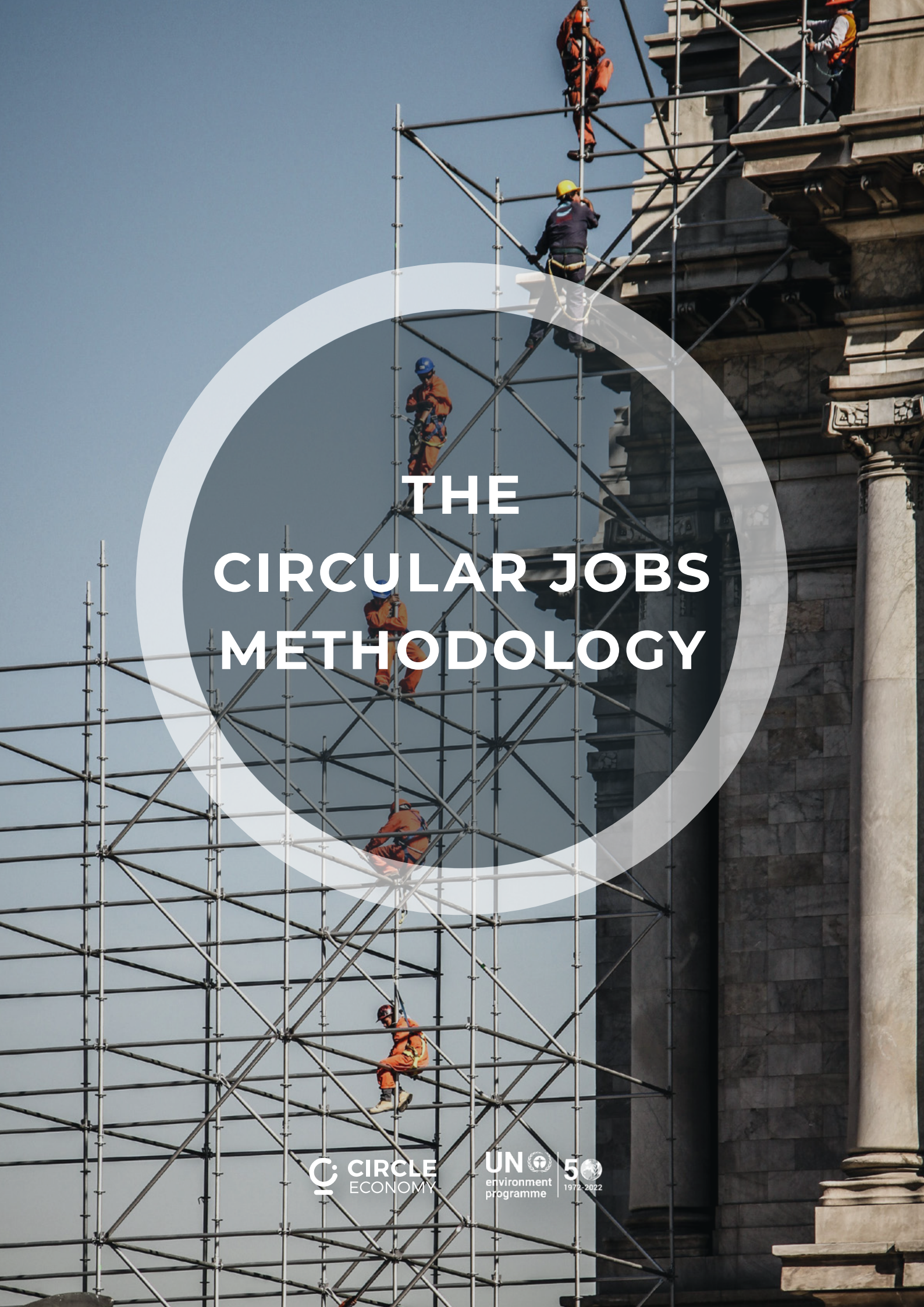

THE CIRCULAR JOBS METHODOLOGY

CIRCLE ECONOMY

UN environment programme 50 1972-2022

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INTRODUCTION

The adoption of circular economy strategies will result in changes in the labour market. To tap into the employment potential of the circular economy, policymakers and other stakeholders need evidence on how jobs contribute to deploying circular strategies and in which economic sectors they occur.

Circle Economy and the United Nations Environment Programme (UNEP) have teamed up to develop a methodology for measuring employment related to the circular economy. It makes use of the Key Elements framework[1] created by Circle Economy and the Spatial Microsimulation Urban Metabolism model developed by UNEP.*[2] The methodology processes employment, economic and environmental data. The results of the methodology are displayed on the Circular Jobs Monitor (CJM),[3] a digital tool that maps the number and range of jobs that drive circular strategies in different geographies.

What is a circular job?[4]

A circular job is any occupation that directly involves or indirectly supports one of the strategies of the circular economy, as according to the Key Elements framework. We differentiate between three types of circular jobs: core, enabling and indirectly circular jobs:

- **Core** circular jobs are all jobs that ensure the **closure of raw material cycles**, including jobs in repair, renewable energy, and waste and resource management. They form the core of the circular economy.
- **Enabling** circular jobs are jobs that remove barriers to and enable the **acceleration and upscaling of core circular activities**, including jobs that arise in leasing, education, design and digital technology. They form the supporting shell of the circular economy.
- **Indirectly** circular jobs are jobs that indirectly uphold the circular economy. These jobs occur in other sectors that do not play a direct role in furthering the transition to the circular economy but can still adopt circular strategies. They include jobs that **provide services to core circular strategies**, including jobs in information services, logistics and the public sector.

CORE CIRCULAR JOBS

PRIORITISE REGENERATIVE RESOURCES

Ensure renewable, reusable, non-toxic resources are utilised as materials and energy in an efficient way.

Agronomic advisors support healthy soil nourishment with organic fertiliser from composted manure and crop remnants. They combine strong interpersonal skills with ecological knowledge.

STRETCH THE LIFETIME

While resources are in-use, maintain, repair and upgrade them to maximise their lifetime and give them a second life through take back strategies when applicable.

Repair technicians repair appliances, machines or vehicles. They possess strong technical and manual skills which can be acquired through a formal and informal education and training.

USE WASTE AS A RESOURCE

Utilise waste streams as a source of secondary resources and recover waste for reuse and recycling.

Process operators sort waste for sellable products, for example to produce livestock feed made from waste flows. Although classed as practical-skill work, knowledge of the quality of incoming raw materials is crucial.

**In order to properly follow the step-by-step explanation, the reader must be knowledgeable in Input-Output methodology and matrix algebra.*

ENABLING CIRCULAR JOBS

DESIGN FOR THE FUTURE

Adopt a systemic perspective during the design process, to employ the right materials for appropriate lifetime and extended future use.

Circular equipment engineers design products to enable parts and resource recovery after the product's use phase. They excel in complex problem solving on a technical level designs for the future.

RETHINK THE BUSINESS MODEL

Consider opportunities to create greater value and align incentives through business models that build on the interaction between products and services.

Demand planners oversee supply and demand to make refurbishment a profitable business model. This role requires logical thinking and reasoning.

INCORPORATE DIGITAL TECHNOLOGY

Track and optimise resource use and strengthen connections between supply-chain actors through digital, online platforms and technologies.

Building information managers maintain data on construction components so as to keep track of these physical assets. They understand how to integrate and interpret virtual information management systems.

TEAM UP TO CREATE JOINT VALUE

Work together throughout the supply chain, internally within the organisation and with the public sector to increase transparency and create shared value.

Procurement professionals stimulate the demand for secondary materials and discern and connect new suppliers in order to do so. This profile points to the need for entrepreneurial, interpersonal skills.

STRENGTHEN AND ADVANCE KNOWLEDGE

Develop research, structure knowledge, encourage innovation networks and disseminate findings with integrity.

Teachers transfer knowledge and skills to the current and future workforce so as to equip workers with skills for circular economy strategies.

INDIRECT CIRCULAR JOBS

Examples of indirectly circular jobs are:

- The courier, who uses and maintains a fleet of second-hand bikes to bring packages to and from consumers as part of a reverse logistics scheme;
- The bank, which uses repair services to maintain the electrical equipment used in its day to day operations;
- The farmer, who utilises renewable energy in the production of their agricultural products.

Mapping economic sectors into the Key Elements framework

Based on the Key Elements framework, the sectors of economic activity as defined by the International Standard Industrial Classification (ISIC) are classified as core circular, enabling circular or indirectly circular. An indication is provided in the table below, followed by a full extract of ISIC level 4 sectors mapped to the Key Elements framework.

TABLE ONE - High-level mapping of sectors into the **Key Elements** framework applied

CIRCULAR JOB	ECONOMIC SECTOR	CIRCULAR ECONOMY ELEMENT	EXAMPLE SECTORS AND ACTIVITIES
DIRECT CIRCULAR JOBS	**CORE SECTORS**	Stretch the lifetime Use Waste as a Resource Prioritise regenerative resources	Repair services Recycling Renewable energy
	ENABLING SECTORS	Design for the Future Incorporate Digital Technology Rethink the Business Model Team up to Create joint Value Strenghten and Advance Knowledge	Industrial design and architecture Digital technology Renting or leasing activities Professional and networking associations Education services
INDIRECT CIRCULAR JOBS	**INDIRECT CIRCULAR SECTORS**		Government services Professional services

TABLE TWO - ISIC-4 Codes[5] mapped to the **Key Elements** framework

CIRCULAR ECONOMY ELEMENT	EXAMPLE SECTORS AND ACTIVITIES
Stretch the lifetime	3311, 3312, 3313, 3314, 3315, 3319, 4520, 4540, 9511, 9512, 9521, 9522, 9523, 9524, 9529
Use Waste as a Resource	3600, 3700, 3811, 3812, 3821, 3822, 3830, 4311
Prioritise regenerative resources	3500*
Design for the Future	7110, 7410
Incorporate Digital Technology	5820, 6110, 6120, 6130, 6190, 6201, 6209, 6311, 6312
Rethink the Business Model	4912, 4923, 5012, 5022, 5221, 5222, 5224, 5229, 7710, 7721, 7722, 7729, 7730, 9601
Team up to Create joint Value	7810, 8411, 8413, 8890, 9411, 9412, 9420
Strenghten and Advance Knowledge	1811, 1812, 5811, 5812, 5813, 5819, 7210, 7220, 7310, 7320, 8521, 8522, 8530, 8541, 8542, 8549, 8550

Steps to quantify jobs

1. DATA SOURCES

The Circular Jobs Methodology requires three main data sources for a correct estimation of circular jobs.

- Macro-economic data:
  - National Input-Output Tables (IOTs) from EORA database.
- Employment data:
  - National employment data at granular sectoral level
  - Regional/City employment data at granular sectoral level
- Material data:
  - National Raw Material Equivalents (RME) data to calculate Material Import Dependency.

**The Renewable Electricity Production Sector Codes at ISIC level 4 are not standardised, therefore bottom-up data is used to establish proxy codes for 3500—Production of Renewable Electricity.*

2. QUANTIFYING CIRCULAR ACTIVITY

Core, enabling and indirectly circular sectors rely on assumptions about the percentage of economic activity demanded that is considered circular. This is based on the interaction between different economic sectors making use of IOTs.

IOTs describe the economy as an integrated system of monetary transactions among industries, consumers and capital, with rows representing the 'source' of activity (industry output or supply) and columns representing the 'destination' (industry input or demand). The sectors in the rows and columns are classified using the ISIC mapping indicated above. For an exhaustive theoretical background on IOTs and Input-Output Analysis (IOA), please refer to Miller and Blair (2009).[6] Generally, IOTs are produced by National Statistical Institutes (NSI) and are therefore at the national level. Whenever the scope of the analysis is at a lower geographical level, for instance, regional or city-level, the Spatial Microsimulation Urban Metabolism (SMUM) model developed by UNEP is used to downscale the intermediate demand matrix based on sector-specific employment data.

Sector classifications can vary greatly between different IOTs. Most tables are specified at ISIC level 2 or similar, as opposed to ISIC level 4, as per the classification table. Because sectors at ISIC level 2 are still quite broad and incorporate many sub-sectors, they can often be intended as a combination of core, enabling and indirect industries. In order to distinguish between sub-sectors, corresponding proportions must be applied to every row and column to disaggregate the broad sectors, thereby exposing fully core, enabling and indirectly circular sectors. We calculate these proportions using granular employment figures at ISIC level 4 and apply it to each ISIC level 4 sector. This transformation is displayed in the image below where Table three is transformed into Table four.

TABLE THREE - Subset of original IO table

	SECTOR **B**
SECTOR **A**	100

TABLE FOUR - Subset of original IO table with circular proportions applied

	SECTOR **B** - **CORE**	SECTOR **B** - **ENABLING**	SECTOR **B** - **INDIRECTLY**
SECTOR **A** - **CORE**	36	24	0
SECTOR **A** - **ENABLING**	24	16	0
SECTOR **A** - **INDIRECTLY**	0	0	0

Once the original table has been disaggregated to ISIC level 4, we can determine circular activity within core, enabling or indirectly circular sectors. The estimation of these circular employment shares is based on the inter-industry relationships between sectors and on the assumption that monetary transactions in the form of supply and demand of products and services are a proxy for employment generation.

3. ACCOUNTING FOR MATERIAL IMPORT DEPENDENCY

Material Import Dependency (MID) is defined as an index of material usage and resource efficiency for economic sectors at the national level, accounting for imported material as a share of the total material used to meet domestic demand.

MATERIAL COEFFICIENT

$$RMI_{ij} = Z_{ij} * M_i(Domestic)$$

where M is monetary import dependency
Z is the inter-industry economic activity
RMI is Raw Material Import Dependency

$$MD_{ij} = Z_{ij}(Domestic) * M_i(Domestic)$$
$$MI_{ij} = Z_{ij}(Imports) * M_i(Imports)$$

$$MID_i = \frac{\Sigma MI_j}{\Sigma(MD_j + MI_j)}$$

Where MID_i is the Material Import Dependency of sector i

In the EORA database, information about imports and exports are available for each country in monetary and material terms. We choose to calculate the MID indicator by looking at the share of imported material weight over the total weight used in the production of final products.

4. CALCULATING CIRCULAR ACTIVITY PER SECTOR

In order to estimate circular activity within each sector, we calculate the amount of materials (along the supply chain) that are required to meet the final demand. We do this by applying the Leontief Inverse to the final demand vector to determine the proportion of circular activity over the total economic output per sector. This coefficient will also determine the proportion of employment that takes part in circular activities, finally referred to as circular jobs.

TABLE FIVE - Schematic representation of circular activity per sector

INDUSTRY BY INDUSTRY IO TABLE	Core sector	Enabling sector	Indirect sector	Original final demand	Circular final demand	1 - MID
Core sector	a1	b1	c1	d1	(D1)*1	M1
Enabling sector	a2	b2	c2	d2	$D2 * \left[\frac{A2}{A2 + B2 + C2}\right]$	M2
Indirect sector	a3	b3	c3	d3	$D3 * \left[\frac{C1 * M1 + C2 * M2}{\Sigma C}\right]$	M3
Linear sector (mining & fossils)	a4	b4	c4	d4	0	M4
Totals	Σa	Σb	Σc			

The formula to determine the circular coefficient as a share of the final demand (varying between 0 and 1) differs according to the sector and the Key Element associated with the sector code.

Core sectors demand

The final demand of core sectors is always regarded as circular, therefore delivering a coefficient equal to 1.

$$\text{Circular Activity}_{\text{CORE}} = \frac{\Sigma Z_{\text{CORE}}}{\Sigma Z_{\text{CORE}}} = 1$$

Where Z is economic activity

Enabling sectors activity

For enabling sectors, we assume that the extent to which they can be considered circular is determined by the share of supply (output) of enabling products or services to core sectors (cell A2) over the total supply of enabling products or services (cell D2). This can also be thought of as the (circular) market share of enabling-to-core sectors over the total enabling output.

$$\text{Circular Activity}_{\text{ENABLING}} = \frac{\Sigma Z_{\text{ENABLING, CORE}}}{\Sigma Z_{\text{CORE}}}$$

Where Z is economic activity

Indirectly circular sectors

For indirectly circular sectors, we assume that the extent to which they can be considered circular is determined by the share of demand (input) of indirectly circular sectors for core (cell C1) and enabling (cell C2) products or services over the total demand of indirectly circular sectors. The MID of core (M1) and enabling sectors (M2) is used in this case to discount non-domestic extraction. This can also be thought of as the (circular) input coefficient of indirectly circular sectors from core plus enabling over the total input of indirectly circular sectors.

$$\text{Circular Activity}_{\text{INDIRECTLY}} = \frac{\Sigma Z_{\text{CORE, ENABLING}} * M_{\text{ENABLING}} + Z_{\text{CORE, INDIRECTLY}} * M_{\text{INDIRECTLY}}}{\Sigma Z_{\text{INDIRECTLY}}}$$

Where Z is economic activity

Demand for linear sectors

Conversely to the demand for core sectors, the final demand for extractive sectors like mining and fossil fuels industries is always regarded as linear and takes the coefficient 0.

Geographical tiers

This methodology could be applied to three levels of territory. These territories correspond to the administrative boundaries of the region of interest. For example, in Europe, we apply Eurostat's Nomenclature of Territorial Units for Statistics (NUTS) regions and display NUTS0-NUTS2-NUTS3, where NUTS0 refers to the state boundaries. Although this territorial classification aims to describe regions at all hierarchical levels, the regions at a given level can differ significantly with respect to land area, population, economic strength and administrative importance.

We adjust the three tiers on display according to the needs of the region under study. In the case of NUTS0, the application of the methodology is straightforward as it uses national statistics provided by the nation of interest. Usually, economic, employment and environmental (RME) statistics are provided at this territorial level. In this case, the implementation of the methodology will not require microsimulation for the urban metabolism and it is possible to get a number for circular jobs processing national IOTs, employment data and RME data directly. For lower tiers (NUTS1, NUTS2 and NUTS3), the SMUM model must be implemented depending on the granularity of the analysis, for instance, regional or local. This is because RME data at the regional or local level could be unavailable or the data quality could be poor.

For example:

- Scotland is a NUTS1 region of the United Kingdom (NUTS0). Here we display NUTS1 - NUTS2 - NUTS3.
- Cornwall and Isles of Scilly is already a NUTS3 region. We applied the calculation at that level and did not show aggregated figures for surrounding regions, or other regions in the same NUTS0 territory, in other words, across the United Kingdom.
- Recife in Brazil is considered a third-level region, similar to the NUTS3 nomenclature applicable to territories in the European Union.

Wherever the methodology is applied it follows the GeoNames geographical database, an international repository with more than 4.8 million populated places, containing over 27 geographical names and 12 million unique features. All of the territorial units included in the CJM are harmonised to make statistics comparable.

Advantages and limitations

The approach holds advantages and limitations:

- The method employs up-to-date, reliable and existing macro-economic data to calculate the number of jobs in the circular economy. There is no need to collect new data, a time-intensive and costly process.

- This data is structured following the ISIC classification: an internationally standardised classification system. This allows for replication and comparison of results over time and across borders.
- Depending on the territorial location, a different classification system could be in place. For instance, the European region implements the NACE Rev. 2 system, which in some cases could differ from the ISIC classification at the 4-digit level. Even though ISIC is the international standard, regions have opted for alternative classifications to better represent certain economic activities. In the case of data provided by a different classification system, it is required to harmonise industrial codes to make the country, region or city in question comparable to the other observations already included in the CJM.
- The method consists of an original application of IOA, which is currently under peer review. Additionally, the method inherits all the assumptions and constructs behind the production of IOTs.[6]
- The method scales down and aggregates employment data based on monetary information. The relationship between employment and monetary transactions rests on the following assumptions:
  - Employment is a good proxy for downscaling national IOTs to lower geographical scopes.
  - Employment is a good proxy for disaggregating sectors in IOTs, which implies full proportionality between monetary transactions and employment.
  - The volume of monetary transactions is a good proxy for estimating the number of jobs (for the estimation of circular market shares and input coefficients), which again implies full proportionality between monetary transactions and employment.
- The method allows for bottom-up estimation of circular activity within sectors.
- The quantification of material use has been a challenge mainly for local economies. Commonly, this quantification relies on urban metabolism approaches. For instance, the Economy-Wide Material Flow Analysis (EW-MFA), which looks at the entire economy of a city-system in an attempt to quantify all material flows within the system. It uses a physical IOT for the description of material flows: for example, Substance Flow Analysis (SFA), which could focus on a group of materials or a specific flow, or the Life Cycle Assessment (LCA) approach focused on a specific process.
- The quality of results produced from data collected at a local level is highly dependent on the quality of the data, and may be limited by ease of collection. Collection of data at a local level can be time-consuming and costly. Usually, key information is scattered or the government may have to retrieve it from costly private repositories.
- The current methodology only calculates MID for each sector at a national level. By assuming the same national-level import dependencies for regions and cities, there is a possible bias towards large countries with lower import dependencies at a national level.
- As the current methodology considers data at an aggregate level for population and employment, it is not possible to observe policy effects on marginalised groups with this methodology at present. For example, The current methodology does not yet incorporate the informal dimension of the labour market.

Considering both the opportunities and limitations, the current methodology makes an important contribution and forms the basis of a monitoring practice for employment in the circular economy.

Updates to the methodology

With the aim of continuous improvement in monitoring jobs in the circular economy, Circle Economy and UNEP update their methodology for quantifying circular economy jobs on a yearly basis, using newly available data from more recent years where possible. It therefore follows that in some cases the results shown in reports using previous versions of the methodology may differ from those displayed on the CJM. In those cases, we include a method update notice on the landing page of all relevant reports.

REFERENCES

1. Circle Economy. (2021). The key elements of the circular economy framework. Circle Economy
2. United Nations Environment Programme. (n.d.). Spatial Microsimulation Urban Metabolism (SMUM) tool. Retrieved from UNEP
3. Circle Economy. (n.d.). Circular jobs monitor. Retrieved from Circle Economy
4. Circle Economy. (2021). The circular jobs definition framework. Circle Economy
5. United Nations. Statistical Division. (2008). International Standard Industrial Classification of all Economic Activities (ISIC) (No. 4). United Nations Publications.
6. Miller, R. E., & Blair, P. D. (2009). Input-output analysis: foundations and extensions. Cambridge University Press.