low-carbon products to cover additional design team costs in piloting innovative products and enabling the sharing of outcomes and learning.

- It will also be important to pursue National Standards Authority of Ireland Agrément certification for bio-based construction materials and set targets for the use of such materials in LA construction and retrofitting, in line with the National Retrofit Plan and as part of a public procurement strategy for bio-based construction materials. **Key stakeholders: National Standards Authority of Ireland, IGBC, DHPLG, LAs.**

5.2.2 Circular food systems

- Membership of the Organic Cities Network Europe would support Ireland's national Organic Strategy 2024–2030 and enable achievement of the target for public sector bodies to spend a minimum of 10% on organic food by value under its Green Public Procurement Strategy and Action Plan 2024–2027. **Key stakeholders: DCEE, Office of Government Procurement, DHLGH.**

- Reducing food waste (commercial and residential) and improving organic waste segregation and capture in urbanised areas using the EU HOOP project toolkit and other regulatory measures is recommended. **Key stakeholders: EPA, LAs, Climate Action Regional Offices.**

- As part of biodistrict development, it will be important to support the implementation of the Planning and Development Act 2024 requirement for LAs to reserve land for use and cultivation as allotments and prescribed community gardens, and the regulation, promotion, facilitation or control of the provision of land for that use. **Key stakeholders: DHLGH, LAs.**

5.2.3 Circular manufacturing

- Bioeconomy manufacturing facilities need to maximise the use of on-site renewable energy and resource efficiency measures, such as energy and water meters. Enterprise Ireland, the Sustainable Energy Authority of Ireland and CIRCULÉIRE offer a range of relevant support to manufacturers. **Key stakeholders: Sustainable Energy Authority of Ireland, Enterprise Ireland.**

- Bio-product design must adopt circularity as a core principle. **Key stakeholders: DCEE; Department of Enterprise, Trade and Employment; Enterprise Ireland.**

- Industrial symbiosis tools, such as those under development as part of the SYMBA project, should be applied to a bio-industrial network as part of a national industrial symbiosis programme. Tools should build on learning from the SMILE Resource Exchange. **Key stakeholders: Irish Manufacturing Research, CIRCULÉIRE, EPA, regional waste management offices.**

5.2.4 Transport and logistics redesign

- Funding for regional bioeconomy clusters to develop local circular bioeconomy supply chains should be increased. Supply chain development can be informed by the EU CITYLAB project, which has produced a range of strategies, actions and tools for zero-emission logistics (see section 4.4). **Key stakeholders: regional circular bioeconomy clusters.**

- Transport emissions within bioeconomy supply chains should be assessed using existing tools, such as the Vehicle Energy Consumption Calculation Tool, and the use of smaller lightweight vehicles, electric vehicles and low-carbon fuels should be incentivised where appropriate. **Key stakeholders: regional circular bioeconomy clusters, Transport Infrastructure Ireland.**

5.2.5 Circular consumption

- The digital platform Circular.ie provides an excellent opportunity for the promotion of sufficiency lifestyles and local circular, bio-based products via an urban circular bioeconomy communications plan that embraces and celebrates urban and rural linkages. The communication plan can be informed by the BioBeo education programme and EU HOOP project toolkit, which provides a range of public engagement resources for boosting citizen awareness of urban circular bioeconomy. **Key stakeholders: DCEE, Rediscovery Centre.**

- Effective green public procurement should be embedded throughout the public sector as a circular bioeconomy market pull measure in accordance with Circular 17/2025 regarding green public procurement obligations. **Key stakeholders: Government of Ireland, Department of the Taoiseach, Office of Government Procurement.**

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Appendix 1

Table A1.1. Categories for grouping key considerations relevant to the development of urban circular bioeconomy hubs in Ireland (see also Figure 2.1)

Numbered categories	Key considerations
1. Climate change and pressure on ecosystems	GHG emissions; net carbon balance; fossil carbon, tracking biogenic carbon; fossil resource consumption; habitat and biodiversity losses; degradation; regeneration; consumption; water quality; LA DZs and the Climate Action Framework; national implementation of EU environmental directives on district heating, security of energy supply, decarbonising energy, education and public engagement, carbon stores – forestry, soils and buildings; and biorefineries (nutrient and gas recovery)
2. Governance, policies, strategies, and legislation and enforcement	Emerging investment ratio; bioeconomy management policies; tertiary sector (use of processed biomass in services) efficiency; transparency of subsidies; specific initiatives to address GHG emissions; LA circular economy action plans; current policy assessment; environmental regulation; food safety regulation; regulation enforcement for urban regeneration, education and public engagement; policy coherence; action co-benefits; and national and regional spatial and economic planning
3. Management of natural resources	Environmental impact for biological cycles; water use and efficiency; carbon capture, storage, sequestration or disposal; natural capital accounting; habitat protection regulations; education and public engagement; and urban food production
4. Waste management	Biowaste recycling; urban waste recycling rate; water use and efficiency; recovery rate of urban materials; recovery rate from municipal wastewater treatment and sludge; material flow analysis; segregation; incineration; waste management regulations; waste as a resource; design and planning in urban areas; education and public engagement; home and community composting; “brown bin” management; nutrient recovery from wastewater; and biorefineries for nutrient and gas recovery
5. Research, development and networking	Biotechnology patents; researcher concentration; subsidies in research and development investments; annual spending on research and development (e.g. BiOrbic); bioeconomy skills and training; training to normalise sustainable choices; stakeholder mapping; mapping of local and regional bioeconomic activities; research centres of excellence; education and public engagement (e.g. Fraunhofer urban BioEconomyLab); urban farming, e.g. Airfield House; biodistrict development; and learning from international best practice (e.g. urban green waste processing in Baden-Baden, Germany)
6. Market development and organisation	Clean revenue; green public procurement; added value from bioeconomy sectors; employment opportunities; presence of biocluster coordinating organisations; socio-economic assessment; innovation; investment; market demonstration; education and public engagement; and market interventions to reduce green premium
7. Infrastructure and technology	Innovation capacity; climate change mitigation technologies; adaptation technologies related to water and wastewater; sustainability threshold levels for bioeconomy technologies; best available technology guidelines; and education and public engagement
8. Production	Biomass consumption and potential; biomass self-sufficiency rate; biomass allocation; co-products; by-products; residues; education and public engagement; and urban food production

Appendix 2

Table A2.1. Local authority decarbonising zones

Local authority	Region	Decarbonising zone	Decarbonising zone geographical description
Carlow County Council	Southern Region	Carlow – district electoral divisions of Carlow Rural, Carlow Urban and Graiguecullen Urban	Rural/urban mix
Cavan County Council	Northern and Western Region	Cavan	Town with rural hinterland
Clare County Council	Southern Region	Loop Head peninsula	Extensive rural area
Cork City Council	Southern Region	Tyndall National Institute to Munster Technological University Bishopstown Campus, including University College Cork	City
Cork County Council	Southern Region	Macroom	Town with rural hinterland
Donegal County Council	Northern and Western Region	An Fál Carrach/Gort a' Choirce	Rural
Dublin City Council	Eastern and Midland Region	Ballymun and Ringsend/Poolbeg	City
Dún Laoghaire–Rathdown County Council	Eastern and Midland Region	Dún Laoghaire and Blackrock	Suburban
Fingal County Council	Eastern and Midland Region	Balbriggan	Town with rural hinterland
Galway City Council	Northern and Western Region	Westside area	Suburban
Galway County Council	Northern and Western Region	Oileáin Árann	Island complex
Kerry County Council	Southern Region	Corca Dhuibhne/Dingle Peninsula	Extensive rural area
Kildare County Council	Eastern and Midland Region	Maynooth	Town with rural hinterland
Kilkenny County Council	Southern Region	South-west area of Kilkenny city	City
Laois County Council	Eastern and Midland Region	Portlaoise (Midlands just transition area)	Town with rural hinterland
Leitrim County Council	Northern and Western Region	Carrick-On-Shannon	Town with rural hinterland
Limerick City and County Council	Southern Region	Newtown Perry	City
Longford County Council	Eastern and Midland Region	Longford (Midlands just transition area)	Town with rural hinterland
Louth County Council	Eastern and Midland Region	Dundalk	Town with rural hinterland
Mayo County Council	Northern and Western Region	Mulranny	Rural
Meath County Council	Eastern and Midland Region	Trim	Town with rural hinterland
Monaghan County Council	Northern and Western Region	Monaghan	Town with rural hinterland
Offaly County Council	Eastern and Midland Region	Tullamore (Midlands just transition area)	Town with rural hinterland
Roscommon County Council	Northern and Western Region	Roscommon	Town with rural hinterland
Sligo County Council	Northern and Western Region	Sligo city – south east	City
South Dublin County Council	Eastern and Midland Region	Clondalkin	Suburban
Tipperary County Council	Southern Region	Centred on the Lisheen National Bioeconomy Campus	Rural
Waterford City and County Council	Southern Region	Waterford city	City
Westmeath County Council	Eastern and Midland Region	Mullingar (Midlands just transition area)	Town with rural hinterland
Wexford County Council	Southern Region	Enniscorthy	Town with rural hinterland
Wicklow County Council	Eastern and Midland Region	Arklow	Town with rural hinterland

Appendix 3

Table A3.1. Bioeconomy and circular economy research and development projects and initiatives (national and EU, 2015–2025) relevant to urbanised areas and the five key target areas for climate action: built environment; food systems; manufacturing and processing; transport and logistics; citizen awareness and consumption

Target area	Project title	Funding source	Lead organisation	Status
Built environment	Circular Reno – Developing Biobased and Recycled/Reused Material Solutions for Retrofit	Interreg North-West Europe (EU co-funding)	Energiesprong Global Alliance (Irish Partner – KORE Retrofit)	Ongoing
	Global Policies Influencing the Greater Adoption of Timber in Construction – 2024	DAFM	Timber in Construction Steering Group	Complete
	Timber in Construction – Academic Survey 2024	DAFM	Timber in Construction Steering Group	Complete
	Resource Management and Materials Circularity Protocol for the Irish construction sector	EPA	Carey Building Contractors	Complete
	A Value-centric Approach for Circular Businesses to Reduce Virgin Material in the construction sector	EPA	Maynooth University	Ongoing
	Town Revitalisation through the Integration of Vacant Buildings into the Circular Economy	EPA	University of Galway	Ongoing
	Circular Built Environment Playbook	EPA	IGBC	Ongoing
	The Circular Economy and Buildings as Material Bank	EPA	Maynooth University	Ongoing
	Towards Establishing Hemp as a Sustainable Crop for Irish Agriculture	EPA	Irish Research Council Applicant (University College Dublin)	Ongoing
	Innovation in Irish Timber Usage	DAFM	University of Galway Timber Engineering Research Group	Complete
	Quantifying the Environmental Impacts Associated with the Production of Wood Products from Irish Forests	Irish Research Council/Coillte; University of Galway	University of Galway Timber Engineering Research Group	Complete
	An In-situ Assessing of Heat Loss through Thermal Bridging by Means of Infrared Thermography Technique	University of Galway; Enterprise Ireland innovation voucher IV-2014-4203	University of Galway Timber Engineering Research Group	Complete
	Impacts of Faster Growing Forest on Raw Material Properties with Consideration of the Potential Effects of a Changing Climate on Species Choice (FASTFORESTS)	EU Seventh Framework Programme WoodWisdom ERANET; DAFM	University of Galway Timber Engineering Research Group	Complete
	Commercialisation of Irish Cross-Laminated Timber (CICLT)	DAFM	University of Galway Timber Engineering Research Group	Complete
	The Influence of Silvicultural Practices on Mechanical Properties of Irish Timber	Teagasc/DAFM	University of Galway Timber Engineering Research Group	Complete
	The Influence of the Fixing System Configuration on the Serviceability Response of Cross-Laminated Timber Floors	University of Galway – College of Engineering and Informatics	University of Galway Timber Engineering Research Group	Complete

Table A3.1. Continued

Target area	Project title	Funding source	Lead organisation	Status
	Exploitation and Realisation of Thinnings from Hardwoods (EARTH)	DAFM	University of Galway Timber Engineering Research Group	Complete
	Innovative Design for the Future – Use and Reuse of Wood (Building) Components (InFutUReWood)	DAFM; EU Horizon 2020 Forest Value ERA-NET	National University of Ireland Galway	Complete
	MODCONS – Modular Mass Timber Building for the Circular Economy	DAFM	DAFM	Ongoing
	Increased Service Life of Innovative Timber Building Systems	DAFM	University of Galway	Ongoing
	Sustainable Construction and Assessment of the Full Lifecycle Impact of Irish Harvested Wood Products	DAFM	University of Galway	Ongoing
	Sumforest – Benchmarking the Sustainability Performances of Value Chains	DAFM	University of Limerick	Complete
	Construct Innovate	Enterprise Ireland	Range of academic and industry partners	Ongoing
	HOMEGROWN C16 – Increasing the Use of Irish Home Grown C16 Timber in Housing Construction	Accelerated Housing Applied Research, Dissemination and Demonstration Programme Fund 2023	University of Galway	Complete
	Engineering and Physical Sciences Research Council– Sustainable Farming Incentive Centre for Doctoral Training in Energy Resilience and the Built Environment	Research Ireland	University College Cork	Ongoing
	A National Climate Risk Index for the Built Environment	Research Ireland	Trinity College Dublin	Ongoing
Circular food system	Reducing Commercial Food Waste in Ireland	EPA	Clean Technology Centre Cork	Complete
	Your Local Food Network and the Simple Food Pledge	EPA	Your Local Food Network	Complete
	To Develop a National End-of-waste Standards for Quality Compost and Digestate	EPA	Cré – Composting and Anaerobic Digestion Association of Ireland	Complete
	Valorisation Alternatives to Landfill for Organic Residues	EPA	Dublin City University	Complete
	Towards a Bio-based All-island Economy: Urban Bio-waste Conversion to Carboxylates, Nutrient Products and Renewable Energy	EPA	University of Galway	Ongoing
	Identifying the Sources and Scale of Plastic in Compost Derived from Household and Commercial Food Waste	EPA	Foster Environmental	Complete
	CircBioCityWaste: Converting Urban Waste Streams into Value-added Products	EPA	University College Cork	Ongoing
	FIX-Eire: Food Waste Footprint Index for Ireland	EPA	Technological University Dublin	Ongoing
	Optimised Plus – Food Waste Collected from Apartments	EPA	Foster Environmental	Ongoing

Table A3.1. Continued

Target area	Project title	Funding source	Lead organisation	Status
	Just Transition in Ireland's Circular Economy: Scaling and Supporting Irish Food and Fashion Resource Recovery	EPA	University College Dublin	Ongoing
	Nurturing Social Inclusion through Urban Agriculture	European Union Erasmus+ Programme	Teagasc; BIA Innovator Campus	Complete
	Food as Learning at Airfield Estate – Living the Legacy	Airfield Estate	Airfield Estate	Complete
	SuperValu Let's GROW – Grow It Yourself and SuperValu Primary School Food Growing Programme	SuperValu	Grow It Yourself	Ongoing
	FoodCloud Community Climate Action Programme Thrive Together	DECC; Pobal	FoodCloud	Ongoing
	FoodCloud – the Carbon Calculator Project	EPA	FoodCloud	Complete
	Brewers Spent Grain Research – BSG Bio-Bev	Teagasc – Marie Skłodowska-Curie Research Leaders 2025 Fellowship	Teagasc	Ongoing
	InformBio – Integrated Framework for Mapping, Modelling and Monitoring Ireland's Bioeconomy	DAFM	DAFM; Munster Technological University; Teagasc; University of Galway; Central Statistics Office	Ongoing
	Reimagining the Irish Food System (Creating Sustainable Cities and Communities)	Research Ireland	Airfield Estate	Complete
	Cultivate – Urban Food Sharing Compass	EU Horizon 2020	Trinity College Dublin	Ongoing
	The HOOP Project – Vitalise Europe's Urban Bioeconomy	EU Horizon 2020	Coordinated by Centro Tecnológico de la Energía y del Medio Ambiente	Ongoing
	FIT4FOOD2030 – A Multi-stakeholder Platform Comprising Interlinked EU Think Tank, Policy Labs and City and Food Labs	EU Horizon 2020	Consortium of partners	Ongoing
	FOODSHIFT2030 – 9 Accelerator Labs, Recruiting and Engaging Food System Innovators (FSIs), Building on Existing Food System Innovation and Public Webinars	EU Horizon 2020	Consortium of partners	Ongoing
	FOODTRAILS – Implement the 2015 Milan Urban Food Policy Pact, with a view to Empowering Cities to Drive Food System Change	EU Horizon 2020	Consortium of partners	Ongoing
	CIRCULAR BIOCARBON: Turning Urban Waste Streams into Added-value Products	Bio-based Industries Joint Undertaking	Urbaser with consortium	Ongoing
	FUSILLI – Twelve City-based Living Labs Developing Local Urban Food Plans	EU Horizon 2020	Fundación Cartif	Ongoing
Circular manufacturing	Sustainable, Biodegradable, Compostable and Recyclable Plastics for Packaging and End-of-life Management	EPA	Trinity College Dublin	Ongoing

Table A3.1. Continued

Target area	Project title	Funding source	Lead organisation	Status
	Advancing the Green Transition via Novel Electrode Materials for Valorisation Processes	EPA	Taighde Éireann – Research Ireland (Trinity College Dublin)	Ongoing
	Bioplastics: An Evaluation of Sustainability	EPA	Irish Research Council (University of Galway)	Ongoing
	Urban Woody Biomass Sustainability through Nanocellulose and Lignin-Based Biomaterials Production for Water Purification and Adhesive Applications	EPA	Technological University Dublin	Ongoing
	Regenerative Value Systems for Irish Grown Wool in Ireland	EPA	University College Cork	Ongoing
	Lisheen Bioeconomy Scaleup Up Initiative (BioScaleUP)	EU Just Transition Fund	Lisheen National Bioeconomy Campus	Ongoing
	BiOrbic Research Ireland Centre for Bioeconomy flagship projects: Farm Zero C, Talent4BBI, Generation Glas, NXTGENWOOD, Atoms-2-Products	Research Ireland; others	BiOrbic	Ongoing
	ReBioCycle – A New European Blueprint for Circular Bioplastic Upcycling Solutions	Circular Bio-based Europe Joint Undertaking	University College Dublin	In progress
	RefineTEXT – Developing a Sustainable Biorefinery System for Textile Waste in Ireland	EPA	Dublin City University	Ongoing
	Amplifying Research and Innovation Supporting Enterprise (ARISE)	Multiple (Bio- and Circular Economies Research Group; Centre for Sustainable Packaging and Bioproducts; Bioprocessing and Fermentation Labs)	Technological University Dublin	Ongoing
	CIRCULÉIRE – The National Platform for Circular Manufacturing (Irish Manufacturing Research)	EPA; DCEE; Climate-KIC	CIRCULÉIRE	Ongoing
Transport and logistics	Sustainable Biomass Supply Chain Development for the Irish Bioeconomy	Research Ireland	University College Dublin	Complete
	European Commission Vehicle Energy Consumption Calculator Tool	European Commission	European Commission	Complete
	SMILE: Smart Mobility Initiative for Lower Emissions – Transforming Mode Selection through HMI, Machine Learning, Personalisation, Transport Engineering and Behavioural Science	Research Ireland	Trinity College Dublin	Complete
Circular consumption	Circular Bioeconomy Research Group (CircBio)	Multiple	Munster Technological University	Ongoing
	BioBeo	EU Horizon	University College Dublin	Ongoing
	Bioeconomy Ireland Week	DCEE; DAFM	Irish Bioeconomy Foundation	Annual
	Ireland's Knowledge Centre for Carbon, Climate and Community Action (IKC3)	Higher Education Authority; Human Capital Initiative	Munster Technological University; University College Dublin; Trinity College Dublin	Ongoing
	Circular.ie – a digital platform and resource hub for circular living	DCEE	Rediscovery Centre	Ongoing

HMI, human–machine interface.

Abbreviations

BbN	Built by Nature
CCRI	Circular Cities and Regions Initiative
CEAP	Circular Economy Action Plan
CMUR	Circular material use rate
DAFM	Department of Agriculture, Food and the Marine
DCEE	Department of Climate, Energy and the Environment
DHLGH	Department of Housing, Local Government and Heritage
DZ	Decarbonising zone
EEA	European Environment Agency
GHG	Greenhouse gas
IGBC	Irish Green Building Council
LA	Local authority
NPF	National Planning Framework
PfG	Programme for Government
SYMBA	Securing local supply chains via the development of new methods to assess the circularity and symbiosis of the bio-based industrial ecosystem

An Ghníomhaireacht Um Chaomhnú Comhshaoil

Tá an GCC freagrach as an gcomhshaol a chosaint agus a fheabhsú, mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ar thionchar díobhálach na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialáil: Rialáil agus córais chomhlíonta comhshaoil éifeachtacha a chur i bhfeidhm, chun dea-thorthaí comhshaoil a bhaint amach agus díriú orthu siúd nach mbíonn ag cloí leo.

Eolas: Sonraí, eolas agus measúnú ardchaighdeáin, spriocdhírithe agus tráthúil a chur ar fáil i leith an chomhshaoil chun bonn eolais a chur faoin gcinnteoireacht.

Abhcóideacht: Ag obair le daoine eile ar son timpeallachta glaine, táirgiúla agus dea-chosanta agus ar son cleachtas inbhuanaithe i dtaobh an chomhshaoil.

I measc ár gcuid freagrachtaí tá:

Ceadúnú

- Gníomhaíochtaí tionscail, dramhaíola agus stórála peitril ar scála mór;
- Sceitheadh fuíolluisce uirbigh;
- Úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe;
- Foinsí radaíochta ianúcháin;
- Astaíochtaí gás ceaptha teasa ó thionscal agus ón eitlíocht trí Scéim an AE um Thrádáil Astaíochtaí.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil

- Iniúchadh agus cigireacht ar shaoráidí a bhfuil ceadúnas acu ón GCC;
- Cur i bhfeidhm an dea-chleachtais a stiúradh i ngníomhaíochtaí agus i saoráidí rialáilte;
- Maoirseacht a dhéanamh ar fhreagrachtaí an údaráis áitiúil as cosaint an chomhshaoil;
- Caighdeán an uisce óil phoiblí a rialáil agus údaruithe um sceitheadh fuíolluisce uirbigh a fhorfheidhmiú
- Caighdeán an uisce óil phoiblí agus phríobháidigh a mheasúnú agus tuairisciú air;
- Comhordú a dhéanamh ar líonra d'eagraíochtaí seirbhíse poiblí chun tacú le gníomhú i gcoinne coireachta comhshaoil;
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Dramhaíola agus Ceimiceáin sa Chomhshaol

- Rialacháin dramhaíola a chur i bhfeidhm agus a fhorfheidhmiú lena n-áirítear saincheisteanna forfheidhmithe náisiúnta;
- Staitisticí dramhaíola náisiúnta a ullmhú agus a fhoilsiú chomh maith leis an bPlean Náisiúnta um Bainistíocht Dramhaíola Guaisí;
- An Clár Náisiúnta um Chosc Dramhaíola a fhorbairt agus a chur i bhfeidhm;
- Reachtaíocht ar rialú ceimiceán sa timpeallacht a chur i bhfeidhm agus tuairisciú ar an reachtaíocht sin.

Bainistíocht Uisce

- Plé le struchtúir náisiúnta agus réigiúnacha rialachais agus oibriúcháin chun an Chreat-treoir Uisce a chur i bhfeidhm;
- Monatóireacht, measúnú agus tuairisciú a dhéanamh ar chaighdeán aibhneacha, lochanna, uiscí idirchreasa agus cósta, uiscí snámha agus screamhuisce chomh maith le tomhas ar leibhéil uisce agus sreabhadh abhann.

Eolaíocht Aeráide & Athrú Aeráide

- Fardail agus réamh-mheastacháin a fhoilsiú um astaíochtaí gás ceaptha teasa na hÉireann;
- Rúnaíocht a chur ar fáil don Chomhairle Chomhairleach ar Athrú Aeráide agus tacaíocht a thabhairt don Idirphlé Náisiúnta ar Ghníomhú ar son na hAeráide;
- Tacú le gníomhaíochtaí forbartha Náisiúnta, AE agus NA um Eolaíocht agus Beartas Aeráide.

Monatóireacht & Measúnú ar an gComhshaol

- Córais náisiúnta um monatóireacht an chomhshaoil a cheapadh agus a chur i bhfeidhm: teicneolaíocht, bainistíocht sonraí, anailís agus réamhaisnéisiú;
- Tuairiscí ar Staid Thimpeallacht na hÉireann agus ar Tháscairí a chur ar fáil;
- Monatóireacht a dhéanamh ar chaighdeán an aeir agus Treoir an AE i leith Aeir Ghlain don Eoraip a chur i bhfeidhm chomh maith leis an gCoinbhinsiún ar Aerthruailliú Fadraoin Trasteorann, agus an Treoir i leith na Teorann Náisiúnta Astaíochtaí;
- Maoirseacht a dhéanamh ar chur i bhfeidhm na Treorach i leith Torainn Timpeallachta;
- Measúnú a dhéanamh ar thionchar pleananna agus clár beartaithe ar chomhshaol na hÉireann.

Taighde agus Forbairt Comhshaoil

- Comhordú a dhéanamh ar ghníomhaíochtaí taighde comhshaoil agus iad a mhaoiniú chun brú a aithint, bonn eolais a chur faoin mbeartas agus réitigh a chur ar fáil;
- Comhoibriú le gníomhaíocht náisiúnta agus AE um thaighde comhshaoil.

Cosaint Raideolaíoch

- Monatóireacht a dhéanamh ar leibhéil radaíochta agus nochtadh an phobail do radaíocht ianúcháin agus do réimsí leictreamaighnéadacha a mheas;
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha;
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta;
- Sainseirbhísí um chosaint ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Ardú Feasachta agus Faisnéis Inrochtana

- Tuairisciú, comhairle agus treoir neamhspleách, fianaise-bhunaithe a chur ar fáil don Rialtas, don tionscal agus don phobal ar ábhair maidir le cosaint comhshaoil agus raideolaíoch;
- An nasc idir sláinte agus folláine, an geilleagar agus timpeallacht ghlan a chur chun cinn;
- Feasacht comhshaoil a chur chun cinn lena n-áirítear tacú le hiompraíocht um éifeachtúlacht acmhainní agus aistriú aeráide;
- Tástáil radóin a chur chun cinn i dtithe agus in ionaid oibre agus feabhsúchán a mholadh áit is gá.

Comhpháirtíocht agus Líonrú

- Oibriú le gníomhaireachtaí idirnáisiúnta agus náisiúnta, údaráis réigiúnacha agus áitiúla, eagraíochtaí neamhrialtais, comhlachtaí ionadaíocha agus ranna rialtais chun cosaint chomhshaoil agus raideolaíoch a chur ar fáil, chomh maith le taighde, comhordú agus cinnteoireacht bunaithe ar an eolaíocht.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil

Tá an GCC á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóir. Déantar an obair ar fud cúig cinn d'Oifigí:

1. An Oifig um Inbhunaitheacht i leith Cúrsaí Comhshaoil
2. An Oifig Forfheidhmithe i leith Cúrsaí Comhshaoil
3. An Oifig um Fhianaise agus Measúnú
4. An Oifig um Chosaint ar Radaíocht agus Monatóireacht Comhshaoil
5. An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tugann coistí comhairleacha cabhair don Ghníomhaireacht agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

epa Research

Evidence Synthesis Report 8

Ireland's Urban Bioeconomy– Opportunities for Climate Action

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