Guidance on Increasing NDC Ambitions through Circular Action

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Contents

Abbreviations and acronyms

AFOLU	Agriculture, Forestry, and Other Land Use
BaU	Business as Usual
BTR	Biennial Transparency Reports
BTX	Benzene/Toluene/Xylene
CC	Climate Change
CE	Circular Economy
EMF	Ellen MacArthur Foundation
EPR	Extended Producer Responsibility
ETF	Enhanced Transparency Framework
EU	European Union
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GST	Global Stocktake
IEA	International Energy Agency
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
LTS	Long-Term Strategy
LULUCF	Land-use, land-use change and forestry
MCA	Multi-criteria Analysis
MRV	Measurement, reporting and verification
NCCC	National Climate Change Committee
NDC	Nationally Determined Contribution
NIR	National Inventory Reports
UNDP	United Nations Development Program
UNEA	United Nations Environment Assembly
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WRI	World Resources Institute

Introduction

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Background

The triple planetary crisis of climate change, biodiversity loss, and pollution calls for innovative and comprehensive approaches and ambitious targets. On climate change, the Paris Agreement was adopted in 2015 with the goal to limit the temperature increase well below 2°C above pre-industrial levels, while pursuing the limit of temperature increase to 1.5°C. According to a 2023 report however, full implementation of current national climate action pledges, known as Nationally Determined Contributions (NDCs), would still leave the world on track for a 2.5-2.9°C temperature rise.[1] The first Global Stocktake (GST), which concluded at the 28th Conference of the Parties (COP 28) in December 2023, stressed that countries are not on track towards achieving the Paris Agreement temperature goal. The stocktake outcome document explicitly encourages sustainable lifestyle, production, and consumption efforts.[2]

The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement […] notes the importance of transitioning to sustainable lifestyles and sustainable patterns of consumption and production in efforts to address climate change, including through circular economy approaches, and encourages efforts in this regard;

UNFCCC (2023): Outcome of the first global stocktake

1 UNEP (2023): Emissions Gap Report 2023
2 UNFCCC (2023): Outcome of the first global stocktake

Climate change is expected to affect regions across the globe with more intense and more frequent extreme weather events, such as heatwaves, heavy precipitation, droughts, and tropical cyclones. However, climate change impacts are not felt equally across the world or within a country, with the most vulnerable communities often being disproportionately affected.[3] Globally, those economies, which are most vulnerable to the effects of climate change often emit small amounts of greenhouse gas (GHG) emissions and might not have the means to adapt to climate change impacts. In 2020, the top six emitting parties plus international transport accounted for 55% of GHG emissions.[4]

In the last years, literature has pointed out that GHG emission targets, including the Paris Agreement goals, cannot be reached without Circular Economy (CE) measures.[5] The Ellen MacArthur Foundation (EMF) outlined that 45% of global GHG emissions are associated with the manufacturing of products such as food, cars and clothes.[6] The 2024 International Resource Panel's Global Resources Outlook estimates that the extraction and processing of material resources like fossil fuels, minerals, non-metallic minerals and biomass causes more than 55% of global GHG emissions. The report also observes that from a per capita perspective, high income countries use six times more materials and are responsible for ten times more climate impacts when compared to low-income countries. In a scenario of absolute decoupling of human well-being from resource use, emissions could decrease by more than 80% by 2060, the report estimates.[7]

CE is gaining recognition as a strategy to increase climate ambitions. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) is the first one, which highlights the specific contributions of CE for achieving climate mitigation goals, in particular in industrial production. There is ample untapped potential to reduce GHG emissions through more upstream measures across all sectors, such as material efficiency, substitution of materials and technical solutions, which could lead to a reduction in GHG emissions of ca. 4.9 Gt CO_2eq/year at global level.[8]

CE approaches often come with reduced investment costs when compared to other GHG mitigation pathways, such as substitution of fossil fuels by renewable energy sources.[9] Circular measures can also contribute to climate change adaptation. For example, the removal of contaminants from wastewater

3 IPCC (2022): Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change
4 UNEP (2022): Emissions Gap Report 2022
5 Trinomics and EDF Europe (2023): The climate mitigation potential of the circular economy; Wang, K., Costanza-van den Belt, M., Heath, G., Walzberg, J., Curtis, T., Barrie, J., Schroder, P., Lazer, L. and Altamirano, J. C. (2022): Circular economy as a climate strategy: current knowledge and calls-to-action
6 Ellen MacArther Foundation (2019): Completing the picture: How the circular economy tackles climate change
7 IRP (2024): Global Resources Outlook 2024
8 IPCC (2022): Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Figure TS.23
9 T., Khandekar, G. & Robson, I. (2018): Industrial Value Chain - A Bridge Towards a Carbon Neutral Europe; Dechema (2017): Technology study: Low carbon energy and feedstock for the European chemical industry

allows to reuse this treated wastewater in areas threatened by increasing water scarcity due to climate change. Additionally, CE measures can generate benefits beyond climate adaptation or mitigation, and help to achieve policy objectives, such as decreasing environmental pollution and creation of sustainable jobs.[10]

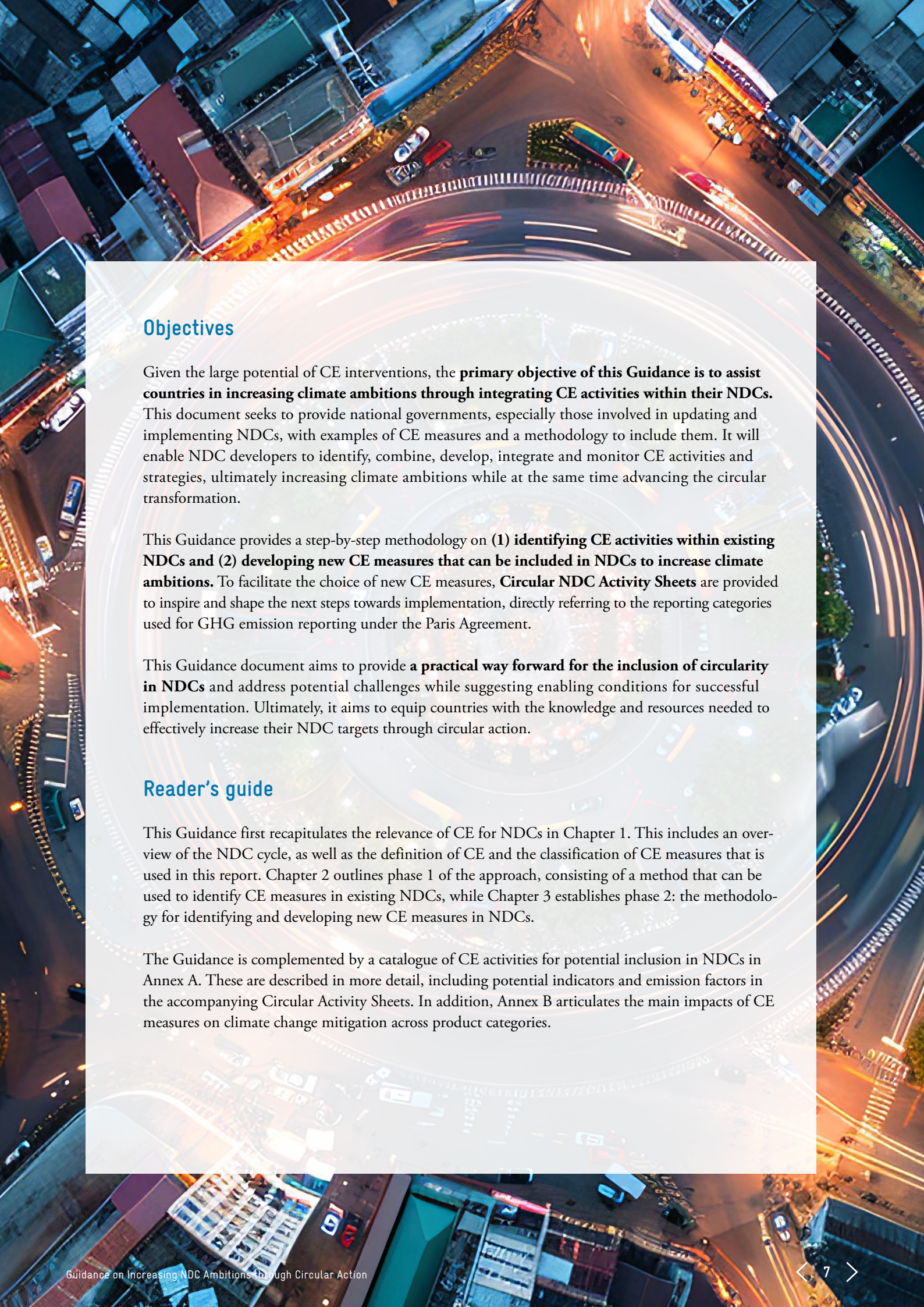
NDCs are main instruments of national climate policies. They set out national commitments on climate change and outline the corresponding climate change actions to achieve these commitments. All Parties to the Paris Agreement, which includes 194 countries and the European Union, are required to outline their commitments in NDCs. Their ambitions are expected to be increased at least every five years. Despite the strong potential of CE activities for achieving climate goals, only about a quarter (or 28%) of NDCs include CE components; these are mostly limited to measures in waste management and waste-to-energy measures.[11]

Added value of the present Guidance

International agencies have already started to advise on enhancing the circular perspective of NDCs and other climate processes. The **2023 UN Toolbox on Building Circularity into NDCs**[12] outlines a four stages process for identifying, prioritizing, implementing and tracking CE interventions in NDCs. For each of these steps, the toolbox suggests activities and refers to suitable methodologies, tools and additional resources. The present Guidance complements the UN Toolbox by offering one distinctive approach for analysing existing NDCs and identifying additional circular climate measures without the need to consider supplementary tools and resources. It focuses on the context of emerging and developing economies and is accompanied by Circular Activity Sheets. These describe potential circular measures to be considered in the next NDC update, including suggested indicators, co-benefits and emission factors where available.

The present Guidance builds on the 2021 **GIZ report "Circular Economy as a Cornerstone for Meeting the Goals of the Paris Agreement"**.[13] The report describes why CE measures are indispensable for reaching climate goals and how they can close the gap between the required and the planned GHG emission reductions. It also includes a roadmap towards CE-smart NDCs considering key policy instruments and actors as well as financial resources. The present Guidance complements this document through an even stronger focus on integrating circular action into standard NDC planning and reporting processes.

10 WRI (2021): 5 Opportunities of a Circular Economy
11 UNFCCC (2023): Nationally determined contributions under the Paris Agreement: Synthesis report (see Fig.12/p.37); Note: The figure increased by 1% compared to the 2022 version of the rep ort
12 UNEP, UNDP and UNFCCC secretariat (2023): Building Circularity into Nationally Determined Contributions (NDCs) - A Practical Toolbox User Guide.
13 GIZ (2021): Circular Economy as a Cornerstone for Meeting the Goals of the Paris Agreement



Objectives

Given the large potential of CE interventions, the **primary objective of this Guidance is to assist countries in increasing climate ambitions through integrating CE activities within their NDCs.** This document seeks to provide national governments, especially those involved in updating and implementing NDCs, with examples of CE measures and a methodology to include them. It will enable NDC developers to identify, combine, develop, integrate and monitor CE activities and strategies, ultimately increasing climate ambitions while at the same time advancing the circular transformation.

This Guidance provides a step-by-step methodology on **(1) identifying CE activities within existing NDCs and (2) developing new CE measures that can be included in NDCs to increase climate ambitions.** To facilitate the choice of new CE measures, **Circular NDC Activity Sheets** are provided to inspire and shape the next steps towards implementation, directly referring to the reporting categories used for GHG emission reporting under the Paris Agreement.

This Guidance document aims to provide **a practical way forward for the inclusion of circularity in NDCs** and address potential challenges while suggesting enabling conditions for successful implementation. Ultimately, it aims to equip countries with the knowledge and resources needed to effectively increase their NDC targets through circular action.

Reader's guide

This Guidance first recapitulates the relevance of CE for NDCs in Chapter 1. This includes an overview of the NDC cycle, as well as the definition of CE and the classification of CE measures that is used in this report. Chapter 2 outlines phase 1 of the approach, consisting of a method that can be used to identify CE measures in existing NDCs, while Chapter 3 establishes phase 2: the methodology for identifying and developing new CE measures in NDCs.

The Guidance is complemented by a catalogue of CE activities for potential inclusion in NDCs in Annex A. These are described in more detail, including potential indicators and emission factors in the accompanying Circular Activity Sheets. In addition, Annex B articulates the main impacts of CE measures on climate change mitigation across product categories.

1

Reporting climate impacts of Circular Economy

1.1 NDCs as the locus to communicate Circular Economy contributions to Climate Action

1.1.1 Processes for the communication, monitoring and reporting of NDCs

The NDCs function as high-level documents communicating national commitments on climate action. Article 4(2) of the Paris Agreement mandates that Parties have an obligation to prepare, communicate and maintain successive NDCs, which should allow to evaluate progress to achievement of the goals of the Paris Agreement. Each subsequent NDC has to be more ambitious than the previous. Countries are encouraged to communicate their NDCs with a 10-year forward-looking time horizon, although the types of targets can vary between countries according to Article 4(4) of the Paris Agreement.

To ensure increased ambition in NDCs over time, a feedback mechanism was created under the Paris Agreement (see Figure 0-1). NDCs are the first step, and countries can revise their NDCs at any point. The feedback to encourage increased ambition takes place via the Global Stocktake (GST) - the first of which took place at COP28 in 2023. The GST aims to assess the collective progress towards the achievement of the Paris Agreement goals. To do so, information from NDCs, national biennial reports, latest science, including from the IPCC and non-Party views are considered. Based on this collective assessment, countries are asked to update their NDCs within less than two years, after the GST.[14]

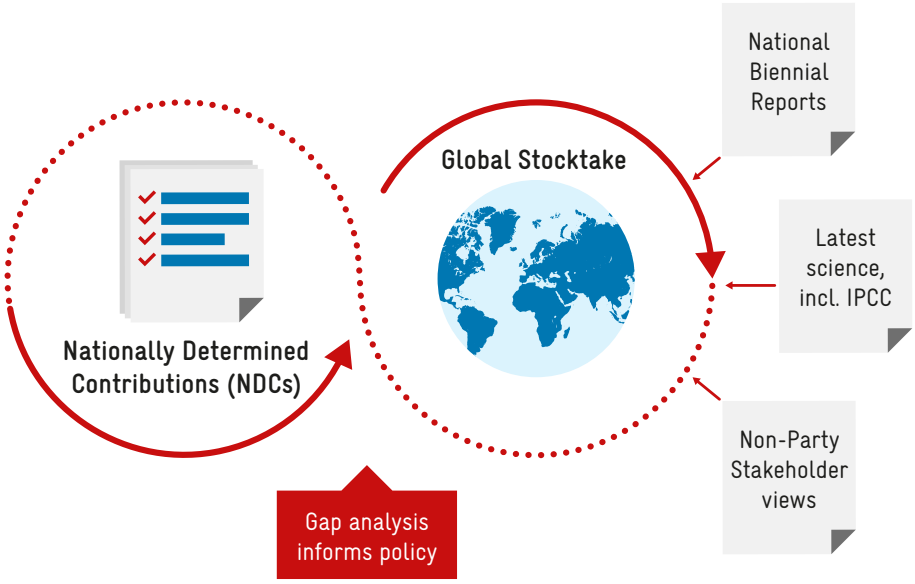


Figure 1-1: Feedback mechanism for increased NDC ambition

As the NDCs are nationally determined, countries are given freedom in which format they communicate their NDC to the United Nations Framework Convention's on Climate Change (UNFCCC) Secretariat, which then publishes it in the NDC Registry.[15] At the same time, there is Guidance provided on what information should be included in NDCs to facilitate their clarity, transparency and understanding.[16] It identifies requirements that have to be included, such as quantifiable information, information on time-scales, scope and coverage of the commitments, as well as assumptions and methodological approaches.

Monitoring and Reporting

Over time, a solid measurement, reporting and verification (MRV) system has been developed under the UNFCCC, which allows for monitoring of GHG emissions per country and provides an understanding of climate change action. In this Guidance document, the monitoring and reporting requirements of NDCs refer to the system established by the Paris Agreement, which

14 For this first cycle it will be in early 2025 – nine to twelve months before COP30 in 2025
15 UNFCCC (no date): NDC Registry
16 UNFCCC (2018): Decision 4/CMA.1. Further guidance in relation to the mitigation section of decision 1/CP.21

expanded the UNFCCC MRV system to the Enhanced Transparency Framework (ETF), in order to build mutual trust and confidence and promote implementation. The ETF expands the reporting requirements to all countries, while also considering that not all countries have equal capacities for measuring and reporting GHG emissions and climate policies. For the purposes of NDC monitoring and reporting, two reports, to be submitted by countries, are particularly relevant: the National Inventory Report (NIR) and the Biennial Transparency Report (BTR).

In BTRs, countries have more freedom than in NIRs to communicate CE actions and how they contribute to climate change mitigation and adaptation.

The NIRs estimate both GHG emissions and removals from sources and sinks in a given year. These reports allow for an identification of the sectors, sources and activities responsible for GHG emissions, as well as GHG emissions and removal trends. There are rigid requirements regarding the modalities, procedures and guidelines of NIRs.[17] They follow a pre-defined structure and the estimations of GHG emissions and removals have to be carried out in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines).[18] GHG emissions and removals have to be reported in the following source and sink categories: (1) energy, (2) industrial processes and product use (IPPU), (3) agriculture, (4) land-use, land-use change and forestry (LULUCF), (5) waste and (6) other. While CE activities can often be categorised according to the IPCC guidelines, the set reporting requirements can limit country ability to specify CE measures in their NIRs. Circular measures might cover more than one of these categories. In these cases, the reporting structure divides integrated approaches into individual sector impacts. In addition, the effects of circular upstream measures including policy and regulation interventions are not always reflected in the reporting format.[19]

In BTRs, countries have more freedom to communicate CE actions and how they contribute to climate change mitigation and adaptation. The BTRs are submitted every two years and are much broader in scope than the NIRs[20] and include information on the tracking of progress in implementing and achieving NDCs.[21] In order to track progress made towards the achievement of NDCs, countries are requested to pick and develop indicators in BTRs. These could address CE actions and countries could use them to clearly communicate how CE activities are contributing towards the achievement of their NDC.

1.1.2 Rationale for including Circular Economy measures in the framework of NDCs

CE measures bear the following features:

- They can generate considerable savings in GHG emissions and increases in carbon sequestration, comparable to the decarbonization of the energy sector, often at small investment costs, even if with a greater need for policy coordination and enforcement;[22]
- Depending on the specific climate risk context, they can significantly contribute to enhance adaptation to the impacts of climate change;
- In particular CE upstream measures have a much broader scope than end-of-pipe measures (e.g. waste management) and cover the whole life-cycle of products;
- Their effects spread to a large number of the sectors (generally in the early stages of value chains) which are covered by IPCC reporting.

17 UNFCCC (2019): Report of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on the third part of its first session, held in Katowice from 2 to 15 December 2018. Addendum 2. Part two: Action taken by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement

18 IPCC (2006): IPCC Guidelines for National Greenhouse Gas Inventories; Countries do have the choice of using the 2019 Refinement to the 2006 Guidelines

19 GIZ (2021): Circular Economy as a Cornerstone for Meeting the Goals of the Paris Agreement

20 The first BTR and NIR, if submitted as a stand-alone report, has to be submitted by 31 December 2024 at the latest

21 UNFCCC adopted guidance can be found in COP Decision 18/CMA.1, 'Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement'

22 Material economics (2018): The Circular Economy – A powerful force for climate mitigation; EJP Soils (2021): Synthesis on estimates of achievable soil carbon sequestration on agricultural land across Europe; Ontl, T. A. and Schulte, L. A. (2012): Soil Carbon Storage

It should also be noted that the pathway towards net-zero GHG emissions, required by the Paris Agreement, needs to address emissions from "hard to abate" sectors, as the abatement of GHG emissions in the energy sector alone will not be sufficient. Such sectors include the GHG-intensive industrial sectors, generally at the start of the value chain, that manufacture the primary basic metals (steel, aluminium, other non-ferrous metals), chemicals (including the monomers that constitute the building blocks of polymers, e.g. in plastics) and minerals (glass, ceramics, cement) as well as agriculture.

In conclusion, integrating CE measures into the framework of NDCs presents a compelling opportunity to address multiple aspects of climate change mitigation and adaptation. Taking a CE approach to the entire product life cycle makes a valuable addition to traditional climate action efforts.

1.1.3 Where and how the Guidance supports NDC processes

Figure 0-2 provides an overview of where this Guidance supports and complements the NDC and overall climate reporting processes. Notably, it provides a methodology for identifying CE activities and measures in already communicated NDCs. The Guidance's Circular Activity Sheets support both the preparation of NDCs providing information on how and which additional CE activities and measures could be included in an NDC update and the respective reporting process, also providing ideas for CE-related indicators that could be used for the tracking of NDC achievement.

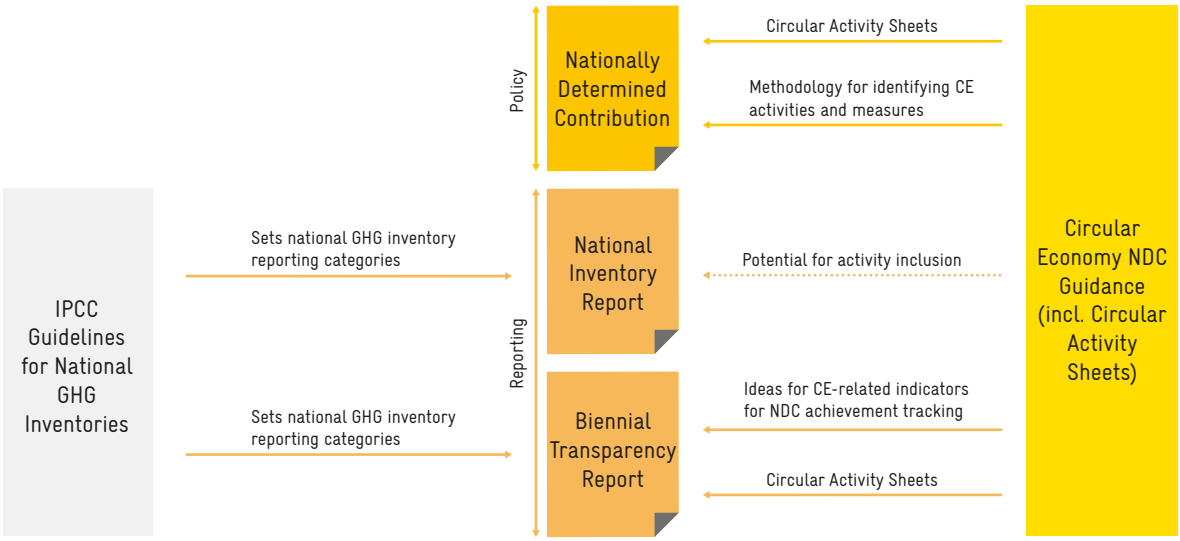


Figure 1-2: Guidance's support and complementarity to the NDC process

Some of the studies that estimate the benefits of CE action for climate change mitigation suggest methodologies that do not match the IPCC guidelines sector classification. The impacts of CE actions could be reported in multiple sectors as set by the IPCC guidelines.[23] This is a challenge, but this Guidance can support the classification of CE activities within these set categories and consequently aid countries in providing a clearer picture in how CE activities contribute to climate change mitigation and adaptation.

23 Trinomics (2018): Quantifying the benefits of CE action on the decarbonization of EU economy

1.2 Circular Economy: definition, classification and impacts on climate change mitigation

1.2.1 General definition of Circular Economy

The United Nations Environment Assembly (UNEA), in its Resolution of 2019 on "Innovative pathways to achieve sustainable consumption and production"[24] and recalled in its Resolution of 2022 on "Enhancing circular economy as a contribution to achieving sustainable consumption and production",[25] defines Circular Economy as:

> *"One of the current sustainable economic models, in which products and materials are designed in such a way that they can be reused, remanufactured, recycled or recovered and thus maintained in the economy for as long as possible, along with the resources of which they are made, and the generation of waste, especially hazardous waste, is avoided or minimized, and greenhouse gas emissions are prevented or reduced."*

1.2.2 Classification of Circular Economy measures aligned with climate change mitigation

CE is a broad concept that applies to a large number of measures across economic sectors, along product value chains and along the lifecycle of products and services. In order to keep a clear understanding and overview of the CE measures to consider and to implement, it is important to rely on a classification system for CE measures.

> *The proposed classification focuses on GHG mitigation effects. For the sake of consistency, the same classification is also used for adaptation measures.*

Several such classification systems exist in the literature.[26] This Guidance re-uses an existing classification of CE measures[27] that is aligned with mitigation of GHG emissions. For the sake of consistency, the same classification will be used for CE measures with a primary impact on adaptation, despite their different effect mechanisms (see section 1.3).

Under this classification system, all CE measures in a given category share the following features:

- the physical phenomenon, for instance "increase in material efficiency" or "increased lifetime" leading to a reduction in GHG emissions is the same, so that
- the method to obtain a quantitative assessment of the potential for reduction in GHG emissions is based on that same phenomenon

24 United Nations Environment Assembly of the United Nations Environment Programme, Fourth session, Nairobi, 11–15 March 2019: Resolution 4/1. Innovative pathways to achieve sustainable consumption and production UNEP/EA.4/Res.1, available at: https://www.unep.org/environmentassembly/unea-4/proceedings-report-ministerial-declaration-resolutions-and-decisions-unea-4

25 United Nations Environment Assembly of the United Nations Environment Programme Fifth session Nairobi/ Resolution adopted by the United Nations Environment Assembly on 2 March 2022 5/11. Enhancing circular economy as a contribution to achieving sustainable consumption and production UNEP/EA.5/Res.11, available at: https://www.unep.org/environmentassembly/unea5/unea-5.2/outcomes-resumed-session-unea-5-unea-5.2

26 (i) The 9R approach: 9 Rs stand for refuse, reduce, reuse, repair, refurbish, remanufacture, re-purpose, recycle, and recover: Trinomics (2018): Quantifying the benefits of CE action on the decarbonization of EU economy;
(ii) The RESOLVE classification proposed by the Ellen McArthur Foundation. RESOLVE stands for: REgenerate, Share, Optimise, Loop, Virtualise, Exchange: Ellen MacArthur Foundation, Sun, and McKinsey Center for Business and Environment (2015): Growth Within: A Circular Economy Vision for a Competitive Europe
(iii) The 4 categories system of CE proposed by the Joint Research Centre of the European Commission: European Commission, European Innovation Council and SMEs Executive Agency, Zibell, L., Petsinaris, F., Smit, T. et al. (2022): Impacts of circular economy on EU climate policies – Mitigation and adaptation

27 European Commission, European Innovation Council and SMEs Executive Agency, Zibell, L., Petsinaris, F., Smit, T. et al. (2022): Impacts of circular economy on EU climate policies – Mitigation and adaptation

Box 1-1: Circular Economy applied per category of product

Existing definitions of CE have the merit of conciseness. When dealing with specific resources however, it helps to adapt the definition:

- When the resource is the purpose of a naturally existing regeneration cycle, as it is the case for water and for the nutrients in soils that feed plant and animal life, the purpose of a CE is to sustain and maintain this cycle, and to ensure that it operates with no irreversible losses;
- When the resource is non-renewable, as it is the case for all mineral-based resources, no natural cycle exists. The purpose of a CE is then to artificially create such a cycle, so as to limit the extraction of new resources, to keep the mineral-based resource already extracted as long as possible in the economy, and to minimise the generation of irrecoverable waste, with the ultimate and ideal goal that this cycle be infinite.

These purposes are summarised in the table below.

Category of products	Purpose of Circular Economy, when applied to this category of products
Mineral-based (a-biotic) products (e.g. buildings, cars, domestic appliances)	Maintain the products and materials in use for the longest possible duration
Food and feed products	Return the largest possible share of nutrients back to agricultural or forestry soils
Durable plant-based (biotic) products (e.g. paper, cardboard packaging)	Maintain the products and materials in use for the longest possible duration (often in cascading uses of the material) **and** Return the largest possible share of nutrients back to agricultural or forestry soils
Water	Minimise the extraction of water from natural reservoirs (groundwater, rivers, lakes, wetlands) **and** Maximise the restitution of clean water to natural reservoirs (groundwater, rivers, lakes, wetlands)

The main impacts of circular approaches per category of product on the mitigation of climate change, including a description of the underlying phenomenon, suggested IPCC reporting categories, data needs and reference studies are provided in Annex B – Main impacts of Circular Economy on GHG mitigation, per category of products

The simple model behind this classification is the following:

1. a given **need in society,** at a given **service level,** is satisfied by the availability of a given **stock** of **durable goods;**
2. the maintenance of this stock depends on a **yearly flow** of incoming new goods – and of outgoing discarded goods;
3. the **GHG emissions** caused by that yearly flow of new goods is the result of the **multiplication** of: (number of units / year) x (mass of material / unit) x (GHG emissions / kg of material).

Each category of the classification acts on one element of this model:

- the GHG emissions per kg of material;
- the mass of material / unit;
- the number of units / year needed to maintain the stock;
- the size of the stock,
- the service level provided by the stock.

The categories of this classification of CE measures, aligned with GHG mitigation and with this simple model, are the following:

1. Increase material efficiency in production and other processes along the lifecycle
2. Reduce service level to reduce size and mass
3. Increase usage intensity
4. Increase lifetime
5. Reduce the amount of materials used to perform a function at constant service level
   - 5.1 Substitute a technical solution by a more material-efficient one
   - 5.2 Reduce mass of a final product or service
6. Reduce the share of non-renewable primary metals, materials or chemicals in each item
   - 6.1 Increase share of biobased materials
   - 6.2 Increase share of secondary materials
7. Measures included in this classification can be complemented by enabling CE measures such as:
   - 7.1 Behavioural measures and awareness campaigns
   - 7.2 Capacity building
   - 7.3 Finance and business support
   - 7.4 Research and development

Table 1-1 below provides for each category in the classification:

- The source of the reduction in the emissions of GHG emissions caused by the CE measures belonging to that category;
- the locus of action, in the simple model, of the CE measures of that category;
- A few examples of CE measures belonging to that category. These examples are illustrative of measures that are effective in mitigating climate change.

Table 1-1: Relation between categories in the classification of CE measures aligned with GHG mitigation of climate change and the source of reduction of GHG emissions that its implementation generates – with concrete examples

Category of Circular Economy measure	Source of the reduction in GHG emissions	Locus of action of the CE measure in the model (all others being constant)	Examples of CE measures belonging to this category
1. Increase material efficiency in production and other processes along the lifecycle	Reduced consumption of materials through reduction of waste during production and other lifecycle processes – with no change made to the material	Resource used per kg of material	Reducing cutting waste in textile production Optimized design and manufacturing processes Avoidance of food losses
2. Reduce service level to reduce size and mass	Reduced consumption of materials per unit manufactured	Service level	Campaign to reduce the consumption of a final product or service Reduce the surface per person of new buildings Limit the power of personal cars
3. Increase usage intensity	Reduced number of units in the stock of durable goods to deliver the same service to society, and hence lower production of durable goods per year to sustain that stock	Size of the stock	Car-sharing Textile services = renting + washing of linen
4. Increase lifetime	Longer duration of durable goods in the stock, and hence lower production of durable goods per year to sustain that stock	Number of units / year needed to maintain the stock	Longevity by design Deposit refund schemes for packaging Public support for second-hand shops or repair cafés Modular design for easier replacement of parts
5. Reduce the amount of materials used to perform a function at constant service level			
5.1 Substitute a technical solution by a more material-efficient one	Substitute products or services with high material use by a functionally equivalent number of products or services with a significantly lower material use	Mass of material / unit	Use a combination of public transport + bicycle instead of personal car Substitute animal-based food with plant-based food
5.2 Reduce mass of a final product or service	Reduced consumption of materials per unit manufactured		Reduce over-specification in the construction of buildings

Category of Circular Economy measure	Source of the reduction in GHG emissions	Locus of action of the CE measure in the model (all others being constant)	Examples of CE measures belonging to this category
6. Reduce the share of non-renewable primary metals, materials or chemicals in each item			
6.1 Increase share of sustainably-sourced biobased materials	Substitute materials with high GHG emissions by a functionally equivalent quantity of materials with significantly lower GHG emissions	Resource used per kg of material	Production of organic fertiliser to replace mineral-based fertilisers Replace steel beams with wooden beams in construction
6.2 Increase share of secondary materials			Increase the share of waste that is prepared for recycling or re-use Avoid irreversible assembly methods, such as gluing Mandate a minimum share of recycled content in products
7. Enabling CE measures	various	n/a	Information campaign on the benefits of CE
7.1 Behavioural measures and awareness campaigns			
7.2 Capacity building			
7.3 Finance and business support			
7.4 Research and development			

1.3 Main impacts of Circular Economy on adaptation to climate change

Accumulation of GHG emissions in the atmosphere will lead to continuous climate system changes, even if the global community succeeds in ambitious climate change mitigation. Accordingly, communities and ecosystems need to adapt to climate risks posed by changes in long-term climate patterns, as well as in the intensity and frequency of extreme weather events. This is also highlighted by the Paris Agreement: One of its core aims under Article 2 is to increase the ability to adapt to the adverse impacts of climate change and foster climate resilience, while under Article 7 a global goal on adaptation is established.[28]

When compared to climate mitigation, the contribution of CE to climate adaptation is much less studied. Adaptation measures are highly dependent on the local context, as climate risks and vulnerabilities depend on geographical, social, economic, and other factors, so they require individual approaches and context-specific prioritisation. The IPCC has developed a climate risk framework, which defines climate risk as a result of interacting hazards, vulnerabilities and exposure.[29] In Assessment Report 6 (AR6) the IPCC elaborates on this to integrate the complexity of climate risks, which includes aggregate, compound and cascading interactions (see Figure 1-3 where compound interactions are denoted with "▶" and "◀▶", while aggregate interactions are denoted with "+").

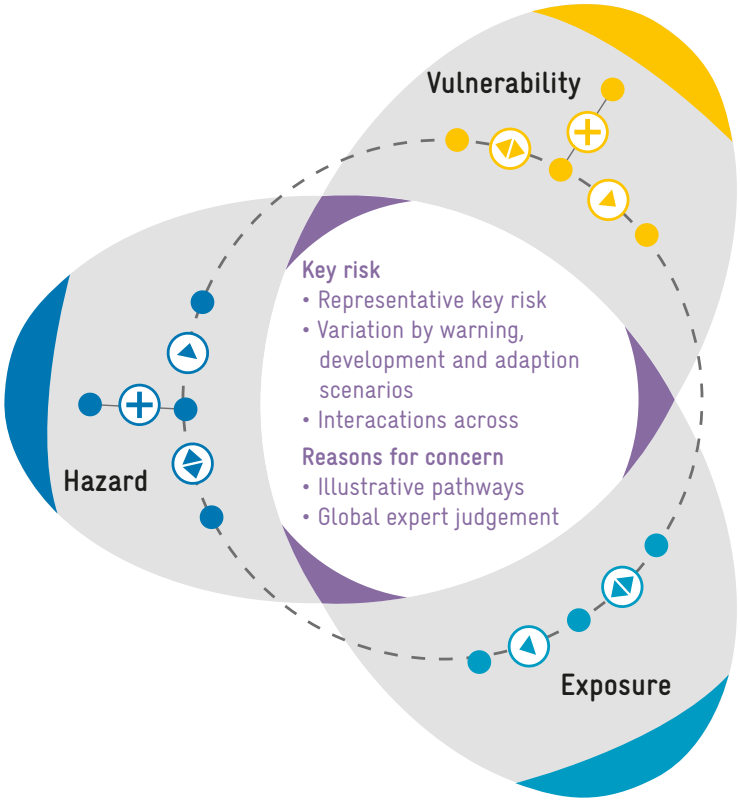


Figure 1-3: climate risk framework, including interactions[30]

For instance, in mining areas threatened by increased flooding due to climate change (hazard), vulnerability can be reduced by decreasing the economic dependence on these raw materials and creating jobs in material recycling, replacing mining activities in the long term. Climate adaptation activities need to directly address a specific impact of climate change and/or climate variability, such as decreasing total precipitation or more frequent heat waves.

28 UNFCCC (2015): COP Decision 1/CP.21 'Adoption of the Paris Agreement', UN Doc. FCCC/CP/2015/10/Add.1
29 IPCC (2022): Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, page 143-158
30 IPCC (2022): Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, page 145

Another illustration is the reduction of pollution and removal of contaminants from wastewater, which could allow to reuse treated wastewater and recover by-products in areas threatened by water scarcity and/or shortage of nutrients due to climate change and variability.[31]

Depending on the specific local context, the following circular activities provide examples, which might reduce climate risks and can therefore contribute to climate change adaptation:

- With the objective to reduce vulnerability to climate change induced water stress:
  - Wastewater reuse e.g. for agricultural irrigation, including the recovery of nutrients;[32]
  - Reduction in the volume of water used in the production processes of other material goods; per unit produced of that good;
  - Diverting waste from landfilling to recycling, avoiding environmental and groundwater pollution in areas threatened by increasing water scarcity.
- With the objective to reduce vulnerability to climate change induced food insecurity:
  - Sustainable production practices that promote nutrient diversity have the potential of promoting a 'circular nutrient economy', i.e., the consideration of nutrient flows in food systems to enhance food and nutrition security, as well as food system resilience;[33]
  - Regenerative agricultural practices, as they can stabilise soil thus reducing the need for freshwater and allowing for adaptation to increasing resource scarcity.[34]
  - Use of local materials and regenerative agricultural practices can improve resilience to global supply chain shocks due to increasing climate variability.
- With the objective to reduce vulnerability to climate change induced intense precipitation events:
  - Removal or prevention of the ingress of waste or debris into wastewater drainage systems, preventing flooding.

There is no universally agreed metric or unit to assess the wide range of adaptation measures, comparable to CO_2 equivalents (CO_2eq) used for mitigation. The risk framework approach helps to outline the impact chain between circular adaptation measure and its effect on reducing climate risks, compared to a scenario without the respective measure.

As noted above, this Guidance will apply the CE categorization used for mitigation introduced in chapter 1.2 also for adaptation actions, despite their different approaches and metrics.

Potential trade-offs and synergies between mitigation and adaptation activities should always be considered. At a first glance, it is possible for adaptation measures to have a negative impact on GHG emissions, as their implementation could increase the consumption of materials and resources.[35] Additionally, CE measures in urban systems can have positive synergies with adaptation; at the same time, it appears that CE mitigation measures in industry have synergies or trade-offs with adaptation.[36]

31 IPCC (2022): Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, page 146
32 IPCC (2022): Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, page 631
33 IPCC (2022): Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, page 1111
34 Elobeid, E. and Schnitger, M. (2023): Bridging the adaptation gap: can the circular economy help?
35 Englund, M. and André, K. (2021): A circular economy: a tool to bridge climate mitigation and adaptation?
36 IPCC (2022): Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, page 2786

2

Identifying Circular Economy measures in existing NDCs

2.1 Process overview

This initial phase aims to determine if, and to what extent, CE measures were already considered in existing NDCs. This serves the purposes to increase the awareness and knowledge of NDC developers on circularity and how circular action already contributes to achieving climate targets. The approach also helps to identify entry points to establish links to CE policies, and/or gaps to fill. The results can then inform the next phase of this Guidance, namely of identifying new CE measures (see Chapter 3).

This phase is designed for NDCs, which include lists of concrete activities, measures or actions. In some cases, these lists are included as annexes or additional documents to an NDC. For NDCs, which estimate emission savings for individual measures, the analysis can be enriched by indicating the share of GHG emission mitigation that can be linked to CE measures.

This phase is designed for NDCs, which include lists of concrete activities, measures or actions.

The validity of the result depends on the level of detail of the individual measures description. General measure descriptions might not provide clear results: for instance, "increasing efficiency" of industrial production might or might not include circular activities, while "increasing material efficiency" of industrial production does signal a CE measure.

The results of this circularity check can vary, depending on the individual interpretation and knowledge of the specific measures. In addition, activities in certain fields such as renewable energies are not considered as CE in this Guidance as they usually represent standard climate mitigation approaches. However, users of the methodology might prefer to apply a different interpretation of circularity.

The methodology in this phase is structured into two steps, plus an optional third step, laid out in Figure 2-1. below. It is recommended to fill Form 1 as a guiding instrument for steps one and two.

The types of tasks and staff requirements for this phase include desk research, quantitative and qualitative analytic skills as well as an understanding of the NDC policy landscape. Understanding of policies related to CE and their implementation is recommended. The robustness of the screening options can be enhanced by having more than one person performing the assessment individually.[37]

The required resources and tools to accomplish this phase are:

- The most recent NDCs; complementarily, previous NDCs can support a better understanding of the evolution related to CE (Steps 1 and 2)
- Form 1 to report and summarize the screening of the NDC (Steps 1 and 2)
- (Optional) Overview of the CE related policy agenda, its goals, objectives and initiatives. Most likely this can be sourced from CE strategies/roadmaps/action plans. (Step 2)
- (Optional) Background documentation/reporting and calculation of the NDC to better understand the scope and impact of the identified CE measures. The NDCs themselves often do not contain this in-depth information (Step 3).

37 In this case, these people would best operate independently and compare results only in the end.

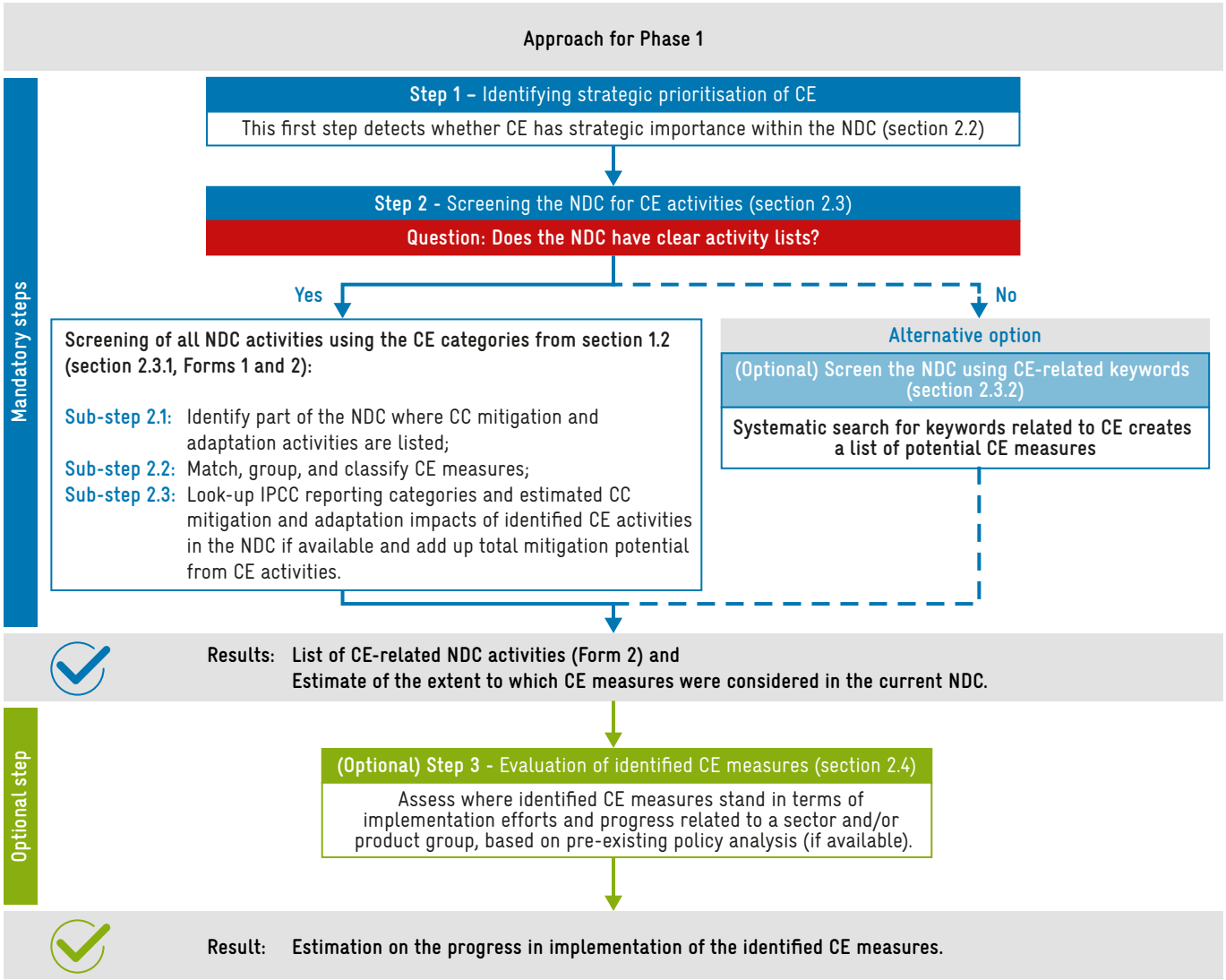


Figure 2-1: Schematic overview of the steps of Phase 1

2.2 Identifying the strategic priority of Circular Economy in an NDC (Step 1)

This first step concerns detecting whether CE has strategic importance within an NDC. A simple approach is to identify whether circularity or CE are mentioned as a policy priority in the summary or strategic part or in other parts of the NDC that present highlights. This can be done by searching for the keywords "circular" and "circle" in these parts. Ideally, this claim should be supported by reference to national policies or strategies in the field of CE. It should then be marked whether the NDC strategically prioritizes CE in Form 1.

If circularity is an important element within overarching climate change mitigation or adaptation strategies this would also be reason to identify the NDC as strategically circular. However, might CE only be discussed as something which is identified as something that could support GHG mitigation as a small additional remark for a specific sub-theme or NDC activity, then this should not be considered "strategic".

Might this step reveal that CE is not recognised at a strategic level while it is present in the measures or activities (see the next step), then this might be an indication that the successful implementation of the NDC could benefit (in terms of policy support and coordination) from acknowledging this importance also at the strategic level in a next update.

Result: *The strategic priority of CE in the NDC is determined (mark accordingly in Form 1).*

2.3 Screening the NDC for Circular Economy activities (Step 2)

This next step consists of a recommended methodology, and an optional alternative methodology, which support the identification of the state of Circular Economy activities in the current NDC:

Form 1: Circularity Checklist Form for existing NDCs

General information

UNFCCC Party: .....

Date: .....

☐ INDC ☐ First NDC

☐ Second NDC ☐ Updated First NDC

Step 1: Strategic level

Circular Economy is considered at strategic level: ☐ yes ☐ no

If yes, in which part and how:

.....

Step 2: NDC Activities Screening

List of activities/measures/actions included: ☐ yes ☐ no

If yes, in which part (e.g. main text, annex, additional document):

.....

.....

If no, was the keyword search method from current 2.3.2 used? ☐ not applicable ☐ yes ☐ no

If also no, was any other method used to identify CE measures in the NDC? ☐ yes ☐ no

Explanation:

>> **List circular activities if available in table 2-1**

Circularity

Total estimated GHG mitigation from CE measures: ..... tonnes CO_2eq

Total estimated GHG mitigation from all measures: ..... tonnes CO_2eq

Estimated GHG mitigation circularity: ..... %

Notes/explanation:

.....

.....

- The standard approach for the screening is to compare the list of mitigation and adaptation activities included in an NDC to the CE categories which were presented in section 1.2;
- An alternative approach is to perform a keyword search on the NDC.

For NDCs, which do not present activities in a recognizable manner, it might not be feasible to identify CE activities.

***Tip:** If screening is not possible, then the user of this Guidance is recommended to continue to Chapter 3 to start the process of reflecting on the role CE could play in their country's NDC.*

2.3.1 Screening of all NDC activities using the CE categories established in section 1.2

The standard approach to screening of NDC activities on CE measures consists of the following sub-steps, which can also be followed by going step-by-step through Forms 1 and 2:

Sub-step 2.1: Identify in which part of the NDC the climate change mitigation and adaptation activities are listed, e.g. in the main text, in an annex, or in an additional document, or possibly at several places.

Sub-step 2.2: Match, group, and classify CE measures using Form 2

- Check if the NDC activities correspond to any of the CE categories presented in section 1.2.2. If this is not clear, mark them as "potential".
- Assign each validated CE measure to:
  - the category of the CE measure classification provided in section 1.2.2 above;
  - the economic sector or group to which the activity is allocated in the NDC (e.g. construction, transport, industry, agriculture).

Sub-step 2.3: If included in the NDC, note down the estimated CO_2eq emission impact and IPCC reporting category (e.g. energy, agriculture or waste) of each identified activity and/or the potential impact on climate change adaptation in Form 2. Note that:

- Might estimates of CO_2eq emission impacts of the NDC activity be unavailable, the CO_2eq emission impact column can be left empty. As an optional alternative, the user might follow the approach for estimating CO_2eq impacts of a measure explained in section 3.5;
- A brief overview of potential impacts on adaptation of CE activities is provided in chapter 1.3, and can serve as support.

Activities can also be counted as partly circular, if they combine several actions, some of which are considered circular.

If the circularity of individual measures is unclear and no additional information is available, it is recommended to estimate the circularity of the measure. Activities can also be counted as partly circular, if they combine several actions, some of which are considered circular.

***Results:** List of CE-related NDC activities is created and extent to which CE measures were considered is assessed.*

2.3.2 Systematic keyword search (optional alternative for step 2)

Several NDCs do not include clear activity lists. In this case, a keyword-based screening might allow identifying CE elements of the NDC. Through the systematic search for keywords related to the CE, such as 'composting' or 'repair', a list of potential CE measures will be composed. A list of keywords for NDCs in English can be found in Table 2-1 below. The keyword search can follow the same approach as the activity search presented above, also using Form 1, adding identified activities to the first column.

In this case, it is suggested to capture – where applicable – additional information on the potential CE measure detected by a keyword in the "additional information" column in Form 2, e.g. the context or an explanation, why it complies with CE principles.

Case Study Colombia NDC

Colombia issued their First NDC update in 2020. The NDC clearly acknowledges the relevance of circularity for achieving climate and development goals and supports this statement through several circular activities across sectors. In the update, Colombia positions CE as a strategic cross cutting issue, explicitly acknowledging the negative impact of linear resource management. The NDC refers to the National Circular Economy Strategy and describes CE as a key tool for GHG mitigation across all economic sectors (p. 4).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The Colombia NDC lists specific activities for both GHG mitigation and adaptation to climate change. These lists include several measures, which can be considered fully or partly circular, covering several parts of the material and product cycle. One activity on waste management aims among other targets at the increased recycling of paper, cardboard and plastics from urban solid waste and the flaring and utilization of biogas at the main landfill of Bogotá. An adaptation activity seeks to reusing 10% of treated wastewater by 2030, increasing water use efficiency, also contributing to economic and environmental benefits. Using the categories introduced in the Guidance section 1.2.2, both measures could be classified under category 6 "Reduce the share of non-renewable primary metals, materials or chemicals".

Three GHG mitigation activities in the transport sector are considered circular, as all of them would substitute a technical solution by a more material-efficient one (category 5.1). The individual transport NDC measures aim at increasing the use of bicycles, sustainable transport in cities and the rehabilitation of a railroad track. Additional partly of fully circular activities in the updated Colombia NDC are included in construction (sustainable cement production), agriculture (sustainable cattle farming) and other sectors.

The NDC shows how circular approaches can already drive climate action, making Colombia a forerunner for circular climate action in the region. Existing circular measures provide a solid foundation for further enhancing circularity in the next update, which will be coordinated and agreed among all involved ministries and stakeholders.

Source: Gobierno de Colombia (2020): Actualización de la Contribución Determinada a Nivel Nacional de Colombia (NDC)

This list will be validated through filtering and structuring. Based on a qualitative manual check, the list of potential CE measures identified via keywords will be validated by filtering out false positives, i.e. those measures detected via the keywords that do not relate to CE. The additional information will help to determine CE measures, on the one hand, and false positive measures or activities, on the other hand. Optionally – if necessary and available – additional background documentation on the NDCs can be used in this step.

Only those potential CE measures that are detected as false positives by a majority of the persons performing the filtering would be removed from the list.

Result: *List of potential CE activities in the NDC is created (Form 2).*

Case Study Egypt NDC

The Republic of Egypt is expected to be severely threatened by the impacts of climate change, such as droughts and intense weather events. Although the country contributes only 0.63% of global GHG emissions (1990-2021), Egypt prioritized climate change early, ratifying the UNFCCC in 1994. Egypt published its Intended Nationally Determined Contribution (INDC) in 2015, which became the country's first NDC after ratifying the Paris Agreement in 2017.


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The second update of the NDC took place in June 2023, and aims to reduce GHG emissions from electricity by 37%, from oil and gas by 65% and from transport by 7% by 2030 compared to a BaU scenario and conditional on international support. The current NDC covers the period 2015 – 2030 and is aligned with several key development and climate change policies, including among others its Sustainable Development Strategy and Integrated Solid Waste Management Strategy.

The NDC does not specifically mention Circular Economy. However, many of the activities included are fully or partially circular. In the oil and gas industry section for example, a programme calls for the introduction of 75,000 tons of biodegradable plastic bags per year. In the transport sector, the NDC covers several public transport measures including metro, monorail and bus networks, complying with the Guidance category 5.1 to substitute a technical solution by a more material-efficient one. It also contains actions to enhance the solid waste management infrastructure, increasing recycling and closing uncontrolled dump sites. In terms of adaptation, the NDC considers circularity for example in the construction of wastewater treatment plants for reuse.

In summary, Egypt's NDC shows how circular approaches can drive GHG mitigation and adaptation to climate change. The development of the National Circular Economy Strategy provides an opportunity for Egypt to further integrate circularity through alignment at the strategic and individual activity levels.

Source: Government of Egypt (2023): Egypt's Second Updated Nationally Determined Contributions

Table 2-1: Keywords per category of Circular Economy measure

Life cycle stages	Keyword
Design	Repair / maintenance instructions
	Product label
	Digital Product Passport
	Eco-modulation
	Single use
Extraction	Sustainable soil management
	Organic fertiliser
	Regenerative agriculture
	Biobased
	Sustainable soil management
Manufacturing	Wood-based construction products
	Composite materials
	Material efficiency
	Material content
	Assembly / Dis-assembly
	Reducing raw material usage
	Process losses
	Process yield
	Cover crops
	Crop rotation
Distribution and Retail	Deposit Refund
	Reverse Logistic
Consumption/Use	Reuse
	Up-cycling
	Multiple use
	Sharing economy
	Maintenance
	Diet change (Meat, Plant-based food)
Collecting and Sorting	Separate waste collection
	Waste flow
	Waste sorting
Recycling and waste management	Recycling
	Anaerobic Digestion
	Composting
	Waste management
	Waste water/wastewater treatment
	Agriculture biowaste
	Digestate
	Extended Producer Responsibility

Form 2: Table to capture information on existing Circular Economy activities (Phase 1 – steps 2 and 3)

Step 2: Screening the NDC for Circular Economy activities						Step 3 (optional): Evaluation of identified Circular Economy measures		
Identified CE measure as part of the NDC (sub-step 2.2 or alternative approach using keywords)	**CE category** (see 1.2.2, or list "n/a" if not possible to identify) (sub-step 2.2)	**Economic Sector or group as indicated in the NDC** (sub-step 2.2)	**Estimated GHG mitigation in tCO_2-eq** (if available) (sub-step 2.3)	**IPCC mitigation reporting category** (if available) (sub-step 2.3)	**Estimated adaptation impact** (if available) (sub-step 2.3)	Mode of implementation; e.g. "policy", "by-law enforce-ment" or "state project"	Progress of implementation; e.g., not started / infancy / mid-term / finalized)	Identified limitations, challenges and bottlenecks

Box 2-1: Identifying and describing activities in NDCs without details

In case NDCs lack a listing of individual activities, or the estimated GHG mitigation or adaptation effect of activities are not described, there is an option to perform desk research based on additional national mitigation and/or adaptation plans. These plans support the NDC climate change objectives and often include more details on specific measures and their estimated impacts.

Concerning mitigation, that analysis could start from the identification of the NIR or BTR categories where the biggest GHG emission reductions would take place. As a rule-of-thumb, one could estimate what the biggest (sub-)categories are, which would be responsible for the majority of the remaining emission reductions in the NDC (see Box 3-1 in section 3.2 below for more guidance). The source for this kind of information often concerns sectoral mitigation plans, which could be linked to one of the identified potential CE categories from section 1.2. When it comes to adaptation, it is worth to look at National Adaptation Plans (NAP), if they exist.

2.4 Evaluation of identified Circular Economy measures (Step 3, optional)

This optional step proposes to further analyse the measures identified, validated and structured under Steps 1 and 2. This will serve the purpose of understanding the scope of the measure, its level of application as well as its effectiveness. This step also aims to derive lessons-learnt that might inform the reporting process. That information could contribute to the formulation or update of additional CE measures as described in chapter 3.

The present evaluation has a focus on assessing, where the identified CE measures stand in terms of their implementation efforts and progress. Due to this step requiring a developed level of pre-existing policy analysis regarding CE measures, it is recommended only (and conditional to) when there is interest and availability of information on the progress of the individual measures or CE policies.

Based on pre-existing policy analysis it can be defined on the one hand, if and how a CE measure is implemented, e.g. through a certain project, programme, initiative or policy, and on the other hand, to which extent has this measure been implemented. The last three columns of Form 2 above are meant for providing an overview of the analysis of this step. However, might comprehensive information lack, or might detailed desk research be out of reach, then a summary of the key points describing overall implementation progress and common challenges can be added instead in a separate table.

This analysis can be enriched by spotting for which CE measures limitations, challenges and bottlenecks have occurred. Such information might be present in background documents as part of the policymaking process informing NDC development. Ad-hoc expert interviews might provide the necessary insight. Also, BTRs might contain relevant information in this regard.

Result: *Implementation progress of the identified CE measures is assessed (Form 2).*

Identifying and developing new Circular Economy measures for NDCs

3.1 Process overview

3.1.1 Introduction

The second and final phase aims to develop new CE measures that will enhance NDC ambitions. Identifying areas where NDCs could benefit from more consideration of circular approaches requires care. Discrepancies can occur between NDCs and current CE policies in a country. On occasion the former can be more ambitious or claim things not yet warranted by the latter or vice-versa.[38] In addition, NDC priorities and individual measures are usually not set by the coordinating ministry (usually the Ministry of Environment) alone. In many cases, sector ministries determine the final NDC activities and their indicators, which requires a strong coordination effort when integrating new measures.

Some related methodologies have already been developed. For example, GAIA (2021) suggests a scoring methodology regarding waste sector ambitions in NDCs.[39] The UN Toolbox on Building Circularity into NDCs provides a process guidance and checklist, referring to a broad selection of tools for identifying, prioritizing, implementing and tracking circular activities for mitigating GHG emissions in NDCs.[40]

Steps 3 to 5 can be skipped if users prefer to conclude after step 2 or follow standard methodologies for the processes described in these steps.

3.1.2 Steps and requirements

To identify and integrate new CE measures which are relevant for a country's NDC, the current phase is structured into **five steps,** for which Figure 31 below gives an overview. While Step 1 and 2 can add significant climate impact at an early stage of NDC planning, Steps 3 to 5 can be skipped if users prefer to conclude after step 2 or follow standard methodologies already established in the respective countries for the processes described in these steps.

Step 1: Broad selection of potential new CE measures;
Step 2: Prioritization of potential new CE measures;
Step 3: Contextualisation of selected CE measures;
Step 4: Estimation of climate impacts of prioritized CE measures;
Step 5: Integration of the new CE measures into the UNFCCC reporting framework.

Based on the outcome from Steps 1 and 2, a list of prioritized CE measures is generated, which can be listed and complemented with further information from Steps 3 and 4 in Form 4. The result of Step 5 feeds directly into the national climate reporting process.

38 GAIA (2021): Wasted Opportunities: A review of international commitments for reducing plastic and waste-sector GHG emissions.
39 GAIA (2021): Wasted Opportunities: A review of international commitments for reducing plastic and waste-sector GHG emissions.
40 UNEP, UNDP and UNFCCC secretariat (2023): Building Circularity into Nationally Determined Contributions (NDCs) - A Practical Toolbox User Guide; See notably Step 2 of the Value Chain Approach of Stage 2.1 of the UN Toolbox Stage 2 – Learning for Nature

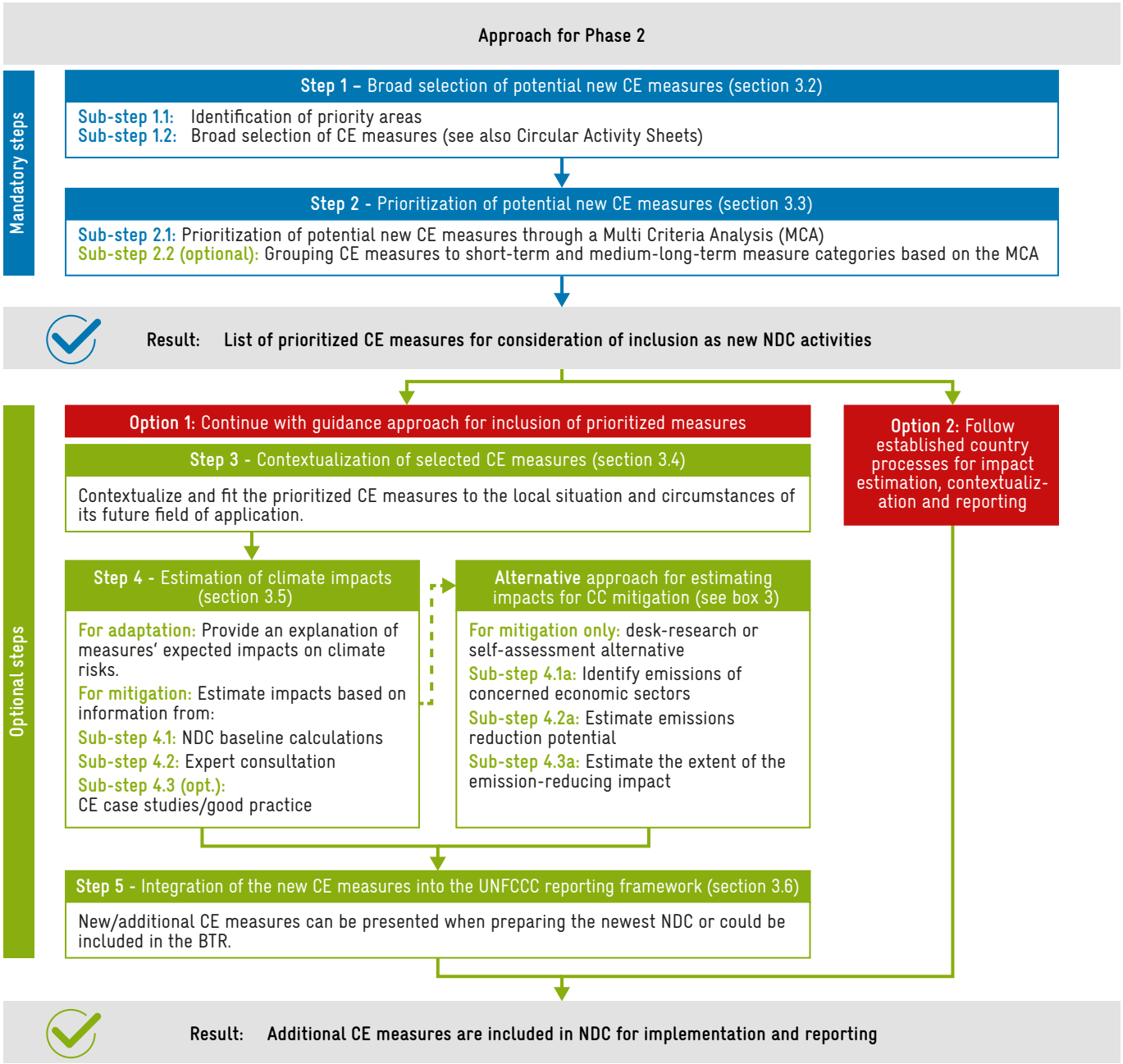

Figure 3-1: Schematic overview of the steps of Phase 2: Identification of new CE measures

The staff requirements for this phase and the resources and tools required to accomplish this phase concern the same resources as used for the first phase of this Guidance (see section 2.1 above), plus additionally:

- **Circular Activity Sheets,** accompanying the present Guidance
- **3 to 5 knowledgeable stakeholders,** particularly for steps 1 and 2 (identification of priority areas and joint measures prioritization)
- **Additional expert engagement** in particular for the more technical optional steps, in order to create a robust basis for identified CE measures to be reviewed by decision makers

3.2 Broad selection of potential new Circular Economy measures (Step 1)

This step assists NDC developers in gathering a variety of potential CE activities in relevant priority areas, part of which might be selected for the further process.

3.2.1 Identification of priority areas (Sub-step 1.1)

With the objective to narrow down the number of potential CE activities, a short-list of high-potential priority areas needs to be identified, which could be addressed in an NDC. A priority area is often a specific sector where the biggest gains are expected in terms of climate change mitigation and/or adaptation.

Some NDCs focus on overarching or cross-cutting priorities. When developing measures based on overarching priority areas it is recommended to assess whether they can translate into sector activities. In addition, it is recommended to consider alignments with relevant national CE policies.[41]

Some further advice on priority areas:

- Priority areas or sectors are usually discussed at national climate change fora and committees, such as National Climate Change Committees (NCCCs). It is assumed that users of the present Guidance are familiar with the country NDC process and its priorities. Current NDCs or accompanying documents often include an overview of adaptation and mitigation sectors and their estimated emission impact, the latter mostly referring to the IPCC categories;
- Might such priorities not be clear, then alternatively the country's most important economic sectors could be considered as a guiding element for the selection of priority areas.

Weaponed with this knowledge, the applicable high-potential areas can then be selected for further elaboration of the list of CE measures in the next sub-step. In addition, it is advised to check the latest NDC and BTR concerning estimated mitigation and adaptation (where included) impacts among sectors. Some sectors might lag in contributing to the climate objectives. CE measures might enable these sectors to essentially contribute to increasing overall NDC ambitions. Box 3-1 below offers further suggestions for priority areas. Depending on the available expertise and time, it is recommended to limit priority areas to not more than five.

Result: *High priority areas for NDC development are identified.*

3.2.2 Broad selection of Circular Economy measures (Sub-step 1.2)

The aim is to pre-select CE measures in the identified priority areas that seem effective, relevant, feasible and fitting to the country context. Concerning GHG mitigation, it is important that emissions reductions happen within the country. For instance, if parts of a product are imported, emission savings from the production of these parts cannot be included.

The accompanying Circular Activity Sheets provide a range of CE activities covering the construction, food, textiles, packaging, waste and other sectors describing their respective climate impacts and approaches for their reporting.

41 Caution was raised by one of the interviewees in the development of this Guidance that if additional or foundational CE measures are not representative of national policies, this reduces the chances of their implementation.

These can be used for the selection of CE activities, while additional activities can be added from other sources (see e.g. box 3-1) and expert knowledge.

The accompanying Circular Activity Sheets provide a range of CE activities across sectors describing their climate impacts and approaches for reporting.

As a basic approach for this broad selection, the user is advised to go through the Activity Sheets and other sources, focusing on the identified priority areas, and to pre-select those measures that seem to be feasible and effective in the national context. It is recommended to consult additional climate and/or sector experts who might be able to assist from their perspective. It is also advised to limit the number of potential measures to maximum five per priority area. Box 3-1 below offers further suggestions for measures with a 2030 time horizon.

Result: *Potential new CE NDC activities are selected for prioritization.*

Box 3-1: Potential CE-related NDC priority areas and associated measures with climate change mitigation impacts by 2030

Requirements exist for information to be included in NDCs, but parties are to a certain extent flexible on how to communicate these in the NDCs.[42] This box shows some ideas for both priority areas and corresponding CE measures with potentially strong mitigation potential by 2030, as reported by the World Resources Institute (WRI) in a recent review of the literature.[43] The measures' respective CE categories according to section 1.2 are added in brackets. Those activities, which are at least similarly covered in the Circular Activity Sheets include a reference to the respective sheet.

- In the construction sector:
  - reduce floor area per person (CE category: 2 - Reduce service level);
    → see Activity Sheet CON1: Reduction of individual space in buildings- reduce over-specification of concrete and steel usage (5.2 - Reduce mass of a final product or service);
    → see Activity Sheet CON4: Reduction of steel use through design adjustments
- in the automotive sector:
  - car sharing (3 - Increase usage intensity);
  - smaller, lighter vehicles (2 - Reduce service level);
  - lifetime extension (4 - Increase lifetime);
  - increased use of aluminum to reduce mass of vehicles (5.2 - Reduce mass of a final product or service);
- in the food system:
  - reducing food waste (1 - Increase material efficiency in production and other processes along the lifecycle);
    → see Activity Sheet AFN2: Food Waste Reduction
  - nutrient cycling: composting, regenerative agriculture, use of manure (6.1 - Increase share of biobased materials);
  - dietary change (5.1 - Substitute a technical solution by a more material-efficient one);
    → see Activity Sheet AFN3: Transition to a Plant-Based Diet
- in the plastics sector:
  - increase the use of recycled plastic (6.2 - Increase share of secondary materials);
    → see Activity Sheet PAC3: Increase discarded packaging sorting and recycling efficiencies
  - use of biobased plastics (6.1 - Increase share of biobased materials);
- in the textiles sector:
  - increase the duration of garment use (4 - Increase lifetime);
    → see Activity Sheet TEX1: Ecodesign requirements for increasing the lifetime of textile articles
  - increase textile recycling and usage of recycled fibres (6.2 - Increase share of secondary
  - materials);
    → see Activity Sheet TEX3: Fibre-to-fibre textile recycling for cotton textiles
- in the electronics sector:
  - recycle materials (6.2 - Increase share of secondary materials).

This overview of priorities might evolve over time. Still several knowledge gaps exist for assessing CE opportunities in the context of climate change, including due to cross-sectoral linkages, data gaps and feedback loops.[44]

42 See section 1.1: Requirements on information to be included in NDCs is included in UNFCCC Decision 4/CMA.1: 'Further guidance in relation to the mitigation section of decision 1/CP.21', UN Doc. FCCC/PA/CMA/2018/3/Add.1 This notably concerns the obligation to use the Modalities, procedures and guidelines for the transparency framework, defined in decision 18/CMA.1:, 'Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement', UN Doc. FCCC/PA/CMA/2018/3/Add.2

43 Wang, K., M. Costanza van den Belt, G. Heath, J. Walzberg, T. Curtis, J. Barrie, P. Schroder, L. Lazer, and J. C. Altamirano (2022): Circular economy as a climate strategy: current knowledge and calls to action. Working Paper. Washington, DC: World Resources Institute

44 IPCC (2022): Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Technical Summary, Box TS.12 (page 120)

3.3 Prioritization of potential new Circular Economy measures (Step 2)

Step 2 assists the user in prioritizing the gathered CE activities with the objective to select prioritized activities for NDC inclusion.

3.3.1 Prioritization of potential new Circular Economy measures through a Multi Criteria Analysis (Sub-step 2.1)

This sub-step aims to support the selection of most effective and relevant measures. To identify which measures those are, this Guidance proposes a simplified Multi Criteria Analysis (MCA) approach. The user is recommended to gather a preferably inter-disciplinary or at least inter-departmental expert group of 3 to 5 experts to discuss their individual ratings of the different criteria for the selected measures.

This Guidance suggests a range of criteria. However, users are encouraged to add additional criteria, which might be specifically relevant to the expert group or the specific context. The group might also decide to skip certain criteria, if appropriate. In case the impact of a given measure on a given criteria is unclear, the analyst can opt to score these criteria as "not applicable" (n/a).

Expert groups can decide to increase the weight of individual criteria, which they deem particularly relevant.

Expert groups might also want to highlight certain indicators by increasing their weight. For instance, a group might agree to double the relevance of a category, which they deem particularly important in the national context.

Information from the Circular Activity Sheets can help performing the MCA. Form 3 can be used for filling in activities as well as individual or combined average scoring. Guidance on how to interpret the suggested criteria and the recommended assessment method is provided in Table 31. A fictional example with three assessed activities from the Circular Activity Sheets is shown in Table 3-3.

Form 3: Template for CE Measures Prioritization MCA

Priority Area	Measure	(1) GHG mitigation	(2) Clim. Resilience	(3) Co-benefits	(4) Inv. costs	(5) Policy priorities	(6) Feasibility	(7) Delivery Time	(8) Int. Support	(9) Other (as decided by group)	Comments

Table 3-1: Suggested indicators used in the MCA

Prioritisation criteria	Indicator description	Recommended assessment method
(1) GHG emission savings	Only for mitigation measures: concerns the roughly estimated potential to directly contribute to climate change mitigation, through the respective GHG emission mitigation potential for carbon dioxide, methane, nitrous oxide and other GHGs.	Categorise estimated GHG emission impact from very high (++), medium (○) to very low (--) based on the informed expert judgement of (i) the size of current sector emissions, and (ii) the technological potential and ease for reduction.
(2) Changes in climate resilience of the target group or ecosystem	Only for adaptation measures: concerns effects relevant for human or ecosystem vulnerability or exposure to the impacts of climate change. A comprehensible impact chain should be conceived to explain how the measure might increase resilience	Use expert-based assessments of impacts on climate risk, taking into account climate change hazards and how the CE measure could interact with them. Categorize estimated reduction of climate risk from very high (++) to very low (--).
3) Co-benefits	Climate measures often come with additional environmental, economic or social co-benefits. Examples include the safeguarding of ecosystems, improved efficiency in production processes and the creation of jobs.	Use stakeholder and expert judgement to assess the number and relevance of co-benefits from very high (++) to very low (--).
(4) Investment costs	Defines the investment or capital costs that are required to implement a certain CE measure. Optionally, this could be complemented with operational costs where available.	Use expert judgement to differentiate between the measures on a scale from very capital intensive (--) to very low financial requirements (++)
(5) National policy priorities	This relates to whether the measure leverages or supports national policy goals (with either a direct link, or a less obvious connection which deserves recognition), and which may strengthen their strategic relevance.	Use policy expertise in the group to evaluate how measures contribute to existing policy priorities from very strong (++) to very little (--).
(6) Feasibility in the local context	Concerns the level of applicability given local circumstances, mostly determined by limitations in the precise specification of technical requirements placed on products or processes, on the monitoring of their implementation, and on the enforcement of rules.	Use the policy expertise of the MCA expert group to evaluate how applicable measures are in the national context from very feasible (++) to very unfeasible (--).
(7) Delivery time	Concerns an indication for the approximate timeline of the CE measure, including the preparation time before actual implementation as well as the anticipated timeline of application.	Use the policy expertise of the MCA expert group to evaluate whether measures are slow or fast to develop, e.g. due to capacity constraints, technical constraints or diligent procedures. Use a scale from very fast (++) to very slow (--).
(8) Potential for international support	This concerns whether there is availability of different kinds of international support, e.g., climate finance or support for technical capacity building.	Use the expertise of the MCA expert group to evaluate the existence and the applicability of different kinds of international support potentially available for the country, and to judge its relevance for successful implementation, from very strong (++) to very low potential (--).
(9) Other (as decided by group)	Add additional aspect if deemed relevant for prioritization by the group.	Rank impact from very positive (++) to very negative (--).

In order to prioritize measures based on these multiple criteria, which are expressed in different units and sometimes in qualitative terms only, the value for each assessment criterion should be translated into a simple qualitative scale (Table 3-2).

Table 3-2: Explanation of MCA scoring values

MCA-scale scoring value	Explanation: The criterion is met with …
++	the most favourable value
+	a favourable value
o	an average value
-	an unfavourable value
--	the least favourable value
n/a	criteria could not be assessed

Performing an MCA can generate discussion around the valuation of the different aspects for each of the measures. Through this discussion a shared understanding not only of the evaluation of each of the measures can arise, but also an understanding for the importance of the different criteria in the national context, which can already help in selecting measures.

The average group score per assessed criteria, possibly multiplied by the quantitative weights for each criterion, provides the result of the MCA ranking among the identified CE measures. The most favourable values appear at the top of the list, when ordered from the highest to the lowest total score. The top priority measures, e.g. two per category as decided by the group, could then be added to Form 4 below and further analysed for formal inclusion in the next NDC.

Result: *Prioritized CE measures for increasing climate ambitions are selected for NDC inclusion.*

3.3.2 Grouping of Circular Economy measures according to time frame (Sub-step 2.2, optional)

As diverse as CE measures are across sectors and in a value chain, the same applies for their requirements for successful application. Optionally, to come up with a selection of CE measures that has a wider level of impact, going beyond short-term solutions, additional categorisation according to the following two different measures' categories is recommended:

1. CE measures with a short-term delivery and low investment costs (low-hanging fruits), to be pursued before the next NDC update (within 5 years) and which could be reported in a BTR; and
2. CE measures with a medium-/long-term delivery and medium investment costs, that will also be a part of future NDC cycles as well as Long-Term Strategies (LTS).[45]

The grouping of measures under these two categories takes place through a simple filtering process.

Result: *Time frame of each measure is added (Form 4).*

45 LTS targets are set for the mid-century.

Table 3-3: Example of an individually filled MCA of CE activities for prioritization

Priority Area	Activity	(1) GHG mitigation	(2) Vulnerability	(3) Co-benefits	(4) Inv. costs	(5) Policy priorities	(6) Feasibility	(7) Delivery Time	(8) Int. Support	Comments (Motivation)
Construction	Reduce clinker, by substitute cementitious materials (CON_3)	+	--	o	-	++	+	+	-	(1) notable emission reducing impact for cement (2) no clear contribution (3) potential job creation in producing substitutes (4) high investment costs estimate (5) included in national cement strategy (6) proven technology used in other countries' NDCs (7) fast to apply in current facilities after limited training (8) little activities of foreign support for transitioning cement industries
Packaging	Switch to reusable packaging/reusable containers (PAC_2)	o	o	+	+	+	+	-	++	(1) medium GHG mitigation impact expected (2) less plastic waste could increase ecosystems resilience, but the impact chain seems too complicated to prove an impact (3) less pollution through less packaging waste, potential green jobs (4) low costs expected for regulations, awareness and facilities for reuse (5) country joined a regional initiative against plastic pollution (6) experience from neighbouring countries can help (7) long-term behaviour change is required (8) International packaging conference this year in country
Waste management	Anaerobic Waste Digestion (WAS_3)	+	+	+	o	++	+	+	+	(1) biogas can substitute fossil fuels (2) local energy production might reduce vulnerability (3) additional source of energy, job creation in waste management (4) medium investment costs estimate (5) National Waste Strategy & Nat. Methane Reduction Plan (6) proven technology already running in the country (7) facilities can be built with available materials by trained engineers (8) several international funds promote anaerobic digestors. (8) several international funds promote anaerobic digestors.

3.4 Contextualisation of selected Circular Economy measures (Step 3, optional)

To facilitate the implementation process, this step includes the exercise to contextualise the prioritised CE measures to the local situation and circumstances. This implies minor to medium changes in the design and implementation process of the CE activities to fit the national context.

Countries might use a standardized process for contextualisation, baseline and impact estimation of existing and new NDC measures, as well as for their reporting to UNFCCC. If this is the case, the user might prefer to skip this step as well as the following steps 4 and 5.

The contextualisation process shall include the identification of important elements and conditions that are required to ensure a successful and effective implementation. The findings should be part of the implementation plan of each measure.

This step can be based on:

- Results of feasibility studies that were conducted for the CE measures or related measures that can at least give an indication or proof of concept/potential;
- Lessons-learned of related measures implemented in the national context or implemented NDC measures.

A recommended way forward is the organisation of a consultation of country stakeholders, e.g. relevant sectoral or geographical administrative policymakers, and of experts in the application field of the CE measures.

Such a consultation process facilitates finding a robust basis for policy support in the country for the identified CE measures and their prioritisation. It might also help to start outreaching on these measures and priorities for further policy development. The most adequate option to start a consultation process depends among other factors on the extent (e.g., sectoral scale) of the CE measures, the geographical scale and complexity of country processes.

Result: *Additional information on the relevant national context for the prioritized CE measures is added (Form 4).*

3.5 Estimation of climate impacts (Step 4, optional)

In order to ensure a proper implementation of the CE measures as a part of an NDC, it is essential to (1) estimate a baseline or a Business as Usual (BaU) scenario for the emissions concerned, as well as (2) to quantify anticipated impacts of the selected CE measures related to climate change mitigation and adaptation in line with international standards. Sufficient reporting and tracking of progress need to be considered to support their implementation as well.

Adaptation measures require an explanation of their respective climate risk impact, comparing the specific climate change and variability scenarios with and without that specific measure implemented.

Mitigation measures should include an estimation of the GHG emissions arising from the value chain of the product or service of interest for the CE measure, by comparing:

- Baseline or BaU scenario; and
- Scenario with implementation of the CE measure.

For climate change mitigation a simplified approach to estimating baseline and anticipated impacts of the new CE measures is suggested:

Sub-step 4.1: NDC baseline calculations (where applicable);
Sub-step 4.2: Additional inputs from experts on CE policies and mitigation plans – e.g. by setting up an ad hoc working group of GHG mitigation experts – to assess expected emission impacts of the prioritized measures, and optionally;
Sub-step 4.3: estimations based on CE case studies, best practices and the Circular Activity Sheets.

If an internal expert consultation process is out-of-scope, Box 3-2 (below) provides an alternative, suggesting desk-research or as a minimum a "self-assessment" based estimation of the order of magnitude of climate change mitigation impacts of new CE measures.

Result: *Climate impacts of prioritized CE measures are estimated (Form 4).*

Box 3-2: Desk research or self-assessment-based alternative for estimating GHG mitigation impacts of new CE measures

Sub-step 4.1a: Obtain NDC baseline calculations and identify the GHG emissions of the concerned economic sectors at a reasonable level of detail (e.g. sub-sectors);

Sub-step 4.2a: Estimate the significance of the emissions, which would be reduced through the CE measures. Preferably, studies would already be available and known, which estimate the emission impact. Otherwise, expert self-assessment is needed to qualify the baseline emission, which would be addressed by the CE measure relative to the sectoral emissions as: Dominant (e.g. more than 50% of the sectoral baseline emissions; Significant (e.g. more than 25%), or Relevant (e.g. above 10%). Note that circular approaches might impact more than one sector. For instance, a decrease in cement use can reduce energy consumption as well as industrial production. Circular approaches in agriculture might impact changes in land use, but also reduce GHG emissions from organic waste management (see also the accompanying Circular Activity Sheets).

Sub-step 4.3a: Estimate the extent of the emission-reducing impact of the CE measure. Again, this might be based on readily available quantitative studies of such measures in the country or at a sub-national level, which could be considered representative for the country. Otherwise, expert self-assessment is needed to estimate the potential emission reduction from "(near) Complete" to "Low".

Form 4: Information gathering on new CE activities for NDCs

List of selected high priority new/additional circular economy measures for a next NDC

Priority area (Sub-step 1.1)	Prioritized CE measure as resulting from MCA (Sub-step 2.1)	Time Frame (Sub-step 2.2, optional)	Economic Sector (optional)	Additional information on national context to be considered (Step 3, optional)	Estimated GHG mitigation (qualitative or in tCO_2-eq, if available) (Step 4, optional)	IPCC reporting category (optional)	Estimated adaptation impact (Step 4, optional)

3.6 Integration of the new Circular Economy measures into the UNFCCC reporting framework (Step 5, optional)

The last step concerns the integration of the selected and prioritized CE measures. In addition to including this information when preparing the newest NDC, it could also be included in the BTR, which has to be submitted every two years, as outlined in section 1.1. BTRs require countries to include information that tracks the progress in implementing and achieving NDCs. Indicators are used for NDC implementation tracking and countries can select their own indicators. Therefore, an indicator related to CE activities could be included and used. The indicators could address CE actions and allow for clear communication on how CE activities contribute towards NDC achievement.

An indication of the IPCC GHG inventory reporting categories[46] to use per nature of product is provided in Annex B, and in greater detail in the Circular Activity Sheets, meticulously designed to enhance the ease of reporting under the Paris Agreement. Each Activity Sheet focuses on different sectors as identified by the IPCC, offering a wealth of information and practical suggestions. These include relevant formulas and emission factors that are crucial for accurate reporting.

However, it is important to note that the precision and accessibility of these emission formulas differ across various activities. This is particularly true for the most innovative measures, for which standard methodologies may not yet be fully established. In such cases, Activity Sheets endeavor to provide at least some initial indicators or formulas as a starting point, acknowledging the evolving nature of this field. This resource is thus tailored to facilitate users in adhering to the reporting requirements of the Paris Agreement, while also accommodating the variability and advancements in emission calculation methodologies.

Result: *Additional CE measures are included in NDC for implementation and reporting.*

46 IPCC (2006): IPCC Guidelines for National Greenhouse Gas Inventories; Countries do have the choice of using the 2019 Refinement to the 2006 Guidelines

4

Outlook and next steps

With its step-by-step guidance and accompanying Circular Activity Sheets and together with other resources such as the UN Toolbox on Building Circularity into NDCs, this report establishes a foundation for strengthening NDC ambitions through increased CE activities. In summary, integrating the perspective of circularity into NDCs is a pivotal step towards achieving climate neutrality and resilience while reaping economic and social benefits. This integration requires a concerted effort, involving methodological support, policy amendments, stakeholder engagement and strategic alignment, ensuring the effectiveness of CE-smart NDCs.[47]

The Guidance application with existing NDC processes is expected to improve and simplify the consideration of circularity while strengthening climate ambitions. Use experience will also reveal remaining shortcomings and challenges in the proposed methodology and gaps in the measures covered by the Activity Sheets. Users are invited to address any comments and suggestions to the GIZ Go Circular programme. It is planned to further enhance the Guidance based on user feedback. The Activity Sheet format might be further refined, while additional activities could be covered in a future update.

Towards a more integrative climate reporting

This Guidance aims at closely aligning circular activities with the reporting requirements and formats agreed by the UNFCCC parties. While this effort facilitates the integration of circularity into climate change practices, it should also be noted that the existing formats limit the description of some CE activities. For instance, circular approaches can cover whole product and service value chains and span over several sectors, which cannot be fully represented by the existing GHG emission categories. A more integrated approach to climate reporting with the flexibility to cover circular activities could significantly enhance the efficiency of CE activities for climate mitigation and adaptation.

Need to address the triple planetary crisis

As a co-benefit, this Guidance can contribute to address the global challenges of biodiversity loss and pollution as well as aspects of sustainable development. However, its clear focus remains on strengthening climate ambitions with no direct target related to other environmental or social agendas. The triple planetary crisis calls for additional efforts directly responding to these processes through enhanced circularity.

47 GIZ (2021): Circular Economy as a Cornerstone for Meeting the Goals of the Paris Agreement

AB

Annexes

Annex A – Catalogue overview of Circular Activity Sheets

An overview of elaborated CE activities in the accompanying Circular Activity Sheets presented in Table 0-1. Each activity comes with a unique Circular Activity Sheet (CAS) code, which is indicated in the table. For GHG mitigation measures, the table also includes the classification introduced in chapter 1.2. For adaptation measures, the table explains the potential impact on reducing climate risks.

Table A1: Overview and description of Elaborated CE measures per category

Sector	CAS Code	CE measure	Category in classification
Agriculture, Food and Nutrition	AFN1	**Food Loss Reduction**	1. Increase material efficiency in production and other processes along the lifecycle
	AFN2	**Food Waste Reduction**	1. Increase material efficiency in production and other processes along the lifecycle
	AFN3	**Transition to a Plant-Based Diet**	5.1 Substitute a technical solution by a more material-efficient one
	AFN4	**Improve soil health through regenerative agricultural practices (adaptation)**	6.1 Increase share of sustainably-sourced biobased materials
Construction, Built Infrastructure	CON1	**Reduction of individual space in buildings**	2. Reduce service level to reduce size and mass
	CON2	**Repurpose buildings usages**	4. Increase lifetime
	CON3	**Use of Substitute Cementitious Materials (SCMs) in cement**	6.1 Increase share of sustainably sources (bio)materials 6.2 Increase share of secondary materials
	CON4	**Reduction of steel use through design adjustments**	5.2 Reduce mass of a final product or service
	CON5	**Reduction of concrete use through design adjustments**	5.2 Reduce mass of a final product or service
	CON6	**Increased longevity of buildings**	4. Increase lifetime
	CON7	**Modular Building Design (adaptation)**	5.1 Substitute a technical solution by a more material-efficient one
Mobility, Transport	MOB1	**Public Transport**	5.1 Substitute a technical solution by a more material-efficient one

Sector	CAS Code	CE measure	Category in classification
Industrial Processes	IPP1	**Increased purity of recycled aluminium**	6.2 Increase share of secondary materials
	IPP2	**Increase the recycling content in plastics**	6.2 Increase share of secondary materials
	IPP3	**Use bio-based feedstock for the production of organic chemicals**	6.1 Increase share of sustainably sourced biobased materials
Plastics and Packaging	PAC1	**Substitute selected plastic products**	4 Increase lifetime 6.1 Increase share of sustainably sourced biobased materials 6.2 Increase share of secondary materials
	PAC2	**Ecodesign requirements on packaging for recycling**	6.2 Increase share of secondary materials
	PAC3	**Increase discarded packaging sorting and recycling efficiencies**	6.2 Increase share of secondary materials
Textiles	TEX1	**Ecodesign requirements for increasing the lifetime of textile articles**	4. Increase lifetime
	TEX2	**Repair textiles for reuse**	4. Increase lifetime
	TEX3	**Fibre-to-fibre textile recycling for cotton textiles**	6.2 Increase share of secondary materials
Waste management	WAS1	**Organic waste composting**	6.2 Increase share of secondary materials
	WAS2	**Anaerobic digestion including biogas generation**	6.2 Increase share of secondary materials
	WAS3	**Diverting waste from landfilling to recycling to avoid pollution (adaptation)**	6.2 Increase share of secondary materials
Water	WAT1	**Wastewater reuse, including the recovery of nutrients (adaptation)**	6.2 Increase share of secondary materials
Cross Cutting	CRC1	**Awareness campaigns on sustainable consumption**	7.1 Behavioural measures and awareness campaigns
	CRC2	**Support for circular procurement in SMEs**	7.3 Finance and business support

Annex B – Main impacts of Circular Economy on GHG mitigation, per category of products

The implementation of CE measures has the potential of reducing and avoiding GHG emissions, and hence to mitigate climate change.

The means by which CE measures cause this reduction in GHG emissions depend upon the nature of the product involved. This annex provides an overview of the main phenomena causing this reduction of GHG emissions, and of the means to report these reductions in GHG emissions within the IPCC Guidelines reporting framework, for each category of products discussed in Box 1-1 (section 1.2).

In each of the following sub-chapters, each bearing on a category of products, we will specify:

- The **underlying phenomenon** through which CE measures lead to a mitigation in GHG emissions;
- The IPCC **reporting categories**;
- The **data** to be used to quantify these reductions in GHG emissions, which should ideally be extracted from data relative to national production, and if not from international data sources;
- When available, the reference to **existing reports** that quantify the reductions in GHG emissions that can be expected from the implementation of CE measures.

B.1 GHG mitigation impacts of circular measures per category of products

Table B1: Impacts of Circular Economy on the mitigation of climate change, per category of products

Categories of products	Underlying phenomenon	IPCC reporting categories	Data needed	Reference studies
Mineral-based (aka: a-biotic) products	• Absolute reduction in the consumption volume of the products being considered • Absolute reduction in the consumption volume of **oil** and **gas** used as industrial feedstock for chemicals and mineral fertilizers respectively • Absolute reduction in the consumption volumes of **ores** and **rocks**, which are the feedstock for the production of basic metals and minerals • Absolute reduction in the consumption volumes of **naphtha**, i.e. the refined oil product that is the feedstock for the whole basic organic chemicals industry • Substitution of these primary products by secondary • Substitution of these primary mineral-based products by biobased products • Reduction in the consumption of electronic products	• AFOLU, 3D1 Harvested Wood Products • Energy: Fuel combustion activities: 1A2 Manufacturing Industries and Construction; • Energy , 1B2 Fugitive Emissions from Oil & Gas • Energy, 1A2 i Mining (excluding fuels) and Quarrying • Energy, 1A1 b Petroleum Refining • Industrial Processes and Product Use – IPPU, 2A Mineral Industry, 2B Chemical Industry, 2C Metal Industry • Industrial Processes and Product Use – IPPU, 2E Electronics Industry	• GHG emissions intensity for the manufacture of 1 tonne of the **primary** basic metal, material or chemical being considered. • if relevant: » GHG emissions intensity for the extraction of 1 tonne of **ore** or of **rock** (when the product of interest is a basic metal or mineral) » GHG emissions intensity for the extraction of 1 tonne of oil or of 1 m3 of natural gas; » GHG emissions intensity for the manufacture of 1 tonne of naphtha (when the product of interest is an organic basic chemical) • GHG emissions intensity for the manufacture of 1 tonne of the **secondary** basic metal, material or chemical being considered, which substitutes for the primary metal, material or chemical being considered. • GHG emissions intensity for the manufacture of the **biobased** product performing a functional substitution for 1 tonne of the primary basic metal, material or chemical being considered. • GHG emissions intensity for the manufacture of 1 m^2 of the microelectronic circuits or flat panel display being considered. The further explanation can be found in explanatory box B-1.	Material Economics estimated in 2018[48] that 56% of the GHG emissions in the EU of the steel, cement, aluminum and plastics sectors could be saved by CE measures by 2050, i.e. 396 Mt CO_2eq / year saved on a total of 530 Mt CO_2eq / year; Trinomics reported in 2018[49] that current estimates of the GHG abatement potential is estimated to rise to around 300-550 Mt CO_2eq / year in Europe, amounting to around 10-18% of the GHG baseline emissions by 2050 in the EU Reference Scenario; The International Resource Panel in 2020[50] assesses the reduction in the GHG emissions associated with the material cycle of residential buildings in G7 countries and China by 80 to 100 per cent by 2050, compared to a scenario without material efficiency (including the benefits of use of recycled material); The World Resources Institute (2022)[51] estimates, based on data by Circle Economy[52], that CE measures in the housing sector can generate global GHG emissions savings in the range of 13 Gt CO_2eq, and of 6.7 Gt CO_2eq in the mobility sector.

48 Material economics (2018) The Circular Economy – A powerful force for climate mitigation
49 Trinomics (2018) Quantifying the benefits of CE action on the decarbonization of EU economy
50 IRP. 2020. "Resource Efficiency and Climate Change: Material Efficiency Strategies for a Low-Carbon Future." Nairobi, Kenya: United Nations Environment Programme; available at: https://www.unep.org/resources/report/resource-efficiency-and-climate-change-material-efficiency-strategies-low-carbon
51 Wang, K., M. Costanza, van den Belt, G. Heath, J. Walzberg, T. Curtis, J. Barrie, P. Schroder, L. Lazer, and J. C. Altamirano. 2022. "Circular economy as a climate strategy: current knowledge and calls-to action." Working Paper. Washington, DC: World Resources Institute, available at: https://www.wri.org/insights/3-ways-circular-economy-can-aid-climate- action .
52 Circle Economy. 2021. Circularity Gap Report. Amsterdam, the Netherlands: Circle Economy, available at: https://www.circle-economy.com/resources/circularity-gap-report- 2021

Annex B – Main impacts of Circular Economy on GHG mitigation, per category of products

Categories of products	Underlying phenomenon	IPCC reporting categories	Data needed	Reference studies
Food and feed products	• Reduction in the consumption of **mineral-based fertilisers**, providing nitrogen • Reduction in the GHG emissions from the **disposal of biowaste** • Increase in the **sequestration of carbon** in agricultural soils • Reduction in the GHG emissions from **livestock**	• AFOLU,3B2Cropland • Industrial Processes and Product Use – IPPU, 2B1 Ammonia Production • Waste,4ASolidWaste Disposal and 4B Biological Treatment of Solid Waste	• GHG emissions 1 intensity for the manufacture of 1 tonne of **ammonia** • Share of ammonia in the mass of nitrogen- based fertilisers. The explanation of why the main focus is on nitrogen-based fertilisers, and the phosphorus-based ones left out of the first- order calculations was defined further in the explanatory box B-2. • GHG emission intensity for the raising of 1 head of **livestock** (per animal species) • **Variation of carbon stocks** in agricultural soils	The World Resources Institute in 2019[53] estimates that that slowing and shifting growth in food de-mand, including more sustainable diets and reduced food loss and waste, could reduce emissions from agriculture by 5 Gt CO_2eq/year globally by 2050; The Ellen MacArthur Foundation estimates in a study of 2019 (updated 2021)[54] that regenerative practices in agriculture could reduce GHG emissions by 3.9 Gt CO_2eq/year globally by 2050.
Durable plant-based (aka: biotic) products	• Reduction in the consumption of paper & cardboard • Increase in the sequestration of carbon in forests and in forest soils	• AFOLU, 3B1 Forestland– Biomass and Soils • Industrial Processes and Product Use – IPPU, 2H1 Pulp and Paper Industry	• GHG emissions intensity for the manufacture of 1 tonne of paper or of cardboard • Variation in carbon stocks in forests and in forest soils	The International Energy Agency (IEA)[55]and a recent study published in Nature Sustainability[56] show that increased recycling of paper and cardboard does not necessarily translate into direct GHG emissions gains, because primary production of pulp, cardboard and paper can rely on biomass energy that is available as a by- product, whereas recycled cardboard and paper cannot. Other impacts along the value chain (in particular: in the forests and regarding the opportunity costs of using the biomass energy for the manufacture of pulp instead of for other uses) may need to be included in the scope of further studies.
All products	1. Reduction in the GHG emissions related to the disposal or incineration of solid waste	2. Waste, 4A Solid Waste Disposal and 4C Incineration and open burning of solid waste	• GHG emissions intensity for the **disposal**, respectively: the **incineration**, of 1 tonne of **solid waste**	The IPCC anticipates a potential for the reduction of GHG emissions of ca. 08 Gt CO_2eq/year from better management of solid waste[57].

53 Searchinger, T., R. Waite, C. Hanson, J. Ranganathan, P. Dumas, E. Matthews, and C. Klirs. 2019. Creating a Sustainable Food Future: A Menu of Solutions to Feed Nearly 10 Billion People by 2050. Final Report. Washington DC, USA: World Resources Institute, available at: https://research.wri.org/sites/default/files/2019- 07/WRR_Food_Full_Report_0.pdf

54 Ellen MacArthur Foundation, Completing the picture: How the circular economy tackles climate change (2019, update 2021), available at: https://www.ellenmacarthurfoundation.org/completing-the-picture . This study states that 45% of global GHG emissions are rooted in the manufacture of products, and are hence amenable to Circular Economy policies, and 55% to the usage of energy, and hence already addressed by existing policies aiming at the mitigation of climate change.

55 https://www.iea.org/energy-system/industry/paper

56 van Ewijk, S., Stegemann, J.A. & Ekins, P. Limited climate benefits of global recycling of pulp and paper. Nat Sustain 4, 180–187 (2021). https://doi.org/10.1038/s41893-020-00624-z

57 Intergovernmental Panel on Climate Change (IPCC) Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Technical Summary, Figure TS.23, available at: https://www.ipcc.ch/report/ar6/wg3/

B.2 Explanatory text boxes

Box B-1: Mineral-based (aka: a-biotic) products explanatory note

Electronic products bear this specific and unique feature in industrial value chains that the bulk of the GHG emissions does not lie in the manufacture of the basic material (in this case: monocrystalline silicon, even if the temperatures involved already lead to significant emissions), but in its processing (the many stages of nanometre scale photolithography and etching / material deposition), which take place in very resource-intensive factories using significant amounts of fluorinated gases.

Considering this, in order to get a correct approximation of the GHG emissions footprint of an electronic device, you need to include the surface of semiconductors, in addition to the materials the device is made of (plastic, aluminium, glass, etc).

Box B-2: Food and feed products explanatory note: nitrogen vs. phosphorus-based fertiliser

The manufacture of nitrogen-based fertilisers relies on the production of ammonia, itself obtained (in the Haber-Bosch process) from the nitrogen of the atmosphere and from hydrogen. This hydrogen is currently in its majority obtained from the reforming of natural gas (methane) and generates thereby large amounts of CO_2 due to the chemical reaction itself (the carbon contained in methane is released).

Phosphorus-based fertilisers on the other hand are produced from phosphate rock along a standard refining process of mineral ores, which is also energy-intensive, but that does not contain process steps that intrinsically generate GHG emissions.

The bulk of ammonia produced in the world tends to be from synthetic production processes (Haber-Bosch process) using hydrogen from the reforming of methane (from natural gas) and hence generating CO_2 emissions.

B.3 Reference Studies

Table B2: Summaries of the Reference Studies

Categories of products	Reference of the Study	Short Summary of the Findings
Mineral-based (aka: a-biotic) products	1. Material economics (2018): The Circular Economy – A powerful force for climate mitigation. https://www.sitra.fi/app/uploads/2018/06/the-circular-economy-a-powerful-force-for-climate-mitigation.pdf	Material Economics estimated in 2018 that 56% of the GHG emissions in the EU of the steel, cement, aluminum and plastics sectors could be saved by CE measures by 2050, i.e. 396 Mt CO_2eq / year saved on a total of 530 Mt CO_2eq / year
	1. Trinomics (2020): Quantifying the benefits of circular economy actions on the decarbonization of EU economy. https://trinomics.eu/wp-content/uploads/2020/04/Trinomics-2018-Quantifying-the-benefits-of-circular-economy-actions-on-the-decarbonization-of-EU-economy_final-report.pdf	Trinomics reported in 2018 that current estimates of the GHG abatement potential is estimated to rise to around 300-550 Mt CO_2eq / year in Europe, amounting to around 10-18% of the GHG baseline emissions by 2050 in the EU Reference Scenario;
	1. International Resources Panel (IRP) (2020): Resource Efficiency and Climate Change: Material Efficiency Strategies for a Low-Carbon Future. https://www.unep.org/resources/report/resource-efficiency-and-climate-change-material-efficiency-strategies-low-carbon	The International Resource Panel in 2020 assesses the reduction in the GHG emissions associated with the material cycle of residential buildings in G7 countries and China by 80 to 100 per cent by 2050, compared to a scenario without material efficiency (including the benefits of use of recycled material);
	1. Wang, K., M. Costanza, van den Belt, G. Heath, J. Walzberg, T. Curtis, J. Barrie, P. Schroder, L. Lazer, and J. C. Altamirano (2022): Circular economy as a climate strategy: current knowledge and calls-to action. Working Paper. World Resources Institute. https://www.wri.org/insights/3-ways-circular-economy-can-aid-climate-action . 2. Circle Economy (2021): Circularity Gap Report. https://www.circle-economy.com/resources/circularity-gap-report-2021	The World Resources Institute (2022) estimates, based on data by Circle Economy, that CE measures in the housing sector can generate global GHG emissions savings in the range of 13 Gt CO_2eq, and of 6.7 Gt CO_2eq in the mobility sector.
Food and feed products	1. Searchinger, T., R. Waite, C. Hanson, J. Ranganathan, P. Dumas, E. Matthews, and C. Klirs (2019). Creating a Sustainable Food Future: A Menu of Solutions to Feed Nearly 10 Billion People by 2050. Final Report. World Resources Institute. https://research.wri.org/sites/default/files/2019- 07/WRR_Food_Full_Report_0.pdf	The World Resources Institute in 2019 estimates that that slowing and shifting growth in food demand, including more sustainable diets and reduced food loss and waste, could reduce emissions from agriculture by 5 Gt CO_2eq/year globally by 2050;
	1. Ellen MacArthur Foundation (2019, update 2021): Completing the picture: How the circular economy tackles climate change. https://www.ellenmacarthurfoundation.org/completing-the-picture .	The Ellen MacArthur Foundation estimates in a study of 2019 (updated 2021) that regenerative practices in agriculture could reduce GHG emissions by 3.9 Gt CO_2eq/year globally by 2050. This study states that 45% of global GHG emissions are rooted in the manufacture of products, and are hence amenable to CE policies, and 55% to the usage of energy, and hence already addressed by existing policies aiming at the mitigation of climate change.
Durable plant-based (aka: biotic) products	1. InternationalEnergyAgency(IEA)(2023):Pulp and Paper. https://www.iea.org/energy-system/industry/paper 2. van Ewijk, S., Stegemann, J.A. & Ekins, P (2021): Limited climate benefits of global recycling of pulp and paper. Nat Sustain 4, 180–187. https://doi.org/10.1038/s41893-020-00624-z	The International Energy Agency (IEA) and a recent study published in Nature Sustainability show that increased recycling of paper and cardboard does not necessarily translate into direct GHG emissions gains, because primary production of pulp, cardboard and paper can rely on biomass energy that is available as a by-product, whereas recycled cardboard and paper cannot. Other impacts along the value chain (in particular: in the forests and regarding the opportunity costs of using the biomass energy for the manufacture of pulp instead of for other uses) may need to be included in the scope of further studies.
All products	1. Intergovernmental Panel on Climate Change (IPCC) (2022): Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Technical Summary, Figure TS.23. https://www.ipcc.ch/report/ar6/wg3/	The IPCC anticipates a potential for the reduction of GHG emissions of ca. 08 Gt CO_2eq/year from better management of solid waste.

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