An international review of national and subnational circular economy monitoring frameworks:
Lessons and ways forward for Italy

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An International Review of National and Subnational Circular Economy Monitoring Frameworks

Lessons and Ways Forward for Italy

This paper takes stock of international good practices to measure progress and impacts towards a circular economy, based on existing circular economy strategies and related measurement frameworks at different levels of government. It also provides an overview of 215 operational and aspirational indicators available in Italy from official statistical sources and targeted circular economy reports. It highlights measurement challenges and concludes by identifying opportunities to expand the monitoring framework in Italy to measure progress towards a circular economy.

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Foreword

This paper takes stock of international good practices to measure progress and impacts towards a circular economy based on existing circular economy strategies and related measurement frameworks at different levels of government. It also maps more than 200 operational and aspirational indicators related to the circular economy in Italy from official statistical sources (e.g. Italian National Institute of Statistics, Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Institute for Environmental Protection and Research) and targeted circular economy reports. Overall, the publication analyses the collected indicators against the conceptual framework of the OECD Expert Group on a New Generation of Information for a Resource-efficient and Circular Economy (RECE-XG). It highlights measurement challenges for each of the four building blocks of the RECE-XG framework: i) material life cycle and value chain; ii) interactions with the environment; iii) policy responses and actions; and iv) socio-economic opportunities of a circular economy. It concludes by identifying opportunities to expand the monitoring framework in Italy to measure progress towards a circular economy. The paper reads as follows: first, it provides an overview of existing definitions, principles and monitoring framework on the circular economy; second, it takes stock of existing international circular economy strategies accompanied by monitoring frameworks at the national and subnational levels; third, it evaluates the state of the art of existing indicators in Italy comparing them with the RECE-XG framework; fourth, it highlights challenges of existing monitoring efforts and; and fifth, it proposes ways forward for a comprehensive monitoring framework in Italy.

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Abbreviations and acronyms

ANAC	*Agenzia Nazionale Anticorruzione,* National Anti-Corruption Authority
BAT	Best available technique
BLEC	*Bureau de la Logistique et de l'Économie Circulaire,* Logistics and Circular Economy Office
CAM	*Criteri ambientali minimi,* Minimum environmental criteria
CDW	Construction and demolition waste
CE	Circular economy
CEAP	Circular economy action plan
CN	Combined Nomenclature
CO$_2$	Carbon dioxide
CPA	Classification of Products by Activity
CPC	Circular public procurement
CREA	*Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria,* Council for Agricultural Research and Economics
DEU	Domestic extraction used materials
EC	European Commission
EEA	European Environment Agency
EMAS	Eco-Management and Audit Scheme
ENEA	*Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile,* Italian National Agency for New Technologies, Energy and Sustainable Economic Development
EPA	Environment Protection Agency
ESO	Electronic System Operator
EUR	Euro
FAO	Food and Agriculture Organization
FDI	Foreign direct investment
GDP	Gross domestic product
GHG	Greenhouse gas
GPP	Green public procurement
GVA	Gross value added
ICESP	Italian Circular Economy Stakeholder Platform
IEA	Integrated environmental assessment
IPPC	Integrated pollution prevention and control
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
ISPRA	*Istituto Superiore per la Protezione e la Ricerca Ambientale,* Italian Institute for Environmental Protection and Research
ISTAT	National Institute of Statistics
IT	Information technology
KIB	Knowledge intensive business services
kW	Kilowatt
LCA	Life cycle assessment
MASE	*Ministero dell'Ambiente e della Sicurezza Energetica,* Ministry of Environment and Energy Security, previously *Ministero della Transizione Ecologica (MiTE)*
MIMIT	*Ministero delle imprese e del made in Italy*, Ministry of Enterprises and Made in Italy, previously *Ministero dello Sviluppo Economico (MiSE)*
NACE	*Nomenclature statistique des Activités économiques dans la Communauté Européenne,* Nomenclature of Economic Activities

ODA	Official development assistance
OECD	Organisation for Economic Co-operation and Development
PACE	Platform for Accelerating the Circular Economy
PM	Particulate matter
PNRR	*Piano Nazionale di Ripresa e Resilience*, National Recovery and Resilience Plan
PREC	Brussels-Capital Region Regional Programme for the Circular Economy
Prodcom	Production Communautaire
R&D	Research and development
R&I	Research and innovation
RBH	Responsible business hub
RECE-XG	OECD Expert Group on a New Generation of Information for a Resource-efficient and Circular Economy
SDG	United Nations Sustainable Development Goal
SEC	*Strategia Nazionale per l'Economia Circolare*, National Strategy for the Circular Economy
SNPA	*Sistema nazionale per la protezione dell'ambiente*, National System for Environmental Protection
SNSvS	*Strategia Nazionale per lo Sviluppo Sostenibile,* National Strategy for Sustainable Development
UK	United Kingdom
UNECE	United Nations Economic Commission for Europe
US	United States
WBCSD	World Business Council for Sustainable Development
WPEI	OECD Working Party on Environmental Information
WPRPW	OECD Working Party on Resource Productivity and Waste
WWTP	Wastewater treatment plant

Executive summary

The challenging task of measuring progress towards a circular economy: An international overview of existing definitions, principles and monitoring frameworks

A circular economy is generally understood as an economy where the generation of waste and contamination is minimised, resources are retained for as long as possible and materials are returned to product cycles at the end of their use. However, there are more than 100 definitions of circular economy worldwide. The lack of a globally agreed-upon definition makes measuring progress towards a circular economy challenging. Currently, no harmonised monitoring framework allows for a deeper understanding of the circular economy and an evaluation of circular economy strategies. In response to this gap, in 2021, the Bellagio Declaration put forward seven principles to guide policy makers in developing robust monitoring frameworks and indicators across levels of government and stakeholders. This paper provides an international overview of existing circular economy strategies and monitoring frameworks and draws lessons and ways forward for Italy. Key findings from the review show that:

- Although several countries have developed circular economy strategies at the national and subnational levels by establishing goals, priority areas and actions, only a few have set up a monitoring framework to track related progress. This is the case for Colombia, France, the Netherlands and Spain at the national level, and Paris (France), Galicia (Spain) and Scotland (United Kingdom) at the subnational level. Regarding the monitoring frameworks developed at the subnational level, the regional scale may be adequate to measure some specific aspects related to the input/output flows of material and resources. At the local level, a number of monitoring frameworks aim to assess impacts, referencing United Nations Sustainable Development Goal 12.

- There are important differences across continents in terms of circular economy dimensions subject to monitoring: for instance, across various European countries, national monitoring systems are often based on the European Commission Monitoring Framework, which aims to measure the progress of the circular economy in all stages of the life cycle of resources, products and services. In the People's Republic of China and Asia-Pacific economies, the relevance of industrial areas in circular economy policy plays a more important role in monitoring frameworks than in European countries. Lastly, in Latin America, Colombia developed a monitoring system based on material flows.

- There are several challenges related to monitoring. First, countries that have developed their own monitoring frameworks face difficulties in collecting data on certain indicators, such as those related to the efficient use of material stocks; second, in most cases, monitoring frameworks do not provide an overview of material loops in an economy; third monitoring frameworks tend to devote relatively less attention to socio-economic metabolism considerations. This is a challenge given that advanced economies are highly dependent on fossil fuels and the consumption of primary resources and they generate high rates of waste and emissions. In other words, systemwide approaches are still missing to effectively monitor a circular economy.

Recently, there have been attempts at developing a harmonised framework to monitor progress towards a circular economy globally. First, the OECD Expert Group on a New Generation of Information for a Resource-efficient and Circular Economy (RECE-XG) and the United Nations Economic Commission for Europe Task Force on Measuring Circular Economy (UNECE-TF) have identified a draft conceptual framework with a set of key indicators based on an in-depth review of existing monitoring frameworks and datasets. Second, the OECD Scoreboard on the Governance of the Circular Economy in Cities and Regions was launched in 2020 with the aim to help national and subnational governments assess the existence and level of implementation of 12 enabling conditions for their transition towards a circular economy, according to three levels of progress, namely Newcomer, In progress and Advanced.

Measuring the circular economy in Italy: The state of the art

Italy has made the circular economy one of its strategic assets to contribute to the country's ecological and environmental transition. Assessing progress in the transition to a circular economy is becoming a pressing issue to measure the achievement of the objectives set out by the 2022 National Strategy for the Circular Economy (SEC). The SEC highlights that monitoring results will help set new priorities. In this context, the SEC has compiled a list of 25 indicators divided into 8 main categories that could be used for a future monitoring framework.

This paper collected 215 indicators from Italian official statistical sources (i.e. Italian National Institute of Statistics, Institute for Environmental Protection and Research, Italian National Agency for New Technologies, Energy and Sustainable Economic Development) and key reports on the circular economy that could potentially contribute to monitoring the circular economy in a comprehensive way and measure progress in the areas prioritised by the SEC. These indicators have been evaluated against the conceptual framework of the RECE-XG, taken as the reference international monitoring framework, in order to identify where Italy could make further efforts in developing a monitoring framework that would be in line both with national priorities and the international agenda.

Results of the analysis show that Italy already holds a wealth of indicators in relation to the four building blocks identified by the RECE-XG: i) material life cycle and value chain; ii) interactions with the environment; iii) policy responses and actions; and iv) socio-economic opportunities of a circular economy. Nevertheless, some gaps have been found in relation to monitoring responses to facilitate the application of circular practices, socio-economic opportunities for a just transition and interactions with the environment. In this sense, desk research shows the availability of information on the dimensions mentioned above but not indicators. Moreover, beyond data on waste management, granular data at the local level are missing or not regularly collected, for example, on life cycle management and responses and actions towards a circular economy, including in sectors like food and construction. The one-stop shop of indicators provided by this paper highlights the need for further co-ordination amongst agencies and data providers, especially to select those key indicators that would help monitor the achievement of the objectives set out by the SEC. The development of a harmonised monitoring framework will necessitate a structured co-ordination mechanism to avoid overlaps and bridge the data gaps. The list of recommended indicators requires continuous refinement in order to take into account major international statistical developments[1] as well as country practices in circular economy policy questions.

Towards a comprehensive monitoring framework in Italy: Proposed ways forward

As a result of the above analysis, this paper suggests three sets of policy recommendations:

- **Align the future Italian circular economy monitoring framework with the objectives of the circular economy strategy and with the RECE-XG conceptual framework** . To that effect, the analysis carried out in this paper highlights that Italy could invest further efforts in measuring: i) life

cycle-related areas such as repair, recovery and reuse of materials: while indicators on waste generation, recycling and treatment are generally well covered, those that are related to eco-design, end of waste but also industrial symbiosis, which are areas of actions identified by the SEC, are less available in the form of indicators; ii) responses and actions, including fiscal and regulatory instruments (e.g. extended producer responsibility schemes) to support a circular economy: information on each of these items is available in technical reports and documents made by the competent ministries, but less so in the form of databases; iii) a just transition: indicators such as jobs in sharing economy, reuse and repair activities; circular economy literacy and skills could be developed to monitor the achievement of SEC objectives.

- **Set up a governance system that can strengthen co-ordination amongst agencies in charge of collecting and analysing data, engage stakeholders and improve transparency**. Italy has a number of official statistics and aspirational indicators on the circular economy produced by various national agencies, among which co-operation takes place on an ad hoc basis and relies predominantly on personal communication rather than institutional channels. The development of a harmonised monitoring framework will necessitate a structured co-ordination mechanism to avoid overlaps and bridge the data gaps. There is also room to strengthen co-ordination between the national government and subnational levels. Finally, communicating the progress made on a regular basis can improve implementation and transparency.

- **Promote and guide the collection of granular data at the micro level**. In Italy, cities and regions are responsible for the collection of data on waste generation and disposal. However, a number of indicators related to material management in life cycles are missing at the subnational level (e.g. material collected for the reuse of building materials). International practices show that cities and regions measure material flows, waste collection and management, food waste and building materials. Going forward, the Ministry of Environment and Energy Security could develop guidelines to promote the collection of disaggregated data and foster capacity building, drawing on the experience of existing capacity building projects such as the CReIAMO PA, which includes training modules on "Models and tools for the transition towards a circular economy".

1 The challenging task of measuring progress towards a circular economy

More than 100 definitions exist worldwide to characterise a circular economy (Blomsma and Brennan, 2017[1]; CIRAIG, 2015[2]; Homrich et al., 2018[3]). In a nutshell, a circular economy designs out waste and pollution, keeps resources in use as much as possible in the economy and transforms outputs into new inputs. According to the European Commission, a circular economy is where the value of products, materials and resources is retained in the economy for as long as possible by returning them to the product cycle at the end of their use, thus minimising the generation of waste (EC, 2015[4]). The Ellen MacArthur Foundation describes a circular economy as an alternative to a traditional linear economy (make, use, dispose), being restorative and regenerative by design (2013[5]). The OECD Expert Group on a New Generation of Information for a Resource-efficient and Circular Economy (RECE-XG) and the United Nations Economic Commission for Europe Task Force on Measuring Circular Economy (UNECE-TF) provide a draft headline definition of a circular economy as one where: i) the value of materials in the economy is maximised and maintained for as long as possible; ii) the input of materials and their consumption is minimised; and iii) the generation of waste is prevented and negative environmental impacts reduced throughout the life cycle of materials (OECD, 2022[6]). Kirchherr, Reike and Hekkert (2017[7]) define the circular economy as operating at the micro (products, companies, consumers), meso (eco-industrial parks) and macro (city, region, nation and beyond) levels with the aim of accomplishing sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity. This is enabled by novel business models and responsible consumers.

The lack of a globally agreed-upon definition makes measuring progress towards a circular economy challenging. Currently, no harmonised measurement framework would contribute to a deeper understanding of the circular economy, its evaluation over time and the rebound effects of circular economy strategies (Blomsma and Brennan, 2017[1]). Most indicators focus on recycling and collection rates (Saidani et al., 2019[8]), while some of the dimensions of the circular economy have historically not been reflected in statistical databases (Ekins et al., 2019[9]). Haupt, Vadenbo and Hellweg (2016[10]) argue that collection rate and recycling rate indicators may give a misleading indication of progress, as they indicate inputs into the recycling processes rather than an indication of the efficiency of the processes itself and how much those flows have avoided primary consumption of materials. Another complex issue is the lack of integration between and within the micro, meso and macro levels, which can hinder the achievement of circularity at the system level (Ekins et al., 2019[9]). Therefore, the need for a universally accepted set of indicators for the circular economy has long been globally recognised (Wijkman, 2019[11]).

Recently, the question of how to measure progress towards a circular economy in a harmonised manner across levels of government and stakeholders led to the definition of key guiding principles and standards.

In 2021, the European Environment Agency and the Italian Institute for Environmental Protection and Research (ISPRA), supported by country representatives (Finland, Ireland, the Netherlands, Portugal and the Slovak Republic) from the Network of the Heads of European Environmental Protection Agencies (EPA Network), published the Bellagio Declaration. The declaration's main objective is to guide policy makers in developing robust monitoring frameworks and indicators (EPA Network, 2023[12]). It consists of seven principles: i) monitor the circular economy transition; ii) define indicator groups; iii) follow indicator selection criteria; iv) exploit a wide range of data and information sources; v) ensure multilevel monitoring; vi) allow for measuring progress towards targets; and vii) ensure visibility and clarity (Box 1.1). Taking into account the Bellagio Principles and other initiatives at the national and international levels, the Platform for Accelerating the Circular Economy (PACE)[2] set four recommendations for the application and use of circular indicators by governments: i) elaborating a common framework for measuring circular economy to prevent multiple frameworks emerging; ii) collecting more granular circular indicator data in different sectors and geographical areas; iii) fostering harmonisation and standardisation by identifying initiatives and their potential for interoperability or convergence; and iv) expanding indicator coverage and use of knowledge pooling to improve data collection (PACE, 2021[13]). Moreover, by the end of 2023, the International Organization for Standardization (ISO)[3] has developed three standards setting out core circular economy principles, a guideline for circular businesses and a framework for measuring and assessing circularity. The three standards applicable at the regional, interorganisational, and product levels are: i) ISO 59004: Circular economy framework and principles for implementation; ii) ISO 59010: Circular economy guidelines on business models and value chains; and iii) ISO 59020: Circular economy measuring circularity framework (ISO, 2021[14]).

Box 1.1. The Bellagio Declaration: Seven principles for monitoring the transition to a circular economy

- Principle 1, "Monitor the circular economy transition", advocates for a holistic approach towards the circular economy. This approach should consider public and private activities in the economy. It should capture the changes happening to the material and waste flows, all stages of the life cycle of products, business models and consumption patterns, without externalising economic, environmental and social developments.

- Principle 2, "Define indicator groups", identifies four main categories of indicators all monitoring frameworks should include: i) material and waste flow indicators to monitor changes throughout the material life cycle, including resource efficiency dimensions; ii) environmental footprint indicators to capture the impacts across the full life cycle of products and materials, so that spill-over effects are assessed and planetary boundaries are respected; iii) economic and social impact indicators; and iv) policy, process and behaviour indicators.

- Principle 3, "Follow indicator selection criteria (RACER)", argues that indicators integrated into a monitoring framework for the circular economy transition should be Relevant, Accepted, Credible, Easy to monitor and Robust. Nevertheless, innovative and experimental indicators should also be encouraged, even if not all RACER criteria are checked.

- Principle 4, "Exploit a wide range of data and information sources", promotes the use of Official statistics from the European Statistical System or national statistical offices, other data from European Union institutions, national or local authorities and international organisations. It encourages the use of data from the private sector, trade associations, research models and digital technologies to bridge data gaps.

- Principle 5, "Ensure multilevel monitoring", aims to address a broad range of stakeholders (public and private sector) and different levels of government from the global to local scale. A well-defined monitoring and governance framework requires capturing multi-dimensional and coherent metrics.

- Principle 6, "Allow for measuring progress towards targets", supports the assessment of relevant policy targets and objectives through indicators. It can help identify if appropriate policies are in place and well implemented or if adjustments or new policies are required.

- Principle 7, "Ensure visibility and clarity", states that a robust circular economy monitoring framework should inform policy makers, stakeholders and citizens. Appropriate indicators as well as user-friendly methods of communication, such as dashboards, should be elaborated as such.

Source: EPA Network (2023[12]), *The Bellagio Declaration*, https://epanet.eea.europa.eu/reports-letters/reports-and-letters/bellagio-declaration.pdf/view.

With the aim of developing a harmonised framework to monitor progress towards a circular economy, the RECE-XG and the UNECE-TF, along with country representatives,[4] have developed a draft conceptual framework with a set of key indicators based on an in-depth review of existing monitoring frameworks and datasets[5] (OECD, 2022[6]). In addition, the draft OECD report "Monitoring progress towards a resource-efficient and circular economy" (2022[6]) provides three principles to select indicators to monitor progress towards a circular economy: i) policy relevance and usefulness for users; ii) analytical robustness; and iii) measurability.

The RECE-XG draft conceptual framework integrates four building blocks, each of them associated with several indicators: i) material life cycle and value chain; ii) interactions with the environment; iii) policy responses and actions; and iv) socio-economic opportunities of a circular economy (Table 1.1).

- **Material life cycle and value chain**. This component sets out different phases of the material life cycle and the value chain around three themes: i) materials supply and their use; ii) material waste and circularity; and iii) interaction with trade and globalisation (e.g. indicators of material import, export and second-hand goods).

- **Interactions with the environment**. This component provides an outlook on natural resource implications associated with material flows and the circular economy, classified into two themes: the physical evolution of natural assets; and the environmental impacts of material extraction, processing, use and end-of-life management.

- **Policy responses and actions**. This component describes environmental, economic, sectoral and social policy responses and actions, which can facilitate the application of circular practices. Related indicators encompass a diversity of policy tools such as tax regulations supporting circular business models and reuse materials, investments in waste management and prevention, expenditure on research and development (R&D) from government and businesses, and packaging instruments.

- **Socio-economic opportunities for a just transition**. This component describes the social and economic results of the circular economy, based on economic efficiency and social equity, such as: market developments and new business models, trade, public awareness and inclusiveness. It builds on indicators related to entrepreneurship, industrial symbiosis initiatives, public opinion on circular topics and behavioural changes. Indicators related to inclusiveness have yet to be defined to illustrate how various areas and populations (age, gender, income) are impacted or can benefit from circular policies.

Table 1.1. Overview of circular economy frameworks, themes and indicator topics of the RECE-XG draft conceptual framework for monitoring progress towards a circular economy

Framework	Themes	Indicator topics - Aspects to be considered
Material life cycle and value chain	The material basis of the economy (level and characteristics of materials supply and their use in the economy)	Material inputs and consumption: share of renewable materials, recyclable materials.
		Material accumulation in the economy.
	The circularity of material flows and the management efficiency of materials and waste (with reference to R strategies and circular economy [CE] mechanisms)	Waste generation.
		Contribution of secondary raw materials to material inputs or consumption.
		Contribution of renewable materials to production processes.
		Products diverted from the waste stream through repair, remanufacture, reuse.
		Materials diverted from final disposal through recycling and recovery.
		Materials leaving the economic cycle.
	Interactions with trade	Material exports, imports, trade balance.
Interactions with the environment	Natural resource implications (physical evolution of natural assets)	Material extraction (used).
		Natural resource residuals (unused extraction).
		Changes in natural resource stocks; extraction rates, depletion ratios.
		Water abstracted for material extraction and processing.
		Intensity of use of forest resources.
	Environmental quality implications (effects of materials extraction, processing, use and end-of-life management on environmental conditions)	Impacts on climate and air quality: greenhouse gas emissions, carbon footprint of priority materials, air emissions.
		Impacts on biodiversity: land and habitats.
		Impacts on water and soil quality: pollutant discharges to water from material extraction and processing; soil contamination due to material extraction and processing and end-of-life management.
Responses and actions	Support circular use of materials, promote recycling markets and optimise design	Taxes, tax reliefs, transfers, regulations supporting circular business models and the use of repaired, refurbished, remanufactured goods.
		Reform of subsidies encouraging unsustainable use or extraction of materials.
		Circular public procurement; green public procurement; extended producer responsibility, deposit-refund, pay-as-you-throw schemes.
		Design for extended lifespans, for recycling and dismantling.
		Taxes on materials/products raising particular concerns.
		Bans/guidelines on substances that restrict recycling.
	Improve the efficiency of waste management and close leakage pathways	Investments in waste management.
		Waste prevention and anti-littering instruments.
		Bans, taxes on frequently littered items (e.g. plastics).
		Bans, taxes on landfilling, on incineration without energy recovery.
	Boost innovation and orient technological change for more circular material life cycles	CE R&D budgets of governments and businesses.
		Development and international diffusion of CE technologies.
	Target setting and planning	Targets on: resource productivity, recycling, recycled content, waste reduction and prevention, landfilling.
		CE plans and strategies.
	Strengthen financial flows for a circular economy and reduced leakage	Domestic flows: government and business expenditure on CE activities; government budgets allocated to CE objectives (link to green budgeting).
		International flows: CE-related official development assistance; foreign direct investment.

Framework	Themes	Indicator topics - Aspects to be considered
Socio-economic opportunities for a just transition (economic efficiency and social equity)	Inform, educate, train	Product and packaging instruments: eco-labelling, certification schemes, etc.
		Integration of CE issues in school curricula and professional training.
		Other information and communication instruments.
	Market developments and new business models	CE entrepreneurship, goods and service; business models, start-ups, industrial ecology/symbiosis initiatives.
		Employment markets and jobs; recycling markets.
	Trade developments	Trade in CE-related goods and services.
		Supply security/autonomy/resilience.
	Skills, awareness and behaviour	CE literacy and skills.
		Public opinion on CE issues.
		Behavioural changes (households, consumers, firms).
	Inclusiveness of the transition (distributional aspects of CE policies)	To be defined; to reflect how different territories and population groups are affected or benefit from CE policies and actions (young people, women, vulnerable communities, etc.).

Source: OECD (2022[6]), "Monitoring progress towards a resource-efficient and circular economy", Unpublished, OECD, Paris.

The OECD Scoreboard on the Governance of the Circular Economy in Cities and Regions was launched with the aim to help national and subnational governments assess the existence and level of implementation of 12 enabling conditions towards their circular economy transition, namely: i) roles and responsibilities; ii) strategic vision; iii) awareness and transparency; iv) co-ordination; v) policy coherence; vi) stakeholder engagement; vii) appropriate scale; viii) regulation; ix) financing; x) capacity building; xi) innovation; and xii) data and assessment (Box 1.2) (OECD, 2020[15]).

Box 1.2. OECD Scoreboard on the Governance of the Circular Economy

The OECD Scoreboard on the Governance of the Circular Economy in Cities and Regions counts 12 key dimensions for governments and stakeholders to evaluate corresponding levels of implementation, namely "newcomer" (planned; in development), "in progress" (in place, not implemented; in place, partly implemented) and "advanced" (in place, functioning; in place, objectives achieved). The visualisations of the results provide an overview of the level of circularity of a city or region for each dimension, with the objective of helping governments promote, facilitate and enable the circular economy.
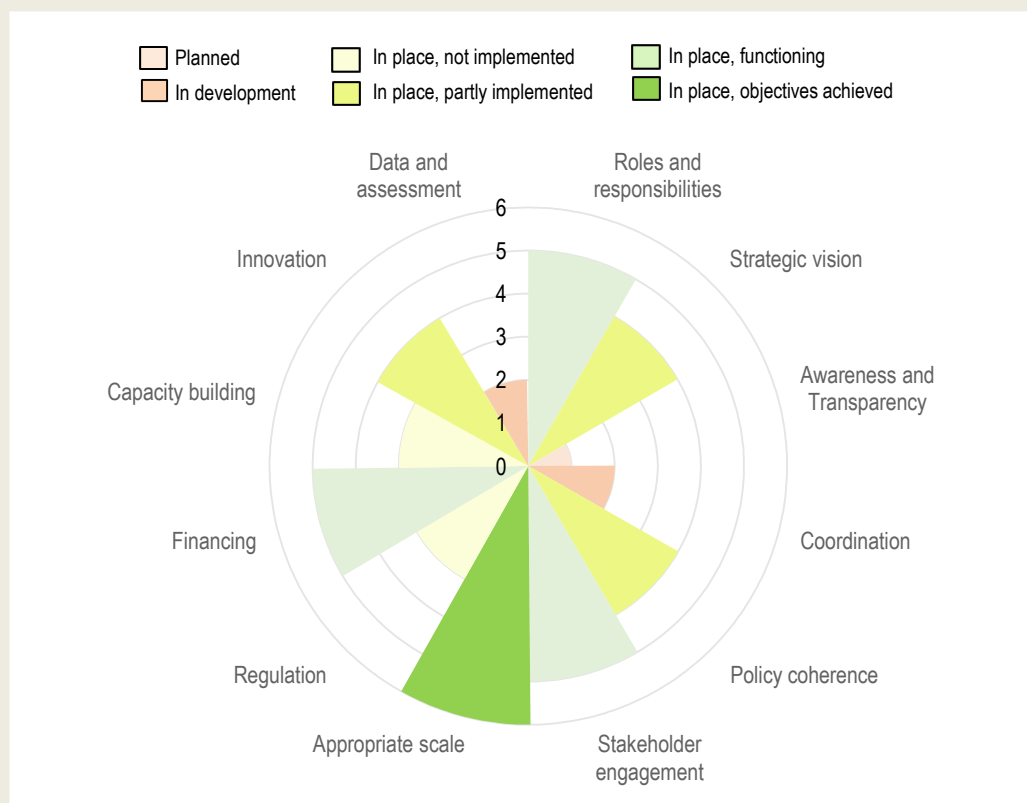
Source: OECD (2020[15]), *The Circular Economy in Cities and Regions: Synthesis Report*, https://doi.org/10.1787/10ac6ae4-en.

Several cities have used the scoreboard to carry out an assessment of their governance conditions. In 2020, the Scottish city of Dundee, United Kingdom, used the OECD scoreboard to gather stakeholders, engage different departments, understand the state of the art of the city's circular transition and design its future vision. In 2021, the city of Montreal, Canada, applied the OECD scoreboard with 117 local stakeholders to assess enabling conditions as a stepping-stone towards a circular economy strategy for the city (*Vers une feuille de route pour l'économie Montréalaise*) (OECD, 2022[16]).

Source (box): OECD (2022[16]), *Vers une stratégie d'économie circulaire à Montréal : comment accélérer la transition ?*, https://www.oecd.org/cfe/cities/Montreal_economie_circulaire.pdf.

2 An international overview of existing circular economy strategies and monitoring frameworks at the national and subnational levels

Circular economy strategies at different levels of government: Goals, priority areas and actions

In recent years, governments at various levels have been increasingly developing long-term strategies for a circular economy. Waste reduction and more efficient use of resources are key goals of many circular economy strategies, with expected positive impacts on the environment and the economy. In the Netherlands, the circular economy strategy envisages a 50% reduction in the use of primary raw materials (minerals, fossils and metals) by 2030 and the use and reuse of raw materials efficiently without any harmful emissions to the environment by 2050. France aims to reduce the use of natural resources related to consumption by 30% in relation to the gross domestic product (GDP) between 2010 and 2030 and the amount of non-hazardous waste by 50% between 2010 and 2025. Spain aims to reduce food waste generation by 50% per capita at the household and retail level and by 20% in production and supply chains while improving water use efficiency by 10%. In Slovenia, one of the main goals of the circular economy roadmap is to achieve greater self-sufficiency in providing raw materials since the country currently imports 71% of the raw materials consumed domestically. The circular economy strategy in Scotland, United Kingdom, includes a series of waste-related targets for 2025, such as: waste reduction by 15% against the 2011 baseline of 13.2 million tonnes; waste sent to landfill must remain at 5% of all waste; 70% recycling/composting and preparing for reuse of all waste; and reduction of all food waste and on-farm losses of edible products (Scottish Government, 2016[17]). At the subnational level, Amsterdam and Rotterdam, the Netherlands, aim to become completely circular by 2050, halving the use of new raw materials and food waste by 50% by 2030 (OECD, 2020[15]).

Circular economy strategies identify priority areas, mainly as a result of public consultations and material metabolism analyses. Priority areas can be established by sector, for example: the circular economy strategic framework in Czechia focuses on four priority areas: consumption and consumers, waste management, economic instruments, and research innovation and digitalisation (OECD, 2021[18]). The Circular Economy in the Netherlands by 2050 strategy identifies five priorities: i) biomass and food; ii) plastics; iii) the manufacturing industry; iv) the construction sector; and v) consumer goods (PBL, 2017[19]). The Regional Programme for the Circular Economy 2016-20 (PREC) in the Brussels-Capital Region, Belgium, includes 111 measures across 4 strategic areas: i) cross-functional measures (a favourable regulatory framework, direct and indirect aid, innovation, procurement contracts, employment,

training, education); ii) sector-based measures (construction, resources and waste, trade, logistics, food); iii) territorial measures; and; iv) governance measures (strengthened co-operation between administrations) (Brussels-Capital Region, 2016[20]). Through Vision 2050. A Long-term Strategy for Flanders, the Flemish government, Belgium, defined the following focus areas: i) circular purchasing; ii) circular cities; and iii) circular entrepreneurship (Circular Flanders, 2023[21]). The city of Paris, France, identified 15 actions for planning and construction, reduction, reuse and repair, support for actors, public procurement and responsible consumption, in its first roadmap adopted in 2017. The second roadmap, adopted by Paris in November 2018, defined 15 revised actions organised into 5 new themes: exemplary administration; culture; events; sustainable consumption; and education (City of Paris, 2018[22]).

In order to achieve the objectives of the strategies according to the priority areas, a number of actions have been set up. Many strategies foresee opportunities for repurposing empty buildings, reducing the use of raw materials for new buildings and extending the life of existing ones. For example, Portugal promotes the use of "empty" built spaces. Eco-design and extension of the useful life of products are also widely foreseen by strategies at various levels of government. The city of Paris, France, emphasises the need to facilitate product life cycle extension and has implemented measures to recover information technology and telephone equipment and furniture. It has also promoted the adoption of a charter in cultural venues for the design of eco-responsible events. Some strategies have set up actions towards reusing and repairing: the Strategy of Circular Economy 2019-2030 of Galicia, Spain, promotes specialised training for repairing products and fosters the creation of collaborative spaces to increase the functionality of materials and products (Government of Galicia, 2019[23]). Sharing, redistributing and service-based initiatives contribute to reducing pollution and waste while optimising the use of resources: cities investing in circular transport have focused on shared municipal fleets of cars and bicycles, as well as on developing urban logistic spaces, increasing the attractiveness of the use of public transport, widening sustainable transportation options and building additional bicycle lanes. France supports local supermarkets and businesses that redistribute surplus food (OECD, 2020[15]).

National monitoring frameworks

Although several countries have developed circular economy strategies, establishing clear goals, priority areas and actions, only a few have set up a monitoring framework. Across various European countries, national monitoring systems follow the European Commission Monitoring Framework, composed of ten indicators, divided into five key areas: i) production and consumption; ii) waste management; iii) secondary raw materials; iv) competitiveness and innovation; and v) global sustainability from circular economy (Box 2.1). This is the case of the Spanish Strategy for the Circular Economy (España Circular 2030) (Government of Spain, 2020[24]) and the roadmap towards the circular economy in Slovenia. The latter also includes indicators from the Slovenian Development Strategy 2030 (material productivity, share of renewable energy in gross final energy consumption and GDP per total greenhouse gas emissions) (Government of Slovenia, 2018[25]). According to Ekins et al. (2019[9]), while "the European monitoring framework provides a comprehensive system of indicators that goes beyond material cycles, considering supply chain implications, reliance on primary raw materials, trade in raw materials, and economic indicators, it does not include indicators related to the scale of the socio-economic metabolism and apparent and real consumption". It has to be noted that the European framework does not apply to cities and regions due to the difficulty in using national indicators (e.g. food production and trade flows) at the local scale (De la Fuente in OECD (2020[26])).

Box 2.1. The European Commission (EC) Circular Economy Monitoring Framework

Following the approval of the Circular Economy Package, in 2018, the European Commission put forward a monitoring framework that aims to measure the progress of the circular economy in all stages of the life cycle of resources, products and services. The monitoring framework complements the existing EC Resource Efficiency Scoreboard and Raw Materials Scoreboard.

The European Commission's New Circular Economy Action Plan, which was launched in 2020 as one of the building blocks of the European Green Deal, called for an update and improvement of the monitoring framework. In May 2023, the European Commission released a revised monitoring framework which includes an additional key area on global sustainability and resilience. In total, the new monitoring framework comprises 11 indicators incorporating new indicators of material footprint, resource productivity, greenhouse gas emissions from production activities, material import dependency and consumption footprint (Table 2.1).

Table 2.1. Indicators included in the EC Circular Economy Monitoring Framework, 2018

Key areas	Indicators
Production and consumption	Material consumption
	Material footprint (tonnes per capita)
	Resource productivity (euros per kilogramme, EUR/kg)
	Green public procurement
	Waste generation
	Total waste generation per capita (kg per capita)
	Total waste generation (excluding major mineral waste) per GDP (kg per EUR)
	Generation of municipal waste per capita (kg per capita)
	Food waste (kg per capita)
	Generation of packaging waste per capita (kg per capita)
	Generation of plastic packaging waste per capita (kg per capita)
Waste management	Overall recycling rates
	Recycling rate of municipal waste (%)
	Recycling rate of all waste, excluding major mineral waste (%)
	Recycling rates for specific waste streams
	Recycling rate for overall packaging waste (%)
	Recycling rate for plastic packaging waste (%)
	Recycling rate for electrical and electronic equipment waste that is collected separately (%)
Secondary raw materials	Contribution of recycled materials to demand for raw materials demand
	Circular material use rate (%)
	End-of-life recycling input rates (%)
	Trade in recyclable raw materials
	Imports from outside the European Union (tonnes)
	Exports to outside the European Union (tonnes)
	Intra-EU trade (tonnes)
Competitiveness and innovation	Private investments, jobs and gross value added (GVA) related to circular economy sectors
	Private investments (% of GDP)
	Percentage of employment
	Gross value added (% of GDP)

Global sustainability and resilience	Green innovation: patents related to waste management and recycling (number and number per million inhabitants)
	Global sustainability from a circular economy
	Consumption footprint (index 2010=100 and times the planetary boundaries are transgressed)
	GHG emissions from production activities (kg per capita)
	Resilience
	Material import dependency (%)
	EU self-sufficiency for raw materials (%)

Source: EC (2018[27]), "Measuring progress towards a circular economy in the European Union – Key indicators for a monitoring framework", https://ec.europa.eu/environment/circular-economy/pdf/monitoring-framework_staff-working-document.pdf; UNECE (2023[28]), "Update on revised EU monitoring framework circular economy – Eurostat", https://unece.org/sites/default/files/2023-03/S3_3_Update%20on%20revised%20EU%20monitoring%20framework%20CE.pdf. https://unece.org/statistics/documents/2023/03/presentations/update-revised-eu-monitoring-framework-circular-economy

In France, the 10 Key Indicators for Monitoring the Circular Economy (2017[29]) are grouped into 3 areas of action: supply from economic stakeholders; consumer demand and behaviour; and waste management. These areas cover seven pillars of the circular economy: i) extraction/manufacturing and sustainable supply chain; ii) eco-design; iii) industrial symbiosis; iv) functional economy; v) responsible consumption; vi) extension of product lifespan, and vii) recycling. In 2021, the framework introduced a new indicator of the material footprint (expressed as "raw material equivalent"), which takes into account all of the raw materials generated by the manufacturing industry and supply chains (Table 2.2). The 2018 monitoring framework for A Circular Economy in the Netherlands by 2050 focuses on input (means), throughput (activities), output (achievements) and core output (core achievements) indicators. The Dutch monitoring system aims to measure the direct and indirect effects of action on biomass and food, plastics, manufacturing, construction and consumer goods on resource use, environment and nature and socio-economic developments. In addition, the framework includes a circularity ladder (also called R-ladder) to prioritise the order in which more efficient products and services should be developed in the product chain: rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, recover (R0-R9) (PBL, 2018[30]) (Table 2.3). In Portugal, the Action Plan for Circular Economy 2017-2020 contains indicators to measure the progress of the ten lines of action set out in the strategy for the macro, meso and micro levels (Table 2.4) (Government of Portugal, 2017[31]).

Table 2.2. The circular economy monitoring framework in France

Areas of action	Pillars	Indicators
Supply from economic stakeholders	Extraction/manufacturing and sustainable supply chain	Domestic material consumption per capita
		Resource productivity
		Material footprint
	Eco-design (products and processes)	European eco-label (number of eco-labelled products and licenses)
	Industrial symbiosis	Number of industrial symbiosis initiatives
	Functional economy[1]	Number of companies and local authorities that have been supported by the French Environment and Energy Management Agency (ADEME) for the functional economy
Consumer demand and behaviour	Responsible consumption	Food waste
	Extension of product lifespan	Household spending on product maintenance and repair (excluding vehicles)
Waste management	Recycling (material and organic)	Landfill tonnage trend
		Use of secondary raw materials
Cross-area indicator	Extension of product lifespan and recycling (combination of pillars)	Jobs in the repair of goods and recycling of materials

1. The functional economy is a new business model aiming to replace the sale of a traditional material product or service by selling the use of the product and its useful effects instead (benefits to customers).
Source: French Ministry of Ecological Transition (2021[32]), *Key Indicators for Monitoring the Circular Economy - 2021*, https://www.statistiques.developpement-durable.gouv.fr/sites/default/files/2021-08/datalab_key_indicators_circular_economy_august2021.pdf.

Table 2.3. The circular economy monitoring framework in the Netherlands

Domain	Indicators
Resource and material use effects	Resource use, direct (billion kg)
	Resource use, chain (billion kg)
	Resource consumption chain (billion kg)
Environmental effects	Land use, direct (percentage of cultured land)
	Water extraction, direct (million cubic metres, m^3)
	Carbon dioxide (CO_2) emissions, direct (billion kg)
	CO_2 consumption footprint (billion kg)
Socio-economic effects	Economic growth – circular economy part (% of GDP)
	Employment - circular economy part (% of total employment)
	Added value recycling industry (billion EUR)
	Self-sufficiency resources (kg extracted/kg direct material input of resources)
Effects on autonomous factors	Dutch economy GDP (billion EUR)
	Employment in the Netherlands (full-time equivalent employees)
Performance - natural resources	Material use, direct (billion kg)
	Waste production (billion kg)
	Reduce (R2): material productivity (EUR GDP/kg)
	Reduce (R2): waste production per kg of product produced (kg waste/kg product)
	Recycling (R8): cyclical use rate (secondary application as a % of total)
	Recycling (R8): reuse waste (% of available waste)
	Recycling (R8): value-based recycling index (price recyclables/price ingoing waste flows)
	Renewable energy (% of energy use)

Source: PBL (2018[30]), *Circular Economy: What We Want to Know and Can Measure*, https://www.pbl.nl/sites/default/files/downloads/pbl-2018-circular-economy-what-we-want-to-know-and-can-measure-3217.pdf.

Table 2.4. The circular economy monitoring framework in Portugal

Line of actions	Indicators
Macro-level actions	
Design, repair, reuse: extended producer responsibility	Ratio of shops offering repair services to the total number of shops
	Repair cafés and/or local actions realised
	Number of users of the services made available
	Ratio of products repaired to new products sold (including reused vs. new school books)
	Savings per student on the price of a basket of school books for each school year
	Number of partnerships with municipalities/distribution
	Number of awareness-raising actions and their respective impact
Incentivising a circular market	Impact of the tax benefit awarded
	GVA generated
	Number of companies or products with tax benefits
	Amount invested in circular economy projects
A new life for waste	Average time to process a byproduct classification decision
	Number of agreements established and countries covered
Regenerating resources: water and nutrients	Number of actions taken to disseminate the guidance document
	Number of directives adopted
	Number of awareness actions and their respective impact
Researching and innovating for a circular economy	Number of actions to divulge the guidance document
	Number of directives adopted
	Number of awareness actions and their respective impact
	Number and investment in circular-economy-related research and innovation projects
	Number of doctorate (PhD) and post-PhD grants and contracts in scientific employment
Meso-level actions	
Built environment: greater efficiency and material productivity	Number of voluntary agreements signed and sectors covered
	Number of guides developed
	Number of reuse initiatives
	Number of quality protocols developed materials from construction and demolition waste
	Number of projects incorporating smart design
	Rate of compliance with the obligation to use at least 5% of recycled materials in construction contracts under the Public Contracts Code
Green and circular public procurement	Number of products/services covered by circularity criteria
	Number of good practices identified and disseminated
	Environmental and economic impact: reduced emissions, waste, costs vs. the traditional option
Micro-level actions	
Responsible business hubs (RBHs)	Number of industrial symbioses/number of industrial businesses set up in RBHs
	Quantity of materials and energy transacted between businesses/number of industrial businesses in RBHs involved
	Savings in consumption (tonne, kilowatt) and corresponding economic saving associated with the efficient use of resources

Source: Government of Portugal (2017[31]), *Leading the Transition - Action Plan for Circular Economy in Portugal: 2017-2020*, https://circulareconomy.europa.eu/platform/sites/default/files/strategy_-_portuguese_action_plan_paec_en_version_3.pdf.

Compared to European frameworks, the circular economy policy in the People's Republic of China (hereafter China) and other economies in the Asia-Pacific gives important consideration to the relevance of industrial areas in monitoring frameworks (Ekins et al., 2019[9]). In particular, China foresees 22 macro indicators divided across 4 main categories: resource output, resource consumption, integrated resource utilisation and waste disposal/pollutant emission indicators. In addition, the 2015 Eco-Industrial Parks

standard (HJ/T274-2015), approved under the leadership of the Ministry of Ecology and Environment of People's Republic of China, contains 32 indicators across 5 main categories: i) economic development; ii) industrial symbiosis; iii) resource conservation; iv) environmental protection; and v) information disclosure (Ekins et al., 2019[9]). Japan applies indicators related to reuse, remanufacturing and recycling, operationalised through the concepts of 3R (reduce, reuse, recycle) or 9R (refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, recover). Finally, Australia, where there is no formal circular economy strategy as yet, proposed in 2022 potential indicators divided into three categories of indicators: i) headline indicators, to provide a high-level view of the level of circularity; ii) impacts indicators to address waste flows, material composition and tracking, R-strategies, as well as socio-economic dimensions; and iii) transition indicators, focusing on resource values, material reusability, quality and expected lifespan, as well as connexions between economic measures and material flows (ACE Hub, 2022[33]).

In Latin America, the 2019 Circular Economy Strategy of Colombia foresees 28 indicators classified into 6 lines of action: i) industrial material flow and products of mass consumption; ii) packing material flow; iii) biomass flow; iv) energy flow; v) water flow; and vi) building material flows (Government of Colombia, 2019[34]) (Table 2.5).

Table 2.5. The circular economy monitoring framework in Colombia

Lines of action	Indicators
Industrial material flow and products of mass consumption	Number of waste streams or subcategories of electrical and electronic waste regulated under extended producer responsibility
	Tonnes of collected and managed waste of computers and peripherals, fluorescent lamps, batteries and accumulators, lead-acid batteries, pesticide containers and expired medicines under the principle of extended producer responsibility
	Tonnes of materials recovered and recycled from 100 000 refrigerators that were replaced
	Tonnes of refrigerants controlled by the Montreal Protocol for reuse
	Percentage of used lubricating oils collected and treated for energy recovery
	Use rate of iron and scrap steel
	Number of vehicle disintegration plants at the national level
	Selective collection and environmental management goal for used tyres from 13 inches to 22.5 rims (by 2022)
	Selective collection and environmental management goal for used tyres from 13 inches to 22.5 rims (by 2024)
	Collection and environmental management for used tyres from bicycles, motorbikes, motorcycles, mopeds and off-road vehicles tyres (of at least 35% by 2022)
	Collection and environmental management for used tyres from bicycles, motorbikes, motorcycles, mopeds and off-road vehicles tyres (of at least 65% by 2028)
Packaging material flow	Use of container and packaging waste
	Adequate environmental management of plastic container and packaging waste
	Number of recyclers in the process of formalisation
	Recovery of packaging waste linked to extended producer responsibility
Biomass flow	Tonnes of residual biomass used
	Number of innovative projects for the use of waste biomass
Energy flow	Intensity of energy saved by energy efficiency programmes in the following sectors: transport, industry, tertiary and residential
	Megawatts (MW) installed from renewable sources
	Number of registered in the National Traffic Register
	MW installed from biomass power generation
Water flow	Total number of water reuse projects (safe use of wastewater) authorised/year
	Loss rate for billed subscriber
	Hydric productivity

Lines of action	Indicators
	Percentage of urban wastewater treated/total wastewater generated
	Number of monitoring points with Water Quality Index
Building material flows	Recovery rate for construction and demolition
	Percentage of construction projects that apply for certification programmes in the construction industry

Source: Government of Colombia (2019[34]), *Estrategia nacional de economía circular : Cierre de ciclos de materiales, innovación tecnológica, colaboración y nuevos modelos de negocio [Circular Economy National Strategy]*, https://www.minambiente.gov.co/wp-content/uploads/2021/06/Estrategia-Nacional-de-Economia-Circular-2019-Final.pdf.

Some observations can be drawn from the overarching analysis of identified monitoring frameworks in the abovementioned countries. First, there is a wide diversity of approaches in terms of scope, indicators and goals and a harmonised and standardised monitoring framework is lacking at a global level. In Europe, although the European Commission's framework inspired many national monitoring frameworks, countries have often developed their own monitoring frameworks in a standalone fashion, showing difficulties in actually collecting data on certain indicators, such as those related to the efficient use of the material stocks. Second, in most instances, monitoring frameworks do not necessarily provide an overview of how much an economy is putting back in loops of goods and materials but rather focus on inputs and processes. Many countries highlight efforts on recycling. Nevertheless, this is not the first best option in a circular economy approach as it may indirectly increase the use of materials and energy compared to primary use (e.g. Cullen (2017[35]); Behera et al., 2014, in Ekins et al. (2019[9])). Third, monitoring frameworks often do not include socio-economic metabolism considerations, which is an issue given that advanced economies are highly dependent on fossil fuels and the consumption of primary resources and that they generate high rates of waste and emissions. As such, a systemwide approach to effectively monitor a circular economy is still missing (Ekins et al., 2019[9]).

Subnational monitoring frameworks

A number of monitoring frameworks have also been developed at the subnational level in several countries. According to Avdiushchenko (2018[36]) in Ekins (2019[9]), the regional (TL2) scale may be adequate to measure specific aspects related to the circular economy, such as sharing initiatives, due to the measurement of inputs and outputs of material flows. Beyond the macro level, monitoring frameworks at the regional level also include the meso level. For example, the 2019 Circular Economy Monitor for Flanders, Belgium, is divided into three main levels: the macro indicators relate to material flows, as well as environmental, economic and social impacts; the meso indicators measure four key systems related to the regional economy, housing, food, consumer goods and mobility; the third level, which does not include micro indicators but features a set of specific products and services meant to illustrate daily consumption habits (e.g. turnover of repair shops for mobile phones) (Circular Flanders, 2023[21]). Nevertheless, in practice, circular economy frameworks at the regional and local levels are designed on the basis of available local resources and data (Bianchi, Cordella and Menger, 2022[37]).

Indicators employed in regional and local monitoring frameworks tend to measure the results and impacts of circular economy strategies. The city of Paris, France, proposes performance indicators and impact indicators for each of the 15 actions included in its 2 roadmaps towards a circular economy (City of Paris, 2018[22]). More than 100 indicators help measure progress towards a circular economy, covering areas such as built environment, energy, food and textile (City of Paris, 2018[38]) (Table 2.6). The city of Amsterdam, the Netherlands, measures its level of circularity by using three main indicators: value preservation, economic impacts and ecological impacts (Table 2.7). Value retention is measured by raw material efficiency and by the use of renewable resources. The economic impact is measured in added value per person and the percentage of circular services in the economy. The environmental impact is

measured by environmental costs, water pollution, toxicity and land, and by CO_2 emissions. These three indicators, which were developed in 2015 by a programme of the Ministry of Infrastructure and Water Management of the Netherlands, are consistent with those developed at the national level (Circle Economy et al., 2016[39]).

Table 2.6. The circular economy monitoring framework in Paris, France

Actions	Performance indicators	Impact indicators
1. Reduce the digital impact of the Parisian administration by aiming for digital sufficiency (*sobriété*)	• Global Green information technology action plan	• Avoidance of energy consumption (kilowatt hour) • Reduced CO_2 emissions • Economic gains
2. Design a donation and resale scheme	• Percentage of end-of-life furniture donated or resold	• Tonnes of waste avoided, EUR recovered
3. Promote the reuse of furniture and equipment from the city's administrative facilities	• Adaptation of the reuse platform • Requests to the Logistics and Circular Economy Office (BLEC) from the city service departments	• Number of goods reused internally • Number of goods donated • Quantity of EUR saved
4. Reduce the use of plastic in the administration and on the Parisian territory	• Number of meetings of the "plastic" commission • Number of restaurants with the ZERO plastic label • Number of shops that have adopted standardised containers • Number of coffee machines with mug detectors and water fountains installed • Number of awareness-raising events held	• Evolution of the tonnage of plastics used, collected and recycled
5. Set up spaces in public and private areas dedicated to the sharing economy and donations	• Number of donations and sharing spaces	• Tonnes of objects exchanged and diverted from the waste stream • Total of positive externalities and number of jobs created
6. Promote responsible and circular fashion in Paris	• Number of conferences • Number of signatories of the commitment charter • Special events hosted at the city hall	• Number of ethical and eco-responsible fashion outlets in Paris
7. Develop the circular economy in cultural institutions	• Creation of a working group • Identification of pilot operations	• Tonnes of materials and objects collected and reused in pilot operations
8. Eco-design events organised on Parisian public areas assessing their environmental impacts	• Compliance rate with the charter • Rate of completion of impact studies	• Analysis and consolidation of impact studies
9. Develop specific actions on the circular economy for higher education	• Launch of the online course "Implementation of the Circular Economy in a Metropolis"	• Number of students who have followed the online course • Number of projects developed in partnership with the city • Number of schools and universities that have responded to the call for projects and participated in the competition
10. Create an educational toolbox for schools and extracurricular institutions in Paris	• Working group meeting time • Creation of the handbook and action brochure	• Number of participants enrolled in the various programmes • Number of events organised
11. Organise continuing education in the circular economy for employees of the city of Paris	• Number of conferences organised, number of training modules created	• Number of city staff member trained
12. Zero waste street: experiment, mobilise and communicate for waste prevention and recovery as part of an emblematic and exemplary project	• Number of participants enrolled in the various programmes • Evolution of bin allocations • Number of collection systems installed and tested	• Evolution of the volume of household and similar waste within the framework of the challenge • Number of illegal deposits • Rate of reporting in the "In my street" mobile application ("*Dans ma rue*")

Actions	Performance indicators	Impact indicators
	• Number of awareness-raising events held • Number of participants	• Perceptions of public space and connection between residents • Number of actors who have changed their practices • Changes in the number of refusals of yellow bins
13. Develop local solutions for the valorisation of energy and water resources	• Number of projects implemented (simple recovery, and with a digital boiler attached to the recovery system)	• Avoidance of energy consumption (kilowatt hours)
14. Promote the disposal of captured deposits and non-recovered stocks/Give a new impetus to reuse practices	• Number of collection points • Number of waste collection centres equipped with a reuse area	• Tonnes/number of items collected and diverted • Number of jobs created
15. Provide collection solutions, storage and sorting for Parisian in the construction industry	• Mapping of existing sites and needs • Study of available permanent or temporary sites • Study on the various administrative, technical and financial structures for providing reuse and/or recycling platforms	• Number of sites identified • Land mobilised

Source: City of Paris (2018[22]), *Plan Economie Circulaire de Paris 2017-2020 - 2e feuille de route [Paris Circular Roadmap]*, https://cdn.paris.fr/paris/2019/07/24/58d790111b39273c144ddc19744a1b5c.pdf.

Table 2.7. The circular economy monitoring framework in Amsterdam, The Netherlands

Indicators	Sub-indicators	Description
Value preservation	Raw material efficiency	Possible waste reduction in the production of goods, measured in kg of waste per EUR 1 000 output
	Use of renewable resources	Percentage of imports (net and domestic) consisting of biomass compared to total imports
Economic impact	Gross value added (GVA)	Economic value in EUR per person
	Circular services	Percentage of services related to the circular economy compared with the GVA
Ecological impact	Environment	Costs of exhaustion, water pollution, CO_2 emissions, toxicity and land use in EUR per kg
	CO_2 emissions	Amount of carbon dioxide released into the atmosphere in kg of CO_2 per person

Source: Circle Economy/Fabric/TNO/Gemeente Amsterdam (2016[39]), *Circular Amsterdam - A Vision and Action Agenda for the City and Metropolitan Area*, https://www.circle-economy.com/resources/developing-a-roadmap-for-the-first-circular-city-amsterdam.

In Toronto, Canada, the 11 indicators from the Circular Economy Procurement Implementation Plan and Framework focus on the impacts and results of procurement activities in environmental (e.g. CO_2 savings as a result of procurement activities), social (e.g. number of green jobs created and secured, number of city staff trained on circular economy procurement principles), economic (e.g. cost savings) and economic (e.g. waste reduction savings) areas (City of Toronto, 2018[40]) (Table 2.8).

Table 2.8. The circular economy monitoring framework in Toronto, Canada

Core areas	Indicators
Environmental	Percentage of waste diversion as a result of procurement activities
	CO_2 savings as a result of procurement activities
	Percentage of recycled content used in materials
	Number of city contracts evaluated using circular economy principles
	Raw materials avoided/displacement factor
Social	Number of green jobs created and secured
	Number of city staff trained on circular economy procurement principles
	Asset utilisation rates/Asset sharing activities
Economic/financial	Cost savings
	Waste reduction savings
	Degree of productivity

Source: City of Toronto (2018[40]), *Circular Economy Procurement Implementation Plan and Framework*, https://www.toronto.ca/legdocs/mmis/2018/gm/bgrd/backgroundfile-115664.pdf.

In Peterborough, United Kingdom, the Circular Peterborough Roadmap launched in 2018 is monitored through eight impact-focused indicators divided into four categories to measure impacts related to four dimensions: i) economic (percentage of circular jobs; percentage of circular business); ii) social (number of shares on Share Peterborough, a resource sharing platform for business in the city; percentage of adults cycling and walking); iii) energy (CO_2 emissions per capita; the amount of renewable electricity available to each household); and iv) waste dimensions (percentage of non-household waste recycled; percentage of household waste recycled) (Table 2.9) (Future Peterborough, 2018[41]).

Table 2.9. The circular economy monitoring framework in Peterborough, United Kingdom

Categories	Indicators
Economic	Percentage of circular jobs out of total employment
	Percentage of circular businesses out of a total number of businesses
Social	Number of shares on Share Peterborough online portal
	Percentage of adults cycling and walking (>3 times per week)
Energy	CO_2 emissions per capita
	Amount of renewable electricity available to each household (MWh)
Waste	Percentage of non-household waste recycled out of total waste
	Percentage of household waste recycled out of total waste

Source: Future Peterborough (2018[41]), *Circular City Roadmap - an ambitious plan & performance monitoring framework towards 2021*, https://www.opportunitypeterborough.co.uk/app/uploads/2022/08/PREVIEW_Peterboroughs-Circular-City-Roadmap.pdf.

Some subnational monitoring frameworks in Spain relate to the United Nations Sustainable Development Goals (SDGs). This is the case of the Extremadura Green and Circular Economy 2030 strategy, Spain, which is endowed with its own monitoring and evaluation model based on the set of indicators from the SDG monitoring framework (Regional Government of Extremadura, 2017[42]). Furthermore, the Agenda for the Development of the Circular Economy in the Spanish region of Navarre 2030 also suggests the use of indicators from SDG 12 to measure the target of extending the culture of sustainability (OECD, 2020[15]).

The waste sector is very relevant for most regional monitoring frameworks. For example, the Making Things Last: A Circular Economy Strategy for Scotland, gathers three waste-related indicators: the total amount of waste produced by sectors; the amount of waste produced by sectors per unit of GVA; and the carbon impact of waste (Scottish Government, 2016[17]). Similarly, the Roadmap of the Circular Economy

of North Karelia, Finland, includes four indicators in the field of construction and waste: recovery rate of construction waste as material; recycling rate of construction waste; separate collection rate of construction waste; and construction waste (Circwaste, 2021[43]).

Regional monitoring frameworks also consider governance dimensions. This is the case of the PREC in the Brussels-Capital Region, which includes a set of 15 proposed indicators, mainly measuring the governance of the circular economy transition (Table 2.10) (Brussels-Capital Region, 2016[20]). The Galician Strategy of Circular Economy 2019-2030, Spain, foresees 101 circular economy indicators to measure the level of implementation of education and awareness-raising related actions, in addition to the following actions: eco-design, service models, industry, food production, urbanism, the built environment and public works, water cycle management and waste management (Table 2.11) (Government of Galicia, 2019[23]).

Table 2.10. The circular economy monitoring framework in Brussels-Capital Region, Belgium

Indicators
Number of legislative and normative obstacles identified and resolved
Number of legislative and normative incentives created
Number of companies that have received financial support related to the circular economy
Amount of financial aid granted to companies in connection with the circular economy
Number of economic operators supported in the circular economy
Number of economic operators made aware of the circular economy
Number of people trained in relation to the circular economy professions
Number of students trained in relation to the circular economy professions
Budgetary amount allocated to calls for projects/living labs carried out/implemented and number of companies that benefitted from them
Number of pilot cases set up via calls for projects/living lab
Number of seminars organised on the circular economy in the framework of the PREC
Budgetary amount and number of pilot circular economy public contracts developed in the Brussels-Capital Region
Number of companies informed/aware of Brussels' public procurement opportunities
Number of jobseekers placed in employment as a result of training developed under the PREC
Number of new neighbourhoods integrating the principles of the circular economy

Source: Brussels-Capital Region (2016[20]), *BRPCE - Brussels Regional Program for a Circular Economy*, https://www.circulareconomy.brussels/a-propos/le-prec/?lang=en.

Table 2.11. Monitoring Framework of the Galician Strategy of Circular Economy 2019-2030

Categories	Indicators
Eco-design	Products and services in the catalogue: number of cases recompiled in the catalogue
	Eco-labelled products and services: number of products and services produced that have some form of eco-label
	Certified companies: number of Galician companies with ISO registrations
	Number of projects submitted under partnerships (between research centres, universities, public bodies and companies) in relation to sustainable processes
	Sectors/facilities assessed subject to an integrated environmental assessment (IEA)
	Installations beyond best available techniques (BAT)
	BAT guidelines for non-integrated pollution prevention and control sectors
	Number of users actively involved: users of the information platform
	Eco-facilities on Galician roads: number of eco-installations and eco-hotelier labels
	Products linked to protected natural areas: nature network space
	Employment growth: number of jobs directly associated to the forest-timber sector
Service models	Repair business: number and types of business activities located outside the territory dedicated to repair
	Number of jobs in the repair sector

Categories	Indicators
	Collaborative spaces: number of locations accessible to the whole society, equipped to promote repair and interactions between users and experts
	Number of idea laboratories and collective projects: creation of laboratories in public places to share ideas and projects related to the "maker" movement
	Number of participants in collective production laboratories
	Number of product-service business models
	Number of community-based based partnerships
	Number of users of community services
	Users of public services: buses, bicycles
	Barriers: identification of the legal aspects limiting the implementation of green public procurement
	Circular public procurement: percentage of public procurement procedures that include green and circular criteria
	Economic value: purchases made of products incorporating recycled or reusable materials (EUR)
Education	Curricula: inclusion of circular economy objectives
	Number of actions lead by administrations
	Number of awareness-raising campaigns
	Achievements: number of didactic proposals/projects designed and implemented under the Plan Project (*Plan Proyecta*)
	Number of schools, levels of education, teaching staff and students participating in teaching proposals/educational innovation projects under *Plan Proyecta*
	Employment: percentage of wage and salary employment in the tertiary sector
	Billing: economic dimension (percentage of GDP)
	Ratio of research funding in sustainability out of overall research funding
	Training: students covered with circular economy training
	Ecological footprint of academic/university activities
	Scope: projects in the scope of this proposal
	Digital multimedia resources: design of interactive multimedia materials for the dissemination and awareness of the circular economy (applications, video games, videos, television programmes, etc.).
Industry	Dialogue roundtable meetings: meetings to elaborate proposals for a better regulatory and legislative alignment to the circular economy
	Percentage of circular public procurement in Galicia
	R&D effort as a percentage of GDP in Galicia
	Number of enterprises benefitting from the aid plan to promote circular business models
	Level of development of the proposal: public programme to support the systematisation of operational excellence as a step prior to the incorporation of clean technologies
	Criteria definition: criteria and approved accreditation process
	Knowledge intensive business services
	Network members: number of members belonging to the Galician circular economy network
	Number of collaborative projects carried out
	Definition of the Ecopark label
	Number of Ecoparks in Galicia (new and adapted)
Food production	Number of vessels potentially benefitting from the measures
	Number of new companies created or implemented providing services that enable the scaling of solutions for a majority of the fleet
	Number of vessels participating in the programme
	Number of ports participating in the programme
	Marine litter collected annually (kg/year)
	Number of campaigns to raise awareness among fishers and citizens of marine litter
	Waste recovered tonnages of waste recovered offshore
	Flour or oil mills on board: number of installations on new-build freezer vessels
	Vermicomposting pomace on site: volume of wine waste managed by vermicomposting
	Biowaste composted on site or small plant (Galician total excluding domestic)

Categories	Indicators
	Plastic in the agricultural sector: reduction of the consumption of fossil plastics
	Plastic packaging: reduction of non-recyclable plastic consumption
	Awareness-raising: number of campaigns and participating restaurants
	Training campaigns: number of training campaigns for local government staff
	Distribution sector helplines: number of measures in the distribution industry to reduce waste in their sites
	Slurry biodigestion: volume of slurry managed by biodigestion for biogas production
	Treatment plants: number of operational biogas slurry management plants
	Food industry waste: Volume of food waste (biomass) generated
Urbanism, building and public works	Artificialisation index of the territory
	Urban mobility: percentage of trips by private car use in cities
	Enhancing urban biodiversity
	Empty housing: percentage of total unoccupied housing
	Number of buildings declared in ruins
	Rural depopulation: change in percentage points of rural population over the total
	Rating system: creation and functionality of the system
	Circular design: percentage of works with circular design
	Reuse: percentage of works with minimum reuse level
	Personalised housing manuals
	Passive design applications
	Registration of use: percentage of registered housing stock
	Products and techniques: construction products and techniques covered by life cycle assessment studies
	Transfer: products and techniques transferred (percentage of sector turnover)
	Galicia Circular eco-label (percentage of sector turnover)
	Reuse: materials and products reused (percentage of construction and demolition waste generated)
	Tonnes of construction and demolition waste ratio per sector (thousands of EUR)
	Modifications of the regulations on sustainability to introduce circular economy principles
	Actual application of new circular economy criteria: in refurbishment work; in new construction
Water management	Water lost in networks: percentage of water not recorded by the Survey on Water Supply and Sanitation
	Percentage of rainwater and runoff water treated by conventional systems
	Research projects on reused water
	Reclaimed and reused wastewater
	Recharging of aquifers with reclaimed water
	Number of population centres supplied
	Percentage of wastewater treatment plants (WWTPs) out of the total that undergo tertiary treatment
	Percentage of WWTPs out of the total that have an advanced filtration in addition to a disinfection treatment
	Number of WWTPs that have introduced the concept of water biorefinery
	Percentage of needs identified to implement the principle of "hierarchy" through sustainability, life cycle assessment and cost-benefit studies
	Detailed study of the establishment of waste disposal levies or other financial instruments
	Percentage of municipal waste collected separately with minimum quality standards
	Percentage of total Galician biowaste managed by onsite composting
	Number of repair and reuse centres set up
	Tonnes of repaired and reused materials
	Scope: percentage of turnover related to the transfer of pilot experiences to the different small and medium-sized enterprise sectors
	Result: waste prevention and recovery as secondary raw materials

Source: Government of Galicia (2019[23]), Estrategia Gallega de Economía Circular 2019-2030 [Galician Strategy of Circular Economy 2019-2030], https://ficheiros-web.xunta.gal/transparencia/informacion-publica/EGEC_cas.pdf.

Some observations can be drawn from the overarching analysis of the local and regional monitoring frameworks described above. First, there is still a limited capacity to measure the level of circularity at the subnational level. Only a few circular economy strategies are complemented by monitoring frameworks. Second, indicators available are mostly data-driven rather than objective-driven. Several monitoring frameworks are driven by data availability, resulting in some cases in an over-representation of sectors that have greater availability of information (e.g. waste-related indicators), which tends to miss the life cycle assessment of policies and gives a misleading picture of progress through recycling. Cities and regions should first and foremost be able to measure material flows across sectors, including food, plastic, textiles and other material streams; and the extent to which procuring products could be replaced by procuring services. Third, there is a lack of a systems approach to circular economy indicators: indicators do not focus on the intelligent use of goods (addressing factors such as planned obsolescence and easing repair); instead, they report on production and wasted resources. In order to move towards a systems change, indicators need to measure and control for several factors (e.g. from urban planning to materials consumption) and not limit themselves to specific sectors such as waste management (OECD, 2019[44]). From the city perspective, metrics can help motivate the transition to the circular economy, measuring carbon neutrality targets, the number of jobs created, the increase in the sharing economy and the positive impacts on material flows.

Measuring the circular economy at the micro level remains a challenge. The literature on the micro level mainly refers to the individual organisation level and supply chain/sector level. Overall, there is a need to adequately capture the micro level in monitoring frameworks due to the considerable implications for the economy. For example, Elia, Gnoni and Tornese (2017[45]) review the use of monitoring frameworks at the micro level. Based on a revision of 29 monitoring systems, they identify 5 main areas that are considered in the monitoring at the micro level: i) reducing input use of natural resources; ii) increasing the share of renewables and recycling; iii) reducing emissions; iv) reducing valuable material losses; and v) increasing the value and durability of products.

3 Measuring the circular economy in Italy: The state of the art

The National Strategy for the Circular Economy (SEC)

Italy has made the circular economy one of its strategic assets to contribute to the country's ecological and environmental transition. In 2022, the Ministry of Environment and Energy Security (MASE) developed a National Strategy for the Circular Economy (SEC) (2022[46]). The objectives of the SEC are the following: i) create the conditions for a market for secondary raw materials as a replacement of traditional raw materials; ii) strengthen and consolidate the principle of extended producer responsibility (EPR); iii) develop taxation favourable to the transition to the circular economy; iv) strengthen actions aimed at upstream circularity (eco-design, extension of product life, reparability and reuse, etc.); v) develop and disseminate methods and models for assessing the life cycle of products and waste management systems and their overall environmental effects; vi) improve traceability of waste streams; and vii) educate and create skills in the public and private sector on the circular economy as a driver for the development of youth and female employment. The SEC identifies 69 actions to be carried out by 2035, which are classified into 12 categories: i) reuse and repair; ii) industrial symbiosis; iii) EPR; iv) minimum environmental criteria for green public procurement; v) eco-design; vi) end of waste; vii) digitalisation; viii) soil; ix) water resources; x) environmental finance and taxation; xi) urban areas and territories; and xii) environmental education. These actions concern the following sectors: electronics and information and communication technology, batteries and vehicles, packaging, construction and demolition, textiles, food chemicals, tanneries and renewable energy infrastructures, in addition to the blue economy and critical raw materials.

The SEC highlights that measuring the progress of policies and actions will create the basis for identifying long-term objectives and setting new priorities (MASE, 2022[46]). In this context, the SEC compiled a list of 25 indicators to monitor and evaluate circularity, divided into 8 main categories, namely: i) production and consumption; ii) waste production; iii) secondary raw materials; iv) soil; v) water resources; vi) air quality; vii) competitiveness and innovation; and viii) environmental education. The Italian National Institute of Statistics (ISTAT) and the Institute for Environmental Protection and Research (ISPRA) are the main data providers for these 25 indicators. In addition, MASE, the National Anti-Corruption Authority (ANAC), the Council for Agricultural Research and Economics (CREA), the National System for Environmental Protection (SNPA) and the Ministry of Enterprises and Made in Italy (MIMIT) also provide data for specific indicators of the SEC (Table 3.1).

Overall, further coherence can be developed between the objectives of the SEC, the actions and the monitoring framework in order to measure progress on action implementation and the level of achievement of the objectives. Table 3.2 summaries objectives, actions and categories in which suggested indicators are currently grouped. As of now, indicators listed in the SEC do not cover the following actions: industrial symbiosis; EPR; eco-design; end of waste; digitalisation; environmental finance and taxation; and urban areas and territories. In other cases, indicators exist and correspond to the actions identified by the SEC. However, progress measures could be further detailed as in the case of green public procurement, to

ensure that objectives indicated by the SEC such as "promoting the evaluation of the life cycle assessment" are fully achieved by 2035.

Table 3.1. Key indicators to monitor the Italian Strategy for the Circular Economy (SEC)

Number	Indicator	Unit of measure	Data source	Frequency
		Production and consumption		
1	Green public procurement	Number/EUR	ANAC	Annual
2	Waste production	Kg/inhabitants	ISPRA	Annual
3	Domestic material consumption	t	ISTAT	Annual
4	Waste management costs	EUR	ISPRA	Annual
5	Food waste	t	ISPRA and CREA	Annual
		Waste production		
		6. Preparation for reuse		
6.1	Preparation for reuse	%	ISPRA	Annual
		7. Recycling rate		
7.1	Recycling rate of municipal waste	% (t)	ISPRA	Annual
7.2	Recycling rate of waste, excluding extractive waste	% (t)	ISPRA	Annual
		8. Recovery/recycling from waste streams		
8.1	Recycling rate of packaging waste	% (t)	ISPRA	Annual
8.2	Recycling rate of plastic packaging waste	% (t)	ISPRA	Annual
8.3	Recycling rate of wood packaging waste	% (t)	ISPRA	Annual
8.4	Recycling rate of waste from electrical and electronic equipment	% (t)	ISPRA	Annual
8.5	Recycling rate of municipal organic waste	Kg/inhabitants	ISPRA	Annual
8.6	Recycling rate of construction and demolition waste	% (t)	ISPRA	Annual
		Secondary raw materials		
		9. Contribution of recycled materials to raw material demand		
9.1	Circular material use rate	%	ISPRA	Annual
		Soil		
		10. Reclamation		
10.1	Rehabilitated brownfield sites	%	MASE	30 June 2024[1]
10.2	Reduction of contaminated sites of national interest	Mq	MASE	Annual
		Water resource		
		11. Purification		
11.1	Wastewater treatment	Mc	ISTAT	Triennial
		Air quality		

Number	Indicator	Unit of measure	Data source	Frequency
12. Emissions				
12.1	Contribution of greenhouse gases in the waste sector	CO$_2$eq (kt)	ISPRA	Annual
12.2	Urban air quality	PM10	ISPRA/SNPA	Annual
Competitiveness and innovation				
13. Investments in circular economy sectors				
13.1	Circular economy patents	Number	MIMIT	Annual
13.2	Interventions for flagship projects	Number	MASE	30 June 2026[2]
13.3	Interventions for projects to improve waste management	Number	MASE	30 June 2026[3]
13.4	Interventions to support economic and productive activities in the circular economy sectors	EUR	MIMIT	Annual
Environmental education				
14. Raising awareness of circular economy issues				
14.1	Communication campaigns in economy circular	Number	MASE	Annual

Note: EUR: euro; kg: kilogramme; t: tonne; %: percentage; CO$_2$eq (kt): carbon dioxide equivalent (kilotonnes).
1: Target of NRRP M2C4-25 (deadline Q1 2026) is to redevelop at least 70% of the land area of orphan sites.
2: Target of NRP M2C1-00-ITA-5 (deadline Q2 2026) foresees the realisation of 10 interventions (completed and tested).
3: Target of NRP M2C1-00-ITA-3 (deadline Q2 2026) foresees the realisation of 50 interventions (completed and tested).
Source: MASE (2022[46]), *Strategia nazionale per l'economia circolare [National Strategy for the Circular Economy]*, https://www.mase.gov.it/sites/default/files/archivio/allegati/PNRR/SEC_21.06.22.pdf.

Table 3.2. Objectives, actions and monitoring categories of the SEC

Macro-objectives	Actions	Monitoring categories
- Create the conditions for a market for secondary raw materials as a replacement of traditional raw materials - Strengthen and consolidate the principle of EPR - Develop taxation favourable to the transition to the circular economy - Strengthen actions aimed at upstream circularity (eco-design, extension of product life, reparability and reuse, etc.) - Develop and disseminate methods and models for assessing the life cycle of products and waste management systems and their overall environmental effects - Improve traceability of waste streams - Educate and create skills in the public and private sectors on the circular economy as a driver for youth and female employment development	- Reuse and repair - Industrial symbiosis - EPR - Minimum Environmental Criteria of the GPP - Eco-design - End of waste - Digitalisation - Soil - Water resources - Environmental finance and taxation - Urban areas and territories - Environmental education	- Production and consumption - Waste production - Secondary raw materials - Soil - Water resource - Air quality - Competitiveness and innovation - Environmental education

Source: Based on MASE (2022[46]), *Strategia nazionale per l'economia circolare [National Strategy for the Circular Economy]*, https://www.mase.gov.it/sites/default/files/archivio/allegati/PNRR/SEC_21.06.22.pdf.

Mapping of circular economy indicators in Italy

This paper collected a total of 215 indicators from official Italian statistical sources and studies that can potentially contribute to monitoring the circular economy and help measure progress in the areas prioritised by the SEC (Box 4.1) (Annex B). Indicators have been mainly retrieved from two main sources: ISTAT (e.g. national accounts; environmental accounts; physical energy flow accounts; economy-wide material flow accounts; environmental taxes; environmental protection expenditure accounts; environmental goods and services sector;[6] international trade in goods statistics; and Prodcom)[7] and ISPRA (waste statistics, circular material use rate and carbon footprint). Other complementary official sources analysed include ANAC, the statistical office of the European Union Eurostat, the International Renewable Energy Agency, the Food and Agriculture Organization, Italian environmentalist association Legambiente, the United Nations Development Programme, the European Environment Agency and the *Italian* National Agency for New Technologies, Energy and Sustainable Economic Development, as well as the strategic documents in Italy led by the Italian government (e.g. MASE, MIMIT) such as the National Recovery and Resilience Plan (NRRP), the report on sustainable and equitable well-being (BES) report in Italy and the SDG monitoring framework.

This publication argues that the SEC could leverage a number of existing datasets in order to bridge the gap and populate SEC's list of 25 indicators (Table 3.1). For example, the 2021 NRRP, launched as a response to the COVID-19 pandemic, monitors progress towards the adoption of various ministerial decrees on circular economy and waste management. ISTAT provides data linked to SDG 12 on sustainable consumption and production patterns[8] (ISTAT, 2022[47]) and on sustainable and equitable well-being[9] (ISTAT, 2022[48]), including relevant indicators of the circular economy such as water reuse, waste generation and treatment and material consumption. Moreover, the draft National Strategy for Sustainable Development (SNSvS) being developed by MASE includes relevant circular economy indicators within the category "Dematerialise the economy, reduce waste production and promote the circular economy" (*Dematerializzare l'economia, abbattere la produzione di rifiuti e promuovere l'economia circolare*)[10] (MASE, 2022[49]). ISPRA's National Centre for Waste and Circular Economy is in charge of the collection, analysis and processing of data on urban waste and packaging waste, including import/export, as well as on the production and management of non-hazardous and dangerous special waste, amongst others. While the one-stop shop of indicators provided in this publication highlights the wealth of indicators, data and information available in Italy, it does not pretend to be exhaustive and can be used as a basis for further additions. The list of mapped indicators is available in Table A B.1.

Although outside the scope of this paper, it is important to highlight that, regarding micro indicators, the 2022 UNI/TS 11820 technical standard "Measuring circularity - Methods and indicators for measuring circular processes in organisations" collects 71 performance indicators aligned with ISO 59020, published in 2023. Indicators are divided into seven categories: i) material resources and components; ii) energy and water resources; iii) waste and emissions; iv) logistics; v) product and service; vi) human resources, assets, policy; and vii) sustainability. The project was carried out between 2020 and 2022 with the participation of more than 150 stakeholders (UNI, 2022[50]).

4 Bridging the gaps for a comprehensive circular economy monitoring framework in Italy

As shown above, Italy can count on a variety of datasets and indicators to measure the achievement of the objectives of the National Strategy for the Circular Economy (SEC). Nevertheless, comparing mapped indicators and the indicators from the OECD Expert Group on a New Generation of Information for a Resource-efficient and Circular Economy (RECE-XG) draft conceptual framework reveals some gaps. Box 4.1 describes the methodology used in this publication to collect and evaluate the indicators. Table A A.1 provides an overview of the main indicators available in Italy that could correspond to the core, complementary and context indicators defined by the RECE-XG conceptual framework.[11] For each of the four building blocks (material life cycle and value chain; interactions with the environment; response and actions; socio-economic opportunities for a just transition), a detailed analysis of the availability of indicators in Italy is presented below. The socio-economic context indicators identified by the RECE-XG framework are also described.

Box 4.1. Methodology and limitations of the analysis

The analysis and comparison of the mapped indicators in Italy and the RECE-XG draft conceptual framework has been conducted according to the following methodology.

- **Selection of sources**: Taking into account the key elements of international monitoring frameworks on the circular economy and following Ministry of Environment and Energy Security (MASE) guidance, the following sources have been selected for the mapping of existing operational and aspirational indicators in Italy: National Recovery and Resilience Plan (Italian Government, 2021[51]); *Circular Economy and Efficient Use of Resources - Indicators for Measuring the Circular Economy* (MASE/MIMIT/ENEA, 2018[52]); the Draft National Strategy for Sustainable Development (SNSvS) (MASE, 2022[49]); Italian data for the United Nations Sustainable Development Goals (SDGs) (ISTAT, 2022[47]); the *BES Report 2021: Sustainable and Equitable Well-being in Italy* (ISTAT, 2022[48]); the *Municipal Waste Report* (ISPRA, 2022[53]); the *Report on Waste from Economic Activities* (ISPRA, 2022[54]); the National Strategy for the Circular Economy (SEC) (MASE, 2022[46]); Communication on a revised monitoring framework for the circular economy (EC, 2023[55]). Indicators have also been retrieved from analysed official sources in Italy (i.e. the Italian National Institute of Statistics ISTAT, the Italian National Agency for New Technologies, Energy and Sustainable Economic Development, the Institute for Environmental Protection and Research ISPRA, Italian environmentalist association Legambiente, the National Anti-Corruption Authority ANAC, International Renewable Energy Agency) and international organisations (the Food and Agriculture Organization FAO, the

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United Nations Development Programme UNDP, European Environment Agency EEA, the European Commission) and international non-governmental organisations (World Wide Fund for Nature, WWF).

- **Extraction of indicators**: 215 circular economy-related indicators have been extracted from each source, avoiding duplications (Table A B.1).

- **Comparing indicators with the RECE-XG framework**: For each of the 101 core, complementary and context draft indicators identified by the RECE-XG framework, one or more of the 215 indicators from Italian sources have been identified and matched. Core indicators correspond to the key elements of the circular economy and aim to provide an overall view of the transition to a circular economy. Complementary indicators accompany the core indicators by providing additional information. Finally, context indicators provide background information on socio-economic and environmental aspects and aim to inform on the drivers of material use. Once selected, the metadata and definitions were checked to ensure that the comparison was consistent. When indicators were not available from the above-mentioned sources or the description of the indicators did not correspond, wider desk research was carried out to check whether the information could be available from other sources. In this case, information was retrieved from sources such as Legambiente, the WWF and reports from international organisations such as the FAO, UNDP and EEA.

This methodology presents some caveats: first, although 215 potential circular economy indicators in Italy have been identified and evaluated against 101 RECE-XG indicators, this document does not claim to be exhaustive but rather provides a one-stop shop of indicators from key sources in Italy. The list of proposed indicators would require a continuous update to consider international statistical developments and national practices on the circular economy. Second, it is important to note that the RECE-XG paper is a work in progress and its indicators are subject to change over time. In addition, the definitions of each indicator are not always detailed, as the conceptual monitoring framework is still under discussion and finalisation. The RECE-XG framework used for this analysis is dated November 2022. Third, the paper contains both operational and aspirational indicators, those for which data do not yet exist. Nevertheless, the choice to include aspirational indicators shows progress in terms of monitoring the circular economy in Italy and the need to clarify definitions that can be, in some cases, open to interpretation.

Material life cycle and value chain

Regarding the material life cycle and value chain building block, Italy shows a good availability of core indicators. In particular, those addressing the material basis of the economy (e.g. domestic material consumption or DMC, also measured per capita and per gross domestic product) as well as indicators of the circularity of material flows and the management efficiency of materials and waste. Most of the core indicators come from ISPRA, either through indicators included in the SEC or as proposed indicators in the *Report on Waste from Economic Activities* (ISPRA, 2022[54]). Indicators of material consumption are taken from the ISTAT indicators of SDG 12 (ISTAT, 2022[47]). Amongst all of the components identified within this pillar, the only missing core indicator is the "renewable content of materials used in production processes".

As per the core indicators, most complementary indicators are also available in Italy, either in the form of official statistics or studies. For instance, regarding the complementary indicator "waste generation compared to DMC", the *Report on the Circular Economy in Italy 2019* provides information on total waste production analysed versus DMC for 2014 (CEN/ENEA, 2019[56]). Lastly, for the complementary indicator "material intensity of trade flows", at the regional level, the region of Tuscany has published a report on

material flow accounting for Tuscany but references proposed by the RECE-XG and that could correspond to the indicator are only theoretical (Region of Tuscany, 2009[57]). This building block shows a considerable representation of indicators at the subnational level, particularly concerning waste management and treatment.

Interactions with the environment

Natural resource implications and environmental quality implications, the main themes of the "Interactions with the environment" building block, are partially covered in Italy. Indicators of the "impacts on climate" and "impacts on air quality" are well covered in Italy, including the core indicator of "greenhouse gas (GHG) emissions from production activities". With regard to the latter, the SEC includes two relevant indicators, with ISPRA as the source: "contribution of GHGs in the waste sector" and "urban air quality", which is also available at the local level. There are many indicators available in Italy on the emission of GHGs and their impact, including: "national GHG emissions by sector", "premature deaths (particulate matter PM2.5)" and the "national GHG emissions by sector". Other complementary indicators of the environmental quality implications are available in Italy, namely "illegal landfills" included in the National Recovery and Resilience Plan (*Piano Nazionale di Ripresa e Resilience*, PNRR), "soil degradation" from ISPRA and "extraction intensity" from ISTAT.

However, a number of indicators related to interactions with the environment should be either better specified or developed. This is the case of indicators indicating the natural resource index/depletion rates and natural resource residuals, which measure the impact on natural resources, and the indicators of pollutant discharges from materials extraction and processing into water.

Response and actions

Numerous indicators exist that can be linked to the "Response and actions" building block. Available indicators in the pillar relate to measures to improve waste management and encourage waste reduction, domestic financial flows, indicators of raising awareness and education, and green public procurement (GPP).

On financial flows, while the PNRR includes an indicator "companies receiving support for investments in innovation investments in the circular economy and bioeconomy", indicators are missing for international flows or foreign direct investment. Lastly, "revenue from environmental taxes" from ISTAT could partially explain the RECE-XG indicator "revenue from circular economy-related taxes" but further efforts could be made to move from an environmental and sustainability perspective to a circular economy one.

The "inform, educate and train" theme of the RECE-XG is covered by indicators with an environmental focus. As such, the PNRR includes an "approval of the capacity-building action plan to support local authorities" indicator, while the eco-labels could be related to the "number of organisations/enterprises with Eco-Management and Audit Scheme (EMAS) registration" from ISTAT and the "environmental quality and sustainability labels for products and services". However, these schemes focus on the environment and sustainability and, consequently, may provide a limited overview of the circular economy.

Regarding GPP, several operational indicators are available from different sources. For example, the SEC includes an indicator of GPP from ANAC. ISTAT provides data at the national and regional levels on "public institutions that purchase goods and/or services by adopting minimum environmental criteria", while the document "Circular economy and efficient use of resources" also includes a "status of GPP implementation" indicator but no further information is available on its interpretation and how it complements the other indicators of public procurement. Additionally, monitoring activities carried out by the Green Procurement Observatory (*Osservatorio Appalti Verdi*) only relate to the process (i.e. the share

of tenders that include the green criteria) and do not cover the impact of GPP (e.g. reduction on carbon dioxide [CO_2] emissions) (Box 4.2). The new Public Procurement Code of Italy assigns to the ANAC the task of monitoring GPP implementation across the national territory. The Green Procurement Observatory, an initiative led by Legambiente and Fondazione Ecosistemi, with the support of other actors, has been measuring the adoption of minimum environmental criteria (*criteri ambientali minimi*) by different contracting authorities since 2018. However, this measurement process is not based on analysis of procurement data but on self-reporting. It mainly relies on an online survey to be filled in directly by the sole head of the procedure (*Responsabile Unico per il Procedimento*) every year. However, information gathered from this survey is relatively limited since it only records whether the minimum environmental criteria were included or not. Moreover, given the absence of public reports, contracting authorities' compliance with this requirement remains unknown.

Finally, regarding the areas for improvement under the "Response and actions" building block, Italy could prioritise its efforts on economic and fiscal instruments (indicators of fees, exemptions and subsidies to promote circular business models), measures to encourage optimised design (to extend life and recycle, disassemble and reuse). Regarding economic instruments, the Ministry of Economy and Finance provides information on the type of aid approved to promote the transition to a circular economy. In terms of measures to promote optimised design, there are also no "design for extending lifespans" indicators but the Ministry of Enterprises and Made in Italy (MIMIT) does provide information on its website on the latest developments in the European Union regulation on the eco-design of sustainable products (MIMIT, 2023[58]).

Additionally, no indicator has been identified to measure "performance of extended producer responsibility schemes". For the monitoring of "deposit refund systems and pay-as-you-throw systems", no indicator could be found that summarises the number of systems in place or their impact but information is available on each of the regions having promoted or required the implementation of these systems. The National Packaging Consortium has issued guidelines to facilitate recycling packaging made of aluminium, plastic and paper (CONAI, 2023[59]).

For target setting and planning, there is no indicator to measure the distance. However, in Italy, targets are in line with European Union regulations. For instance, the Circular Economy Package plan sets the target of achieving a landfilling target of 10% in 2035 and preparation for the reuse and recycling of municipal waste should be increased to a minimum of 65% in weight by 2035.

Box 4.2. An international review of monitoring the implementation, output and impact of GPP

National governments use different frameworks, systems and mechanisms to track progress on GPP implementation, as well as different indicators and data sources. They often look at different aspects of GPP according to the country's institutional setting, priorities and the objectives of their monitoring exercise. These aspects can be classified into three main areas: institutionalisation (process), which refers to the process and actions undertaken by an organisation to integrate and embed GPP into its own culture and daily operations; outputs (procurement activities), which are the direct results of procurement activities; and outcomes (environmental benefits), which are the benefits to or the impact on the environment generated by procurement practices.

- **Process**: To better understand how GPP practices are embedded into the organisational culture of public administrations, several countries are developing specific indicators or reference points that help them track progress and develop further initiatives to mainstream GPP across the public sector.

- **Output**: When it comes to evaluating outputs produced by GPP strategies, governments tend to monitor the adoption of sustainability criteria in procurement processes, the number of sustainable products purchased or the number of purchases from preferred green companies – both in the number of transactions and in economic volume. In Italy, such information is collected via surveys from a sample of contracting authorities, which then serves to extrapolate national trends.

- **Outcomes**: Beyond procurement processes and actual products purchased, several countries and public institutions have been trying to understand the impact of GPP on environmental outcomes. When estimating GPP environmental outcomes, the most frequent indicator is GHG emissions reduction. However, several approaches exist and the following table illustrates a few examples at different levels of government (Table 4.1).

Table 4.1. International approaches to measuring environmental outcomes of GPP

Aspect	Korea	Japan	State of Massachusetts (United States)	Netherlands	State of Berlin (Germany)
Frequency	Annual (since 2005)	Annual (since 2006)	Annual (since 2012)	Annual (since 2017/18)	One-off (2014-15)
Scope	All public sector	National government	Statewide contracts	All public sector	State government
Data required	No. of products	No. of products	No. of products + amount of waste	No. of products	No. of products + product stock + amount of waste
Data used	Actual annual purchases	Actual annual purchases	Actual annual purchases in supply contracts + actual number of products used in service contracts + waste generated	Purchases or product used in a sample of contracts	Estimates based on different reports, number of employees and building surface
Data gathering	E-government mall + online form for decentralised procurement	Reports by authorities (standard reporting form)	Reports by SWC vendors (standard reporting form)	e-procurement system + interviews with contract owners	Internet search and existing studies + data provided by the state

Definition of green and conventional	Using proxies based on national GPP criteria	Using proxies based on national GPP criteria	Using proxies based on national GPP criteria	Using proxies based on national GPP criteria	Using proxies specifically produced for the study
Calculation of benefits	Using own calculations	Using own calculations + subtracting from the actual level of GPP, baseline from 2000	Using external calculations + own calculations	Using own calculations + extrapolating from a sample to all identified tenders	Using own calculations + applied to all existing stock and consumption
Environmental benefits reported	CO_2 equivalent emissions	CO_2 equivalent emissions	CO_2 equivalent emissions + others (energy, water and toxic material savings, avoided air and water emissions, etc…)	CO_2 equivalent emissions + others (avoided air emissions and fossil fuel raw material savings)	CO_2 equivalent emissions + others (avoided air emissions, water and wood savings)
Socio-economic benefits reported	Cost savings (from use cost and some externalities depending on product) + jobs in the green economy	None	Cost savings (lower acquisition cost, labour and/or use costs depending on the product)	None	Cost savings (using life cycle costing)

Source (table): Adapted from Schaefer, B. (2022[60]), "Overview of different approaches to measure SPP impacts", Asia Pacific GPP Network.

Source (box): UNEP (2017[61]), *Global Review of Sustainable Public Procurement*, https://www.unep.org/resources/report/2017-global-review-sustainable-public-procurement.

Socio-economic opportunities for a just transition

The RECE-XG building block addresses "Socio-economic opportunities for a just transition", which includes four main themes: i) market developments and new business models; ii) trade developments; iii) skills and awareness; and iv) inclusiveness of the transition. All of these themes present some gaps in the list of indicators available from Italian sources.

No indicators were identified of the "market developments and new business models" to measure the value added related to circular economy sectors. For "circular economy start-ups and trademarks and circular economy certification of companies", while there are no formally established indicators, there are initiatives that can provide complementary information. For example, in 2021, the Polytechnic University of Milan launched the Circular Economy Report on business models, technological solutions and the potential of the circular economy in Italy. It is based on a questionnaire addressed to 250 companies, focusing on the level of adoption of circular economy practices (Politecnico di Milano, 2021[62]). Concerning the indicators available in Italy for "jobs in sharing economy, reuse and repair activities: number and change over time", the European Commission Circular Economy Monitoring Framework includes an indicator of the number of persons employed in circular economy sectors. Moreover, the *4th Report on the Circular Economy in Italy 2022* can also provide partial information, as it highlights that in 2019, around 23 000 companies in Italy were repairing electronic products and other personal goods (clothing, shoes, watches, jewellery, furniture, etc.) (CEN/ENEA, 2022[63]).

Indicators of "trade development" are well covered, with many available indicators available in Italy, such as "quantity of waste destined for the replacement market" (Fondazione Sviluppo Sostenibile, 2022[64]), "strategic and critical raw materials" from the *Circular Economy and Efficient Use of Resources* report

(MASE/MIMIT/ENEA, 2018[52]) and the "material import dependency" and "net installed renewable energy generating capacity" indicators from ISTAT.

On "skills and awareness", the SEC includes an indicator of the "communication campaigns on the circular economy" and the *Circular Economy and Efficient Use of Resources* report (MASE/MIMIT/ENEA, 2018[52]) includes an indicator of "dissemination of good waste management practices at the local level". It is also worth noting that ISTAT publishes a survey on environmental concerns, which presents the environmental issues that most concern citizens (e.g. climate change, air pollution, soil pollution, etc.), though no indicators of awareness of the circular economy as such can be found (ISTAT, 2023[65]).

Missing indicators in this building block include circular economy literacy, skills and behaviour. There is no indicator available for "inclusiveness of the transition", which focuses on how different territories and population groups are affected by or benefit from the circular economy.

Socio-economic and environmental context

Lastly, beyond the four building blocks, the RECE-XG conceptual framework also includes a set of indicators to explain the socio-economic and environmental context. Table A A.1 shows that all of the socio-economic and environmental context indicators included in the RECE-XG framework are available in Italy. This set of indicators is intended to facilitate the interpretation of a country's specific context and provide information on the main drivers of material use. The indicators presented in this section are already operational and monitored, mainly obtained from ISTAT, with the exception of some indicators of water use efficiency (FAO), protected areas (ISPRA) and the Human Development Index (HDI) (UNDP).

Conclusions

This mapping exercise highlights a number of issues that Italy could take into account when developing a comprehensive circular economy monitoring framework.

First, there is limited availability of data and indicators for the measurement of life cycle phases, such as design, use, reuse and remanufacture. The overrepresentation of waste indicators is not a problem per se but it may provide a misleading indication of progress, as waste indicators do not necessarily show how primary material consumption is reduced and optimised. For instance, the "Material life cycle and value chain" building block has several indicators of waste generation, recycling and treatment but the few missing indicators in this pillar are related to repair and recovery (e.g. "remanufacturing by sector or by branch" and "ratio of products repaired or reused to new products sold").

Second, while there are some indicators in relation to the building blocks "Responses and actions" and "Socio-economic opportunities for a just transition", there is also room for improvement. For example, there are no indicators of economic and fiscal instruments to promote the circular economy (e.g. taxes, subsidies, exemptions). Indicators of requirements to extend the life of products or of measures (in the form of bans, guidelines, etc.) to promote circular design are missing, as are indicators of extended producer responsibility schemes. Indicators of circular economy information and education tools are limited or do not correspond to the RECE-XG definitions or those on literacy, skills and circular economy entrepreneurship.

Third, many indicators are aspirational: as such, data are not available in official statistical sources. For example, indicators addressing waste prevention measures or the use of secondary materials in production processes would be valuable to measure progress over time but they are not yet available. Moreover, in some cases, some of the documents analysed contain indicators (e.g. circular economy and efficient use of resources) for which it is unclear if they are operational in terms of data collection and at which level.

Fourth, the mapping of indicators also reveals gaps at the local level. Difficulties remain in developing indicators and implementing data collection at the subnational level. The statistical sources analysed show that information is available at the national level for most mapped indicators that could correspond to the RECE-XG conceptual framework. At the subnational level, statistical sources mainly provide information on waste generation and treatment, mineral extraction, soil degradation, adoption of minimum environmental criteria, registration with the EMAS and other socio-economic and environmental context indicators. Table A A.1 provides a granular overview of the availability of each indicator by level of government. This is in line with one of the main conclusions of the working group "Tools for measuring the circular economy" within the Italian Circular Economy Stakeholder Platform, arguing that much still needs to be done to enable the measurement of circularity at the local and regional levels. The subnational perspective is very important, as national averages may not be able to highlight important territorial disparities, hampering the ability of local and national governments to implement place-based responses to identified challenges.

5 Towards a comprehensive monitoring framework in Italy: Proposed ways forward

As a result of the above gap analysis, this paper suggests three sets of policy recommendations:

- Align the future Italian monitoring framework with the objectives of the circular economy strategy and with the OECD Expert Group on a New Generation of Information for a Resource-efficient and Circular Economy (RECE-XG) conceptual framework for international comparisons.
- Set up a governance system that can strengthen co-ordination amongst agencies in charge of collecting and analysing data; engage stakeholders and improve transparency.
- Promote the collection of granular data at the micro level to support effective place-based policies.

Align the Italian monitoring framework with the objectives of the circular economy strategy and with the conceptual framework of the RECE-XG

The main objective of a comprehensive monitoring framework should be to monitor progress in the areas prioritised by the National Strategy for the Circular Economy (SEC). To that effect, the Ministry of Environment and Energy Security (MASE) should carefully select the indicators that best reflect the main trends related to the transition towards a circular economy and that can better adjust to the strategic objectives set in the SEC. Table A A.1 shows which indicators could be further developed, detailed or specified. The analysis above and the comparison with the RECE-XG frameworks highlight that Italy could invest further efforts in:

- **Life cycle related areas**, such as repair, recovery and reuse of materials. While indicators of waste generation, recycling and treatment are generally well covered, those related to eco-design, end of waste but also industrial symbiosis, which are areas of action identified by the SEC, are less available in the form of indicators. These areas are amongst the identified objectives of the SEC, including: strengthening actions aimed at upstream circularity; and developing and disseminating methods and models for assessing the life cycle of products and waste management systems and their overall environmental effects.
- **Responses and actions**, including fiscal and regulatory instruments (e.g. extended producer responsibility schemes) to support a circular economy. Considering the two strategic categories of the SEC that are extended producer responsibility and environmental finance and taxation, these areas could be particularly relevant. Information on each of these items is available in technical reports and documents made by the competent ministries but less in the form of databases. Amongst international practices, on fiscal instruments, Portugal includes indicators of the number of companies or products with tax benefits as well as their impact (Table 2.4).

- **Just transition**: indicators such as "jobs in the sharing economy, reuse and repair activities; circular economy literacy and skills" could be developed to monitor the achievement of the following SEC objectives: educate and create skills in the public and private sector on the circular economy as a driver for the development of youth and female employment. At the international level, there are several indicators used on this topic, e.g. the "number of students enrolled in online training on the circular economy" and "number of schools and universities that responded to the call for projects on the circular economy education" in the city of Paris, France (Table 2.6), and the "number of students trained in the circular economy fields of activity" in Brussels, Belgium (Table 2.10). Examples of employment include employment in the circular economy (France) (Table 2.2) and circular economy employment (Netherlands) (Table 2.3).

Set up a governance system that can strengthen co-ordination amongst agencies in charge of collecting and analysing data; engage stakeholders and improve transparency

Italy has a number of official statistics and aspirational indicators of the circular economy produced by various national agencies, among which co-operation takes place on an ad hoc basis and relies predominantly on personal communication rather than institutional channels. The development of a harmonised monitoring framework will necessitate a structured co-ordination mechanism to avoid overlaps and bridge the data gaps. In the short term, for the design or selection of circular economy indicators for the SEC, Italy could make use of existing co-ordination bodies that gather key actors in the field of measurement (i.e. the Observatory on the Implementation of the National Strategy for the Circular Economy, which gathers representatives from all levels of government, and the Italian Circular Economy Stakeholder Platform, which brings together representatives from the Italian National Agency for New Technologies, Energy and Sustainable Economic Development [ENEA], the Italian Institute for Environmental Protection and Research [ISPRA], the Italian National Standards Body UNI, among others). Strengthening co-ordination in Italy could leverage current co-ordination practices (i.e. memorandum of understanding between ISPRA and Italian National Institute of Statistics, ISTAT) and explore the use of new tools (e.g. monthly co-ordination meetings).

There is also room to strengthen co-ordination between the national government and subnational levels. Since the SEC includes actions targeting local and central administrations, co-ordination efforts should also involve subnational institutions. For example, the Observatory on the Implementation of the National Strategy for the Circular Economy, created in October 2022, is composed of different ministries, regions, autonomous provinces and the National Association of Italian Municipalities. Among its tasks, the observatory is expected to monitor, define and quantify the intermediate targets of the measures set in the SEC (MASE, 2022[66]). Nevertheless, the observatory has not been operational so far due to its recent creation. Co-ordination is an important feature of the Australian methodology to build a monitoring framework for the circular economy (Box 5.1) in the form of allocating clear roles and responsibilities across levels of government and departments to mobilise stakeholders.

Box 5.1. Key steps to build a monitoring framework for the circular economy in Australia

The Australian report *Measuring the Circular Economy: An Australian Perspective*, launched in 2022 by Edge Environment and Planet Ark's Australian Circular Economy Hub (ACE Hub), sets key recommendations for building an efficient monitoring framework. It identifies three pillars: plan, do and evolve.

Plan – Align objectives

- Building on international frameworks to learn from their experience while customising content and setting indicators to fit domestic needs.
- Reviewing available data currently disaggregated across levels of government, departments and the private sector while providing guidance on improving data collection and dissemination. This revision would help identify data gaps and issues related to harmonisation across jurisdictions and scales.
- Allocating clear roles and responsibilities across levels of government and departments to mobilise stakeholders. Consultation within departments and levels of government could effectively support the measurement and implementation of a circular economy in Australia.

Do – Calculate the circular economy baseline for Australia

- Making use of available data to calculate a baseline across the indicators associated with the Australian circular economy measurement framework is a major starting point. It can help diagnose Australia's current performance levels, identify remaining gaps in measurement and understand where additional efforts are needed to support the transition towards a circular economy.

Evolve – Evaluate and iterate.

- Assessing the effectiveness of selected indicators requires setting a review mechanism that iterates the Australian measurement of the circular economy and gradually enlarges the measuring scope with a long-term vision. Identified actions on this pillar include:
  - Evaluating and evolving over time. Regular reviews of the measurement framework should be incorporated into the plan to assess the effectiveness of indicators with regard to set objectives.
  - Expanding the scope of measurement to gain additional insights. Datasets from various stakeholders are necessary to inform actions that can broaden the scope of circular economy measurement and data infrastructure and fill data gaps.
  - Establishing a strategy to drive long-term improvement. A robust national strategy for the circular economy requires setting meaningful targets from a long-term perspective to drive improvement and continuously monitor progress provided by the framework.

Source: ACE Hub (2022[33]), *Measuring the Circular Economy: An Australian Perspective*, https://acehub.org.au/documents/measuring-the-circular-economy-an-australian-perspective.

Communicating the progress made on a regular basis can improve implementation. Once a systemic monitoring framework has been set, MASE should prioritise communicating progress on the achievement of the objectives of the SEC, regularly engaging with stakeholder groups to improve implementation. In September 2022, MASE signed a decree to adopt the timetable (*cronoprogramma*) for implementing the SEC. The *cronoprogramma* identifies the actions, objectives and measures to be pursued in defining

institutional policies to ensure an effective transition towards a circular economy. The timetable contains the details related to the timing and actions envisaged by the strategy. MASE will publish an annual report on the implementation of the SEC, including an updated *cronoprogramma* (MASE, 2022[67]). Beyond reporting, additional options are foreseen to promote transparency and raise awareness through events and roundtables across levels of government, businesses, civil society and academia, as well as a targeted communication strategy (e.g. creating a section on the MASE website dedicated to measuring the circular economy, including the most relevant papers).

Promote the collection of granular data at the micro level to support effective place-based policies

In Italy, cities and regions are responsible for the collection of data on waste generation and disposal. However, a number of indicators related to material management in life cycles are missing at the subnational level (e.g. material collected for the reuse of building materials). International practices show that cities and regions measure material flows, waste collection and management, food waste and building materials. Similarly to the international context, at the sectoral level, cities and regions collect data mainly on waste generation, food and energy consumption, construction and built environment and water cycles (Table 5.1). This reflects the sectors included in local circular economy strategies. According to the OECD survey (2020[68]), the waste sector is a key sector for the circular economy (98%) in cities and regions, followed by the built environment (75%), land use and spatial planning (70%), food and beverages and water and sanitation (65%). Going forward, MASE could develop guidelines to promote the collection of disaggregated data and foster capacity building, drawing on the experience of existing capacity-building projects such as the CReIAMO PA, which includes training modules on "Models and tools for the transition towards a circular economy". The training sessions foreseen for this thematic area include: developing and strengthening the knowledge of public operators on the circular economy and material flows and strengthening administrative capacity on statistical analysis activities and waste prevention and management (MASE, 2021[69]). A further opportunity for MASE to make progress in obtaining micro-level data could be to advance on the economic areas funded by the Ministry of Enterprises and Made in Italy (MIMIT) (e.g. subsidies for industrial programmes and industrial symbiosis on how to reuse material and energy within a closed economic system) (MIMIT, 2023[70]). MASE could build on ENEA's previous work on industrial symbiosis to identify appropriate indicators (ENEA, 2023[71]; 2020[72]).

Table 5.1. International overview of sectors included in selected circular economy initiatives at the local and regional levels

Cities and regions	Initiative	Waste	Construction and demolition	Land use and spatial planning	Food and beverage	Manufacturing	Textile	Water and sanitation	Energy	Biomass	Agriculture	Mobility	Transportation	ICT sector	Forestry	Culture
Amsterdam (Netherlands)	Amsterdam Circular 2020-2025 Strategy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Barcelona Metropolitan Area (Spain)	Circular Economy Promotion Programme AMB Circular (2019)	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓			
Flanders (Belgium)	Circular Flanders (2016)	✓	✓	✓	✓	✓		✓						✓		
Greater Porto Area (Portugal)	LIPOR Commitment to Circular Economy Principles (2018)	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓			
Nantes (France)	Circular Economy Roadmap	✓	✓	✓	✓				✓	✓	✓	✓	✓			
North Karelia (Finland)	CIRCWASTE – Towards Circular Economy in North Karelia	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓	
Paris (France)	Paris Circular Economy Plan 2017-20	✓	✓	✓	✓				✓	✓						✓
Rotterdam (Netherlands)	Rotterdam Circularity Programme 2019-2023	✓	✓	✓	✓	✓	✓	✓		✓	✓					
Scotland (United Kingdom)	Circular Glasgow	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓		
Tilburg (Netherlands)	Tilburg Circular Agenda 2019	✓	✓	✓	✓	✓	✓			✓						
Valladolid (Spain)	Valladolid Circular Economy Roadmap (2017-18)		✓	✓	✓	✓	✓	✓			✓	✓				
Maribor (Slovenia)	Strategy for the Transition to a Circular Economy in the Municipality of Maribor	✓	✓	✓				✓	✓			✓	✓			

Cities and regions	Initiative	Waste	Construction and demolition	Land use and spatial planning	Food and beverage	Manufacturing	Textile	Water and sanitation	Energy	Biomass	Agriculture	Mobility	Transportation	ICT sector	Forestry	Culture
London (United Kingdom)	London's Circular Economy Route Map	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓		

Source: OECD (2020[68]), "OECD Survey on the Circular Economy in Cities and Regions", OECD, Paris

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Notes

[1] E.g. ongoing international work on classifications. The European statistical classification of economic activities, Nomenclature of Economic Activities (NACE), and the European statistical classification of products by activity (CPA) are currently being revised. Changes in these classifications will be reflected in the annual survey for the collection and dissemination of statistics on the production of industrial goods in the European Union, Prodcom (Production Communautaire), and in the Combined Nomenclature (CN) for classifying goods for the Common Customs Tariff and European Union external trade statistics.

[2] A global collaboration platform for key decision makers and private sector actors to share best practices and scale up the circular economy. The World Economic Forum launched this platform in 2018 and it is currently hosted by the World Resource Institute in The Hague (Netherlands).

[3] An independent, non-governmental organisation of 167 national standard bodies that brings together experts to share knowledge and develop international standards to support innovative solutions to global challenges.

[4] The Expert Group was established in April 2021 to assist the OECD Secretariat in developing better information and practical guidance to support policies for a resource efficient and circular economy while taking advantage of synergies with national and international efforts. The group is composed of members of the OECD Working Party on Environmental Information and the OECD Working Party on Resource Productivity and Waste, as well as representatives of international organisations and non-governmental organisations.

[5] For example, the OECD core set of environmental indicators, OECD sectoral sets of environmental indicators, the set of green growth indicators and OECD indicators to monitor material flows and resource productivity.

[6] The Environmental Protection Expenditure Account and the environmental goods and services sector use the Classification of Environmental Protection Activities (CEPA) and the Classification of Resource Management Activities (CReMA). Eurostat's taskforce on classification of environmental activities produced a draft Classification of Environmental Functions (CEF) late 2022, as the outcome of years of work and discussion. Though the CEF is based on the CEPA and CReMA, once adopted, it will overrule these. The proposal is also to include CEF groupings in circular economy and climate change mitigation, which are extremely relevant for institutional/policy uses. Those uses require data about jobs, output, investments, etc. in those policy areas and this is the only approach to provide them with Senea-based information on those areas. Eurostat, as proposed custodian agency for the classification, is working with the United Nations Statistics Division to seek an international agreement on the CEF.

[7] Since 2020 (for reference years ranging from 2019), Prodcom has added secondary raw material (SRM) products to its list. Moreover, 12 new codes for SRM products were added in the 2022 product list (secondary raw materials of platinum group metals; secondary raw material of silver; secondary raw materials of ferrous metals: iron; secondary raw materials of copper; secondary raw materials of nickel; secondary raw materials of aluminium; secondary raw materials of cobalt; secondary raw materials of lithium; secondary raw materials of rare earth metals; secondary raw materials of other metals; slag sands; non-metal secondary raw materials). ISTAT is currently working to improve results of the survey.

[8] Namely domestic material consumption per capita (*consumo materiale interno pro capite*), domestic material consumption per gross domestic product (*consumo materiale interno per unità di Pil*), domestic

material consumption (*consumo materiale interno*), public institutions that adopt forms of social and/or environmental reporting (*istituzioni pubbliche che adottano forme di rendicontazione sociale e/o ambientale*), tourism intensity index (*indice di intensità turistica*), nights spent in open air establishments, farmhouses and mountain refuges out of total nights spent in all accommodation establishments (*presenze in esercizi ricettivi open air, agriturismi e rifugi montani sul totale delle presenze in esercizi ricettivi*) and tourism trips in Italy by type of trip and main means of transport (*viaggi per turismo in Italia per tipologia di viaggio e principale mezzo di trasporto*).

[9] The categories are: health; education and training; work and life-time balance; economic well-being; social relations; politics and institutions; security; subjective well-being; landscape and cultural heritage; environment; innovation, research and creativity; quality of services.

[10] Data sources are: ISTAT (for indicators of internal material consumption per capita and domestic material consumption per unit of GDP), ISPRA (separately collected municipal waste and circular material utilisation rate) and the Ministry of Agricultural, Food and Forestry Policies (share of utilised agricultural area under organic cultivation). All of indicators of waste are sourced from ISPRA: recycling rate; special hazardous waste sent for recovery operations; production of special hazardous waste; systemic food waste.

[11] The selection of indicators considered as "core", "complementary" and "context" indicators is subject to change as the RECE-XG conceptual framework remains under discussion and completion.

Annex A. An application of the RECE-XG conceptual framework in Italy: Overview of indicators' availability

Table A A.1. Comparison of indicators available/not operational/not available in Italy against the conceptual framework of the RECE-XG

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
Material life-cycle and value chain	The material basis of the economy	Material inputs	Direct material inputs: - Production-based DMI - Demand-based RMI	Complementary	DMI	ISTAT website	ISTAT	ISTAT	Already operational and monitored	National
					RMI	Environmental Data Yearbook ISPRA	ISPRA	ISPRA	Already operational and monitored	National
			Share of materials from renewable natural stocks in DMI	Complementary	Indicator to be detailed/identified					
		Material consumption	Material consumption and footprint: - Production-based DMC - Demand-based RMC (material footprint)	CORE	DMC per capita	Italian data for UN SDGs	ISTAT	ISTAT	Already operational and monitored	National
					DMC	SEC	MASE	ISTAT	Already operational and monitored	National
					RMC	Environmental Data Yearbook ISPRA	ISPRA	ISPRA	Already operational and monitored	National
			Material and footprint intensity: - Production-based material productivity (DMC/GDP)	CORE	Domestic material consumption per GDP	Italian data for UN SDGs	ISTAT	ISTAT	Already operational and monitored	National

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
			- Demand-based raw material productivity (RMC/net disposable income)							
			Share of materials from renewable natural stocks in DMC	Complementary	Indicator to be detailed/identified					
			Share of recyclable materials in DMC	Complementary	Indicator to be detailed/identified					
		Material accumulation	Net addition to stocks	Complementary	Net addition to stocks	EC Circular Economy Monitoring Framework	Eurostat	Eurostat	Already operational and monitored	National
			Changes in manufactured stocks of mineral resources	Complementary	Indicator to be detailed/identified					
	The circularity of material flows and the management efficiency of materials and waste	Waste generation	Total waste generation (trends; intensity per GDP, per capita)	CORE	Separate waste collection	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National and regional
					Municipal waste generation	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National and regional
					Non-hazardous waste	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National and regional
					Waste production	SEC	MASE	ISPRA	Already operational and monitored	National and regional
					Total generation of waste from economic activities	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National and regional
			Waste generation trends by source and by waste or material type:	Complementary	Hazardous waste generation: construction and demolition wastes	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National and regional

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
			hazardous waste; construction and demolition waste; mining and quarrying waste; waste electrical and electronic equipment, packaging waste, plastics		Hazardous waste generation from shaping and physical and mechanical surface treatment of metals and plastics	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National and regional
			Total primary waste supply by sector (% share in total, intensities per value added)	Complementary	Indicator potentially available from ISPRA based on Eurostat methodology					
			Waste generation compared to DMC (or DMI)	Complementary	Indicator available by comparing waste generation (ISPRA) and DMC (ISTAT)					
			Food waste generated: - Food loss index (production and supply levels) - Food waste index (retail and consumption levels)	CORE	Food waste	SEC	MASE	ISPRA	Already operational and monitored	National
			Hazardous waste generated and percentage treated, by type of treatment	Complementary	Hazardous waste generation: waste from waste management facilities, off-site wastewater treatment plants and the preparation of water intended for human consumption and water for industrial use	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National
					Hazardous waste generation: oil waste and liquid fuel waste	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
					Hazardous waste generation from chemical surface treatment and coating of metals and other materials	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National
					Hazardous waste generation from thermal processes	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National
					Hazardous waste generation from organic/ inorganic chemical processes	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National
					Hazardous healthcare waste incinerated or sterilised	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National
					Co-incineration of combustible waste	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National and Regional
		Circularity of material flows	- Circular material use rate - Share of recycled materials (secondary raw materials) in material consumption (all materials, material groups, selected materials)	CORE	Circular material use rate	SEC	MASE	ISPRA	Already operational and monitored	National
			Intermediate consumption of secondary raw materials in production processes	Complementary	Indicator to be detailed/identified					
			Renewable content of materials used in production processes (average percentage)	CORE	Indicator to be detailed/identified					

	OECD RECE-XG Conceptual framework				Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
		Products diverted from the waste stream	Ratio of products repaired or reused to new products sold, by product type	Complementary	Indicator to be detailed/identified					
			Placeholder: remanufacturing by sector or by branch	Complementary	Indicator to be detailed/identified					
		Materials diverted from final disposal	National recycling rate: share of recycled in total waste generated (or collected)	CORE	Recycling rate of municipal waste	SEC	MASE	ISPRA	Already operational and monitored	National
					Recycling rate of municipal organic waste	SEC	MASE	ISPRA	Already operational and monitored	National
					National recycling rate	Italian data for UN SDGs	ISTAT	ISPRA	Already operational and monitored	National
			Recycling or recovery rates for selected waste or material types	Complementary	Recycling rate of electrical and electronic equipment waste	SEC	MASE	ISPRA	Already operational and monitored	National
			Incineration rates with energy recovery	Complementary	Percentage of energy recovery out of total waste treated	Municipal Waste Report	ISPRA	ISPRA	Already operational and monitored	National
			Capacity of waste recovery infrastructure by type (recycling, incineration with energy recovery, other recovery)	Complementary	Indicator to be detailed/identified					
		Materials leaving the economic cycle	Waste going to final disposal (landfill or incineration without energy recovery): total; by type of materials	CORE	Landfill disposal (*Smaltimento dei rifiuti - a esempio discarica*)	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National and regional
					Incineration	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National and regional
					Non-hazardous and hazardous waste: landfill disposal	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
					Non-hazardous and hazardous waste: other disposal operations	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National
					Other disposal operations	Report on Waste from Economic Activities	ISPRA	ISPRA	Already operational and monitored	National
	Interactions with trade	Trade in materials	- Material exports, material imports (including in Rme) - Physical trade balance (including in Rme)	Complementary	Direct input of materials from the rest of the world	ISTAT website	ISTAT	ISTAT	Already operational and monitored	National
					Import/export in raw material equivalents	Circular economy and efficient use of resources	MASE	ISPRA	NA	NA
			Material intensity of trade flows (trade value indicator)	Complementary	Sectoral database	ISTAT website	ISTAT	ISTAT	Already operational and monitored	National
		Trade in circular economy-related materials and products	- Trade in secondary raw materials: share in imports, in exports - Trade in second-hand goods, end-of-life products Trade in waste and scrap	Complementary	Waste import/export balance	Circular economy and efficient use of resources	MASE	ISPRA	Already operational and monitored	National and regional
					Trade in recyclable raw materials	Trade in recyclable raw materials	Eurostat	Eurostat	Already operational and monitored	National
Interactions with the environment	Natural resource implications	Changes in natural resource stocks	Domestic extraction from natural stocks (renewable and non-renewable) (trends; mix)	Complementary	Domestic extraction of used materials: fossil energy materials/ carriers	ISTAT website	ISTAT	ISTAT	Already operational and monitored	National

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
			- Placeholder: Natural resource index (aggregate and by type of material; non-renewable assets)/ depletion ratios, extraction over existing reserves. - Energy and mineral resources	CORE	Indicator to be detailed/identified					
			Changes in natural stocks (global) of mineral resources	Context	Mineral resources extracted	ISTAT website	ISTAT	ISTAT	Already operational and monitored	National and regional
			Intensity of use of renewable freshwater resources (abstraction over available renewable stocks) (water stress)	CORE	Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	A disaggregation of indicator 6.4.2 "Level of water stress: freshwater withdrawal as a proportion of available freshwater resources" at the river basin district level in Italy	FAO	FAO	Already operational and monitored	National
			Intensity of use of forest resources (removals overgrowth)	Complementary	National forest surface area	The forest bioeconomy	Legambiente	Legambiente	Already operational and monitored	National
					CO_2 emissions and removals from land use, land use change and forestry	Italian Greenhouse Gas Inventory 1990-2021 National Inventory Report 2023	ISPRA	ISPRA	Already operational and monitored	National
		Other natural resource impacts	Water abstracted for material extraction and processing	Complementary	Water used for the extraction of minerals	Water use and quality in Italy	ISTAT	ISTAT	Already operational and monitored	National
			Water footprint of selected products or	Complementary	Water footprint	WWF study: Water footprint of Italy	ISTAT	ISTAT	Already operational and monitored	National

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
			sectors							
			Natural resource residuals: unused extraction (by material group)	Complementary	Indicator to be detailed/identified					
	Environmental quality implications	Impacts on climate	GHG emissions from production activities (trends, intensities)	CORE	GHG emissions CO$_2$ equivalent from mining, manufacturing, electricity, gas, steam and air conditioning supply, water supply, sewerage, waste treatment and remediation activities	Air emission accounts	ISTAT	ISTAT	Already operational and monitored	National
					Urban air quality	SEC	MASE	SPRA/SNPA	Already operational and monitored	National, regional and local
			Share of emissions from waste management or waste sector	Complementary	Contribution of GHGs in the waste sector	SEC	MASE	ISPRA	Already operational and monitored	National
			Carbon footprint (CO$_2$)	Complementary	Carbon footprint	Air emission accounts	ISPRA	ISPRA	Already operational and monitored	National
			Carbon footprint of priority materials or products of selected sectors	Complementary	Carbon footprint by product groups	Air emission accounts	ISPRA	ISPRA	Already operational and monitored	National
		Impacts on air quality	Air pollutant emissions from production activities (trends, intensities)	Complementary	Air emission accounts	Air emission accounts	ISTAT	ISTAT	Already operational and monitored	National

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
			Population exposure to air pollution; related premature deaths and welfare costs	Complementary	Premature deaths (PM2.5)	Italy – air pollution country fact sheet	EEA	EEA	Already operational and monitored	National
		Impacts on water and soil quality	Pollutant discharges from material extraction and processing to water bodies and share safely treated	CORE	Indicator to be detailed/identified					
			- Share of waste improperly managed (proxy for waste leakage) - Number of uncontrolled open landfills	Complementary	Illegal landfills	National Recovery and Resilience Plan	MASE	NA	NA	National
			Placeholder: Soil contamination	Complementary	Soil degradation	ISPRA website	ISPRA	ISPRA	Already operational and monitored	National and regional
		Impacts on biodiversity	Placeholder: Impacts from material extraction, processing, use and end-of-life management on land, habitats and species	Complementary	Extraction intensity	Extractive activities from mining	ISTAT	ISTAT	Already operational and monitored	National and regional
Responses and actions	Support circular use of materials, promote recycling markets and optimise design	Measures supporting circular business models and encouraging reuse, repair, remanu-facturing	Taxes, tax reliefs and exemptions for circular economy business models	CORE	Indicator to be detailed/identified					
			VAT relief and tax credits for refurbished/repaired items	Complementary	Indicator to be detailed/identified					
			Tax benefits for businesses for the	Complementary	Indicator to be detailed/identified					

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
			purchase/use of repaired, refurbished, remanufactured items							
			Trade tariffs: import and export taxes for reused and refurbished equipment compared to taxes on new equipment	Complementary	Indicator to be detailed/identified					
			Subsidies and other transfers supporting a circular economy	CORE	Indicator to be detailed/identified					
			Circular public procurement or GPP	Complementary	GPP	SEC	MASE	ANAC	NA	National
				Complementary	Public institutions that purchase goods and/or services by adopting minimum environmental criteria, in at least one purchase procedure (green purchases or GPP)	Italian data for UN SDGs	ISTAT	ISTAT	Already operational and monitored	National and regional
				Complementary	GPP	EC Circular Economy Monitoring Framework	Eurostat	European Commission	Existing but not yet implemented (first data will become available in 2024, with reference year 2023)	National
				Complementary	Status of GPP implementation	Circular economy and efficient use of resources	MASE	MASE	Existing but not yet implemented	National
		Measures encouraging optimised	Design for extending lifespans (i.e. durability, repairability, upgradeability):	Complementary	Indicator to be detailed/identified					

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
		design	- Requirements for minimum lifespan, warranties, software upgrades - Requirements for accessibility to spare parts		Indicator to be detailed/identified					
			Design for recycling, dismantling and material circularity: - Bans/guidelines on hazardous substances - Taxes on difficult-to-recycle items - Availability of guidance documents on design for recycling	Complementary						
		Measures encouraging efficient use of materials and economically efficient waste recovery	Reform of subsidies encouraging unsustainable use or extraction of materials, e.g. taxes on virgin materials	Complementary	Indicator to be detailed/identified					
			EPR schemes: availability of EPR schemes in different product sectors; distance between reported performance and set target	CORE	Indicator to be detailed/identified					
			Deposit-refund systems (DRS) & Pay-as-you-throw (PAYT) schemes	Complementary	Indicator to be detailed/identified					

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
	Improve the efficiency of waste management and close leakage pathways	Measures to improve waste management	Investments in waste management infrastructure, waste collection and sorting (government, businesses)	CORE	Interventions for Projects to Improve Waste Management	SEC	MASE	MIMIT	Existing but not yet implemented	National
					Interventions to support economic and productive activities in the circular economy sectors	SEC	MASE	MIMIT	Existing but not yet implemented	National
		Measures to encourage waste reduction	Bans, taxes on frequently littered items or single-use items (e.g. plastics)	Complementary	Tax on coal consumption	Environmental tax revenue – ISTAT	ISTAT	ISTAT	Already operational and monitored	National
			Tax rate/tonne landfilled or incinerated	Complementary	Regional special tax on landfill dumping	Environmental tax revenue – ISTAT	ISTAT	ISTAT	Already operational and monitored	National
			Landfill bans	Complementary	Indicator to be detailed/identified					
	Boost innovation and orient technological change	Measures supporting R&D	Government and business R&D expenditure on circular economy technologies (recycling, secondary raw materials, …): budget allocations	CORE	Investment in research and eco-innovation	Circular economy and efficient use of resources	MASE	NA	Existing but not yet implemented	National
		Technology development and international diffusion	Patented inventions related to: recycling and secondary raw materials; and reuse and repair models as: − Percentage of total technologies, by inventor's residence − Percentage of foreign inventors, by patent office	Complementary	Patents related to recycling and secondary raw materials	EC Circular Economy Monitoring Framework	Eurostat	Eurostat	Already operational and monitored	National
	Target setting and planning	Targets and distance to	Placeholder: Distance to targets	CORE	Indicator to be detailed/identified					

OECD RECE-XG Conceptual framework				Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
		achieving targets	Resource productivity targets	Complementary	Indicator to be detailed/identified					
			Recycled content targets, by type of product	Complementary	Indicator to be detailed/identified					
			Recycling targets, by type of waste	Complementary	Indicator to be detailed/identified					
			Reuse targets, by type of product	Complementary	Indicator to be detailed/identified					
			Waste reduction and prevention targets, by type of waste	Complementary	Indicator to be detailed/identified					
			Landfill targets, distance to targets by type of waste	Complementary	Indicator to be detailed/identified					
		Circular economy strategies and plans	To be determined	Complementary	Entry into force of the Ministerial Decrees on the Circular Economy	National Recovery and Resilience Plan	MASE	MASE	Existing but not yet implemented	National
	Strengthen financial flows	Domestic financial flows	Business investment in circular economy activities	CORE	Companies receiving support for investments in innovation in the circular economy and bioeconomy	National Recovery and Resilience Plan	MASE	MASE	Existing but not yet implemented	National
			Revenue from circular economy-related taxes	Complementary	Revenue from environmental taxes	Environmental tax revenue	ISTAT	ISTAT	Already operational and monitored	National
			Government budgets allocated to circular economy objectives	Complementary	Budget allocated to the PNRR: Improving the capacity for efficient and sustainable waste management and the circular economy paradigm	National Recovery and Resilience Plan	MASE	MASE	Already operational and monitored	National
		International	Circular economy-related official	Complementary	Indicator to be detailed/identified					

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
		financial flows	development assistance							
			Circular economy-related foreign direct investment	Complementary	Indicator to be detailed/identified					
	Inform, educate and train	Information instruments	Placeholder: - Eco-labelling; product labelling and certificates - Requirement to provide repair guidelines - Requirement to provide: information on expected lifespan; dismantling guidelines and material content lists for recyclers	Complementary	Number of organisations/enterprises with EMAS registration	Italian data for UN SDGs	ISTAT	ISPRA	Already operational and monitored	National and Regional
					Environmental quality and sustainability labels for products and services (*marchi di qualità ambientale e di sostenibilità di prodotti e servizi*)	Circular economy and efficient use of resources	MASE	MASE	Existing but not yet implemented	National
		Education and training	Placeholder: Integration of circular economy issues in school curricula and professional training	CORE	Approval of the capacity-building action plan to support local authorities	National Recovery and Resilience Plan	MASE	MASE	Existing but not yet implemented	National
Socio-economic opportuni-ties for a just transition	Market developments and new business models	Circular economy entrepreneur-ship, goods and services	Gross value added related to circular economy sectors	CORE	Indicator to be detailed/identified					
			- Circular economy start-ups and trademarks - Circular economy certification of companies	Complementary	Indicator to be detailed/identified					
		Employment markets and jobs	Jobs in circular economy sectors: share in total employment and change over time	CORE	Persons employed in circular economy sectors	EC Circular Economy Monitoring Framework	Eurostat	Eurostat	Already operational and monitored	National

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
			Jobs in sharing economy, reuse and repair activities: number and change over time	Complementary	Indicator to be detailed/identified					
		Recycling markets	Markets for recycled materials	Complementary	Indicator to be detailed/identified					
	Trade developments	Trade in circular economy-related goods and services	Trade in recycled (secondary raw) materials	Complementary	Indicator to be detailed/identified					
			Trade in recyclable materials	Complementary	Quantity of waste destined for the replacement market	Il Riciclo in Italia 2022	Fondazione per lo Sviluppo Sostenibile	ISPRA	Already operational and monitored	National
		Supply security/ autonomy	Domestic material autonomy (aggregate, by material group): - Share of domestic extraction in DMI or DMC - Share of domestic extraction in RMI or RMC	CORE	Material imports dependency (physical imports over DMI)	ISTAT website	ISTAT	ISTAT	Already operational and monitored	National and regional
			Supply security of "strategic" raw materials, by material or material group	Complementary	Strategic and critical raw materials	Circular economy and efficient use of resources	MASE	MASE	Existing but not yet implemented	National
			- Food security - Energy security	Complementary	Net installed renewable energy generating capacity	Italian data for UN SDGs	ISTAT	IRENA	Already operational and monitored	National
	Skills and awareness (placeholders)	Skills	- Circular economy literacy - Circular economy skills: indicator to be determined	Complementary	Indicator to be detailed/identified					

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
		Awareness	Public opinion on circular economy issues and actions	Complementary	Dissemination of good waste management practices at the local level such as home and community composting	Circular economy and efficient use of resources	MASE	MASE	Existing but not yet implemented	National
					Communication campaigns on the economy circular	SEC	MASE	MASE	Existing but not yet implemented	National
		Behavioural changes	Placeholder: Households, consumer, firm behaviour	Complementary	Indicator to be detailed/identified					
	Inclusiveness of the transition		Placeholder: Distributional aspects and socio-economic inequality of circular economy policies	Complementary	Indicator to be detailed/identified					
Socio-economic and environmental context	Factors that drive demand for materials	Socio-demographic factors	- Population growth and structure - Household size	Context	Average number of members per household	Census: Households in Italy - 2018-19	ISTAT	ISTAT	Already operational and monitored	National and regional
		Economic factors	GDP growth and structure (trends, value added by sector)	Context	GDP	GDP and main components	ISTAT	ISTAT	Already operational and monitored	National and regional
			Income levels: GDP per capita	Context	GDP at market prices per inhabitant	Per capita values	ISTAT	ISTAT	Already operational and monitored	National
			Income inequality (Gini index); wealth inequality	Context	GINI index	Regional income homogeneity: Gini index	ISTAT	ISTAT	Already operational and monitored	National and regional
			HDI	Context	HDI value	Human development insights	UNDP	UNDP	Already operational and monitored	National

OECD RECE-XG Conceptual framework					Indicators available in Italy					
Framework	Theme	Indicator topic	Proposed core, complementary and context indicators	Category of the indicator	Indicator	Report/web	Author of the report/website	Data source	Status	Scale
			Final consumption expenditure: government, household	Context	Expenditure for final consumption in the economic territory and abroad of resident households	National accounts quarterly main aggregates: final consumption expenditure of households	ISTAT	ISTAT	Already operational and monitored	National
		Sectoral drivers	Construction: to be determined, e.g. floor space per capita, value added of construction sector	Context	Value added of construction sector	Output and value added by industry	ISTAT	ISTAT	Already operational and monitored	National
	Factors that influence the environmental implications of material use	Environmental drivers	Energy supply and consumption: trends and intensities	Context	Net domestic energy use (for energy and non-energy purposes) by industry	ISTAT	ISTAT	ISTAT	Already operational and monitored	National
			Water use efficiency	Context	Change in water use efficiency over time	Progress on water use efficiency (SDG Target 6.4)	UN	FAO	Already operational and monitored	National
			Protected areas	Context	Land protected areas	Land protected areas	ISPRA	ISPRA	Already operational and monitored	National and regional

Note: ANAC: National Anti-Corruption Authority; CO_2: carbon dioxide;; DMC: domestic material consumption; DMI: domestic material input; EC: European Commission; EEA: European Environment Agency; EMAS: Eco-Management and Audit Scheme; ENEA: Italian National Agency for New Technologies, Energy and Sustainable Economic Development; EPR: extended producer responsibility; Eurostat: European Union statistical office; FAO: Food and Agriculture Organization; GDP: gross domestic product; GHG: greenhouse gas; GPP: green public procurement; HDI: Human Development Index; IRENA: International Renewable Energy Agency; ISPRA: Italian Institute for Environmental Protection and Research; ISPRA/SNPA: National Agency for the Protection of the Environment; ISTAT: National Institute of Statistics; MASE: Ministry of Environment and Energy Security; MIMIT: Ministry of Enterprises and Made in Italy; PNRR: National Recovery and Resilience Plan; R&D: research and development; RECE-XG: OECD Expert Group on a New Generation of Information for a Resource-efficient and Circular Economy; RMC: raw material consumption; RMI: raw material input; RME: Raw material equivalents; SEC: National Strategy for the Circular Economy; UN: United Nations; UNDP: United Nations Development Programme; UN SDGs: United Nations Sustainable Development Goals; VAT: value added tax; WWF: World Wide Fund for Nature.

Source: Based on the mapping of indicators from: Italian Government (2021[1]), *Piano Nazionale di Ripresa e Resilience (PNRR)*, https://italiadomani.gov.it/it/home.html; MASE/MIMIT/ENEA (2018[2]), *Circular Economy and Efficient Use of Resources - Indicators for Measuring the Circular Economy*, http://www.minambiente.it/sites/default/files/archivio/notizie/documento_indicatori_EconomiaCircolare_versione_consolidata_def.pdf; MASE (2022[3]), *Strategia Nazionale per lo Sviluppo Sostenibile [Draft National Strategy for Sustainable Development 2022]*, https://www.mite.gov.it/pagina/strategia-nazionale-lo-sviluppo-sostenibile; ISTAT (2022[4]), *Istat Indicators for Sustainable Development Goals*, https://www.istat.it/en/well-being-and-sustainability/sustainable-development-goals/istat-indicators-for-sustainable-development; ISTAT (2022[5]), *Rapporto Bes 2021: il benessere equo e sostenibile in Italia [BES Report 2021: Sustainable and Equitable Well-being in Italy]*, https://www.istat.it/it/archivio/269316; ISPRA (2022[6]), *Municipal Waste Report - Edition 2022*, https://www.isprambiente.gov.it/en/publications/reports/municipal-waste-report-edition-2022; ISPRA (2022[7]), *Report on Waste from Economic Activities – 2021*, https://www.isprambiente.gov.it/en/publications/reports/report-on-waste-from-economic-activities-2021-1; MASE (2022[8]), *Strategia nazionale per l'economia circolare [National Strategy for the Circular Economy]*, https://www.mase.gov.it/sites/default/files/archivio/allegati/PNRR/SEC_21.06.22.pdf; EC (2018[9]), "Measuring progress towards a circular economy in the European Union – Key indicators for a monitoring framework", https://ec.europa.eu/environment/circular-economy/pdf/monitoring-framework_staff-working-document.pdf. The table also contains indicators from official statistics in Italy (i.e. ISTAT, ENEA, ISPRA, Legambiente) and international organisations (FAO, UNDP, EEA) and international non-governmental organisations (WWF) that have been identified as suitable for monitoring the themes of the RECE-XG conceptual framework.

Annex B. Potential indicators in Italy to monitor the transition towards a circular economy

Table A B.1. List of potential indicators available in Italy to monitor the transition towards a circular economy

	Indicator	Report/study
1	Air emission accounts	Air emission accounts, ISTAT
2	Allocation of interventions for the improvement of waste management (municipal waste) and flagship projects	National Recovery and Resilience Plan
3	Amount of differentiated waste collection	Circular economy and efficient use of resources
4	Amount of products handled in reuse centres	Circular economy and efficient use of resources
5	Amount of reusable packaging placed on the market	Circular economy and efficient use of resources
6	Approval of the capacity-building action plan to support local authorities	National Recovery and Resilience Plan
7	Average number of members per household	Census: Households in Italy - 2018-19, ISTAT
8	Budget allocated to the PNRR: improving the capacity for efficient and sustainable waste management and the circular economy paradigm	National Recovery and Resilience Plan
9	Business plans for prevention of waste production	Circular economy and efficient use of resources
10	Carbon footprint	Air emission accounts, ISTAT
11	Carbon footprint by product group	Air emission accounts, ISTAT
12	Change in water use efficiency over time	Progress on Water Use Efficiency (SDG Target 6.4), United Nations
13	Circular economy patents	National Strategy for the Circular Economy
14	Circular material use rate	National Strategy for the Circular Economy
15	CO_2 emissions and removals from land use, land use change and forestry	Italian Greenhouse Gas Inventory 1990-2021. *National Inventory Report 2023*
16	Co-incineration of combustible waste	*Report on Waste from Economic Activities*
17	Co-incineration of non-hazardous and hazardous waste	*Report on Waste from Economic Activities*
18	Co-incineration of oil waste from liquid fuels	*Report on Waste from Economic Activities*
19	Co-incineration of total waste	*Report on Waste from Economic Activities*
20	Co-incineration of waste from cement production	*Report on Waste from Economic Activities*
21	Co-incineration of waste from electricity production	*Report on Waste from Economic Activities*
22	Co-incineration of waste from the lime production sector	*Report on Waste from Economic Activities*
23	Co-incineration of waste from the manufacture of abrasive products and non-metallic mineral products	*Report on Waste from Economic Activities*
24	Co-incineration of waste from recovery of sorted materials	*Report on Waste from Economic Activities*
25	Co-incineration of waste from waste collection, treatment and disposal	*Report on Waste from Economic Activities*
26	Co-incineration of waste from wood products manufacturing	*Report on Waste from Economic Activities*
27	Collection performance in comparison with recycling waste (for traced chains)	Circular economy and efficient use of resources
28	Communication on the circular economy	National Strategy for the Circular Economy
29	Companies receiving support for investments in innovation in the circular economy and bioeconomy	National Recovery and Resilience Plan

	Indicator	Report/study
30	Company-wide waste/sub-product management	Circular economy and efficient use of resources
31	Consortium platforms	Circular economy and efficient use of resources
32	Construction and demolition waste	*Report on Waste from Economic Activities*
33	Consumption of energy from renewable sources	Draft National Strategy for Sustainable Development (Indicator source: GSE)
34	Contribution of greenhouse gases in the waste sector	National Strategy for the Circular Economy
35	Cumulative volume of Energy Efficiency Certificates (EEE) issued and primary energy savings certified	Draft National Strategy for Sustainable Development (Indicator source: GSE)
36	Direct input of materials from the rest of the world	ISTAT website
37	Direct material input (DMI)	Circular economy and efficient use of resources
38	Dissemination of centres for the preparation for reuse	Circular economy and efficient use of resources
39	Dissemination of good waste management practices at the local level, such as home and community composting	Circular economy and efficient use of resources
40	Distance from the 10% disposal target (new target of the newly approved waste package)	Circular economy and efficient use of resources
41	Domestic extraction of used materials: fossil energy materials/carriers	ISTAT website
42	Domestic extraction used (DEU) materials	Circular economy and efficient use of resources
43	Domestic material consumption (DMC) DMC per capita DMC per GDP	Circular economy and efficient use of resources Italian data for United Nations (UN) Sustainable Development Goals (SDGs) National Strategy for the Circular Economy
44	Ecologically equipped industrial areas	Circular economy and efficient use of resources
45	Electricity from renewable sources	Draft National Strategy for Sustainable Development (Indicator source: TERNA SPA)
46	End-of-life vehicle processing plants	*Report on Waste from Economic Activities*
47	End-of-life vehicles	*Report on Waste from Economic Activities*
48	Energy balance	Circular economy and efficient use of resources
49	Energy consumption by households	Circular economy and efficient use of resources
50	Energy consumption by primary sources	Draft National Strategy for Sustainable Development (Indicator source: Italian Institute for Environmental Protection and Research, ISPRA)
51	Energy consumption for industrial use	Circular economy and efficient use of resources
52	Energy intensity	Draft National Strategy for Sustainable Development (Indicator source: Italian National Agency for New Technologies, Energy and Sustainable Economic Development, ENEA)
53	Energy intensity of the industry sector	Draft National Strategy for Sustainable Development (Indicator source: ENEA)
54	Energy recovery from waste	Circular economy and efficient use of resources
55	Entry into force of separate collection for domestic hazardous waste fractions and textiles	National Recovery and Resilience Plan
56	Entry into force of separate collection systems for domestic hazardous waste fractions and textiles	National Recovery and Resilience Plan
57	Entry into force of the ministerial decree for the adoption of the National Strategy for the Circular Economy	National Recovery and Resilience Plan
58	Entry into force of the ministerial decree for the national waste management programme	National Recovery and Resilience Plan
59	Entry into force of the Ministerial Decrees on the Circular Economy	National Recovery and Resilience Plan
60	Entry into force of the obligation to separate collection of organic waste	National Recovery and Resilience Plan
61	Environmental quality and sustainability labels for products	Circular economy and efficient use of resources
62	Environmental quality and sustainability labels for services	Circular economy and efficient use of resources
63	Expenditure for final consumption in the economic territory and abroad of residents' households	National Accounts quarterly main aggregates: final consumption expenditure of households, ISTAT
64	Extraction intensity	Extractive activities from mining, ISTAT

	Indicator	Report/study
65	Food waste	National Strategy for the Circular Economy
66	Fossil-fuel subsidies as a percentage of GDP	Italian data for UN SDGs
67	Gap in respect of the incineration need	Circular economy and efficient use of resources
68	Gap with respect to the need for organic waste recycling plants	Circular economy and efficient use of resources
69	Generation of sludges from other treatments of industrial wastewater	*Report on Waste from Economic Activities*
70	Generation of sludges containing hazardous substances from other treatment of industrial wastewater	*Report on Waste from Economic Activities*
71	Generation of sludges from biological treatment of industrial wastewater	*Report on Waste from Economic Activities*
72	Generation of sludges from treatment of urban wastewater	*Report on Waste from Economic Activities*
73	Generation of waste containing asbestos	*Report on Waste from Economic Activities*
74	GHG emissions CO_2 equivalent from mining, manufacturing, electricity, gas, steam and air conditioning supply, water supply, sewerage, waste treatment and remediation activities	Air emission accounts, ISTAT
75	GINI index	Regional income homogeneity: Gini index, STAT
76	Green public procurement (GPP)	National Strategy for the Circular Economy
77	Gross domestic product (GDP)	GDP and main components, ISTAT
78	GDP at market prices per inhabitant	Per capita values, ISTAT
79	Gross final energy consumption	Draft National Strategy for Sustainable Development (Indicator source: GSE)
80	Hazardous healthcare waste incinerated or sterilised	*Report on Waste from Economic Activities*
81	Hazardous waste generation	*Report on Waste from Economic Activities*
82	Hazardous waste sent to the recovery operations	Italian data for UN SDGs
83	Hazardous wastes, excluding end-of-life vehicles	*Report on Waste from Economic Activities*
84	Human Development Index value	Human development insights, UNDP
85	Healthcare sector waste sent for co-incineration	*Report on Waste from Economic Activities*
86	Healthcare waste produced	*Report on Waste from Economic Activities*
87	Home and community composting	Circular economy and efficient use of resources
88	Illegal landfills	National Recovery and Resilience Plan
89	Illegal dumps	National Recovery and Resilience Plan
90	Impact of tourism on waste	Italian data for UN SDGs
91	Import/export in raw material equivalents	Circular economy and efficient use of resources
92	Incidence rates of regional waste generation related to total national value	*Report on Waste from Economic Activities*
93	Incineration of non-hazardous and hazardous waste	*Report on Waste from Economic Activities*
94	Incineration of total waste	*Report on Waste from Economic Activities*
95	Interactions and sharing of services between geographical areas (e.g. municipalities, provinces)	Circular economy and efficient use of resources
96	Internal material consumption Internal material consumption per capita Internal material consumption per unit of GDP	Sustainable and equitable well-being in Italy Draft National Strategy for Sustainable Development National Strategy for the Circular Economy
97	Interventions for flagship projects	National Strategy for the Circular Economy
98	Interventions for projects to improve management of waste	National Strategy for the Circular Economy
99	Interventions for projects to imrpove waste management services	National Strategy for the Circular Economy
100	Interventions to support economic and productive activities in the circular economy sectors	National Strategy for the Circular Economy
101	Investment in research and eco-innovation	Circular economy and efficient use of resources
102	Investments in eco-innovation and new technologies	Circular economy and efficient use of resources
103	Land protected areas	Land protected areas, ISPRA
104	Landfill disposal	*Report on Waste from Economic Activities*
105	Landfill disposal of non-hazardous and hazardous waste	*Report on Waste from Economic Activities*
106	Landfilling of municipal waste	Sustainable and equitable well-being in Italy

	Indicator	Report/study
107	Landfills for hazardous waste	*Report on Waste from Economic Activities*
108	Landfills for inert waste	*Report on Waste from Economic Activities*
109	Landfills for non-hazardous waste	*Report on Waste from Economic Activities*
110	Launch of tendering procedures, by non-interconnected islands, for the implementation of integrated energy/water/transport/waste projects	National Recovery and Resilience Plan
111	Leakage from municipal water mains	Sustainable and equitable well-being in Italy
112	Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	Food and Agriculture Organization
113	Management costs of waste	National Strategy for the Circular Economy
114	Material import dependency (physical imports over DMI)	ISTAT website
115	Material recovery (total)	*Report on Waste from Economic Activities*
116	Material recovery from non-hazardous and hazardous waste	*Report on Waste from Economic Activities*
117	Material recovery from special waste	Circular economy and efficient use of resources
118	Material recovery from waste energetic valorisation plants	Circular economy and efficient use of resources
119	Mineral resources extracted	ISTAT website
120	Municipal waste collection	Sustainable and equitable well-being in Italy
121	Municipal waste generation per capita	Circular economy and efficient use of resources
122	National forest surface area	The forest bioeconomy
123	National recycling rate	Italian data for UN SDGs
124	Net addition to stocks	European Commission Circular Economy Monitoring Framework
125	Net domestic energy use (for energy and non-energy purposes) by industry	Physical Energy Flow Accounts, ISTAT
126	Net installed renewable energy generating capacity	Italian data for UN SDGs
127	Nights spent in open-air establishments, farmhouses and mountain refuges on nights spent in all accommodation establishments (%)	Italian data for UN SDGs
128	Non-hazardous waste generation	*Report on Waste from Economic Activities*
129	Non-hazardous waste generation, excluding construction and demolition waste	*Report on Waste from Economic Activities*
130	Number of interventions for flagship projects on collection, treatment and recycling projects with a high innovative content	National Recovery and Resilience Plan
131	Number of interventions for waste management improvement projects (municipal waste)	National Recovery and Resilience Plan
132	Number of organisations/enterprises with Eco-management and Audit Scheme registration	Italian data for UN SDGs
133	Number of reuse centres	Circular economy and efficient use of resources
134	Opening of the public consultation on the national circular economy strategy	National Recovery and Resilience Plan
135	Paper and board recycling rates in the Circular Economy Action Plan	National Recovery and Resilience Plan
136	Patents related to recycling and secondary raw materials	EC Circular Economy Monitoring Framework
137	Percentage distribution of types of hazardous waste recovered	*Report on Waste from Economic Activities*
138	Percentage distribution of types of non-hazardous waste disposed of	*Report on Waste from Economic Activities*
139	Percentage distribution of types of non-hazardous waste recovered	*Report on Waste from Economic Activities*
140	Percentage of energy recovery out of total waste treated	*Municipal Waste Report*
141	Persons employed in circular economy sectors	EC Circular Economy Monitoring Framework
142	Podcasts, video lessons for schools and recorded and live video content on the web platform	National Recovery and Resilience Plan
143	Premature deaths (Particulate Matter PM2.5)	Italy air pollution country fact sheet, European Environment Agency
144	Preparation for reuse	National Strategy for the Circular Economy
145	Preparation for reuse, recycling and other material recovery, excluding backfilling, of construction and demolition waste	*Report on Waste from Economic Activities*

	Indicator	Report/study
146	Prevention (extension of useful life, reduction of material use, increase in reusability and recyclability, decrease in packaging, etc.)	Circular economy and efficient use of resources
147	Public Institutions that adopt forms of social and/or environmental reporting	Italian data for UN SDGs
148	Public institutions that purchase goods and/or services by adopting minimum environmental criteria, in at least one purchase procedure (green purchases or GPP)	Italian data for UN SDGs
149	Quantity of separately collected waste (% of research and development)	Circular economy and efficient use of resources
150	Quantity of waste destined for the replacement market	*Il Riciclo in Italia 2022*
151	Raw material consumption	ISPRA website
152	Raw material inputs	ISPRA website
153	Recovery of food waste	Circular economy and efficient use of resources
154	Recovery/disposal of sludges from treatment of industrial wastewater	*Report on Waste from Economic Activities*
155	Recovery/disposal of sludges from treatment of wastewater of the agro-food sector	*Report on Waste from Economic Activities*
156	Recycling of packaging waste	Circular economy and efficient use of resources
157	Recycling rate of municipal organic waste	National Strategy for the Circular Economy
158	Recycling rate of municipal waste	Circular economy and efficient use of resources National Strategy for the Circular Economy
159	Recycling rate of packaging waste in plastic	National Strategy for the Circular Economy
160	Recycling rate of packaging waste in wood	National Strategy for the Circular Economy
161	Recycling rate of packaging waste packaging	National Strategy for the Circular Economy
162	Recycling rate of waste electrical and electrical and electronic equipment	National Strategy for the Circular Economy
163	Recycling rate of waste, excluding waste from mining	National Strategy for the Circular Economy
164	Recycling rate of waste from construction and demolition	National Strategy for the Circular Economy
165	Reduction of irregular landfills	National Recovery and Resilience Plan
166	Regional special tax on landfill dumping	Environmental tax revenue, ISTAT
167	Resource productivity	Circular economy and efficient use of resources
168	Reuse and conversion of industrial assets	Circular economy and efficient use of resources
169	Reuse of final fractions from the purification of civil wastewater (purified water, sludge, sand)	Circular economy and efficient use of resources
170	Reuse of final fractions from urban wastewater treatment	Circular economy and efficient use of resources
171	Reuse of permanent materials	Circular economy and efficient use of resources
172	Revenue from environmental taxes	Environmental tax revenue, ISTAT
173	Sectoral database	ISTAT website
174	Separate collection of municipal waste	Italian data for UN SDGs Draft National Strategy for Sustainable Development
175	Separate collection rates	National Recovery and Resilience Plan
176	Share of energy from renewable sources in gross final energy consumption	Draft National Strategy for Sustainable Development (Indicator source: GSE)
177	Sharing economy	Circular economy and efficient use of resources
178	Sharing mobility	Circular economy and efficient use of resources
179	Sharing/exchange platforms	Circular economy and efficient use of resources
180	Soil degradation	ISPRA website
181	Special hazardous waste generation	Draft National Strategy for Sustainable Development (Indicator source: ISPRA)
182	Special hazardous waste sent for recovery operations	Draft National Strategy for Sustainable Development (Indicator source: ISPRA)
183	Status of GPP implementation	Circular economy and efficient use of resources

	Indicator	Report/study
184	Strategic and critical raw materials	Circular economy and efficient use of resources
185	Systemic food waste	Draft National Strategy for Sustainable Development (Indicator source: ISPRA)
186	Tax on coal consumption	Environmental tax revenue, ISTAT
187	Total waste generation Waste generation per unit of GDP	Circular economy and efficient use of resources National Strategy for the Circular Economy *Report on Waste from Economic Activities*
188	Tourism trips in Italy by type of trip and main means of transport	Italian data for UN SDGs
189	Trade in recyclable raw materials	EC Circular Economy Monitoring Framework
190	Treatment of sludge from urban wastewater	*Report on Waste from Economic Activities*
191	Treatment operation for end-of-life tyres (co-incineration)	*Report on Waste from Economic Activities*
192	Treatment operation for end-of-life tyres (disposal operations)	*Report on Waste from Economic Activities*
193	Treatment operation for end-of-life tyres (material recovery)	*Report on Waste from Economic Activities*
194	Treatment operation for end-of-life tyres (storage)	*Report on Waste from Economic Activities*
195	Urban air quality	National Strategy for the Circular Economy
196	Use of permanent materials	Circular economy and efficient use of resources
197	Value added of construction sector	Output and value added by industry, ISTAT
198	Waste from chemical treatment of waste and wastewater sent for co-incineration	*Report on Waste from Economic Activities*
199	Waste from demolition of end-of-life vehicles and waste from electrical and electronic equipment sent for co-incineration	*Report on Waste from Economic Activities*
200	Waste from de-pollution and demolition of end-of-life vehicles sent for disposal	*Report on Waste from Economic Activities*
201	Waste from de-pollution and demolition of end-of-life vehicles sent for energy recovery	*Report on Waste from Economic Activities*
202	Waste from de-pollution and demolition of end-of-life vehicles sent to recycling	*Report on Waste from Economic Activities*
203	Waste from de-pollution and demolition of end-of-life vehicles sent for reuse	*Report on Waste from Economic Activities*
204	Waste from the mechanical treatment of waste sent for co-incineration	*Report on Waste from Economic Activities*
205	Waste from the production of basic organic chemicals sent for co-incineration	*Report on Waste from Economic Activities*
206	Waste from wood processing, pulp, paper and cardboard sent for co-incineration	*Report on Waste from Economic Activities*
207	Waste import/export balance	Circular economy and efficient use of resources
208	Waste management costs	Circular economy and efficient use of resources
209	Waste packaging sent for co-incineration	*Report on Waste from Economic Activities*
210	Wastewater treatment	National Strategy for the Circular Economy
211	Wastes from agriculture, food preparation and processing sent for co-incineration	*Report on Waste from Economic Activities*
212	Water consumption for domestic use	Circular economy and efficient use of resources
213	Water consumption for industrial use	Circular economy and efficient use of resources
214	Water footprint	World Wide Fund for Nature study: *Water Footprint of Italy*
215	Water used for the extraction of minerals	Water use and quality in Italy, ISTAT

Source: Based on the mapping of indicators from: Italian Government (2021[1]), *Piano Nazionale di Ripresa e Resilience (PNRR)*, https://italiadomani.gov.it/it/home.html; MASE/MIMIT/ENEA (2018[2]), *Circular Economy and Efficient Use of Resources - Indicators for Measuring the Circular Economy*, http://www.minambiente.it/sites/default/files/archivio/notizie/documento_indicatori_EconomiaCircolare_versione_consolidata_def.pdf; MASE (2022[3]), *Strategia Nazionale per lo Sviluppo Sostenibile [Draft National Strategy for Sustainable Development 2022]*, https://www.mite.gov.it/pagina/strategia-nazionale-lo-sviluppo-sostenibile; ISTAT (2022[4]), *Istat Indicators for Sustainable Development Goals*, https://www.istat.it/en/well-being-and-sustainability/sustainable-development-goals/istat-indicators-for-sustainable-development; ISTAT (2022[5]), *Rapporto Bes 2021: il benessere equo e sostenibile in Italia [BES Report 2021: Sustainable and Equitable Well-being in Italy]*, https://www.istat.it/it/archivio/269316; ISPRA (2022[7]), *Report on Waste from Economic Activities – 2021*, https://www.isprambiente.gov.it/en/publications/reports/report-on-waste-from-economic-activities-2021-1; ISPRA (2022[6]), *Municipal Waste Report - Edition 2022*, https://www.isprambiente.gov.it/en/publications/reports/municipal-waste-report-edition-2022; MASE (2022[8]), *Strategia nazionale per l'economia circolare [National Strategy for the Circular Economy]*, https://www.mase.gov.it/sites/default/files/archivio/allegati/PNRR/SEC_21.06.22.pdf; EC (2018[9]), "Measuring progress towards a circular economy in the European Union – Key indicators for a monitoring framework", https://ec.europa.eu/environment/circular-economy/pdf/monitoring-framework_staff-working-document.pdf. The table also contains indicators from official statistics in Italy (i.e. ISTAT, ENEA, ISPRA, Legambiente) and international organisations (FAO, UNDP, EEA) and international non-governmental organisations (WWF) that have been identified as suitable for monitoring the themes of the RECE-XG conceptual framework.

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