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Guidelines on promoting Circular Economy in Public-Private Partnerships for the United Nations Sustainable Development Goals

Note by the secretariat[*1]

Background

This document contains a set of guidelines with practical industry examples and policy options to encourage a transition towards a circular economy within the infrastructure sector to achieve the Sustainable Development Goals (SDGs).

The document draws heavily on panel discussions at the 5th session of the Working Party on PPPs on 29-30 November 2021, at the 6th ECE International PPP Forum on 4-6 May 2022, and at the 15th session of the Committee on Innovation, Competitiveness and Public-Private Partnerships (CICPPP) on 25-27 May 2022. It also aims to contribute to the cross-cutting theme of the 69th session of the ECE on the circular economy transition, and will be made available through the Circular STEP network.[1]

The guidelines were prepared by the secretariat at the request of the Working Party and the CICPPP with substantive inputs from Anand Chiplunkar. Work on the document was initiated in early 2022 and a peer review process was established.[2]

The document was shared with the Bureau in October 2022 and is submitted to the Working Party for its consideration.

[*] This document was scheduled for publication after the standard publication date due to consultations with interested parties and stakeholders.

[1] The ECE stakeholder engagement platform to accelerate the circular transition in the ECE region. See online https://unece.org/circular-economy/press/unece-launches-platform-policy-dialogue-circular-economy

[2] A list of experts who contributed to review the document is provided in Annex I.

Avant Propos

This document provides a general discussion supplemented by examples[3] intended to create awareness of existing industry practice contributing to the circular economy (CE) agenda within the built environment.[4] The present Guidelines thus provide informative context for member States to develop an enabling environment that promotes CE practices through the use of the United Nations Economic Commission for Europe (ECE) approach of Public-Private Partnerships for the Sustainable Development Goals (PPPs for the SDGs). More broadly, these Guidelines aim to encourage a transition towards a CE within the infrastructure sector to achieve the SDGs and showcase the value and importance of circularity. While the present document is addressed at policymakers, others such as industry actors, development scientists and practitioners may find them useful.

The present document is not intended as all-exhaustive, as infrastructure and digital technologies are evolving rapidly and advancements in CE practices and opportunities are ever expanding. Material for further reading is available in Annex IV for those seeking further details.

The ECE is currently working on separate guidelines that will complement the present document and cover topics related to PPPs for the SDGs in the fields of sustainable procurement, sustainable finance, and digital and green transformations for sustainable development. As such, this document will solely refer to these topics in the immediate context of implementing CE practices, but does not intend to provide in-depth discussions on the same. Furthermore, it also forms part of a broader set of three documents contributing to the cross-cutting ECE theme on the CE transition prepared by the ECE Economic Cooperation and Trade Division (ECTD).

Table 1. ECTD documents on infrastructure and financing of the circular economy transition

2.	Guidelines on Public-Private Partnerships for the Sustainable Development Goals in Waste- to-Energy Projects for Non-Recyclable Waste: Pathways towards a Circular Economy (ECE/CECI/WP/PPP/2022/3)
3.	Guidelines on Promoting Circular Economy in Public-Private Partnerships for the United Nations Sustainable Development Goals (ECE/CECI/WP/2022/4)
4.	Policy Paper on Financing for Circular Economy and Sustainable Use of Natural Resources

Source: ECE

Structure

Beyond this avant-propos, the present document is structured as follows:

- Section I provides details and context and introduces the concept of CE, the PPPs for the SDGs approach, and their interactions.
- Section II showcases concrete examples and opportunities for the application of CE practices in PPPs for the SDGs projects whilst building the case for government action to further promote and encourage SDG-compliant industry practices.

[3] Project examples have been collected by the secretariat with the help of reviewers listed in Annex I and are included for informative purposes only. Showcasing of an example does not imply endorsement by ECE

[4] The built environment refers to man-made structures, features and facilities. See for example the Ellen MacArthur Foundation at https://ellenmacarthurfoundation.org/topics/built-environment/overview

- Section III presents a set of policy options derived from the main findings of these Guidelines.

I. Introduction

A.Context

The urgency of strengthening the adoption of CE practices in PPP projects and the built environment is now widely acknowledged, particularly as the infrastructure sector is held to be responsible for 79 per cent of global greenhouse gases and consumes 60 per cent of the world's materials.[5] While boosting the transition towards the CE has turned into an emerging approach for infrastructure development, many governments still need to commit to a CE agenda and seek to fulfil some of their commitments made towards achieving the SDGs.

The ECE PPPs for the SDGs approach is a useful vehicle to not only advance CE practice in PPP projects, but to also ensure that they bring value to people and the planet along the way. This is the case as CE principles are embedded in the broader PPPs for the SDGs approach. Therefore, member States implementing PPPs for the SDGs will have already gone a long way in ensuring that CE practices are undertaken in their projects.

Consequently, the underlying argument of these Guidelines is that a CE-enabling environment is needed so that PPPs for the SDGs can effectively incorporate circularity and therefore guarantee project's fitness within the CE agenda. The present document thus provides CE industry examples[6] that highlight how governments may incorporate the CE agenda in their PPP projects, and policy options on how to best incentivise and promote such circular behaviour within the built environment.

As further described below, the PPP for the SDGs approach refers to well-designed infrastructure projects that put "people" and the "planet" at the core. The approach seeks to not only implement the CE agenda but also to ensure people's access and equity to public services, strengthen the economic effectiveness and fiscal sustainability of projects, improve environmental sustainability and resilience (including by being aligned with the CE agenda), showcase the viability and replicability of such PPP projects, and lastly, it aims to demonstrate a project's intent to be inclusive and engage with all stakeholders.

B.Circular Economy

The CE is an economic system of production and consumption. The core principles of a circular economy are (i) elimination, or alternatively minimization of waste and pollution, (ii) maintenance of the value of products, materials, and resources in the economy for as long as possible, (iii) replacement of the "end-of-life" concept with a regenerative and restorative design, and (iv) achieving sustainability goals and reducing environmental impact.[7] Essentially, this means that in order to achieve a CE, these aspects ought to be implemented at individual, project, and member state levels. In practice, the CE can be enabled by stakeholders through the "6Rs" approach which covers many action points: Reduce, Reuse, Repair, Remanufacture, Recycle, and Recover.[8]

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[5] See online: https://www.unep.org/news-and-stories/press-release/new-report-reveals-how-infrastructure-defines-our-climate?sp=true?sp=true

[6] Additional information on the examples is provided in Annex II

[7] See among others: https://ellenmacarthurfoundation.org/towards-the-circular-economy-vol-1-an-economic-and-business-rationale-for-an , https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

[8] See online: https://www.retrace-itn.eu/2019/07/15/the-6-res-of-the-circular-economy-reduce-reuse-repair-remanufacture-recycle-and-recover/#:~:text=As%20the%20Circular%20Economy%20is,Remanufacture%2C%20Recycle%2C%20and%20Recover

(i) **Reduce:** reduce the amount of raw materials entering the system, by avoiding or rethinking the need for products, and maximising the use of materials and products already on the market.

(ii) **Reuse**: an operation by which the product and material can be used again and for the same purpose for which they were conceived.

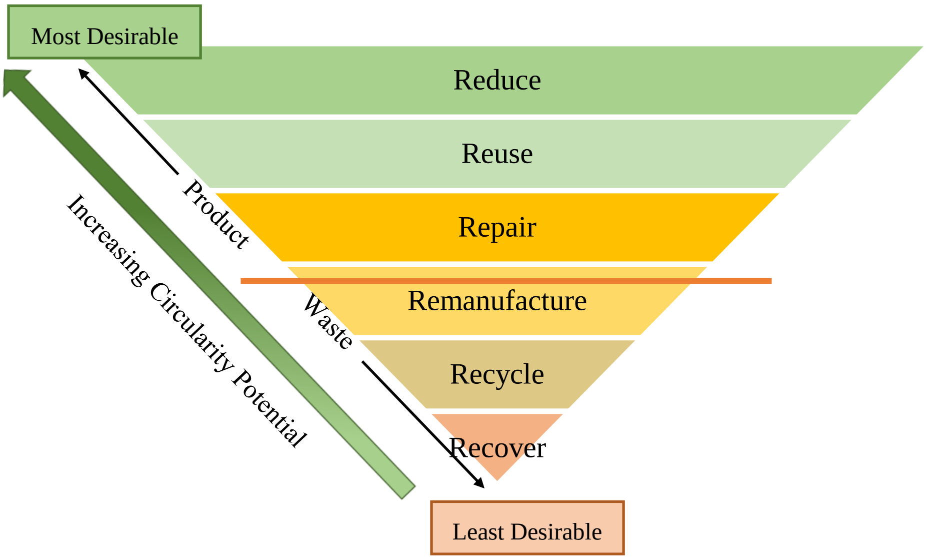
(i) **Repair:** the product and material can be repaired and brought back to its original form, with additional energy, labour or material, to further its integrity and utility for a longer period of time.

(ii) **Remanufacture:** the product is disassembled to its component level and rebuilt with replacement components to provide a similar or even better performance standard than a new product. This is distinguished from Refurbish, wherein the product is restored as much as possible without necessarily disassembly and replacement of components.

(iii) **Recycle**: the product or component is reduced to its basic material level, after stripping off its added value (labour or energy) so that some or all the material can be reprocessed to make new products and return the material to the economy.

(iv) **Recover**: the embedded energy in non-recyclable waste or residues can be recovered through waste-to-energy or other (bio-)chemical processes that avoid landfilling.

Figure 1. Circular economy hierarchy



Source: ECE, based on the 6Rs of sustainability

While many of the concepts behind the CE are not new, their adoption and proliferation in public infrastructure and service policy is gaining momentum. For example, as part of the overarching European Green Deal,[9] the European Commission adopted the new Circular Economy Action Plan (CEAP) in March 2020[10] which targets climate neutrality by 2050 and decouples economic growth from resource use Many countries worldwide have similarly introduced CE "roadmaps" or policy equivalents, setting targets and strategies to support the implementation of CE practices.

[9] See online: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[10] See online: https://ec.europa.eu/environment/pdf/circular-economy/new_circular_economy_action_plan.pdf and, based on the CEAP, the newest plan to make sustainable products the norm in the EU https://ec.europa.eu/commission/presscorner/detail/en/IP_22_2013

Furthermore, the SDGs embed CE principles within various goals. In particular, relevant CE principles are found explicitly in SDG 12 on Sustainable Consumption and Production, but also implied in several other goals such as in SDG 7 on energy, SDG 8 on economic growth, SDG 11 on sustainable cities, SDG 13 on climate change, SDG 14 on the oceans, and SDG 15 on life on land, among others.[11] The promotion of the CE is thus a key objective of the international community, and is further reflected in global organizations' discussions.[12]

C.Public-Private Partnerships for the United Nations Sustainable Development Goals

PPPs are a project delivery tool employed by public entities that provide public infrastructure and/or public services through long term contractual arrangements that typically involve private financing. They are often categorized into two types: "government-pay PPPs" which are PPP projects primarily funded by public funds, and "concessions" which are primarily funded by the users of the infrastructure or service.[13]

In furtherance of the UN SDGs and SDG 17.17 in particular, the ECE has developed the PPP for the SDGs approach[14] that focuses on the achievement of these goals. Its main objective is to ensure value for money, value for "people" and for the "planet" in the infrastructure sector using this model. PPPs for the SDGs are thus designed to achieve public infrastructure and service needs while ensuring the following five desirable outcomes:

(i) Access and Equity;

(ii) Economic Effectiveness and Fiscal Sustainability;

(iii) Environmental Sustainability and Resilience;

(iv) Replicability; and

(v) Stakeholder Engagement.

PPPs for the SDGs are thereby an enhanced model of PPPs, designed to implement the SDGs and be "fit for purpose". In ensuring value for people and for the planet, this PPP process is designed to overcome some of the weaknesses of both traditional procurement and traditional PPP models.

The ECE has developed and published several materials, including these Guidelines, to support the implementation of PPPs for the SDGs. Notably, it has developed *Guiding Principles on PPPs in Support of the SDGs*[15] in 2019, [16] as well as a *PPP Evaluation Methodology for the SDGs* in 2021[17] to assist governments in assessing whether a PPP and infrastructure project meet the above-mentioned five desirable outcomes for the SDGs.

D.The Circular Economy Agenda in Public-Private Partnerships for Sustainable Development Goals

As stated earlier, the SDG framework already reflects a large number of CE objectives within its goals. As the PPPs for the SDGs approach is modelled upon the SDGs framework, there is a large overlap between it and the CE. Indeed, CE objectives are embedded and weaved within and across the SDGs and the PPPs for the SDGs approach in various ways. Table 1 below summarises the main convergences between the practices and objectives of the CE agenda and the PPPs for the SDGs model

[11] See online: https://www.un.org/en/ga/second/73/jm_conceptnote.pdf
[12] See, e.g. online https://openknowledge.worldbank.org/handle/10986/34326 and https://openknowledge.worldbank.org/handle/10986/34320
[13] See online: https://unece.org/DAM/ceci/ppp/Standards/ECE_CECI_2019_05-en.pdf
[14] Previously referred as People first PPPs (until 2021)
[15] See online: https://unece.org/DAM/ceci/ppp/Standards/ECE_CECI_2019_05-en.pdf
[16] See online: https://unece.org/ppp/standards
[17] See online: https://unece.org/ppp/em

Table 2. Relevance of the PPPs for the SDGs approach to ensure the implementation of CE principles

"PPPs for the SDGs" desirable outcome	*Fitness of the "PPPs for the SDGs" approach to ensure implementation of CE principles*[18]	*CE principle that the PPPs for the SDGs approach is linked to*[19]
(i) Access and Equity	• Aims to ensure the expansion and improvement of essential services to populations in an environmentally sound manner • Seeks to guarantee that an Environmental and Social Impact Assessment is conducted to mitigate adverse socio-environmental impacts	"Replacement of the "end-of-life" concept with a regenerative and restorative design" and "achieving sustainability goals and reducing environmental impact"
(ii) Economic Effectiveness and Fiscal Sustainability	• Seeks to promote local sourcing • Aims to foster local procurement	"Maintenance of the value of products, materials, and resources in the economy for as long as possible"
(iii) Environmental Sustainability and Resilience	• Promotes the implementation of measures to offset or reduce green gas emissions and energy consumption • Promotes the utilisation of unwanted waste and the reduction of raw material intensity • Encourages the preparation of a waste management plan, the reduction of waste generation and diversion from landfill • Seeks the restoration of degraded land and ensures a net-zero impact on the quantity and availability of fresh surface water and groundwater supplies	Depending on the type of PPP project: "Elimination, or alternatively minimization of waste and pollution and/or "maintenance of the value of products, materials, and resources in the economy for as long as possible" and "achieving sustainability goals and reducing environmental impact"
(iv) Replicability	• Encourages the implementation of one or more innovative methods, technologies, or processes that eliminate or substantially reduce significant problems, barriers or limitations, and/or create scalable and transferrable solutions • Promote the transfer of technology or know-how that contributes to inclusive growth, service quality, sustainability and replicability	Depending on the type of PPP project: "Elimination, or alternatively minimization of waste and pollution and/or "maintenance of the value of products, materials, and resources in the economy for as long as possible" and "replacement of the "end-of-life" concept with a regenerative and restorative design"
(v) Stakeholder Engagement	• Seeks to ensure that members of the public, including environmental	Ensures that the core principles are respected by engaging with

[18] Based on the CE principles described in Section I B

[19] Building on and as operationalised by the PPPs for the SDGs Evaluation Methodology, https://unece.org/ppp/em

"PPPs for the SDGs" desirable outcome	*Fitness of the "PPPs for the SDGs" approach to ensure implementation of CE principles[18]*	*CE principle that the PPPs for the SDGs approach is linked to[19]*
	defenders, able to express their views and participate freely in the project • Aims to guarantee transparent project information	stakeholders concerned about achieving the CE agenda

Source: ECE

It is worth noting, however, that the PPPs for the SDGs approach arguably goes further than CE aspirations with regards to access and equity, economic effectiveness, fiscal sustainability, and stakeholder engagement.[20] As such, the key value-added of the PPPs for the SDGs approach is that it is a model that strives to ensure sustainable development (which includes circularity) but also sustainability for local populations and the promotion of stakeholder engagement to maximise the desirable outcomes of PPPs.[21] At their core, PPPs usually promote a full lifecycle assessment in infrastructure and service provision. The PPPs for the SDGs approach further promotes full project assessment by calling for a long-term vision and holistic approach to strengthening the adoption and promotion of CE-compliant practices that ensure value for people and the planet in the built environment. It helps governments crafting CE-enabling policies and frameworks that support CE practices across all the stages of a PPP.

II. Circular Economy Practices Across Public-Private Partnership Stages

A fundamental initial step to enable circular approaches in projects through the PPPs for the SDGs approach is to adopt national, regional, and/or local CE laws and policies to establish a much-needed CE-enabling environment. Such an overarching CE framework should be designed to promote, *inter alia*, reduction of waste, effective management of resources, economic incentives, innovations and multi-stakeholder collaborations.[22]

Law and policy frameworks such as green procurement requirements and standards,[23] energy use regulations,[24] CE specifications, or quantifiable CE standards in the design of buildings are just some of the ways governments can set minimum requirements with respect to the CE agenda and ensure that these are operationalised through the design, construction, and operation of projects. Governments may furthermore incentivise CE conduct through more generalised economic law and policy that promotes CE behaviour (e.g., Value Added Tax (VAT) rates, tipping fees for dumping waste, import/export duties on materials, eased licensure requirements for innovative technology, etc.)

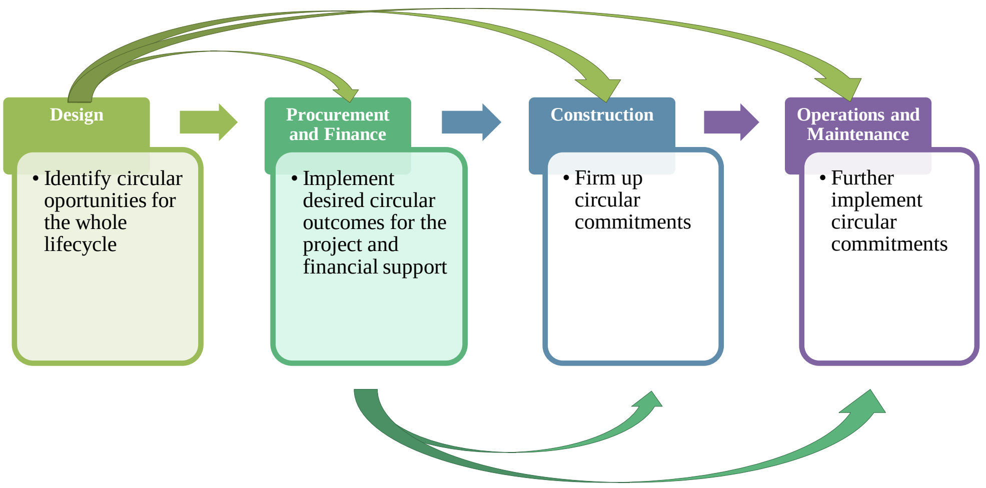
Governments are not limited however to incentivising CE conduct from the periphery and only through law and policy. An approach that seeks to reduce carbon emissions beyond energy efficiency measures calls to incorporate CE practices and the 6Rs approach of the CE hierarchy into the many necessary activities that are performed prior to and throughout the life of a public infrastructure and/or service project.[25] Indeed, at each of the four stages of a

[20] Although many CE examples include best practice supporting these outcomes, they are not an immediate priority as set by the principles of the CE.
[21] Refer to indicators for Access and equity, Economic effectiveness and fiscal sustainability, and Stakeholder engagement from the UNECE Evaluation Methodology.
[22] See online: https://ellenmacarthurfoundation.org/universal-policy-goals/overview
[23] The construction industry can become more circular if it can be transformed to "component base industry" where the components are traceable building blocks that can be reused, in contrast to monolithic building that have to be demolished when its utility ends.
[24] These were under the EU Directive. See online https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02012L0027-20210101
[25] See online: https://ellenmacarthurfoundation.org/topics/built-environment/overview

PPP project there is an opportunity for CE practices, across design, procurement and finance, construction, and operation and maintenance.[26]

Whilst this document distinguishes four stages of the PPP process, in practice these very often interact and are thereby not mutually exclusive, as shown by Figure 2.

Figure 2. Flow of circular economy practices during the PPP process



Source: ECE

A.Project Design

Much of the commitment and mitigation of environmental impacts of a project occurs during the design stage of a PPP. This can include from selecting the type of project, to utilizing design techniques that consider the construction, operation and maintenance costs, but also end-of-life disposal uses and costs of disposing or repurposing products, equipment, and material. Most project outcomes are considered and planned out by designers (engineers) very early in the project identification and preparation process, and as such, it is when governments can best embed CE principles and practice.

1. Design to reduce raw materials

With reference to the CE hierarchy and the 6Rs approach, a paramount objective of project designers should be to discourage new raw materials from entering the system, as shown in examples 1 to 4. For instance, appropriate regulation and/or the decision process on materials should opt for local, salvaged resources that have previously had another life. As such, policy could pave the way towards a CE whilst also encouraging projects to direct possible benefits resulting from increased circularity towards local populations. The latter is expected to include, *inter alia*, an increase in jobs in repairing, remanufacturing, or recycling services.

[26] The “four stages” are based on the six steps identified in the Public-Private Partnership Reference Guide 3.0. See online: https://ppp.worldbank.org/public-private-partnership/library/ppp-reference-guide-3-0

> ***Example 1:*** *The design of Brent Cross Substation in the UK opted for re-using reclaimed steel to complete all the steelwork for the wrap. This includes 90 per cent of all columns and maintenance walkway beams.*
>
> ***Example 2:*** *N4 Carrick-on-Shannon to Dromod Road Project in Ireland was designed to use existing carriageway space to reduce the size of new road required, and therefore lower the need of resources, and to use pavement with locally sourced recycled materials.*
>
> ***Example 3****: Designers of Villa Welpeloo in the Netherlands used Google Earth to identify waste stock in local industrial zones to be able to reuse and repair during construction.*
>
> ***Example 4:*** *Designers of the Biological House in Denmark opted for farming waste such as tomato stems, straw and wood chips, as their primary component of their modular bio composites that form the main structure of the asset.*

Current market constraints or other inefficiencies may limit designers that aim to follow a PPPs for the SDGs approach from incorporating CE principles in some projects. In such cases, the use of new raw materials may be unavoidable, and market regulations should encourage the use of renewable and sustainably sourced options, a practice that is already common in many sectors as seen in example 5. To pave the way towards CE-compliant PPP projects that can overcome these inefficiencies whilst keeping to the desirable outcomes of the PPPs for the SDGs approach, governments should support the growth of local markets of used materials and products. Example 6 presents an existing effort by industry practitioners to pave the way towards a local market of second-hand construction products and materials.

> ***Example 5****: The project Flat House in the UK was designed to use plant-based materials instead of concrete as renewable, low-carbon materials that reduced dependency on finite resources such as sand and gravel. Similarly, the country's Believe in Better Building was designed to use sustainable timber instead of concrete.*
>
> ***Example 6****: Oogstkaart is an existing online marketplace of used construction materials and products in the Netherlands. It can be a good resource for designers as it includes information on available materials, as well as their exact location to incentivise their local sourcing.*

2. Design for Disassembly

Aiming to simply reduce the immediate use of raw materials is not sufficient to achieve the CE. "Designing for Disassembly" is a particularly powerful approach that can further incorporate CE principles in project delivery by supporting the possible reuse of materials and components in future stages of the PPP process, as shown in examples 7, 8, 9 and 10. To enable PPPs for the SDGs to further promote circularity along these lines, governments should support the assessment and design of systems, equipment, and materials for disassembly, including, *inter alia*:

(i) reparability and availability of spare parts;
(ii) ease of disassembly and adaptability to future changing needs;
(iii) eliminate complex finishes that would limit component's future reuse, repair, remanufacture or recycling; and
(iv) record all materials and components, such as in a "materials passport",[27] a detailed information document used in a project to support future efforts to incorporate CE practices.

[27] Materials passports, sometimes also known as product passports, are detailed inventories of components and materials employed to construct an infrastructure asset so that these may be easily identified and recycled in the future. See online: https://ellenmacarthurfoundation.org/circular-examples/brummen-town-hall and https://ellenmacarthurfoundation.org/circular-examples/using-

Example 7: *The design of the Municipal office of Venlo in the Netherlands made sure to list all the materials and components used in a materials passport.*

Example 8: *The Better Shelter is a novel approach to modular shelters to house refugees and other displaced groups, used in refugee camps in Iraq and Ethiopia. They are designed to be re-assembled and modified as needed whilst reducing waste.*

Example 9: *The ADPT system is designed to enable disassembly of an asset without loss of value, considering factors such as ease of access, avoidance of unnecessary treatments and finishes, supporting re-use business models (product-as-a-service) standardization, as well as safety of disassembly.*

Example 10: *During the design of buildings such as the Circular Building and Edbury Edge in the UK, designers issued disassembly manual documents for the buildings, useful in future stages of the project.*

3. Full lifecycle design to promote Circular Economy practices

Taking a full lifecycle approach from the design stage also lends itself to successfully incorporate CE practices throughout the whole life of a PPP project, which goes hand in hand with the Design for Disassembly approach. For instance, design approaches that prioritise CE aspects in a new project, such as in example 11, could appear more capital expenditure (CAPEX) intensive in the short term but may in turn reduce overall operating expenditures (OPEX) over the long term.[28] As such, a full lifecycle approach has the potential to maximise future capabilities of operating the asset according to circular standards developed in the design stage.

Example 11: *During the design of the Calvert infrastructure maintenance depot in Buckinghamshire for High Speed 2 in the UK, a full lifecycle approach to costs was used to demonstrate how CE principles would be beneficial to the project without necessarily being more costly in the long run.*

Example 12: *Projects such as Gasholders in the UK and Circl in the Netherlands were designed to opt for the Product-as-a-Service (PaaS) approach instead of purchasing components. PaaS considers a full lifecycle approach to a building's components, where they are designed to be maintained by the manufacturer and are also retrieved in the end of their useful life to the project so that they can be reused, repaired, remanufactured, or recycled.*

Incidentally, digital technology can support the implementation of CE design approaches and promote transparency throughout the life of the project because project performance and operational information remain more transparent and accessible to stakeholders. While the ECE is already collecting information on digital transformation of PPP projects, which would eventually be published in a set of policy guidelines, it bears mentioning that digital technology does not only improve project delivery and operational performance, but can further improve CE aspirations, stakeholder engagement and communication between and across project stages.

product-passports-to-improve-the-recovery-and-reuse-of-shipping-steel. For more information on materials traceability, see ECTD's work on Traceability for Sustainable Garment and Footwear https://unece.org/trade/traceability-sustainable-garment-and-footwear

[28] For example, designing for disassembly could reduce OPEX if it allows for easier cost-effective modification of a building's components that meet change in utility needs

Project designers are already using technology to this end. Digital tools and "InfraTech"[29] such as in example 13, are being used by designers to better conceptualise projects, identify opportunities for application of CE approaches, and overall improve project delivery. Such technology allows unprecedented access to data on facility and service delivery, construction methods and materials and systems to be incorporated into a project. Applying such tools at the design stage supports the ability to introduce and monitor CE practices throughout the full PPP lifecycle, allowing firms to track in real time their supply chains, verify the quality and quantity of material usage (recycled or virgin), and provide "cradle to grave" access to a project's information that enhances CE monitoring and the use and reuse of materials and equipment in projects.

Example 13*: Platforms such as BimCrone in Türkiye allow project designers to share data on chosen materials and equipment with corresponding information on designed circular approaches with all stakeholders.*

B.Procurement and Finance Stage

The procurement[30] and finance stage of a PPP project development can further be leveraged by governments to implement CE approaches.

1. Circular Procurement Regimes

To some degree, the procurement stage is no more than a reflection of the desired design of a project, but it is also one of the first practical steps a government may take in obtaining the CE components it desires and achieving the PPP for the SDGs' objectives.[31]

Circular procurement is the application of CE principles to the public procurement process. It refers to public authorities tendering for and purchasing works, goods or services that are part of closed energy and material loops within supply chains, and minimising, or in the best case avoiding, negative environmental impacts and waste creation. As explained by the European Commission:

"It is purchasing that considers the environmental, social and economic consequences of – design, material use, manufacture and production methods, logistics, service delivery, operation, maintenance, reuse, recycling options, disposal, and bidder's/suppliers' capabilities to address these consequences throughout the supply chain".[32]

While CE objectives may be accomplished through overarching policy and project design, many "green purchasing" or "circular procurement" recommendations, voluntary GPP criteria, and/or communications already exist[33] and can influence how circular procurement is to be achieved in a project. The provisions vary, but the frameworks may require everything from specified levels of energy efficiency in the products that are being purchased, to recycled content, biobased or biopreferred products, to water efficiency or non-ozone depleting manufacturing of product requirements. Procuring authorities seeking a CE approach in their PPP projects should therefore take note of any local, regional, and/or

[29] Technology-enabled infrastructure (InfraTech) broadly refers to technology that can be used during the full lifecycle of an infrastructure asset, aiding its delivery, construction and ongoing operations and maintenance. See online: https://openknowledge.worldbank.org/handle/10986/34320

[30] A comprehensive guide on green and sustainable PPP procurement will be prepared by ECE in 2023. This will complement the ECE Standard on a Zero Tolerance Approach to Corruption in PPP Procurement (ECE/CECI/WP/PPP/2017/4).

[31] Topics discussed are all in line with international commitments on procurement.

[32] See online: https://ec.europa.eu/environment/gpp/pdf/Public_procurement_circular_economy_brochure.pdf

[33] See online: https://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm , https://www.oecd.org/gov/public-procurement/Going_Green_Best_Practices_for_Sustainable_Procurement.pdf and https://www.gsa.gov/about-us/regions/welcome-to-the-rocky-mountain-region-8/sustainability-in-action/green-purchasing

national green or circular procurement requirements and craft their tenders in conformance with applicable frameworks.

2. Circular Economy Strategies in the Bidding Process

The tender documentation itself and certain procurement approaches can be used to obtain a government's circular needs. For instance, procuring authorities could demand the submission of tender containing circular aspects, include technical specifications that seek circular targets, craft minimum circular criteria for materials or equipment, or use award criteria that put special weight on the targets of CE or its Rs approaches. Examples 14, 15 and 16 briefly illustrate how this may be done in practice. A two-step procurement process can also be used to first qualify appropriate CE bidders or suppliers, and then contractually bind the winning bidder to the long-term maintenance of that asset thereby incentivizing CE solutions throughout the life of the project. Tenders can also employ the following strategies:

(i) "Best value award criteria", moving away from "low bid" awards to full lifecycle costing and award considering circular contributions[34] ;

(ii) "Qualification criteria", which refers to the pre-qualifying or pass/fail of bidders with a track record of implementing CE approaches and use of CE solutions, [35] (use of supply chain tracking systems or environmental and circular management systems and schemes such as the EU Eco-Management and Audit Scheme (EMAS))[36];

(iii) "Preference criteria", providing award/evaluative bonus to certain firms that meet CE objectives, e.g., CE experience, those prioritising local Small and Medium Enterprises (SMEs)[37] or serving disadvantaged populations while create skills or local job creation in recycling or reuse of materials, those making commitments on local material use or reuse, etc.);

(iv) "Threshold criteria", defining a minimum CE standard that must be met by suppliers (noting however that market readiness for such requirements should be tested), e.g., minimum recycled material volumes, minimum locally sourced material; and

(v) "Functional design criteria"[38] which refers to performance requirements or desired outputs/outcomes of the project rather than input-based technical criteria, e.g., office building that uses renewable energy sources, net zero CO_2 emissions by year 5 of operation, and is designed to be deconstructed in 20 years.

[34] See online: https://wedocs.unep.org/bitstream/handle/20.500.11822/26599/circularity_procurement.pdf?sequence=1

[35] See online: https://ec.europa.eu/environment/gpp/buying_handbook_en.htm

[36] A voluntary eco-management and audit scheme for the evaluation and improvement of the environmental performance of a participating organisation. See online: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32001R0761 and https://ec.europa.eu/environment/emas/emas_for_you/premium_benefits_through_emas_en.htm

[37] See online: https://op.europa.eu/en/publication-detail/-/publication/ee874832-decc-11eb-895a-01aa75ed71a1/language-en

[38] UNEP (2021) describes the "Functional criteria describe the problems to be solved or functions to be fulfilled, allowing for innovative solutions, whereas technical criteria describe the characteristics, manufacturing processes and material compositions of products to be purchased, to a larger degree specifying the exact product or service to be delivered". See online: https://www.unep.org/resources/publication/second-edition-uneps-sustainable-public-procurement-guidelines

> ***Example 14**: The Norwegian Road Authority in the E10/Rv85 PPP Road tendered a requirement that the road operation be CO2 emission free from year 5 of the concession.*
>
> ***Example 15**: The State of Victoria, Australia has commenced the EcologiQ programme that integrates recycled and reused requirements in transport infrastructure projects and made the use of green materials business-as-usual. (e.g. materials like plastics, organics, crumb rubber, glass, reclaimed asphalt pavement, crushed bricks, fly ash, slag, ballast and steel).*

Procurement authorities can also promote CE objectives by assessing the opportunities for application of the 6Rs in a project and, subject to value for money considerations, including 6R requirements in the tender. For example, when the economic life of equipment or material to be used in a facility is less than the contemplated life of the project, a procuring authority can specify that the component, e.g. be bought back by a supplier as scrap and/or recycled, be refurbished or remanufactured for reuse, or be procured as a service rather than as a good (product-as-a-service (PaaS) systems[39] as previously mentioned in example 9) or better utilized by allowing for a component's shared use, access or ownership.

No matter the approach, circular procurement requirements need to be tailored by each procuring authority to the project type, sector, product/good/equipment proposed, and any other jurisdictional factors that may influence or control the desired approach. CE requirements in tenders must furthermore strive to maintain the competitive tension amongst bidders and encourage performance-based solutions over prescriptive statements of work.

3. Financing Circular Public-Private Partnerships

The funding and financing of PPP projects is another area where steps to support the CE and PPPs for the SDGs may be taken.

First, green finance exists that prioritises investments in companies or projects that are deemed environmentally responsible, such as the one showcased in examples 16 and 17.[40] These funds and financing investment vehicles are designed to incentivise green and/or circular behaviour in the projects they support and can include verification requirements that are designed to confirm those aspirations.[41] It is also worthwhile noting that green financing mechanisms also prioritise local solutions assisting SMEs, as shown in example 16. As important actors of the CE transition, every effort should be made to support SMEs to make their contribution to the CE transition and to benefit from it..

Industry performance and disclosure systems also continue to proliferate and guide companies and investments in environmentally friendly projects, i.e. ESG criteria, Task Force On Climate Related Financial Disclosures (TCFD), Carbon Disclosure Project (CDP).

> ***Example 16:** Through green loans and as part of the France Recovery program, this finance initiative in France supports SMEs and mid-caps wishing to finance an ecological and energy transition project.*
>
> ***Example 17**: The Green Giant Project in Uzbekistan is targeting an investment of USD 1.3 billion of green finance.*

While funding and financing products evolve to further support CE requirements, some fear that adopting CE practices in PPPs may introduce unique performance risks that, in turn, may require innovative approaches to financing as well as special green funds and/or blended finance. For example, some financing is purposefully aligned with achieving green outcomes, and some financing is "blended" to favourably diversify or distribute the risk across various

[39] Other models include Licensing as a Service (LaaS), Software as a Service (SaaS)
[40] GBP_2015_27-March.pdf (icmagroup.org)
[41] https://documents.worldbank.org/en/publication/documents-reports/documentdetail/712651468025506948/green-infrastructure-finance-a-public-private-partnership-approach-to-climate-finance

tranches of funds and/or de-risk certain aspects of the financing structure. According to the Addis Ababa Action Agenda on Financing for Development, blended finance instruments serve to lower investment-specific risks and incentivize additional private sector finance across key development sectors.[42] Projects involving blended finance including PPPs, such as example 18, should share risks and rewards fairly, include clear accountability mechanisms and meet social and environmental standards. Hence, blended finance is investment with altered structural approaches that can more finely calibrates the risk-reward relationship, and can allocate financial risk across different classes of investors with different risk appetites (e.g. subordinated or mezzanine debt, tranched equity funds, aggregated funds of funds, first loss mechanisms, etc.).[43]

> ***Example 18****: The Pamir Private Power Project in Tajikistan used a mix of funds and financing that included World Bank International Development Association (WB IDA), Tajikistan Government, Aga Khan Fund for Economic Development (AKFED), International Finance Corporation (IFC), and Swiss (SECO) facilities and support.*

To develop an effective financial system, governments are called to boost sustainable financing mechanisms that favorably enhance the risk-reward relationship of the PPP for SDGs projects adopting CE practices. Additionally, governments with healthy budgets may wish to align financial policy to further support projects demonstrating circularity and sustainability, boosting the potential for new CE-compliant PPP projects.

C.Construction Stage

The EU Circular Economy Action Plan estimates that the construction sector is responsible for over 35 per cent of the EU's total waste generation. Instituting CE practices in construction can therefore be an important step to limiting waste generation and promoting CE practices through PPPs for the SDGs.

4. Rethinking construction materials and methods

Many current construction standards and specifications are outdated as they encourage the use of virgin resources and maintain legacy systems and methods that either prohibit circular approaches and/or discourage the development of new, innovative, circular construction methods as shown in example 19. To enable PPPs for the SDGs to boost circularity during construction effectively, market regulations should be regularly updated to allow for innovation in construction methods that are more efficient and embrace CE principles, such as those shown in examples 20 and 21.

[42] Refer para 48 online: https://www.un.org/esa/ffd/publications/aaaa-outcome.html
[43] Adapted from https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2021/11/Blended-Finance-for-Scaling-Up-Climate-and-Nature-Investments-1.pdf

Example 19: *The A6 PPP Motorway Expansion in Germany recycled 100 per cent of the existing motorway surface in the rehabilitation and expansion of that motorway. Extensive tests and calculations had to be undertaken by specialists to demonstrate that the new surface was of equal quality and longevity to those specified in the existing standards.*

Example 20*: Additive Manufactured (AM) structural nodes is a construction technique that produces structural steel elements for buildings using 3D printing, maximising efficiency with minimum material input whilst delivering the same function and strength as those created through traditional methods.*

Example 21*: Through Australia's EcologiQ Programme, innovative recycled materials have been successfully employed in various projects:*

- *Mordialloc Freeway's noise walls will be made from 75 per cent recycled plastic collected from households across the state.*
- *Kororoit Creek Road Level Crossing Removal Project used recycled glass sand from bottles and jars as bedding fill and backfill for drainage areas.*
- *Wyndham Vale Train Stabling Yard where railway sleepers were made from recycled plastic, instead of concrete.*
- *East Boundary Road in Bentleigh East used asphalt made of crumb rubber from used tyres.*

5. **Rethinking construction waste**

Policy should also allow for changes in materials and processes during the full construction stage. Examples 22 and 23 show how new opportunities to develop CE techniques may come to light during construction. Furthermore, regular and rapid testing mechanisms should be established to "ramp up" innovative construction techniques and material uses, such as in example 19, and thus enable PPPs for the SDGs achieve CE outcomes during construction.

Example 22: *In the building of a new Eurasia Tunnel in Istanbul, Türkiye, the concessionaire used advanced technology and a slurry treatment plant to reuse bentonite waste material generated from the tunnel.*

Example 23: *The digging of Espiño Tunnel in Spain generated wastewater with large amounts of solid matter. Constructors saw an opportunity to decant and clean the water and reuse it on-site for construction needs, reducing the necessity to collect water from natural rivers.*

Constructors may also find situations where waste from operations cannot be repurposed within the immediate context of the project. As such, governments must limit its landfilling through appropriate regulation, incentivising industry actors to identify remaining value in construction waste that may occur outside of the project's context, including, *inter alia*, solid, liquid, and gasification waste. Additionally, strengthening stakeholder engagement throughout this process may ensure that potential alternative uses to construction waste not only take place but also benefit local populations and the environment. Examples 24 and 25 showcase how this may be possible.

Example 24*: Waste from the development of Quito metro in Ecuador such as leftover wood was donated to the local community for various activities: carpentry, guitar making, furniture, and wood ovens for panela (unrefined whole cane sugar) making.*

Example 25: *Excavation spoil from the construction of Sydney's Metro City in Australia was fully repurposed for coastal protection, beach nourishment and land raising, flood mitigation work, and fill for embankments and mounds, amongst other things.*

D.Operation and Maintenance Stage

CE opportunities during the operations and maintenance (O&M) stage of PPP for the SDGs projects can be found within daily maintenance and system renewals of the infrastructure asset, as well as waste generation and energy consumption from its daily operations, amongst other things. As mentioned above, CE actions undertaken in previous stages can improve circular capabilities during the operational life of the asset, whilst also offering possible reductions in OPEX. Nevertheless, after having executed the PPP contract and the construction of the infrastructure project, the PPP enters its final and longest stage: operating and maintaining the contract, which will last throughout a project lifetime.[44] As such, the O&M stage creates many CE opportunities in the medium to long-term.

CE opportunities may thus vary greatly and could depend on the asset and sector of the project, the type of public service being delivered, and the rate of evolution and innovation in technology. Policy makers and procuring authorities should therefore make long term assessments for potential CE opportunities and anticipate that a project or technology may evolve along with new CE opportunities, including some that may not be anticipated.

6. Increasing longevity

Performance requirements and operational regulations should incentivise operational efficiencies, and the reduction of material consumption, and allow for the application of new technologies. They should similarly promote system longevity and maintenance strategies that are holistic and prioritise the achievement of CE outcomes, such as in examples 26 and 27 below. CE strategies can furthermore be incorporated into handover and end of service transfer provisions so that, for instance, CE practices may continue, or facilities are received in such a condition that will allow CE solutions to be applied.

Example 26: *During Pipeline maintenance work of Scottish Water's national sewage system in the UK, an innovative approach was deployed to repair and refurbish the sewage structure that increased its longevity and negated the need to replace the pipes.*

Example 27: *The lifespan of an onshore wind farm in Ireland was extended and costly replacement of components was avoided by removing damaged concrete, strengthening the remaining components using a specialized epoxy resin, and reinforcing the structure using corrosion inhibitors and special sealants*

7. Rethinking waste from operations and maintenance activities

Regardless of the longevity of an infrastructure asset, the O&M stage could generate waste. Therefore, governments should develop relevant frameworks that allow PPPs for the SDGs to integrate CE approaches during O&M. This could include allowing for the treatment of recyclable liquid or solid waste that is generated from an asset, preferably repurposing it at a local level, rather than disposing of it entirely. Example 28 shows how this may be possible.

Example 28*: Green Solution House in Denmark recycles water through biological purification. Wastewater from the sinks and toilets in the main building is collected and flows through anaerobic, clarifying, and biological filtering stages to enable on-site reuse.*

In the context where such waste cannot be remanufactured or recycled, governments can promote the development of local facilities that can recover energy from the waste and thereby avoid the typical linear economy solutions that take place, such as the approaches

[44] See online: https://ppp.worldbank.org/public-private-partnership/PPP_Online_Reference_Guide/PPP_Cycle

shown in examples 29 and 30.[45] The energy recovered can then be fed back into the loop and/or support the daily operations of an infrastructure asset.

Example 29*: Green Solution House in Denmark recovers energy from organic waste material generated by operations of the building with a pyrolysis plant, solar thermal plant and integrated photovoltaics. The on-site process heats the waste, breaking it down to produce natural gas and biochar, which is valuable as a soil additive for the gardens. The gas is combusted in a combined heat and power engine, generating heat and electricity for the building.*

Example 30: *The Integrated Waste Management Plant (PIVR) of Sant Adrià de Besòs in Spain includes two plants: a Waste to Energy (WTE) Plant, and a Mechanical Biological Treatment (MBT) Plant. The MBT plant processes unsorted wastes for recycling, and organic materials for composting, and for the production of a small fraction of energy through anaerobic digestion (AD). The residues of the MBT are mixed with non-recyclable municipal solid waste and are processed in the WTE plant for energy recovery.*

III. POLICY OPTIONS

These Guidelines showcased examples to demonstrate that pioneering initiatives are developing fast. Considering these PPP projects, this section provides policy options for national and municipal governments, its finance and procurement authorities, and its sector implementation agencies. Policy options are designed to assist developing policies and adopting procedures that encourage projects to adopt CE practice through a PPPs for the SDGs approach. Some of these options are general and target all phases of a PPP project, others target a specific PPP project stage. All policy options stem directly from the arguments and examples set above.

As each country is in a unique stage of development with various infrastructure and service needs, and different local and national socio-economic, environmental and political contexts, these Guidelines do not prescribe a “one-size-fits-all” approach.

A. Overarching policy options aimed at Governments for their consideration

1. Adopt an overarching policy to encourage circularity and sustainable infrastructure targets and outcomes in PPP projects

Commentary: CE targets and outcomes should be aligned to the national and local priorities, design options may have to be ruled out if CE outcomes are not being achieved, even if it entails a higher investment.

2. Develop or adopt circular indicators that assess the progress made towards achieving circularity through the full lifecycle of a PPP

Commentary: The use of a common set of indicators is essential for coherence in the assessment of aggregated performance at national and local levels. These indicators should be as objective as possible, and where necessary developed in consultation with equipment manufacturers and operators. Digital technology tools should be encouraged to enable tracking of infrastructure components during their lifecycle and to verify its recirculation within the economy.

[45] For further information on WTE, see online: https://unece.org/sites/default/files/2022-10/ECE_CECI_WP_PPP_2022_03-en.pdf

3. Provide well-designed economic incentives that support the use of circular approaches and sustainable choices in PPPs and/or provide reasonable assurance to project designers, private investors and operators

Commentary: These incentives can define taxes such as environmental taxes, landfill and incineration taxes for disposal, and value added tax (VAT) rates or import duties for the discouragement of use of virgin resources, to promote the development secondary markets of used resources, or to promote circular economy. It is necessary to incentivize the selection of used or recycled resources that can compete, on availability and cost, with virgin resources, without sacrificing acceptable safety and performance norms.

4. Encourage specified minimum local and/or recycled material content and performance based on the use of local resource and local waste mitigation/generation, while prioritising SMEs

Commentary: Whilst including CE best practice will naturally accomplish many of the desirable outcomes from the PPPs for the SDGs approach, special attention should be given to encourage PPPs to develop holistic approaches that also incorporate solutions at the local level whilst prioritising SMEs, and thus strengthen (i) Access and Equity, as well as (ii) Economic effectiveness and Fiscal sustainability, which are currently not fully encompassed by the CE approach alone. For example, standards could direct benefits from CE approaches towards local populations, which could for instance include an increase in jobs in repairing, remanufacturing, or recycling services.

5. Encourage the use and development of stakeholder engagement tools and platforms that allow projects to take into account all viewpoints and improve communication between involved parties.

Commentary: Special attention should be given to encourage PPPs to develop holistic approaches that also incorporate solutions that strengthen stakeholder engagement. Improving circularity in infrastructure naturally leads to an increased need for better communication and information between stakeholders in all project stages so that appropriate and efficient CE approaches can be employed. At the same time, keeping this information transparent and accessible to the public is also pivotal to maximise stakeholder engagement in a way that may currently not be fully covered by the CE approach alone.

6. Discourage the landfilling of waste

Commentary: Law and policy should discourage landfilling project waste and instead incentivize the identification of remaining value in waste, including but not limited to solid, liquid, and gasification waste. For example, creating concrete performance ratings such as waste generation per unit of output or service can encourage industry actors to integrate the CE hierarchy as a means to reduce overall waste.

B. Policy options for each PPP stage aimed at Governments for their consideration

A. Design

7. Discourage the use of virgin materials within the built environment. In the case where these may be unavoidable, there should be a policy encouraging industry to opt for renewable and sustainably sourced options

Commentary: Derived directly from examples 1 to 6. Reducing the amount of virgin resources entering the system is the first and most important step of the CE hierarchy. However, due to current market constraints or other inefficiencies, some projects may not be able to use, repair, remanufacture, or recycle used components and materials, nor recover energy from existing waste. Governments should therefore support growth of local markets for used materials and products. When virgin materials must be used they should be amenable for circularity during or at the end of the project.

8. Encourage the adoption of regulations and/or standards that actively promote the Design for Disassembly approach

Commentary: Derived directly from examples 7 to 10. Design for Disassembly requirements should include instructing contractor(s) to record decisions on materials and products used and their capacity for disassembly, ensuring that components remain durable, accessible, and reversible, actively supporting their future reuse, repair, remanufacture, recycling, and energy recovery. Markets may also need to provide access to data on current usable components from the built environment. In the case of an asset with no design for disassembly, pre-refurbishment audits should be encouraged to assess the waste that would be produced from the demolition of the project and an assessment made of opportunities for reusing, repairing, remanufacturing, or recycling of materials.

9. Promote a full lifecycle approach that takes into account costs and encourages information transfer between all stakeholders so that CE opportunities can be successfully captured during all project stages

Commentary: Derived directly from examples 11 to 14. Early discussions between all stakeholders, especially the local population and private companies (involved in design, construction, operation and maintenance) as a collaborative process, is productive for shaping the project and achieving the outcomes of PPPs for the SDGs. This can encourage innovations in the design approach that rethink the manner in which the infrastructure or services are delivered. Transfer clauses and/or handover provisions should furthermore ensure that governments and/or their service providers are able to implement end-of-life treatment and commitment to circularity. Designs that do not allow reasonable opportunity to do so should be discouraged.

B. Procurement and Finance

10. Incorporate circular procurement methods

Commentary: Derived directly from example 15. Governments should avoid the procurement preference for least capital cost solutions, and tailor the procurement methods and documentation to incentivize bids and bidders that provide the best project lifecycle costs and meet the government's aspirations for circularity aspirations.

11. Align financing policies and approaches to the achievement of circularity and sustainability targets

Commentary: General policy recommendation discussed in III.6. Financial budgets and priorities should support projects demonstrating circularity, sustainability and successful achievement of the SDGs.

12. Boost sustainable financing mechanisms, where necessary, and empower sponsors to consider financial resources from different financial institutions having different risk-reward expectations

Commentary: Derived directly from examples 16 and 18. Green finance may be used by choosing the right financial instruments, relevant for each project, for promoting SMEs, circularity practices and outcomes of PPP for the SDGs. This may bring in additional performance requirements and consequently may introduce more risk of default. To favorably enhance the risk-reward relationship of the PPP for SDGs projects adopting CE practices, it may be necessary to de-risk the financing structure of a project, so that it becomes attractive to private investors and credit-worthy for the financing institutions.

C. Construction

13. Develop or adopt standards and specifications that support new construction techniques in line with the circular economy hierarchy

Commentary: Derived directly from examples 19 to 21. construction standards and specifications should promote a closed loop approach to materials that reduces the demand for virgin resources.

14. Encourage regular and rapid testing mechanisms for innovative products that support circularity

Commentary: Derived directly from examples 19, 22 and 23. Fixed, outdated market regulations may constrain innovation driven by industry, and as such limit the incorporation of the CE hierarchy within the built environment. Laws and policies should therefore undergo more regular updates of standards and specifications for construction material and building components, or that may present a bias toward virgin resources or non-circular approaches or techniques, and instead should support innovative circular construction techniques that incentivize the reuse, repair, remanufacture, and recycling of existing components, and hence reduce the number of new materials entering the system.

D. Operation and Maintenance

15. Enact operational regulations incentivizing operational efficiency, whilst reducing energy consumption from non-renewable sources and enhancing longevity of infrastructure

Commentary: Derived directly from examples 26 to 30. The "once use and dispose" approach of the linear economy must be restrained by minimizing of virgin resources use and direct waste disposal practices. This will improve resource circularity and hence resource use efficiency, through innovation in operation practices and lead to the development of competitive circular business models.

C. Way forward

To give effect to policy options as set out in ECTD infrastructure and financing of the circular economy documents,[46] possible entry points include:

(a) **Disseminate** the CE Guidelines to ECE region and **encourage** countries to disseminate best practice circular PPPs for the SDGs at future PPP events and on platforms;

(b) **Promote discussion** between Governments, CE actors and PPP practitioners on the CE Guidelines and its policy options;

(c) **Share experience** including between governments who have ample experience and those whose commitments towards CE are still at an emerging stage; and

(d) **Building capacity** subject to resources and demand by countries in the ECE region, the secretariat could provide capacity building and policy advisory services on the topic.

[46] See table 1.

Annex I. [English only]

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Annex II.

[English only]

Detailed examples used in the Guidelines[47]

Example 1. Brent Cross Town Substation, UK

Description: The primary substation will form an integral piece of key infrastructure at Brent Cross Town, which aims to be net zero carbon by 2030 and which will deliver 6,700 homes, 3 million square feet of workspace and a new high street. As such, the design seeks to transform a neglected site into an eye- catching landmark to benefit the local community.[48]

Adoption of CE principles:

Steelwork for the wrap will be formed from reclaimed steelwork which will reduce the embodied carbon of the project and advance the industry in promoting steel re-use and CE principles, resulting in 46 tonnes of virgin steel consumption avoided. This includes 90 percent of all columns and maintenance walkway beams.

Example 2. N4 Carrick-on-Shannon to Dromod Road Project, Ireland

Description: Transport Infrastructure Ireland is creating a CE plan along with a pilot study to apply CE principles to the N4 Carrick-on-Shannon scheme. This section of the N4 is a single carriageway approximately 21km long, comprising both rural and urban sections. The project is currently at early planning stage.[49]

Adoption of CE principles:

- Reduce material input: Prioritising reuse of existing sections of road and pairing this with strategic local interventions to minimise vehicle traffic has potential to minimise both the length and cross section of new carriageway elements and increase local trips, meaning emissions, material use and cost of the scheme can also be minimised.
- Resource efficiency in earthworks and alignment: The pilot developed a methodology for investigating material properties, sourcing and deposition options, emissions and impacts early in the design development process so that they could be considered as part of the optioneering process.
- Facilitate low impact short trips using active travel modes, keep existing road in use as far as possible, local sourcing and deposition of materials, reuse and recycling of pavement materials and regenerate nature on national transport schemes.

Example 3. Villa Welpeloo, the Netherlands

Description: Villa Welpeloo is a house and art studio in the Netherlands constructed by Superuse Studios. In its construction, 60 percent of materials used were salvaged from local waste, highlighting the potential of unused or waste resources. This project brought to light the difficulty to locate and recover materials suitable to apply CE principles.[50]

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[47] The findings, interpretations, and conclusions expressed in the examples in Annex II do not necessarily reflect the views of the UNECE secretariat. Mention of company names or commercial products does not imply endorsement of the United Nations.

[48] See online https://docs.planning.org.uk/20210428/78/QRX6MNJIM5600/0vprz52jeujrhcse.pdf

[49] See online:https://carrickdromod.ie/wp-content/uploads/2022/05/274219-ARUP-02-OS-PP-YE-000009.pdf

[50] See online:https://ellenmacarthurfoundation.org/circular-examples/finding-and-utilising-waste-materials-for-construction-purposes

Adoption of CE principles:

- Designers used Google earth was to identify waste stock of materials in industrial zones decreasing the need for virgin resources.
- During the construction stage, steel sourced from machinery previously used in textile production was reused.
- Timber used in the construction of the façade was taken from 200 damaged cable reels and was repaired through a treatment using the “Plato method” to extend its life for at least another 35 years.

Example 4. The Biological House, Denmark

Description: A house made from farming waste, just as durable as a conventional building.[51]

Adoption of CE principles:

- Constructed using modular units made from bio composites entirely composed of biological farming waste. Some of this waste includes tomato stems, straw, hay, wood ships, eelgrass, flax fibres, cork, corn, and soybeans.
- The modular units are flexible, created for easy disassembly and thereby encouraging future reuse of components.

Example 5. Flat House and Believe in Better Building, UK

Flat House, UK

Description: Located in a 21-hectares hemp farming facility in England, the building is a low embodied carbon three-bedroom 100m2 house makes use of the renewable materials grown on-site.[52]

Adoption of CE principles:

- Using plant-based materials, which are renewable and low-carbon, reduced the need for finite resources like sand and gravel. Designers worked closely with engineers and material specialists to develop a prefabricated panel infilled with hemp grown on 20 acres of the farm.

Believe in Better Building, UK

Description: The tallest commercial timber building in the UK, demonstrating the potential of switching to renewable materials in the built environment.[53]

Adoption of CE principles:

- Design for disassembly: partitions are designed to slide and unfold easily to create new rooms so that spaces would remain useful to users over the long-term.
- Using timber instead of concrete as a renewable, low-carbon material allowed a reduction on the extraction of finite resources like sand and gravel for its construction.

Example 6. oogstkaart.nl

Description: This in online marketplace where used construction materials and products are available to “harvest”.[54]

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[51] See online: https://gxn.3xn.com/project/biological-house/
[52]See online:https://ellenmacarthurfoundation.org/circular-examples/hemp-as-a-renewable-low-carbon-building-material-flat-house
[53] See online: https://ellenmacarthurfoundation.org/circular-examples/switching-to-renewable-materials-to-sequester-carbon-believe-in-better
[54] See online: https://www.oogstkaart.nl/

Adoption of CE principles:

- By including detailed data on available second-hand products, such as their category, material information, design, exact location, and photos, the online marketplace enables the harvest of material with a range of possible uses within the CE.

Example 7. Municipal office of Venlo, The Netherlands

Description: The municipality of Venlo commissioned the design of this 27.700 m2 municipal office in Venlo, comprising many innovative sustainable solutions. The municipal office is also self-sufficient in its operational energy needs.[55]

Adoption of CE principles:

- Inspired on the “cradle to cradle” principle, all the materials and components used are recorded in a materials passport.

- Design for disassembly: modular characteristics of the building will make its disassembly and reassembly easier in the future, encouraging future reuse of components.

Example 8. Better Shelter, Iraq and Ethiopia

Description: A collaboration between the IKEA Foundation and the UNHCR has resulted in a new, innovative, safer and more durable shelter for refugee families around the world.[56]

Adoption of CE principles:

- Designed for disassembly: The shelters are designed with modularity in mind to adjust to the residents and their situation, and to offer the possibility to upgrade and prolong their lifespan or to turn them into something else when the situation changes, encouraging the on-site reuse of structural components.

Example 9. ADPT modular system

Description: This is a modular, circular building system that uses the product-as-a-service business model to reduce consumption of resources. It can be individually adapted to the needs of the respective users and the specific location in terms of size, materials, and equipment; the building system can be added to, extended, reduced or converted as required.[57]

Adoption of CE principles:

- Uses durable products and materials that guarantee a long life, preferably beyond the necessary service life, so they can be adapted and reused in the future.

- Modular features enable full adaptability to new future functions of the building without loss of value.

- Designed to enable disassembly without the loss of value, considering factors such as ease of access, avoidance of unnecessary treatments and finishes to material used, supporting re-use business simplicity and standardization, as well as safety of disassembly.

[55] See online https://www.kraaijvanger.nl/en/projects/city-hall-venlo/ and https://archello.com/project/municipal-office-venlo

[56] See online https://bettershelter.org/ and https://ikeafoundation.org/press-release/better-shelter-ikea-foundation-and-unhcr-ready-to-improve-life-for-thousands-of-refugee-families/

[57] See online: https://ce-toolkit.dhub.arup.com/case_studies/s7 and https://www.arup.com/projects/adpt-circular-building-system

Example 10. The Circular Building and Edbury Edge, UK

The Circular Building, UK

Description: A prototype for a new approach to housing in which all components are to be selected for their inherent low levels of embodied energy and at the end of the building's life, all components would be taken apart and returned to the supply chain for reuse and recovery.[58]

Adoption of CE principles:

- Digital technology was used to “tag” all items, including everything from window frames to individual fixings, each with a unique QR code containing information allowing it to be reused.
- The building is designed with reversible connections within the building’s super-structure elements, to easily modify spaces in the future.
- Design for disassembly: Designers developed and issued a Disassembly Manual Document for the building providing instructions to effectively disassemble different components.

The Edbury Edge, UK

Description: It is a temporary infrastructure facility in Westminster that provides affordable workspace and retail units, a café, community hall and public courtyard. It was designed maximising CE principles.[59]

Adoption of CE principles:

- Designers communicated and worked closely with the contractor and timber manufacturer to maximise reuse in the construction of the building.
- Design for disassembly: the infrastructure can be completely disassembled, relocated and reassembled multiple times, without compromising its structural integrity.

Example 11. Calvert infrastructure maintenance depot, UK

Description: High Speed 2 the planned high speed rail line in the UK with the first phase under construction. Upon completion, the new track is designed to stretch from London to Manchester, via Coleshill east of Birmingham. High Speed 2 defined three CE principles for implementation across the project.[60]

Adoption of CE principles:

- Design for disassembly, including:
- All building structures and envelopes in the Infrastructure Maintenance Depot are designed and constructed such that they can be dismantled and reused in their existing form.
- All mechanical, electrical and public health installations in the Infrastructure Maintenance Depot are designed to be removable for refurbishment and reuse in their existing form.
- All floor finishes, ceilings and partitions in the Infrastructure Maintenance Depot administration building are designed to be removable for refurbishment and reuse in their existing form.

[58] See online: https://ce-toolkit.dhub.arup.com/case_studies/25 and https://www.arup.com/news-and-events/the-circular-building-the-most-advanced-reusable-building-yet
[59] See online: https://www.arup.com/projects/ebury-edge
[60] See online: https://www.hs2.org.uk/building-hs2/trains/calvert-infrastructure-maintenance-depot/

- Full lifecycle approach: a life cycle assessment of material, energy, water and wastes was undertaken and optimised over the lifecycle of the depot.

Example 12. Gasholders, UK, and Circl, the Netherlands

Gasholders, UK

Description: A residential development of 145 apartments constructed within a trio of Grade II listed Victorian gasholder frames.[61]

Adoption of CE principles:

- The 19th century ironwork frames were dismantled, restored and relocated within the King's Cross development.
- Project designers switched to "renting" through PaaS instead of purchasing the components that were expected to have a short or medium service life for this particular project.
- A whole life-cycle cost assessment was conducted considering the retained value of assets and materials at end-of-life, instead of focusing only on capital costs, operational costs and maintenance costs.
- Design for disassembly: A building materials passport document was issued for the project so that building components could be identified and accessible in the future. The use of standardized, modular elements were also prioritised over tailor-made solutions, increasing the utility of the components in the future of the building or to use in other projects.

Circl, The Netherlands

Description: Circl is a pavilion in Amsterdam's Zuidas district created to be energy efficient and easy to disassemble, as well as to make as little impact as possible on the planet. Many of the things used to build Circl have already had a previous life. Other raw materials – from the wood used in its construction to the aluminium on its outer walls – can be put to new uses in the future.[62]

Adoption of CE principles:

- Design for disassembly: designed with reversible connections between the building super-structure elements to easily reuse and modify spaces in the future. A disassembly manual document for the building was circulated to stakeholders in other stages, providing instructions to effectively disassemble different components. A Building Materials Passport document was issued for the project so that building components could be identified and accessible in the future.
- For its construction, the use of reclaimed components was maximized for all building layers. It used concrete with high secondary content, recycled from by-products of other industrial processes.
- The project designers switched to "renting" through PaaS instead of purchasing the components that were expected to have a short or medium service life for this particular project.
- A whole life-cycle cost assessment was conducted considering the retained value of assets and materials at end-of-life, instead of focusing only on capital costs, operational costs and maintenance costs.

[61] See online: https://ce-toolkit.dhub.arup.com/case_studies/37 and https://www.arup.com/projects/gasholders
[62] See online: https://circl.nl/themakingof/en/ and https://ce-toolkit.dhub.arup.com/case_studies/41

Example 13. BimCrone

Description: A cloud platform that creates a digital twin of the project, making all phases of the building lifecycle traceable, from planning to demolition. It collects all data related to project processes and ensures that this information is shared securely with project stakeholders.[63]

Adoption of CE principles:

- Share real-time transparent information about materials and methods chosen, clearly specifying circularity elements to all project stakeholders.
- Record decisions by designers that are relevant to constructors or operations and maintenance stakeholders.
- Access information on how to further improve circularity in a project.

Example 14. E10/Rv85 PPP Road, Norway

Description: The project was chosen by the Norwegian Public Roads Administration to challenge the construction industry in terms of sustainability during the construction and operation phase. The goal is to halve project CO2 emissions and develop new measures and solutions for greener road construction and operation. [64]

Examples of green requirements for this project:

- A quantified minimum level of greenhouse gas reduction.
- Requirements for a binding greenhouse gas budget with bonus and sanction schemes.
- Enable possibilities for further CO2 reductions during the contract period.
- Consistent focus and requirements for sustainable implementation, linked to the UN's sustainability goals.
- Rewarding of innovative implementation that can provide further climate and environmental benefits.

Example 15. EcologiQ Program, Australia

Description: The program runs initiatives to support builders, designers, contractors and industry in increasing the use of recycled materials over recycled counterparts. Tenderers commit to the use of recycled materials and report on material and product use during construction for measurement and follow-up.[65]

Adoption of CE principles in projects, including:

- M80 Freeway Upgrade (from Sydney Road to Edgars Road): This includes 100% recycled capping material.
- Mordialloc Freeway: For instance, noise barriers made from 75 per cent recycled plastic collected from households across the state.
- Duncans Road Werribee: For instance, using plastic bags and ink toner from 13,000 print cartridges to resurface a road.

[63] See online: https://bimcrone.com/

[64] See online: https://www.vegvesen.no/vegprosjekter/prosjekt/halogalandsvegen/nyhetsarkiv/e10-halogalandsvegen-kan-endre-hele-bransjen/ [65] See online: https://bigbuild.vic.gov.au/__data/assets/pdf_file/0003/647265/EcologiQ-Brochure.pdf

[65] See online: https://bigbuild.vic.gov.au/__data/assets/pdf_file/0003/647265/EcologiQ-Brochure.pdf

- Kororoit Creek Road Level Crossing Removal Project: for instance, using recycled glass sand from bottles and jars, instead of freshly quarried sand, as bedding fill material for combined service routes, as well as backfill for drainage piping.
- Wyndham Vale Train Stabling Yard: For instance, a Level Crossing Removal Project which trialled railway sleepers made from recycled plastic, instead of concrete.
- East Boundary Road in Bentleigh East: For instance, a section of this was laid with asphalt made of crumb rubber from used tyres.

Example 16. Green Loans, France Recovery Program, France

Description: As part of France Recovery program (“France Relance”), the financing group Bpifrance supports SMEs and mid-caps to finance ecological and energy transition projects. Loans are granted for a period of 2 to 10 years, without guarantee on the assets of the company, not on the assets of the manager.[66]

CE objective:

- Optimise processes, or improve performances (energy, water, material) to better control or reduce the impacts on the environment, including CE processes.
- Promote zero-carbon mobility for employees, goods and products
- Innovate to bring to the market products or services in terms of environmental protection, CE and/or to allow a reduction in the consumption of resources renewable or not.
- Promote a more virtuous energy mix by integrating more renewable energy.

Example 17. Green Giant Project, Uzbekistan

Description: Green Giant is the initiative that SkyPower has developed for the Republic of Uzbekistan. This project will enforce the solar PV industry in the Republic of Uzbekistan and will be focused on sustainable development.[67] The capital investment amounts to USD 1.3 billion, and can be split into:

- One crystalline solar PV module fabrication and assembly factory, producing 400 MW of solar panels per year, along with a world-class manufacturer.
- 1,000 MW of solar PV capacity to support the Republic of Uzbekistan objectives in renewable energies, from 2020 to 2022. In the first two years, 300 MW will be installed each year, while in 2022, 400 MW will be installed.

Example 18. Tajikistan Pamir Private Power Project

Description: The Pamir Energy PPP project was designed to utilize the existing Government hydropower assets under private sector management under a 25-year concession agreement in the year 2002 to complete the 28 MW hydropower plant by adding 14 MW new capacity and upgrade some existing generation capacity. The project was made operational in 2006.[68]

Example 19. A6 Motorway Expansion, Germany

Description: The A6 project is a 47.2km motorway widening from 2 lanes in each direction to 3 lanes in each direction plus an emergency lane. A 30 year concession for the project was awarded to Via6West a consortium, comprising Hochtief PPP Solutions, Johann Bunte and

[66] See online: https://www.aides-entreprises.fr/aide/10321?id_ter=100

[67] See online: https://skypower.com/2020/09/21/solar-energy-providing-power-to-grow/

[68] See online: https://unece.org/fileadmin/DAM/ceci/documents/2016/PPP/Forum_PPP-SDGs/Presentations/Case_19_Tajikistan__Energy_Sector__Daler_Jumaev.pdf and https://projects.worldbank.org/en/projects-operations/project-detail/P075256

DIF in early 2017 and the construction is expected to be completed in 2022. The project saved 250.000 m^3 worth of virgin materials.[69]

[69] See online: https://via6west.de/2020/02/06/neue-verwendung-fuer-alten-asphalt/

Adoption of CE principles:

- During the construction phase, 100% of the existing motorway pavements was recycled when constructing the new 3 lane motorway. This resulted in higher percentages of recycled asphalt being added to all pavement layers, with the exception of the wearing course. As this is currently not enabled directly by German standards, extensive tests and calculations were undertaken by pavement specialists to demonstrate that the new pavement is of equal quality and longevity to those specified in the existing standards.

Example 20. Additive Manufactured (AM) structural nodes

Description: Technique for producing structural steel elements for buildings through 3D printing, also called Additive Manufacturing (AM). It is designed to maximises efficiency with minimum material input. This technique was first developed to build a trio of large tensegrity structures for street lighting project in The Hague, the Netherlands.[70]

Adoption of CE principles:

- Production of smaller, lighter structural steel elements that deliver the same function and strength as those created through traditional methods but reducing the amounts of materials needed.

Example 21. EcologiQ Program, Australia

As example 16 above

Example 22. Eurasia Tunnel in Istanbul, Turkey

Description: The first submarine tunnel crossing Bosphorus will provide an important transportation link between the European and Asian sides of Istanbul. The Eurasia Tunnel Project commenced construction in 2011 on a Build-Operate-Transfer contract for 30 years and completed in 2016.[71]

Adoption of CE principles:

- Slurry from construction activity was treated during the construction of the project to reuse bentonite for the tunnel boring machine during excavation the tunnel.

- The project was designed with a rainwater collection system to irrigate of landscape areas during the operations and maintenance stage.

- yearly targets are set to recycle waste and wastewater during the operational stage of the tunnel.

Example 23. Espiño Tunnel, Spain

Description: building 8.1 km of rail bed for the new high-speed railway line linking Madrid and Galicia, within the 7.9 km Espiño Tunnel.[72]

Adoption of CE principles:

- Pyrite (FeS2) and heavy metals were found during excavation of the right-hand bore of the Espiño tunnel in Orense (Galicia). In order to treat the pyrite material from the tunnel, Ferrovial is applying a customised artificial soil solution called “Tecnosol” (a type of technical soil). The “Tecnosoles” are produced locally (in Galicia) using 70 % of non-hazardous recycled waste. According to projections, approximately 35,000

[70] See online: https://ce-toolkit.dhub.arup.com/case_studies/s2
[71] See online: https://www.unece.org/fileadmin/DAM/ceci/documents/2018/PPP/Forum/Documents/Case_Study_Database_2018.pdf and https://www.avrasyatuneli.com/en/corporate/why/benefits-of-the-project
[72] See online: https://www.ferrovial.com/en/business/projects/espino-tunnel/

tons of technical soil will be used for a total of 1.2 million cubic metres of excavated materials.

- Wastewater generated during excavation was collected in basins and vertical tanks for treatment. Most of this water was then reused on site, thereby considerably reducing the volume of water collected from rivers or underground sources.

Example 24. Quito Metro, Equador

Description: 22 km of tunnel that will constitute Quito's first metro line, in Ecuador. The Line 1 Quito Metro Consortium is executing Phase II of the first line of the Ecuadorian capital's metro.[73]

Adoption of CE principles:

- The project has encouraged the reduction, reuse and recycling of materials and waste generated during the construction**.** For example, leftover wood has been donated to the local community for various activities: carpentry, guitar making, furniture and wood ovens for panela making.

Example 25. Sydney Metro, Australia

Description: 22 km of tunnel that will constitute Quito's first metro line, in Ecuador. ACCIONA, through the Line 1 Quito Metro Consortium, is executing Phase II of the first line of the Ecuadorian capital's metro. The project will connect the South, Centre and North of the city in 34 minutes, with 18 six-carriage trains.[74]

Adoption of CE principles:

- The project has encouraged the reduction, reuse and recycling of materials and waste generated during the construction**.** For example, leftover wood has been donated to the local community for various activities: carpentry, guitar making, furniture and wood ovens for panela making.

Example 26. Scottish Water, UK

Description: Maintenance was needed of two hundred metres of national sewage system in Scotland, which included two pipe bridges across North Calder Water, to reduce the risk of pollution.[75]

Adoption of CE principles:

- Scottish Water deployed an innovative approach to the repair and refurbish the sewer structure, by wrapping it in a carbon fibre and epoxy coating. This technique helps to strengthen the original structure and negates the need to replace the whole length of a pipe whilst retaining the value of the original structure and material.

Example 27. Ballybane wind farm, Ireland

Description: The foundations of the onshore farm needed maintenance to keep the stability of the turbines. The turbines are held in place by a steel "can" embedded into a concrete foundation. Balvac was contracted to repair and reinforce this concrete, helping to keep the turbines secure and ensuring they continue to produce energy.[76]

Adoption of CE principles:

- Balvac removed damaged concrete from the "can", using precise drilling to access the base of the foundation. They strengthened the remaining concrete by injecting a

[73] See online: https://www.acciona.com/projects/metro-quito/?_adin=02021864894
[74] See online: https://www.acciona.com/projects/metro-quito/?_adin=02021864894
[75] See online: https://www.scottishwater.co.uk/-/media/ScottishWater/Document-Hub/Key-Publications/Energy-and-Sustainability/200120SustainabilityReport2019.pdf
[76] See online: https://www.balfourbeatty.com/projects/#item_3525

specialist epoxy resin. Lastly, the structures were then reinforced and protected from future damage using corrosion inhibitors and specialist sealants.

Example 28. Green Solution House, Denmark

Description: A pioneering green hotel and conference centre with a big focus on sustainability.[77]

Adoption of CE principles:

- Green Solution House was designed for disassembly through the Cradle-to-Cradle concept, so that it would support the eventual reuse or recycling of building components at the end of the asset's lifecycle.
- Local waste glass was recycled to make a paved walking path in the Green Footprints Park. The glass was tumbled in a cement mixer to soften sharp edges sharp edges before being applied as a smooth and glittering glass path.
- During construction, chips and dust from granite cutting were recycled to use in the construction of the parking lot.
- During its operational life, Green Solution House recovers energy on-site, with a pyrolysis plant, solar thermal plant and integrated photovoltaics. All food scraps and organic materials from the main building are fed into the stationary pyrolysis plant for this process. The process heats the waste, breaking it down to produce natural gas and biochar, which is valuable as a soil additive for the gardens. The gas is combusted in a combined heat and power engine, generating heat and electricity for the building.
- During its operational life, water from the sinks and toilets in the main building is recycled on-site. The first stages of purification are hidden below ground, after which the system emerges into view and is assisted by sunlight and LED lighting. Here, the water flows through algae tubes that absorb CO2 and continue the water cleansing process.

Example 29. Green Solution House, Denmark

As example 28 above

Example 30. Integrated Waste Management Plant (PIVR), Spain

Description: The Integrated Waste Management Plant (PIVR) of Sant Adrià de Besòs includes two plants; The WTE Plant, managed by TERSA, and the Mechanical-Biological Treatment (MBT) Plant, managed by Ecoparc del Mediterrani.[78]

Adoption of CE principles:

- The MBT plant processes unsorted wastes for recycling, and organic materials for composting, and for the production of a small fraction of energy through anaerobic digestion (AD). The residues of the MBT are mixed with non-recyclable municipal solid waste and are processed in the WTE plant.
- The WTE plant processes 360,000 tonnes of municipal waste per year to produce about 195 GWh of electricity, and over 125,000 tonnes of steam that is used for district heating and cooling.

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[77] See online: Reference: https://gxn.3xn.com/project/green-solution-house and http://grafisk.3xn.dk/files/permanent/GreenSolutionHouseENG.pdf

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Annex III.

[English only]

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