

Learning Brief

Circular Economy for WASH

Circular economy principles, when appropriately applied, can strengthen water, sanitation and hygiene (WASH) service systems. Increasingly seen as a way to achieve sustainable development, circular economy ideas encourage a focus on efficient resource use, recovery of valuable substances and regeneration of nature. How can circular economy ideas be applied to WASH in ways that drive multiple critical outcomes of sustainability, safe management, inclusion and climate resilience?

Key messages

- Circular economy is based on three principles: eliminate waste and pollution, circulate products and materials, and regenerate nature.
- For WASH, circular economy concepts can drive a focus on efficiency, optimisation, resource recovery and regeneration of nature.
- To achieve optimal outcomes, we need to align circular economy approaches with principles of safe management, inclusion and climate resilience.
- This learning brief shares key principles and strategies for driving circular, safe, inclusive and resilient services and introduces a new framework: 'The 8Rs Framework for Circular Economy Water and Sanitation'.



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1 Foundations of circular economy and its relevance to WASH

As interest in circular economy has increased, so too have definitions. At its heart, circular economy is about systems change to decouple economic growth from the consumption of finite resources. It is based on three principles: eliminate waste and pollution, circulate products and materials, and regenerate nature¹. When people hear the phrase ‘circular economy’, novel revenue sources and business opportunities often come to mind. While new revenue streams and business opportunities may be by-products of focusing on optimising resource use and pursuing new cross-sectoral opportunities, the **core purpose of circular economy is systems change towards greater sustainability**. Similarly, focusing on the word ‘circular’ leads to thinking about moving from linear (take-make-dispose) to circular (reuse and recycle) modes of production, which emphasises the second of the three circular economy principles while overlooking others. Yet eliminating waste and regenerating nature are core to circular economy concepts, which sees ‘waste’ as a design flaw and seeks to minimise any waste created by reducing the use of resources and redressing environmental harm.

Circular economy practices can directly contribute to achieving the Sustainable Development Goals. A review found particularly strong synergies

between circular economy approaches and SDG 6 (Clean Water and Sanitation) along with SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), and SDG 15 (Life on Land)².

For WASH, circular economy concepts can drive a focus on efficiency, optimisation, resource recovery and regeneration of nature. In doing so, a circular economy approach can enhance the WASH sector’s contribution to climate mitigation by, for example, increasing energy efficiency and producing renewable energy from waste³. Circular economy approaches can also strengthen adaptation and resilience, with regeneration of nature (e.g. as part of nature-based solutions) offering co-benefits in the form of treatment, storage, buffer, and recreation³.

Circular economy approaches are well-placed to contribute to UNICEF’s three climate resilient WASH objectives of building resilient WASH services, strengthening community resilience through WASH, and moving to a low-carbon WASH sector⁴.



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It is important to note that circular economy approaches won't automatically lead to climate resilient, safely managed services. There may be trade-offs, for example between efficient resource use (a circular economy principle) and the resilience principle of diversity and redundancy. Similarly, reuse of water or faecal sludge must adhere to stringent quality criteria to achieve safe management. Specific attention must also be paid to inclusion, to ensure circular economy-informed water and sanitation services strengthen, and don't inadvertently undermine, gender equality, disability and social inclusion (GEDSI).

Yet when appropriately applied, circular economy principles can drive greater alignment between WASH services, climate resilience, and wider sustainable development aims. A circular economy approach places focus on how we use, manage and care for the natural resources on which WASH services, and flourishing, resilient communities, depend.

Interest in circular economy has taken off in the WASH sector, and many ongoing areas of focus (e.g. reducing non-revenue water) are aligned with circular economy ideas.

Over recent decades there has been growing interest in reuse of faecal sludge for agriculture or energy generation. The potential for circular economy approaches to generate additional streams of revenue has also been widely discussed, with evidence to date indicating that circular approaches can make a modest but meaningful contribution to financing services. Beyond these areas of interest, there is much more we can do to integrate circular economy ideas in pursuit of sustainable, climate resilient WASH services at the same time as focusing on safe management and inclusion.

This learning brief presents a framework for applying circular economy concepts in the design and delivery of inclusive, climate resilient water and sanitation services in diverse contexts.



“ A circular economy approach places focus on how we use, manage and care for the natural resources on which WASH services, and flourishing, resilient communities, depend. ”

Photo credit: Đinh Văn Đạo (IWEM)

Terminology

Circular economy: a systemic approach to economic development that is regenerative by design and aims to gradually decouple growth from the consumption of finite resources¹. Applied to water, circular economy demands “reducing, preserving and optimising the use of water through waste avoidance, efficient utilisation and quality retention while ensuring environmental protection and conservation”⁵. Beyond this water focus, there are opportunities to reduce water-related energy use, turn sanitation waste into a source of nutrients or energy, and regenerate nature in support of water source protection and environmental quality.

Safely managed: water and sanitation services that meet JMP criteria and human rights to water and sanitation standards of availability, accessibility, quality and safety, affordability, and acceptability.

Inclusive: water and sanitation services that align with principles of social inclusion related to both outcomes (universal services and structural equality) and processes (valuing diversity and embracing transformative approaches)⁶.

Climate resilient water and sanitation systems ensure continuity of services by adapting or reconfiguring system components such as social actors, organisations, infrastructure, and environmental resources to accommodate climate-related changes and shocks⁷. More broadly, UNICEF defines resilience as the ability of people and systems to anticipate, adapt to and recover from the negative effects of shocks and stresses in a manner that reduces vulnerability, protects livelihoods, accelerates and sustains recovery, and supports economic and social development, while preserving cultural integrity⁸.

Also see Annex A for principles underpinning each concept.



“Circular economy approaches can make a modest but meaningful contribution to financing services.”

Photo credit: Naomi Carrard (UTS-ISF)

2 Applying circular economy thinking in water and sanitation: the 8Rs framework

What is the 8Rs framework?

The 8Rs framework is a circular economy thinking tool and guide for planning. It supports application of circular economy principles to achieve safely managed, inclusive, climate resilient water and sanitation services. The framework was developed by an international team from UTS-ISF in Australia, the Institute for Water Resource Economics and Management in Viet Nam, UNICEF Pacific and the International Water Management Institute. It is theory-based and underpinned by principles of circular economy, safely managed water and sanitation, climate resilience and social inclusion (Annex A)⁹.

What makes the 8Rs framework different from other circular economy tools?

The integration of circular economy, climate resilience and inclusion principles (Annex A) into one accessible framework is the strength of this framework. Circular economy thinking has been slow to engage with climate resilience and social inclusion^{10, 2}, both of which are core to sustainable WASH services. The framework is also designed to support locally-led ideation of circular economy opportunities, rather than prescribing particular circular solutions. It can be used in diverse contexts with government, community and private sector actors, so is complementary to tools focused on urban water systems¹¹. Finally, the tool facilitates surfacing and negotiating tensions that may exist between different principles and drivers, e.g. between diversity and redundancy as a climate resilience strategy, and the circular economy strategy of reducing resource use through efficiency.

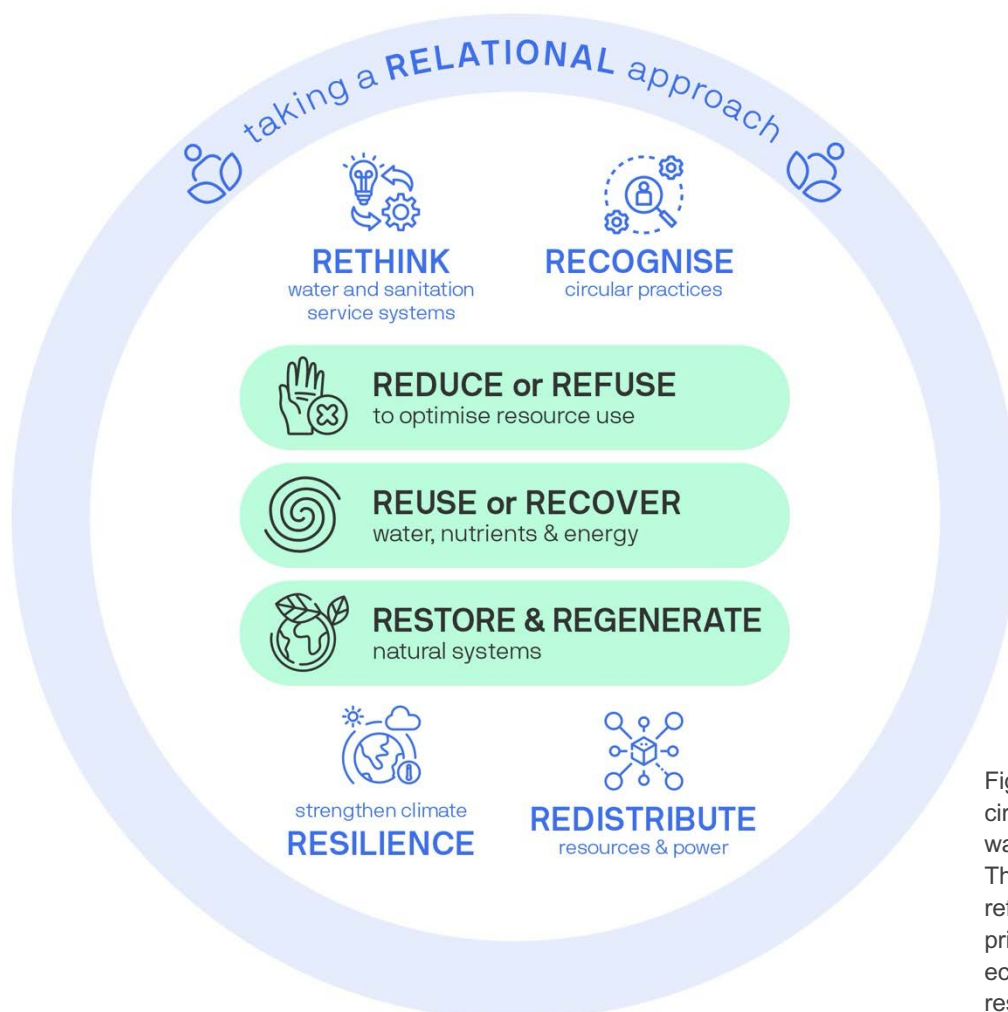


Figure 2 8Rs for circular economy water and sanitation. The R strategies reflect theory-based principles of circular economy, climate resilience and inclusion.

What are the 8Rs?

The framework includes 8 'R' strategies for progressing water and sanitation in low- and middle-income contexts. Using the memorable idea of circular economy being enacted through 'R strategies'¹² (e.g. reduce, reuse, recycle) the framework interprets circular economy strategies for WASH and adds additional Rs foundational for achieving inclusion and climate resilience.

How do the Rs relate to circular economy?

The three central *practical* Rs directly reflect the three core principles of circular economy.



REDUCE or **REFUSE** is about eliminating waste and pollution.



REUSE or **RECOVER** is about circulating products and materials at their highest value.



RESTORE & REGENERATE speaks to the principle of regenerating nature.

A circular economy water and sanitation opportunity aligns with at least **one** of the three practical Rs that echo circular economy principles

What are the other five Rs about?

Alongside the three practical Rs, the framework includes five Rs related to purpose and process.



RETHINK drives a focus on system change and questioning assumptions, making space for innovation and experimentation in service delivery.



RECOGNISE encourages a deeply contextualised approach to circular economy water and sanitation, building from existing circular approaches (which might be driven by traditional wisdom or as coping strategies) and ensuring their safety.



Strengthening climate **RESILIENCE** must be core to the identification and development of any circular economy water and sanitation opportunities, in line with the latest thinking about WASH and climate resilience.



REDISTRIBUTE drives a focus on social inclusion and equality, requiring attention to how circular economy ideas are developed (diversity of perspectives, inclusive approaches) and who they serve (reaching all and leaving no one behind).



Finally, taking a **RELATIONAL** approach emphasises collaboration and trust building, ensuring technical circular economy discussions are strengthened by a focus on connections between people and the world around them. Taking a relational approach means focusing on the *process* of moving towards circularity, and on interdependence between people and nature.

Table 1 Putting the 8Rs framework into practice: prompt questions and examples¹³

R strategy	Prompt questions	Examples
REDUCE OR REFUSE to optimise resource use	How can we optimise use of resources in water and sanitation systems? Are there alternatives to water and energy use (refuse)? How can we improve efficiency (reduce)?	Reducing water losses and water demand. Designing low-energy wastewater treatment systems. Waterless toilets. Reusable menstrual health products.
REUSE & RECOVER water, nutrients & energy	How can we close loops in water and sanitation systems? Are there opportunities to reuse water (treated or for lower quality purposes)? Can nutrients or energy be recovered from waste?	Household storage and reuse of water for different uses. Faecal sludge reuse to improve soil condition, nutrient capture and use to benefit food production, wastewater reuse at various scales, use of sludge in biogas systems. Natural reuse systems e.g. irrigation system recharges groundwater where it is naturally treated before reuse.
RESTORE & REGENERATE natural systems	How can water and sanitation systems connect to natural systems? How can they contribute to the regeneration of nature?	Nature based solutions e.g. source water protection, aquifer recharge, wetland restoration or construction as a component of wastewater treatment.
RETHINK service systems	How could water and sanitation systems be different? What ideas come to mind if we think about changing typical approaches and questioning the assumptions that underlie current systems and models?	Changing thinking from 'wastewater' to 'resource-water'. Sanitation as a public service with shared government, service provider and household responsibilities.
RECOGNISE circular practices	What is already circular? This could include traditional practices and coping or adaptation strategies. How can we value existing circular practices and ensure they are safe?	Saving and reusing water in a household, e.g. bathing water for garden. Use of dried faecal sludge as soil conditioner. Use of human urine as fertilizer.
strengthen climate RESILIENCE	What climate change impacts do we need to consider when planning circular water and sanitation systems? How can circular options strengthen resilience? Resilience includes social, institutional, technical and natural dimensions.	Regeneration and reuse activities such as capturing, treating and reusing water supports resilience during times of drought. Soil conditioners from faecal waste (a reuse strategy) can increase water storage capacity of soil.
REDISTRIBUTE resources and power	How can we ensure everyone has equal access to water and sanitation services? How can we include diverse voices when planning circular approaches? How can the benefits of circular approaches be fairly shared?	Sustainable cost recovery approaches that balance what users pay with public investment to ensure affordability. Representation from diverse social groups when planning and implementing circular opportunities.
taking a RELATIONAL approach	Which groups and institutions are implicated in potential circular water and sanitation systems? How can collaboration and trust building be made central to the process? How do the people involved relate to the natural world, and how can circular opportunities strengthen (and not undermine) human-nature connections?	Bringing diverse perspectives together for conversations about circular economy water and sanitation systems. Creating space for connections to emerge and to shape actions. Building new connections and trust to enable new pathways. Re-imagining human-nature connectedness to shift unsustainable patterns.

How should the 8Rs framework be used?

The 8Rs framework is intended to be used as a tool for ideation of locally appropriate circular economy water and sanitation opportunities, and as a guide for assessing and planning implementation of those opportunities. The framework can be applied flexibly in the context of both initiatives focused on WASH systems strengthening, as well as programs or interventions with a focus on service delivery.



Ideation about locally-relevant circular economy opportunities

Facilitate dialogue using the 8Rs as prompts. Start with rethink and recognise, build from strengths and ensure an inclusive process. As a group, participants should have knowledge of water and sanitation, climate change and socio-economic dynamics. The facilitator should be familiar with principles underpinning the 8Rs framework



Investigating promising opportunities

Promising opportunities can be assessed with reference to the 8Rs. Several forms of analysis might be needed .e.g. financial analysis, social acceptability, regulatory analysis, technical feasibility. Applying the R strategies as lenses will bring to light potential synergies and trade-offs requiring stakeholder consideration, e.g. between efficiency (a circular economy principle) and redundancy (a climate resilience principle).



Planning and implementing opportunities

Use the 8Rs framework to ensure opportunities are planned and implemented in line with underpinning principles of safe management, climate resilience and social inclusion.

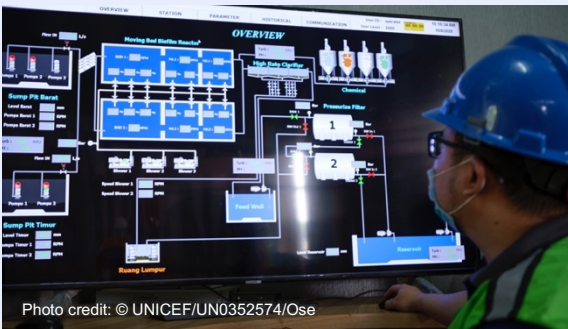


Evaluating activities against circular economy, inclusion and climate resilience principles

The 8Rs and underpinning principles can be used to explore and assess the extent to which WASH activities are placed to achieve circularity, inclusion and climate resilience.

3 Foundations to build on: Highlights of existing UNICEF EAP region water, sanitation and hygiene activities that incorporate circular economy principles

Several UNICEF teams are already involved in circular aligned water and sanitation activities. These activities illustrate some of the diverse ways in which circular economy-economy principles can be integrated in water and sanitation, including examples that connect circular economy approaches with inclusion and climate resilience.



In **Indonesia**, UNICEF is providing technical assistance for young innovators, including projects with circular economy-aligned activities. One focuses on the use of water sensors to detect leakages in the piped water system, driving efficiency by enabling operators to respond and **reduce** water losses.



In **Timor-Leste**, UNICEF worked with civil society organisations across 15 communities to **restore and regenerate** water catchments. A knowledge sharing and skills development program promoted the benefits of nature-based solutions for water management. Addressing water stress due to reduced rainfall and seeking to strengthen climate change resilience, the initiative improved water retention and groundwater recharge by facilitating construction of ponds, reservoirs, earth dams and terraces. UNICEF has worked with the former National Authority for Water and Sanitation (ANAS), linking the approach to a larger scale watershed management pilot programme.



In **Viet Nam**, UNICEF partnered with the private sector Masterise Group to pilot a net-zero toilet device that converts wastewater into clean water using solar energy. The project, implemented in a school in Soc Trang Province, demonstrates how one project can both **reduce** non-renewable energy use and **reuse** valuable water. The Net Zero Aquonic toilet was developed by SCG Chemicals and Asian Institute of Technology Thailand with support from the Bill and Melinda Gates Foundation. Powered by solar cells (which reduces energy and operational costs), it converts septic tank waste into treated water suitable for irrigation or toilet flushing. A private corporation and local manufacturer attempted to produce the Aquonic tanks in Viet Nam with a substantial cost reduction when compared with the original product.



Photo credit: © UNICEF/UNI279253/Berger

In **Cambodia**, UNICEF has introduced small-scale decentralised wastewater systems to treat faecal sludge from schools and health care facilities. The initiative **reduces** fuel consumption associated with truck-based desludging services, and prevents pollution associated with untreated effluent discharge and informal sludge disposal. UNICEF is also promoting the use of solar energy by private water operator to **reduce** fossil fuel energy dependence for water pumping, which also lowers operation and maintenance costs. In parallel UNICEF, through the Climate Resilient Water Safety Plans, is supporting private water operators to **reduce** non-revenue water, improving both water efficiency and financial sustainability.



Photo credit: © UNICEF/CHINA

In **China**, UNICEF collaborated with the Ministry of Agriculture and Rural Affairs to pilot inclusive climate smart sanitation facilities for schools and health facilities in high-altitude regions of Qinghai Province. The pilot program sought to **reduce** water demand through conservation activities, and to safely **reuse** both water and treated human waste from school toilets.

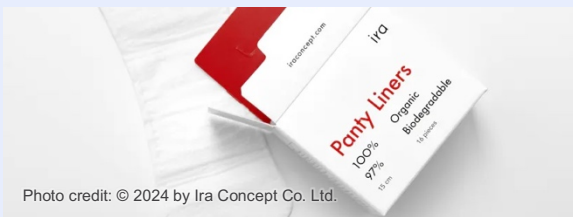


Photo credit: © 2024 by Ira Concept Co. Ltd.

In **Thailand**, UNICEF's Regional WASH Young Changemakers programme supported a scale up of Ira Concept's biodegradable menstrual pad business, which **reduces** waste. The pads are made from a mixture of corn and bamboo fibres, and are designed to decompose within six months (1,600 times faster than a standard pad).



Photo credit: © UNICEF/UN0224085/Sokhin




In **Kiribati**, UNICEF is working with UTS-ISF and an i-Kiribati researcher exploring how circular economy strategies might benefit sanitation in urbanising Kiritimati Island¹⁴. A situation analysis recognised existing informal **reuse** of dried faecal sludge as a soil conditioner, and the team is working with government and community to explore the potential for local manufacture of affordable, safe sanitation products using **recycled** plastic waste. This work complements ongoing work UNICEF is undertaking investigation opportunities for faecal sludge treatment and reuse as part of ongoing sanitation programming.



Photo credit: © UNICEF/UN0788386/Piojo

Elsewhere in the **Pacific**, UNICEF is piloting a range of initiatives aligned with the '**reduce**' circular economy principle including in-depth supply chain analysis to identify potential optimisation strategies and promoting reusable menstrual pads.

Summary of UNICEF activities mapped to circular economy principles

 <p>REDUCE or REFUSE</p>	 <p>REUSE or RECOVER</p>	 <p>RESTORE & REGENERATE</p>
<ul style="list-style-type: none"> • Using water sensors to detect leaks in piped water network (Indonesia) • Reducing fuel use associated with faecal sludge management by installing decentralised wastewater treatment systems, and improving environmental conditions by preventing untreated effluent discharge and informal sludge disposal (Cambodia) • Working with private water operators to reduce non-revenue water and increase energy efficiency (Cambodia) • Water conservation activities in school and health care sanitation facilities (China) • Supply chain analysis to identify potential optimisation strategies (Pacific) • Supporting scale up of a business manufacturing biodegradable menstrual pads (Thailand) • Promoting reusable menstrual pads (Pacific) 	<ul style="list-style-type: none"> • Making briquettes from dried faecal sludge, turning waste into energy (Indonesia) • Exploring opportunities to reuse treated wastewater in health care facilities for nearby gardens (Mongolia) • Net-zero toilet device that converts wastewater into clean water using solar energy (Viet Nam) • Treatment and safe reuse of both water and human waste in school and health care sanitation facilities (China) • Exploring opportunities to integrate faecal sludge reuse and plastic waste recycling into urban sanitation service systems (Kiribati) 	<ul style="list-style-type: none"> • Restoring and regenerating catchments to strengthen water security and resilience (Timor-Leste)

4 Future directions

There are opportunities to broaden and deepen integration of circular economy principles into WASH programming in ways that support climate resilience, inclusion and safe management. To ensure circular economy approaches can deliver on this ambition, future activities will benefit from a focus on:

- **Purpose:** the purpose of circular economy approaches is ultimately to shift currently unsustainable systems towards better use of finite resources and regeneration of nature. Circular economy-informed WASH initiatives will have most impact when this purpose is kept in mind. Placing specific initiatives in this wider context can strengthen their design and demonstrate how WASH can contribute to global sustainability and climate resilience – in alignment with the Global Goal on Adaptation’s forthcoming metrics on climate-resilient WASH.
- **Co-benefits:** articulating co-benefits associated with circular economy approaches supports optimal program investments. Circular economy activities can achieve co-benefits in climate mitigation, for example a shift to renewable energy use reduces GHG emissions and nature-based solutions can both avoid GHG emissions and increase carbon storage. Non-revenue water reduction can drive both climate mitigation by reducing energy demand, and achieve operational efficiencies. Regeneration activities also have conservation and co-benefits, as does treating and reusing wastewater rather than discharging to waterways. [considering adding a diagram highlighting illustrative CE contributions to climate mitigation and climate adaptation].
- **Connections between sectors:** the connections between WASH and related sectors will be critical to the success of circular approaches and can be a focus for WASH program stakeholder engagement. For example, food systems and agriculture sectors are integral to the success of waste to fertiliser initiatives, water resource managers have a critical role to play in source protection and restoration, and engaging with manufacturers involved in WASH service supply chains can drive product innovation.
- **Conversations about complexity:** Bringing circular economy principles into ongoing engagement with government and other partners can surface innovative ideas about directions in service delivery. The 8Rs framework can be a helpful tool to frame conversations about complex systems (and achieving the multiple goals of safety, inclusion and resilience) in constructive ways. This includes going beyond ideas for specific technical or infrastructure opportunities to address wider systems change goals. The 8Rs prompt questions (Table 1) can be used across ideation, investigation, implementation and evaluation phases of program activities.

There is substantial global momentum around circular economy. As governments around the world adopt circular economy within policy frames across multiple sectors, there is opportunity for WASH programs to lead, innovate and refine circular WASH approaches that are climate resilient, inclusive and contribute to sustainable development.



Photo credit: Naomi Carrard (UTS-ISF)

Annex A Principles underpinning the 8Rs framework: circular economy, safe management, inclusion, climate resilience

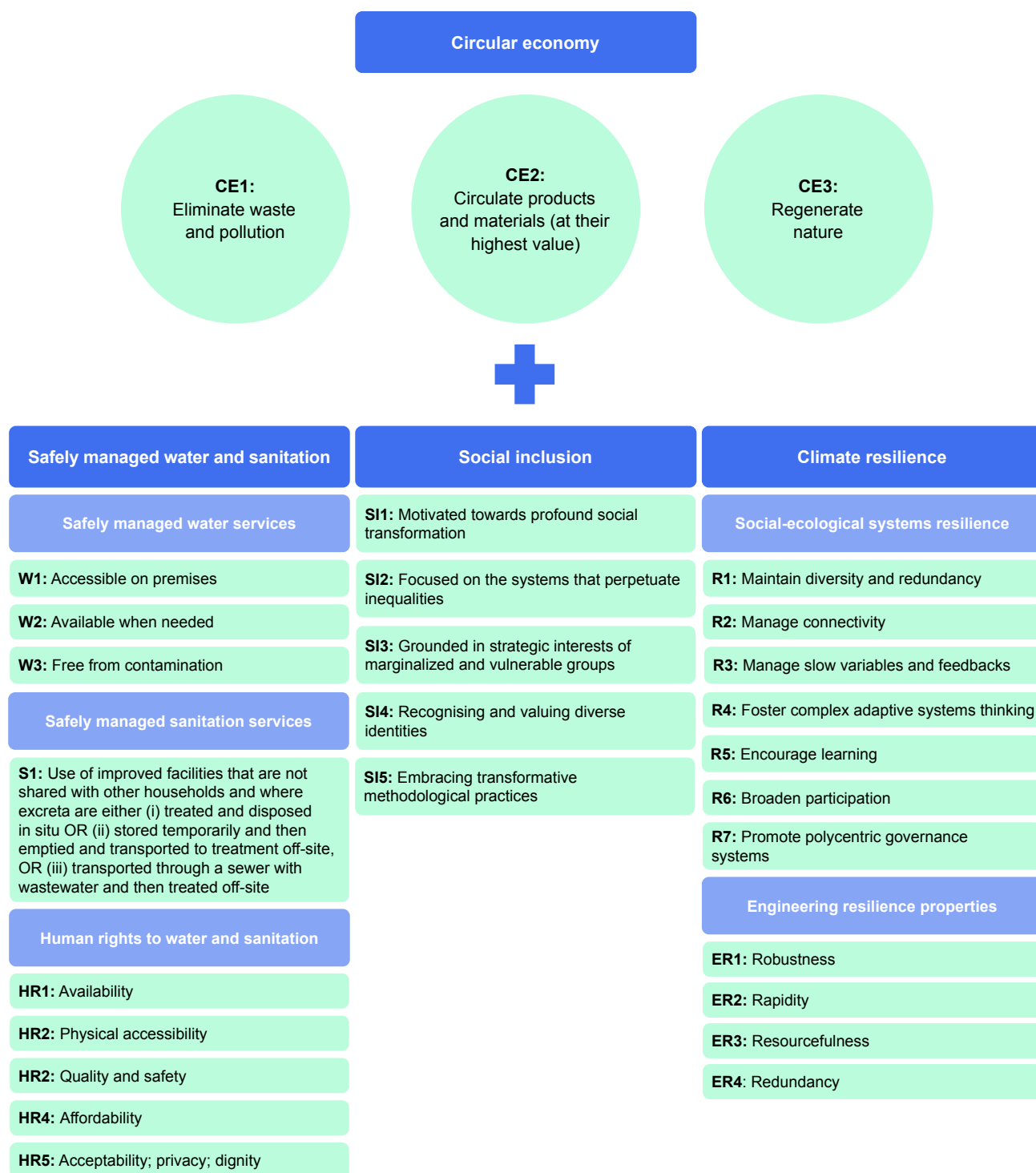


Figure 1 Leveraging circular economy to drive inclusive climate resilient WASH (and wider sustainable development) requires focusing on four sets of principles. A principles-based approach enables us to navigate potential tensions and achieve our multiple interconnected sustainable development objectives.

Sources: circular economy principles drawn from the work of Ellen MacArthur Foundation¹⁵, safely managed water and safely managed sanitation defined by WHO/UNICEF Joint Monitoring Programme (JMP), human rights to water and sanitation criteria from United Nations Office of the High Commissioner for Human Rights (OHCHR), social inclusion principles adapted from MacArthur et al. (2002)², social-ecological systems resilience from Liggs et al. (2015)¹⁶ and engineering resilience properties from Bruneau et al. (2003)¹⁷.

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Learning brief prepared by Naomi Carrard, Georgina Robinson and Avni Kumar of UTS-ISF with contributions from UNICEF EAP teams. Design: Jeffrey Kaster (UTS-ISF).

Suggested citation: Carrard, Naomi., Robinson, Georgina., Kumar, Avni., 2024. Learning Brief: Circular Economy for WASH. Prepared by UTS-ISF for UNICEF East Asia and Pacific Region.