AWASTER — Adopting WASTE as Resource

Guidelines for Low Resource Economy

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Project: AWASTER – Adopting WASTE as Resource
Programme priority: Green and resilient shared environment.
Specific objective: 2.2: Enhancing protection and preservation of nature, biodiversity and green infrastructure, including in urban areas, and reducing all forms of pollution.

↘ Disclaimer:
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↘ List of Acronyms

Acronym	Explanation
CE	Circular Economy
LCA	Life Cycle Assessment
ISO	International Organization for Standardization
EU	European Union
EMAS	Eco-Management and Audit Scheme
EPR	Extended Producer Responsibility
EC	European Commission
CEAP	Circular Economy Action Plan
GPP	Green Public Procurement
ICT	Information and Communication Technology
ESPR	Ecodesign for Sustainable Products Regulation
GHG	Green House Gases
EP	European Parliament
ESRS	European Sustainability Reporting Standards
NFRD	Non-Financial Reporting Directive
CSRD	Corporate Sustainability Reporting Directive
SME	Small and Medium Enterprises
PPWR	Packaging and Packaging Waste Regulation
EPRS	European Parliament Research Centre
UNIDO	United Nations Industrial Development Organization
KPI	Key Performance Indicators
OECD	Organization for Economic Co-operation and Development
WBCSD	World Business Council for Sustainable Development
ESG	Environmental, Social and Governance

Key glossary for circular economy

↘ Circular economy

Circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible: in this way, the life cycle of products is extended.
In practice, the circular economy approach implies reducing waste to a minimum: when a product reaches the end of its life, its materials are kept within the economy wherever possible thanks to recycling. These can be productively used again and again, thereby creating further value.

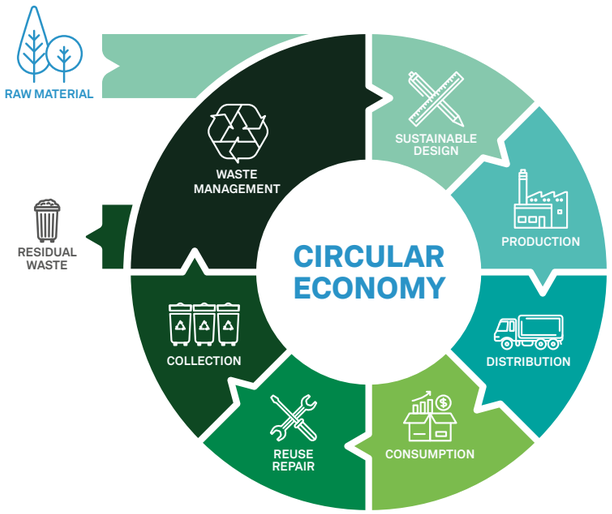

Figure 1
The circular economy model: less raw material, less waste, fewer emissions.

↘ Linear economy[1]

Linear economy refers to the traditional economic model, which is based on a take-make-consume-throw away pattern. This model relies on large quantities of cheap, easily accessible materials and energy. Also, part of this model is planned obsolescence, which refers to the fact that products are often designed to have a limited lifespan to encourage consumers to buy it again.
The term linear refers to the straight progression that a product can follow, with a beginning, a middle and an end, characterized by a high volume of new manufacturing. Linear economic thinking was the dominant economic model for most of the 20th century. Raw materials are extracted from nature at the lowest cost, turned into products with the least amount of labour, and sold at the highest price.

[1] Link ↩

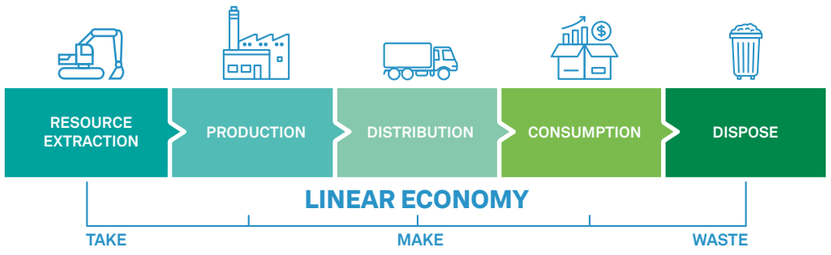

Figure 2
The linear economy model.

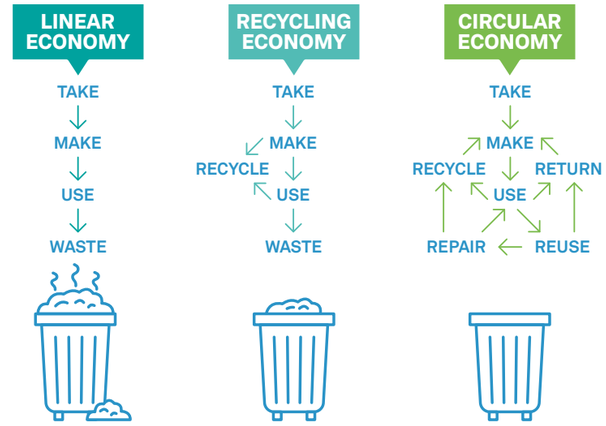

Figure 3
The difference between the linear, recycling and circular economy model

↘ Product life cycle

In the circular economy, a product life cycle is defined as the sequence of stages a product goes through, from the design phase - which includes the choice of materials to be used - through production, distribution, use and reuse, to final disposal.
The product life cycle in the circular model can be traced back to the life cycle of nature: the end for one product represents the beginning of a new cycle for another. In contrast, in a linear economy, the life cycle of a product begins with its introduction into the market and ends with its disposal. The product's creation phase and the phase after its end are not considered. In the new paradigm of the circular economy, the product is created in order to be restored, to retain its value and that of its materials for as long as possible, in order to be able to reintroduce them into the economy at the end of the life cycle.
From the sustainable and circular design of the product, which considers durability, modular and decomposable parts, and biodegradability, we move on to production, substituting virgin raw materials with secondary raw materials and fossil-based raw materials with biomaterials. This leads to the management of production waste and then to the analysis of return flows of returns and end-of-life products and then reflects on their final management.

↘ Life Cycle Assessment (LCA)

An international standardized methodology called Life Cycle Assessment (LCA) has been created to assess the environmental impacts, benefits and all energy loads associated with a product or service throughout its life cycle.
This international tool can be used to develop and improve products and processes, to develop environmental marketing, to enable strategic planning and to implement public policies.
For the European Union, the LCA methodology plays a fundamental strategic role in the analysis of potential product-related environmental impacts, as stated in the Green Paper on Integrated Product Policy and indirectly expressed by several European regulations (EMAS, Ecolabel). At international level, it is the ISO standards (ISO 14044) that regulate the LCA tool and define its steps.

↘ Industrial symbiosis

Industrial symbiosis is a process in which the waste products and by-products of one company or industrial activity become raw materials for another company or for another production process: in this way, it is possible to create interdependent relationships where energy and waste circulate continuously without waste being produced, similar to what happens in natural ecosystems.
How to generate value
The symbiosis between companies means that the outputs of one production line become inputs for another, thus reducing the environmental impact of industrial activities (use of raw materials, disposal in landfills, energy consumption) and giving value to materials that are now considered waste, all fundamental principles for implementing a circular economy. Through industrial symbiosis, the companies involved are able to internalize their externalities, thus maximizing profit jointly. Symbiosis aims at a territorial collaboration between originally separate industries to make them interact for competitive advantages through the exchange of resources such as waste and by-products, energy and water - in the latter two cases, infrastructure and utilities can also be shared. In addition, once the exchange of activities has begun, a provision of services for common needs such as safety, hygiene, transport, and waste management can also be jointly activated.

↘ Extended Producer Responsibility (EPR)

Extended Producer Responsibility (EPR) describes environmental policies that makes producers responsible for the entire life cycle of their products, spanning from design to end-of-life management, including waste collection and recycling. EPR aims to ensure that producers actively engage in sustainable practices and decrease the total environmental impact from their products and packaging. In practice, EPR requirements can translate into a wide variety of obligations for the producers and resellers and can affect multiple product groups (non-exhaustive list).
Although any product can fall within the scope of EPR legislation, legislators have identified three core product categories due to the volume and toxicity of their waste streams: packaging, electrical and electronic equipment, and batteries.

↘ Green growth and green economy

A green economy is defined as low carbon, resource efficient and socially inclusive. In a green economy, growth in employment and income are driven by public and private investment into such economic activities, infrastructure and assets that allow reduced carbon emissions and pollution, enhanced energy and resource efficiency, and prevention of the loss of biodiversity and ecosystem services.
Green growth means fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies.

↘ The R-paradigm

The R-paradigm is a fundamental principle of the circular economy as it defines the 'how to' guidelines of the circular economy, i.e. the strategies to be implemented to bring a system to circularity.
In 2017, the study 'Conceptualising the circular economy: an analysis of 114 definitions[2] theorised the existence of at least 9 R-strategies and numerous possible combinations of them. The 9 most commonly used R-strategies are divided into three categories according to the circular economy objective they support:

[2] Kirchherr J., Reike D., Hekkert M. 2017

Aim	Strategy	Definition
Produce and use products in a smarter way	**R0 Refuse**	Making the product superfluous by abandoning its function or offering the same function with a radically different product
	R1 Rethink	Making intensive use of a product (e.g. sharing)
Extend the life of the product and its components	**R2 Reduce**	Increase efficiency in the production or use of products by reducing the use of natural resources or materials.
	R3 Reuse	Reuse of a discarded product still in good condition and fulfilling its original function by a new consumer
	R4 Repair	Repair and maintenance of a malfunctioning product so that it can be used in its original function
	R5 Renovate	Restore an old product and update it
	R6 Refurbish	Using discarded products or parts thereof in a new product with the same function
	R7 Requalify	Using discarded products or parts thereof in a new product with a different function
Useful application of materials	**R8 Recycle**	Process materials to obtain the same or lower quality
	R9 Recover	Energy recovery through material incineration

Table 1
The 9 R-strategies for the circular economy

The most commonly used paradigms are the 3R and 4R paradigms, where, however, the combination of R can vary in numerous ways depending on the objectives set and the strategies implemented.
The European waste directive (Waste Framework Directive, 2008) is based on the 4Rs paradigm - reduce, reuse, recycle and recover - and is still the most widely used.

↘ Waste hierarchy

The waste hierarchy applies as a priority order in waste prevention and management legislation and policy. It is the cornerstone of EU waste policies and legislation and is laid down in the EU waste framework directive (Directive 2008/98/EC).
Its aim is twofold:
• to minimize adverse impacts of the generation and management of waste; and
• to improve resource efficiency.

The hierarchy is generally depicted in the form of an inverted pyramid with the most preferred options at the upper end and disposal at the bottom as the last-resort solution to managing waste.

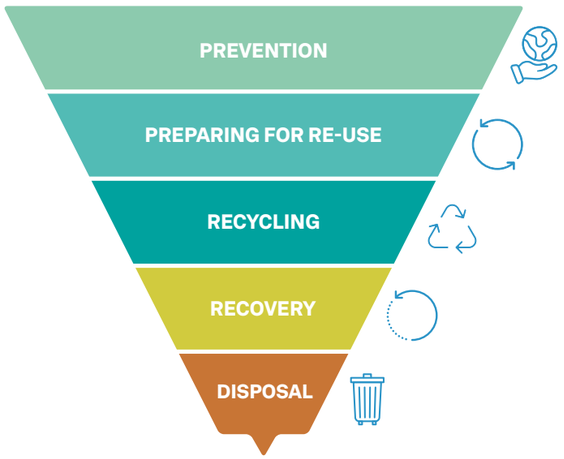

Figure 4
The pyramid of the waste hierarchy

- **Prevention**. Measures, taken before a substance, material or product has become waste, that reduce
  - the quantity of waste, including through the reuse of products or the extension of the life span of products;
  - the adverse impacts of the generated waste on the environment and human health; or
  - the content of harmful substances in materials and products.
- **Preparing for reuse**. Checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be reused without any other preprocessing.
- **Recycling**. Any recovery operation by which waste materials are reprocessed into products, materials or substances, whether for the original or other purposes. It includes the reprocessing of organic material (e.g. composting) but does not include energy recovery and reprocessing into materials that are to be used as fuels or for backfilling operations.
- **Other recovery** (e.g. energy recovery). Any other operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy.
- **Disposal**. Any operation which is not recovery, even where the operation has as a secondary consequence the reclamation of substances or energy (e.g. landfilling, incineration).

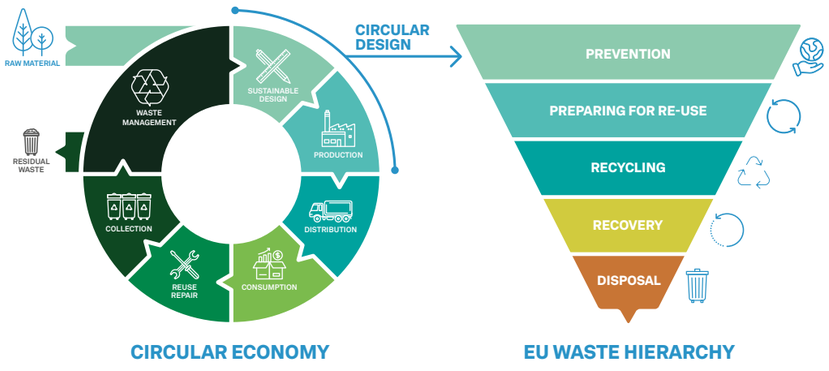

Figure 5
Relation between circular economy and waste hierarchy

↘ Green Public Procurement (GPP)

GPP is a voluntary policy within the strategic public procurement framework supporting public authorities in the purchase of goods, services and works with a reduced environmental impact.
The concept of GPP has been widely recognized in recent years as a useful tool for driving the market for greener products and services and reducing the environmental impacts of public authorities' activities. National action plans are the means by which Member States implement GPP.
The European Commission (EC) has been developing voluntary GPP criteria for several product groups. Furthermore, following the adoption of the 2020 Circular Economy Action Plan, the Commission is proposing minimum mandatory GPP criteria and targets in sectoral legislation and phase in compulsory reporting to monitor its uptake.

General framework of circular economy in EU

↘ Importance of the circular economy at EU level

The EU has recognized that moving away from the linear “take-make-use-dispose” model and transitioning to a regenerative growth model is essential to keep resource consumption within planetary boundaries.
The current mostly widespread linear economy approach is continually increasing the demand of scarce natural resources: a transition to a circular economy in the EU will reduce pressure on natural resources, create sustainable growth and jobs, and is necessary to achieve the EU’s 2050 climate neutrality target and to halt biodiversity loss.
The circular economy will help EU decouple economic growth from resource use, protecting Europe’s natural resources while helping to reduce its consumption footprint and to double its circular material use rate in the coming decade.
In particular, the integration of a circular economy approach in the EU economic, social and environmental framework will:

- enable a healthier planet and reduce pollution;
- reduce pressure on natural resources such as water and land use;
- reduce emissions to help the EU become the first climate-neutral continent;
- create new business opportunities and local quality jobs;
- enable more resilient value chains.

↘ EU strategic and regulatory framework

The European Commission has recognized the potential of circular economy for achieving sustainability in the EU territories and, throughout the years, developed a strategic and regulatory framework accordingly.
Also, in March 2022, the European Commission released the first package of measures to speed up the transition towards a circular economy, as part of the circular economy action plan, including a Sustainable Products Initiative to boost the circularity of products on the EU market, a reform of Ecodesign laws and an Ecodesign Work Plan for 2022-2024, a Strategy for Sustainable and Circular Textiles, a proposal for the revision of the Construction Products Regulation (CPR), and new rules to reinforce the power of consumers .
In particular, 2024 was a crucial year in the progress towards a more circular future in the European Union. Indeed, the EU has reinforced its strategy towards the circular economy, sustainability and efficient waste management through a series of regulations:

- Critical Raw Materials Act (CRMA)
- Waste Shipment Regulation
- Industrial Emissions Directive (IED)
- Corporate Sustainability Due Diligence Directive (CSRD)
- Ecodesign Regulation
- Right-to-Repair (or R2R) Directive
- Packaging and Packaging Waste Regulation

Moreover, an action for the revision of the EU waste framework directive 2008/98/EC has been initiated, setting more ambitious targets to prevent waste from fast fashion and to facilitate re-use and to significantly reduce food waste by 2030, given the food and textile sectors are the first and the fourth most resource-intensive respectively.

Hereby, an insight on the main regulatory framework currently in place in the EU is provided.

Figure 6
Overview of the main policy developments regarding circular economy at EU level until 2021

↘ Circular Economy Action Plan (CEAP)[4]

[4] Link ↩

To accelerate the EU's transition to a circular economy, the European Commission adopted the new circular economy action plan in March 2020. It is one of the main building blocks of the **EU Green Deal**, Europe's new agenda for sustainable growth.
The new action plan announces initiatives along the entire life cycle of products. It targets how products are designed, promotes circular economy processes, encourages sustainable consumption, and aims to ensure that waste is prevented, and the resources used are kept in the EU economy for as long as possible. It introduces legislative and non-legislative measures targeting areas where action at the EU level brings real added value.

The measures that will be introduced under the new action plan aim to:

- make sustainable products the norm in the EU
- empower consumers and public buyers
- focus on the sectors that use most resources and where the potential for circularity is high such as: electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and buildings, food, water and nutrients
- ensure less waste
- make circularity work for people, regions and cities
- lead global efforts on circular economy

In particular, some measures are foreseen focusing on some specific sectors:

- Plastics: EU action on plastic production and pollution to contribute to a circular economy.
- Waste and recycling: EU action on waste management, treatment and recycling.
- Green claims: new criteria to stop companies from making misleading environmental claims.
- Repair of goods: consumer rights for easy and attractive repairs of goods
- Textiles: EU action to address the production and consumption of textiles.
- Critical raw materials: the EU's action plan on critical raw materials, and list of these materials.
- Industrial emissions: EU action to reduce industrial emissions.
- Sustainable products: initiatives to make sustainable products[5] the norm in the EU.

↘ Farm to Fork Strategy

The Farm to Fork Strategy is at the heart of the European Green Deal aiming to make food systems fair, healthy and environmentally-friendly, as they account for nearly one-third of global GHG emissions, consume large amounts of natural resources, result in biodiversity loss and negative health impacts (due to both under- and over-nutrition) and do not allow fair economic returns and livelihoods for all actors, in particular for primary producers.
The Farm to Fork Strategy aims to accelerate our transition to a sustainable food system that should:

- have a neutral or positive environmental impact.
- help to mitigate climate change and adapt to its impacts.
- reverse the loss of biodiversity.
- ensure food security, nutrition and public health, making sure that everyone has access to sufficient, safe, nutritious, sustainable food.
- preserve affordability of food while generating fairer economic returns, fostering competitiveness of the EU supply sector and promoting fair trade.

The strategy sets out both regulatory and non-regulatory initiatives, with the common agricultural and fisheries policies as key tools to support a just transition.

*[5] **According to the EC**, the term sustainable product refers to goods or services designed, produced, and utilized in a manner that minimizes environmental impact, conserves resources, and promotes social responsibility throughout their entire lifecycle. In particular, a sustainable product is likely to display one or more of the following characteristics: uses less energy, lasts longer, can be easily repaired, parts can be easily disassembled and put to further use, contains fewer substances of concern, can be easily recycled, contains more recycled content, has a lower carbon and environmental footprint over its lifecycle*

↘ European Green deal

EU Parliament adopted the **EU Climate Law** on 24 June 2021, which makes legally binding a target of reducing emissions 55% by 2030 and climate neutrality by 2050. This moves the EU closer to its post-2050 objective of negative emissions and confirms its leadership in the global fight against climate change.
It should allow the targets to be more easily applied to legislation and should create benefits such as cleaner air, water and soil; reduced energy bill; renovated homes; better public transport and more charging stations for e-cars; less waste; healthier food and better health for current and future generations.
Business will also benefit as opportunities are created in areas where Europe aims to set global standards. It is also expected to generate jobs, for example in renewable energy, energy efficient buildings and processes.

↘ Circular economy package

Managing waste in a more efficient manner is the first step towards a circular economy, where most products and materials are recycled or re-used repeatedly. On 18 April 2024, European Parliament adopted the circular economy package, which establishes new legally binding targets and fixed deadlines for waste recycling and the reduction of landfilling. It will still need to be approved by the Council before it can enter into force.
The package includes a common EU target for recycling at least 55% of municipal waste by 2025; this target would rise to 60% by 2030 and 65% by 2035. Also envisaged is a common EU target for recycling 65% of packaging waste by 2025, and 70% by 2030.
There would be separate targets for specific materials:

	By 2025	By 2030
All packaging	**65%**	**70%**
Plastic	50%	55%
Wood	25%	30%
Ferrous metals	70%	80%
Aluminium	50%	60%
Glass	70%	75%
Paper and cardboard	75%	85%

Table 2
Waste reduction targets of the Circular economy package

By 2035, no more than 10% of municipal waste would be deposited in a landfill.
A crucial aspect of the Plan is to make the management of natural resources, which are under increasing pressure due to the growing population, increasing demand for raw materials and increasing inequalities, even in less wealthy nations, more rational and sustainable.

The issue is characterized by a double dimension:

- upstream, it is about managing resources more efficiently, i.e. increasing their productivity in production and consumption processes, reducing waste and maintaining the value of products and materials as much as possible;
- downstream, it is a question of ensuring that everything that still intrinsically possesses some utility is not disposed of in landfills in forms that are not always legal, but is recovered and reintroduced into the economic system.

↘ Waste Framework Directive 2008/98/CE[6]

[6] *Link ↩*

The Waste Framework Directive is the EU's legal framework for treating and managing waste in the EU. It introduces an order of preference for waste management called the "waste hierarchy".
Certain categories of waste require specific approaches. Therefore, as well as the overarching legal framework, the EU has many laws to address different types of waste. EU waste policy aims to protect the environment and human health and help the EU's transition to a circular economy.
It sets objectives and targets to

- improve waste management
- stimulate innovation in recycling
- limit landfilling

It introduced the so-called 'waste hierarchy' in Article 4, depicted as an inverted pyramid with the widest part at the top to represent the pre-eminence of a principle, that of prevention, which operates well before one can speak of waste and precisely to prevent waste production.

↘ Corporate Sustainability Reporting Directive (CSRD)

The EU Directive 2022/2624 of 14 December 2022) replaces the previous Directive 2014/95/EU (Non-Financial Reporting Directive, NFRD) and is aimed at ensuring that investors and other stakeholders have access to the information they need to assess the impact of companies on people and the environment and for investors to assess financial risks and opportunities arising from climate change and other sustainability issues.
The obligement addresses all large companies - also unlisted - and all listed SMEs: companies subject to the CSRD will have to report according to European Sustainability Reporting Standards (ESRS). The CSRD ESRS E5 reporting standard provides for three areas of reporting on the circular economy (General disclosures - Management of impacts, risks and opportunities - Metrics and targets), which respectively require the following requirements to be met:

- Information requirement E5-1 - Policies related to resource use and the circular economy
- Information requirement E5-2 - Actions and resources related to resource use and the circular economy
- Information requirement E5-3 - Objectives related to resource use and the circular economy
- Information requirement E5-4 - Input resources
- Information requirement E5-5 - Output resources
- Information requirement E5-6 - Expected financial effects of resource use and impacts, risks and opportunities related to the circular economy.

The standard requires the company to report circular performance on the basis of resource inflows (inputs) and outflows (outputs), waste management following the waste hierarchy (defined in Directive 2008/98/EC) and the overall contribution to circularity through the recovery and recycling of products and materials according to the 9R model.
Consequently, in order to maintain its reputation and meet the demands of stakeholders and investors, a company will need to minimize the use of virgin raw materials and rethink the design of its products and services in a circular manner.

↘ Right-to-repair directive

In April 2024, the Parliament adopted the directive on the right to repair that aims to encourage more sustainable consumption by making it easier to repair defective goods, reducing waste and supporting the repair sector.

The new legislation aims to make repairs more attractive and available for consumers:

- sellers will be required to prioritize repair within the legal guarantee period if it is cheaper or equal in cost to replacing a good. The legal guarantee will be extended by one year once a product has been fixed;
- consumers will have the right to request repairs for products such as washing machines, vacuum cleaners and smartphones after the guarantee has expired. The list of product categories eligible for repair can be extended over time;
- replacement devices should be offered on loan for the duration of the repair. If a device proves irreparable, consumers may opt for a refurbished unit as an alternative;
- a European online platform with national sections will be set up to help consumers find local repairers in their area;
- consumers will be offered incentives to repair products rather than replace them with new ones;
- consumers should be offered harmonized set of information details regarding the reparability of devices so that they can assess and compare repair services.

↘ Ecodesign for Sustainable Products Regulation (ESPR)

The Ecodesign for Sustainable Products Regulation (ESPR), which entered into force on 18 July 2024, is the cornerstone of the Commission's approach to more environmentally sustainable and circular products. It introduces additional requirements and minimum standards for durability, reparability, energy efficiency as well as recycling. It also addresses premature obsolescence practices, to avoid products losing their functionality due to design features, unavailability of spare parts or lack of software updates.
EU Parliament made sure that eco-design requirements should be introduced as a matter of priority for some products with a high impact on the environment, including iron, steel, aluminum, textiles, furniture, tires, detergents, paints and chemicals.
A Digital Product Passport will accompany products, providing consumers with all the relevant information needed to help them make informed decisions. Consumers will have the possibility to compare information from the product passports on a web portal managed by the Commission. It will also make controls easier for public authorities.
In addition, the new rules aim to stop the destruction of unsold products, which is a waste of valuable economic resources and is becoming an environmental problem. The rules oblige large companies to report the number of unsold consumer products discarded per year and the reasons why that was necessary.
The destruction of unsold apparel, clothing accessories and footwear will be banned two years after the regulation enters into force and some other categories could be added in the future.

↘ Packaging and Packaging Waste Regulation (PPWR)

The PPWR sets out a comprehensive framework aimed at preventing packaging waste and fostering re-use and recycling of packaging.
PPWR requires all packaging to be recyclable, with very limited exceptions. Three recyclability performance grades and thresholds—A, B and C—will gradually increase pressure on producers over the coming years
The rules include packaging reduction targets (5% by 2030, 10% by 2035 and 15% by 2040) and require EU countries to reduce, in particular, the amount of plastic packaging waste. To reduce unnecessary packaging, a maximum empty space ratio of 50% is set for grouped, transport and e-commerce packaging; manufacturers and importers will also have to ensure that the weight and volume of packaging are minimized.
Certain single use plastic packaging types will be banned from 1 January 2030. These include packaging for unprocessed fresh fruit and vegetables, packaging for foods and beverages filled and consumed in cafés and restaurants, individual portions (for e.g. condiments, sauces, creamer, sugar), accommodation miniature packaging for toiletry products and very lightweight plastic carrier bags (below 15 microns).

↘ Critical Raw Materials Act[7]

EU Critical Raw Materials Act aims at ensuring a diverse, secure, and sustainable supply of critical raw materials for the EU's industry. Secured access to critical raw materials is essential for strategic sectors including clean technologies, digital, defense and aerospace industries.
Europe now has a regulatory framework to strengthen domestic capacities and consolidate the sustainability and circularity of critical raw material supply chains in the EU, while continuing to pursue its diversification agenda. With this Act, the EU will strengthen domestic supply and reduce reliance on single suppliers. As highlighted in the aftermath of Covid-19 and Russia's invasion of Ukraine, strategic dependencies exposed the European industry to supply chain disruption risks.
The Act establishes benchmarks to increase capacities for extraction, processing, and recycling of critical raw materials in the EU and guide diversification efforts. In addition, it creates a framework to select and implement Strategic Projects, which can benefit from streamlined permitting and enabling conditions for access to finance; as well as sets out national requirements to develop exploration programmes in Europe. Moreover, the Regulation will improve the circularity and the efficient use of the critical raw materials by creating value chains for recycled critical raw materials. To ensure resilience of the supply chains, the Act allows the monitoring of critical raw materials supply chains, and information exchange and future coordination on strategic raw materials' stocks among Member States and large companies.

[7] *Link ↩*

↘ Useful tools and networks

→ EU Ecolabel
The EU's label of environmental excellence, helping consumers make greener choices.
→ European Circular Economy Stakeholder Platform
Bringing together stakeholders active in the broad field of the circular economy in Europe.
→ Eco-management and audit scheme
The EU's management instrument for companies to improve their environmental performance.
→ Green public procurement
A voluntary instrument to green public purchasing.
→ Raw materials initiative
The EU's strategy for tackling the issue of access to raw materials in the EU.
→ Eco-innovation action plan
Eco-innovation and green technologies are key to the circular economy.
→ Circular economy monitoring framework
Monitor the progress of EU countries towards a circular economy.
→ European Innovation Partnership on Raw Materials
Bringing together stakeholders on innovative approaches to the challenges related to raw materials.
→ Environmental Footprint methods
Measuring environmental performance through Product and Organisation Environmental Footprint methods.

↘ Low resource economy: perspectives from different industries

In 2012, the Ellen MacArthur Foundation framed the circular economy as a business opportunity. Since then, business and research interest in the circular business model concept has rapidly increased. Regardless of the variations in the definitions and typologies used to explain and discuss circular business models, companies need to understand and identify both economically and environmentally feasible ways to carry out their activities.
As a matter of fact, businesses play a fundamental role in the transition for a circular and low-resource economy system. Nevertheless, the process of uptaking a circular approach widely differs across industries and economy sectors, also entailing different type of challenges and opportunities.

For the scope of the project AWASTER, three main industries, i.e. manufacturing, agriculture and tourism, have been considered, that have a relevant impact on environment in the cross-border area between Italy and Croatia, with significant differences according to the economic landscape of the regions.

↘ Manufacturing

According to the United Nations Industrial Development Organization (UNIDO), the demand for materials and energy has continued to increase. The manufacturing sector's raw material needs are expected to double by 2050 to 180 billion tons[8]. According to the European Parliamentary Research Service (EPRS), a circular economy in manufacturing could be achieved by 2030 by the application of disruptive business models and technologies that will help to improve resource productivity by 30%.
Developing circular economy models in manufacturing would make it less necessary to extract new resources. For manufacturers, this means ensuring parts and materials within their control never unintentionally exit their sphere of influence: by retaining control over the lifecycle of products, materials and components, manufacturers can prevent resource loss, ensure efficient reuse, enable capitalization of circular practices and reduce their environmental impact
This would result in biodiversity protection, reduced pollution, less marine littering, and mitigation of climate change. The EPRS also predicts that circularity in manufacturing can create two million jobs in the EU and increase the GDP by 0.8 per cent.
Therefore, this approach not only helps to decouple economic growth from resource consumption but also fosters a more sustainable and resilient supply chain.
The circular approach compels manufacturers to consider the end-of-life stage of their products, facilitating a smoother transition of materials back into the supply chain, thereby conserving value and reducing environmental impact[9].
Manufacturing companies can create a circular business model in many ways, involving a combination of three basic strategies.

- **Retain Product Ownership (RPO)**. In the classic version of this approach, the producer rents or leases its product to the customer rather than selling it. Thus, the producer is responsible for products when consumers have finished with them. RPO is an interesting strategy for companies that offer complex products with a lot of embedded value. RPO can also work with simpler products when they are relatively expensive and seldom needed.
- **Product Life Extension (PLE)**. Companies applying this strategy focus on designing products to last longer, which may open up possibilities for markets in used products. Because a longer product lifespan means fewer purchases over time, this may seem like a bad idea for original-equipment manufacturers. But durability is a key competitive differentiator and provides a strong rationale for premium pricing. PLE can also help companies prevent their customers from defecting to a rival brand.
- **Design for Recycling (DFR)**. Companies applying this strategy redesign their products and manufacturing processes to maximize recoverability of the materials involved for use in new products. This strategy often involves partnering with companies that have specific technological expertise or that may be best able to use the materials recovered.

Determining which combination of the three basic strategies will unlock the most value for a specific company involves some practical and very specific questions, such as whether you can reclaim your product from the customer, whether it can be moved, and whether you can remanufacture it.
The adoption of digital technologies offers potential innovative solutions for

[8] ***Lucaci, Ancuța & Nastase, Carmen. (2019).*** *The circular economy: Importance and evolution in European Union.*

[9] *Link ↩*

manufacturers, enabling transparent, efficient and adaptable supply chains that can support circular practices.
The path forward calls for a fundamental reimagining of how products are designed, produced and consumed.

↘ Agriculture

The agriculture sector by and large operates as a linear economic model that creates food waste and greenhouse gases: the principles of a circular economic model can reduce agriculture's waste by reusing all products and byproducts to generate additional value[10].
As the global demand for food and fiber continues to rise, the need for sustainable agriculture practices has never been more urgent. Embracing the principles of a circular economy offers a promising approach to address the challenges faced by the agricultural sector. By focusing on reducing waste, reusing resources, and recycling materials, circular agriculture can contribute to a more resilient and sustainable food system.
The concept of a circular economy revolves around closing the loop of resource use, minimizing waste, and maximizing value: in the context of sustainable agriculture, this means designing farming systems that utilize resources efficiently and minimize environmental impact. Practices such as crop rotation, composting, and integrated pest management are examples of circular agriculture methods that enhance soil health, reduce chemical inputs, and promote biodiversity. By adopting these practices, farmers can create more resilient and sustainable agricultural systems.
Adopting circular economy principles in agricultural supply chain management involves optimizing logistics, reducing food waste, and promoting responsible sourcing. Technologies such as blockchain can enhance transparency and traceability, allowing stakeholders to track the journey of food and fiber products from farm to fork. By integrating circularity into supply chain management, global food and fiber corporations can improve efficiency, reduce costs, and enhance sustainability.
Advancements in technology and research play a crucial role in advancing sustainable agriculture and circular economy principles. Innovations such as precision agriculture, biotechnology, and renewable energy can help farmers optimize resource use, improve productivity, and reduce environmental impact. Collaborative research initiatives involving academia, industry, and government can drive innovation and develop solutions to complex challenges faced by the agricultural sector. By investing in research and technology, global food and fiber corporations can lead the way in adopting circular economy principles and promoting sustainable agriculture.
Applying circular economy principles to agriculture offers a holistic approach to addressing the challenges of feeding a growing global population while protecting planet's resources[11].

[10] *Link ↩*

[11] *Link ↩*

↘ Tourism

Tourism is a cross-cutting economic activity with a great driving effect of development, transformation and change, which, under the premises of sustainability, contributes to the improvement and competitiveness of destinations, and the organizations and societies that live in them. However, it is also an activity that generates negative impacts associated with waste, consumption, carbon emissions, depletion of resources, saturation of spaces, among others; all of which are the object of the solutions that can be provided by the correct implementation of the circular economy as a restorative model of the human activity on the planet, and consequently, of the visitor's economy.
The tourism industry (which includes not only travel agencies, but also entities such as hotellerie, restaurant, cafè, leisure and entertainment businesses, shops, etc.) is deeply interlinked with and dependent on multiple key resource flows, asset and commodity value chains in society – from agriculture to food, to the built environment and transport industries to name a few. Travel and tourism actors can act as powerful enablers of circularity and benefit from shared circular value creation and value capture within relevant value chains.
Integrating circularity and further advancing resource efficiency in the tourism value chain represent an opportunity for the tourism sector to embrace a sustainable and resilient pathway.
For tourism businesses, the circular economy can bring competitiveness, not only in connection with opportunities for innovation, differentiation and the diversification of income streams, but also as government and investors are increasingly looking at environmental, social, and governance (ESG) policies. Nevertheless, successfully transitioning to a more sustainable and resilient tourism model through the application of circular economy principles will depend on active public-private collaboration and partnerships, inter-governmental cooperation, effective policies and policy instruments and financing.
Each tourism industry sub sector and player exhibit differences in type and intensity of asset and material use (from asset light to asset heavy), type of customer engagement etc. and thus, presents differences in type of circularity and circular business model potential and levers.

- For **asset heavy businesses**, circular procurement is a key lever for enabling circularity in the upstream supply chain, powering initiatives that extend and optimize material and asset use and avoid waste.
- For **asset light businesses**, delivering non-tangible services, market positioning and differentiation through circular, collaborative and purpose driven business propositions with the aim to deliver a positive impact for all stakeholders would likely be a powerful circular transformation lever.

From a practical point of view, **the main areas of intervention in the tourism industry to unlock circular economy potential include**:

1. **Governance**: focusing on the need to have and manage an effective governance model that accompanies, motivates, and monitors the transition process towards circular economy. Therefore, this requires a strategic planning for the management of circular tourism, which will inevitably start from a measurement and monitoring of the activity.
2. **Food**: Implementing circular practices in the food sector, such as reducing food waste, promoting local and sustainable food production, and implementing circular food systems.
3. **Mobility**: Promoting sustainable and circular transportation options, such as public transportation, cycling, and electric vehicles and encouraging the use of shared mobility services and reducing the environmental impact of transportation.
4. **Infrastructure and municipal facilities**: Implementing circular practices in the design, construction, and operation of tourism infrastructure and local facilities. This includes using sustainable materials, promoting energy efficiency, and implementing circular waste management systems.
5. **Waste management**: Implementing circular waste management practices, such as recycling, composting, and reducing single-use items and promoting the use of recycled materials and implementing circular packaging solutions.
6. **Water management**: Implementing circular water management practices, such as water conservation, wastewater treatment, and reuse and promoting sustainable water use in tourism activities[12].

[12] *Link ↩*

Put into practice

↘ The circular economy model for businesses

[13] *OECD (2019), Business Models for the Circular Economy: Opportunities and Challenges for Policy, OECD Publishing, Paris*

Link ↩

A business model is the fundamental way through which a company creates, delivers, and captures value: in other words, it is a firm's competitive strategy[13].
The circular economy aims to reduce waste and resources' use by rethinking every aspect of a product's life cycle. Thus, **circular business models try to find economically viable ways to continually reuse products and materials, using renewable resources where possible**.
A circular business model articulates the logic of how an organization creates, delivers, and captures value to its broader range of stakeholders while **minimizing ecological and social costs**. Circular business models have a number of other distinguishing characteristics beyond their relatively sparing use of natural resource inputs.
First, the underlying sales strategy tends to place less emphasis on maximising the sales volume of low-margin and short-lived products. Instead, **the focus tends to be on selling higher quality products or, increasingly, marketing access to, rather than ownership of, products.**
Second, the business case often leverages the value contained in already existing materials, components, and products. For example, by largely avoiding the use of new material and energy inputs, firms offering repair, refurbishment, or remanufacturing services can market products at a significantly lower cost than their traditional counterparts.
Third, circular business models often involve greater levels of collaboration between different actors in the supply chain. There are often repeated interactions between suppliers and customers, and this can foster a heightened sense of customer loyalty. For example, operating within an industrial symbiosis framework requires significant inter-firm cooperation to ensure the ongoing availability of high quality of raw material inputs.

↘ Advantages of the circular economy approach for businesses

The adoption of the circular economy approach can offer a number of benefits to companies and enterprises at different levels:

- **Environmental**
  - Reduction of CO2 emissions
  - Reduction of waste production and related soil and water pollution
  - Reduction of energy consumption
- **Social**
  - Improvement of the business image and reputation not only for consumers, but for all kinds of stakeholders
  - Increase in collaboration, networking and knowledge sharing among businesses, governments and communities
  - Enhancement of a sense of collective responsibility and engagement in sustainable practices
  - Reduction of vulnerability to global disruptions, by providing a more robust and adaptable framework.
- **Economic**
  - Increase in efficiency and cost reduction by valuing raw materials and resources
  - Increase in innovation by development of improving quality and features of products and services
  - Increased opportunities of access to new markets
  - Increase in employees' sense of belonging and retention
  - Improved supply chain resilience
  - Reduction in dependence on imports by encouraging a more self-sufficient and resilient economy

Indeed, companies that embrace this transition will not only contribute to a greener future, but also position themselves as leaders in a rapidly changing market where sustainability is increasingly demanded by consumers and the general public.

↘ Main challenges in implementing a circular economy approach at company level

Despite its potential to drive long-term positive change, creating more sustainable and resilient business environment, the integration of circular economy in the business model can face some regulatory, market and financial hurdles[14].

[14] Link ↩

- **Navigating regulatory hurdles**
  Regulations regarding waste, product standards and cross-border movement of materials can inadvertently hinder recycling and remanufacturing efforts. For instance, certain materials classified as "waste" under current legislation may face strict controls or prohibitions on their reuse or transport, even for recycling or remanufacturing purposes.
- **Building market acceptance and supplier's support**
  Consumers and customers may have reservations about products made from recycled materials or remanufactured products, perceiving them as inferior to new ones. As a matter of fact, customers often prioritize cost over sustainability, making it difficult to justify the adoption of an higher price for circular practices. Similarly, the lack of alignment with suppliers not focused on circular economy practices. Suppliers may not provide recyclable or reusable materials, overcoming this perception requires substantial efforts in education and communication to demonstrate the benefits of circular products.
- **Addressing cost implications**
  The initial costs associated with transitioning to circular economy models can be prohibitive. Investing in the necessary infrastructure for recycling, remanufacturing or setting up product-as-a-service models requires upfront capital. Additionally, the operational costs of collecting, sorting and processing used products and materials can be higher than sourcing new materials, at least in the short term.
- **Fostering mindset shifts**
  Transitioning to a circular economy requires overcoming entrenched resistance at multiple levels. Internally, organizations may face inertia from established linear processes, with the prevailing "this is how we've always done it" mentality posing a significant barrier to change.
  Upstream in the supply chain, the shift can disrupt the value propositions of some players, leading to resistance from those who stand to lose from the transition away from linear models. While downstream, altering customer habits and preferences to align with circular practices requires concerted effort and engagement, as it challenges traditional behavior patterns.
- **Building a market for services**
  Building a market for circular service providers requires creating demand for such services and ensuring a supply chain that supports the repair, refurbishment and recycling of products. Establishing this market requires overcoming consumer skepticism, adapting existing business models and fostering partnerships across industries.
- **Tackling the lack of knowledge and specific skills**
  The lack of available information about businesses or facilities that recycle specific types of waste, such as Styrofoam or compact materials, makes it difficult to identify suitable recycling partners and establish systems for managing these materials within a circular economy framework. The transition to circular models requires specific skills that are often difficult to find on the market and involve substantial investment in training. It is also related to the issue of organizational inertia.

↘ Fields of actions

[15] OECD (2019), Business Models for the Circular Economy: Opportunities and Challenges for Policy, OECD Publishing, Paris,

Link ↩

The **OECD[15] identifies five key business models** that could facilitate a transition towards a more resource efficient and circular economy.
According to the OECD taxonomy, circular activities are categorised according to a business-centric perspective. This draws attention to the business proposition underlying each of the business models, which is significant given that widespread adoption will remain largely theoretical unless the private sector perceives substantial value.
The five types of headline circular business models addressed in this report are: **(I) circular supply models, (II) resource recovery models, (III) product life extension models, (IV) sharing models, and (V) product service system models**.

	Circular supply	Resource recovery	Product life extension	Sharing	Product service system
Key characteristic	Replace traditional material inputs with renewable, bio-based, recovered ones	Produce secondary raw materials from waste	Extend product lives	Increase utilisation of existing products and assets	Provision of services rather than products. Product ownership remains with supplier
Resource efficiency driver	Close material loops	Close material loops	Slow material loops	Narrow resource flows	Narrow resource flows
Business model sub-types	Cradle to cradle	Industrial symbiosis	Classic long life	Co-ownership	Product-oriented
		Recycling	Direct reuse	Co-assess	User-oriented
		Upcycling	Repair		Results-oriented
		Downcycling	Refurbishment		
			Remanufacture		
Main sectors currently applied in	Diverse consumer product sectors	Metals	Automotive	Short tem lodging	Transport Chemicals
		Paper and pulp	Heavy machinery	Transportation	Chemicals
		Plastic	Electronics	Machinery	Energy
				Consumer products	

Figure 7
The five types of circular business models according to the OECD

While the distinction between each type of business model is clear in theory, it may be less so in practice. In some cases, firms adopt combinations of business models rather than one in isolation. For example, the adoption of product service system model – and the retention of product ownership that goes with it – may well serve to incentivise the parallel adoption of the product life extension model.

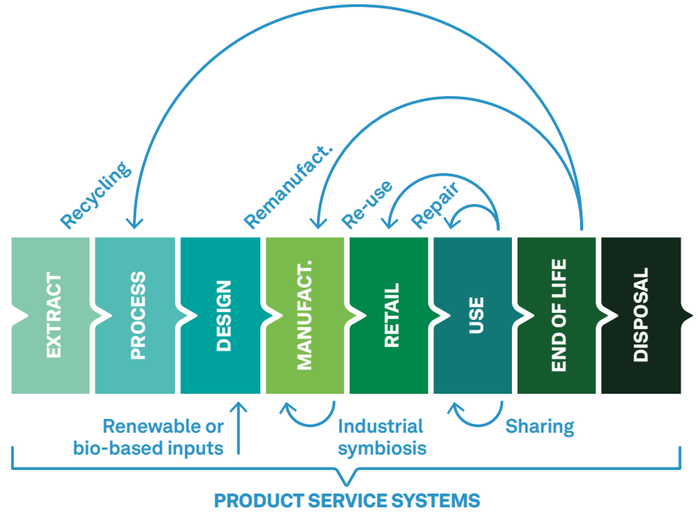

Figure 8
The impact of circular business models on the linear economy

In other cases, the decision to adopt a particular circular business model by a firm or group of firms can facilitate the adoption of a related business model by others. The adoption of the circular supply model, where strategic sourcing and design decisions are made early in a product's life, can improve the business case for component and material recovery further downstream.
A key-impact map is provided below, which summarizes the most influential changes in each area that assist in the management of businesses towards greater sustainability. It is important that organizations understand and accurately internalize circularity principles within their strategic plan.
On that note, adopting a circular thinking might enable an organization to obtain more sustainable (economic) results while reducing impacts.

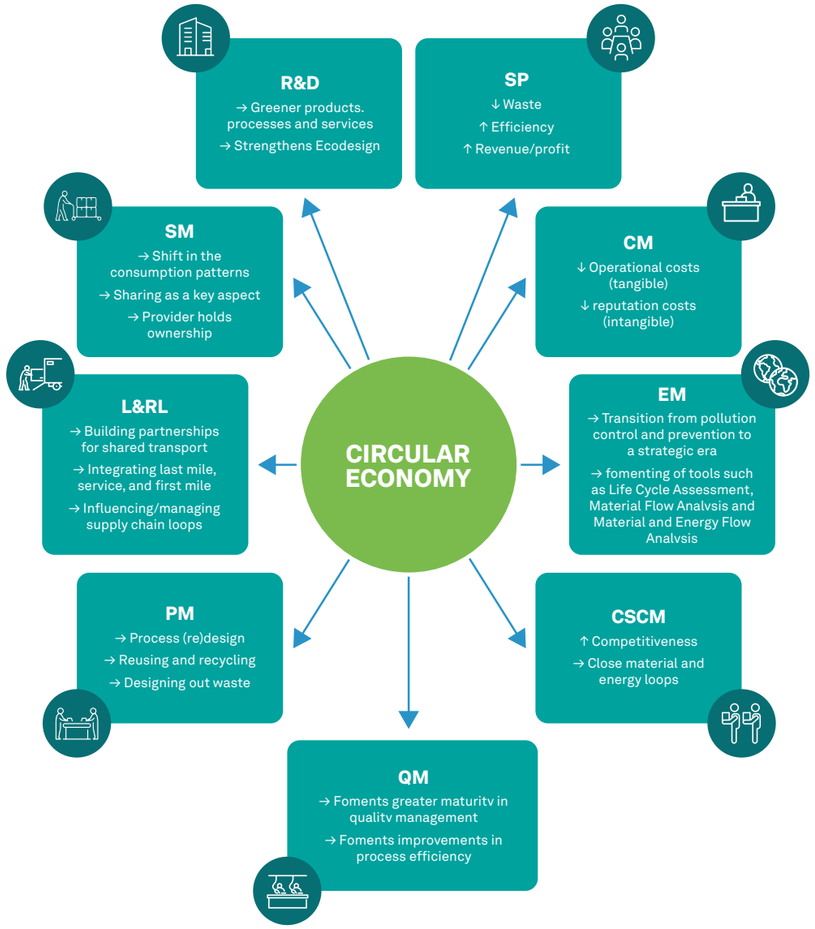

Figure 9
Overview of the most influential changes in each business towards sustainability

↘ Circularity measurement and assessment

To understand their level of circularity and to be able to set goals that can be monitored by reliable Key Performance Indicators (KPIs), **companies need a system of metrics that can guide their decision-making process in integrating circularity into their strategy and business models**.

↘ International standards

Circular transition indicator (CTI)

World Business Council for Sustainable Development (WBCSD), in collaboration with KPMG and 30 companies from 16 different industries, has developed the **Circular Transition Indicators (CTI)** Framework, an objective and quantitative framework that supports companies in measuring their circular performance and understanding the associated risks and opportunities.
The CTI Framework provides any company, regardless of its size, sector or position in the value chain, with a set of indicators, some optional and some mandatory, to measure:

- The circularity of materials, water and the percentage of renewable energy used within the company's perimeter (Close the Loop);
- The percentage of critical materials, the potential life cycle extension, the type of recovery and the percentage of water that is recirculated back to the site (Optimise the Loop);
- The productivity of circular materials and the turnover related to circularity of materials (Value the Loop);
- the GHG emissions saved and the impact avoided on nature and biodiversity by the development of circular strategies (Impact of the Loop).

If carried out on a regular basis by a company, the circular performance assessment process outlined by the CTI Framework also allows companies to monitor progress in their circular transition and identify risks and opportunities to integrate within their business model.
It is important to mention that, especially for SMEs, this assessment process is quite onerous, if not completely unattainable, to be carried on one's own: in this sense, a specific expert and consultancy external support represents an enabling condition to carry out the assessment.

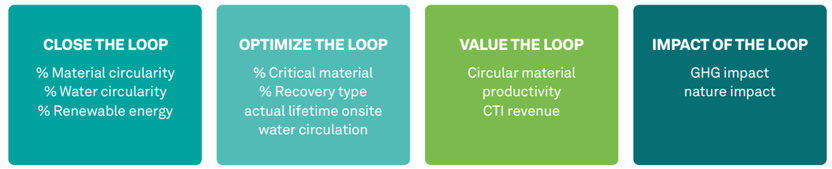

Figure 10
CTI Framework indicators

ISO Norms

In the international context, the transition to a circular economy is promoted by the International Organisation for Standardisation (ISO), which, as of 2018, has initiated a formal regulatory process for the circular economy, with standards currently being developed in the **ISO 59000 series**.

Figure 11
Overview of the ISO 59000 family of standards

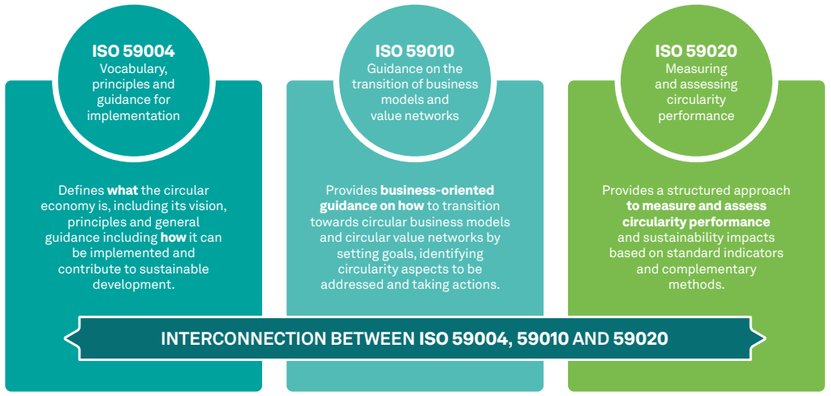

Figure 12
The interconnection between different standards of the ISO 59000 serie

As mentioned, alongside the standards that have just been issued, there are others in the pipeline. Among them is ISO 59040:2024 'Circular Economy - Product Circularity Data Sheet (PCDS)', designed to standardise the way in which product circularity information is communicated. This standard will provide a basic template for creating a Product Circularity Data Sheet (PCDS) and disclosing its circularity performance information.
The other standard at the final draft stage and awaiting publication later this year is ISO 59014:2024 'Environmental Management and the Circular Economy - Sustainability and traceability of secondary materials recovery - Principles, requirements and guidance'. This standard focuses on the use of secondary materials or secondary raw materials, materials used in previous production cycles and resulting from a recovery process, which can still be reused as an input for a new production process. Its aim is to establish the principles and requirements for secondary raw materials to be recovered and used with minimal environmental impact and maximum traceability.
Another draft still under consideration by the ISO/TC 323 'Circular Economy' Committee is ISO/CD TR 59031 'Circular economy - Performance-based approach - Analysis of case studies[16].

↘ International standards

Italy: UNI/TS 11820:2022

The Italian standardisation body UNI has adopted the UNI/TC 11820 standard. This is a technical specification that allows companies and other organisations to measure their own circularity rate by adopting shared criteria.
The standard is aimed at any organisation that supplies products and/or provides services and currently includes 71 circularity indicators, some of which are optional, divided into six categories: material resources and components, energy and water resources, waste and emissions, logistics, products/services, human resources, assets, policy and sustainability.
The latter, especially related to reporting, are intended to support companies in understanding and measuring an organisation's current level of circularity in order to be able to identify the main points of improvement and seize the opportunities and benefits of the circular economy.

Croatia: HRN EN ISO 14001:2015

The Croatian standard HRN EN ISO 14001:2015 defines the requirements for the environmental management system, which helps organizations to increase their success in environmental management through the efficient use of resources and the avoidance and reduction of waste generation, thereby increasing the organization's competitiveness and the trust of interested parties.

[16] The acronym CD stands for Committee Draft, *and the standard will cover the analysis of case studies in order to evaluate them using a performance-based approach.*

This standard is intended for organizations that seek to manage their environmental responsibilities in a systematic manner.
The expected results of the environmental management system include:
- Increasing the success of environmental management,
- Fulfillment of compliance obligations,
- Achievement of goals related to the environment.

It can be applied to any organization regardless of its size, type and nature and applies to aspects of its activities, products and services that are related to the environment, which the organization determines it can manage or influence from a life cycle perspective. Also, this norm does not establish specific criteria for the success of environmental management.
As for other norms for management systems, the approach on which the environmental management system is based is the concept of "plan-do-check-act" (Plan-Do-Check-Act - PDCA).
The norm can be used in whole or in part for the systematic improvement of environmental management. However, the organization's claim of compliance with this international standard is not acceptable if its environmental management system does not include all the requirements of this standard and if they are not fully met.

An organization that wishes to demonstrate compliance with this international standard can do so in the following ways:
- By determining one's own conformity and giving one's own declaration of conformity, or
- By requesting confirmation of its conformity from parties that have an interest in the organization, for example from customers, or
- By seeking confirmation of its own declaration of conformity from an external party, or
- By requesting certification/registration of its environmental management system from an external organization[17].

[17] Link ↩

What the AWASTER project offers

The **AWASTER project** aims to **minimize waste generation by promoting circular economy approach through the organisation of educational courses and the exchange of experience in the Italy-Croatia coastal areas.**

The project improves the consumer, focusing on younger population, and economy sector knowledge base on waste collection managing, promotion of recycling and waste reuse, thus contributing to the protection of biodiversity and fight against pollution.

The project proposes an **innovative training scheme** aiming to foster the sustainable use of resources and promote adoption of CE principles through the organisation of workshops, trainings and testing innovative solutions on reusing the collected waste and promoting low resource economy schemes by implementing two Joint Pilot Actions:

- The first action will be related on returning the collected waste to the economic cycle by establishing **small-scale EcoLabs** in five cross-border regions and co-developing with high-school students innovative viable products. Through EcoLabs, the students will be working on activities, e.g. processing the plastic waste and producing new products by using 3D printers.
- The second Joint Pilot Action will be performed in the form of the organization of **waste-free events**, jointly developed by using examples of cross-border good practices and combined with the pilot action to promote the innovative solutions resulting from EcoLab workshops.

↘ AWASTER awareness raising programme

The AWASTER project aims to raise awareness of the economy sector to propose **ways and business schemes to increase resource productivity and decouple economic growth from resource use and its environmental impact.**
The project targets in particular companies and SMEs from the manufacturing, agriculture and tourism sector, particularly relevant for the regions included in the project, and which generally have a tremendous collective footprint on the environment. They are those who can strongly influence the implementation of circular economy development in the targeted regions, by investing in new solutions and technologies to increase resource productivity and decouple economic growth from resource use and its environmental impact.
By participating in the AWASTER activities and by jointly discussing viable waste-free economy schemes, companies and SMEs who aspire to become more resource efficient will **increase their competencies and gather knowledge on how to improve resource use and improve their business, in a more green and efficient way**.

↘ AWASTER educational workshops on resource efficiency

AWASTER educational workshops on resource efficiency will be focused on the **presentation and discussion of the application of innovative and sustainable business models**, which are minimizing the direct and indirect costs on the environment by developing viable product and rethinking process designs.
Participating companies and SMEs will have the opportunity to enhance their knowledge and to broaden their horizons on improving resource efficiency thus contributing to decreasing material use and costs, creating competitive advantages and new markets.
During the implementation of the AWASTER project, the workshops will be organized in 5 regions (Veneto and Apulia Regions in Italy, and Istria, Split-Dalmatia and Dubrovnik-Neretva Counties in Croatia), for a total of 10 workshops (2 per region).
After each workshop, a survey and short interviews will be conducted among the involved economic entities to assess the workshop's impact on the level of knowledge and intention for action of the participating businesses.
After the project ends, similar workshops can be organized for the employees of the interested business, which will allow to deep-dive and focus in order to find viable solutions to the specific business case. Representatives of interested entities will be invited to explore all the developed content in the AWASTER project and use it in its regular activities to boost circular economy principles in their businesses.

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Project partners:

↘ **Lead partner**

IRENA
Istrian Regional Energy Agency Ltd.

↘ **Partners**

SINLOC SpA

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Local Action Group

SUNCE
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