Water Circularity Metric: Tool application and guidance note

In partnership with

BEVERAGE INDUSTRY ENVIRONMENTAL ROUNDTABLE

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1 Background and introduction

① Background and introduction

Circular water management has gained attention in recent years as an approach to address challenges related to water quantity, quality and value from a context-based perspective. Where water is scarce, circular water management offers an opportunity to do more with less, reducing demand on the watershed; where water is too dirty, it offers an opportunity to reduce pollution and use water of a quality that is 'fit for purpose'; and, where water is undervalued, circular water management offers an opportunity to capture additional value.

A variety of circular water management solutions for industry have been well documented (see WBCSD's Business guide to circular water management: spotlight on reduce, reuse and recycle and BIER's Context-based Decision Guide for Water Reuse and Recycling) and as industry adopts circular practices, they are identifying relevant targets and metrics that demonstrate circular performance. At the same time, in the broader context of the circular economy, frameworks that bring transparency, alignment and a common language in measuring circularity have emerged (see WBCSD Circular Transition Indicators).

This guidance note and associated tool aims to provide a pragmatic approach for businesses to adopt a common metric for water circularity. In adopting this metric, the intention is to highlight areas where water circularity can be improved, both in terms of 'closing the loop' (effectiveness) and 'optimizing the loop' (efficiency).

The development and piloting of this metric has been a collaborative effort between the Beverage Industry Environmental Roundtable (BIER) and the World Business Council for Sustainable Development (WBCSD). Together, they have engaged a group of companies to conceptualize and test the metric.

2 Metric development

② Metric development

The overall objective was to develop guidance on measuring the circularity of a facility's sourcing, use and discharge as contributions to a net reduction in water demand within the local watershed. To enable this, a set of indicators and an application tool were developed. In addition, the indicators are included in the second version of [Circular Transition Indicators](), launched in early 2021.

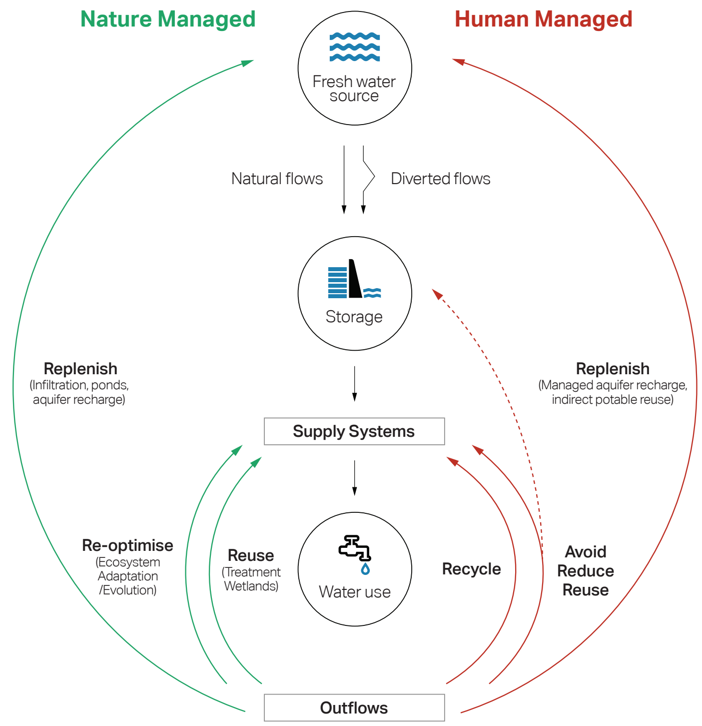
BUILDING ON EXISTING WORK

After initial research on existing work on circularity aspects in relation to water, three foundational concepts for the development of the metric, with a specific focus of site-level water use, were considered to build upon:

1. Quantity and quality of water as a service dimension of the local watershed, acknowledging that water is important for both Human Managed System as well as Nature Managed System (see figure 1)

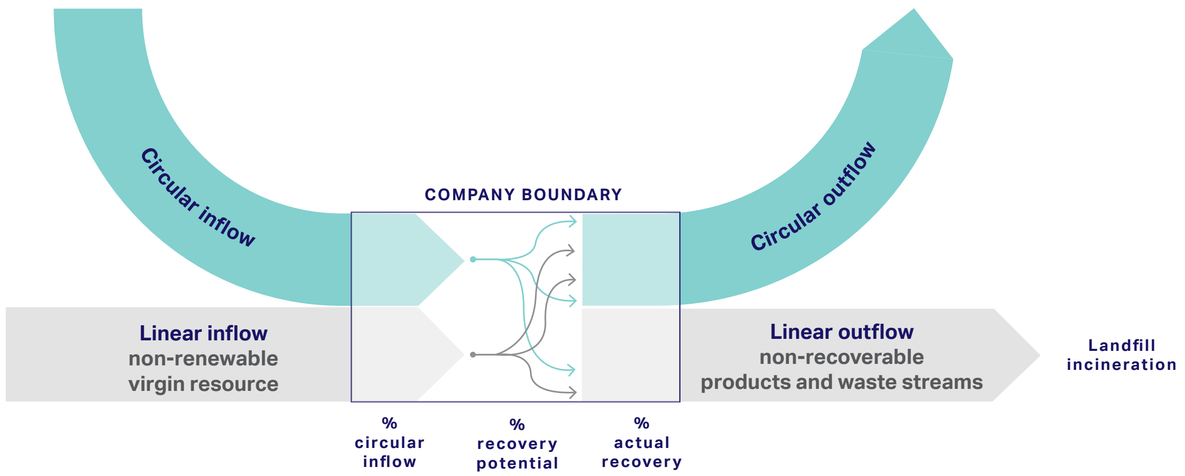
2. WBCSD CTI methodology logic, to assess the flows within the company's boundaries at three key intervention points (see figure 2)

Figure 1: The 'water butterfly'



Source: [Water and Circular Economy: White Paper]()

Figure 2: Illustration of material flows



Source: [Circular Transition Indicators V2: Metrics for business, by business]()

3. Common definitions for key terms using the BIER terminology on Reduce, Reuse, and Recycle (see figure 3)

   Water Reduction: The process of avoiding or eliminating water use, then optimizing processes to minimize water consumption and manage water waste. Reducing water use is the baseline and should be standard practice by facilities today.

   Water Reuse: Water that does not require additional treatment or reconditioning to use more than one time/cycle in the same or different process(es) within a facility.

   Water Recycling (Onsite): Water that requires additional treatment and reconditioning to use more than once within facility processes and/or on-property (e.g. landscaping, washing, etc.), instead of or prior to discharging as industrial effluent to a receiving body, the environment or a third-party wastewater treatment provider.

   Water Recycling (Offsite): Water that requires additional treatment and reconditioning for beneficial use off-property by the company or a third-party (e.g. irrigation, green infrastructure, neighboring industry, etc.) as an alternative to discharging as industrial effluent to a receiving body, the environment or a third-party wastewater treatment provider.

Figure 3: BIER definitions for reduce, recycle and reuse

Source: Context-Based Decision Guide for Water Reuse and Recycling

DEVELOPMENT OBJECTIVES

In developing the metric, the following objectives were established:

1. Describe how water is used (operation/ site-level) and consumed (operation and product) regarding established circular (water) principles (avoid/prevent, reduce, reuse, recycle, restore/replenish) and accounting for quantity, quality, and context.

2. Establish consensus for this project on underlying terminology to make clear distinction between different water volumes/qualities and local conditions.

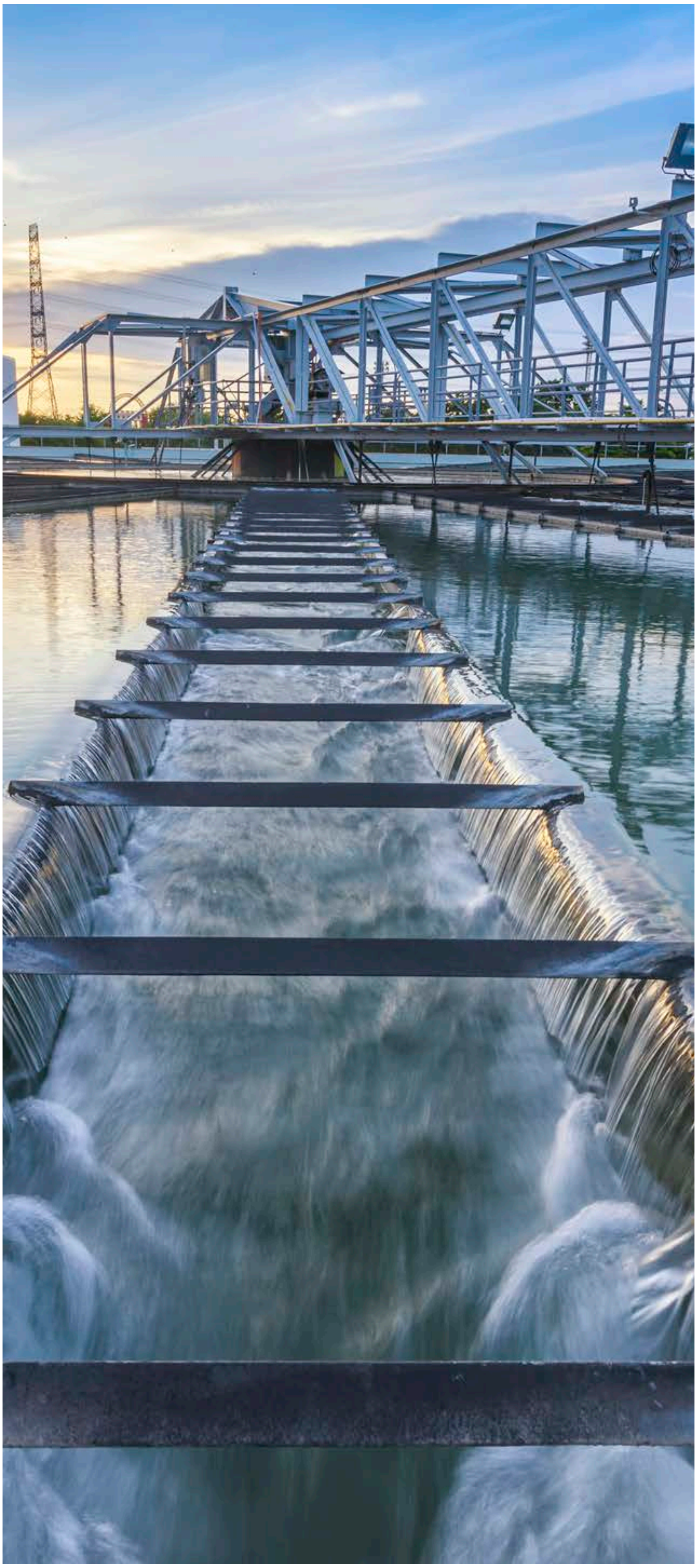
3. Be applicable for all industrial operations (sites, industrial parks, and other inter-site collaboration) in all geographies (results can be used as benchmark in context of both industry and geography).

4. Align with other Circular Transition Metrics, presented as a % water circularity [function (quantity, quality) based on local condition].

5. In its entirety, the tool shall help to measure how to 'close the loop' on water in the local water cycle and with a subset thereof help to 'optimize the loop'.

6. Present an option to measure over time and therefore demonstrate the positive impact on renewable water resources through the application of circularity principles.

7. Water is not lost when returned into the local watershed within an appropriate time, quality, and location.



AWARENESS OF CHALLENGES

Framing the metric in the bigger picture: Sustainability and stewardship

The metric is focused on **circularity performance**; that is how circular - at a facility and enterprise level – are the actions and processes of **managing water from intake, through use and outflow**. Whilst being generally supportive to achieving sustainability and water stewardship goals, it is important to note that water circularity, sustainability, stewardship, and security are not the same, and each has its own objectives and means of measuring progress and impacts.

In terms of sustainability and water stewardship, Science Based Targets (SBTs) and Volumetric Water Benefit Accounting respectively, are the most appropriate approaches for setting targets and measuring impact.

For instance, circularity can help realize water stewardship goals, which in turn can lead to more sustainable water use but circularity is not equal to sustainable use of water.

WATER vs MATERIALS vs ENERGY

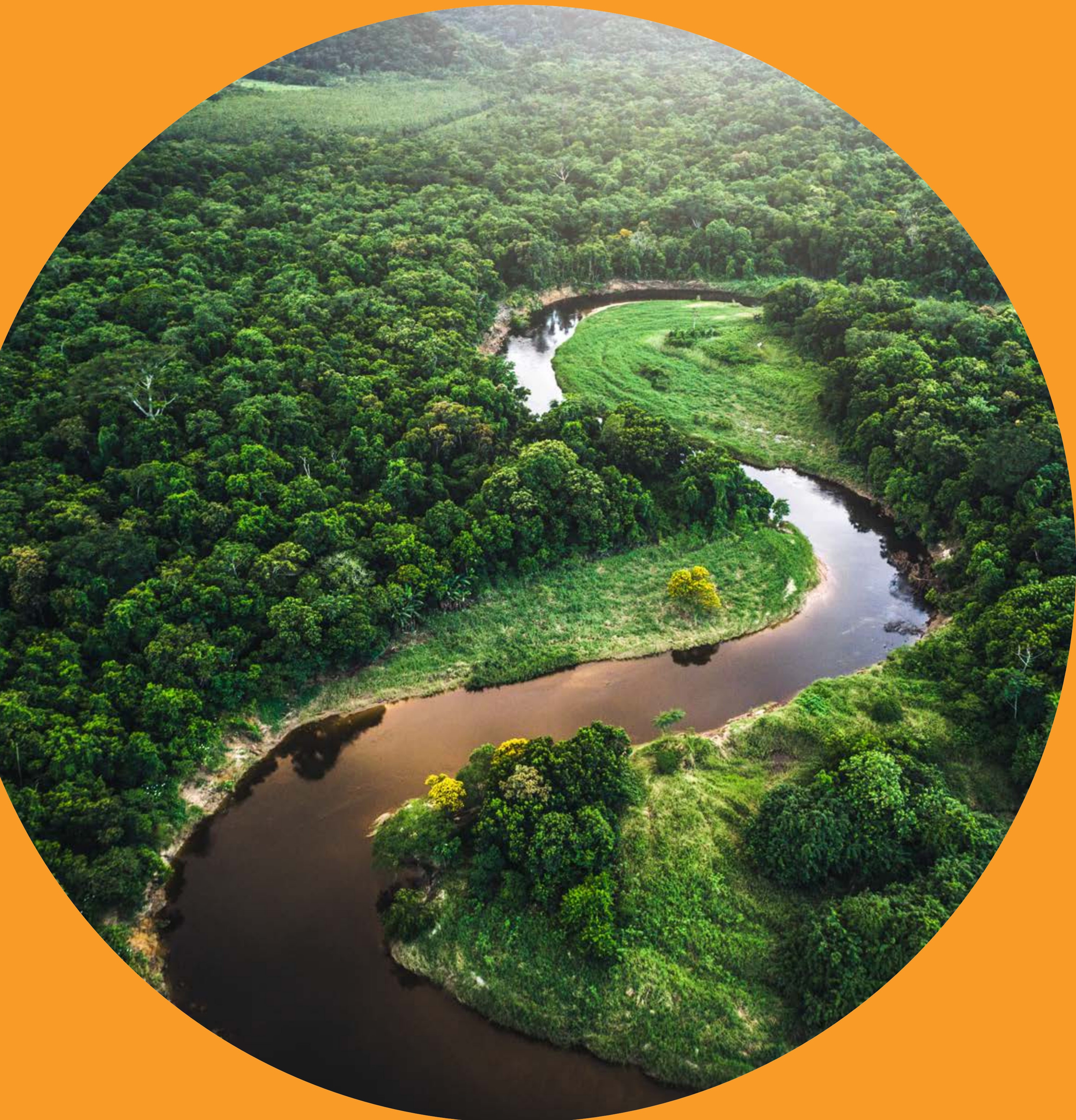
Unlike circularity of materials, such as from extractive origin, where material could be recovered and fed back into production cycles, water circularity is considered local in nature, benefiting from demand management, reuse and recycling (onsite/offsite) and return to the local river basin / ecosystem. Product water leaving the local context (embedded water) or lost (evaporation) does not benefit the local system. Locally 'lost' water might have benefits externally to other local systems. But most often, they might not to be quantifiable or is insignificant in volumes.

There is still a lack of understanding of both co-benefits and the negative impacts on other circularity aspects such as material use and energy use/emissions when closing or optimizing the loop. For instance, can material be recovered to solve the quality issue rather than diluting discharge volumes with water in the natural system (acknowledging that the natural system might be highly impacted by anthropogenic factors)? This is closely related to quantity and quality considerations when water quality is "appropriate" for a specific context.

In addition, the water circularity metric (WCM) should be considered with other circularity metrics for material and energy use/emissions as they are potentially highly inter-dependent.

The focus of this WCM is on the service function of water as "material" with highly local characteristics. Water leaving the watershed is generally seen as lost as it cannot any longer provide a service function in the local context. It is not only about optimizing the use of water by considering where additional value could be added (e.g. internal or external reuse/recycling) but also that reduction is a key aspect in the circularity to protect the nature managed cycle.

3 Assessing site-level water circularity



③ Assessing site-level water circularity

To assess site-level water circularity, specific site level information needs to be defined and captured. A framework with a corresponding excel based [WCM tool] was developed to help companies capture this relevant information, mapping water at a site level in the context of their location's water characteristics and calculate and summarize water circularity.

To consider water reductions, the ability to compare the current with the potential future or a past water use scenario/reporting cycle has been included in the tool.

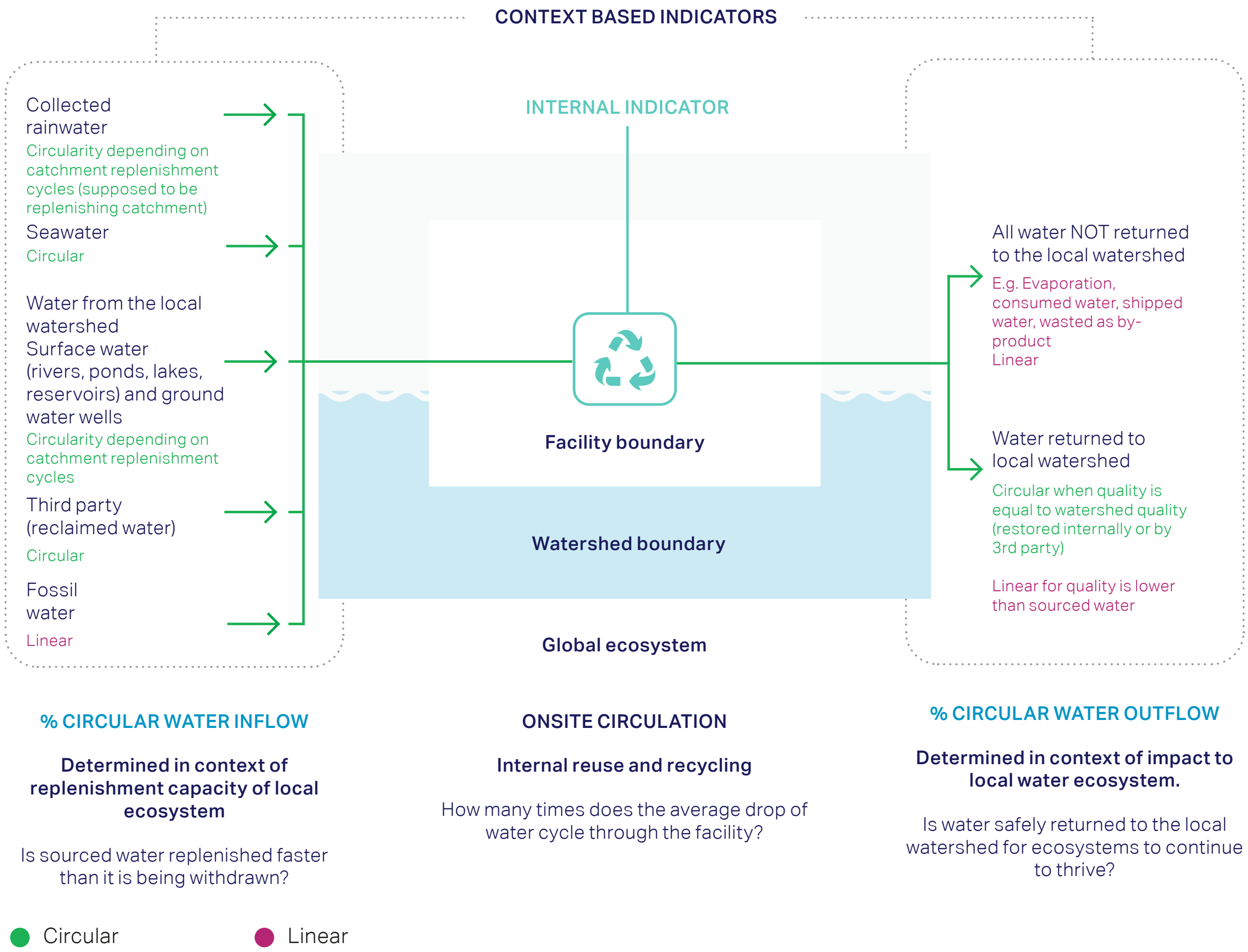
DEFINING THE SYSTEM – THE SITE IN THE LOCAL WATER SYSTEM

An industrial site with a defined area acts within the relevant local watershed context.

The approach considers quantities of water with certain characteristics crossing the site's boundary as well as moving within the site's boundaries.

Figure 4 provides the conceptual site-based model environment for the tool, including established descriptors (as defined by GRI) for water flow paths into and out of a site. In addition, it indicates the four-step assessment framework for circular decision guidance and is reflected in the structure of the WCM tool's "Data Entry" sheet.

Figure 4: **Conceptual site-based water flow model including four key steps to calculate site water use.**



Source: Circular Transition Indicators V2: Metrics for business, by business

SITE-LEVEL WATER CIRCULARITY CONSIDERATIONS

The tool has been conceptualized considering the four key steps defined below. The user will need to provide information to assess site-level water circularity with both location-based data of water inflow and outflow and operations/internal data of onsite water use and reuse. While efficiency measures are common practice, the user is also encouraged to consider alternative water sources and recipients of treated wastewater.

1. **Define water quantity and quality required for use (facility demand)**

   Why: Defining the required quantity and quality of water for a given process can guide a decision on the most circular source available (i.e. a source, or mix of sources, that most closely meets the required quantity and quality).

   How: Insert data on quantity required for a given process.

2. **Determine quantity and quality of source water (current and alternatives)**

   Why: To understand the circularity of source water, it should be assessed against the required (quantity and quality) need. Alternative sources, if available, can guide circularity potential (e.g. there may be an alternative and more circular source(s) that is closer to the required quantity and quality).

   How: Insert data on quantity and quality for current source(s), insert data on quantity and quality for alternative future / past source(s) (including data from step 3).

3. **Determine quantity and quality of water post-use (pre –treatment -discharge)[1]**

   Why: Defining the quantity and quality of water post-use (pre -treatment/ -discharge) can guide a decision on the options available for reusing, recycling and discharging (e.g. does the quantity and quality meet the needs of the same or different process). It can also guide a decision on optimizing the process to minimize changes to quantity and quality during use.

   How: Insert data on quantity post-use.

4. **Determine quantity and quality of water required for use or discharge (current and alternatives)**

   Why: To understand the circularity of used water, it should be assessed against the existing and alternative reuse, recycling, and source options (if used water is being discharged it should be discharged in a quantity and quality that is close to the quantity and appropriate in quality of source water)

   How: Insert data on quantity for current reuse, recycling, and discharge, insert data on quantity for alternative future/ past reuse, recycling (including data from step 1) and discharge options.

[1] This step is not currently considered in the tool for calculation of circularity. However, it is an important consideration for circularity of the site that treats water tailored to recipient's needs and can potentially save material and energy.

4 Indicators

④ Indicators

The inflow and outflow indicators describe the transfer of water quantities with certain characteristics across a site's boundary. To claim circular sourcing and discharge, evidence is required from the site that there is no negative impact on the environment and society. The on-site circulation indicator describes quantities of water required by processes (i.e. use) of a site's operation in relation to water quantities sourced externally (i.e. withdrawals) to supplement water requirements. In addition, the absolute reduction of water use and withdrawal is measured by comparing two reporting periods.

INFLOW INDICATOR

% Circular water inflow - The combined circularity of all sourced water

% Circular water inflow

$$= \frac{\text{Qtotal circular water withdrawal}}{\text{Qtotal water withdrawal}} * 100\%$$

Sum of all circular water sourced by site: **Qtotal circular water withdrawal**

Sum of all circular and linear water sourced by site: **Qtotal water withdrawal**

Required documentation: SVA (Source Vulnerability Assessment), SBT for local watershed (in future when available) or local water stress level.

Objective: Water is used from non-freshwater (recycled/reused water) sources of a quality that is fit for purpose.

Figure 5 provides a decision tree to evaluate the circularity of a water source. However, the tool acknowledges that it might not always be possible to clearly define the absolute circularity of the water source or have circular sources available for a given site.

In defining circularity, the user should consider the prior use of the water source, water availability and demand (including variability), governance issues and whether there is connectivity to wastewater / sewer networks. All of these issues should be supported by robust information (e.g. publicly available data). The degree of circularity of a source indicated by 0% (i.e. linear), 50%, 75% and 100% aims to guide a decision made by the user on levels of circularity.

Figure 5: Decision tree to evaluate circularity of water source

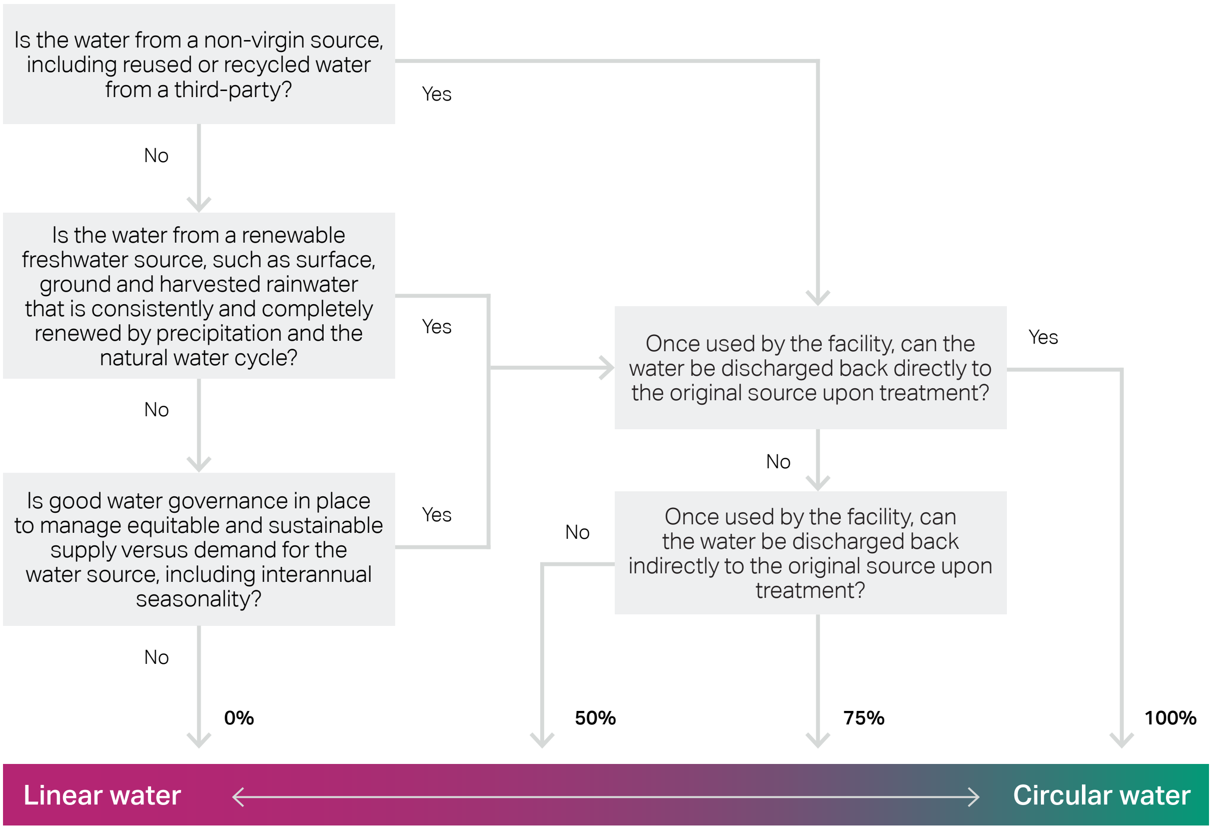


Table 1: Depending on the information available, the table can be used to determine the circularity/ linearity of the source

LINEAR SOURCING CHARACTERISTICS	DEPENDING ON INFORMATION AVAILABLE	CIRCULAR SOURCING CHARACTERISTICS
• Virgin / Fresh and salt water such as fossil water, operational by-product i.e. produced water	⟵ Prior Use ⟶	• Non-Virgin / Recycled Water & Non-freshwater natural sources such as sea or brackish water, product/commodity embedded water (e.g. food and beverage industry, chemicals industry)
• Consistently, completely renewed by engineered inflows (bulk water transfer, artificial aquifer recharge, water reclamation, including from sea water). • Highly stressed sources due to high industrialization, where overall demand exceeds supply (water stress). • Reduced availability (demand and seasonal or periodic variation), causing availability and quality issues locally and downstream (i.e. stress).	⟵ Natural Renewability ⟶ ⟵ User demand intensity (own & collectively within basin) ⟶ ⟵ Seasonality ⟶	• "Rapidly" renewable fresh water sources, such as surface, ground- and harvested rainwater. Consistently and completely renewed by precipitation and natural flows (direct and/or indirect inflows).
• Weak water governance with inequitable and unsustainable allocations to all users.	⟵ Governance ⟶	• Strong water governance with equitable and sustainable allocations to all users.
• If the water from a site cannot be discharged back to original water source once treated, e.g. due to being evaporated, incorporated into products and shipped away or lost otherwise from the local water shed. High water consumption causing less return flow.	⟵ Connectivity (direct/ indirect) to Discharge ⟶	• If the water from a site can be discharged back to original water source once treated (including third-party treatment after own or third-party use) either directly (after own use) or indirectly through incorporation into products that are used within the local watershed and returned with a lag-time (e.g. chemicals, food and beverages).

ON-SITE INDICATOR

On-site circulation – The total amount of water re-used onsite

X-times onsite circulation

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

Sum of all process water required (includes internally recirculated water): **Qwater use**

Sum of all circular and linear water sourced by site: **Qtotal water withdrawal**

Required documentation: Site's Process documentation.

Objective: Water is reused or recycled as many times as possible within a facility.

Table 2: Depending on the information available, the table can be used to determine the circularity/linearity of water used in operations

LINEAR USE CHARACTERISTICS	DEPENDING ON INFORMATION AVAILABLE	CIRCULAR USE CHARACTERISTICS
• Water is simply being used after withdrawal and thereafter discharged without feeding into any other on-site processes after one-time use. There is no on-site circulation. Water is being used 1 time. Does not imply that there is no context-based circularity as this metric focusses on water use within the site only.	⟵ ⟶ On-site circulation	• The total quantity of water used by the facility is the sum of all water required by all its processes (e.g. washing, cooling, ingredient water, tap water etc.). On-site circulation will be larger than 1.0 time use when the quantity of required water by the facility surpasses the amount of water that needs to be sourced externally (withdrawal). E.g. condensate water in cooling towers is being reused for cooling rather than discharged etc. Quantities of water being used within the site's processes that are returned to a site's process after the first use, being reused or recycled after treatment.

WATER USE/WITHDRAWAL REDUCTION INDICATOR

Absolute reduction of water required for process and withdrawal from external sources

% Water use reduction

$$= \frac{Q_{\text{total water use, Y1}} - Q_{\text{total water use, Y2}}}{Q_{\text{total water use, Y1}}} * 100$$

% Water withdrawal reduction

$$= \frac{Q_{\text{total water withdrawal, Y1}} - Q_{\text{total water withdrawal, Y2}}}{Q_{\text{total water withdrawal, Y1}}} * 100$$

Sum of all process water required (includes internally recirculated water) by site in reporting period Y1: **Qtotal water use, Y1**

Sum of all process water required (includes internally recirculated water) by site in reporting period Y2: **Qtotal water use, Y2**

Sum of all circular and linear water sourced by site in reporting period Y1: **Qtotal water withdrawal, Y1**

Sum of all circular and linear water sourced by site in reporting period Y2: **Qtotal water withdrawal, Y2**

Required documentation: Site's Process documentation.

Objective: Efficiency of freshwater use within the site's processes (including internally recirculated water) that results in reducing withdrawal from external sources.

OUTFLOW INDICATOR

Circular water outflow – The combined circularity of all returned water

$$\textbf{\% Circular water outflow} = \frac{\text{Qtotal circular discharge}}{\text{Qtotal water withdrawal}} * 100\%$$

Sum of all circular water discharged by site: **Qtotal circular discharge**

Sum of all circular and linear water sourced by site: **Qtotal water withdrawal**

Required documentation: Local regulatory requirements (when available) or industry standards like Zero Discharge Hazardous Chemicals (ZDHC); assuming appropriate thresholds are considered to maintain ecosystem integrity

Objective: Water is discharged to a quality that makes it readily available for additional beneficial and productive environmental, social, agricultural or industrial purposes.

Table 3: Depending on the information available, the table below can be used to determine the circularity/linearity of water discharged

LINEAR RETURN CHARACTERISTICS	DEPENDING ON INFORMATION AVAILABLE	CIRCULAR RETURN CHARACTERISTICS
• Water that leaves the basin as shipped product, or is lost within process (evaporation, contained in waste products (i.e. sludge etc.))	⟵ ⟶ Recycle (offsite) / increase duration in human managed water cycle within basin	• Water is being recycled (offsite) by other sites for beneficial use such as for agricultural, municipal or industrial purposes.
• Water is discharged with inappropriate quality, to surface or groundwater bodies: Water is not easily available with appropriate water quality for other water demands/uses (e.g. difficult to treat) and/or has therefore negative impact on environment and society. Water is discharged into fossil aquifer and therefore lost from the watershed.	Return/replenish to natural system/ local basin ⟵ ⟶	• Discharged water is returned to the same local watershed with an appropriate (including legally compliant) quality that makes it readily available for environmental, social, agricultural or industrial purposes.
• Water that is discharged into sea: The site is at the end of a water basin (e.g. close to the sea, with only brackish or sea water recipients in the close vicinity of the site) and no additional value could be added, by use in other process, site, or within the environment (e.g. aquifer recharge countering salt water intrusion; wetland use etc.). It can be sustainable to do so but it is a linear flow.	Recycle (uncontrolled by site /return/replenish to natural system/local basin ⟵ ⟶	• Product water that stays within the local basin by being returned (local drinking water supply or other products containing water that is knowingly returned to the local basin (e.g. through wastewater treatment))

5 How to use the tool

5 How to use the tool

The WCM tool can help companies to capture water-related flows at multiple sites, based on common reporting language (as described by GRI). The tool provides alternative future scenarios (comparison with past scenarios is also possible). In addition to the site's quantitative water flows, it is key to qualitatively assess the characteristics of the flow as described in the indicators section chapter 4. Due to the qualitative nature in assessing these characteristics, there is a level of uncertainty (due to lack of data, perspective, assumptions made etc.) that needs to be accepted. It is recommended to support circularity decisions for a specific water source or recipient with available data, its interpretation and existing analysis (e.g. source vulnerability assessments etc.) to establish documented defendable arguments for your circularity consideration.

In addition, there may be special cases that cannot be assessed with this tool, meaning they do not provide plausible and defendable outcomes of representing a sites water circularity.

TOOL INPUT

1. Provide inflow and outflow per source and recipient in m3/ per reporting period. Providing input (water volumes and quality estimation) based on the four-step assessment framework:
    - Define water quantity and quality required for use. This includes also reused and recycled water from own processes.
    - Determine quantity and quality of source water (by external source) that needs to be withdrawn to satisfy water requirements.
    - Determine quantity and quality of water post-use (pre-treatment discharge). Including how much water was embedded into the product. This indirectly reflects all losses and is a control value for volumes of water leaving the facility[2].
    - Determine quantity and quality of water required for third-party use or discharge back into the environment (by recipient).
2. Use the guidance provided in chapter 4 to judge circularity of inflowing or outflowing water volumes including references to relevant supporting documents.
3. In addition to the current reporting period, the user can provide a second or alternative period that can be in the past or a potential future scenario. (Select past or potential future in the Excel tool to ensure correct output of the tool.)
    - Repeat steps 1 and 2.

[2] Currently not relevant in the tool's circularity calculation. However, it provides deeper insight for sites that treat water tailored for recipient use and is often hard to measure.

TOOL OUTPUT

Results dashboard

On the results dashboard (standard and detailed), the user can find the level of circularity for the three indicators and an aggregated score. It also provides supporting indicators (water use and withdrawal reduction) by comparing the current scenario with a previous or potential/future scenario.

Circular inflow and outflow data is presented for both nature managed and human managed components.

Additionally, if current and past/future scenario was provided, the difference [%] in relation to the current scenario is provided to highlight the impact of changes.

The differentiation of human and nature managed circularity components emphasizes the use and discharge to third-party users, reminding the user to consider potential opportunities to use suitable available water or be a source for a third-party user with appropriate quality water.

Water quality changes require material and energy/causing emissions. Careful consideration of options can reduce such requirements – other key elements of circularity. Water quality is not yet directly considered in the assessment tool.

Linkage of circular inflow and circular outflow

For circular water inflow, the methodology considers the potential ability for water of a certain source to be returned directly (includes non-use third-party treatment) to its source after appropriate treatment – but can be sent to third-party use instead. If water could be returned indirectly, e.g. own product being used in watershed entering the cycle potentially, the decision is more difficult as this scenario has both linear and circular characteristics.

Circular outflow is considered in relation to water withdrawal. That means 100% outflow can only be reached when the facility does not consume any water at all and therefore fully available again to the local watershed with appropriate quality and considerable time lag.

6 Considerations for application

6 Considerations for application

Clearly, defining circular and non-circular can be difficult as the results are a measure to what degree a site operates circular in relation to their water use. The metric is based on quantitative measurements (water volumes) and qualitative assigned characteristics (based on assumptions) – a combination of analytical and empirical evidence is required.

Circularity is achieved in the context of the local watershed. On-site circulation can help to reduce demand and therefore support location-based water circularity. The same operation, with the same on-site characteristics could be considered from 100% circular to 100% linear. The circularity metric (inflow and outflow) based on local context can guide the user, supported by on-site circulation and water use/withdrawal reduction metric.

Given the variety of sector-specific requirements for water use, there may be differences and limitations in how the metric is applied in practice. Over the coming year, BIER and WBCSD will continue to work with member companies on applying the metric and produce sector guidance in the form of case studies.

ACKNOWLEDGEMENTS

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DISCLAIMER

This report has been developed in the name of WBCSD. Like other WBCSD publications, it is the result of a collaborative effort by members of the secretariat and senior executives from member companies. A wide range of members reviewed drafts, thereby ensuring that the document broadly represents the perspective of the WBCSD membership. Input and feedback from stakeholders listed above was incorporated in a balanced way. This does not mean, however, that every member company or stakeholder agrees with every word.

ABOUT THE BEVERAGE INDUSTRY ENVIRONMENTAL ROUNDTABLE (BIER)

The core mission of BIER is to advance the sector's environmental sustainability by developing industry-specific methods and data. In other words, we seek to create tools and methodologies that accelerate sustainability and its journey from analysis to action.

BIER is a technical coalition of leading global beverage companies working together to advance environmental sustainability within the beverage sector. Formed in 2006, BIER aims to accelerate sector change and create meaningful impact on environmental sustainability matters. Through development and sharing of industry-specific analytical methods, best practice sharing, and direct stakeholder engagement, BIER accelerates the process of analysis to sustainable solution development.

BIER is facilitated by Antea Group (https://us.anteagroup.com)

www.bieroundtable.com

ABOUT WBCSD

WBCSD is a global, CEO-led organization of over 200 leading businesses working together to accelerate the transition to a sustainable world. We help make our member companies more successful and sustainable by focusing on the maximum positive impact for shareholders, the environment and societies.

Our member companies come from all business sectors and all major economies, representing a combined revenue of more than USD $8.5 trillion and 19 million employees. Our global network of almost 70 national business councils gives our members unparalleled reach across the globe. Since 1995, WBCSD has been uniquely positioned to work with member companies along and across value chains to deliver impactful business solutions to the most challenging sustainability issues.

Together, we are the leading voice of business for sustainability: united by our vision of a world where more than 9 billion people are all living well and within the boundaries of our planet, by 2050.

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