Employment in the circular economy:

Leveraging circularity to create decent work

Technical annexe

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List of abbreviations

ADEME	French Agency for Ecological Transition
CGR	Circularity Gap Report
CPI	Circularity Performance Indicator
DG EMPL	European Commission's Directorate-General for Employment, Social Affairs and Inclusion
DMC	Domestic Material Consumption
ECLAC	The United Nations Economic Commission for Latin America and the Caribbean
EGSS	Environmental Goods and Services Sector
GWS	Gesellschaft für Wirtschaftliche Strukturforschung
ICLS	International Conference of Labour Statisticians
ILO	International Labour Organization
IO / IOA	Input-Output / Input-Output Analysis
IOE	International Organization of Employers
ISIC	International Standard Industrial Classification
ITUC	International Trade Union Confederation
MRIO	Multi-Regional Input-Output
OECD	Organisation for Economic Co-operation and Development
PAGE	Partnership for Action on Green Economy
RMC	Raw Material Consumption
RMI	Raw Material Input
SEEA	System of Environmental-Economic Accounting
SINTEF	Stiftelsen for Industriell og Teknisk Forskning
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNITAR	United Nations Institute for Training and Research
WaW	What a Waste (Database)

1. Introduction

This document outlines the methodology used to produce *Employment in the circular economy: Leveraging circularity to create decent work*—the first-of-its-kind global baseline of circular economy employment under *Jobs in the Circular Economy*, a joint initiative of Circle Economy, the International Labour Organization (ILO) and the World Bank Group (WBG). The development of this methodology was led by Circle Economy, with technical inputs from teams at the ILO and WBG in close partnership and with support from the Partnership for Action on Green Economy (PAGE), an interagency programme that brings together the expertise of five UN agencies: UNEP, UNDP, ILO, UNIDO and UNITAR. It also benefited from the guidance of an international advisory board of experts from leading research institutions, policy organisations and statistical agencies working on labour and circularity. Members include representatives from ITUC/IndustriALL, the IOE, Statistics Finland/UNECE, Eurostat, DG EMPL, the University of Cape Town, the African Development Bank, Tsinghua University, ECLAC, Bruegel, GIZ India, Hamad Bin Khalifa University, SINTEF, the University of São Paulo, and GWS.

As circularity becomes a critical pillar of economic, social and environmental transitions worldwide, the need for robust, evidence-based and comparable employment data has never been greater. This is needed to better understand the impact of the circular economy on employment and how to foster an enabling ecosystem for inclusive circular economy solutions. This methodology provides a data-driven framework for measuring global employment in the circular economy, building upon existing efforts to define the circular economy and classify and measure circular economy activities. It achieves this by differentiating between fully circular and partially circular sectors, developing sector-specific circularity coefficients to estimate the share of circular economy activities within partially circular sectors, and including informal employment. Additionally, it estimates the prevalence of circular economy employment across ten economic sectors, world regions, and country income groups.

Existing efforts to classify and measure employment in the circular economy were reviewed by the programme partners in a 2024 study that helped lay the

foundations for this methodological development.[1] These existing approaches were further examined as part of the development of this methodological document, and the producers of each existing methodology were engaged throughout this process. This included coordination with members of the UNECE Taskforce developing Guidelines for measuring the circular economy, Eurostat, ADEME, IRENA, among others.[2] See Section 2.3 for further discussion of these existing approaches. A systematic review carried out by programme partners in 2023 provided an overview of the existing evidence on decent work within the circular economy and also serves as a foundational pillar that informs the development of this methodology.[3]

The methodology outlined in this document is intended to provide a starting point for ongoing monitoring of employment in the circular economy, both at the global and national levels, as well as a basis for future studies that monitor trends in the circular economy. It aims to provide a basis for assessing and modelling the impacts of circular economy policy scenarios on employment, including working conditions, employment status, and employment in the informal economy, alongside their impact on material flows and Gross National Income (GNI). It is also a step towards supporting the establishment of linkages between economic activities and the environmental pressures that they exert, permitting policymakers to arrive at concrete goals towards circularity and employment in each sector. Future extensions of this methodology should also endeavour to include quality of work indicators such as employment by type (temporary, permanent, casual) and enterprise; an approach to integrate circular economy employment in agriculture, and a bottom-up approach for developing a list of circular products and services that could facilitate reaching estimates of circular economy employment for a broader range of partially circular sectors.

2. Scope

2.1 Territorial scope and timeline

The scope of this circular economy employment baseline is global, covering 177 countries for which sufficient employment and economic data are available. The

[1] Circle Economy, International Labour Organization & World Bank Group. (2024). *Measuring and modelling circular jobs: A review of definitions, databases, methods and models for understanding employment in the circular economy*. Circular Jobs Initiative. Retrieved from Circle Economy website

[2] United Nations Economic Commission for Europe (UNECE). (2024). *Guidelines for measuring the circular economy: Part A – Conceptual framework and indicators*. Retrieved from: UNECE website

[3] Circle Economy Foundation, International Labour Organization & World Bank Group. (2023). *Decent work in the circular economy: An overview of the existing evidence base*. Circular Jobs Initiative. Retrieved from Circle Economy website

term ‘country’ is used interchangeably with ‘economy’ and refers to territories that report distinct labour and economic statistics, regardless of political status. The baseline year for this study is 2023, aligning with the latest year for which input-output tables are available in the Eora database. For countries where the most recent employment data predates 2023, employment figures have been nowcasted using sectoral changes in gross output from the Eora MRIO framework as a proxy for employment growth. Findings are presented using the ILO’s regions categorisation: Africa, Arab States, Asia and the Pacific, Europe and Central Asia, and the Americas as well as the World Bank’s country classification by income level for fiscal year 2025, which is based on the GNI per capita of the previous full calendar year, 2023. It classifies economies into four categories: high-income, upper-middle-income, lower-middle-income and low-income economies.

2.2 Defining circular economy employment

This baseline study focuses on measuring direct circular economy employment and does not include indirect or induced employment. The method calculates the share of circularity for a given ISIC sector. It applies this share directly to employment data to estimate the baseline level of direct employment in the circular economy. Due to the absence of an internationally agreed-upon definition, in this methodology, employment in the circular economy refers to employment that contributes to the development of a circular economy. In developing this methodology, the authors have made efforts to align closely with existing circular economy classifications, namely those produced by Circle Economy and UNEP (2021),[4] ADEME (2024),[5] and Eurostat,[6] outlined in Table one. The latter is also currently the basis for UNECE and OECD’s joint effort towards developing CES Guidelines for Measuring Circular Economy: Conceptual Framework, Indicators and Measurement Framework for better understanding and measuring the circular economy sectors.[7]

[4] Circle Economy Foundation & United Nations Environment Programme. (2021). *Circular Jobs Methodology*. Circle Economy Foundation. Retrieved from Circle Econfull-timeomy.

[5] Service des données et études statistiques (SDES). (2024). *Quantification de l’emploi dans l’économie circulaire* [Document de travail]. Ministère de la Transition écologique (France). Retrieved from SDES

[6] Eurostat. (n.d.). *Circular economy monitoring framework*. European Commission. Retrieved from https://ec.europa.eu/eurostat/web/circular-economy/monitoring-framework

[7] United Nations Economic Commission for Europe (UNECE) & Organisation for Economic Co-operation and Development (OECD). (2024). *Conference of European Statisticians Guidelines for Measuring Circular Economy, Part A: Conceptual Framework, Indicators and Measurement Framework*. Retrieved from UNECE website.

PRODUCER & GEOGRAPHICAL SCOPE	APPROACH TO DEFINING AND MEASURING CIRCULAR ECONOMY EMPLOYMENT
Eurostat (EU)	Indicator on 'persons employed in circular economy sectors' (% of total employment) Circular economy employment is expressed as the number of persons employed full-time equivalent (FTE) and as a percentage of total employment in recycling, repair, reuse and rental. Distinguishes between: ● Primarily circular economy purposes (e.g. waste collection, treatment, equipment for recycling activities, secondary raw materials), ● Primarily non-circular purpose, with a secondary circular economy purpose (e.g. e-books, leasing and renting).
Circle Economy & UNEP[8] (International)	A circular job is defined as any occupation that directly involves or indirectly supports an activity of the circular economy, according to Circle Economy's Key Elements Framework. This includes: ● Direct circular jobs: ○ Core circular jobs in repair, renewable energy production, and waste and resource management ○ Enabling circular jobs in leasing, education, design and digital technology. ● Indirectly circular jobs that use services provided by core circular strategies.
The French Agency for Ecological Transition (ADEME)[9] (France)	Circular economy definition used by ADEME to build a circular economy employment indicator for monitoring circular jobs. Core circular activities are organic agriculture, rental, reuse/secondhand use/repair, recovery/sale of secondary raw materials, waste collection and processing, recycling and repurposing. Adjacent circular activities are those whose primary objective is not the circularity of production processes or the reduction of resources used, such as waste (incineration with energy recovery) and energy management.

Table one. *Existing approaches to circular economy definitions, classification and employment reviewed as a part of the methodological development process*

These efforts are closely aligned with the strategies laid out in the R-framework as delineated in the 2017 Circularity Ladder:[10] R0 Refuse, R1 Rethink, R2 Reduce, R3 Reuse, R4 Repair, R5 Refurbish, R6 Remanufacture, R7 Repurpose, R8 Recycle and R9 Recover, depicted in Figure one.

[8] Circle Economy. (2023). *Circular jobs methodology*. Retrieved from: Circle Economy website
[9] Ministère de la Transition écologique. (2024). *Quantification de l'emploi dans l'économie circulaire*. Retrieved from: French government website
[10] Potting, J., Hekkert, M. P., Worrell, E., & Hanemaaijer, A. (2017). Circular Economy: Measuring Innovation in Product Chains. The Hague: PBL Netherlands Environmtoental Assessment Agency.

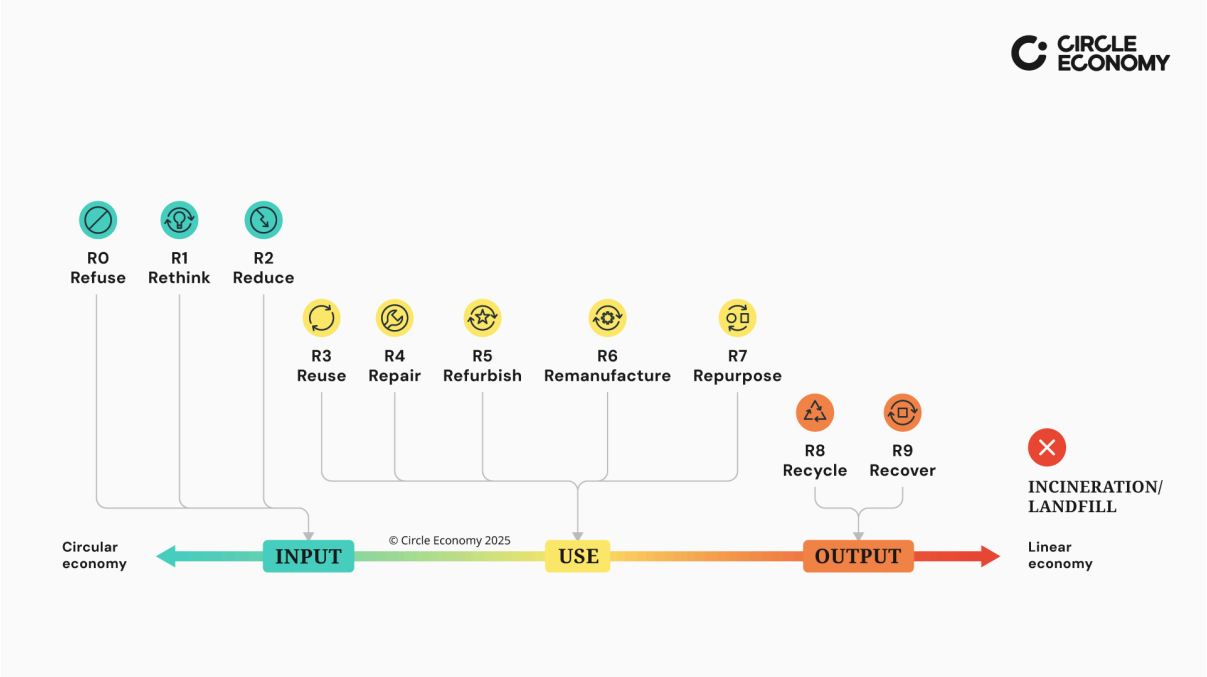

Figure one. *Visual depiction of the R-framework*

This methodology relates these definitions of the circular economy to economic sectors to determine circular economy employment. This approach to classifying circular economy sectors also shares similarities with the ILO-UNEP and ILO GJP policy definitions of 'green jobs', as well as statistical definitions like the UN SEEA's 'environmental activities' and the 19th ICLS Guidelines on 'employment in the environmental sector' (EGSS) and 'green jobs'. In particular, classifying sectors whose primary activity directly aligns with R-strategies as 'circular' includes some sectors with 'environmental activities', defined under the Classification of Environmental Activities (CEA), whose primary purpose is environmental protection or resource management (See Annexe I below). Meanwhile, the treatment of 'partially circular' sectors echoes the recognition in these frameworks that some economic activities only partially contribute to environmental (or circular) objectives. However, this methodology focuses more strictly on the core activities of the circular economy, which emphasise the reduction in, long-term use and recycling of resources, distinguishing it from broader environmental or green jobs definitions, which include jobs in renewable energy, pollution control and environmental protection or conservation.

2.3 Classifying circularity of economic sectors

In line with the reviewed definitions and classification approaches, this study categorises economic activities based on their circularity at the 4-digit level of

ISIC Rev. 4. ISIC is a global standard used to classify industries based on their primary economic activities. At the 4-digit level, industries are classified into highly specific categories, allowing for granular analysis of different sectors. This list of sectors, along with their alignment with reviewed approaches, is listed in Annexe I. Ensuring international consistency and in alignment with established guidelines on circular economy, this list of economic sectors is derived by mapping the similarities and differences between circular activities as defined by Eurostat, ADEME, and the Circle Economy-UNEP *Circular Jobs Methodology*. For countries where employment data is available in ISIC Revision 3.1, a concordance table was used in line with guidance from the United Nations Statistics Division (UNSD).[11]

2.3.1 Building block approach

The building block approach has been adopted with the intent of providing a practical method to support the widespread application of this methodology across countries and regions. As a result, countries and institutions can choose to focus on one or more blocks of the methodology presented in this report, in line with the scope and extent of the circular economy activities they wish to measure in their own contexts. This methodology only takes into account direct circular economy employment, as well as induced and indirect circular economy employment or effects. This building block approach categorises selected circular economy activities (in ISIC) into fully or partially circular sectors, depending on how circular economy employment is calculated for these sectors.

- **Fully circular sectors** are economic sectors in which all employment is considered to contribute directly to the circular economy by virtue of occupational functions in this sector. By contributing to the generation of circular products and services, all employment in these sectors is counted as circular. As such, employment in these sectors is not determined through the material or economic circularity of the sector itself. They include repair and maintenance activities; waste management services and remediation activities (excluding landfill and incineration); wholesale of waste, scrap, and other products; renting, leasing and library activities; sewerage; waste collection; retail sale of second-hand goods; material recovery; and urban and suburban passenger land transport, hereafter referred to as urban transit.

[11] The concordance table used to align economic activities in ISIC Rev 3.1 to ISIC Rev 4 is as per UNSD

- **Partially circular sectors** are material-intensive sectors where circular practices are present but not easily discernible in employment datasets, such as mining, manufacturing, and construction. As ISIC data do not allow for the disaggregation of circular activities within these sectors, circularity is estimated through modelling approaches. These models assess the contribution of each sector to two types of circularity coefficients.

2.3.2 Excluded activities and sectors

Several economic activities are outside the scope of the study due to the inability to discern circular practices in these sectors, primarily because of the way data is captured under existing classification systems and datasets, or because they are considered not strictly part of the circular economy or are more adequately covered by other studies.

- The methodology does not currently measure circular economy employment in agriculture, due to the absence of a harmonised definition, recognised classification of circular agricultural activities, and consistent employment data directly linked to such practices. Nevertheless, many agricultural and forestry systems, such as crop–livestock integration, composting, nutrient cycling, use of biochar, and regenerative soil management, embody key circular economy principles by regenerating natural systems, reducing external inputs, and maintaining ecological balance. On the other hand, formal and informal agricultural practices, such as slash-and-burn, monocropping, and overharvesting, remain widespread, posing ongoing climate and biodiversity risks. Existing indicators of biological circularity, such as nutrient or biomass cycling rates, remain insufficiently standardised or inapplicable in low-data contexts, while certification-based proxies often exclude informal, smallholder, and subsistence systems prevalent in the Global South.

  Organic agriculture reflects several principles of the circular economy; however, certification remains largely inaccessible in low-income settings and fails to capture the diversity of circular practices in informal and subsistence farming, where resource reuse and closed-loop nutrient flows are widespread but often unrecorded in official statistics. Future iterations of the methodology could bridge this substantial sectoral gap by developing models that integrate complementary indicators and

proxies such as organic agriculture shares, nutrient cycling rates, sustainable forestry management data, soil restoration metrics, and other innovative measures to construct a more comprehensive representation of circular economy employment in agriculture and allied activities. Such advances would enable the framework to more accurately reflect the circular potential inherent in both formal and informal biological resource cycles, thereby enhancing its global inclusiveness and completeness.

- All forms of energy production (ISIC Section D) are excluded. This includes renewable energy, as well as any forms of technical cycling for energy production, such as waste-to-energy, biomass, and biofuels**.** Employment in the renewable energy sector is the focus of an annual series on jobs in renewable energy by the IRENA and the ILO. The latest *Renewable Energy and Jobs Annual Review (2024)* finds 16.2 million jobs in the renewable energy sector.
- Activities under ISIC 382, i.e. Waste treatment and disposal activities, have not been included. This is because the activities listed under this ISIC group 382 are linked with linear waste management activities. This group includes the disposal and treatment prior to disposal of various forms of waste by different means, such as waste treatment of organic waste with the aim of disposal; treatment and disposal of toxic live or dead animals and other contaminated waste; treatment and disposal of transition radioactive waste from hospitals, *etcetera*.; dumping of refuse on land or in water; burial or ploughing-under of refuse; disposal of used goods such as refrigerators to eliminate harmful waste; disposal of waste by incineration or combustion.[12] While treatment of organic waste and production of compost could be considered a part of circular economy, all the rest of the activities under group 382 are either linear economy solutions (such as operations of landfills, combustion or incineration and disposal) or are linked broadly to environmental protection but not circular economy (such as treatment of dead animals, handling radioactive nuclear waste). Countries with advanced and at-scale organic waste treatment could be included as an additional bottom-up correction in future iterations of the study.

[12] United Nations, Department of Economic and Social Affairs, Statistics Division (2008). International Standard Industrial Classification of All Economic Activities (ISIC), Rev. 4. Statistical Papers, Series M, No. 4/Rev. 4. New York: United Nations.

- Beyond what is measured as economic activities, there are also many voluntary, own-use and unpaid circular activities, such as DIY and communal repairs, informal sharing economy, contribution to collection and sorting activities, and freecycling that are out of scope for this study, but which are nonetheless an important component of the circular economy. Similarly, while industrial symbiosis is an important circular practice that deserves recognition, the activities usually take place within a specific industry or a local industrial park, making its inclusion methodologically complicated in a global study.

2.3.3 Partially included activities and sectors

- The sharing economy is partly but not fully accounted for in the methodology. Part of the sharing economy is accounted for through the renting, leasing and libraries, and urban and suburban passenger land transport (ISIC H4921), but other aspects, such as activities generated from online marketplaces and software, or shared living and working spaces, are not accounted for due to limitations in existing statistical classifications.
- Water management activities are partly accounted for in the methodology. Sewerage and wastewater activities (ISIC 37) are considered circular, but water collection, treatment and supply activities (ISIC 36) are not. This is in line with other studies, as it is not possible to differentiate circular practices in water collection, supply and treatment in ISIC-based employment data.
- Public transport is partly accounted for through the inclusion of urban and suburban passenger land transport sector (ISIC H4921) based on the principle of shared access (‘reduce’), enabling a shift from car ownership to service-based mobility and providing vital services in more necessity-driven contexts.[13] [14]

[13] Okraszewska, R., Romanowska, A., Laetsch, D. C., Gobis, A., Reisch, L. A., Kamphuis, C. B. M., Lakerveld, J., Krajewski, P., Banik, A., den Braver, N. R., Forberger, S., Brenner, H., & Żukowska, J. (2024). *Interventions reducing car usage: Systematic review and meta-analysis. Transportation Research Part D: Transport and Environment, 131*, Article 104217. https://doi.org/10.1016/j.trd.2024.104217

[14] Korsunova, A., Halme, M., Kourula, A., Levänen, J., Lima-Toivanen, M. (2022). Necessity-driven circular economy in low-income contexts: How informal sector practices retain value for circularity. *Global Environmental Change, 76*, Article 102573. doi:10.1016/j.gloenvcha.2022.102573

3. Methodological approach

3.1 Clustering regions and same income-level countries for comparability

The results of this methodology are presented in the global baseline report using the ILO's regions categorisation: Africa, Arab States, Asia and the Pacific, Europe and Central Asia, and the Americas and the WBG's country classification by income level for fiscal year 2025, which is based on the GNI per capita of the previous full calendar year, 2023. This is in line with the baseline year. It classifies economies into four categories: high-income, upper-middle-income, lower-middle-income and low-income economies.

3.2 Approaches to determining circularity and circular economy employment per sector

This methodology calculates the share of circularity ('alpha', α) for a given ISIC sector and applies this coefficient to ILOSTAT employment data to estimate the baseline level of direct employment in the circular economy. Alpha reflects circularity at the time of measurement, that is 2023.

$$Employment\ in\ the\ circular\ economy\ (sector)\ =\ \alpha(sector) \times Employment(sector)$$

3.2.1 Fully circular sectors

For circular sectors, α is considered as one. The primary economic activity of these sectors is considered to contribute to the circular economy directly, and as such, all employment in this sector is considered direct circular economy employment, 100% of employment ($\alpha = 1$).

3.2.2 Partially circular sectors

For partially-circular sectors, (where $\alpha < 1$ in a given sector), α is determined as the average between the material circularity coefficient (use of secondary inputs

over total inputs), proxied by the share of technical cycling rate (TCr)[15] as a proportion of total raw material input (RMI), and the economic circularity coefficient proxied by the share of the sector's contribution to domestic and export intermediate demand to downstream sectors, specifically the materials recovery sector[16] over the sector's total economic output. This equal weighting assumption aims to balance the representation of secondary material use by weight and the economic value they create by supplying materials for recycling. Given the absence of universally agreed-upon criteria favouring one measure over the other, equal weighting serves as a neutral baseline. This is except for mining and quarrying, which includes only estimates on economic circularity (such as tailings reprocessing and mineral recovery). This avoids overstating the employment in primary extraction associated with the circular economy.

The proxy for economic circularity includes:

- Domestic intermediate demand (Z)
- International intermediate demand (Zx, Z from other countries)
- Total output(x)

For the numerator, we sum the domestic and international Z values that represent the link between construction and waste management. This gives us a combined measure of both local and export-related circular activity.

$$\alpha(sector) = \omega 1 \times TCr + \omega 2 \times [Z(sector \rightarrow 37, 38) + Zx \quad (sector \rightarrow 37, 38)\ ] / x(sector)$$

where $\omega 1 = \omega 2 = 0.5$ for manufacturing and construction sectors, and

$\omega 1 = 0$, $\omega 2 = 1$ for mining sectors,

Otherwise, $\omega 1 = \omega 2 = 0$.

This methodology focuses on measuring direct circular economy employment in specific sectors, in line with other methods like Eurostat's, rather than indirect employment (such as those created in related industries).

[15] The technical cycle relates to the management of non-renewable and largely non-biological resources that are difficult to reintroduce into the biosphere safely. Examples include concrete, plastics and metals, as well as some processed biological materials, such as timber, paper, textiles and bioplastics—this is referred to as 'technical biomass'. Materials that are part of the technical cycle fall into one of four categories: they become Secondary Materials, are Virgin, Non-Renewable Materials destined for disposal without recovery, are added to Stocks, or are Fossil Fuels combusted for energy.

[16] MRIO Eora and Eora26 use the term 'recycling sector' which corresponds to ISIC 383 – Materials Recovery, to represent outputs to material recovery activities as a proxy for economic circularity.

Economic circularity: This category of sectors is considered to be partially circular, and the proportion of circularity is estimated by accounting for the sector's contribution to the materials recovery sector. This proportion is computed through the IO Tables for the latest available year, 2023. The list of partially circular sectors for which this approach applies includes the mining sector (their contribution in the form of products such as waste rock, tailings and mine water), manufacturing (contribution such as pipes for sewerage) and the construction sector (such as material and debris from demolition and construction activities. These activities are listed below in Annexe I under partially circular sectors, with the approach mentioned as 'Economic circularity (IO)'.

Material circularity: Material circularity for a given sector is determined by accounting for the use of secondary inputs (non-virgin materials). We do not expect any sector to rely entirely on secondary inputs, although for some sectors in certain regions, a very high number may be the case. Therefore, we have only one approach to estimating the secondary inputs, and technically allow the result to be 100% if this is the case.

This approach applies to materially intensive sectors such as Manufacturing (ISIC C10 - C32 inclusive) and Construction (F41 - F43 inclusive). This secondary model calculates sub-sector-specific coefficients at the level of ISIC 2-digit, or where data is available for some particularly relevant[17] manufacturing subsectors at the ISIC 3-digit level.[18]

The proportion of circular activity in a particular sector in a given country is estimated by taking the weighted average of all the country cycling rates per resource group (Biomass, Metals, Non-metallic Minerals, and Fossil Fuels) in the country's region, as applied to the RMI of the sub-sector in question of that country.

For example Sub-sector in Country X

RMI % Resource group 1 * Cycling rate Resource group 1 CountryAverage
+ RMI % Resource group 2 * Cycling rate Resource group 2 Country Average
+ RMI % Resource group 3 * Cycling rate Resource group 3 Country Average

[17] Relevance in this case would be determined by significantly top employing sub sectors that require extra attention.
[18] There are 23 sub sectors for Manufacturing at ISIC 2-digit.

+ RMI % Resource group 4 * Cycling rate Resource group 4 Country Average

The calculated weighted average coefficient represents the estimated share of secondary materials used in a specific sub-sector for a given country, and consequently, the estimate of circular inputs for that sub-sector.

Circularity as a function of both economic and material flows: For construction and manufacturing sectors, both material circularity (proxied by estimating the share of secondary inputs over total inputs into the sector, measured in kilograms), and economic circularity (proxied by the monetary values of flows from the sector to sector's contribution to the material recovery sector through domestic sales and exports) are considered. For these sectors, an average ($\omega 1 = \omega 2 = 0.5$) of the economic and material circularity is applied to determine the final estimate for circularity in this sector. Activities under this approach are listed in Annexe I with the label 'average of economic and material circularity'. To assess the sensitivity of the employment estimates to changes in these weighing assumptions, a sensitivity analysis was conducted by evaluating two scenarios ($\omega 1 = 1, \omega 2 = 0$) and ($\omega 1 = 0, \omega 2 = 1$). For the manufacturing sector, the analysis revealed a moderate variation. Prioritising economic circularity ($\omega 2 = 1$) yields 11% higher employment estimate compared to material circularity ($\omega 1 = 1$). On the other hand, the construction sector, is substantially more sensitive to weighting. Giving full weight to material circularity ($\omega_2 = 1$) leads to an estimated employment figure for the construction sector that is almost twice as high (99%), whereas emphasising economic circularity ($\omega_1 = 1$) produces substantially lower estimates. This suggests a stronger interlinkage between the construction and the use of secondary materials, as compared to that between construction and the recycling sectors.

In light of the diverse nature of activities in the manufacturing sector, it has been categorised as a partially circular sector. However, a fraction of employment in this sector, such as .ISIC C331- Repair of fabricated metal products, machinery and equipment, is fully circular. Nevertheless, this categorisation does not impact the overall number or presentation of results for the manufacturing sector. Unless mentioned otherwise, employment in the manufacturing sector includes employment in the repair sector (C331).

4. Approach for the informal economy

Informal circular economy employment accounts for the majority of the global labour market, particularly in low-income and emerging economies. The informal economy refers to all economic activities, excluding illicit activities, by workers and economic units that are, in law or in practice, not covered or insufficiently covered by formal arrangements. According to the ILO, informal employment refers to working arrangements that are *de facto* or *de jure* not subject to national labour legislation, income taxation or entitlement to social protection or certain other employment benefits such as advance notice of dismissal, severance pay, paid annual or sick leave.[19] The *Jobs in the Circular Economy Initiative*'s first report highlighted that informal economic activities such as waste collection across plastics, e-waste and textile sectors; informal public transport; and the bio compost sector are key examples of how circular activities, despite occurring in hazardous, unprotected and unregulated environments, contribute to circularity goals and provide income to these workers.[20] However, data on the extent of informal employment is inadequate, and a review of the evidence base reported that only four of the reviewed publications attempted to capture informal work in the circular economy, and each of these relied on ILOSTAT data on the informal economy.[21] Except for one, studies have not incorporated bottom-up corrections for measuring informal work.[22]

4.1 Approach to determining informal employment in circular sectors

In countries with employment data disaggregated by status (formal/informal), circular economy employment in each sector is apportioned using the sector's informal employment share, allowing us to estimate the number of informal circular economy employees within that sector. Data on informal employment were available at ISIC 1 or 2-digit levels from ILOSTAT for 122 countries included

[19] International Labour Organization (ILO). (2023). *Working Paper on informality measurement*. Retrieved from: ILO website
[20] Circle Economy Foundation, International Labour Organization & World Bank Group. (2023). *Decent work in the circular economy: An overview of the existing evidence base*. Circular Jobs Initiative. Retrieved from Circle Economy website
[21] Circle Economy Foundation, International Labour Organization & World Bank Group. (2024). *Measuring and modelling circular jobs: A review of definitions, databases, methods and models for understanding employment in the circular economy*. Circular Jobs Initiative. Retrieved from Circle Economy website
[22] ILO. (2021). *La reconstrucción verde. Avances de la economía circular hacia una transición justa en Argentina*. Retrieved from: ILO website

in this analysis. For the remaining 55 countries, where disaggregation of employment data by status was not available in terms of ISIC, the given country's regional and income group average of informality rate is used to estimate the extent of informal circular economy employment at the national level. Similar shares are applied to economic sectors for the given country.

4.2 Approach to determining informal employment in partially-circular sectors

The same approach is used for determining informal employment in partially circular sectors as for the formal sector, including mining, construction, and manufacturing. This is based on the assumption that the circularity shares are similar for these sectors, and informal circular activities in each are important in their own way. Nevertheless, the method is based on the overall economic structure and technological integration of the formal economy as well as sectoral interactions, which may or may not apply to the informal economy in the country in question. Future research could focus on identifying key occupations engaged in circular practices, assessing the environmental and economic benefits, and developing methodologies to account for these contributions in both national and global contexts. For the time being, we echo the approach taken for the formal sector.

4.2.1 Mining, manufacturing and construction

Informal work in the mining, manufacturing, and construction sectors makes a meaningful contribution to circularity and sustainability, despite being underrepresented in formal data systems and existing studies on circularity. In informal mining, workers often reprocess tailings or extract residual value from low-grade ores, thereby reducing waste and extending the life of resources. In manufacturing, informal actors engage in the small-scale manufacturing of metals, plastics, and textiles from waste streams. In the construction sector, workers in the informal economy often reuse materials such as bricks, timber, and aggregates from demolition sites, particularly in informal settlements where cost-saving and material availability drive these practices. A recent firm-level study in Kigali, Rwanda, showed that for the surveyed 546 firms

across the construction value chain, 5% of jobs are highly green and 58% are partially green.[23]

Despite these contributions, significant challenges remain in measuring employment and material flows within these informal activities. Data on scale, safety, material quality, and economic impact are sparse, context-specific, and largely undocumented across countries. Informal practices vary widely, making it difficult to apply consistent bottom-up corrections to employment estimates or material input-output analyses. Addressing this would require targeted research, the development of occupation-specific methodologies, and new frameworks for capturing informal circular activities across value chains. Presently, we propose applying the same approach as for the formal sector, detailed in Section 3.2. However, future research should prioritise identifying key occupations, assessing their environmental and economic benefits, and integrating their role into broader sustainability assessments.

5. Data approach, availability and granularity

Designed to be truly global in its application, this methodology relies on internationally available datasets to ensure consistency across countries. To this end, employment data from 2012 to 2024 (for several countries, modelled employment data for countries with employment preceding 2023) is sourced from ILOSTAT, with preference given to ISIC Rev. 4 four-digit disaggregation and further broken down by gender and informality. The informal employment rate is the share of persons in informal employment as a percentage of total employment, as captured in ILOSTAT and according to the 19th International Conference of Labour Statisticians (ICLS). To estimate sectoral linkages and intermediate demand flows, input-output tables are sourced from the Eora database and aligned to the same base year as the employment data. The IOTs are utilised for estimating economic circularity in partially circular sectors such as manufacturing, construction, and mining. Material circularity is proxied using the technical cycling rate, as provided in the *Circularity Gap Report (CGR®) 2025*.

[23] Never, B., Stöcker, A., Tsinda, A., Mujanama, E., & Mugisha, R. (2025). Green jobs and green economic development in Kigali's construction value chain: Evidence from a firm survey (IDOS Discussion Paper 24/2025). German Institute of Development and Sustainability (IDOS)

5.1 Employment data availability and approach to handling data at lower resolution

The study utilises employment data for 177 countries, sourced from ILOSTAT, and detailed in terms of economic activity, according to ISIC Revision 4. Accordingly, the total employment considered in the present version of the study is 3.26 billion. For the most relevant results with sectoral granularity, employment data at the ISIC 4-digit level is preferred. This is available for 63 countries. If employment data is not available at the ISIC 4-digit level, then ISIC 2-digit (available for 48 countries) or ISIC 1-digit (available for 33 countries) levels are used to determine estimates. In these instances, the circular economy employment proportion for a particular ISIC sector (1-digit) or division (2-digit) is applied to these countries. The employment proportions are derived by averaging the shares of sectoral circular economy employment for the given sector or group from countries (where detailed data are available) within the income group (low, lower-middle, upper-middle, and high income), in which the given economy falls. The countries and territories for which data is not available in ISIC 1 but as clusters of ISIC 1, that is, in the form of aggregates of two or more ISIC 1-digit sections (33 countries), have been included by deriving the (global) proportion of a particular ISIC division within this aggregated cluster. This proportion is then applied to the aggregation of divisions to extract the share of employment for the desired division.

5.2 Input-output data

To facilitate the calculation of economic circularity for applicable sectors, where a sector outputs to the materials recovery sector, input-output tables (IOTs) are required. This study uses Eora as the basis for the analysis,[24] [25] [26] which (where available) gathers national IOTs using the local sector classification, as each nation has its own economic structure and harmonising the sectors would lose important detail. Data in Eora is available up until 2023. Global MRIOs have to harmonise national IOTs that may not use the same classifications, or even directly contradict each other. This process means that no single country can be assumed to be correct and may be rebalanced to uphold global constraints. Additionally, the sector classifications are frequently harmonised to create a

[24] Eora. (n.d.). *Eora Global Multi-Region Input–Output database*. Retrieved from: Eora website

[25] Lenzen, M., Kanemoto, K., Moran, D., & Geschke, A. (2012). Mapping the structure of the world economy. *Environmental Science & Technology*, 46(15), 8374–8381. doi:10.1021/es300171x

[26] Lenzen, M., Moran, D., Kanemoto, K., & Geschke, A. (2013). Building Eora: A global multi-region input–output database at high country and sector resolution. *Economic Systems Research*, 25(1), 20–49. doi:10.1080/09535314.2013.769938

fully symmetrical IOTs. A perfect mapping between different classification systems is never possible, and because the sectors and their relation to both the waste management sector and their respective ISIC 4-digit employment data are critical to this analysis, this study employs Eora using its heterogeneous sector classification strategy.

This choice means that, depending on the country, the sector classification may range from 26 to 500 sectors, which is closely aligned to the national IOT and the country's unique economic structure. The full details of the sectors will be used for the top three employing countries, whereas, as a fallback, Eora26 will be used as an intermediate mapping for the remaining countries. Future iterations will explore the creation of additional mapping tables between the national sector classification and ISIC 4. Other prominent MRIOs, such as Exiobase and GLORIA, were not used because they harmonise the national sector classifications, which introduces error. Countries for which IO data is not available are not included in the study.

5.2.1 IO Data availability

Due to the decision not to use an IO system with harmonised sectors, there is no single metric that can describe the sectoral and temporal granularity. Eora is used for the latest year that is available in the employment data for that region. This data may include GDP nowcasted results. Out of 177 countries, 69 have their own classifications. For a detailed overview of the regions and their sectoral detail, see Annexe II below. 119 regions have 26 sectors, which means they have been estimated to include Eora26 coverage. This data is highly unreliable, as it is not representative of the national IOT and contains mostly modelled data. These regions employ ~20.5% of total employment, but there are a total of 119 of them with likely very low data availability, as a result of which efforts have not been made to address this data gap. The sectors will be downscaled to the appropriate ISIC (2 or 4 digits) to complete the economic circularity calculations.

5.3 Secondary sources for bottom-up corrections

Some of the data used to compute the coefficients in the secondary models are extracted from the CGR 2025.[27] CGR 2025 is a global study that reports on the

[27] Circle Economy. (2025). *The Circularity Gap Report 2025*. Circle Economy. Retrieved from Circularity Gap Report website

state of circularity providing data on material use, waste, secondary material use, and other key indicators to map the state of circularity for every country from 2017 to 2023. CGR 2025 combines a variety of data sources to compute indicators, most notably material flow data from the IRP,[28] waste data from What a Waste (WaW),[29] monetary flows from Eora26[30] and Exiobase,[31] and key bottom-up corrections and data updates from national statistics and Eurostat. For detailed information on circularity indicators from CGR 2025, please refer to the CGR methodology. It is important to note that while IOTs and employment data are consistent across years, this was not possible for data prior to 2017, where the material coefficients extracted from CGR 2025 are not available. Therefore, the 2017 material coefficients are applied to the employment data from earlier years.

5.3.1 Manufacturing and construction secondary model

The technical cycling rate as computed from the data in CGR 2025, is defined as secondary material use over total material input (raw material consumption or RMC). Secondary material use consists of the amount of recycled waste, plus the net trade balance of trade of waste and by-products. A key source of waste data is WaW, although corrections are made using external publications, statistics, and modelling estimates for the top-producing countries in the world. To relate secondary material use to economic activities, RMI is computed per region per sector. This is achieved using IOA, where material extraction is sourced from the IRP and Eurostat.

5.4 Employment data nowcasting

Not all data from ILOSTAT (see Section 5.1) is available for the year of analysis (2023). To unify per-country results (pre-clustering), employment data is nowcasted to 2023.

Nowcasting is achieved by analysing changes in industrial output per region and sector. This data is retrieved from Eora by comparing ‘x’ (industrial output) between the data year and 2023 per sector for the given region. The resulting

[28] United Nations Environment Programme International Resource Panel (UNEP IRP). (2024). *Technical annex for Global Material Flows Database – Version 4, June 2024*. Retrieved from: UNEP IRP website
[29] World Bank. (n.d.). *World Bank global material flows database*. Retrieved from: World Bank Data Catalog
[30] Eora. (n.d.). *Eora26 global multi-region input–output database*. Retrieved from: Eora website
[31] Stadler, K., Wood, R., Bulavskaya, T., Södersten, C.-J., Simas, M., Schmidt, S., Usubiaga, A., Acosta-Fernández, J., Kuenen, J., Bruckner, M., Giljum, S., Lutter, S., Merciai, S., Schmidt, J. H., Theurl, M. C., Plutzar, C., Kastner, T., Eisenmenger, N., Erb, K.-H., de Koning, A., & Tukker, A. (2021). *EXIOBASE 3.8.2* [Data set]. Zenodo. doi:10.5281/zenodo.5589597

shares are then mapped to the ISIC 4 sectors used by that region, repeating the shares where the Eora sector detail was less granular than the ISIC 4 sectors. The choice for industrial output from Eora was chosen due to its likeness to GDP,[32] a common method for nowcasting, but providing more sectoral detail. First, the year of data is used for all calculations determining circularity and circular economy employment per sector. Then, the employment data per sector is nowcasted from the data year to 2023 using the change in industrial output.

6. Limitations and assumptions

6.1 Measuring circular economy employment

This methodology relies on several key assumptions.

Circular and partially circular economic activities are classified under the ISIC, where data are assigned based on primary economic activity. However, not all employment within a given ISIC code necessarily corresponds to circular or partially circular activities, as sector classifications are based on the dominant activity and may include a mix of circular and non-circular roles. This means that ISIC classifications are often less than 100% representative of the actual distribution of circular economy employment within a sector.

Within the current ISIC classification, it is not possible to delineate specific circular activities within economic sectors, making it challenging to isolate employment that directly contributes to circular economy goals. For example, jobs in sectors like manufacturing or construction may involve both linear practices and circular economy activities. Similarly, circular activities undertaken by economic units as a secondary or ancillary activity will not be fully captured, such as second-hand sales or repairs undertaken by stores primarily selling new products.

An important assumption, and an extension to the point above, is that all employment in fully circular sectors is circular economy employment. In reality, these sectors may still depend on materials and services that are not entirely

[32] An IOT can be used to compute GDP itself, and thus gives us the same type of output but with much more detail. There are multiple, equivalent ways to computing total GDP using an IOT, one of which also uses industrial output (GDP = total industrial output at basic prices - total intermediate consumption in purchasers' prices + taxes less subsidies)

circular, or may perform activities that are not circular; for example, repair and remanufacturing services may use new spare parts; the use of fossil fuels and virgin materials for material recovery, second-hand goods may end up in landfill or incineration; sewerage may be discharged without reuse. Additional examples are provided in the table in Annexe I of the report.

Even as circularity coefficients are applied directly to employment data using secondary models for partially circular sectors, it is important to recognise that labour productivity and technological capabilities vary significantly across countries. This variation introduces a limitation to the methodology, potentially skewing the accuracy of employment estimates and circular economy contributions in countries with differing economic conditions and technological advancements.

As elaborated in Section 3.2.2, the approach to calculate economic circularity in partially circular sectors is presently limited to capturing the contribution of these sectors to the materials recovery sector. Limiting sectoral circularity output only to its contribution to the materials recovery sector does not account for the fact that sectors may (and do) sell secondary inputs to sectors beyond materials recovery. Employment contributing to this exchange has not been captured.

Similarly, no direct circular economy employment is estimated for major employing services sectors (retail trade beyond second-hand trade, financial services, research, *etcetera*). However, there may be occupations and activities within these sectors that contribute to the circular economy.

Assumptions and limitations pertaining to the two specific secondary models for manufacturing and construction are expressed in their respective sections. Overall, using a national technical cycling rate as an approach for estimating circular activity inside a sector assumes that composite products can be processed for recycling due to the use of RMIs. However, the country technical cycling rate average for a material may not represent what the manufacturing and construction sectors are using.

Relying on product and service-level data flowing in and out of sectors, which has been Eurostat's approach for measuring circular economy employment across EU countries, was not an option, because at the global level, only exim trade-related product data is presently available, which cannot be considered an

accurate reflection of total production and therefore of employment for this analysis.

6.2 Pertinent data limitations

6.2.1 Employment data

The methodology has been applied to countries with the highest levels for which data are available. As highlighted above, only a third of the nowcasted (2023) employment data is available at ISIC 4-digit granularity. Employment analysis, therefore, relied on older employment data and data at ISIC 2-digit, ISIC 1-digit and aggregates thereof, which reduces the precision of job estimates and may obscure sector-specific trends within the circular economy. In these instances, employment numbers should be interpreted within the context of their data availability limitations. Similarly, applying regional income group averages assumes uniformity in informal employment patterns across countries with similar income levels and overlooks variations in national economic arrangements. Sex-disaggregated data is available at the same granularity as the total employment. Utilising the same income grouping averages to assign circularity shares to countries where employment data is not available at ISIC-4 level has implications, including over- and underestimating circular economy employment due to different domestic economic arrangements for countries within the same region and income group. Instead of a punitive approach that allocates zero circularity in these cases, or using the global average, the methodology takes into consideration existing circular economy employment through income group averages based on the assumption that countries with similar income levels have similar levels of circular economy practices.

6.2.2 Data on informal employment

Data captured by ILOSTAT on the informal economy is likely to under-represent the true scale of informal work, primarily due to methodological limitations and challenges in data collection, such as difficulties in reaching workers in informal employment, reliance on household surveys that miss transient, hidden and seasonal work, and underreporting driven by respondents' fear of taxation or legal repercussions. Consequently, the ILOSTAT indicators may provide conservative estimates. As this study relies entirely on ILOSTAT data on

employment, the estimates derived for a specific region or sector should not be interpreted as comprehensive measures of informal economic activity, but rather as an indicative measure, reflecting only the extent captured through standardised survey methodologies. Comprehensive measurement thus requires complementary qualitative and value-chain, sectoral or territorial assessments to better capture the nuanced extent and nature of informal circular economy employment.

6.2.3 Reliability of IOT databases

The methodology draws on both the Eora and Eora26 MRIO databases, which provide valuable insights into global trade, economic flows, and environmental impacts. However, both IOTs carry inherent limitations and assumptions. First, both rely heavily on official national accounts, which often exclude or under-represent informal economic activity, particularly in low- and middle-income countries where such work is significant. Eora26 further aggregates data into 26 sectors, which can obscure important differences within broad industries under consideration, such as manufacturing or construction.

There are structural limitations inherent to IO analysis. Technical coefficients are assumed to be fixed, implying constant input structures and technologies over time and do not allow for substitution or innovation. These assumptions are standard in IO-based environmental and employment analysis, but limit the scope of interpretation. In both versions, sectoral outputs are assumed to be homogeneous, and input structures are standardised, which may oversimplify the diversity of real-world production systems. Additionally, data gaps are filled through estimation and harmonisation techniques, potentially reducing accuracy in countries with limited statistical capacity. For MRIOs in particular, combining and balancing multiple national accounts can introduce inconsistencies, and accuracy is lower where underlying statistical systems are weak.

The flow of secondary materials, including recycled products and waste, is not always well-documented, especially when they are embedded within other economic activities and product categorisations. This makes it difficult to track and quantify the role of secondary materials in circular economy sectors and establish linkages with employment. Therefore, the coefficients derived using Eora must be interpreted with caution. While they provide a coherent global

framework, they remain constrained by assumptions of fixed technologies, homogeneity, partial coverage of informal and secondary activities, and reliance on modelled data in many regions.

6.2.4 Aligning data sources

Matching IO data, employment data, and data from secondary sources for a single year is challenging for most countries, as the latest available data for each type may differ. As a result, the methodology utilises data from the same year for IO and employment data, but relies on the most recent secondary sources for analysing employment in a given country, which may not match the IO and employment data.

ANNEXE I

Table two: *Overview of sectors of fully circular economy activity, identified in ISIC, and alignment with other classification approaches*

Sectors of circular economy activities	ISIC	R-strategies	Rationale for inclusion	Known issues/challenges	CEA	Eurostat	ADEME	Circle Economy & UNEP
Renting and leasing of motor vehicles; personal and household goods; other machinery, equipment and tangible goods (N)	771 772 773	Rethink Reduce	Shared access and the shift from product to service can reduce production needs. Can create incentives for extended product lifespans.	Rebound effects[33] (e.g. increased affordability of new, luxury goods). Circularity depends on product longevity, usage patterns and business models.	No	Yes	Yes	Yes
Library and archives activities (R)	9101		Shared access improves product utilisation. Reduces demand for new goods.	Need to be accessible to avoid idle time. Digital alternatives may be more resource-efficient.	No	Yes	No	No
Urban and suburban passenger land transport (H)	4921	Rethink Reduce	Shared access and the shift from product to service can reduce production needs.	The extent of circular strategies like repair, remanufacturing and recycling within public transport is not captured.	No	No	No	Yes

[33] 'Circular economy rebound occurs when circular economy activities, which have lower per-unit-production impacts, also cause increased levels of production, reducing their benefit'. (ZInk and Geyer, 2017).

			Reduces demand for new extraction and private car usage.	Public transport in many countries still largely relies on fossil fuels.				
Retail sale of second-hand goods (G)	4774	Reuse	Extends product lifespans. Reduces demand for new goods.	Rebound effects (e.g. increased affordability of new, luxury goods that retain resale value). Circularity depends on product longevity and usage patterns.	No	Yes	No	Yes
Repair of fabricated metal products, machinery and equipment (C)	331	Repair Refurbish	Extends product lifespans. Reduces the need for new production.	Often requires new manufactured parts rather than refurbished/reused equipment. Some specialised repairs may be energy and resource-intensive.	No	Yes	Yes	Yes
Maintenance and repair of motor vehicles (G)	452				No	Yes	Yes	Yes
Repair of computers and personal household goods (S)	95				No	Yes	Yes	Yes
Washing and (dry-) cleaning of textile and fur products (S)	9601		Extends the lifetime of products. Can also carry out repairs	It sometimes requires intensive use of chemicals, water and energy.	No	Yes	No	Yes

			and alterations.					
Sewerage (E)	37	Recycle Recover	Wastewater treatment enables recycling and reuse, and the recovery of nutrients.	Wastewater is not always treated. Treated water is often discharged instead of recycled.	Yes	Yes	No	Yes
Waste collection (E)	381		Extracts valuable materials from waste streams. Enables recycling and materials recovery.	Waste collection does not ensure recycling. Downcycling limits full recovery potential. Losses during recovery, sorting and processing.	Yes	Yes	No	Yes
Materials recovery (E)	383				Yes	Yes	No	No
Remediation activities and other waste management services (E)	39				Yes	Yes	Yes	Yes
Wholesale of waste and scrap and other products n.e.c. (G)	4669		Extracts value from waste streams. Reduces demand for new extraction.	Should exclude wholesale of industrial chemicals (‘other products n.e.c.’).	No	Yes	Yes	Yes

Table three: *Overview of sectors of partially circular economy activities, identified in ISIC*

Sector of partially circular economy activities	Sectors of circular economy activities	ISIC 4-digit	Approach to determining circularity
Mining and quarrying	Quarrying of stone, sand and clay	0810	Economic circularity
	Support activities for other mining and quarrying	0990	Economic circularity
Manufacturing	Processing and preserving of meat	1010	Average of economic circularity and material circularity
	Processing and preserving of fish, crustaceans and molluscs	1020	Average of economic circularity and material circularity
	Processing and preserving of fruit and vegetables	1030	Average of economic circularity and material circularity
	Manufacture of vegetable and animal oils and fats	1040	Average of economic circularity and material circularity
	Manufacture of dairy products	1050	Average of economic circularity and material circularity
	Manufacture of grain mill products	1061	Average of economic circularity and material circularity
	Manufacture of starches and starch products	1062	Average of economic circularity and material circularity
	Manufacture of bakery products	1071	Average of economic circularity and material circularity
	Manufacture of sugar	1072	Average of economic circularity and material circularity
	Manufacture of cocoa, chocolate and sugar confectionery	1073	Average of economic circularity and material circularity
	Manufacture of macaroni, noodles, couscous and similar farinaceous products	1074	Average of economic circularity and material circularity
	Manufacture of prepared meals and dishes	1075	Average of economic circularity and material circularity

	Manufacture of other food products n.e.c.	1079	Average of economic circularity and material circularity
	Manufacture of prepared animal feeds	1080	Average of economic circularity and material circularity
	Distilling, rectifying and blending of spirits	1101	Average of economic circularity and material circularity
	Manufacture of wines	1102	Average of economic circularity and material circularity
	Manufacture of malt liquors and malt	1103	Average of economic circularity and material circularity
	Manufacture of soft drinks; production of mineral waters and other bottled waters	1104	Average of economic circularity and material circularity
	Manufacture of tobacco products	1200	Average of economic circularity and material circularity
	Preparation and spinning of textile fibres	1311	Average of economic circularity and material circularity
	Weaving of textiles	1312	Average of economic circularity and material circularity
	Finishing of textiles	1313	Average of economic circularity and material circularity
	Manufacture of other textiles	1391	Average of economic circularity and material circularity
	Manufacture of knitted and crocheted fabrics	1392	Average of economic circularity and material circularity
	Manufacture of made-up textile articles, except apparel	1393	Average of economic circularity and material circularity
	Manufacture of carpets and rugs	1394	Average of economic circularity and material circularity
	Manufacture of cordage, rope, twine and netting	1399	Average of economic circularity and material circularity
	Manufacture of wearing apparel, except fur apparel	1410	Average of economic circularity and material circularity
	Manufacture of articles of fur	1420	Average of economic circularity and material circularity

	Manufacture of knitted and crocheted apparel	1430	Average of economic circularity and material circularity
	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness	1511	Average of economic circularity and material circularity
	Manufacture of footwear	1520	Average of economic circularity and material circularity
	Sawmilling and planing of wood	1610	Average of economic circularity and material circularity
	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board and other panels	1621	Average of economic circularity and material circularity
	Manufacture of builders' carpentry and joinery	1622	Average of economic circularity and material circularity
	Manufacture of wooden containers	1623	Average of economic circularity and material circularity
	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	1629	Average of economic circularity and material circularity
	Manufacture of pulp, paper and paperboard	1701	Average of economic circularity and material circularity
	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard	1702	Average of economic circularity and material circularity
	Manufacture of other articles of paper and paperboard	1709	Average of economic circularity and material circularity
	Printing	1811	Average of economic circularity and material circularity
	Service activities related to printing	1812	Average of economic circularity and material circularity
	Reproduction of recorded media	1820	Average of economic circularity and material circularity
	Manufacture of coke oven products	1910	Average of economic circularity and material circularity

	Manufacture of refined petroleum products	1920	Average of economic circularity and material circularity
	Manufacture of basic chemicals	2011	Average of economic circularity and material circularity
	Manufacture of fertilisers and nitrogen compounds	2012	Average of economic circularity and material circularity
	Manufacture of plastics and synthetic rubber in primary forms	2013	Average of economic circularity and material circularity
	Manufacture of pesticides and other agrochemical products	2021	Average of economic circularity and material circularity
	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	2022	Average of economic circularity and material circularity
	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	2023	Average of economic circularity and material circularity
	Manufacture of other chemical products n.e.c.	2029	Average of economic circularity and material circularity
	Manufacture of man-made fibres	2030	Average of economic circularity and material circularity
	Manufacture of pharmaceuticals, medicinal chemical and botanical products	2100	Average of economic circularity and material circularity
	Manufacture of rubber products	2211	Average of economic circularity and material circularity
	Manufacture of plastics products	2220	Average of economic circularity and material circularity
	Manufacture of glass and glass products	2310	Average of economic circularity and material circularity
	Manufacture of refractory products	2391	Average of economic circularity and material circularity
	Manufacture of clay building materials	2392	Average of economic circularity and material circularity
	Manufacture of other porcelain and ceramic products	2393	Average of economic circularity and material circularity

	Manufacture of cement, lime and plaster	2394	Average of economic circularity and material circularity
	Manufacture of articles of concrete, cement and plaster	2395	Average of economic circularity and material circularity
	Cutting, shaping and finishing of stone	2396	Average of economic circularity and material circularity
	Manufacture of other non-metallic mineral products n.e.c.	2399	Average of economic circularity and material circularity
	Manufacture of basic iron and steel	2410	Average of economic circularity and material circularity
	Manufacture of basic precious and other non-ferrous metals	2420	Average of economic circularity and material circularity
	Casting of metals	2431	Average of economic circularity and material circularity
	Manufacture of structural metal products	2511	Average of economic circularity and material circularity
	Manufacture of tanks, reservoirs and containers of metal	2512	Average of economic circularity and material circularity
	Manufacture of steam generators, except central heating hot water boilers	2513	Average of economic circularity and material circularity
	Manufacture of weapons and ammunition	2520	Average of economic circularity and material circularity
	Manufacture of fabricated metal products, except machinery and equipment n.e.c.	2591	Average of economic circularity and material circularity
	Manufacture of cutlery, hand tools and general hardware	2592	Average of economic circularity and material circularity
	Manufacture of other fabricated metal products n.e.c.	2599	Average of economic circularity and material circularity
	Manufacture of electronic components and boards	2610	Average of economic circularity and material circularity
	Manufacture of computers and peripheral equipment	2620	Average of economic circularity and material circularity
	Manufacture of communication equipment	2630	Average of economic circularity and material circularity

	Manufacture of consumer electronics	2640	Average of economic circularity and material circularity
	Manufacture of measuring, testing, navigating and control equipment	2651	Average of economic circularity and material circularity
	Manufacture of watches and clocks	2652	Average of economic circularity and material circularity
	Manufacture of irradiation, electromedical and electrotherapeutic equipment	2660	Average of economic circularity and material circularity
	Manufacture of optical instruments and photographic equipment	2670	Average of economic circularity and material circularity
	Manufacture of magnetic and optical media	2680	Average of economic circularity and material circularity
	Manufacture of electric motors, generators, transformers and electricity distribution apparatus	2710	Average of economic circularity and material circularity
	Manufacture of batteries and accumulators	2720	Average of economic circularity and material circularity
	Manufacture of wiring and wiring devices	2731	Average of economic circularity and material circularity
	Manufacture of electric lighting equipment	2740	Average of economic circularity and material circularity
	Manufacture of domestic appliances	2750	Average of economic circularity and material circularity
	Manufacture of other electrical equipment	2790	Average of economic circularity and material circularity
	Manufacture of general-purpose machinery	2811	Average of economic circularity and material circularity
	Manufacture of pumps, compressors, taps and valves	2813	Average of economic circularity and material circularity
	Manufacture of lifting and handling equipment	2816	Average of economic circularity and material circularity
	Manufacture of other general-purpose machinery	2819	Average of economic circularity and material circularity
	Manufacture of special-purpose machinery	2821	Average of economic circularity and material circularity

	Manufacture of metal-forming machinery and machine tools	2822	Average of economic circularity and material circularity
	Manufacture of machinery for metallurgy	2823	Average of economic circularity and material circularity
	Manufacture of machinery for mining, quarrying and construction	2824	Average of economic circularity and material circularity
	Manufacture of other special-purpose machinery	2829	Average of economic circularity and material circularity
	Manufacture of motor vehicles	2910	Average of economic circularity and material circularity
	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	2920	Average of economic circularity and material circularity
	Manufacture of parts and accessories for motor vehicles	2930	Average of economic circularity and material circularity
	Building of ships and boats	3010	Average of economic circularity and material circularity
	Manufacture of railway locomotives and rolling stock	3020	Average of economic circularity and material circularity
	Manufacture of air and spacecraft and related machinery	3030	Average of economic circularity and material circularity
	Manufacture of military fighting vehicles	3040	Average of economic circularity and material circularity
	Manufacture of transport equipment n.e.c.	3090	Average of economic circularity and material circularity
	Manufacture of furniture	3100	Average of economic circularity and material circularity
	Manufacture of jewellery and related articles	3211	Average of economic circularity and material circularity
	Manufacture of musical instruments	3212	Average of economic circularity and material circularity
	Manufacture of sports goods	3230	Average of economic circularity and material circularity
	Manufacture of games and toys	3240	Average of economic circularity and material circularity

	Manufacture of medical and dental instruments and supplies	3250	Average of economic circularity and material circularity
	Manufacture of brooms and brushes	3290	Average of economic circularity and material circularity
	Repair of fabricated metal products, machinery and equipment	3311	Average of economic circularity and material circularity
	Installation of industrial machinery and equipment	3320	Average of economic circularity and material circularity
Construction	Construction of buildings	4100	Average of economic circularity and material circularity
	Construction of roads and railways	4210	Average of economic circularity and material circularity
	Construction of utility projects	4220	Average of economic circularity and material circularity
	Construction of other civil engineering projects	4290	Average of economic circularity and material circularity
	Demolition	4311	Average of economic circularity and material circularity
	Site preparation	4312	Average of economic circularity and material circularity
	Electrical installation	4321	Average of economic circularity and material circularity
	Plumbing, heat and air-conditioning installation	4322	Average of economic circularity and material circularity
	Other construction installation	4329	Average of economic circularity and material circularity
	Building completion and finishing	4330	Average of economic circularity and material circularity
	Other specialised construction activities	4390	Average of economic circularity and material circularity

ANNEX II

Table four: *Summary of regions in Eora and their total number of distinct sectors (excluding Eora26)*

Country	Code	Type	Sector
Argentina	ARG	Industries	125
Australia	AUS	Industries	345
Austria	AUT	Industries	61
Belgium	BEL	Industries	61
Bolivia	BOL	Industries	37
Brazil	BRA	Industries	56
Canada	CAN	Industries	49
Chile	CHL	Industries	75
Colombia	COL	Industries	60
Czech Republic	CZE	Industries	61
Denmark	DNK	Industries	131
Ecuador	ECU	Industries	49
Estonia	EST	Industries	61
Finland	FIN	Industries	61
France	FRA	Industries	61
Georgia	GEO	Industries	47
Greece	GRC	Industries	61
Greenland	GRL	Industries	31
Hong Kong	HKG	Industries	38
Hungary	HUN	Industries	61
India	IND	Industries	116
Iran	IRN	Industries	100
Ireland	IRL	Industries	61
Israel	ISR	Industries	163
Italy	ITA	Industries	61
Kenya	KEN	Industries	51
Kuwait	KWT	Industries	55
Kyrgyzstan	KGZ	Industries	89
Latvia	LVA	Industries	61

Lithuania	LTU	Industries	61
Malta	MLT	Industries	61
Mauritius	MUS	Industries	57
Mexico	MEX	Industries	80
Netherlands	NLD	Industries	61
Netherlands Antilles	ANT	Industries	16
New Zealand	NZL	Industries	127
Norway	NOR	Industries	61
Paraguay	PRY	Industries	34
Peru	PER	Industries	46
Poland	POL	Industries	61
Portugal	PRT	Industries	61
Romania	ROU	Industries	61
Russia	RUS	Industries	49
Singapore	SGP	Industries	154
Slovakia	SVK	Industries	61
Slovenia	SVN	Industries	61
South Africa	ZAF	Industries	95
Spain	ESP	Industries	76
Sweden	SWE	Industries	61
Switzerland	CHE	Industries	43
TFYR Macedonia	MKD	Industries	61
Turkey	TUR	Industries	61
UK	GBR	Industries	511
USA	USA	Industries	429
Uruguay	URY	Industries	84
Venezuela	VEN	Industries	122
China	CHN	Commodities	123
Germany	DEU	Commodities	72
Indonesia	IDN	Commodities	77
Japan	JPN	Commodities	402
Kazakhstan	KAZ	Commodities	121
Malaysia	MYS	Commodities	98
Philippines	PHL	Commodities	77
South Korea	KOR	Commodities	78

Taiwan	TWN	Commodities	163
Thailand	THA	Commodities	180
Ukraine	UKR	Commodities	121
Uzbekistan	UZB	Commodities	123
Viet Nam	VNM	Commodities	113

ANNEXE III

Table five. *Overview of countries included in the baseline and their employment data resolution in ISIC Rev 4.*

Countries with ISIC 4-digit employment data [63 countries]	Afghanistan, Angola, United Arab Emirates, Argentina, Bangladesh, Bahamas, Bolivia (Plurinational State of), Brazil, Barbados, Brunei, Bhutan, Botswana, Colombia, Costa Rica, Dominican Republic, Ecuador, Egypt, Ethiopia, Fiji, United Kingdom, Ghana, Gambia, Guyana, Honduras, Indonesia, India, Iran (Islamic Republic of), Iraq, Kenya, Cambodia, Lao People's Democratic Republic, Lebanon, Sri Lanka, Madagascar, Maldives, Myanmar, Mongolia, Namibia, Nigeria, Nepal, Pakistan, Panama, Peru, Philippines, Rwanda, Saudi Arabia, Sudan, Senegal, Sierra Leone, El Salvador, Suriname, Eswatini, Seychelles, Thailand, Tajikistan, Tunisia, Tanzania (United Republic of), Uganda, Uruguay, Viet Nam, Vanuatu, Samoa and Zambia.
Countries with ISIC 2-digit employment data [48 countries]	Albania, Armenia, Australia, Austria, Burundi, Benin, Burkina Faso, Bosnia and Herzegovina, Belarus, Switzerland, Chile, Côte d'Ivoire, Congo, The Democratic Republic of the, Cyprus, Czechia, France, Georgia, Greece, Guatemala, Israel, Italy, Jordan, Japan, Kyrgyzstan, Korea (Republic of), Liberia, Lesotho, Mexico, North Macedonia, Mali, Mozambique, Mauritania, Mauritius, New Caledonia, Niger, Papua New Guinea, Portugal, Palestine (State of), Singapore, Somalia, Serbia, Slovakia, Chad, Togo, Turkey, Ukraine, United States, Zimbabwe.
Countries with ISIC 1-digit employment data [33 countries]	Belgium, Bulgaria, Belize, Cameroon, Cabo Verde, Germany, Denmark, Spain, Estonia, Finland, Croatia, Haiti, Hungary, Ireland, Iceland, Jamaica, Lithuania, Luxembourg, Latvia, Morocco, Moldova (Republic of), Malta, Montenegro, Netherlands, Norway, Poland, Romania, Russian Federation, Sao Tome and Principe, Slovenia, Sweden, Trinidad and Tobago and Uzbekistan.
Countries with employment data in clusters of ISIC sections or in ISIC Rev 3.1 [33 countries]	Canada, Hong Kong, Macao, Nicaragua, Taiwan, Venezuela, Yemen, South Africa, China, Malaysia, Korea (the Democratic People's Republic of), Algeria, Kazakhstan, Malawi, Syrian Arab Republic, Cuba, Azerbaijan, South Sudan, Guinea, Paraguay, New Zealand, Kuwait, Oman, Turkmenistan, Qatar, Libya, Congo, Central African Republic, Eritrea, Bahrain, Gabon, Djibouti, French Polynesia.

Table six. *Overview of countries included in the baseline with gender/informality availability.*

Countries with gender disaggregation availability in ISIC 1, 2 or 4 digit [177 countries]	Azerbaijan, Belgium, Bulgaria, Bahrain, Belize, Central African Republic, Canada, China, Cameroon, Congo, Cape Verde, Cuba, Germany, Djibouti, Denmark, Algeria, Eritrea, Spain, Estonia, Finland, Gabon, Guinea, Hong Kong, Croatia, Haiti, Hungary, Ireland, Iceland, Jamaica, Kazakhstan, Kuwait, Libyan Arab Jamahiriya, Lithuania, Luxembourg, Latvia, Macao, Morocco, Moldova, Republic of, Malta, Montenegro, Malawi, Malaysia, Nicaragua, Netherlands, Norway, New Zealand, Oman, Poland, Korea, Democratic People's Republic of, Paraguay, French Polynesia, Qatar, Romania, Russia Federation, Sao Tome and Principe, Slovenia, Sweden, Syrian Arab Republic, Turkmenistan, Trinidad and Tobago, Taiwan, Province of China, Uzbekistan, Venezuela, Yemen, South Africa, Albania, Armenia, Australia, Austria, Burundi, Benin, Burkina Faso, Bosnia and Herzegovina, Belarus, Switzerland, Chile, Côte d'Ivoire, Congo, The Democratic Republic of, Cyprus, Czechia, France, Georgia, Greece, Guatemala, Israel, Italy, Jordan, Japan, Kyrgyzstan, Korea, Republic of, Liberia, Lesotho, Mexico, Macedonia, The Former Yugoslav Republic Of, Mali, Mozambique, Mauritania, Mauritius, New Caledonia, Niger, Papua New Guinea, Portugal, Palestinian Territory, Occupied, Singapore, Somalia, Republic of Serbia, Slovakia, Chad, Togo, Turkey, Ukraine, United States, Zimbabwe, Afghanistan, Angola, United Arab Emirates, Argentina, Bangladesh, Bahamas, Bolivia, Brazil, Barbados, Brunei Darussalam, Bhutan, Botswana, Colombia, Costa Rica, Dominican Republic, Ecuador, Egypt, Ethiopia, Fiji, United Kingdom, Ghana, Gambia, Guyana, Honduras, Indonesia, India, Iran, Islamic Republic of, Iraq, Kenya, Cambodia, Lao, People's Democratic Republic, Lebanon, Sri Lanka, Madagascar, Maldives, Myanmar, Mongolia, Namibia, Nigeria, Nepal, Pakistan, Panama, Peru, Philippines, Rwanda, Saudi Arabia, Sudan, Senegal, Sierra Leone, El Salvador, Suriname, Swaziland, Seychelles, Thailand, Tajikistan, Tunisia, Tanzania, United Republic of, Uganda, Uruguay, Vietnam, Vanuatu, Samoa, Zambia, South Sudan.
Countries with informal status disaggregation available in ISIC 1 or 2 digit [122 countries]	Afghanistan, Angola, Argentina, Armenia, Austria, Burundi, Belgium, Benin, Burkina Faso, Bangladesh, Bulgaria, Bahamas, Bosnia and Herzegovina, Bolivia, Plurinational State of, Brazil, Barbados, Brunei Darussalam, Botswana, Switzerland, Chile, Côte d'Ivoire, Cameroon, Congo, The Democratic Republic of the, Colombia, Cabo Verde, Costa Rica, Cyprus, Czechia, Germany, Denmark, Dominican Republic, Ecuador, Egypt,

	Spain, Estonia, Ethiopia, Finland, Fiji, France, United Kingdom, Georgia, Ghana, Gambia, Greece, Guatemala, Guyana, Honduras, Croatia, Haiti, Hungary, Indonesia, India, Ireland, Iraq, Iceland, Italy, Jamaica, Jordan, Kenya, Kyrgyzstan, Cambodia, Korea, Republic of, Lao People's Democratic Republic, Lebanon, Liberia, Sri Lanka, Lesotho, Lithuania, Luxembourg, Latvia, Moldova, Republic of, Madagascar, Maldives, Mexico, North Macedonia, Mali, Malta, Myanmar, Mongolia, Mozambique, Mauritania, Mauritius, Namibia, Niger, Netherlands, Norway, Nepal, Pakistan, Panama, Peru, Poland, Portugal, Palestine, State of, Romania, Russian Federation, Rwanda, Sudan, Senegal, Sierra Leone, El Salvador, Somalia, Serbia, Suriname, Slovakia, Slovenia, Sweden, Eswatini, Seychelles, Chad, Togo, Thailand, Tajikistan, Tunisia, Turkey, Tanzania, United Republic of, Uganda, Uruguay, Viet Nam, Vanuatu, Samoa, Zambia, Zimbabwe
Countries with informal status disaggregation available as regional and country income group averages [55 countries]	Albania, United Arab Emirates, Australia, Azerbaijan, Bahrain, Belarus, Belize, Bhutan, Central African Republic, Canada, China, Congo, Cuba, Djibouti, Algeria, Eritrea, Gabon, Guinea, Hong Kong, Iran, Islamic Republic of, Israel, Japan, Kazakhstan, Kuwait, Libya, Macao, Morocco, Montenegro, Malawi, Malaysia, New Caledonia, Nigeria, Nicaragua, New Zealand, Oman, Philippines, Papua New Guinea, Korea, Democratic People's Republic of, Paraguay, French Polynesia, Qatar, Saudi Arabia, Singapore, Sao Tome and Principe, South Sudan, Syrian Arab Republic, Turkmenistan, Trinidad and Tobago, Taiwan, Ukraine, United States, Uzbekistan, Venezuela, Bolivarian Republic of, Yemen, South Africa

Table seven. Overview of countries not included in the baseline due to no data available for material and economic coefficients.

Countries with total employment available but without partial coefficients [17 countries]	Saint Lucia, Comoros, Micronesia, Federated States of, Kiribati, Kosovo, Niue, Cook Islands, Guinea-Bissau, Grenada, Marshall Islands, Nauru, Palau, Solomon Islands, Timor-Leste, Tonga, Tuvalu, Wallis and Futuna.