wbcsd

CIRCULAR TRANSITION INDICATORS V4.0

Metrics for business, by business

CTI

Contents

Thank you to the companies and organizations that have contributed to the development and implementation of the Circular Transition Indicators.

Advisory group

The Circular Transition Indicators framework is developed by members of the Circular Transition Indicators project of WBCSD's Products & Materials Pathway.

The Circular Transition Indicators are co-authored by KPMG

We are proud to continue to partner with WBCSD to further business progress toward a more circular economy. As a participant in the Circular Transition Indicators project, we helped identify tools to better self-assess our use and reuse of resources. We can now prioritize and establish targets to monitor our progress within the circularity space.

Stephan B. Tanda
President and CEO, Aptar

At CHEP, we know that our share & reuse business model is inherently circular. The challenge is how to measure it! We initially welcomed the CTI Tool with a view to finding a company-wide circular performance KPI. We soon realized it is actually much more and also found their approach to material flows analysis complement other circularity measurement systems. We are also able to quickly identify risks at an appropriate level of detail and prioritize actions to improve our circularity.

Juan Jose Freijo
Vice President, CHEP

Transforming towards sustainable mobility the Mercedes-Benz way means taking the lead in electric drives while at the same time taking on responsibility as a company and in terms of products and production. Therefore, we drive the conversion of the value chain into a value cycle, to get closer to our goal of CO_2-neutral mobility. By implementing the CTI framework into our business structures, we are able to measure and improve the circularity of our processes in a comprehensive and standardized way in order to derive appropriate measures to accelerate our transformation into a circular economy.

Markus Schäfer
Member of the Board of Management, Mercedes-Benz AG

KPMG is proud of our continuous involvement in the development of the CTI Framework v3.0. As an implementation partner we see the added value that this framework brings to our clients to help assess circular performance, identify risks and opportunities and steer towards resilient and future-proof business practices.

Richard Threlfall
Global Head of KPMG IMPACT, KPMG International

The circular economy is not just about recycling – it is about a transformation of the entire value creation system by decoupling growth from finite resources. At LANXESS, we support this transformation. Being in the middle of long value chains, we are not only working on alternative raw materials, but are also exploring different recycling technologies for our products. For example, our engineering materials are suitable for mechanical and multiple chemical recycling pathways.

Anno Borkowsky
Board member responsible for value-chain circularity, LANXESS

I believe in the circular economy. Today Holcim is one of the world's leaders in this area, recycling 50 million tonnes of waste into our products and processes. By 2030, I set the target to double this rate, to recycle 100 million tonnes across our business. I see a big opportunity in recycling construction and demolition waste, as concrete can be infinitely recycled. Using WBCSD's Circular Transition Indicators (CTI), we are closing material loops and measuring our revenue from green products and solutions. With the CTI framework we are actively measuring our contribution to building greener cities to keep on raising the bar.

Jan Jenisch
CEO, Holcim

The Circular Transition Indicators (CTI) framework developed by the World Business Council for Sustainable Development (WBCSD) provides a universal global definition and measurement method to make circular entrepreneurship understandable, measurable and manageable. The framework brings us the right focus and encouraged us to move from a waste-report to an inflow-report and outflow-report. For example, at this moment we use the framework to measure the level of circularity of our trains, and to steer decision-making during procurement to achieve our goal: 100% circular trains in 2030.

Marjan Rintel
CEO, NS

The Port of Rotterdam, as a key hub for resources in Northwestern Europe, has used the CTI framework to assess the circularity of production and throughput in the port. This exercise has resulted in a baseline for improvements in the future. The scan made it clear that there is enormous potential to improve the circularity of our port and industrial cluster. The circular economy is an increasingly important component of our strategy and we are actively working with our partners to make supply chains more circular.

Allard Castelein
CEO, Port of Rotterdam

Security Matters (SMX) supports and acknowledges the leadership role of WBCSD and the importance of the Circular Transition Indicators (CTI) framework as it complements SMX's digital twin technology and blockchain platform solutions enabling companies to successfully transition to a truly circular economy in a tangible, credible and measurable way – where every material is fully utilized and nothing goes to waste.

Haggai Alon
CEO, Security Matters Ltd

Transitioning to a circular economy is about much more than just reducing the waste inherent in the linear economy. It's about sustainable growth that creates economic opportunities, environmental and social benefits and increases business resilience. This transition requires a systemic shift that closes, optimizes and values resource loops across the value chain which makes collaboration across companies pivotal.

Alistair Field
CEO, Sims

Foreword

Circularity must be accelerated to optimize resource use and enable the systems transformation required for sustainable production and consumption. A net-zero, nature-positive world can't be delivered without significantly growing the circular economy. The developing accountability systems for Climate and Nature are accelerating business commitments to a low-carbon, nature-positive world. Equity is closely following. The circular economy, through the adoption of circular sourcing and design strategies, longer and multiple product lives, and the closing of resource loops, is a fundamental building block of the transformations we need for a world where more than nine billion people can live well within the limits of the planet, by 2050.

Companies can reduce risks, maximize resource value and develop organizational resilience while mitigating climate change and reducing pressures on nature by increasing circularity. Moving from linear to circular economic models requires the adoption of new metrics to drive progress in circularity.

Built for business, by business, the Circular Transition Indicators (CTI) provide a reliable framework of metrics that companies can use to develop insights into how to increase circularity along their value chain and understand how that reduces their impact on climate and nature.

We know that the environmental benefits of a circular economy are extensive. To date, however, businesses have struggled to measure the effect of circularity on reducing carbon emissions and preserving nature.

In this updated version of CTI, we have extended the greenhouse gas (GHG) impact methodology to provide a more complete picture of how circularity can affect the carbon footprint of a company's products and materials. The updated methodology draws from widely adopted carbon accounting practices and focuses on incentivizing the reuse of products and materials across value chains.

In CTI v4.0 we begin the journey toward quantifying the impact of circularity on nature, where business has a critical role to play in protecting and restoring natural systems. This requires fundamental changes in the way we extract, produce and consume resources but promises to deliver great benefits in halting and reversing nature loss. For example, a landmark report by Sitra estimates that a shift to a circular food and agriculture sector can deliver up to 73% in biodiversity recovery by 2035.

Up to 75% of the Earth's land surface has been significantly altered by human actions to meet the growing demand for food, fuel, and raw materials.[1] The adoption of circular practices in materials sourcing is a critical step in ensuring healthy ecosystems and life on our planet. CTI v4.0 will help companies assess how regenerative production and minimizing resource extraction can reduce impacts on land use, the most impactful driver of nature loss.

Since the inception of CTI, thousands of companies are now using consistent circular metrics to transform their business toward building resilience, unlocking new growth opportunities and pathways to value generation, delivering on their sustainability roadmaps and developing readiness toward accountability systems for circularity and sustainability.

We welcome you with us on this transformational journey!

Diane Holdorf
Executive Vice President,
WBCSD

Executive summary

As the circular economy builds momentum, it is imperative for companies to prepare for their transition based on insights into their circular performance and associated risks and opportunities. To do this, business needs a universal and consistent way to measure its circularity.

According to the Circularity Gap Report, the global economy is only 7.2% circular today.[2]

The Circular Transition Indicators (CTI) shaped by 30 WBCSD member companies help answer questions like:

- How circular is my company?
- How do we set targets for improvement?
- And how do we monitor improvements resulting from our circular activities?

CTI is simple, applicable across industries and value chains, comprehensive yet flexible, complementary to a company's existing sustainability efforts and agnostic as to material, sector or technology.

Central to CTI stands a self-assessment that determines a company's circular performance. It focuses primarily on the circular and linear mass that flows through the company, in which design, procurement and recovery models are crucial levers to determine how well a company performs.

In addition to the ability to close the loop, CTI provides insights into overall resource use optimization and the link between the company's circular material flows and its business performance.

The framework does not evaluate absolute environmental and social impacts. However, it gives insights into how circularity helps to achieve sustainability objectives related to climate and nature. This shows the circular economy as a key enabler in reaching sustainability objectives.

Although the use of common indicators for circular performance is essential to accelerating the transition to the circular economy, the value of CTI for a company goes beyond the calculation in the guidance, analysis and explanation for how circularity drives company performance. The CTI process helps companies scope and prepare the assessment and interpret its results, understand its risks and opportunities, prioritize actions and establish SMART targets to monitor progress.

CTI is inward-facing, objective, quantitative and based on demonstrable data. This data may sit in hidden corners of the company or even outside the company, with its value chain partners. In order to support and guide companies through this process, we have partnered with Circular IQ to develop the CTI Online Tool available at www.ctitool.com. Through the tool, CTI initiates value chain discussions, which are essential to accelerating the transition to the circular economy. As customer, investor and regulatory pressures to demonstrate circular performance increase, it is in each company's best interest to respond credibly.

CTI delivers a framework to prepare this response. The framework does not provide a rating but leaves it to the company to determine whether the results are in accordance with its ambitions, putting the company in the driver's seat of its own circular transition.

We invite companies of all sizes and industries worldwide to demonstrate their commitment to the circular economy by measuring their circular baseline with the launch of this updated version of CTI in May 2023.

ANNOTATIONS

- NEW CONTENT
- EXAMPLES
- NOTES

CTI VERSION 4.0: WHAT'S NEW

CTI v4.0 includes updates to its Impact of the Loop module which helps companies prioritize circular strategies in light of their impact on the company's sustainability targets.

In this version, we update greenhouse gas (GHG) impact with a methodology to measure the impact of using higher value inflows (reused, refurbished, remanufactured content) and enabling the recovery of outflows on material carbon footprint.

CTI v4.0 includes a new indicator to measure impact on nature. CTI v4.0 begins this important work focusing on a key pressure on nature loss: land use. This report provides a methodology to measure land use impact of circular sourcing strategies.

If you have already completed an assessment with CTI, the new content will not affect your performance. CTI has only become easier and more valuable with these changes.

Part 1.

Circular Transition Indicators: Framework

Circular Transition Indicators

Today the world is only 7.2% circular.[3] Not only is it clear that this is not sustainable, the urgency to step away from a take – make – waste economic model is growing. It will be virtually impossible to achieve the Sustainable Development Goals (SDGs) and the Paris Agreement if this wasteful trend continues, as we will need the natural resources of two Earths by 2030.[4] Business must step up action to deliver solutions for a net-zero emissions, nature-positive and equitable world.

Where some see waste, we see value, opportunity and a business case to use resources for as long as they can last. As the pressure to shift from linear to more circular ways of doing business increases, the good news is that the opportunity to improve stands at over 91%.

The momentum to transition is growing and both the private and public sector are beginning to set ambitious circular targets.

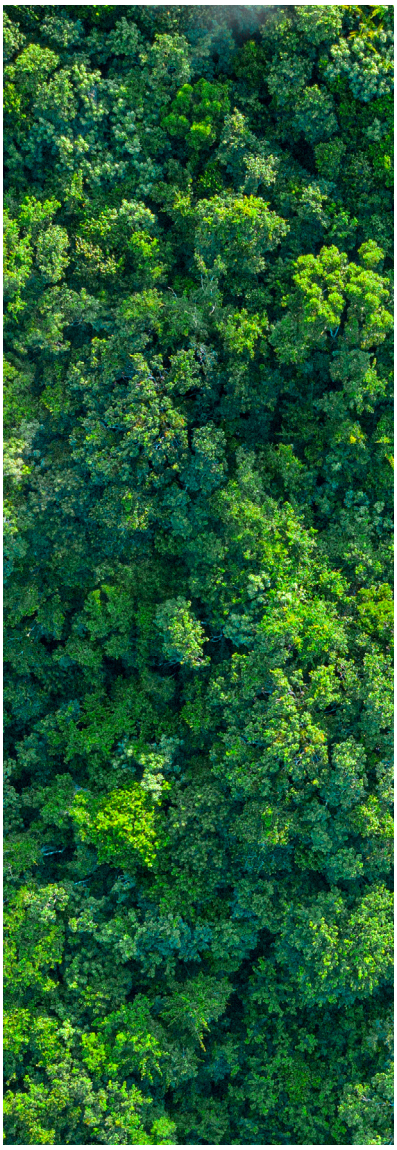
For example, the European Commission is promoting an accelerated transition and the Netherlands introduced a government-wide program to reduce primary raw material use by 50% by 2030 and transition to a full circular economy by 2050.

Transparency and alignment are critical to establishing a common language across industries and governments to develop strategies and measure progress. For this reason, 30 global companies have come together through WBCSD's Products and Materials pathway to develop the Circular Transition Indicators (CTI).

We have developed an objective, quantitative and flexible framework, identifying risks and opportunities to determine circular priorities and set targets. We do not intend for this framework to replace existing sustainability frameworks already used by industry; rather, we endeavor to provide additional insights into circularity performance.

This CTI framework is based on an assessment of material flows within company boundaries, combined with additional indicators on resource efficiency and efficacy, as well as the value added by circular business.

Through this lens, the framework can guide companies in gaining concrete insights into how they can most effectively transition to a circular economy and the associated opportunities.



Need for circular metrics

Linear business models have been profitable for decades. However, with finite natural resources and the increasing cost of externalities, companies are increasingly exposed to market, operational, legal and business risks. At the heart of the business case for circularity sits the opportunity for companies to create more value by being smarter about how they use resources. Through circular business models, companies can accelerate growth, enhance competitiveness, and mitigate risk.

TRANSITION

While a circular economy is an economic model that provides opportunities for companies across industries, the transition to a circular economy is not straightforward. Companies must change business models, adapt strategies and evolve the skills of their workforces, and governments must adjust policies to enable the circular economy.

This makes it difficult to plan for and set clear targets for a coordinated transformation. To understand where a company currently stands in its circularity and allow for the setting of targets monitored by clear key performance indicators (KPIs), companies need a system of metrics that can guide their decision-making when adopting circularity in their corporate strategy.

ONE COMMON APPROACH

No company can drive the transition to a circular economy on its own.

The circular economy requires a larger industry, value chain and cross-sector effort. To transform, companies must speak the same language, regardless of size, industry or value chain position.

Having a common approach to measuring and monitoring circular performance is essential. This will allow value chains to become value cycles, progressing towards a shared vision.

This initiative started as the Circular Metrics Landscape Analysis,[5] in which we carefully studied and reviewed existing protocols and standards for circular metrics. The analysis and subsequent conversation identified several ways to calculate circularity, such as the Material Circularity Indicator and Circulytics by the Ellen MacArthur Foundation;[6] and Circularity Gap Report Initiative by Circle Economy[7] or the Circularity Check by Ecopreneur.eu for a qualitative circularity self-assessment.

These methodologies converge on material flows – establishing a common language for circularity across industry and government.

The analysis concluded that there was an existing need for an inward facing, quantitative approach and guidance to measure circularity for the whole company, business unit or product (group) with a framework that complements assessments and tools used by companies today. Building upon material flows, CTI incorporates water, renewable energy and business value into its scope to create a multidimensional perspective of a company's circular performance.

CIRCULAR ECONOMY DEFINITION

The circular economy is an economic model that is regenerative by design.

The goal is to retain the value of the circulating resources, products, parts and materials by creating a system with innovative business models that allow for renewability, long life, optimal (re)use, refurbishment, remanufacturing, recycling and biodegradation.

By applying these principles, organizations can collaborate to design out waste, increase resource productivity and maintain resource use within planetary boundaries.

Note: CTI is in alignment with the Ellen MacArthur Foundation circular economy principles:

- Design out waste and pollution
- Keep products and materials in use
- Regenerate natural systems.

Use of CTI

CTI offers companies insights into their circular economy performance, allowing them to:

- **Identify circular opportunities and linear risks**, with the aim of improving company longevity and resilience
- **Set a baseline and monitor progress** on their circular transition
- **Respond to customers and external stakeholders** (e.g., investors or civil society organizations)
- **Start value chain conversations** on shared circular priorities
- **Attract new business** by simultaneously advancing customers' circular objectives
- **Prepare for disclosure** to regulatory standards on circularity (e.g., the EU Corporate Sustainability Reporting Directive or GRI 306).[8]

We designed this framework to be easy to implement and versatile in scope. It allows business to measure circularity at any level, from product and product level to the entire business, so that companies can use the indicators at the level that best suits their business.

With CTI, we aim to empower companies in their circular transition by allowing them to better understand their circular economy potential.

As such, we endeavor to be as non-prescriptive as possible.

WBCSD does not play a role in a company's CTI assessment, which it developed as an inward-facing tool for companies to gain insights into their circularity. As such, CTI does not:

- **Constitute an assessment of sustainability performance.** Through the latest additions to the Impact of the Loop module, CTI is now able to estimate the impact of circular economy interventions on sustainability targets and, hence, can be seen as complementary to existing and commonly used frameworks that cover a company's wider sustainability performance (e.g., greenhouse gas (GHG) emissions, biodiversity, human capital, etc.).
- **Compare industries, companies or products.** Each company's circularity journey is unique. It is therefore only possible to make comparisons in a relevant context and upon careful consideration.
- **Target non-sustainability marketing and promotional materials.** Circular economy is an important and necessary pathway to more sustainable production and consumption.

However, its influence on a company's sustainability performance depends on the larger context of other sustainability indicators. Companies are discouraged from communicating the results of the framework externally unless they present them in the appropriate context.

SHARED PRIORITIES

One of the key drivers behind the aluminum industry's highly effective recycling infrastructure was a coalition of aluminum value chain stakeholders that realized the material was at risk of both depletion and reduced competitiveness if linear consumption rates continued their trajectory. Their combined commitment and resources to develop a powerful recycling infrastructure lay at the core of today's 70% recovery rate for aluminum cans.

In 2015, the Aluminium Stewardship Initiative (ASI) incorporated as a non-profit entity to develop and operate an independent third-party certification program to drive a material stewardship approach for aluminum throughout the value chain.

Source: Aluminium Stewardship Initiative

We consider the following to be an appropriate context:

- The company carefully discloses the scope of the assessment to give the reader a comprehensive view of its circularity performance;
- The company clearly states that the "Circular Transition Indicators are not a full-scope sustainability assessment and that results should not be used to benchmark companies or industries on their full scope sustainability performance";
- An independent third party assures the results.

For product-level circularity, we encourage companies to disclose the scope of the assessment and how it compares to the rest of the company's portfolio.

THE CTI ONLINE TOOL

Data is a crucial ingredient in CTI. This includes data that may be readily available, as well as data hidden in pockets of the company or even data that exists outside your company with supply chain partners. Obtaining this data and performing the calculations constitute the most resource-intensive parts of the framework.

To optimize CTI accessibility and usability, we have partnered with Circular IQ to develop the CTI online tool: www.ctitool.com.

This tool structures data collection and calculates the outcome per indicator.

It includes functionality that can support users as they contact internal stakeholders or value chain partners for data requests to avoid confidentiality issues.

Additionally, it documents the exact scope and steps taken, allowing for consistency and monitoring over subsequent cycles. The CTI online tool serves a facilitating function and stores outcomes in a structured manner; it supports decision-making and allows companies to keep track of progress. However, we recommend that companies first read the methodology and user manual within this document for optimal results and a smooth process. Further, we recommend to involve different experts from the company in the implementation of CTI's seven steps rather than attempting to complete the tool in isolation.

The CTI online tool guarantees data security and confidentiality[9] and we are continuously improving it for user experience and actionable and meaningful outcomes.

FRAMEWORK PRINCIPLES

Simplicity

Be as simple as possible within the context of the circular economy.

Consistency

Use one common, cross-industry language and provide consistent insights into circular opportunities and linear risks regardless of organization size, sector or value chain position.

Completeness and flexibility

Offer a complete set of metrics with the flexibility of accommodating diverse business needs.

Complementarity

Given that circularity is one pathway to more sustainable production and consumption, assessments should never take place in isolation and should always complement other existing sustainability and business metrics.

Neutrality

Refrain from prioritizing specific materials over one another insofar as they all contribute to the circular economy.

A value chain effort

The circular economy requires collaboration. The entire value chain must work together to maximize the value created for every unit of resource.

Figure 1 illustrates a simplified value chain. The further a company is from the red arrows, the more difficult it can be to obtain information.

CTI is a catalyst in the initiation of cross value chain conversations. It provides a process for value chain partners to collectively pursue shared goals.

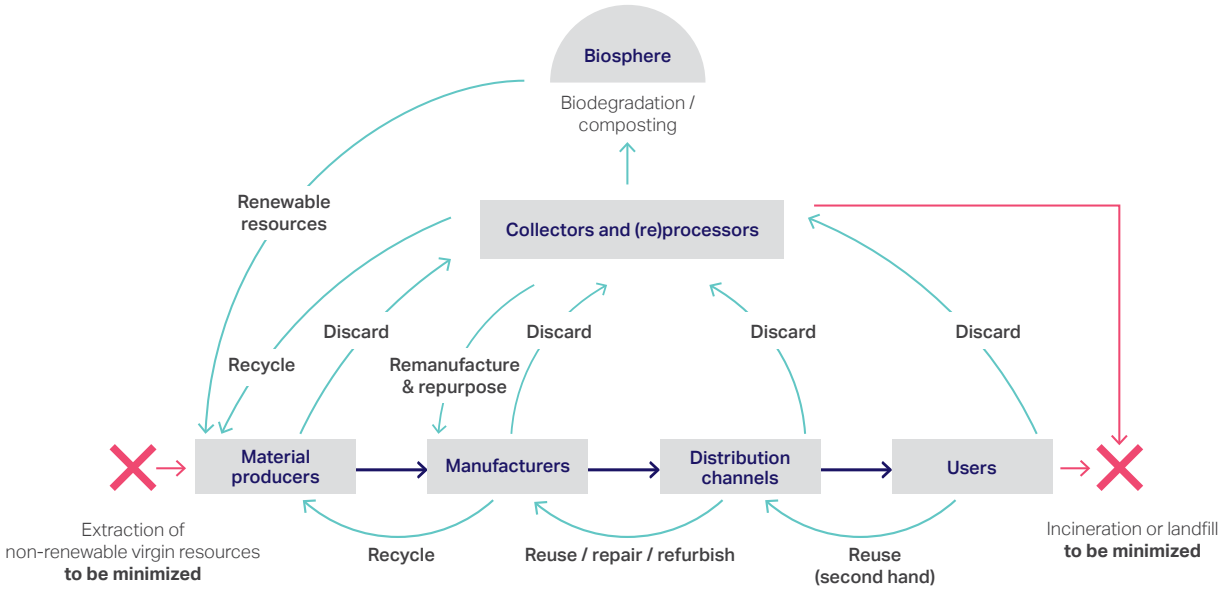
The CTI online tool helps companies obtain required data from value chain partners without raising privacy or confidentiality concerns.

SHARED PRIORITIES

A Dutch telecom company engages with its supplier through a Circularity Manifesto, ensuring upstream value chain partners conduct their business in the same circular way the telecom company does.

Source: KPN Circular Manifesto and Appendix 2017

Figure 1: Simplified representation of the value chain recovery system



The CTI methodology logic

CTI is based on material flows through the company. By analyzing these flows, the company determines its ability and ambition to minimize resource extraction and waste material. It entails the assessment of the flows within the company's boundaries at three key intervention points:

INFLOW

How circular are the resources, materials, products and parts sourced?

OUTFLOW – RECOVERY POTENTIAL

How does the company design its products to ensure the technical recovery of components and materials at a functional equivalence (e.g., by designing for disassembly, repairability, recyclability, etc.) or that they are biodegradable?

OUTFLOW – ACTUAL RECOVERY

How much of the outflow does the company actually recover?

The outflow includes products, by-products and waste streams. Companies can improve actual recovery rates through closed loop business models or mandatory or voluntary open loop recovery scheme efforts.

The results will illustrate how effectively a company closes the loop.

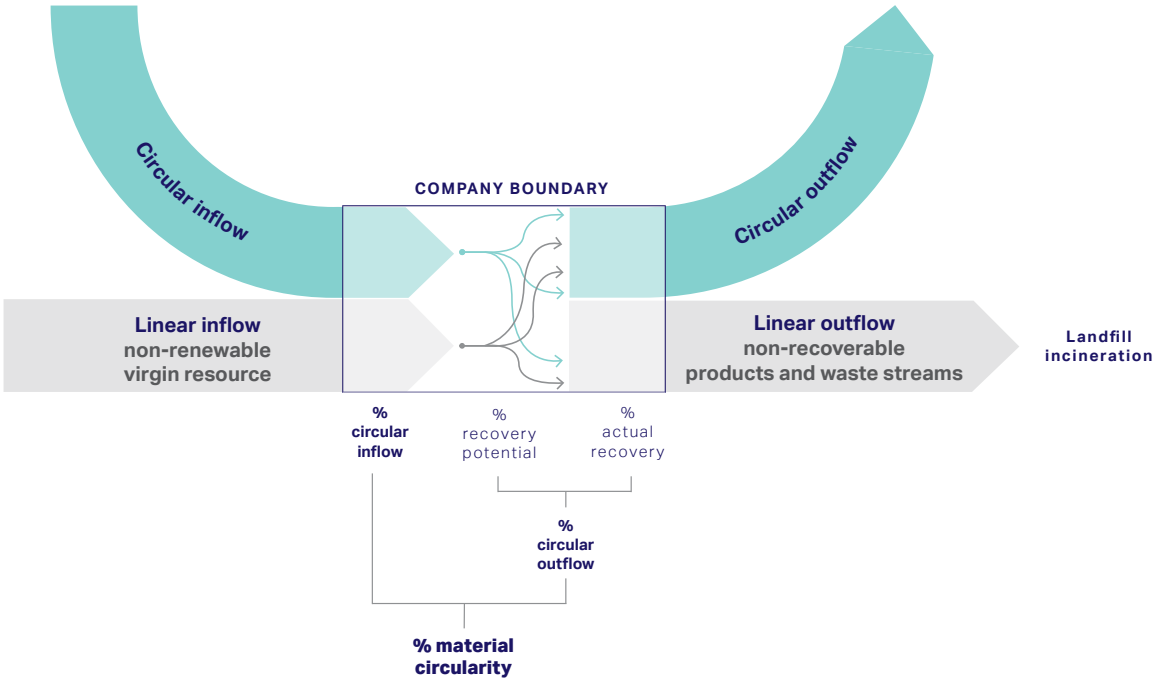
MATERIAL FLOWS

Material flows can include nutrients, compounds, materials, parts, components or even products. For readability, this report refers to all of these as material flows.

RECOVERY

Recovered refers to the technically feasible and economically viable recovery of nutrients, compounds, materials, parts, components or even products (depending on the organization) at the same level of functional equivalence through reuse, repair, refurbishment, repurposing, remanufacturing, recycling, biodegradation (including composting).

Figure 2: Illustration of material flows



The indicators

Any company, regardless of size, sector or position in the value chain, can use this framework. As such, the selection of indicators relevant for any business will vary. CTI provides a menu of indicators, some of which are optional.

Assessments start with the completion of the full Close the Loop module. Companies may then calculate indicators from Optimize the Loop and Value the Loop for additional insights.

Impact of the Loop is a new module that helps companies measure the impact of circular strategies on their sustainability.

Close the Loop
% material circularity
% water circularity
% renewable energy

Optimize the Loop
% critical material
% recovery type
actual lifetime
onsite water circulation

Value the Loop
circular material productivity
CTI revenue

Impact of the Loop
GHG impact
nature impact

1. CLOSE THE LOOP

This module calculates the company's effectiveness in closing the loop on its material flows.

This can be assessed on the level of the company, a business unit, facility or product (group) level.

% material circularity

A company's performance in closing the loop is expressed in % material circularity, which is the weighted average between % circular inflow and % circular outflow, as outlined in the formula structure below. The % circular inflow is determined by the % non-virgin content and % renewable content (sustainably grown bio-based sources). The % circular outflow is determined by the % recovery potential (which is focused on design) and the actual recovery. These three pillars address different aspects of the business: procurement for inflow, design for potential recovery and business model innovation (closed) and legal and partnerships (open) for the actual recovery.

BIOLOGICAL CYCLE GUIDANCE

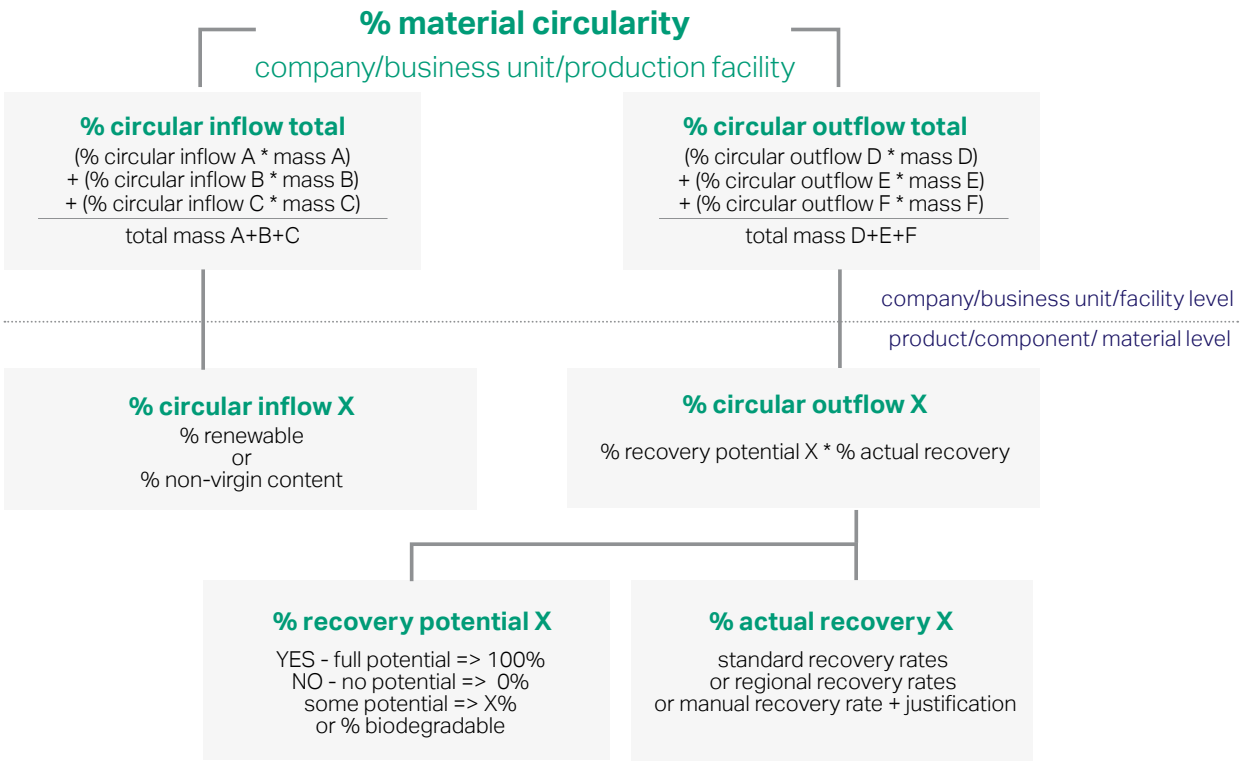
CTI includes specific guidance for the assessment of materials in both technical and biological cycles.

SEPARATE INDICATORS

The resulting outcomes from the Close the Loop module are:

1. % material circularity, which is the weighted average of:
   - % circular inflow
   - % circular outflow
2. % water circularity
   - % circular water inflow
   - % circular water outflow
3. % renewable energy

Figure 3: % material circularity



Water circularity

In addition to material flows, we consider the circularity of freshwater to be an important element of the circular economy. What sets water apart from other materials and resources is the scale of the relevant ecosystem. Where materials can circulate in a global system, it is necessary to assess water circularity on a local level for a water catchment area or local watershed. The purpose of water circularity is to lower freshwater demand and ensure water resource availability for all users and the environment. Circularity of water is therefore determined through the % circular water inflow and % circular water outflow, which in turn depend on local water conditions.

Context-based indicators

% water circularity

$$\frac{\%\ \text{circular water inflow} + \%\ \text{circular water outflow}}{2}$$

% circular inflow total

$$= \frac{\text{Q total circular water withdrawal}}{\text{Q total water withdrawal}} \times 100\%$$

% circular water outflow (discharge, restore)

$$= \frac{\text{Q total circular water discharge}}{\text{Q total water withdrawal}} \times 100\%$$

In addition, the water circularity section offers an internal-facing indicator focusing on internal facility circulation through reuse and recycling.

Internal indicator

Onsite water circulation (reuse & recycle)

$$= \frac{\text{Q water use - Q total water withdrawal}}{\text{Q total water withdrawal}} + 1$$

Renewable energy

The circular economy requires the transition to renewable energy. As most companies already have metrics in place to measure renewable energy consumption for business operations, CTI considers energy separately for which companies can use this existing data. The % renewable energy calculation is as follows:

% renewable energy

$$\frac{\text{renewable energy (annual consumption)}}{\text{total energy (annual consumption)}} \times 100\%$$

WORKING GROUP FOR METRICS FOR WATER CIRCULARITY

WBCSD and BIER (Beverage Industry Environmental Roundtable) combined their expertise to develop a solid and meaningful set of indicators to assess the circularity of water at the facility level. Supplementary guidance and a water circularity metrics tool that provides more granular detail and guidance on the water indicators are available from WBCSD and BIER.

Consult the water metric guidance and tool.

2. OPTIMIZE THE LOOP

This module provides insights on material criticality, resource-use efficiency and higher value recovery strategies. This module and its indicators are optional.

Critical materials

The **% critical inflow** highlights the share of the inflow considered critical. Companies can refer to internal critical materials lists or existing public lists such as those compiled by the European Commission or the United States Geological Survey.[10] This allows companies to assess the risk level of specific material flows and to prioritize accordingly.

The calculation is:

% critical inflow

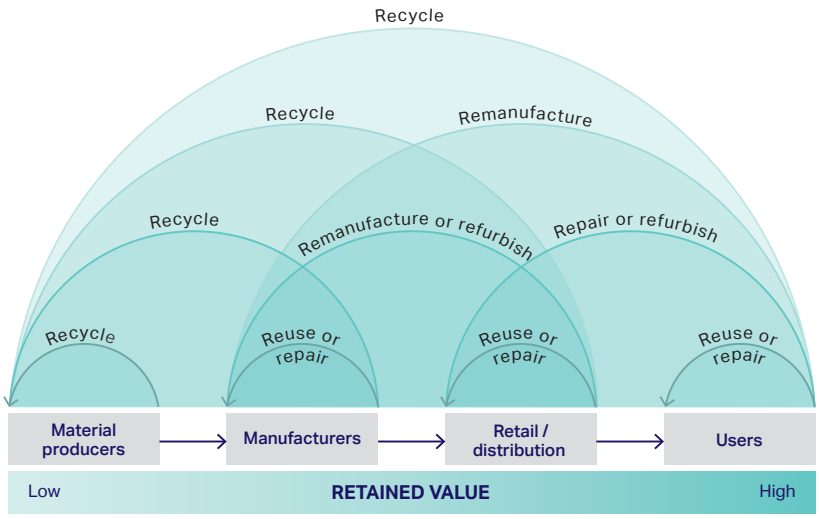
$$\frac{\text{mass of inflow defined as critical}}{\text{total mass of linear inflow}} \times 100\%$$

Recovery type

The other indicator of the Optimize the Loop module, **% recovery type,** focuses on how the company recovers outflow and recirculates it into the value chain. Recovery type is applied to % actual recovery. The results provide a breakdown of the recovered outflow in shares reused/repaired, refurbished, remanufactured recycled or biodegraded. The CTI online tool automatically generates this breakdown based on the Close the Loop data entered.

Depending on the value chain position of the company, the possibilities for optimization in recovery loops may vary.

Figure 4: Recovery types and retained value



CASCADING

CTI includes a model for cascading in the technical sphere and one for the biosphere.

Lifetime extension strategies such as reuse, refurbish or remanufacture are considered to be recovery strategies that retain higher value as they allow companies to preserve the economic value embedded in products and materials, slow down resource flows, and reduce waste and negative environmental impacts. While recycling is a circular strategy under recovery type, it does not lead to lifetime extension. As a preference, lifetime extension strategies should be considered above recycling whenever possible.

To encourage companies to consider lifetime extension strategies whenever available, CTI v3.0 provides the **% recovery by lifetime extension** sub-indicator to help companies track their performance across strategies aimed at retaining higher value: reuse, refurbish and remanufacture.

Actual lifetime

Longer design lives and the lifetime extension of products contribute to slowing down the overall flow of resources, reducing environmental impacts and the production of waste while preserving the economic value embedded in products and materials.[11]

CTI recognizes design for longevity and lifetime extension of products as a circular practice. Designing durable products and materials and implementing strategies to extend their lifetime once they become obsolete leads to higher circularity and value retention through the life cycle of materials and products.

A product's lifetime is intended as the duration of the period that starts at the moment a product is released for use after manufacturing or recovery and ends at the moment a product becomes obsolete.[12] Its durability, intended as the ability to "function as required, under specified conditions of use, maintenance and repair, until a limiting event prevents its functioning", drives longer product lifetime.[13]

A product's technical lifetime and functional lifetime enable its durability. The technical lifetime is the time span or number of usage cycles for which a product is considered to function as required, under defined conditions of use, until a first failure occurs. Functional lifetime is the time a product is used until the requirements of the user are no longer met, due to the economics of operation, maintenance and repair or obsolescence. While the technical lifetime is part of the intrinsic properties of the product, the conditions created around the product determine its functional lifetime.[14]

NOTE

In designing products for longevity and exercising product lifetime extension strategies, companies should ensure that these do not do significant harm to efforts to mitigate and adapt to climate change, the sustainable use and protection of water and marine resources, pollution and prevention control, and the protection and restoration of biodiversity and ecosystems. For more background, companies may refer to the European Commission's Do no significant harm (DNSH) principles or other similar regional, national, sector or industry directives.

EXAMPLE

A computer mouse is designed to last 6 years but the average lifetime of a computer mouse is 4.5 years. The actual lifetime indicator in CTI will provide a positive score for companies whose computer mouse stays in use demonstrably longer than the industry average. (Lifetime data source: Product Life Database, International Living Future Institute).

NOTE

For more context on product lifetime, its impact on slowing the loop and relevant policies and strategies refer to the Product Lifetime Extensions Working Group's reports under UNEP Circularity Platform.

These conditions facilitate the repairability, upgradability and reusability of products extending their useful life. We have developed CTI's **actual lifetime** indicator with the intention of driving companies to develop an understanding of a product's average life duration.[15] This means the duration of life that the product actually experiences, on average, rather than design life or warranty period.

The actual lifetime indicator provides a higher score for products that stay in use for longer than the industry average and is calculated as follows:

$$\textbf{actual lifetime} = \frac{\text{product actual lifetime}}{\text{average product actual lifetime}}$$

Companies can measure lifetime in number of years OR number of use cycles.

3. VALUE THE LOOP

This module illustrates the added business value of a company's circular material flows. The indicators are optional.

While the Close the Loop and Optimize the Loop modules focus on material flows, the Value the Loop module goes beyond material flows to address how circularity creates maximum value with minimum resources.

Circular material productivity

This indicator illustrates the company's effectiveness in decoupling financial performance and linear resource consumption. Companies can calculate circular material productivity by dividing revenues generated by the mass of linear inflow as considered in the Close the Loop module.

The calculation is:

circular material productivity

$$\frac{\text{revenue}}{\text{total mass of linear inflow}}$$

The greater the circular material productivity, the better a company is at decoupling financial performance from linear resource consumption. Insights stem from looking at historic data to understand the evolution of material productivity and by monitoring progress over time to demonstrate a decoupling (or increasing dependency).

CTI revenue

Financial institutions increasingly recognize the value that the circular economy presents in terms of risk mitigation, financial opportunity and positive environmental and social impacts. A solid grasp of value created through circular investments allows investors to proactively recognize and reward companies that make progress on circularity.

However, the lack of a consistent methodology to measure circular performance in terms of both resource efficiency and its associated financial benefits has served as a barrier in scaling up circular investments.

Using the Close the Loop results, a company measures its circular CTI revenue by multiplying the sum of a product (group) or business unit's weighted average of the % circular inflow and % circular outflow and multiplying that by the revenue generated by that product (group) or business unit. As outlined under Close the Loop, calculate both % circular inflow and % circular outflow based on weight of the material flows.

In other words, a company's CTI revenue is its revenue adjusted for the % material circularity of its product portfolio. To calculate CTI revenue for a product:

CTI revenue (product)

$$\left[\frac{\text{(\% circular inflow + \% circular outflow)}}{2}\right] \text{X revenue}$$

To calculate CTI revenue for a business unit or company, sum up all product CTI revenues calculated:

CTI revenue (company)

CTI revenue A
+CTI revenue B
+CTI revenue C +...

The greater the CTI revenue, the better a company can generate revenues from its circular products/business. This metric also reflects decoupling as revenues increase from circular flows.

The methodology is currently based on material circularity and does not provide revenue measurement for services and digital solutions.

4. IMPACT OF THE LOOP

Transitioning to a circular economy will be key to addressing the world's most pressing challenges: the climate emergency, the loss of nature and growing inequality.[16]

Moving to a circular economy offers numerous benefits for both people and planet. It has the potential to significantly reduce greenhouse gas emissions and pressure on nature by decreasing the need for new production and reducing energy consumption. It can promote social and economic equity by creating new jobs, increasing access to resources and to affordable and sustainable products. Shifting to circular approaches may involve trade-offs that companies must be aware of to maximize benefits and minimize any negative impacts. By combining impacts on GHG emissions and land use, for example, companies can capture trade-offs of switching from oil-based to bio-based inputs.

The fourth module, called **Impact of the Loop**, aims to help companies understand the impact of circular strategies on achieving sustainability objectives related to climate, nature and equity. This module measures the difference in impact between the company's current material circularity performance versus improved circularity performance, striving to achieve 100% material circularity, which – in CTI – means using 100% secondary or renewable materials and enabling 100% reuse, remanufacturing or recycling of materials and products into a next cycle through design and recovery strategies. CTI v4.0 includes methodologies to measure the impact of circular strategies on climate and nature. The next version of the CTI report will address equity.

CTI v4.0 provides an approach to understanding the impact of circular strategies on GHG emissions reduction targets. It includes a methodology to understand the circular sourcing impact on GHG emissions for reused, refurbished, remanufactured and recycled inflow and the recovery of technical outflows versus linear disposal methods (landfilling/incineration).

Along with climate impact, companies can now start to understand how their circular performance impacts nature. Land use is the biggest driver of nature loss. Companies can help halt nature loss by switching to circular sourcing strategies.

This indicator allows for comparison between different sourcing strategies to identify the most effective circular actions in reducing land-use impacts.

GHG impact

Greenhouse gas(GHG) impact aims to provide companies with a high-level indication of the GHG emissions savings they may obtain by applying circular strategies. Circular strategies include the use of secondary or renewable materials as inflow and enabling recovery via "higher value retention" recovery such as reuse, refurbish and remanufacture or recycling of the outflow (products and materials). Companies can use this information to better understand GHG emissions savings, evaluate trade-offs and help prioritize circular improvements.

CTI v3.0 focuses on material inflow impact on GHG emissions by measuring the savings of sourcing a higher percentage of recycled content for technical materials. It provides guidance for companies to determine the difference in material carbon footprint of the current amount of recycled materials used, compared to a situation in which the inflow is composed of 100% recycled materials.

CTI v4.0 expands the GHG impact focus for circular inflow, to provide guidance on the impact of sourcing reused/refurbished products and remanufactured components on a company's scope 3 emissions accounting. Additionally, it addresses the impact of renewable (sustainably grown) biobased materials versus non-renewable (conventionally grown) biobased materials on GHG emissions. For the GHG impact of circular outflow, CTI v4.0 focuses on the difference in the impact on the material carbon footprint of enabling higher value retention recovery (reuse, refurbish, remanufacture) and recycling, versus linear disposal methods (landfill, incineration).

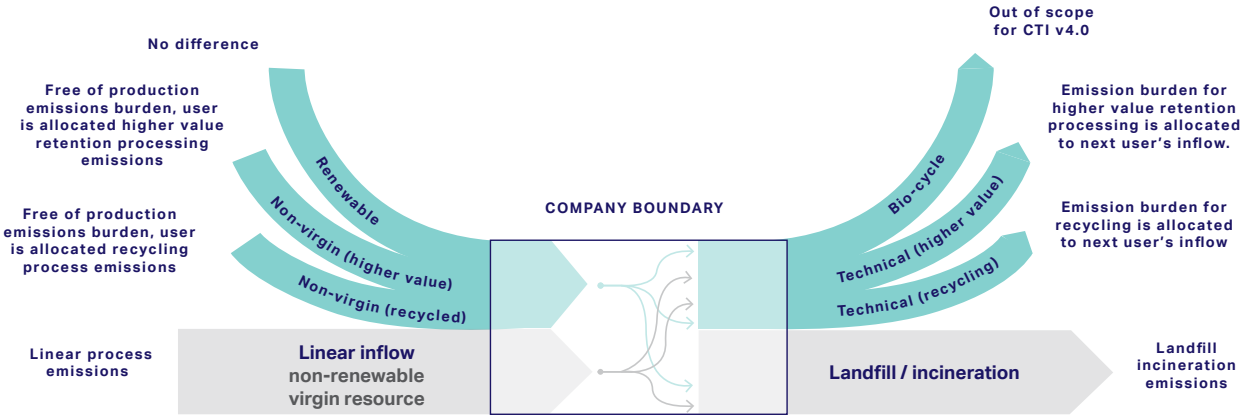
CTI v4.0 provides an approach to understanding the impact of circular strategies on GHG emissions reduction targets. It includes a methodology to understand the circular sourcing impact on GHG emissions for reused, refurbished, remanufactured and recycled inflow and the recovery of technical outflows versus linear disposal methods (landfilling/incineration).

The material flow illustration in figure 5 presents the approach developed in both CTI v3.0 and CTI v4.0 and provides an overview of material carbon footprint savings that companies may obtain by applying circular strategies.

The system model "Allocation, cut-off by classification", or the cut-off system model, is based on the recycled content, or cut-off, approach. In this system model, wastes are the producer's responsibility ("polluter pays"), and there is an incentivisation to use recyclable products, that are available burden free (cut-off).

Learn more: https://ecoinvent.org/the-ecoinvent- cut-off

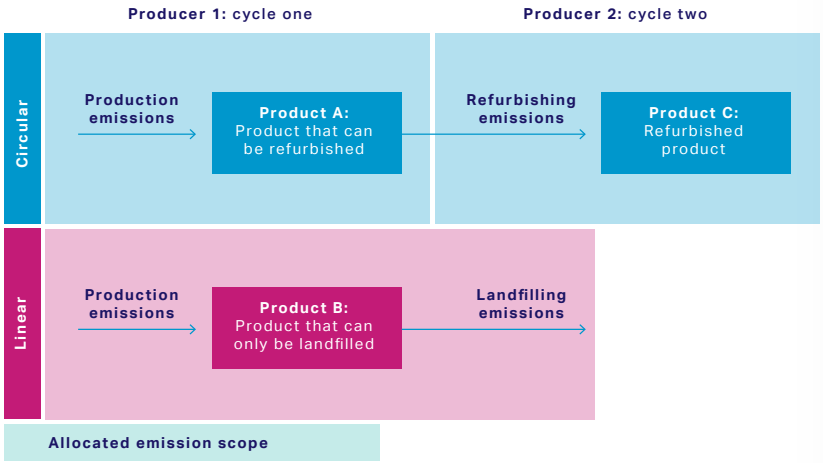
Figure 5: Material carbon footprint savings of circular strategies



To determine the GHG impact of circular flows, CTI adopted the "Allocation, Cut-off by classification" system model,[17] also referred to as "recycled content method" in the GHG Protocol.[18] In this methodology the producer of a material or product is fully accountable for the GHG emissions of the production of that material or product. The non-virgin material part or product becomes available free of burden emissions for the user of the non-virgin material or product in the next production cycle. The user of the non-virgin material or product only accounts for the GHG emissions related to the preparation for reuse or recycling processes needed. The producer also accounts for the GHG emissions of any incineration or landfilling of not recoverable material or waste. The producer of the materials or product is encouraged to make products and materials available for a next production process.

In this approach, users and producers of non-virgin materials benefit from materials that are free from the burden of production emissions while the producers of primary materials benefit from incentivizing product and material recovery to avoid high landfill and incineration emissions.

Figure 6: Allocation of emissions scope for circular versus linear scenarios



Circular process

Producer 1 is only responsible for the emissions of the primary production when the product is refurbished and used in a second production cycle. This second production cycle leads to Product C (refurbished product).

Producer 2 is only responsible for the emissions of the refurbishing process for the refurbished product (cycle two). Due to the use of the "Allocation, Cut-off by classification" methodology, Producer 2 is not responsible for the production emissions of production cycle one.

Linear process

Producer 1 is allocated the emissions of the production of Product B. Producer 1 is also allocated the landfilling emissions of Product B since the product was designed in a way that could not be refurbished and used again in a second use cycle.

EXAMPLE

GHG impact – Circular inflow
In a laptop the average amount of recycled aluminum is 60%. Based on the weight of the aluminum used in the laptop and the emissions factor per kg for both the processes related to virgin (mined) and non-virgin (recycling from scrap aluminum sourcing, there is an emissions savings of 15% on aluminum when the amount of recycled content increases from 60% to 100%.

GHG impact Circular outflow

The manufacturer of an aluminum laptop cover produces two types of laptop covers. One that is designed to be fully refurbished and used in a second cycle, one that is not designed for reuse and can only be landfilled at end of life. The two recovery strategies are compared. Based on the "Allocation, Cut-off by classification" system model, the aluminum in strategy one becomes available free of primary production emission burden for the user of the refurbished laptop cover. In that case, the user is only allocated emissions associated with the refurbishment process on the inflow side. The emissions of strategy two (landfilling), are fully accounted to the producer of the aluminum laptop cover, since the product could not be used in a second cycle, leading to a linear disposal method.

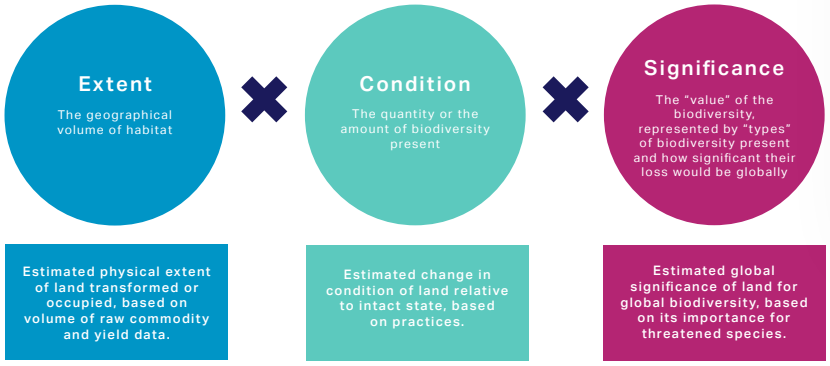
Nature impact

Biodiversity is declining at an unprecedented rate. Estimates show that extinctions are currently occurring a thousand times faster than the "natural" extinction rate.[19] Some 90% of nature loss is due to the extraction and processing of natural resources.[20] The third principle of the circular economy is to regenerate nature.[21] This can be achieved by applying regenerative production practices, extending product lifetimes, reducing waste and resource extraction.[22] Through this principle, the circular economy can reverse and halt nature loss, leaving more room for nature to thrive. Circular interventions have the potential to recover the world's biodiversity to year 2000 levels by 2035.[23]

This indicator focuses specifically on impact from land-use change. Land-use change is the most impactful driver of nature loss and includes land occupation, land-use change, land degradation and deforestation impacts.[24] This indicator will provide an initial screening of land-use impacts from the material extraction and cultivation related to a company's material inflow. It helps companies understand how their circular performance impacts nature by measuring the land-use impacts of their current inflow and potential improvement by shifting to circular sourcing. The indicator is especially relevant for companies that are highly dependent on materials that have a significant contribution to negative impacts on nature. Measuring land-use impacts is in line with the vision of a nature-positive world by 2030 and complements ongoing efforts among WBCSD members to develop the Roadmaps to Nature Positive that will deliver a tailored sectoral framework for business accountability, ambition and support the implementation of the Global Biodiversity Framework.

There are three dimensions to consider when estimating the impact of land-use change on nature: the **extent** of land use, the **condition** of the land used and the **significance** of the land (Figure 7).

Figure 7: Key components of land use impacts to calculate impact on nature



Key drivers of nature loss

The key drivers that lead to nature loss are: land- and sea-use change, direct resource exploitation, climate change, pollution and invasive species.[25] On a global scale, land-use change is the biggest and most direct driver of nature loss. CTI already addresses water use and GHG emissions. Future updates will include other key drivers to complement this indicator.

What it is (not)

This indicator measures land-use impacts associated with a company's material inflow, focused on measuring extent of land used, the intactness of the biodiversity on the land and the significance of land for biodiversity. This indicator can be used for technical materials and biological resources.

For simplicity and usability, the scope of this indicator is limited to the extraction and cultivation stage of sourced materials only. This stage has the most impactful land-use impacts. This indicator excludes land use of other stages along the value chain, such as processing manufacturing or distribution or recovery. It also excludes toxicity or other air, soil or water emissions that negatively impact nature.

EXAMPLE/S

Consider a company whose material inflow consist of aluminum to produce laptops. The company analyzes the land-use impacts of their inflow in 2022, producing 10 million laptops. The impact on nature will depend on how the aluminum is produced and from where the company sources it. For example:

- **Scenario A. Virgin materials:** The company produces laptops using virgin-sourced aluminum derived from bauxite. Bauxite is typically mined in large open pits, resulting in impacts on nature due to the transformation and occupation of land for mine shafts and storage of mine tailings. Moreover, these mines are often located in places that are globally significant for biodiversity (i.e., home to threatened species and high-integrity ecosystems) such as Brazil, Guinea or Australia.
- **Scenario B. Recycled material:** In contrast, if the company produces laptops using recycled aluminium, the recycling process entails a significantly lower change in the extent of land used since the material is an input in the recycling process.

SBTN & TNFD

Understanding and addressing land-use impacts is a priority for alignment with voluntary corporate biodiversity frameworks such as the **Science-based Targets for Nature by the Science Based Targets Network (SBTN)** and the **Taskforce on Nature-Related Financial Disclosures (TNFD)**. For example, SBTN has recently published draft guidance on developing science-based targets for metric can support companies to understand whether they have material impacts on land and conduct an initial materiality assessment for products and commodities.

The technical and biological recovery cycles

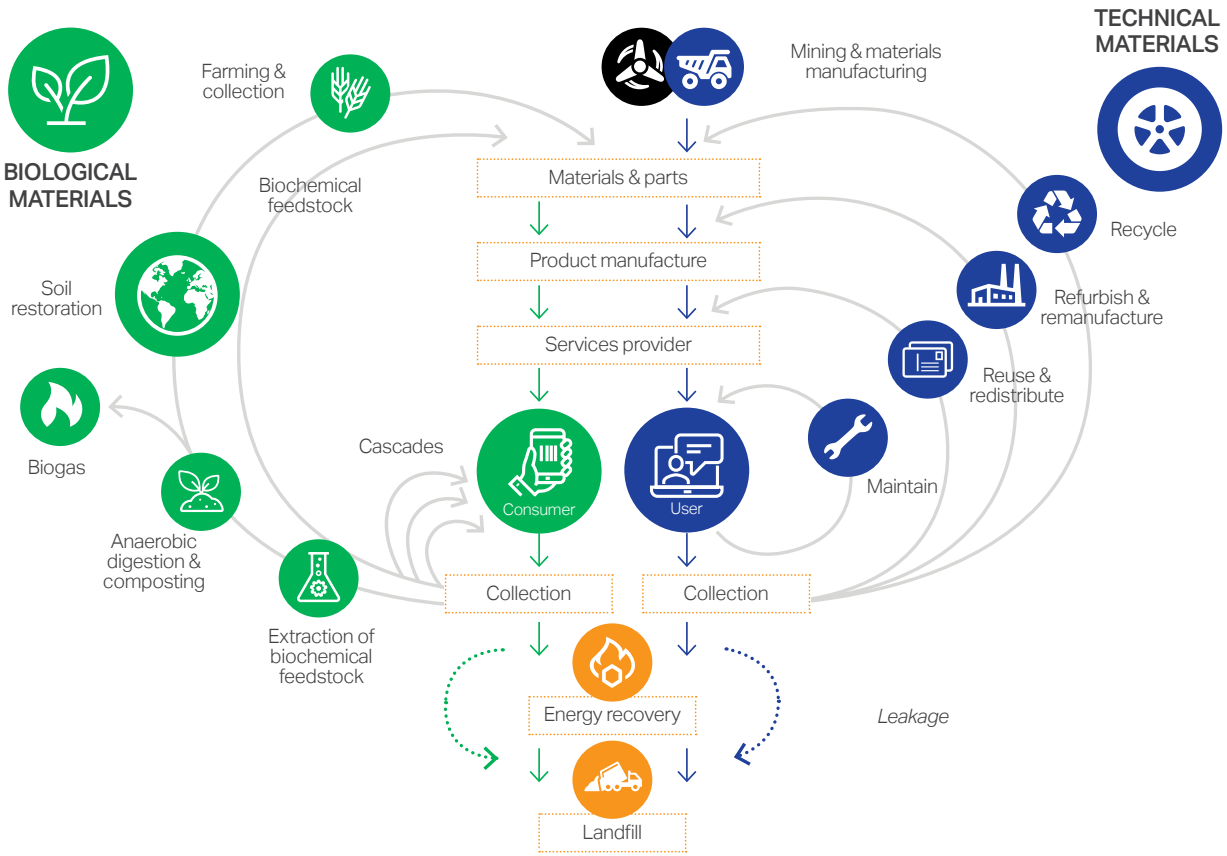
The circular economy recognizes two distinct sides, as shown in Figure 8. It is possible to recover technical materials through the technical cycle by means of different loops: maintenance and repair, reuse and redistribution, refurbishment and remanufacturing, and finally recycling.

Bio-based resources follow a different recovery path, as depicted on the left side of the graph. They circulate back into the biological cycle at their end of life for the reuse of their nutrients for a new cycle. It is important to note that bio-based resources are not unlimited in supply and need to originate from sustainably managed sources.

BIOLOGICAL CYCLE GUIDANCE

CTI offers extensive guidance on how to understand both biological and technical cycles and what that means for the circularity of the material flows.

Figure 8: Technical and biological recovery cycles



*Adapted from the Ellen MacArthur Foundation: https://www.ellenmacarthurfoundation.org

The classification of technical materials and biological resources

For optimal consistency between different circularity measurement frameworks, the classification of materials in either cycle draws from the Ellen MacArthur Foundation:

Materials suitable for the technical cycle

Those that companies can use, reuse/redistribute, maintain/prolong, refurbish/remanufacture or recycle. This includes all inorganic and fossil materials, such as metals, plastics and synthetic chemicals, as well as bio-based materials designed to be used within the technical cycle. Note that this category also includes materials of biological origin used as reactants in chemical processes and that form the basis of another material or product that behaves as a technical material.

Materials suitable for the biological cycle

Those that the company consumes or otherwise safely recovers into the biological cycle for conversion into nutrients, fibers or non-nutrient-rich materials in the next cycle.

The CTI process cycle

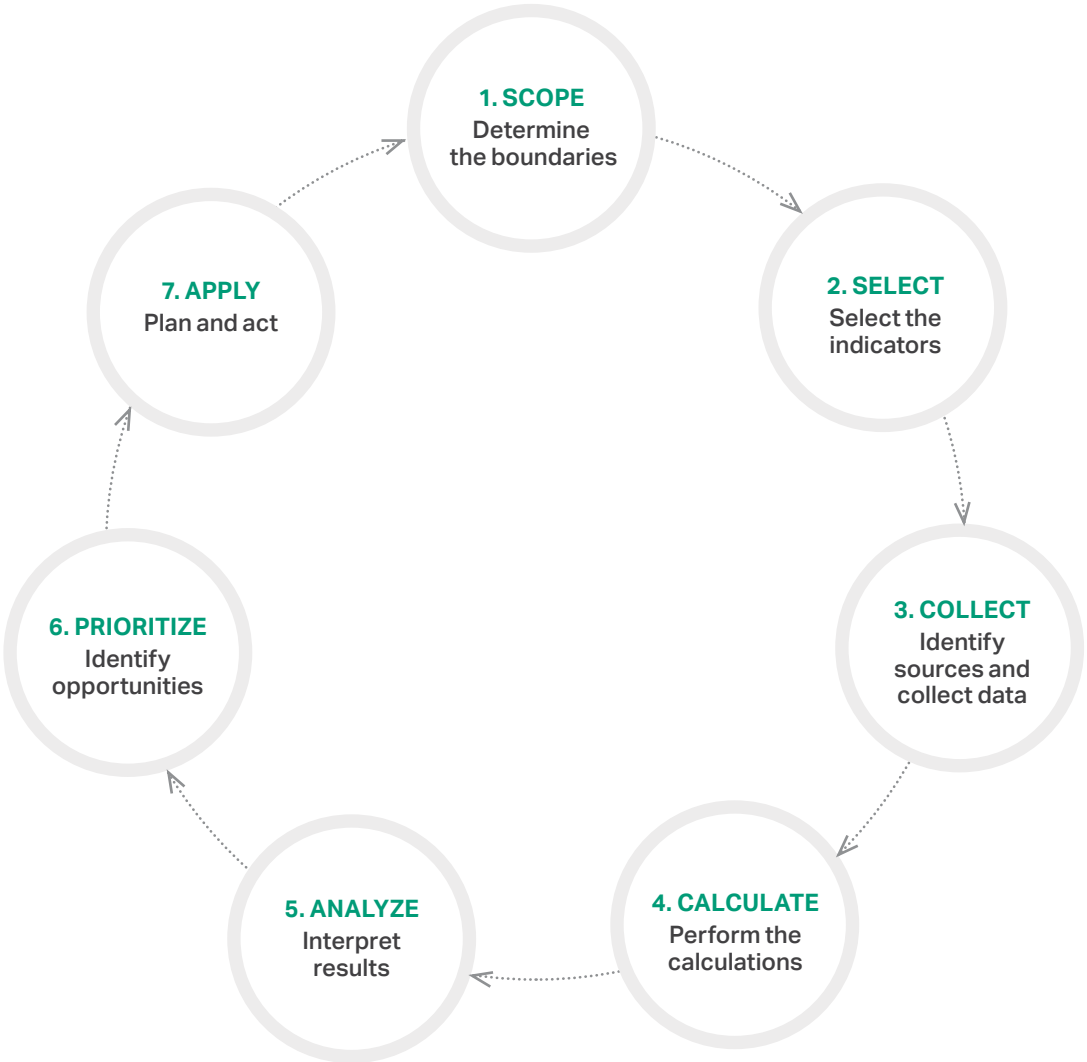
The framework outlines seven process steps that cover one assessment cycle. Running the assessment for the first time will be informative and insightful.

However, repeating the cycle regularly allows the company to monitor progress in its circular transition.

COMPATIBILITY

This process step approach is adapted from and consistent with other industry frameworks, like the Natural Capital Protocol.

Figure 9: The process cycle



Getting started

If you are interested in learning more and/or potentially using CTI and the online tool to start calculating your company's circularity, we have a few recommendations.

It may seem like a challenging exercise, but there are many free resources available to you to facilitate the process. We recommend the following:

1. Review the user manual for more instructions on how to find data, interpret outcomes and convert insights into action (see page 33).
2. Visit the CTI Academy at www.wbcsd.org/ctice to watch webinars, access case studies and sign up for upcoming events like training sessions and other learning opportunities.
3. Then sign up for your free Essential CTI Online Tool license at www.ctitool.com to help you start your assessment.
4. Start a simple and small scoped test assessment, something you may already have the data for.

KEEP IN TOUCH

These are the ways to stay informed or involved.

Stay informed
Regularly check www.wbcsd.org/ctice for updates on the framework.

- Sign up for CTI circular and receive notifications on framework updates.
- Keep an eye on the events calendar for planned webinars and training opportunities and sign up.

Get involved
Share your insights and ideas through the feedback functionality in the CTI online tool www.ctitool.com

Actively help shape future CTI developments by joining WBCSD and the Circular Transition Indicators project.