TOWARDS A SOUTH AFRICAN CIRCULAR ECONOMY MONITORING SYSTEM (SACEMS)

PHASE 1: DRAFT SET OF INDICATORS FOR MONITORING SOUTH AFRICA'S TRANSITION TO A CIRCULAR ECONOMY

GRANT NO. CSIR/BEI/WRIU/2023/060

FINAL REPORT

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Abbreviations

ACEN	African Circular Economy Network
AFOLU	Agriculture, Forestry and Other Land Use
AU	African Union
BOKU	University of Natural Resources and Life Sciences, Vienna
BRICS	Brazil, Russia, India, China, South Africa
CBD	Convention on Biological Diversity
CE	Circular Economy
CEIC	The Circular Economy Indicators Coalition
CEMF	Circular Economy Monitoring Framework
CGRi	Circularity Gap Reporting initiative
CMUR	Cyclical Material Use Rate / Circular Material Use Rate
CO_2 / GHG	Carbon Dioxide / Green House Gas
DFFE	Department of Forestry, Fisheries and the Environment
DFI	Development Finance Institution
DMC	Domestic Material Consumption
DSI (now DSTI)	Department of Science & Innovation (now Department of Science, Technology & Innovation)
DWS	Department of Water and Sanitation
EEA	European Environmental Agency
EMF	Ellen MacArthur Foundation
EPR	Extended Producer Responsibility
ESG	Environmental, Social and Governance
EU	European Union
EW-MFA	Economy-Wide Material Flow Analysis
GBF	Global Biodiversity Framework
GDP / GVA	Gross Domestic Product / Gross Value Added
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ILO	International Labour Organisation
ISO	International Organization for Standardisation
IWMP	Integrated Waste Management Plan
MF	Material Footprint
MFA	Material Flow Analysis
MoA / MoU / NDA	Memorandum of Agreement / Memorandum of Understanding / Non-Disclosure Agreement
MSMEs / SMMEs	Micro, Small and Medium-sized Enterprises / Small, Medium and Micro Enterprises
NAQI	National Air Quality Indicator
NBA	National Biodiversity Assessment
NWMS	National Waste Management Strategy
PACE	Platform for Accelerating the Circular Economy
PROs	Producer Responsibility Organisations
RDI	Research, Development and Innovation
RLI / RLIe	Red List Index (species) / Red List Index of ecosystems
SACEMS	South African Circular Economy Monitoring System
SANBI	South African National Biodiversity Institute
SDGs	Sustainable Development Goals
STATSSA	Statistics South Africa
STI	Science, Technology and Innovation
STI4CE	Science, Technology and Innovation for a Circular Economy
UCT	University of Cape Town
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

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1. Introduction and aims

The circular economy has emerged as an opportunity for reframing economic development and unlocking new opportunities for growth and employment, while achieving global commitments relating to climate change and sustainable development, and reducing the negative impacts associated with both resource extraction and waste. In contrast to the linear economic model, a circular economy "entails keeping materials and products in circulation for as long as possible through practices such as reuse of products, sharing of underused assets, repairing, recycling and remanufacturing" (Schröder, 2020).

The circular economy is based on three principles, driven by design (Ellen MacArthur Foundation (EMF), 2024):

1. Eliminate waste and pollution
2. Circulate products and materials (at their highest value)
3. Regenerate nature.

The Department of Science and Innovation's (DSI's) Science, Technology and Innovation (STI) White Paper (2019), as well as its Decadal Plan (2022), identify the circular economy as a key new source of economic recovery and growth, and as a priority area for STI. The need to transition towards a circular economy is therefore embedded in South African policy.

However, there is currently no agreed upon approach to assess the implementation of the circular economy (CE) in South Africa, or to monitor South Africa's progress towards a CE. In transitioning from a linear to a circular economy, it is important to monitor the key trends and patterns to understand how the various elements of the CE are developing over time, and to

[1] https://acen.africa/project/south-africas-national-circular-economy-dialogue/

assess whether sufficient action has been taken. Tracking progress should inform the setting of new priorities towards the long-term objective of a CE. A monitoring framework should not only be relevant to policy makers, but should inspire all relevant role-players, and drive new innovations, while also enabling a structure for potential monitoring and reporting.

The CE is not limited to specific materials or sectors, but cuts across the entire economic system. In South Africa, various indicators are in use at a sectoral level, but there is a significant gap in terms of cross-sectoral monitoring. While there are efforts at developing CE indicators in other countries, there is a need to assess the extent to which these could potentially be adapted for tracking progress towards a CE at a national level in the South African context.

In short, there is a clear need for a holistic, consistent set of indicators to track South Africa's progress towards a CE, based on a clear understanding of what needs to be measured. At the same time, the indicators need to be coupled to a comprehensive assessment framework for the South African context that is flexible, representative, and easy to use; while reflecting the principles of the CE, as well as South Africa's key policy priorities.

The aim of this project is to develop a framework and indicators for tracking South Africa's progress towards a CE; as well as guidance for monitoring and populating each indicator (data sources and custodians, methodologies etc.). Ultimately, the intention is to lay the groundwork for the development of a South African Circular Economy Monitoring System (SACEMS).

This aim will be achieved in a phased approach, as follows:

- The current Phase (Phase 1), which runs from November 2023 to December 2024, is focused on developing the underlying framework; as well as a draft set of indicators for monitoring South Africa's CE transition.
- In a proposed Phase 2, the draft indicators will then be tested with stakeholders, refined and finalised. In addition, guidance on measurement and monitoring systems will be developed. This will provide the foundation for the development of the SACEMS in future work.

This report presents the results of Phase 1, namely the framework and draft set of indicators for monitoring South Africa's progress towards a CE. It is important to emphasise that **the indicators identified in this report are a draft set of proposed indicators only; which should be further validated through consultation with stakeholders**.

2. Scope of the study

Tracking South Africa's progress in transitioning to a CE requires a clear understanding of what needs to be monitored, and how it will be measured. The CE has often been narrowly interpreted in South Africa as a 'waste' issue; i.e., as synonymous with recycling. However, in the more recent international literature, the circular economy has come to be seen as a far broader concept. It is about rethinking the way that resources are used and how products are designed, to enable more sustainable resource management, keep products and materials in

use for as long as possible, and to avoid pollution and waste from being generated in the first place. It also has broader socio-economic and environmental benefits, unlocking new opportunities for economic growth and employment; while contributing toward global commitments relating to climate change, biodiversity, and sustainable development.

Circularity can be measured at various levels, often distinguished as:

- Macro-level indicators (national, regional and city-level)
- Meso-level indicators (sectoral level, or referring to clusters of industrial activity, such as industrial parks or industrial symbiosis programmes)
- Micro-level indicators (individual products or organisations) (Ghisellini et al., 2016; Kirchherr et al., 2017; PACE, 2021).

International progress with measuring circularity has suggested that circular metrics for a business may look very different to the metrics relevant for policymakers. In the private sector, different sectors have taken diverse approaches, resulting in the formation of sectoral silos; and in fragmented, non-comparable Environmental, Social and Governance (ESG) disclosures; as well as potential greenwashing (FICCI and Accenture, 2022).

In South Africa, with its three spheres of government, it is important to clearly define the scope of the CE monitoring framework, so as to accurately determine the correct metrics to use. Given the intention to move towards a standard reporting framework to track progress towards a CE, it is imperative to standardise on a unified measurement framework at a national level. Standardisation in measurement and reporting will allow for assessment of the impact of government regulations and private sector initiatives on circularity of the economy at a country level (FICCI and Accenture, 2022).

It could also be argued that, given the complexity of monitoring progress towards a CE at a country level, it may make more sense to focus on the sectoral level. However, at the inaugural expert consultation workshop for the project, hosted online on 28 February 2024, it was agreed that the scope of the study should primarily be at the macro (national) level; with the intention of developing a suite of indicators that could be used by national government to track progress toward a CE. Nevertheless, it was argued that the macro level approach should ultimately be coupled with a focus at a more detailed level (e.g. at a sectoral and/or city level), to ensure that the underlying detail would not be ‘lost’.

In this first phase of the study, the focus is on identifying macro-, national level indicators only; rather than attempting to also incorporate indicators at a sectoral or sub-national level. It is proposed that sector-specific detail, as well as indicators for sub-national geographic levels, could be added in future phases.

Nevertheless, the study began with a broad overview of existing CE indicator frameworks at all levels (including sectoral, sub-national, organisational, material and product level). The intention of this review was to identify existing frameworks and indicators which could potentially be used as a basis to start adapting and developing a set of CE indicators for South Africa, to draw possible lessons from these existing frameworks, and/or to adopt specific elements of these frameworks that may be relevant for monitoring the transition to a CE in the

South African context. The detailed findings from this review are captured in the interim report[2] submitted in March 2024.

Given the focus of this phase of the study on developing a framework and identifying a draft set of indicators for monitoring South Africa's progress towards a CE at a national level, this report focuses on:

- providing a brief overview of existing national level CE indicator frameworks from other countries;
- outlining the methodology applied to develop a draft national level CE indicator framework and to identify potential indicators for South Africa; and
- presenting the framework and the draft set of CE indicators for South Africa; as a first step towards the development of a South African Circular Economy Monitoring Systems (SACEMS).

3. Frameworks for CE indicators at a national level

Given the multi-faceted nature of the circular economy, a broad range of indicators is needed for monitoring progress toward a CE at a national level. Policymakers may choose to measure progress in terms of the circularity of materials within the economy, or to measure the broader socio-economic and/or environmental impacts of the transition to a CE; or both.

For example, the OECD compiled an inventory of 474 circular economy-related indicators between 2018 and 2020 (OECD, 2021). The inventory classifies CE indicators into five main categories, as follows:

- **Environmental** – indicators related to direct impacts on the ecosystem; including emissions, output material processes, and production and consumption
- **Governance** – indicators related to education, capacity building and regulations
- **Economic and business** – indicators expressed in monetary units such as value added by the CE and public investment in CE projects; as well as indicators specifically focussing on activities performed by and within organisations
- **Infrastructure and technology** – indicators that measure the existence of tools, technologies and spaces that boost the CE
- **Societal** – indicators associated with employment and human resources.

In Europe, the Bellagio Declaration (EEA, 2021), developed through a collaboration between the European Environmental Agency (EEA), the environmental agency of Italy (ISPRA), and representatives from a number of other European countries; aims to guide national and regional authorities in the development of CE monitoring frameworks and indicators. The framework consists of seven principles (See Figure 1) for ensuring that CE monitoring systems capture all relevant aspects of the CE, and that all relevant stakeholders are involved (EEA, 2021).

[2] Available on request.

1. Monitor the circular economy transition

Monitoring the transition towards a circular economy needs to holistically consider all relevant initiatives—public and private—across the economy. It should capture the full extent of changes happening to the material and waste flows, products over their lifecycles, business models, and consumer behavior, including the economic, environmental, and social dimensions of thse changes.

2. Define indicator groups

A robust monitoring system for the circular economy transition should include:

- Material and waste flow indicators to monitor changes throughout the material lifecycle, including resource efficiency dimensions
- Environmental footprint indicators to capture the impact across the full lifecycle of products and materials, so that spill-over effects are assessed, and planetary boundaries are respected
- Economic and social impact indicators to capture positive as well as negative impacts that may occur during structural changes of the circular economy transition
- Policy, process, and behavior indicators to capture the implementation of specific circular economy policy measures and initiatives, in particular for key sectors

3. Follow indicator selection criteria (RACER)

Indicators included in a transparent monitoring framework for the circular economy transition should follow RACER criteria: Relevant, Accepted, Credible, Easy to monitor, and Robust

However, development of innovative, experimental indicators should also be encouraged, even if not all RACER criteria may initially be fulfilled

4. Exploit a wide range of data and information sources

The data underpinning a monitoring framework for the circular economy transition may consist of:

- Official statistics from the European statistical system or national statistical offices, other data produced by EU institutions, national or local authorities, as well as from international organizations—exploiting and integrating official information sources
- Policy information—tracking policy developments and implementation including qualitative assessments
- New data sources—exploiting new information sources beyond official statistics, such as data from the private sector and trade associations, research models, or from new applications of digital technologies

5. Ensure multi-level monitoring

Monitoring should capture changes happening across all levels of the economy. It should address both public and private sector stakeholders, and different governance levels from global to local. A well-defined monitoring and governance structure is required to promote the development of coherent metrics that capture the multiple dimensions of the circular economy transition

6. Allow for measuring progress towards targets

Monitoring circular economy implementation should help assess progress to relevant policy targets and objectives, thus helping inform if the right policies are in place and well implemented, or if corrections or new policies are needed

7. Ensure visibility and clarity

A well-designed circular economy monitoring framework will inform policymakers, stakeholders and citizens. Appropriate indicators as well as user-friendly methods of communication, such as dashboards, should therefore be identified.

Where possible, open data principles should be followed, with data being made fully and freely available.

Figure 1: The Bellagio Principles for circular economy monitoring frameworks (Source: PACE 2021).

The Bellagio framework also identifies four groups of indicators that every robust CE monitoring system should include (EEA, 2021):

- **Material and waste flow indicators**: monitor changes throughout the material life cycle, including resource efficiency dimensions
- **Environmental footprint indicators**: capture the impacts across the full life cycle of products and materials, so that spill-over effects are assessed, and planetary boundaries are respected
- **Economic and social impact indicators**: capture positive as well as negative impacts that may occur during the structural changes of the CE transition
- **Policy, process, and behaviour indicators**: capture the implementation of specific CE policy measures and initiatives, in particular for key sectors.

For example, the European Union (EU) Circular Economy Monitoring Framework (CEMF) (European Union, 2024) follows the logic and structure of the EU Circular Economy Action Plan (EU, 2020), while also drawing from and complementing the existing Resource Efficiency Scoreboard and Raw Materials Scoreboard. The revised framework groups indicators into five dimensions: **production and consumption**, **waste management**, **secondary raw materials**, **competitiveness and innovation**, and **global sustainability and resilience**.

PACE (2021) expanded on the four Bellagio indicator categories to assess the extent to which existing national CE indicator sets cover the following key aspects of the CE:

- Waste
- Recycling
- Material flows
- R-strategies *beyond recycling* (Refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose etc.).
- Policy and process
- Environmental impact
- Economic and social impact.

They assess CE indicator sets developed (or under development) within 20 different countries and regions (including the EU's CEMF). Most of the work to date in developing national-level CE indicator sets has been conducted in European or other developed countries (e.g. Japan and Canada); although a number of developing countries (e.g. China, Colombia and Chile) have also made significant strides (see Figure 2).

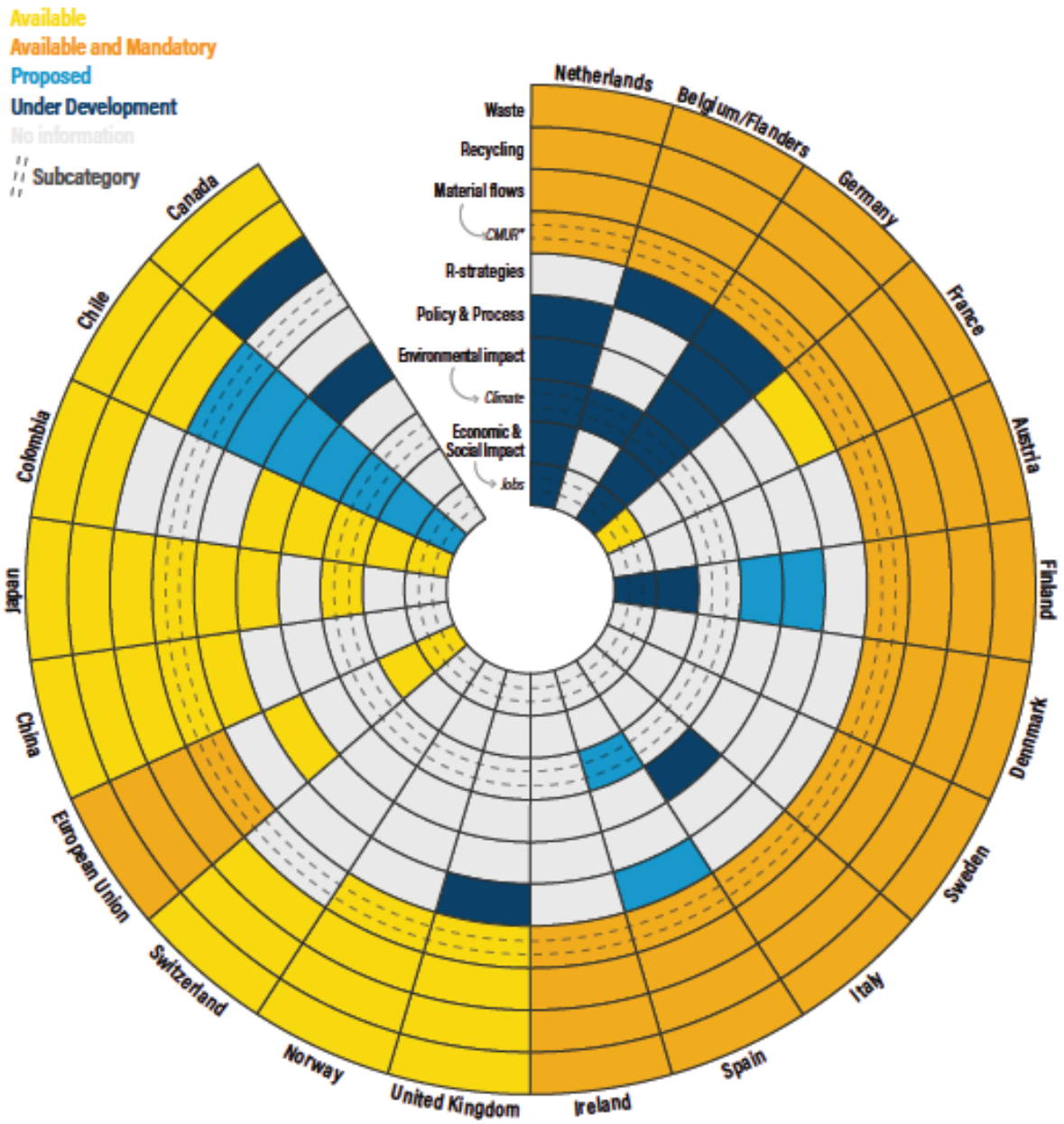

Figure 2: Scope of existing national circular economy indicator frameworks (Source: PACE 2021).

PACE's (2021) analysis (see Figure 2) shows that:

- Most existing national CE indicator sets tend to focus on indicators related to **waste**, **recycling** and **material flows**; as these tend to be easier to measure and/or are aligned with data that is already typically collected at a national level (PACE, 2021).
    - For material flows, a common indicator is the Cyclical Material Use Rate (CMUR), which is derived from Economy-Wide Material Flow Analysis (EW-MFA). This indicator, also known as the Circular Material Use Rate, Circularity Rate or Total Cycling Rate; measures the share of secondary raw materials in the total use of materials in an economy (PACE, 2021). It is the inverse of the 'Circularity Gap', which is reported in Circle Economy's Circularity Gap Reporting Initiative (CGRi) (Circle Economy, 2024). The CMUR and/or the

Circularity Gap are often presented as 'headline indicators' in various reporting initiatives, presenting an overall snapshot of progress towards circularity.

- However, most existing national CE indicator sets **lack** indicators for:
  - The various R-strategies, aside from recycling (rethink, reuse, repair etc.); as these are typically more difficult to measure and are not well aligned with existing data collection efforts. According to PACE (2021); "the challenge with developing indicators for measuring the uptake of R-strategies is the level of data required, calling for detailed and granular data at the meso and micro level for product categories and specific materials. Such data can be difficult to obtain, may not be collected on a regular basis or publicly available, and may suffer from data quality and consistency issues. As a result, R-strategy indicators are currently less commonly included in CE indicator sets".
  - Policy and process indicators; aside from green public procurement.
  - The environmental, economic and social outcomes of a circular economic transition; e.g. impacts related to climate and biodiversity. This could be because methodologies for calculating the impacts of a CE on climate change and biodiversity don't yet exist, or are underdeveloped (PACE, 2021).

Figure 3 provides a high-level overview of the state of data availability and of challenges in data collection associated with these different categories of indicators at the national level (PACE, 2021). While this assessment was conducted for those countries where CE indicator sets have already been developed or are in progress; it is likely that many of the same challenges will apply in other countries, or may in fact be more significant; given that those countries who have developed national CE indicator sets are likely to be more advanced in terms of data collection.

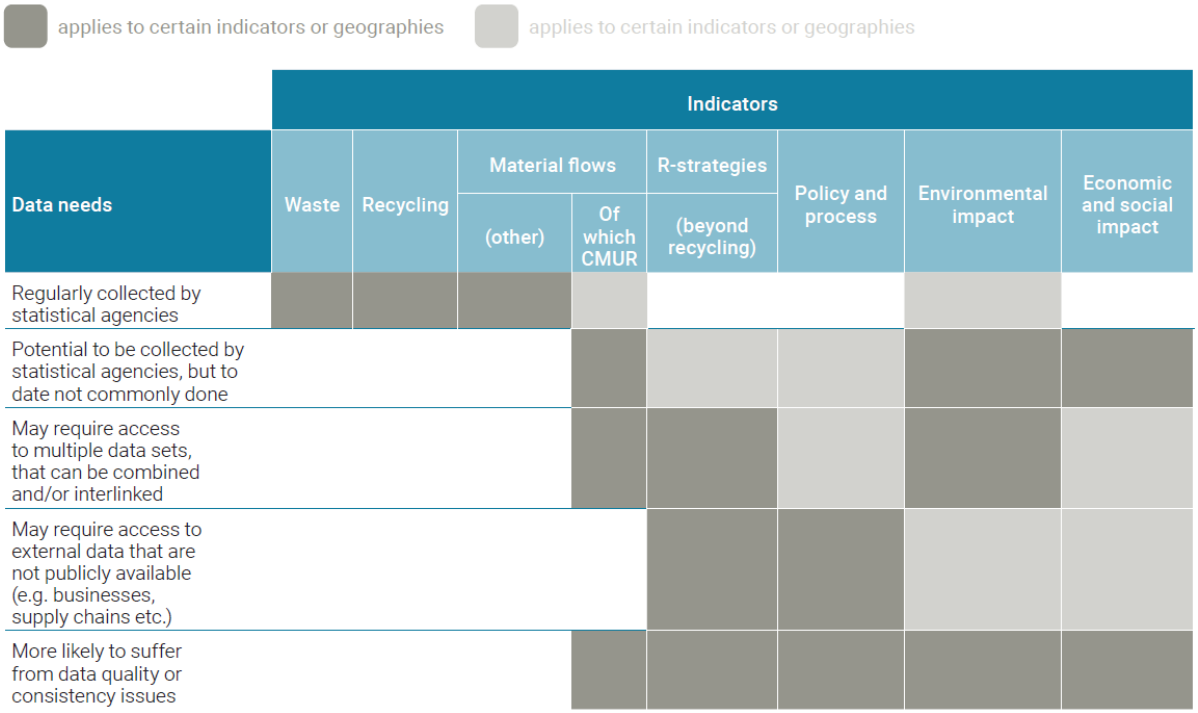

Figure 3: State of data availability and challenges in data collection for different categories of CE indicators (Source: PACE, 2021).

The Bellagio framework also highlights that different types of indicators are needed to tell different parts of the story. For example, some indicators will focus on measuring the transition from a linear to a circular model; while others will measure the impact of the transition. In addition, some indicators will focus on the processes taking place within the economy itself, others will focus on the inputs to and outputs from the economy, while still others will measure the ultimate impacts of the CE transition, in terms of environmental and social outcomes (PACE, 2021).

These different types of indicators may be more or less relevant depending on the level of implementation of the CE in the specific country. For example:

- At the early stages of the CE transition, policy and process indicators, reflecting the extent to which an effective enabling environment (e.g. policy and financing etc.) are in place, will be important.
- On the other hand, indicators relating to the ultimate intended social and environmental outcomes of a CE (e.g. impacts on employment, biodiversity and climate) may not yet be relevant at the early stages of the transition, other than for providing a baseline against which the impacts of the CE transition can be assessed at a later stage, once the CE is more firmly entrenched and has had an opportunity to contribute towards these outcomes. Impact monitoring (i.e. assessing the environmental and social outcomes of the CE transition) therefore gains greater importance in the later stages of the transition (PACE, 2021).

Furthermore, for purposes of communicating and reporting on progress; it is often useful to distinguish between different tiers or levels of indicators; for example:

- **headline indicators**, which provide a very high level, aggregated overview (e.g. a summary of the overall circularity of the economy); and
- **component indicators**, which provide more detail on specific elements (e.g. material flows, waste, and implementation of the various 'R-Strategies'; as well as impacts on e.g. employment, climate and biodiversity).

As such, existing CE indicator frameworks employ a variety of structures to distinguish between different stages of the CE transition, and/or between different levels of indicators. For example:

- PACE (2021) distinguishes between a **formative phase** (pre-development and take-off) and a **growth phase** (acceleration and stabilisation)
    - In the formative phase, the focus is on creating the right conditions for strong growth in circular products and services later in the process (i.e., the focus is on innovation, the creation of new supply chain networks and relationships, new revenue and business models, the identification of new partners, changes to existing organisations in line with circular models, etc).
    - The growth phase, on the other hand, is "characterized by a rapid increase in the market share of circular products and services" (PACE 2021).

- In its framework for monitoring the CE transition process in the Netherlands, the Netherlands Environmental Assessment Agency distinguishes between 'means', 'activities' and 'achievements'. The framework consists of three layers of indicators:
    - 'Raw material use'; represented by material inputs, use and stock levels, and outputs;
    - 'The effects of raw material use', i.e. environmental and (socio)economic impacts; and
    - 'The progress of the transition process', which is focused on application of the various R-strategies (PACE, 2021).
- The EU Resource Efficiency Framework (see Figure 4) distinguishes between headline, dashboard/performance and transition/process indicators (PACE, 2021):
    - **Headline indicators** provide an overall indication of how circular the economy is (circularity of an economy expressed in percentages or resources consumed per unit; e.g. % circularity of an economy as expressed in Circularity Gap Reports).
    - **Dashboard/performance indicators** add further details to the headline indicators (e.g. if the headline indicator is absolute resource consumption or resource productivity, this could be broken down into dashboard indicators for specific types of resources).
    - **Transition/process indicators** focus on drivers / enablers for the transition to a CE, and on progress made (PACE, 2021).
- China's CE indicator framework distinguishes between:
    - 'Comprehensive' indicators, which focus on resource productivity and recycling rates (analogous to headline indicators in the EU framework);
    - 'Work' Indicators (focused on inputs, such as land, energy, and water; and
    - 'Reference' Indicators (focused on waste generation and disposal) (PACE 2021).
- Colombia's Circular Economy Information System is based on four components: extraction of environmental assets; production of goods and services; consumption and use; and closing and optimising material and product loops (PACE, 2021).
- At a city level, the 'Amsterdam Circular Monitor' (City of Amsterdam, 2020), based on the doughnut model (https://doughnuteconomics.org/), comprises of five core indicator sections; namely input indicators, throughput indicators, indicators for waste collection by public authorities, indicators for the waste treatment processes of regional industries, and indicators for the social foundation.

Finally, indicators can also be categorised in a number of other ways; such as:

- Input, output, production, throughput, process, and consumption (demand) indicators.
    - In particular, measuring impacts associated with production and consumption is important, in order to properly capture the cross-boundary nature of resource use (PACE, 2021).
- Quantitative (expressed as absolute numbers, percentages, per unit, per capita, or per $ GDP) versus qualitative indicators (PACE, 2021).

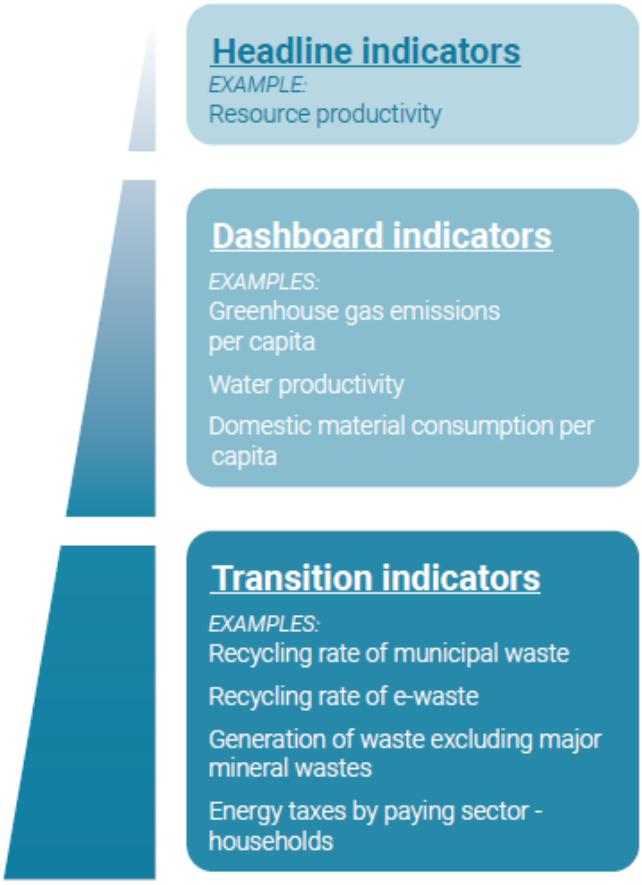

Figure 4: Categories of indicators in the EU Resource Efficiency Scorecard (Source: PACE, 2021).

4. Development of a framework for the South African Circular Economy Monitoring System

4.1. Approach: Principles, Criteria and Indicators (PCI)

In order to identify appropriate indicators for monitoring South Africa's progress towards a CE, it is critical to start by understanding exactly what it is that needs to be measured – in other words, what do we mean by a circular economy? What is it that we want to achieve?

The circular economy means different things to different people. It is often seen as synonymous with improved waste management and recycling, whereas it in fact a much broader concept, calling for a systemic change to the economy as a whole.

There are many definitions of the CE found in literature. Kirchher et al. (2017) analysed 114 different definitions of the CE. Their analysis found that the CE is "most frequently depicted as a combination of reduce, reuse and recycle activities, whereas it is oftentimes not highlighted that CE necessitates a systematic shift" (Kirchher et al., 2017). Furthermore, they found that many definitions fail to provide explicit linkages between the CE and sustainable development, and that many definitions seem to promote economic prosperity and environmental quality,

but ignore the impacts of a CE on social equity and future generations. In addition, definitions often overlook the role of business models and consumers as enablers for the CE.

In an analysis of the circular economy and related concepts, Geisendorf and Pietrulla (2018) proposed the following definition: “In a circular economy, the value of products and materials is maintained, waste is avoided, and resources are kept within the economy when a product has reached the end of its life”.

However, there is no globally agreed definition of the CE. In much of its previoius work, the CSIR has been applying the following definition: A circular economy “entails keeping materials and products in circulation for as long as possible through practices such as reuse of products, sharing of underused assets, repairing, recycling and remanufacturing” (Schröder, 2020).

However, even this definition is limited, in that it focuses on specific CE actions; rather than on the systemic shift that is required, or the outcomes that a CE is expected to achieve. It also ignores the more recent understanding of the main driver of the circular economy in the South African context; namely the CE being a development opportunity, based on more sustainable resource management (i.e., managing South Africa’s future development risks by keeping resources circulating productively within the economy) (Godfrey, 2021).

Indeed, it was mentioned by participants at the February 2024 expert consultation workshop that trying to agree on a definition will not necessarily be worthwhile; as definitions will tend to be reductionist, and achieving agreement on the wording will be difficult, while not necessarily adding value. Instead, it was argued that focusing on the **principles** of the circular economy (e.g. as per the EMF principles; see Section 1) would be a more sensible approach.

In order to identify indicators based on the principles of a circular economy, it is necessary to translate these high-level principles into more concrete, specific and measurable actions or impacts.

One approach for doing so is the so-called **Principles-Criteria-Indicators (PCI) approach** (see Figure 5), which we have previously applied in identifying relevant indicators aligned with the principles of the green economy (Nahman et al., 2016). The PCI approach is a structured, rigorous and consistent framework for the selection, identification or development of indicators, built hierarchically on the basis of broad, high-level **principles** describing the concept being measured, which are in turn broken down into more specific **criteria**, for which measurable **indicators** can then be identified (Nahman et al., 2016):

- **Principles** are defined as fundamental statements about a desired outcome; i.e. as fundamental laws or rules, serving as a basis for reasoning and action
- **Criteria** are the conditions that need to be met in order to comply with a Principle; i.e. desired states of the system which should be in place as a result of adherence to a Principle
- **Indicators** are the measurable states which allow assessment of whether or not a particular criterion has been met; i.e. qualitative or quantitative variables that can be assessed to check compliance with a criterion (Lammerts van Bueren & Blom, 1997; Prabhu et al., 1999).

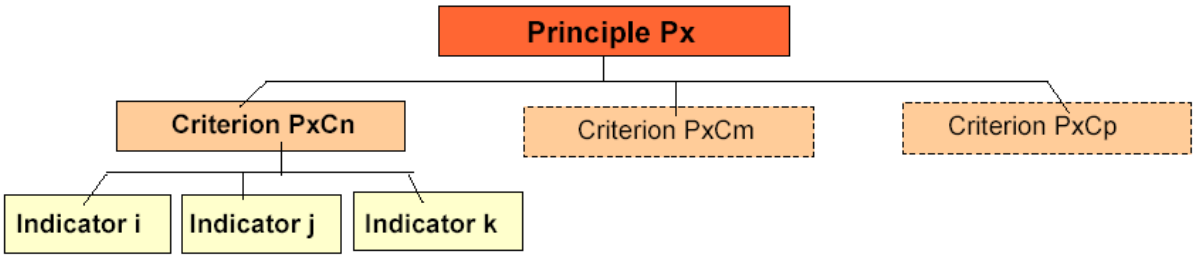

Figure 5: Overview of the Principle-Criteria-Indicator (PCI) approach for identifying indicators based on high level principles (Source: Rey-Valette et al., 2008).

The PCI approach therefore assists in translating the high-level principles associated with an abstract concept into more specific, concrete elements; as well as measurable indicators.

Since the principles of the CE are relatively well known and understood, it was proposed that the PCI framework be used for identifying relevant indicators for the South African Circular Economy Monitoring System (SACEMS). This approach would help to ensure that all of the key elements of the CE are covered within the monitoring framework. The approach also allows for context specific principles and criteria to be added (e.g. relating to social / socio-economic aspects), thereby ensuring relevance to the local context and to South Africa's key policy priorities.

The approach involves (1) firstly, identifying the high-level principles of the concept to be measured, (2) identifying relevant criteria which unpack the principles in more specific detail, and finally (3) identifying measurable indicators to reflect progress towards meeting each of the criteria. In the following section, we briefly review the **principles** of a circular economy, as the first step in the development of the PCI framework. The criteria and indicators are identified in subsequent sections.

4.2. Circular Economy principles

Perhaps the most well-known circular economy principles are those developed by the Ellen MacArthur Foundation (EMF). These three principles have evolved slightly over time, and are still cited slightly differently by different authors. In its most recent work (EMF, 2024), the EMF describes the CE as being based on the following three principles, driven by design:

1. **Eliminate waste and pollution**
2. **Circulate products and materials (at their highest value)**
3. **Regenerate nature.**

However, a number of alternative frameworks have been developed by other key global organisations and circular economy think tanks.

For example, a United Nations Environment Programme (UNEP) framework (UNEP, 2024) refers to five principles of the circular economy, as per Figure 6.

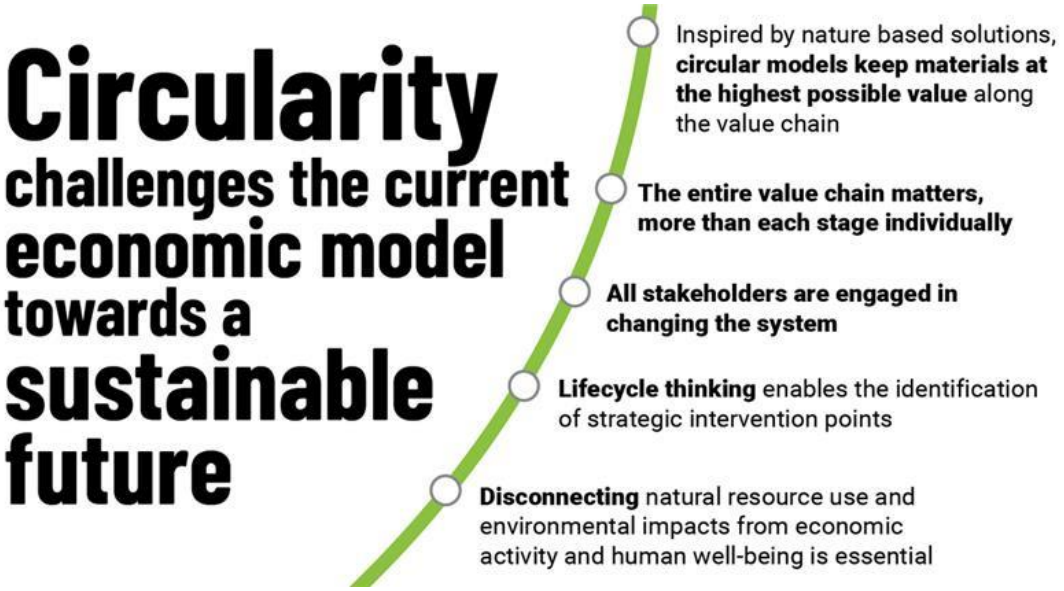

Figure 6: UNEP's circular economy framework (Source: UNEP, 2024).

The Dutch think tank Metabolic argues that current definitions of the circular economy are limited, in that they focus on specific types of activities and business models, rather than describing the end state of what the world will look like once the CE approach has been embedded. They have developed a broad, holistic framework of **Seven Pillars of the Circular Economy** (Metabolic, 2019), as illustrated in Figure 7.

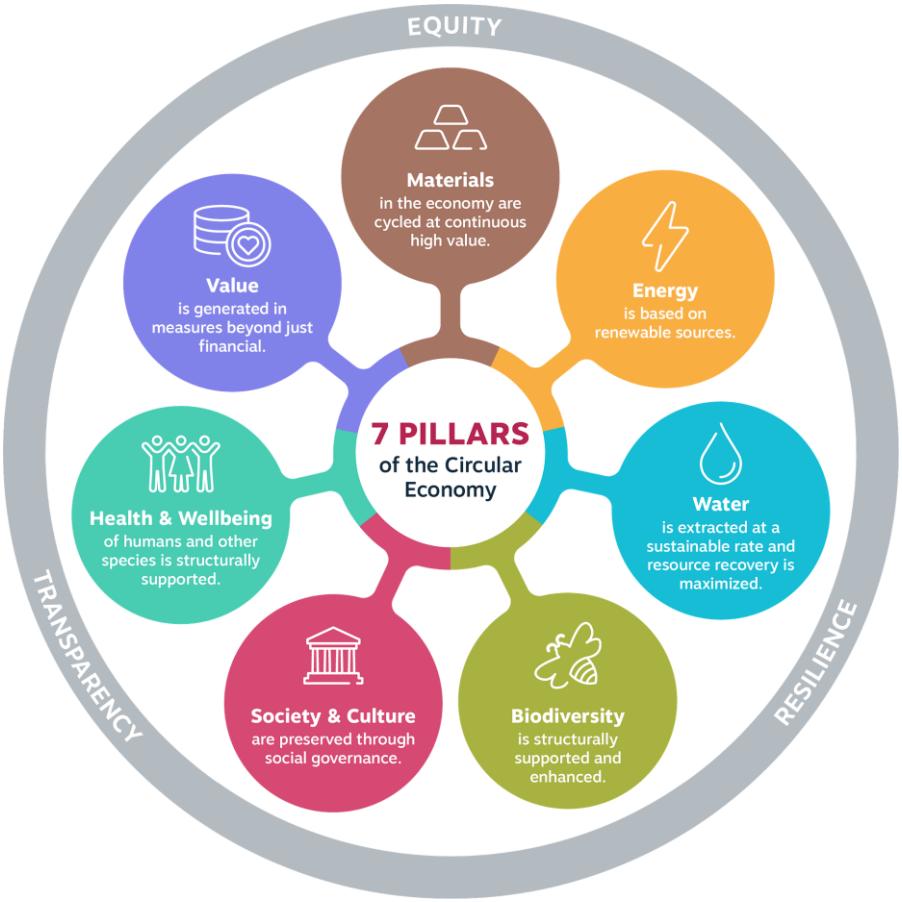

Figure 7: The seven pillars of the circular economy (Source: Metabolic, 2019).

Another well-known think tank in the CE space is Circle Economy, who have developed a 'Key Elements framework' for the circular economy. This conceptual framework consists of eight circularity elements – five **enabling elements**, and three **core elements**; which can be considered in a variety of contexts, such as nations, regions, industries, companies, businesses or products:

- Enabling elements:
    - **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
    - **Team up to create joint value**: Work together throughout the supply chain, internally within organisations and with the public sector to increase transparency and create joint value
    - **Design for the future**: Account for the systems perspective during the design process, to use the right materials, to design for appropriate lifetime and to design for extended future use
    - **Incorporate digital technology**: Track and optimise resource use and strengthen connections between supply chain actors through digital, online platforms and technologies that provide insights
    - **Strengthen & advance knowledge**: Develop research, structure knowledge, encourage innovation networks and disseminate findings with integrity.

- Core elements:
    - **Prioritise regenerative resources**: Ensure renewable, reusable, non-toxic resources are utilised as materials and energy in an efficient way
    - **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
    - **Use waste as a resource**: Utilise waste streams as a source of secondary resources and recover waste for reuse and recycling.

In addition to these CE-specific frameworks, a number of related frameworks were also identified at the February 2024 expert workshop as being relevant or aligned to the CE. These include the Doughnut Economy model (see Figure 8), and the Planetary Boundaries framework (see Figure 9).

It was also suggested at the expert workshop that although none of the existing circular economy frameworks are likely to be suitable for 'plug and play' application in the South African context, there are likely to be certain elements of each of them that could be adapted to suit our purposes; while other elements (e.g. a focus on socio-economic aspects, which is critical in a developing country context) can also be added.

In the following sub-section, we propose a Principles-Criteria-Indicators (PCI) framework for the South African Circular Economy Monitoring System (SACEMS); by adapting relevant components from the existing frameworks described in this section, and adding elements of particular relevance to the South African context, based on our specific policy priorities.

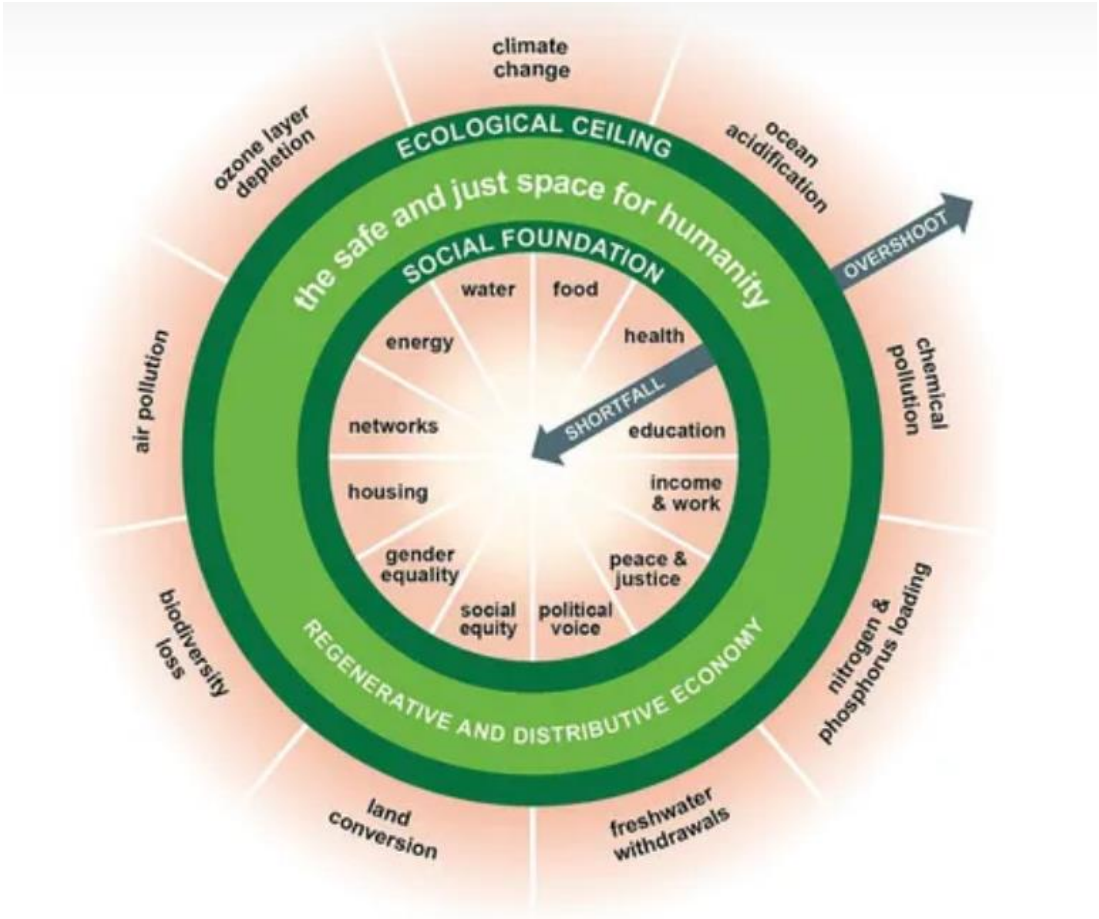

Figure 8: The Doughnut economy model (Source: Raworth, 2017).

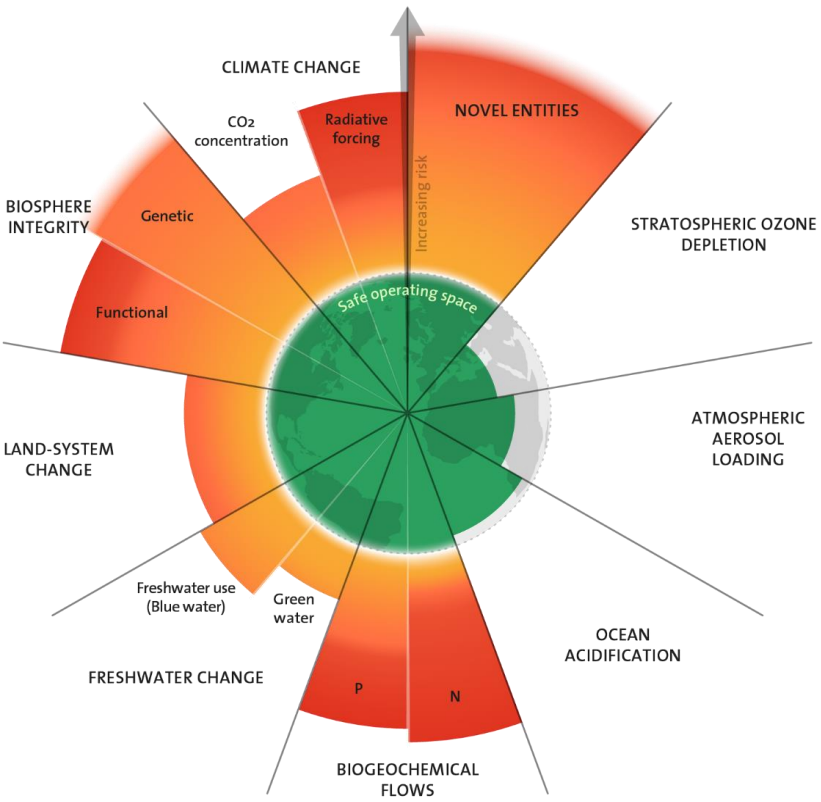

Figure 9: The Planetary Boundaries framework (Source: Stockholm Resilience Centre, 2023).

4.3. Proposed PCI framework for the SACEMS

4.3.1. Principles

The various circular economy frameworks and principles outlined in Section 4.2 were reviewed and debated, in order to derive a set of principles of greatest relevance to the South African context. Ultimately, based on discussions both at the February 2024 expert workshop and within the project team; it was agreed that the three EMF principles (**Eliminate waste and pollution**, **Circulate products and materials (at their highest value)**, and **Regenerate nature**) provide a good starting point; but that there was a need to build on these and to further unpack specific priorities in the South African context.

Specifically, it was highlighted at the expert workshop that the EMF principles, although at first glance seemingly limited, do in fact speak to all aspects of the CE; they just need to be better interpreted and unpacked, to ensure that everything is covered and that certain key issues are made more explicit. In particular, there is a need to ensure that the key issues of relevance to the South African context; particularly socio-economic imperatives relating to poverty, inequality and unemployment; as well as resource constraints related to energy and water resources; are adequately reflected and explicit in the framework.

This resulted in an 'EMF+' framework, which is based on the three well-known EMF principles, but which is expanded to include a fourth principle, '**Leave no one behind'**; which speaks to South Africa's key socio-economic priorities (particularly poverty, unemployment and inequality). Issues related to energy and water resources will be incorporated within criteria under the three existing principles (see Section 4.3.2). This resulted in a four-principle framework, as per Figure 10.

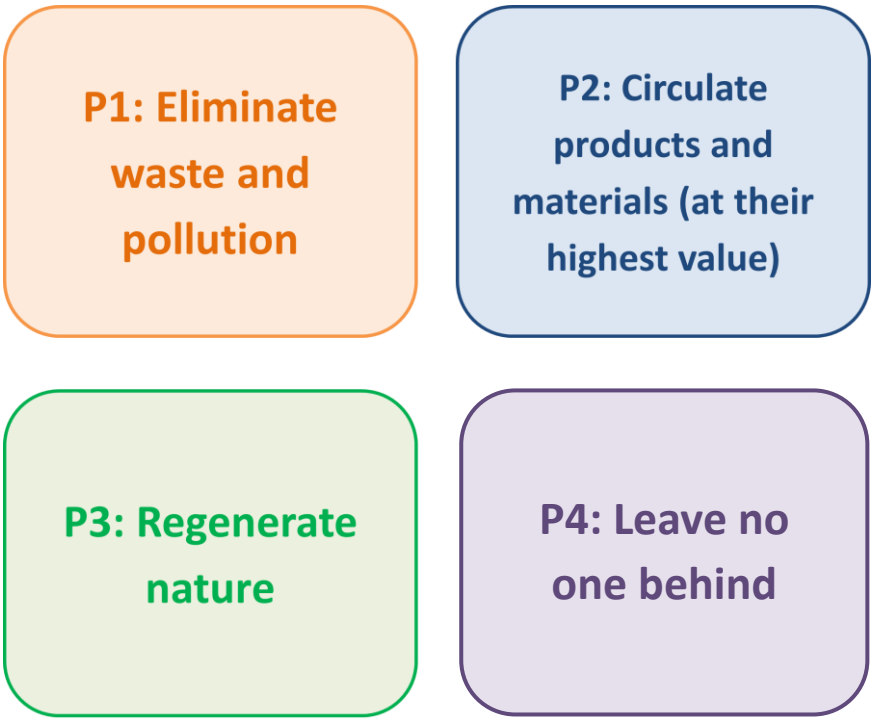

Figure 10: Proposed CE principles for the SACEMS, based on the three EMF principles (EMF, 2024); and a fourth principle speaking to socio-economic imperatives of relevance to the SA context.

4.3.2. Criteria

In order to derive specific, measurable indicators based on the four circular economy principles identified above, the next step in the PCI approach is to identify **criteria** associated with each principle. Criteria essentially unpack the principles in more detail; providing a middle layer in the hierarchy between the principles, which are very high-level in nature; and the indicators, which need to be specific and measurable. Indicators associated with the specific criteria can then be identified in the final step (see Sections 5-7).

Criteria associated with each of the four principles outlined in Section 4.3.1 were identified on the basis of relevant circular economy literature, and based on discussions at the February 2024 expert workshop. Three criteria associated with each of the four principles were identified (twelve criteria in total). The criteria are described in Table 1, and summarised in Figure 11.

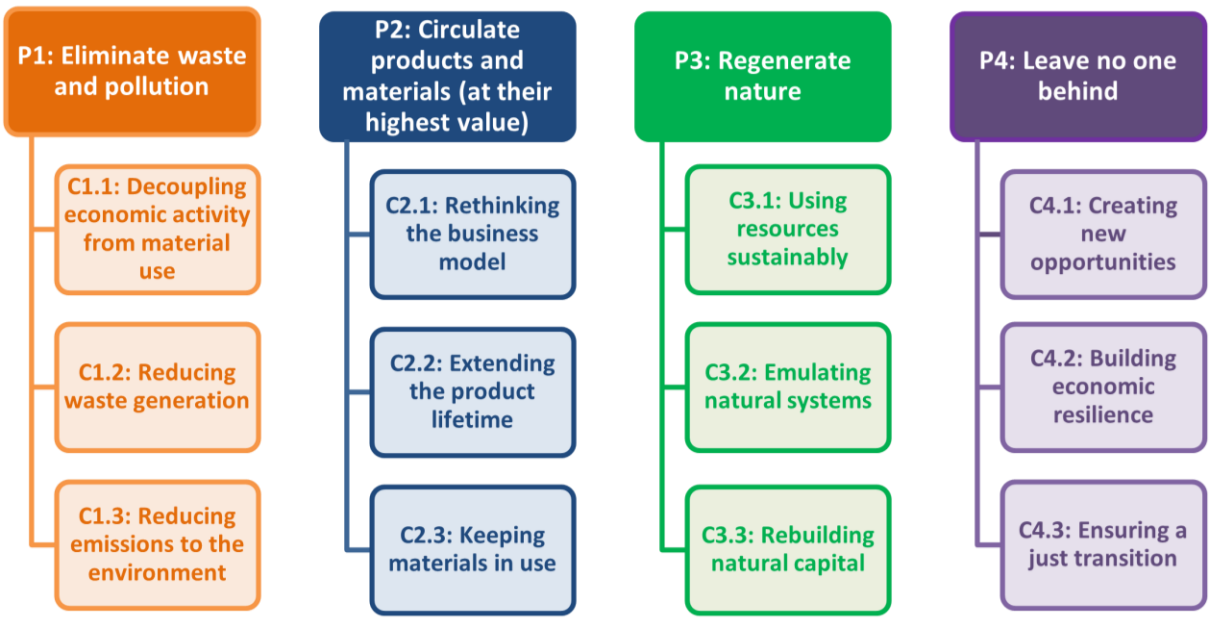

Figure 11: Criteria associated with the four principles

Table 1: Proposed criteria under each of the four circular economy principles for the South African Circular Economy Monitoring System (SACEMS)

Principles	Criteria	Notes / examples
P1: Eliminate waste and pollution	C1.1: Decoupling economic activity from material use	• Promoting the concept of sufficiency – ensuring that basic needs are met but avoiding over-consumption. • Eliminating unnecessary/problematic items; particularly single-use items with low potential for circularity. • Changing the default with regards to the provision of unnecessary, single-use items (e.g. only providing straws/disposable cutlery etc. with take-out meals if consumers specifically request them; rather than providing them by default); and giving consumers the 'right to refuse'. • Material use efficiency / reducing material intensity and maximising the value derived from the use of materials. • 'Right-weighting' of products and packaging (designing products with minimal material content; provided that this does not reduce the potential for circularity).
	C1.2: Reducing waste generation	• Reducing waste generated (throughout the product lifecycle). The emphasis should be on reducing the amount of waste generated in the first place; not specifically waste to landfill; as reducing waste to landfill could just mean that less waste is being collected, or that more is being illegally dumped or leaking to the environment. • Reducing waste leaking into the environment.
	C1.3: Reducing emissions to the environment	• Reducing anthropogenic greenhouse gas emissions, particularly emissions associated with the extraction and use of materials, i.e. emissions that could be addressed through greater circularity. • Reducing other anthropogenic emissions to air, land/soil, and water.
P2: Circulate products and materials (at their highest value)	C2.1: Rethinking the business model	• Uptake of circular business models (e.g. sharing, leasing / renting, and product-as-a-service models (e.g. subscription models). • Implementation of take-back schemes, deposit-refund schemes or other systems to enable products to be returned to the manufacturer and recirculated.
	C2.2: Extending the product lifetime	• Designing products for durability, longevity and increased utility; and elimination of planned obsolescence. • Designing for maintenance, repair, reuse, repurposing, refurbishment, disassembly and remanufacture. • Providing consumers the 'right to repair' (e.g. by ensuring products can be easily dismantled and reassembled, and making the required tools and knowledge available), rather than having to frequently replace items. • Extending the lifetime of products; through practices such as maintenance, repair, reuse, repurposing, refurbishment and remanufacture.
	C2.3: Keeping materials in use	• Designing products for the inclusion of maximum recycled content; particularly the use of post-consumer recyclate (PCR); and substituting primary / virgin materials with secondary / recycled materials. • Designing for recycling through multiple lifetimes. • Prioritising upcycling and closed loop recycling (retaining the value of materials so as to maximise the number of times they can be recycled) over downcycling / open loop recycling. • Keeping materials in use for as long as possible. • Waste-to-energy should be considered only as a last resort when no further options for recycling/recovery are available and the waste would otherwise end up in the environment; and where the technology is proven to be sustainable.

P3: Regenerate nature	C3.1: Using resources sustainably	• Sustainable resource management so as to address resource scarcities / resource security issues, and to avoid resource depletion.
		• This criterion focuses primarily on energy and water resources; other resources (e.g. land and materials) are addressed under other criteria. Specifically, it includes:
		  ○ Transitioning from fossil-based energy sources towards sustainable and renewable alternatives, taking into account circularity (e.g. ensuring renewable energy infrastructure is designed for recycling and that recycling options are available)
		  ○ Implementation of energy efficiency measures
		  ○ Extracting water resources at a sustainable rate, including through water use efficiency measures, and the reuse and recycling of water to maximise resource recovery.

	C3.2: Emulating natural systems	• Taking our queue from nature, biological materials reaching their end of life should be returned to the biosphere (EMF, 2022). This will enable nutrients to be returned to the soil and other natural systems, and recirculated. This requires:
		  ○ Substituting non-renewable materials with renewable alternatives, provided this is done in a sustainable way
		  ○ Designing products using bio-based, biodegradable materials (where practical / feasible; i.e., in specific targeted applications where it makes sense to do so, and where doing so will not negatively affect the product's functionality or potential for circularity)
		  ○ Designing products using materials that minimise environmental and health risks (e.g. avoiding toxic materials and 'forever chemicals'), and that can be safely returned to the natural environment.

	C3.3: Rebuilding natural capital	• Slowing and reversing the transformation of land and other ecosystems required for extraction of natural resources (i.e., reducing the footprint of economic activity on land and other natural systems). For example; by keeping products and materials in use, and decoupling economic activity from material extraction; less land is required for sourcing virgin raw materials, e.g. from mines; and more land is available for nature to thrive (EMF, 2022). • Adoption of regenerative, nature positive practices; nature-based solutions; and practices that promote the integrity of ecosystems, support and enhance biodiversity, and build the long-term resilience of social-ecological systems. • Contributing to the remediation and restoration of land and other ecosystems.
P4: Leave no one behind	C4.1: Creating new opportunities	• Generating opportunities for local business development in the circular economy. • Creating employment opportunities in the circular economy; entailing decent work and with equal access for all.

	C4.2: Building economic resilience	• Increasing the resilience of the local economy and safeguarding against future resource constraints and market volatility; by
		  ○ closing/shortening of resource and material loops;
		  ○ reducing our reliance on exports of raw materials and imports of finished products;
		  ○ transitioning and diversifying the economy from an over-reliance on primary extractive sectors; towards higher value add activities, circular activities and service-related sectors; and
		  ○ using resources extracted domestically to build stocks of critical infrastructure.

	C4.3: Ensuring a just transition	• Reskilling and retraining of workers to ensure a just transition.
		• Promoting equity, including through
		  ○ equal rights to economic resources, and equal access to opportunities
		  ○ reducing income equalities (including for women and the disabled).
		• Improved access to resources, products and services; thereby contributing to poverty alleviation and improved quality of life, and reducing the cost of living. Includes:
		  ○ Supporting local self-reliance through access to resources (energy, water and materials)
		  ○ Access to products through alternative delivery models (e.g. sharing, renting, product-as-a-service etc.); and to more durable, repairable, reusable products; thereby reducing living costs in the long term.

Note that the principles and criteria described above can also be framed in relation to the EMF's 'Butterfly diagram' (see Figure 12):

- Principle 2, 'Circulate products and materials' (and specifically Criteria 2.2, 'Extending the product lifetime', and 2.3, 'Keeping materials in use') relates to the right-hand side of the Butterfly diagram (cycling of technical / finite materials).
- Principle 3, 'Regenerate nature' (specifically Criterion 3.2, 'Emulating natural systems') relates primarily to the left-hand side of the diagram (cycling of biological / renewable materials).

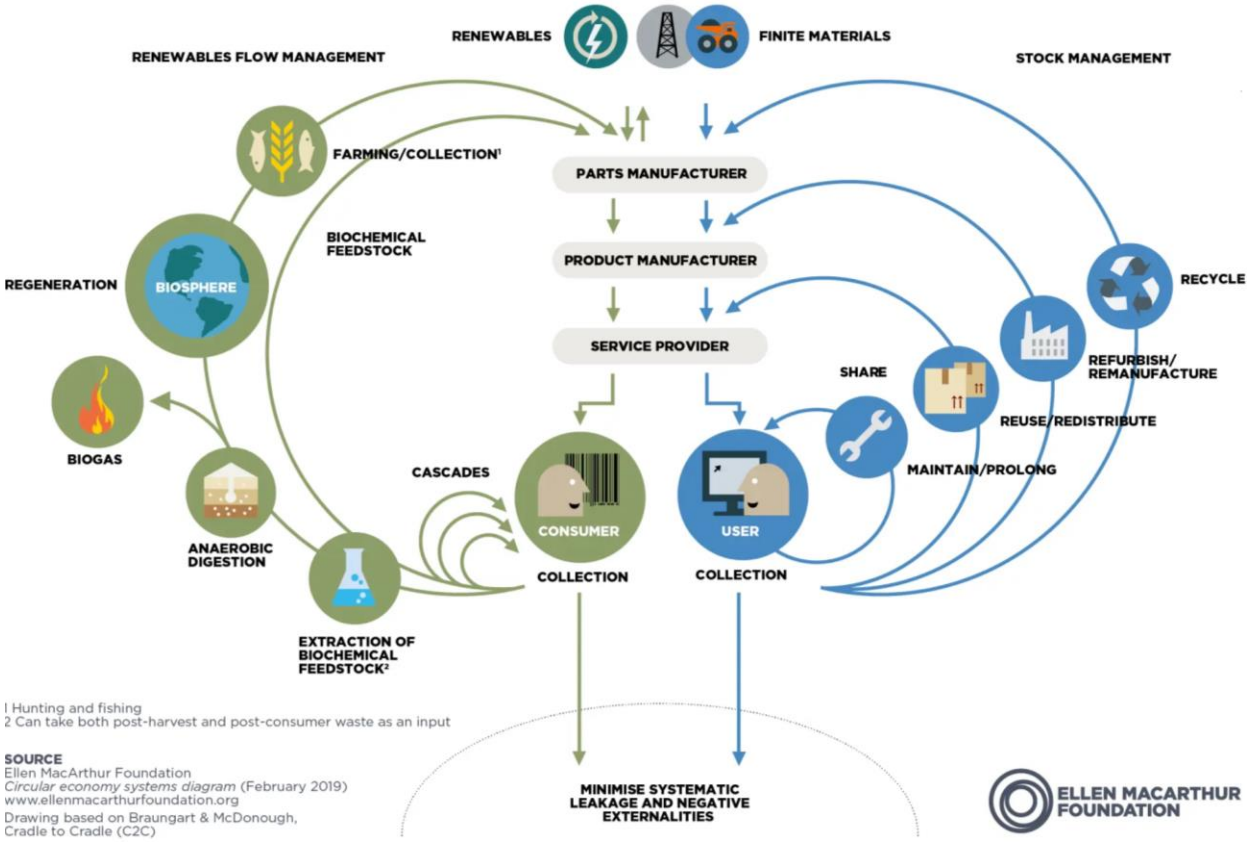

Figure 12: The EMF Butterfly diagram; indicating cycling of technical and biological materials (Source: https://www.ellenmacarthurfoundation.org/circular-economy-diagram).

4.3.3. Other elements of the framework

In Sections 5 and 6, the approach to identifying indicators associated with each of the twelve criteria identified in Section 4.3.2 will be described in detail. However, two further elements of the framework should be noted. Specifically, in addition to indicators associated with the twelve criteria, there will also be a need for:

- A headline indicator (or headline indicators); and
- Indicators relating to the enabling environment.

These elements are briefly described below.

4.3.3.1. The need for a headline indicator

At the February 2024 expert workshop, there was much discussion around the fact that the circular economy is a systems concept, cutting across all economic sectors and having multiple impacts on society and the environment. It was therefore argued that the framework needs to ensure an appropriate balance between:

- Capturing the systemic, cross-cutting nature of the circular economy, and ensuring that a siloed approach is avoided (i.e. avoiding a long list of indicators that don't necessarily 'speak' to each other); while at the same time
- Avoiding an approach that is too aggregated or high level (e.g. having a single aggregated metric), in which important details (e.g. relating to specific circular economy actions or outcomes) would be lost. This would in turn reduce the ability to track specific issues, such as the impacts of the circular economy on climate change or biodiversity.

It was suggested that a 'cascading' approach would help to ensure the appropriate balance; with an over-arching indicator to track the 'systems' level aspects; as well as more specific indicators to track key issues in more detail (particularly in relation to the key drivers for a circular economy in the South African context, such as climate change, biodiversity loss, water stress, and socio-economic imperatives).

Therefore, following some of the frameworks discussed in Section 3; as well as the structure of indicator frameworks applied in other domains (e.g. in the Kunming Montreal Global Biodiversity Framework (Convention on Biological Diversity, 2022)); we propose that the SACEMS framework should include both:

- An appropriate **headline indicator** (or a small number of headline indicators) to track overall progress towards a circular economy at a national level; and
- A number of more specific **component indicators,** associated with the circular economy principles and criteria identified in Sections 4.3.1 and 4.3.2.

Headline indicators are also useful for purposes of communicating a snapshot summary of overall progress towards a circular economy, while the component indicators go into more detail on specific aspects.

4.3.3.2. Indicators for the enabling environment

During the February 2024 expert workshop, it was highlighted that an enabling policy and legislative environment provides a key foundation for the transition to a circular economy, and should therefore be incorporated in the framework.

In addition to policy and legislation however, a number of other enabling elements need to be in place to create the conditions for the transition to a circular economy. Based on the literature, as well as discussions at the expert workshop, some of the key enablers for a CE include:

- Policy and legislation that encourages innovation and supports development of the circular economy;
- Financing and investment to incentivise innovation and to scale solutions across the full value chain;
- Science, technology and innovation around circular solutions; and implementation through demonstration and pilot projects;
- Collaboration and transparency within organisations, across the full value chain and with all relevant role-players to enable system-wide change; and
- Education, awareness raising, training and capacity building to advance knowledge and enable innovation; as well as skills development and transfer to enable a just transition.

Therefore, in accordance with the Bellagio Declaration (EEA, 2021) (see Section 3); a number of policy and process indicators are proposed for the SACEMS, to reflect the key enabling elements providing the foundation for the transition to a circular economy. These indicators will be particularly important during the early stages of the CE transition (PACE, 2021), to track the extent to which an effective enabling environment for the circular economy is being put in place.

4.4. Overarching structure of the SACEMS framework

Based on the various elements of the framework discussed in Sections 4.3.1 to 4.3.3, the proposed overall structure of the framework underlying the SACEMS is depicted in Figure 13. Specifically, it is proposed that the framework will consist of:

- **A headline indicator** (or a small number of headline indicators) (see Section 4.3.3.1);
- **Component indicators** associated with each of the principles and criteria (see Sections 4.3.1 and 4.3.2); and
- **Policy and process indicators** reflecting the enabling environment (see Section 4.3.3.2).

The headline indicator(s) should provide a high-level snapshot of South Africa's progress towards a CE; while the various component indicators will provide more detail on key areas of concern. Specific targets as well as monitoring and reporting systems could be established in future phases of development of the SACEMS (see Section 9).

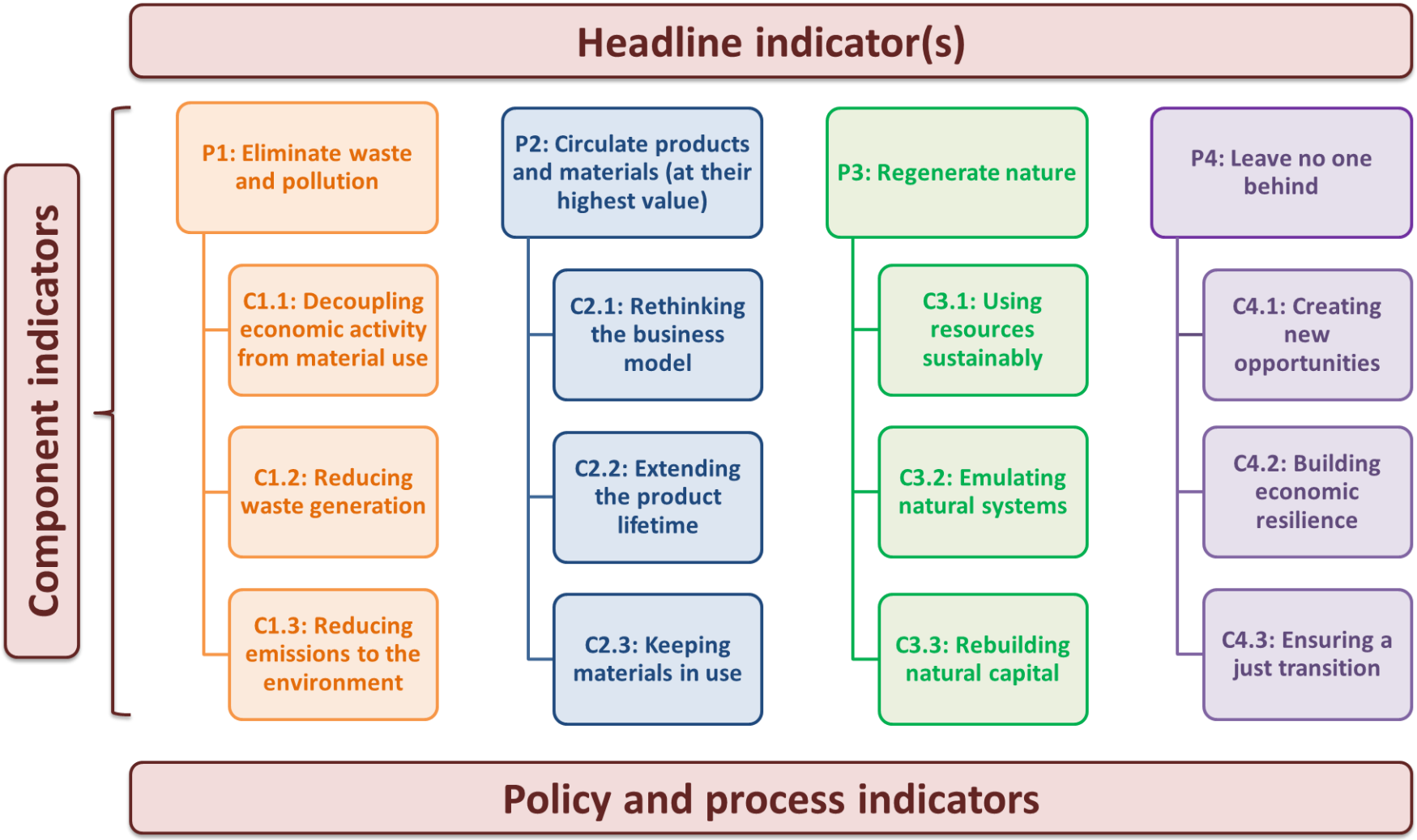

Figure 13: Proposed structure of the framework underlying the South African Circular Economy Monitoring System (SACEMS); indicating headline, component, and policy and process indicators

5. Identification of relevant indicators

Having identified the principles and criteria for the PCI framework, as well as the need for a headline indicator and for indicators relating to the enabling environment (see Section 4); the next step was to identify the relevant **indicators**. Specifically, there was a need to identify:

- A relevant **headline indicator** / headline indicators;
- Relevant **component indicators** associated with each of the principles and criteria;
- Relevant **policy and process indicators** reflecting the enabling environment.

This was done by consulting a wide variety of sources, including:

- Existing regional or national CE indicator sets that have been developed elsewhere; as well as a number of sub-national (e.g. city-level) frameworks where relevant. Indicator frameworks focused at an organisational, product or material level[3] were also consulted in order to draw potential lessons; however, given the focus of the project on identifying national level indicators, the emphasis was on indicator frameworks with a geographic (national, regional or city-level) scope.
- Other international sources; including:
    - reviews and meta-analyses of circular economy indicators
    - global standards and databases relating to CE and material use
    - CE indicator frameworks and initiatives developed by relevant global think-tanks.
- Existing and potential future data collection and reporting requirements in South Africa:
    - Existing data collection and reporting efforts in South Africa; e.g. based on relevant global, regional and national reporting frameworks that South Africa is currently required to report against
    - Indicators proposed as part of new national, regional or global frameworks, strategies or action plans currently under development or being finalised; which South Africa will likely have to report against in future
    - Related monitoring initiatives that have been undertaken in the South African context.

Each of these sources are briefly described below.

5.1. Circular economy indicator sets developed internationally

Internationally, a number of CE indicator sets have been developed or proposed for specific regions (e.g. the EU), countries or cities. While most of the work on CE indicators has been conducted in developed countries (particularly in Europe), it was felt important to focus as far as

[3] Refer to the interim report submitted in March 2024 (available on request).

possible on indicators that have been proposed in countries with a similar socio-economic context as South Africa, i.e. other developing and BRICS nations.

Specifically, BRICS and other developing countries which have developed CE indicator frameworks, and which were therefore consulted, include:

- **India**'s Circular Economy monitoring framework[4]
- **China** - Circular Economy Indicators[5]
- **Colombia** – Circular Economy Information System[6]
- **Rwanda**'s Circular Economy Action Plan and Roadmap[7]

Furthermore, **Ghana** is in the process of developing a national Circular Economy Action Plan (not available at the time of writing); while **Chile** has published a Roadmap for a Circular Chile by 2040[8], although a monitoring system with specific indicators is still under development.

In terms of developed countries, a number of individual European countries (and cities) have developed their own national (or city-level) CE indicator sets (see PACE, 2021). However, in order to avoid a 'Eurocentric' bias, as a starting point we consulted only regional (EU) frameworks or initiatives; rather than focusing on each of the individual European country or city efforts in depth.

Specifically, we consulted the **EU's Circular Economy Monitoring Framework (CEMF)**[9]; as well as related EU monitoring frameworks, such as:

- the **EU Resource Efficiency Scoreboard**;[10]
- the **EU Raw Materials Scoreboard**;[11] and
- the European Environment Agency's **Eco-Innovation Action Plan**.[12]

We also considered indicators proposed in a paper by Avdiuschenko and Zajac (2019), titled 'Circular Economy Indicators as a Supporting Tool for European Regional Development Policies'.

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[4] https://www.ficcices.in/Ficci_Accenture_CES_REPORT_2022.pdf
[5] https://www.sciencedirect.com/science/article/abs/pii/S0959652611002460
[6] https://www.cepal.org/sites/default/files/presentations/colombia-dane-circular-economy-environmental-economic-accounting-system.pdf
[7] https://www.environment.gov.rw/index.php?eID=dumpFile&t=f&f=58556&token=1efafef04395aa568ceac5346426c5d29864bced
[8] https://economiacircular.mma.gob.cl/wp-content/uploads/2022/01/HOJA-DE-RUTA-PARA-UN-CHILE-CIRCULAR-AL-2040-EN.pdf
[9] https://ec.europa.eu/eurostat/web/circular-economy/monitoring-framework
[10] https://composite-indicators.jrc.ec.europa.eu/explorer/explorer/scoreboards/res/resource-efficiency-scoreboard
[11] https://op.europa.eu/en/publication-detail/-/publication/eb052a18-c1f3-11eb-a925-01aa75ed71a1
[12] https://www.eea.europa.eu/policy-documents/the-eco-innovation-action-plan

However, in cases where significant gaps emerged in terms of indicators for specific criteria (particularly in relation to the 'R-strategies' (beyond recycling) under Criteria 2.1 and 2.2); we consulted the indicator sets of specific European countries who have attempted to develop such indicators; notably those of France, Germany and Belgium (Flanders).

We also consulted indicator frameworks from other developed countries outside of Europe which were deemed to be relevant, namely:

- **Australia**'s Circular Economy Metrics (Circular Australia, 2022 and Miatto et al., 2024)
- **Japan**'s Circular Economy indicators.[13]

Finally, we considered a number of sub-national frameworks, to identify potentially relevant indicators proposed at other geographic levels that could potentially be applied at a national level; including the **Circle City Scan Tool**[14] and the **Circular City Analysis Framework** (Ferreira and Fuso-Nerini, 2019).

5.2. Other international sources

In addition to consulting the specific indicator sets listed in Section 5.1, we also consulted a number of reviews and meta-analyses of CE indicators, including:

- The **OECD's Inventory of Circular Economy Indicators** (OECD, 2021);
- The Platform for Accelerating the Circular Economy (PACE, 2021) report "**Circular Indicators for Governments**"; and
- Saidani et al.'s (2018) **Taxonomy of Circular Economy Indicators**.

Furthermore, we consulted global standards and databases relating to circular economy and material use, including:

- The new International Organization for Standardisation **(ISO) Standard 59020 (2024), Circular economy — Measuring and assessing circularity performance** (ISO, 2024); although bearing in mind that this standard is geared primarily toward measuring circularity at a product / organisational level, rather than at a national level.

[13] https://www.jica.go.jp/Resource/english/our_work/thematic_issues/management/jcci/dbil86000000oo4i-att/220119_01_19.pdf
[14] https://iclei.org/circle_city_scan_tool/

- A number of global databases and tools relating to material use and material flows, including the **Global Material Flows Database**,[15] the Sustainable Consumption and Product Hotspot Analysis Tool (**SCP-HAT)**,[16] **Supply Chain Explorer**[17] and **Exiobase**[18].

We also consulted a number of relevant frameworks and initiatives developed by global circular economy think-tanks, including

- The **Ellen MacArthur Foundation**; although noting that the EMF's work on CE metrics tends to focus on organisation and/or product level indicators, such as the Material Circularity Indicator[19] and Circulytics.[20]
- **Circle Economy**;[21] including its Circularity Gap Reporting Initiative[22] (CGRi), which publishes annual reports highlighting the global circularity "gap", as well as national reports for certain countries. We also consulted Circle Economy's Circular Jobs[23] framework for insights on indicators relating to employment in the circular economy.
- **The Platform for Accelerating the Circular Economy**[24] **(PACE)**.
- **The Circular Economy Indicators Coalition**[25] **(CEIC)**, which has been established by Circle Economy and PACE to drive harmonization and increased application of circular indicators.
- **Metabolic**;[26] although note that this framework does not provide a generic list of indicators that can be applied at a national level; rather it is suggested that indicators should be developed that are specific to the context in question.

5.3. Aligning with existing and likely future reporting requirements

In identifying potentially relevant indicators, it was also deemed important to harmonise and align with existing global, regional and national reporting frameworks that South Africa is required to report against; in order to build on existing data collection and reporting efforts, rather than creating an additional monitoring and reporting burden. For example, at a national level, it would be important to align with reporting under:

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[15] https://www.resourcepanel.org/global-material-flows-database
[16] https://scp-hat.org/
[17] https://www.exiger.com/products/supply-chain-explorer/
[18] https://www.exiobase.eu/
[19] https://www.ellenmacarthurfoundation.org/material-circularity-indicator
[20] https://www.ellenmacarthurfoundation.org/resources/circulytics/resources
[21] https://www.circle-economy.com/metrics ; https://knowledge-hub.circle-economy.com/indicator
[22] https://www.circularity-gap.world/
[23] https://www.circular-jobs.world
[24] https://pacecircular.org/the-metrics-program)
[25] https://www.circle-economy.com/metrics/circular-economy-indicators-coalition ; https://pacecircular.org/circular-economy-indicators-coalition-0
[26] https://www.metabolic.nl/what-we-do/circular-economy/

- The **National Development Plan** (NDP) (National Planning Commission, 2012); although noting that the NDP doesn't specifically include a monitoring framework with specific indicators; but rather a set of objectives (including some targets).
- **Environmental reporting**, including:
    - State of the Environment reporting.[27]
    - Reporting related to **water** (e.g. under the Water and Sanitation Master Plan and the Blue and Green Drop Reports), **energy**, **greenhouse gas emissions**, **biodiversity** (e.g. the National Biodiversity Assessments), etc.
    - **Waste-related reporting**, e.g. under the:
        - The National Waste Management Strategy[28] (NWMS) (DFFE, 2020)
        - the first State of Waste Report (Department of Environmental Affairs, 2018), although noting that this report provides estimates rather than measured data
        - the South African Waste Information System[29] (SAWIS), although again it should be noted that reporting to SAWIS is currently incomplete.[30]
    - Other environment-related reporting through DFFE and Statistics South Africa.
- **Economic statistics** published by Statistics South Africa and the South African Reserve Bank.

In addition, South Africa is a member to multiple global treaties, and already reports to several goals and targets under various international frameworks. As such, particular attention was paid to the following:

- Indicators that are already being reported on for South Africa to fulfil existing global reporting requirements, including requirements under:
    - The United Nations' **Sustainable Development Goals (SDGs)**: We consulted all of the indicators under the 17 Goals; as well as the latest (2023) country report for South Africa (Statistics South Africa, 2023), to determine which of the indicators South Africa is currently reporting on (including additional or domesticated indicators).

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[27] https://soer.environment.gov.za/soer/CMSWebSite/Content.aspx?menuId=16064,16063

[28] Section 7 of the NWMS (DFFE, 2020) refers to annual reporting systems to be established; however it is unclear whether such systems have been developed. In addition, DFFE is responsible for monitoring the implementation of Extended Producer Responsibility (EPR) schemes according to NWMS. Producer Responsibility Organisations (PROs) must submit 6 monthly interim reports to DFFE and annual external performance audit reports by 31 December. These must report on performance against targets, number of jobs, allocation of EPR fees, and financial performance. The NWMS also states that effective reporting on Integrated Waste Management Plans (IWMPs) and EPR programmes should provide a steadily improving picture of the status and outcomes of both private and public investments in waste management services and infrastructure.

[29] https://sawic.environment.gov.za/

[30] The NWMS states that the SAWIS will develop guidelines for provinces and local government on the content and format of annual reporting on IWMPs. However, the project team were not able to locate such guidelines.

    - The **United Nations Framework Convention on Climate Change** (UNFCCC), as reported in the National Greenhouse Gas Inventory Reports (e.g. DFFE, 2022a) and in the Biennial Update Reports to the UNFCCC (e.g. DFFE, 2023).
    - The **United Nations Convention to Combat Desertification** (UNCCD), including the 2024 South African country report (UNCCD, 2024).
- Indicators proposed as part of new national, regional or global frameworks, strategies or action plans currently under development or being finalised, including:
    - The **Continental Circular Economy Action Plan for Africa 2024-2034** (African Union, 2023); which has been ratified by South Africa; and which contains a broad range of indicators which it is understood that South Africa will have to report on.
    - The DSTI's **Science, Technology and Innovation for a Circular Economy (STI4CE) strategy** (DSI, 2024; currently being finalised).
    - The **Kunming-Montreal Global Biodiversity Framework (GBF)**, which was adopted during the fifteenth meeting of the Conference of the Parties (COP 15) to the Convention on Biological Diversity (CBD), but for which the monitoring framework is still being finalised (CBD, 2022; 2024).

It would also be important to align with reporting under the forthcoming **National Circular Economy Action Plan** (currently being commissioned by DFFE); although this plan has not yet been drafted at the time of writing.

Finally, we considered related initiatives that have been undertaken in South Africa, including:

- The UN-PAGE **South African Green Economy Progress Measurement Framework**[31].
- The **Economy-wide Material Flow Analysis to Develop Circular Economy Indicators for South Africa**,[32] conducted for DSI by the University of Cape Town (UCT) in collaboration with the Institute of Social Ecology, University of Natural Resources and Life Sciences (BOKU), Vienna, Austria (Von Blottnitz et al., 2022).

6. Selection of indicators

Based on the sources listed in Section 5, a total of 934 potentially relevant indicators were identified across the 12 criteria;[33] although this figure includes a number of duplicates (e.g. similar indicators being identified from more than one source; as well as some indicators that were identified as being potentially relevant across more than one criterion).

These indicators were then assessed against the following criteria, in order to select the most relevant indicators for the SACEMS framework:

[31] https://www.un-page.org/static/a5e98b4e339208b8e9cbf80ea8743020/south-african-national-green-economy-progress-measurement-framework-08-12-20-0.pdf
[32] https://wasteroadmap.co.za/research/grant-024/
[33] Full list of indicators available on request.

a. Relevance to the circular economy
b. Relevance to the specific principle and criterion under which it has been identified
c. Relevance for reflecting progress at a national level
d. Relevance to the South African context
e. Data availability
f. Currently being reported on in South Africa (or likely to be reported under future requirements).

In terms of criteria (e) and (f); as mentioned in Section 5.3, South Africa is a member to multiple global treaties, and already reports to several goals and targets under various international frameworks. These frameworks offer coordinated targets in which the indicators have a systematic reporting structure and unit of measurement, which could likewise facilitate the measurement of some components of the circular economy. Some, such as the SDGs, offer quantifiable indicators that report changes across various sectors, and which are relevant to some of the principles and criteria within the PCI framework developed in Section 4. Other global frameworks are more specific, such as those relating to climate change and biodiversity.

As a member to these various treaties or conventions, South Africa has already mobilised, coordinated and implemented reporting on some of these indicators through government departments and structures. Assessing the relevance and use of these existing indicators to the circular economy would therefore facilitate effective implementable reporting based on existing networks. For this reason, we prioritised indicators drawn from existing reporting frameworks as far as possible.

While it is important to align with existing reporting requirements, or to at least ensure that data is currently being collected to facilitate reporting; in some cases there may be a need to consider indicators that are important from a circular economy perspective, but for which data is not currently being collected. According to PACE (2021), “the development of circular indicators has so far mostly focused on those where data can be readily and easily gathered. The limitation of this is that it leads to a focus on indicators that can be measured with data derived from the predominantly still linear economy”.

For example, most existing national CE indicator sets include indicators related to waste and recycling, as these tend to be easier to measure and/or are aligned with data that is already typically collected at a national level (PACE, 2021). On the other hand, for example, indicators for the various R-strategies beyond recycling (rethink, reuse, repair etc.) are largely lacking; as these are not well aligned with existing data collection or reporting efforts, and may be more difficult to measure. Since these concepts are important from a circular economy perspective, it may be necessary in some cases to consider indicators that we are not currently measuring or monitoring, even if this will require that additional resources be allocated towards data collection and reporting.

7. Proposed draft set of indicators for the South African Circular Economy Monitoring System

7.1. Headline indicator

Recall from Section 4.3.3.1 that, in addition to the various specific indicators under each of the circular economy principles and criteria, it is also useful to have a smaller number of 'headline indicators', which are useful for communication purposes to provide an overall summary of progress towards a circular economy.

At its core, the circular economy is about materials. As such, many CE indicator sets and reporting frameworks derive their headline indicator(s) from **Economy-Wide Material Flow Analysis (EW-MFA)**. Specifically,

- A typical headline indicator derived from EW-MFA is the total rate of material cycling in the economy. This indicator goes by different names, including the **Cyclical Material Use Rate (CMUR), Circular Material Use Rate, Circularity Rate, or Total Cycling Rate.**
- Alternatively, in Circle Economy's Circularity Gap Reporting Initiative[34] (CGRi); the headline indicator is the '**circularity gap**' which is essentially the inverse of the material cycling rate, and which is likewise derived through EW-MFA.

For example, in the EU's CE Monitoring Framework, the Circular Material Use Rate "measures the share of material recovered and fed back into the economy in overall material use. The CMUR is defined as the ratio of the circular use of material to the overall material use. The overall material use is measured by summing up the aggregate domestic material consumption (DMC) and the circular use of materials. DMC is defined in economy-wide material flow accounts. The circular use of materials is approximated by the amount of waste recycled in domestic recovery plants minus imported waste destined for recovery plus exported waste destined for recovery abroad. A higher CMU rate value means that more secondary materials substitute for primary raw materials thus reducing the environmental impacts of extracting primary material" (Eurostat, 2024).

Recently, the DSTI commissioned an EW-MFA for South Africa (Von Blottnitz et al., 2022). In that study, the headline indicator was referred to as the **Total Cycling Rate** (or, in other publications, as the **circularity rate**). While the study distinguishes between input and output cycling rates, the well-quoted figure of 7% cycling refers to the total **input** cycling rate. On the input side, the total cycling rate is defined as the total of:

- socio-economic cycling (share of recycled & reused materials in processed materials); and
- ecological cycling (share of sustainably produced primary biomass in processed materials).

[34] https://www.circularity-gap.world/

The total (input) cycling rate for SA was estimated at approximately 7%, of which the socio-economic cycling rate was approximately 2%, and ecological cycling 5% (Von Blottnitz et al., 2022). This would be an important headline figure to track over time to indicate whether we are making progress toward a more circular economy.

Indeed, at the expert workshop conducted in February 2024, it was generally agreed that since EW-MFA has already been applied in South Africa in order to establish a national baseline, this could be replicated over time in order to track progress. Unfortunately, it is unlikely that this would be done more frequently than every five years, as the underlying datasets aren't updated frequently enough (Godfrey, 2024, pers comm). However, it is nevertheless proposed that the **total cycling rate derived from EW-MFA** would be **the most relevant headline indicator for tracking overall progress towards a CE** in South Africa. It is therefore **recommended that the EW-MFA** (Von Blottnitz et al., 2022) **be replicated as frequently as possible in future**.

7.2. Component indicators

Based on the sources listed in Section 5, and the selection criteria discussed in Section 6, **the proposed component indicators** associated with the circular economy principles and criteria (see Section 4.3.2) **are described in Table 2**. In addition, Table 2 provides a definition and rationale for each indicator, and provides information on linkages with existing reporting frameworks.

In the case of criteria where no suitable indicator is currently being reported on in South Africa or for which there is no data currently being collected (e.g. for Criteria 2.1 and 2.2), recommendations are made with respect to potential indicators that could be considered (derived from the sources described in Section 5).

In these cases, or when there is no clear choice on the most relevant indicator, a number of options are provided (in *italics*) for consideration. In some of these cases, there is some overlap of potentially relevant indicators across multiple criteria in the framework, as these indicators could potentially be relevant to more than one criterion. This duplication will be resolved in the final determination of indicators in Phase 2 of the project.

Furthermore, in some cases, in addition to the primary recommended indicator(s), one or more additional or alternative / 'second best' options are suggested (in the last column). This is done, for example:

- in cases where it is unclear whether the primary proposed indicator can easily be measured or reported on.
- in cases where the primary proposed indicator might be deemed inadequate following further review or during the stakeholder validation process; and where additional or alternative indicator(s) could be considered.

Table 2: Proposed component indicators for the South African Circular Economy Monitoring System (SACEMS)

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
P1: Eliminate waste and pollution	C1.1 Decoupling economic activity from material use	**Indicator 1.1.1:** Material footprint, material footprint per capita, and material footprint per GDP	SDG Indicator 12.2.1 (and 8.4.1). Material footprint (MF) and MF per capita were reported in the 2023 SDG Country Report for South Africa (Statistics South Africa, 2023). It is recommended to also report on MF per GDP (or its inverse, GDP per kg MF).	Material Footprint (MF) is "the attribution of global material extraction to domestic final demand of a country while the total MF is the sum of the material footprint for biomass, fossil fuels, metal ores and non-metal ores. This indicator is calculated as raw material equivalent of imports (RMEIM) plus domestic extraction (DE) minus raw material equivalents of exports (RMEEX). Multi-regional input-output (MRIO) framework is employed for the attribution of the primary material needs of final global demand". [35]	MF: Tonnes MF per capita: Tonnes per capita MF per GDP: Kg per constant US dollar	A more circular economy should reduce the demand for extraction of raw materials, and drive increased efficiency of material use. Material footprint per GDP (or it's inverse, GDP per kg of material used) is particularly relevant as an indicator of material productivity, i.e. of the amount of material required to generate economic value (or of economic value generated per kg of material used).	
		Indicator 1.1.2: Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP.	SDG Indicator 12.2.2 (and 8.4.2). Domestic Material Consumption (DMC) and DMC per capita were reported in the 2023 SDG Country Report for South Africa (Statistics South Africa, 2023). It is recommended to also report on DMC per GDP (or its inverse, GDP per kg DMC).	Domestic Material Consumption (DMC) is "a standard material flow accounting (MFA) indicator and reports the apparent consumption of materials in a national economy. DMC measures the total amount of material (biomass, fossil fuels, metal ores and non-metallic minerals) directly used in an economy and based on accounts of direct material flows, i.e., domestic material extraction and physical imports and exports". [36]	DMC: Tonnes DMC per capita: Tonnes per capita DMC per GDP: Kg per constant US dollar	In addition to reducing raw material extraction, a circular economy should also aim to drive more sustainable consumption patterns (reduction, reuse, etc.); thereby reducing the amount of materials consumed in the economy.	

[35] https://www.unep.org/topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-12-7

[36] https://unstats.un.org/sdgs/metadata/files/Metadata-12-02-02.pdf

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
	C1.2 Reducing waste generation	**Indicator 1.2.1:** Total waste generated per year	State of Waste Reporting (see e.g. DEA, 2018).	Total waste generated in tonnes per annum. Includes both general and hazardous waste. Currently waste generation is estimated in the State of Waste reporting (DFFE, 2018). It is recommended that waste generation be calculated according to international best practice; as the sum of waste recycled, disposed, or treated using any alternative technology (includes informal disposal, incineration, anaerobic digestion and any other waste treatment technology applied).	Tonnes	A circular economy aims to eliminate waste. As such, in a more circular economy, the total amount of waste generated should decline over time. Focusing on total waste generated (including waste that is recycled, disposed (including informal disposal), or otherwise treated) is seen as a more relevant indicator than simply waste disposed of to landfill; as the goal should be to reduce the amount of waste generated in the first place (irrespective of how it is handled thereafter).	
	C1.3 Reducing emissions to the environment	**Indicator 1.3.1:** Total greenhouse gas emissions per year	SDG Indicator 13.2.2	Annual national level of emissions of the following greenhouse gases (substances or substance groups) in CO_2 equivalents: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), nitrogen triflouride (NF_3), hydroflourocarbons (HFC), perflourocarbons (PFC) and sulphur hexaflouride (SF_6) [37]	Mt CO_2-equivalent	It is broadly recognized that climate change is driven in large part by unsustainable consumption and production patterns. Demand for materials is a key driver of energy use and greenhouse gas (GHG) emissions. Transitioning towards a more circular economy, which would encompass more sustainable consumption and production patterns, reduced demand for materials (particularly for virgin material extraction), as well as improved energy efficiency and a switch to renewable energy sources; could contribute significantly to reductions in GHG emissions (UNEP et al., 2023).	

[37] https://sdg-indikatoren.de/public/Meta/13.2.2.pdf

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
						An indicator of total GHG emissions is recommended over an indicator of emissions associated with certain specific activities only (e.g. material extraction and use); in order to simplify reporting; and because the circular economy is a system-wide concept that is likely to reduce emissions across multiple activities (including energy-related emissions, as well as emissions associated with AFOLU, material extraction and material use).	
		Indicator 1.3.2: National Air Quality Indicator (NAQI)	SDG 11.6.2A (Additional indicator) SDG Indicator 11.6.2 is "Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)". Indicator 11.6.2A is an additional indicator that South Africa has reported on within the 2023 SDG Country Report (Statistics South Africa, 2023).	NAQI is based on an annual measure of the concentrations of PM_{10} and SO_2, two of the most prevalent pollutants in the country (DFFE, 2022b); based on reporting by stations within the National Ambient Air Quality Monitoring Network (NAAQMN) (DFFE, 2019). The measure is based on the National Ambient Air Quality Standards (NAAQS).	Index value (values <1 indicate concentrations within acceptable limits set by the NAAQS; values >1 indicate concentrations exceeding acceptable limits (StatsSA, 2023).	This indicator provides a composite index of air quality in South Africa, based on the most prevalent air pollutants in the country (DFFE, 2019; Statistics South Africa, 2023). Since these pollutants arise from a number of industrial processes as well as energy generation, transitioning towards a more circular economy should result in a reduction in emissions and in the concentrations of these pollutants.	
		Indicator 1.3.3: Proportion of bodies of water that comply to South African water quality objectives	SDG Indicator 6.3.2D (Domesticated Indicator). SDG Indicator 6.3.2 is "Proportion of bodies of water with good ambient water quality". Indicator 6.3.2D is a	"Water quality objectives are set by governments and international organizations to define the acceptable quality of water for various uses such as drinking, irrigation, and recreational activities. Compliance with these objectives is important for protecting human health and the environment. Bodies of water that	Percentage (%)	Non-compliance with water quality objectives "may point out to issues relating to high levels of pollution" (StatsSA, 2023), among other factors (such as levels of wastewater treatment). All else being equal, the circular economy would be expected to reduce water pollution (particularly from mining, agricultural and industrial	*Proportion of domestic and industrial wastewater flows safely treated and lawfully discharged (Domesticated SDG indicator 6.3.1D; StatsSA,*

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
			domesticated indicator in South Africa's 2023 SDG Country Report (Statistics South Africa, 2023).	comply with water quality objectives vary depending on the specific objectives and the location of the water body. These meet the standards for various physical, chemical, and microbiological parameters" (StatsSA, 2023)		sources), and thereby to give rise to an improvement in water quality.	*2023). However, this speaks more to wastewater treatment relative to total wastewater generated; and may therefore not be a relevant indicator of reductions in wastewater generation due to CE interventions.*
P2: Circulate products and materials (at their highest value)	C2.1 Rethinking the business model	**Indicator 2.1.1 (to be confirmed):** • *Number of circular MSMEs*[38] • *GVA*[39] *of circular businesses* • *Value of investment into new business models* • *Number of repair, reuse and refurbishment initiatives* • *Number of materials-as-a-service systems piloted*	The options proposed here are all derived from the Continental Circular Economy Action Plan for Africa 2024-2034 (African Union, 2023) Some of the options proposed (e.g. Value of investment into new business models; Number of repair, reuse and refurbishment initiatives; and Number of materials-as-a-service systems piloted) are listed under specific sectors within the Action Plan, rather than being cross-cutting.	Refer to the Continental Circular Economy Action Plan for Africa 2024-2034 (African Union, 2023). Depending on the indicator selected, there will be a need for clear definitions of what constitutes e.g. a "circular business" or a "new business model".		A number of potential indicators related to new business models have been proposed internationally, but not clear whether they could be readily adopted in South Africa. Many of the proposed indicators require access to data at micro or meso level to be calculated. It is recommended that the indicators selected for the South African Circular Economy Monitoring System (SACEMS) link to a framework(s) or reporting requirement(s) that South Africa will need to report against; such as the Continental Circular Economy Action Plan for Africa 2024-2034 (African Union, 2023).	*Market share of product as services sector (Avdiushchenko and Zaja 2019).*

[38] MSME's = Micro, Small and Medium-sized Enterprises

[39] GVA = Gross value added

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
		• *Number of product-as-a-service systems / models implemented*	'Number of product-as-a-service systems /models implemented' is a new indicator proposed by the project team; adapted from the AU CE Action Plan.				
	C2.2 Extending the product lifetime	**Indicator 2.2.1 (to be confirmed)**: • *Reuse rate* • *Number of repair, reuse and refurbishment initiatives* • *Sales of 2nd hand goods* • *Proportion of short-lived and single use consumption relative to durable consumption (or total consumption)*	• Average reuse rates could potentially be calculated based on reporting under the EPR Regulations (DFFE, 2021); however, currently only glass packaging has targets for reuse, and it is not clear how this will be measured or reported. • 'Number of repair, reuse and refurbishment initiatives' is derived from the AU CE Action Plan (AU, 2023); but was specifically listed	Depending on the indicator selected, there will be a need for clear definitions and guidance in terms of e.g. how to measure reuse rates or sales of 2nd hand goods; how "short lived" and "durable" consumption are defined, etc.			• *Rate of reuse; Rate of remanufacturing & refurbishment (Avdiuschenko and Zajac, 2019* • *Reuse indicator (Total (product) reuse across all formal and informal reuse channels) (Flanders CE Monitor)*[40] • *Repair indicator (number of items repaired, as well as household spending on repairs (Flanders CE Monitor)*[41] • *Household spending on*

[40] Defines reuse as when a discarded product is used by another user in the same function (i.e. excludes reuse by the same user). Estimated based on annual figures of reuse through recognised recycling centres, plus a survey among the population to gain insight into the distribution of wider reuse across various reuse channels (see https://cemonitor.be/en/indicator/circularity/r-strategies/reuse-indicator/).

[41] Estimated based on two data sources: a broader survey of the population, and an analysis of the household budget survey (see https://cemonitor.be/en/indicator/circularity/r-strategies/repair-indicator/).

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
			under the electronics sector. • 'Sales of 2nd hand goods' could potentially be recorded under the 2nd Hand Goods Act (Republic of South Africa, 2009). • Short-lived & single use consumption relative to durable or total consumption would need to be estimated through EW-MFA.				*product maintenance & repair (excluding vehicle maintenance) (French Ministry of Ecological Transition, 2001).*
	C2.3 Keeping materials in use	**Indicator 2.3.1:** Percentage of municipal waste generated that is recycled	SDG indicator 12.5.1D (Domesticated Indicator in the 2023 Country Report (StatsSA, 2023). SDG Indicator 12.5.1 is "National recycling rate, tons of material recycled".	Municipal waste that is recycled as a percentage of total municipal waste generated.	%	Although not the primary focus, recycling of waste is still a component of the circular economy. In a circular economy, in addition to reducing the amount of waste generated, a higher proportion of the waste that is generated would be recycled.	
		Indicator 2.3.2: Socio-economic cycling rate	Component of the total cycling rate as per Economy-Wide Material Flow Analysis (EW-MFA) (Von Blottnitz et al., 2022).	On the input side, the socio-economic cycling rate is defined as the share of recycled and reused materials in total processed materials (Von Blottnitz et al., 2022).	%	In a circular economy, recycled and reused materials as a proportion of total material use would be expected to increase.	

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
P3: Regenerate nature	C3.1 Using resources sustainably	**Indicator 3.1.1:** Renewable energy share in the total final energy consumption	SDG Indicator 7.2.1. Reported in the 2023 Country Report (StatsSA, 2023).	Percentage of final consumption of energy that is derived from renewable resources.[42]	%	There is a growing recognition within CE definitions and frameworks that a CE should be "underpinned by a transition to renewable energy" (EMF, 2024; Metabolic, 2019); whereas energy generation from fossil fuels is an inherently linear process.	
		Indicator 3.1.2: Energy intensity measured in terms of primary energy and GDP	SDG Indicator 7.3.1. Reported in the 2023 Country Report (StatsSA, 2023).	Energy supplied to the economy per unit value of economic output.[43]	MJ / GDP	In a CE, a net reduction in energy demand would be expected, particularly from primary material extraction (e.g. mining) due to the transition toward secondary (recycled) materials. A reduction in overall material consumption in the economy would also be expected to result in reduced energy use in material processing.	
		Indicator 3.1.3: Change in water-use efficiency over time	SDG Indicator 6.4.1. Reported in the 2023 Country Report (StatsSA, 2023).	Water-use efficiency is "a measure of how efficiently water is used in various human activities and ecosystems. It is defined as the ratio of the output or benefits obtained from a given amount of water input or usage" (StatsSA, 2023).	USD/m^3	Improving water-use efficiency is "critical to address water scarcity, promote sustainable water use, and ensure that water resources are used effectively. This can be achieved through a combination of technological, regulatory, and behavioural interventions" (StatsSA, 2023); including interventions aligned with the circular economy. In particular, in a circular economy, a reduction in water use associated with primary resource extraction (particularly agriculture and mining, which are significant users of water) would be expected.	*SDG 6.4.2: Level of water stress: freshwater withdrawal as a proportion of available freshwater resources. However, this is determined by a number of drivers in addition to water use (e.g. climate change, natural weather cycles, etc.) and is therefore difficult to link specifically to the CE.*

[42] https://unstats.un.org/sdgs/metadata/files/Metadata-07-02-01.pdf

[43] https://unstats.un.org/sdgs/metadata/files/Metadata-07-03-01.pdf

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
		Indicator 3.1.4 (to be developed): *Indicator for reuse, reclamation and recycling of water*	The National Water and Sanitation Master Plan (DWS, 2018) includes Actions relating to reuse, reclamation and recycling of water; but an indicator is still to be developed.				
	C3.2: Emulating natural systems	**Indicator 3.2.1:** Ecological cycling rate	Component of the total cycling rate as per EW-MFA (Von Blottnitz et al., 2022).	On the input side, the ecological cycling rate is defined as the share of sustainably produced primary biomass inputs (excluding socioeconomic cycling) in processed materials (Von Blottnitz et al., 2022).	%	In addition to cycling of finite / technical materials (as depicted on the right-hand side of EMF's 'Butterfly diagram' (see Figure 12); and captured in Indicator 2.3.2: Socio-economic cycling rate); the CE also entails cycling of renewable / biological materials (left side of the Butterfly diagram). In EW-MFA, this is captured through the ecological cycling rate.	
		Indicator 3.2.2: Share of organic waste diverted from landfills	Continental CE Action Plan 2024-2034 (African Union, 2023). Specifically, this indicator is listed under: • Sector: Energy • Goal/Action: Energy and electricity generation from organic solid and liquid waste through anaerobic digestion	Percentage of total organic waste generated that is diverted from landfill, specifically through composting or anaerobic digestion.	%	Diversion of organic waste from landfill would incorporate both composting and anaerobic digestion, both of which are aligned with the circular economy, specifically contributing to the biological cycle and regenerating natural capital (EMF, 2021).	
	C3.3: Rebuilding natural capital	**Indicator 3.3.1:** Red List Index of Ecosystems (RLIe)	Global Biodiversity Framework (GBF; Goal A / Target 1, Indicator A.1.	The Red List of Ecosystems framework 'assesses the relative risk of ecosystem collapse of an ecosystem type. The indicator 'Red List Index of ecosystems (RLIe)' measures the average risk of	Index value (0-1). Decreases result from more threatened ecosystem	By keeping products and materials in use, and decoupling economic activity from material extraction; a CE can contribute towards reducing the amount of land (and other ecosystems) required for	• *GBF Target 1; Indicator A2: Extent of natural ecosystems*

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
			Also reported in South Africa's National Biodiversity Assessments (NBAs) by SANBI and DFFE (e.g. see Skowno et al., 2019).	ecosystem collapse of a group of ecosystems, and tracks change in this over time based on genuine change in the risk category of each ecosystem (i.e. excluding changes in categories owing to improved knowledge or better data)'.[44] It addresses Goal A of the GBF: 'The integrity, connectivity and resilience of all ecosystems are maintained, enhanced, or restored, substantially increasing the area of natural ecosystems by 2050'.[45] It therefore speaks to both the extent and integrity of ecosystems.	categories or heighted risk, increases indicate improvements in risk status. A value of 0 means that all ecosystems have collapsed. A value of 1 means that all ecosystems are listed as 'Least Concern'.[46,47]	sourcing virgin raw materials; leaving more land available for nature to thrive (EMF, 2022). A CE can therefore contribute towards slowing and reversing the transformation of land (and other ecosystems) from their natural state. For Criterion 3.3, the GBF indicators are recommended; as they will be reported by DFFE and StatsSA; and present a holistic and consistent approach to measuring impacts on ecosystems and biodiversity.	• *GBF Target 2; Indicator 2.2: Area under restoration* • *SDG 15.3.1: Proportion of land that is degraded over total land area*
		Indicator 3.3.2: Red List Index (RLI)	GBF Goal A / Target 4, Indicator A3. Also an SDG Indicator (15.5.1); and reported in the South African NBAs (e.g. Skowno et al., 2019).	The Red List Index (RLI) "measures change in aggregate extinction risk across groups of species. It is based on genuine changes in the number of species in each category of extinction risk on The IUCN Red List of Threatened Species (www.iucnredlist.org)"[48]	Index value (0-1). A value of 0 indicates that all species are categorised as 'Extinct'. A value of 1 indicates that all species are categorised as 'Least Concern' [49, 50]	A CE could be expected to impact positively on biodiversity in a number of ways. For example, by reducing the demand for land and other resources (see above); the CE could contribute to reducing anthropogenic pressures on habitats critical for species to thrive. In addition, reducing pollution and waste (including GHG emissions) would be beneficial to species impacted by reduced air and water quality and by anthropogenic climate change.	

[44] https://www.gbf-indicators.org/metadata/headline/A-1
[45] https://www.gbf-indicators.org/metadata/headline/A-1
[46] Excluding ecosystems in the Data Deficient and Not Evaluated categories
[47] https://www.gbf-indicators.org/metadata/headline/A-1
[48] https://www.gbf-indicators.org/metadata/headline/A-3
[49] Excluding species in the Data Deficient and Not Evaluated categories
[50] https://www.gbf-indicators.org/metadata/headline/A-3.

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
P4: Leave no one behind	C4.1: Creating new opportunities	**Indicator 4.1.1 (to be confirmed):** • *Number of circular MSMEs* • *GVA of circular businesses* • *Number of CE jobs created* • *Number of circular jobs.*	The options proposed here are all derived from the Continental Circular Economy Action Plan for Africa 2024-2034 (African Union, 2023).	Refer to the Continental Circular Economy Action Plan for Africa 2024-2034 (African Union, 2023). Depending on the indicator selected, there will be a need for clear definitions of what constitutes e.g. a "circular business" or a "circular job".		It is recommended that the indicators selected for the SACEMS link to a framework(s) or reporting requirement(s) that South Africa will need to report against; such as the Continental Circular Economy Action Plan for Africa 2024-2034 (African Union, 2023).	
	C4.2: Building economic resilience	**Indicator 4.2.1:** Trade balance (goods)	Reported on quarterly by the South African Reserve Bank in the Balance of Payments accounts[51]	The trade balance (or balance of trade) is the "difference between the value of a country's exports and the value of a country's imports for a given period".[52] It is typically the largest component of a country's balance of payments.	R billions, year.	An improvement in South Africa's trade balance indicates an increase in the value of our exports relative to the value of our imports. This would in turn suggest that we are reducing imports (and/or increasing exports) of finished products; rather than relying primarily on exports of low value raw materials and importing higher value finished products. Reducing our reliance on primary resource extraction and moving up the value chain towards higher value adding (beneficiation) activities is well aligned with the CE.	
		Indicator 4.2.2: Primary sector % contribution to GDP	Total GDP as well as the contribution of primary sectors are published quarterly by Statistics South Africa[53]	Calculated as the combined industry value added of (i) agriculture, forestry and fishing and (ii) mining (including quarrying); as a percentage of GDP over the same period.		In a CE, the relative contribution of primary sector extractive activities (such as agriculture and mining) to the economy would be expected to decline; while the contribution of secondary (manufacturing) and tertiary (service) sectors would be expected to increase in relative terms.	

[51] https://www.resbank.co.za/en/home/publications/quarterly-bulletin1/current-account-release

[52] https://www.investopedia.com/terms/b/bot.asp

[53] https://www.statssa.gov.za/?page_id=1859

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
		Indicator 4.2.3: Rate of domestic stock building	Derived from EW-MFA (Von Blottnitz et al., 2022).	Tonnes of material used domestically for building and maintaining stocks of productive infrastructure (roads, buildings, dams, factories etc.); as a % of the total tonnage of materials extracted domestically (Von Blottnitz et al., 2022).	% of domestic extraction (tons)	The rate of domestic stock-building gives an indication of the extent to which a country uses the materials extracted domestically to contribute towards building critical infrastructure necessary for socio-economic development and for delivering services (roads, buildings etc.); and of whether there is a transition from producing short-lived products towards more durable applications; as opposed to exporting most of its raw materials, producing short-lived products, and generating waste.	
	C4.3: Ensuring a just transition	**Indicator 4.3.1:** Unemployment rate, by sex, age and persons with disabilities	SDG Indicator 8.5.2. Reported in the 2023 Country Report (StatsSA, 2023).	The unemployment rate is defined as the percentage of persons in the labour force who are unemployed.[54] . The labour force is in turn defined as the number of people who are currently employed or who are actively seeking employment (i.e. working age persons not currently seeking employment are excluded).	%	While it is important to understand the number of jobs being created specifically in circular activities, as well as the quality of these jobs; it is also critical to understand the overall (net) effect on employment of the transition to a circular economy. Monitoring the overall **unemployment** rate would give an indication of whether potential job losses in traditional linear economic activities are outweighed by new jobs created in the circular economy. This is important from a just transition perspective, and in the context of current high unemployment rates in South Africa. This indicator also allows for disaggregation by sex, age and persons with disabilities, which would provide an indication of equality in access to opportunities.	

[54] https://unstats.un.org/sdgs/metadata/files/Metadata-08-05-02.pdf

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
		Indicator 4.3.2: (to be confirmed) • *Fatal and non-fatal occupational injuries per 100,000 workers, by sex and migrant status* • *Level of national compliance with labour rights (freedom of association and collective bargaining) based on International Labour Organization (ILO) textual sources and national legislation, by sex and migrant status*	The proposed indicators are both SDG Indicators (8.8.1 and 8.8.2 respectively); and are both reported in the 2023 Country Report (StatsSA, 2023).	• *SDG 8.8.1: "This indicator provides information on the number of fatal and non-fatal occupational injuries per 100,000 workers in the reference group during the reference period. It is a measure of the personal likelihood or risk of having a fatal or a non-fatal occupational injury for each worker in the reference group".*[55] • *SDG 8.8.2: "Measures the level of national compliance with fundamental rights at work (freedom of association and collective bargaining, FACB) for all ILO member states based on six international ILO supervisory body textual sources and also on national legislation. It is based on the coding of textual sources against a list of evaluation criteria and then converting the coding into indicators".* [56]	• *SDG 8.8.1: Ratio of cases per 100,000 workers* • *SDG 8.8.2: number of coded evaluation criteria*[57]	In addition to a focus on the quantity of jobs created and on the overall unemployment rate, the quality of jobs created (and of existing jobs in traditional linear activities) is also important. The concept of "**decent work**" has therefore become prominent. It is recommended that the indicators selected for the SACEMS link to a framework(s) or reporting requirement(s) that South Africa is already reporting against, such as the SDGs.	
		Indicator 4.3.3: Proportion of men, women and children of all ages living in poverty in all its dimensions according to	SDG Indicator 1.2.2. Reported in the 2023 Country Report (StatsSA, 2023).	A composite measure of multidimensional poverty, the exact definitions and measurement of which differs by country. The most commonly used method is the Alkire Foster (AF) methodology, which is the methodology applied in South	%	In a developing country context, one of the key socio-economic outcomes of a circular economy transition should be to contribute towards alleviating **poverty**. SDG 1 incorporates a number of indicators reflecting poverty;	• *SDG 1.1.1: Proportion of the population living below the international poverty line by sex, age, employment*

[55] https://unstats.un.org/sdgs/metadata/files/Metadata-08-08-01.pdf
[56] https://unstats.un.org/sdgs/metadata/files/Metadata-08-08-02.pdf
[57] See Tables 1-2 of https://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/meetingdocument/wcms_648636.pdf

Principle	Criteria	Proposed indicators	Links to existing reporting frameworks	Definition	Units	Rationale	Additional / alternative indicators that could be considered
		national definitions		Africa's Multidimensional Poverty Index (SAMPI) (StatsSA, 2023). This method includes indicators across a number of dimensions, including health, education and living standards. Individuals or households are "considered as multidimensionally poor if they are deprived in multiple dimensions, exceeding certain thresholds".[58]		including two indicators speaking to the proportion of the population living below the international or national poverty line. However, SDG Indicator 1.2.2 is proposed, as it speaks to multi-dimensional poverty; which includes health, education and living standards.	*status and geographical location (urban/rural)* • *SDG 1.2.1: Proportion of population living below the national poverty line, by sex and age*
		Indicator 4.3.4: Gini coefficient	Aligned with the National Development Plan (NDP) target to "Reduce inequality"; specifically that the Gini coefficient should fall from 0.69 to 0.6 by 2030. Reported by Statistics South Africa through the Income and Expenditure Survey (IES). [59]	The Gini index or Gini coefficient (for income) determines a nation's level of income inequality by measuring the income distribution across its population. The Gini coefficient can also be applied to the distribution of wealth rather than income. However, "because wealth is more difficult to measure than income, Gini coefficients usually refer to income and are reported simply as the Gini coefficient or Gini index, without specifying that they refer to income".[60] As such, in this case, the Gini coefficient for income is proposed.	Index value (0-1). A value of 0 represents perfect equality (i.e., all residents in the country have the same income). A value of 1 represents perfect inequality (i.e., one resident earns all the income while all other residents earn nothing).[61]	In the South African context, another key socio-economic imperative relates to **inequality**. SDG 10 includes a number of indicators related to inequality. However, the Gini coefficient, while not among the SDG indicators, is seen as a more robust measure of economic inequality. [62]	• *SDG 10.1.1: Growth rates of household expenditure or income per capita among the bottom 40 per cent of the population and the total population* • *SDG 10.2.1: Proportion of people living below 50 per cent of median income, by sex, age and persons with disabilities*

[58] https://unstats.un.org/sdgs/metadata/files/Metadata-01-02-02.pdf

[59] See for example https://www.statssa.gov.za/?p=15911 , https://www.statssa.gov.za/?p=15858 and https://www.statssa.gov.za/?p=12930

[60] https://www.investopedia.com/terms/g/gini-index.asp

[61] https://www.investopedia.com/terms/g/gini-index.asp

[62] https://www.cesr.org/sdg-targets-risk-missing-mark-inequality/

7.3. Indicators for the enabling environment

As mentioned in Section 4.3.3.2, it has been highlighted both in literature (EEA, 2021; PACE, 2021) and by participants at the February 2024 expert workshop that 'policy and process' indicators (i.e., indicators relating to the enabling environment) should be included in the framework. Specifically, as per Section 4.3.3.2, indicators should reflect the following enabling elements:

- Policy and legislation that encourages innovation and supports development of the circular economy;
- Financing and investment to incentivise innovation and to scale solutions across the full value chain;
- Science, technology and innovation around circular solutions; and implementation through demonstration and pilot projects;
- Collaboration and transparency within organisations, across the full value chain and with all relevant role-players to enable system-wide change; and
- Education, awareness raising, training and capacity building to advance knowledge and enable innovation; as well as skills development and transfer to enable a just transition.

Some **potential indicators relating to the enabling environment are proposed in Table 3**. It is not suggested that all of the indicators proposed in Table 3 should be selected for the final indicator set. Instead, these should be seen as examples of potential indicators for further discussion and validation with stakeholders.

Since the proposed indicators for the enabling environment are specific to the circular economy; for the most part, they are not currently being reported against. However, they are drawn primarily from the Continental Circular Economy Action Plan for Africa 2024-2034 (African Union, 2023), and from the *draft* STI4CE strategy[63] (DSI, 2024); in order to align with existing or likely future reporting requirements.

However, note that the final STI4CE strategy was not available at the time of writing. As such, the indicators proposed in Table 3 which are drawn from the draft STI4CE strategy (DSI, 2024) will need to be updated to reflect the final set of indicators as captured in the final strategy.

[63] Note that the final STI4CE strategy was not available at the time of writing. As such, the indicators proposed in Table 3 that are drawn from the draft STI4CE strategy (DSI, 2024) will need to be updated to reflect the final set of indicators as captured in the final strategy.

Table 3: Potential policy and process indicators (indicators for the enabling environment) for the SACEMS

Enabling element	Potential indicators	Links to existing reporting frameworks
Policy and legislation	• *Publication of National CE roadmap for South Africa* • *Amendment of policy and/or promulgation of new policy*	STI4CE Strategy (draft) (DSI, 2024).
	• *Circular public procurement regulation*	Continental Circular Economy Action Plan for Africa 2024-2034 (African Union, 2023)
	• *Number of Standards developed and implemented*	NWMS (DFFE, 2020): Action "Develop and implement industry standards that align technology requirements between primary producers and recyclers of all materials, by ensuring that the design and packaging of products maximise the value of the materials that circulate within the economy".
Financing and investment	• *Value of financial contribution to circular economy initiatives* • *Average interest rates proposed to CE businesses* • *Share of public budget spent on CE projects* • *Regulation on introduction of tax breaks for CE businesses*	Continental Circular Economy Action Plan for Africa 2024-2034 (African Union, 2023)
	• *Number of SMMEs receiving funding through supported schemes to experiment with new technologies and processes that are aligned with CE principles*	STI4CE Strategy (draft) (DSI, 2024).
STI, demonstration and pilots	• *Number of multi-institution publications around STIC4CE* • *Number of new patents per year* • *Establishment and record of 'living labs' to enable contextualised research and expedite pilot projects to test circular processes or technologies*	DSI STI4CE Strategy (draft) (DSI, 2024).
Collaboration and transparency	a. *Establishment of a common online platform to (1) connect CE actors between different sectors and industries and (2) host and connect research between researchers and practitioners; and* b. *Number of institutions and attendees participating in the platform*	DSI STI4CE Strategy (draft) (DSI, 2024).
	• *MOUs/MOAs/NDAs between entrepreneurs and relevant stakeholders to facilitate access to technical resources, such as research facilities, testing laboratories, and innovation centres where they can experiment with new technologies and prototype innovative solutions*	DSI STI4CE Strategy (draft) (DSI, 2024).
Education, awareness and training	• *Number of CE courses appropriate to South African contexts, consistently available for registration / participation* • *Number of certified course/programme completions* • *Number of local government officials with accredited CE-related qualifications*	DSI STI4CE Strategy (draft) (DSI, 2024).

8. Summary of proposed indicators for the South African Circular Economy Monitoring System

The indicators proposed in Section 7 for the South African Circular Economy Monitoring System (SACEMS) are summarised in Table 4.

As far as possible, the indicators proposed are either:

- Already being reported under existing frameworks/requirements, e.g. the SDGs;
- Regularly reported as part of standard economic statistics (by StatsSA or the Reserve Bank);
- Part of likely future reporting requirements, such as the Global Biodiversity Framework or the Continental Circular Economy Action Plan for Africa (African Union, 2023)
- Derived from the initial EW-MFA modelling conducted for South Africa in 2022 (Von Blottnitz et al., 2022); which we recommend be replicated as regularly as possible to enable tracking against the baseline.

This approach will enable alignment with existing and future data collection and reporting efforts, and will avoid creating an addition monitoring and reporting burden. Indeed, for most of the component indicators, we were able to draw on existing indicators that South Africa is already reporting on; as many of these reflect elements of the circular economy. However, our framework presents the first attempt to pull these various indicators together in a structured framework under the circular economy umbrella.

Nevertheless, a challenge globally in terms of circular economy indicators is the mismatch between the types of indicators required to reflect progress towards a circular economy, and existing data collection efforts. In particular, while existing indicators and data tend to focus on waste management and recycling, there is a gap in terms of data related to the higher-order R-Strategies beyond recycling, such as rethink, redesign, and reuse (PACE, 2021). These are key concepts in the circular economy; but are not typically measured or monitored.

As such, in some cases there is a need for new indicators to be considered, drawing on or adapting indicators developed elsewhere; even if these are not currently being monitored in South Africa; in order to capture aspects that are of specific relevance to the circular economy, but which we are not currently measuring (e.g., for the various R-strategies beyond recycling).

Note that **the indicators proposed in this report are a draft set of indicators for further discussion only**. The aim is to at least start a conversation regarding which indicators could potentially be used to measure progress towards a circular economy in South Africa, and to discuss which indicators need to be prioritised for data collection and reporting if this is not currently being undertaken.

Table 4: Summary of proposed indicators for the South African Circular Economy Monitoring System (SACEMS)

Headline indicator: Total Cycling Rate (as per Economy-Wide Material Flow Analysis, EW-MFA)		
Principles	**Criteria**	**Indicators**
P1: Eliminate waste and pollution	C1.1: Decoupling economic activity from material use	**Indicator 1.1.1:** Material footprint, material footprint per capita, & material footprint per GDP
		Indicator 1.1.2: Domestic material consumption, DMC per capita, & DMC per GDP
	C1.2: Reducing waste generation	**Indicator 1.2.1:** Total waste generated per year (tonnes)
	C1.3: Reducing emissions to the environment	**Indicator 1.3.1:** Total greenhouse gas emissions per year ($MtCO_2e$)
		Indicator 1.3.2: National Air Quality Indicator (NAQI)
		Indicator 1.3.3: Proportion of bodies of water that comply to South African water quality objectives
P2: Circulate products & materials (at their highest value)	C2.1: Rethinking the business model	***Indicator 2.1.1 (to be confirmed):*** *No. of circular MSMEs / GVA of circular businesses / Value of investment into new business models / No. of repair, reuse & refurbishment initiatives / No. of materials-as-a-service / product-as-a-service systems implemented*
	C2.2: Extending the product lifetime	***Indicator 2.2.1 (TBC)****: Reuse rate / Number of repair, reuse & refurbishment initiatives / Sales of 2nd hand goods / Proportion of short-lived and single use consumption relative to durable consumption (or total consumption)*
	C2.3: Keeping materials in use	**Indicator 2.3.1:** Percentage of municipal waste generated that is recycled
		Indicator 2.3.2: Socio-economic cycling rate (as per EW-MFA)
P3: Regenerate nature	C3.1: Using resources sustainably	**Indicator 3.1.1:** Renewable energy share in total final energy consumption
		Indicator 3.1.2: Energy intensity measured i.t.o. primary energy and GDP
		Indicator 3.1.3: Change in water use efficiency over time (USD/m^3)
		To be developed: *Indicator for reuse, reclamation and recycling of water*
	C3.2: Emulating natural systems	**Indicator 3.2.1:** Ecological cycling rate (as per EW-MFA)
		Indicator 3.2.2: Share of organic waste diverted from landfills
	C3.3: Rebuilding natural capital	**Indicator 3.3.1**: Red List Index of ecosystems (RLIe)
		Indicator 3.3.2: Red List Index (RLI)
P4: Leave no one behind	C4.1: Creating new opportunities	***Indicator 4.1.1 (TBC)****: Number of circular MSMEs / GVA of circular businesses / Number of CE jobs created / Number of circular jobs*
	C4.2: Building economic resilience	**Indicator 4.2.1:** Trade balance (goods) (R billions, year)
		Indicator 4.2.2: Primary sector % contribution to GDP
		Indicator 4.2.3: Rate of domestic stock building (% of domestic extraction)
	C4.3: Ensuring a just transition	**Indicator 4.3.1**: Unemployment rate, by sex, age & persons with disabilities
		Indicator 4.3.2 (decent work; to be confirmed)*: Fatal & non-fatal occupational injuries per 100,000 workers / Level of national compliance with labour rights*
		Indicator 4.3.3: Proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions
		Indicator 4.3.4: Gini coefficient
Indicators for the enabling environ-ment	Policy and legislation	**TBC**: *Publication of National CE roadmap / Amendment of policy and/or promulgation of new policy / Circular public procurement regulation / Number of [design for circularity] standards developed and implemented*
	Financing and investment	**TBC**: *Value of financial contribution to CE initiatives / Average interest rates proposed to CE businesses / Share of public budget spent on CE projects / Introduction of tax breaks for CE businesses / No of SMMEs supported*
	STI, pilots and demonstrations	**TBC**: *Number of multi-institution publications around STIC4CE / Number of new patents per year / Establishment and record of 'living labs'*
	Collaboration and transparency	**TBC**: *Establishment of an online platform and number of actors participating / MOUs/MOAs/NDAs between entrepreneurs & relevant stakeholders*
	Education and training	**TBC**: *No. of CE courses relevant to SA context / No. of course completions / No of local government officials with accredited CE-related qualifications*

It should be clear from Table 4 that the proposed indicators speak to different stages within the circular economy transition, or within the value chain of the circular economy. Specifically, the indicators can be categorised as:

1. **Headline indicator**: provides a high-level summary of South Africa's progress towards a circular economy.
2. **Policy and process indicators**: The required enablers for driving the transition towards a circular economy.
3. **Input indicators**: Inputs into the economy; such as energy, water and materials
4. **Circularity indicators**: indicators reflecting the extent to which materials and other resources are cycled within the economy.
5. **Output indicators:** Outputs from the economy; either useful (e.g. jobs, productive stocks of infrastructure) or otherwise (e.g. waste and emissions).
6. **Impact/outcome indicators**: The ultimate environmental and social outcomes of the transition to a circular economy (e.g. supporting ecosystems and biodiversity; alleviating poverty and inequality).

It is useful to distinguish between these different categories of indicators and to understand the relationships between them; in order for the indicators to tell a coherent story. We attempt to depict this relationship graphically in Figure 14.

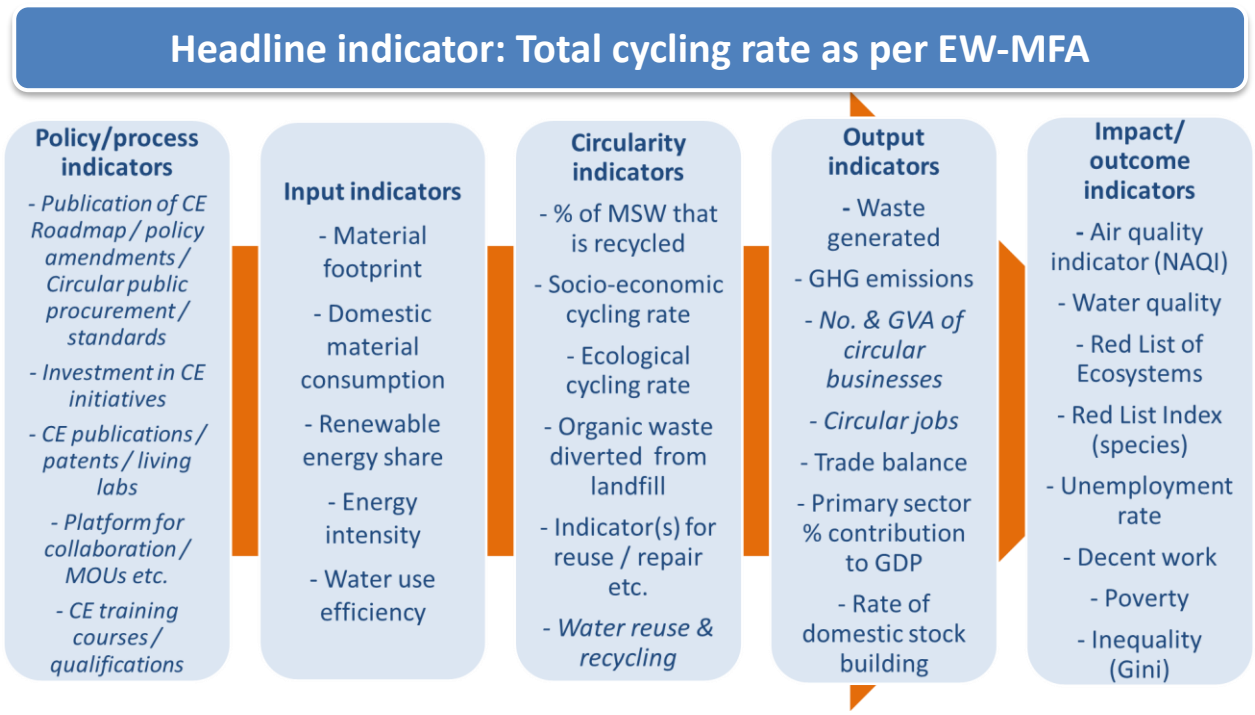

Figure 14: Relationships between the indicators proposed for the South African Circular Economy Monitoring System (SACEMS)

As per the Bellagio framework (EEA, 2021) and PACE (2021), these different types of indicators may be more or less relevant at different stages of the circular transition. Specifically:

- **Policy and process** indicators are more relevant in the early stages of the circular economy transition; as they will reflect the extent to which the required enabling environment is being created.
- On the other hand, the **impact / outcome indicators** will initially be useful mainly for providing a baseline against which the impacts of the circular economy transition can be assessed at a later stage, once the circular economy is more firmly entrenched and has had an opportunity to contribute towards these outcomes (PACE, 2021).

9. Next Steps

It should be emphasised that the indicators put forward in this report are a proposed draft set of indicators for discussion and validation with stakeholders; they should not be seen as the 'final' set of indicators for implementation. The work to date constitutes the first phase in the development of a set of indicators for tracking South Africa's progress towards a circular economy; and ultimately in the development of a proposed South African Circular Economy Monitoring System (SACEMS).

In the next phase, it is proposed that the draft indicators be discussed and validated with relevant stakeholders, including Statistics South Africa, DFFE and other relevant government departments, circular economy experts, as well as experts in some of the specific domains covered by the indicators. Based on these discussions, a final agreed set of indicators will be compiled. In addition, guidance will be provided on monitoring and reporting systems; including data sources, calculation methodologies, entities responsible for reporting, as well targets and thresholds; to enable monitoring and reporting at a national level. This will in turn provide the foundation for the development of the SACEMS in future work.

Potential future phases could also explore aspects around implementation of the indicators at other levels and in other contexts; such as at a sectoral or sub-national (e.g. provincial or city) level. In addition, it could be explored how the indicators could be adapted and implemented for other applications, such as by Development Finance Institutions (DFIs) and other funding institutions to assess proposals and projects from a circular economy perspective.

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