

Department of Business, Enterprise and Innovation Submission to Public Consultation Waste Action Plan for a Circular Economy 2019



An Roinn Gnó,
Fiontar agus Nuálaíochta
Department of Business,
Enterprise and Innovation

The Department of Business, Enterprise and Innovation (DBEI) welcomes the opportunity to respond, in consultation with its agencies Enterprise Ireland, IDA Ireland and SFI, to the Consultation on Waste Action Plan for a Circular Economy. A holistic national approach to the Circular Economy provides potential for the development of research, strengthening of our existing enterprise base internationally and emergence of new enterprises. Waste is one aspect of the circular economy, and we welcome the opportunity to provide inputs to this consultation, as we strengthen Ireland's approach to sustainability.

The Circular Economy and Enterprise Policy

The DBEI paper '*Realising the opportunities for enterprise in the bioeconomy and circular economy in Ireland*'¹ advances the perspectives set out in the *Refresh of Research Prioritisation, Innovation 2020, Enterprise 2025* and *Future Jobs Ireland 2019* by identifying how the bioeconomy and circular economy will impact on Ireland's enterprise base and the importance for Ireland in identifying and pursuing specific opportunities in which Irish enterprises can capture global value from these transitions. It identifies the catalytic role of lead disruptive innovators and the need for policy to identify and support the emergence of a critical mass of lead innovators in niche areas of comparative advantage for Ireland.

A common definition of the circular economy adopted in that paper is that "a fully circular economy requires a systemic and transformative approach to production and consumption that effectively designs out waste and keeps materials and resulting products in use for as long as possible." While waste policy forms a critical part of the circular economy, a circular economy encompasses a much wider range of sectors, technologies, practices and stakeholders than a strategy aimed at waste policy alone could capture.

The circular economy has become a policy priority of the European Commission in recent years. The EU Circular Economy Package is at an advanced stage, following the publication of the European Commission's plan *Closing the Loop: An EU Action Plan for the Circular Economy*. This plan contains 54 measures covering a range of areas concerning consumption and production processes and products across priority sectors including plastics, food waste, critical raw materials, biomass and bio-based products, and construction and demolition. It includes financial incentives for research and innovative policy measures using structural funds (€5.5bn) and Horizon 2020 (€650mn). This is combined with a suite of regulatory and legislative actions aimed at changes to product design, production processes, waste management, consumption, and procurement.

¹ <https://dbei.gov.ie/en/Publications/Publication-files/Realising-opportunities-for-enterprise-bioeconomy-and-circular-economy-Ireland.pdf>

Ireland's enterprise policies are responding to European developments and to Ireland's ambition to develop the bioeconomy and circular economy here and to maximise the opportunities arising for Irish enterprise.

The '*Refresh of Research Priority Areas 2018-2023*' identifies six themes with which the majority of competitively awarded public investment in research will be aligned. A number of these are of direct relevance to the bioeconomy and circular economy, including the priority themes 'Food', 'Manufacturing and Materials', and 'Energy, Climate Action and Sustainability'. This latter theme was introduced in 2018 as an outcome of the refresh process in response to a marked increase in importance of the challenges of climate change and sustainability over recent years, as evidenced by significant policy developments at national and international level.

Ireland's national innovation strategy '*Innovation 2020*' highlights the need for innovation to help address the grand challenges of our time, including climate change, resource depletion, environmental degradation and pollution. The challenges informing *Innovation 2020* are therefore the same as those driving the development of both the bioeconomy and the circular economy in Ireland. *Innovation 2020* acknowledges the need for enterprises to innovate both to find solutions to these challenges, while at the same time seizing on the opportunities that such disruptive innovation presents.

This message is reinforced in *Enterprise 2025 Renewed* which sets out the challenges and opportunities presented to enterprise in Ireland due to a rapidly changing global environment. It sets out Ireland's enterprise strategy as one in which we aim to sustain what we have in the immediate term; transform our enterprise base for longer-term resilience; and build on our strengths to be successful in international trade while managing potential vulnerabilities. The development of the circular economy and the bioeconomy in Ireland have the potential to be important drivers in the renewal of Ireland's enterprise base, as envisaged in *Enterprise 2025 Renewed*. Enterprise and enterprise policy have a role to play to develop and embrace new technologies, products and services that increase efficiencies, reduce waste and deliver a higher quality of life².

Future Jobs Ireland 2019 contains the ambition to leverage Ireland's natural resources, enterprise strengths and innovative capacity to be a global leader in the circular and bioeconomy. Pillar 5: Transitioning to a Low Carbon Economy addresses the need to achieve a step change in decarbonising the economy in order to meet Ireland's climate goals. This includes actions related to overcoming regulatory barriers, raising awareness, developing infrastructure and scoping of biomass resources and business support services.

Circular Economy and Ireland's Enterprise Base

Of particular interest to DBEI is the fact that under Action 34 of the *Climate Action Plan 2019*, DBEI is tasked with assessing the opportunities and barriers to achieving carbon emission reductions associated with the cement sector. The use of Solid Recovered Fuel (SRF) in the cement sector and increasing the proportion of SRF in the energy mix of the sector will be essential to achieving significant carbon abatement and facilitating the sector to contribute to a reduction in enterprise sector emissions and our national policy objectives in this regard. It is critical that the Waste Action Plan for a Circular Economy includes measures to ensure that the Waste sector is in a position to facilitate the increased use of SRF in the cement sector, and to liaise closely with actors in the

² <https://dbei.gov.ie/en/Publications/Publication-files/Enterprise-2025-Renewed.pdf>

cement sector to ensure visibility of supply for different waste types and circular economy opportunities.

The circular economy, of course, will impact on enterprises across the economy, from micro-enterprises to SMEs to large multinational firms. It encompasses a wide range of firm practices regarding the usage of materials, manufacturing processes, packaging, waste management, water management, product design, recovery and reuse of materials, and consumer behaviour. Opportunities are arising for innovative firms able to provide technology and services solutions based on circular economy principles.

The European Commission estimates that the circular economy can save EU businesses €600bn. However, the combined economic, social and environmental benefits are likely to be considerably more. The World Economic Forum reported in 2014 that the materials-saving potential alone was estimated at over \$1trn a year.

The NESC report '*Moving Towards the Circular Economy in Ireland*', the most comprehensive study of the Circular Economy in Ireland to date, points to the potential for job growth and enterprise development. Another Irish study estimates that new jobs could be created through recycling materials such as plastics, paper, glass and WEEE, with a potential added GDP value of €1.65bn³. Such jobs would range from low to high-skilled, from sorting recyclables to eco-design, and could be an important stimulus for employment, including in rural areas and areas of economic and social deprivation.

Attracting Foreign Direct Investment (FDI) to Ireland, and strengthening Irish enterprises, encompasses having a world class proposition to put to prospective investors across a range of areas. Meeting the needs of world leading multinational client companies regarding environmental standards, the use of renewable energy, sustainability and reducing their carbon footprint is an increasingly important element in Ireland's overall attractiveness for high quality FDI.

IDA Ireland and Enterprise Ireland have operated an Environmental Aid Programme for over a decade now, helping clients realise substantive renewable energy, Combined Heat and Power and other energy efficiency driven investments, often making Ireland the leader in the use of such technologies among businesses.

A key consideration for enterprises at present is in the areas of plastics processing and specifically, around the treatment of single use plastics, contaminated plastics, and products that are a mix of contaminated and non-contaminated plastics. Currently, much of these materials are sent abroad for incineration, which is not optimum. In addition, because of factors including the scale of the FDI sector in Ireland across ICT, Biopharmaceuticals and Medical devices, it's likely that there is potentially sufficient scale to:

- Process additional categories of waste plastics in an environmentally optimum manner in Ireland, by having in place the infrastructure, technologies and capacity to recycle them into useful new products, in a cost-effective manner, thus, achieving the objectives of the circular economy.

³ Veolia (2015), The circular revolution in Ireland, Veolia. http://www.veolia.ie/sites/g/files/dvc286/f/assets/documents/2016/01/5254_IRELAND_LIVING_CIRCULAR_BROCHURE_LR.pdf, 13.10.17.

- Carry out world class collaborative research into new effective and cost-efficient methods of recycling waste plastics and broadening the range of products that would be suitable for processing.

If this can be achieved, we can help Ireland meet its circular economy objectives, reduce global emissions and enhance our attractiveness for advanced, high tech FDI and indigenous industry investment into the future.

In addition, Ireland's indigenous enterprises see a range of opportunities from circular economy practices: from designing products with built-in re-use or recycling in mind, right through to delivering supply chain mapping, tracking and linked services. Programmes such as Lean and GreenStart and GreenPlus support enterprises to build knowledge and capacity in this area and can facilitate companies looking to build circular principals into their operations. These LEAN/GREEN programs provide an opportunity for companies to examine their business in terms of minimising waste and optimising efficiencies for climate mitigation.

A National Policy direction that facilitates enterprises to build recycling and re-use into their operations will allow firms develop increased capability and knowledge of this area. The opportunities in this area extend far beyond the Waste sector exclusively. The Department of Communication, Climate Action and Environment's Action Plan could therefore reflect actions that allow for circular economy principles to be embedded in the design and delivery of a wide range of products and services. A supportive policy framework, applicable from micro-enterprises up to large industrial manufacturers, can drive innovation and capability building within Irish firms to apply these principles. This could potentially build an expertise and skillset in circular economy practices that would be a competitive advantage and differentiator for Irish businesses competing in international markets. Training, knowledge sharing and some form of certification or recognition of applied circular economy principals will be essential to achieving significant capacity in Irish SMEs to implement such practices.

A policy framework that drives circular economy practices in the wider enterprise sector will in turn provide opportunities for the Waste sector to provide additional services that increase the 'value add' of their operations. The Waste Action Plan for a Circular Economy can drive the development of a synergistic eco-system where the waste sector and industry work collaboratively to reduce societies' environmental impact. In order to achieve this, better communication and capacity building to support the embedding of circular economy practices across Ireland's enterprise base will be essential.

As noted above, the Circular Economy has become a policy priority for the European Commission. It is important to ensure that the Waste Action Plan for a Circular Economy takes advantage of opportunities for Ireland once Green Deal initiatives and related Programmes are agreed and finalised.

Responses to Consultation Questions

5.7 Consultation Questions – Plastic and Packaging Waste

- How can we make it easier for citizens to play a role in delivering on our targets?
 - Inform citizens so they can make the right choices. Important to provide information on Life Cycle Analysis of Packaging, i.e. carbon cost of alternative packaging solutions, the importance of eliminating food waste, public health issues in relation to food safety etc. Increase public awareness e.g. on the need for increased infrastructure, and on what materials can be recycled and what cannot, differences between home & industrial compostable, and segregation of waste.
- What is the role of manufacturers?
 - Currently print & packaging (P&P) industry is a high-volume low-margin business. New regulations are going to impact on this sector and their margins. Changing regulations may require SMEs to invest in materials development, packaging design, and at times capital investment, to achieve new sustainable standards. This will be a challenge in a low margin business.
 - Some packaging (multilayer laminate packaging which is typically used in the food industry) cannot be recycled and is typically currently burnt. (However, benefits could be made in linking this burning to district housing heating).
 - Recyclable PET (rPET) is the preferred materials for beverage products. However, the pricing of rPET is quite volatile, e.g. <https://worldaerosols.com/news/european-recycled-pet-could-soon-be-more-expensive-than-virgin-pet/> and may be more expensive than virgin PET.
 - EI have engaged in training of suppliers, see “Sustainable Packaging for Food & Beverage industries” <https://www.independent.ie/business/small-business/good-things-come-in-sustainable-packages-38124882.html>
 - Public procurers have a role in taking the lead with circular economy and sustainability.
- Have you any other comments or suggestions on how you would like to see Ireland transition to a more resource efficient and circular economy by improving our waste management practices?
 - International best practice is for cross supply chain collaboration to develop and implement sustainable circular economy solutions. Critical to engage each component:
 - Information / awareness on achieving sustainable packaging solutions
 - Need to address who pays for the increased costs of more sustainable packaging, and required investment in infrastructure
 - A key challenge is the design of packaging for recycling and re-use. This is a challenge in a low-margin high-volume business.

6.6 Consultation Questions – Single Use Plastics

- What measures could be considered to reduce the amount of single use food containers we use, taking the provisions of the Packaging Directive into account? Should a ban on non-reusable cups be explored?
 - Increased education of consumers for the reduction in single use plastics where possible.

- There is a need for increased infrastructure, in particular for industrial compostable solutions; currently this packaging contaminates the waste cycle
- Defined national standard on home compostable solutions, as opposed to industrial compliance with EN 13432
- Increase separate infrastructure for compostable / recyclable options
- A reduction in green washing (with uncertain environmental claims) of products by recognised standards on packaging
- Are there measures already in place that could be strengthened by legislation – for example, obligating retailers to give a reduction to consumers who use re-useable ware?
 - Evolving EU legislation will inform Government action here
- Do retailers have role to play in exploring viable reusable food containers for on the go consumption?
 - Retailers are a critical part of the supply chain as they directly interface with the consumers. The major retailers have sustainability programmes and guidelines e.g. Tesco traffic light system for packaging, see <https://bioplasticsnews.com/2019/08/22/tesco-communicates-its-packaging-strategy-and-guidelines-for-suppliers/> Needs to be more informed by cross supply chain collaboration
- Are there additional products that are suitable for consumption reduction?
 - EU directive is for reduce, reuse, recycle all packaging. Need for packaging to prevent food wastage, LCA (Life Cycle Analysis); understanding the carbon cost of packaging options will allow more informed choices
- Are there other SUP items that cause litter and for which there are sustainable alternatives are available, which Ireland should consider banning?
 - EU directives & trends important here
- Can our current co-mingled collection model be enhanced in order to deliver a collection rate of 90% for PET beverage containers?
 - rPET is currently the most economically viable packaging material and is the low hanging fruit. Water / beverage bottles are clean and there are examples across the EU of bottle return schemes in supermarkets, collaborating with large suppliers creating closed loop recycling
 - The challenge for Irish companies is the cost of rPET is increasing because companies are using this material to achieve their sustainability targets, so supply within the EU is becoming a challenge
 - Sub-optimal handling of “clean-waste” plastics, e.g. plastics from pharma industry, in the waste collection system contribute of a decrease (20/25% loss) of a valuable resource into the re-processing industry
- Would you use a segregated bin just for the responsible disposal of single use PET containers?
 - Food packaging needs to be cleaned pre-flaking; other issues such as easy removal of labels are required; segregated bins for recyclable and compostable & general waste (conversion to thermal energy better than landfill European norm). Investment required to segregate recyclable materials; intelligent sensor technology that can scan packaging is an option.

7.7 Consultation Questions – Circular Economy

- What are the areas with greatest potential for transformation in Ireland under the Circular Economy?
 - Productivity gains lie at the heart of the bioeconomy and the circular economy. While conventional productivity gains are achieved by raising labour productivity or through the adoption of technology, when it comes to the circular economy, the issue of improving resource productivity is central. The growth of resource productivity through circular economy practices generates primary-resource benefits. It is estimated that Europe could grow resource productivity through circular economy practices by up to 3 percent annually, which would generate a primary-resource benefit of as much as €0.6 trillion per year by 2030.
- Have you any other comments or suggestions on how you would like to see Ireland transition to a more resource efficient and circular economy by improving our waste management practices?
 - Ireland’s transition to a more resource efficient and circular economy will require much more than improving our waste management practices
 - A fully circular economy requires a systemic and transformative approach to production and consumption that effectively designs out waste and keeps materials and resulting products in use for as long as possible. It represents a fundamental shift in the relationship between production and consumption and natural resources.
 - The circular economy presents challenges and opportunities for manufacturing practices. The ‘use, reuse’ model at the heart of the circular economy requires a shift in how conventional product design, manufacturing and retail is configured. Critically, the emphasis has to shift to product design (eco-design) where 80 per cent of a product’s environmental impact is determined. There has been slow progress globally to date, however, in making the shift across supply chains, given the level of systemic change required.
 - Changes are also needed in manufacturing processes by making greater use of closed loop manufacturing whereby inputs are recovered and reused, and in greater use of sustainable materials to replace one-use-only inputs to production.
 - Distribution and retail subsystems will need to focus on reducing waste and creating value through the reuse of secondary materials, remanufacturing and repair services. With regard to waste, particular emphasis will need to be placed on reducing food waste, water management, and reuse of materials used in construction, which taken together account for a high proportion of materials used by society. Increased investments in infrastructures to enable increased circularity in these sectors will be required. This will require increased data flows & logistics systems connecting across diverse sectors.
 - Extending the product life of goods and reuse of materials requires a shift in consumer expectations. The social acceptability of recycled materials is high in some areas of manufacturing such as packaging and plastics. For many consumer goods, however, the attraction of recycled, repaired or remanufactured goods remains low.

15.7 Consultation Questions – Extended Producer Responsibility

- How do we influence decisions made at the product design stage to ensure circular design principles are put in place?
 - Enterprise Ireland is communicating with its client basis on a continuous basis regarding the challenges and opportunities for sustainable packaging. Enterprise Ireland, where appropriate, can support clients through strategic funds for Innovation & Competitiveness to increase their design & manufacturing capabilities. The challenge for EI clients is a significant level of the innovation will come from material development; clients convert the materials into packaging, which is a high-volume low margin business focussed on export to the UK. Our clients in this area support 5,000 jobs, 68% of which are outside Dublin. Sustainability is a big challenge. EI's challenge is to ensure the ongoing competitiveness of client companies.

A cross supply chain approach is needed that spans suppliers, packaging companies, food manufacturers, retailers, consumers and waste disposal infrastructure and processors.

17.7 Consultation Questions - Waste Data

- Do you believe it would be beneficial to have all/most waste data available on at least a quarterly basis?
 - More frequent/live data needed
- What resources are needed to validate this data more quickly and what are the barriers?
 - Correct characterisation and accurate data at source – training of the system operators, checks and audits for accuracy
- Do you believe that all waste should and could be tracked from site of creation to final destination?
 - Yes
- Are there confidentiality or other issues for industry in reporting on waste flows?
 - Potentially yes. For some industries, indications of the nature and quantities of waste streams could signify deployment of particular technologies or approaches that are of commercial/competitive advantage or significance. Allowance may need to be made on a case by case or exceptions basis.
- Should there be voluntarily reporting on particular waste streams and its treatment destination prior to legislative changes being put in place?
 - Probably and would need a pilot approach that allows for co-design of the system.

18.6 Consultation Questions - Research & Innovation

- What are the research areas you would consider to be important in developing a circular economy?
 - Plastics, Agriculture, Transportation, Construction, Waste Segregation Technology, Digital Support Platforms, Carbon Capture
 - Smart design:
 - To extend the life of a product
 - For ease of separation for re-use, recycling e.g. Smart packaging – smart design for a circular economy
 - Design for re-use and reduction of material use
 - Circular economy in manufacturing (short loops)

- Big data, IOT and shared resources (car-pooling, and sharing of other resources). Shared resource models.
 - Research for the development of local waste refineries and biorefineries.
 - Research to foster the idea that waste is resource and all value must be extracted by end-of-life. Focus on scientifically innovative and challenging projects such as waste material purification.
 - Polymer recycling and de-polymerisation. A key focus would be practical methods to convert waste materials to virgin-like materials with reproducibility in properties and performance expected from current production methodologies.
 - Examining methods that could be developed for scaling processes such as cracking, pyrolysis and waste processing for small towns and cities
 - Developing methods for recycling food packaging for use in food packaging
 - Improving the uniformity and reproducibility of materials prepared from the waste stream
 - Develop quantitative measures of circularity
 - Develop new models for life-cycle analysis and validate models through practice. This also includes research on developing quantitative data.
 - New techniques for separation and sorting of waste streams to develop higher value materials. This will extend simple material screening to property screening (for polymers e.g. includes molecular weight screening, plasticizer and other additives). This will allow sorting into higher value resource
 - New end-of-life value recovery methods
 - CO₂ as a waste from biobased processes can serve as a substrate in the circular economy, thus reducing emissions and increases resource efficiency. The area of CO₂ conversion to value added products is an area of great potential for Ireland, Europe and the globe.
- What new research programmes/initiatives do you think could be put in place?
 - Challenge-based funding (CBF) is an effective way to incentivise the development of novel solutions that could address the complex, multi-actor and multi-sector challenges that are faced in achieving a circular economy. CBF is an increasingly prevalent tool used by governments and funding agencies to drive research, development and innovation (RD&I) activities toward addressing significant societal challenges. It provides an important complementary tool to traditional RD&I funding models that can be used to effectively incentivize the development of novel, potentially disruptive, solutions to important problems by enabling teams of innovators from a broader range of backgrounds together with beneficiaries to co-create mutually valued solutions. Under its Zero Emissions Challenge, SFI is already funding a number of teams developing solutions of relevance to the circular economy.
 - Talent recruitment from abroad at faculty and professorial level.
 - What do you see as the main barriers/enablers to fostering a positive research culture around the circular economy?
 - Increasing relevant knowledge and increasing expertise in Ireland will help.
 - The waste industry is low profit, due to being high volume, highly competitive and reliant on expensive infrastructure. Research in Ireland is highly fragmented and has not reached critical mass

- Increasing understanding of what the CE is and how it might develop at Governmental and Agency level.
- Do you think research on waste, resource efficiency and the circular economy could be better publicised and more readily accessible? How?
 - Yes, there needs to be more a view of waste as a resource and understanding that CE is critical to meeting environmental goals.
 - Could develop key spokespeople to bring the CE to the general public
 - STEAM training and awareness programmes would also be of benefit; Could be integrated into school teaching
 - Quantifying CE, resource efficiency etc. standards and monitoring would help to show the size of the problem.
- What further incentives could be put in place to encourage research?
 - Public Private collaborations to support demonstrators. Getting industry and academia to work together to address key societal and industry needs.
- Have you any other comments or suggestions on how you would like to see Ireland transition to a more resource efficient and circular economy by improving our waste management practices?
 - A North-South partnership on Circular Economy research could be an option. AMBER, the SFI Research Centre for Advanced Materials and BioEngineering Research, has been engaging with Queen’s University Belfast about potentially developing a whole-of-Ireland approach. This could include developing an island of Ireland model for enhancing domestic, commercial, industrial and construction waste. This would identify infrastructural requirements, research gaps and costs.
 - It is also important to emphasise the importance of encouraging multi and cross disciplinary research. The solution to addressing challenges such as waste will require input from a range of researchers as well as enterprise involvement.
 - Also important is a focus on research on changing behaviour and promoting adoption of waste mitigation initiatives.

22.5 Consultation Questions – Bioeconomy

- Have you any other comments or suggestions on how you would like to see Ireland transition to a more resource efficient and circular economy by improving our waste management practices?
 - The analysis in the DBEI report *‘Realising the opportunities for enterprise in the bioeconomy and circular economy in Ireland’* shows the transitions to a bioeconomy and circular economy will impact on firms right across the economy and that companies can be grouped into three broad categories:
 - A broad swathe of firms who are innovating in order to comply with regulation and standards with respect to the bioeconomy and circular economy;

- A smaller cohort of innovative firms who are providing technology and services solutions to help other firms comply with regulation and reduce costs; and
 - Lead innovators who are developing or adopting leading edge technologies and services solutions based on bioeconomy technologies and circular economy principles.
- While it is important to support a range of firms, disruptive lead innovators will play a key role in realising enterprise opportunities for Ireland. Lead innovators play a major role in transforming value chains when they adopt new technologies and practices. In doing so, they can induce suppliers and customers to innovate in ways which can have a significant impact in terms of the development of the bioeconomy and circular economy as a whole. The fact that the bioeconomy is at an early stage of development is reflected in the fact that a diverse range of lead innovators globally are currently engaged in a search process to identify how to extract higher value products from existing products and wastes streams. This search process is capital intensive, high risk, and requires a supportive innovation ecosystem capable of enabling lead innovators to bridge the ‘valley of death’ from research to market.
- In Ireland, a small number of lead innovators are well advanced on this search process and are already bringing products to market. This small cohort of lead innovators, however, is just the advance edge of a much larger cohort of firms that could diversify their product portfolio to potentially produce products of even greater value than they currently produce.
- A strategic approach to the development of the bioeconomy and circular economy in Ireland is needed to assist a critical mass of lead innovators to emerge, based on the identification and exploitation of niche areas appropriate to our enterprise base, science base and natural resource base, in which Ireland can capture global value and which can become a major export sector for Ireland.
- Challenges faced by lead innovators include the fact that many of the technologies upon which the bioeconomy is based are still at an early stage of development and require large capital investments, and that the adoption of bioeconomy technologies and circular economy practices require fundamental changes in firm behaviours, including the possible restructuring of value chains. These changes can be costly in terms of time and money and can be challenging, particularly for SMEs.
- The Bioeconomy Implementation Group is leading a whole of government policy response to the Bioeconomy and providing a forum for stakeholders to work collaboratively to address these challenges.
- In addition, Ireland appears to be behind comparison countries with regard to the adoption of existing technologies in both the bioeconomy and the circular economy. An increased focus on the adoption and diffusion of existing technologies and practices could further accelerate the development of the bioeconomy and circular economy here.