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Coordination of international statistical work in the United Nations Economic Commission for Europe region: Measuring circular economy

IN-DEPTH REVIEW OF MEASURING CIRCULAR ECONOMY (FULL VERSION)

Prepared by Finland (lead), Belarus, Canada, Colombia, Netherlands, EEA, Eurostat, UNECE, UNSD, UNEP and OECD

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Executive summary

1. In the past two decades, many countries and the European Union have been orienting their waste and materials management policies towards preventive and integrated approaches, with emphasis on the life-cycle and supply chains of materials and products. Policy initiatives aimed at establishing a circular economy (CE) have increased as an essential contribution to the development of a sustainable, low carbon, resource efficient and competitive economy.

2. There is no single or internationally agreed upon definition of a circular economy. But the definitions used by countries, international institutions and NGOs have many common elements. In all definitions the notion of material circularity is key. Definitions also tend to include reduced demand for certain natural resources and the materials and products derived from them.

3. International organizations, such as the European Environment Agency (EEA), Eurostat, FAO, OECD, UNECE, UNEP and UNSD have initiated important methodological work for measuring CE which forms the basis for measuring certain aspects of CE by many countries. Of particular importance are:

a) The „Bellagio process": EEA in partnership with the Italian Institute for Environmental Protection and Research (ISPRA) are taking forward this initiative which aims at building consensus on 'What to Monitor' and use best-practice examples as well as innovative ideas to identify shared principles on 'How to Monitor'.

b) Eurostat's work related to the "EU Monitoring Framework for the Circular Economy", including methodological development on measuring the circularity rate and improvements of Sankey diagrams;

c) OECD's Expert Group on a new Generation of Information on Waste and Materials: This small expert group, in its work program 2020-2021, will encompass the development of a conceptual framework for circular economy metrics for policy making, and the preparation of guidance on information and indicators needed for the transition to a resource-efficient and circular economy.

d) The United Nations Committee of Experts on Environmental-Economic Accounting (UNCEEA) is working on a publication highlighting narratives and use cases for the SEEA's application to policy.

e) Joint UNECE's and FAO's work exploring the issue of wood-based value chains in a circular economy.

f) UNEP's methodological work related to economy-wide material flow accounting in the context of sustainable production and consumption.

4. Many countries have started measuring selected aspects of CE (e.g. based on waste statistics and material flow accounts), and case examples from Belarus, Canada, Colombia, Finland and the Netherlands are presented in this in-depth review.

5. The examples show that there are still challenges for measuring CE from a statistical point of view. It is currently not possible to measure CE in a comprehensive and fully internationally comparable manner. There are various issues and challenges which require further methodological work, coordination and practical guidelines, including

a) Clarification of the measurement scope;

b) Harmonisation of definitions and classifications;

c) Improvement of data availability and fitness, including the use of SEEA;

d) Coordination across institutions and within NSOs;

e) Understanding the demand and expectations by users (e.g. policy makers, research etc.);

f) Use of new tools to efficiently communicate data relevant for circular economy;

g) Consideration of interlinkages with other social, economic and environmental domains.

6. Therefore, the authors of this in-depth review recommend to

a) Strengthen coordination and communication of work of international organizations and their expert groups related to measuring CE;

b) Draft practical guidelines by a task force or expert group, in close collaboration with UNSD and other international organizations being active in this area;

c) Provide platforms for exchange of experience and knowledge, including coordination of activities of international organizations, e.g. the annual "Joint OECD/UNECE Seminar on SEEA implementation".

I. Introduction

7. The Bureau of the Conference of European Statisticians (CES) regularly reviews selected statistical areas in depth. The aim of the reviews is to improve coordination of statistical activities in the UNECE region, identify gaps or duplication of work, and address emerging issues. The review focuses on strategic issues and highlights concerns of statistical offices of both a conceptual and a coordinating nature. The current paper provides the basis for the review by summarising the international statistical activities in the selected area, identifying issues and problems, and making recommendations on possible follow-up actions.

8. The CES Bureau selected "Measuring the Circular Economy" for an in-depth review at its meeting in February 2020. Finland (lead), Belarus, Canada, Netherlands, the European Environment Agency (EEA), Eurostat and OECD volunteered to prepare the paper providing the main basis for the review. Colombia, UNECE, UNSD and UNEP have also contributed to the paper.

II. Scope/definition of the statistical area covered

9. In the past two decades, many countries and the European Union have been orienting their waste and materials management policies towards preventive and integrated approaches, with emphasis on the life-cycle and supply chains of materials and products. More recently, policy interest in establishing a circular economy (CE) has increased as an essential contribution to the development of a sustainable, low carbon, resource efficient and competitive economy. There is also a lot of interest in how CE

initiatives relate to climate change policies, such as greenhouse gases emitted during manufacture of products, energy savings from more energy efficient products, etc.

10. New business models have emerged, using technological and social innovation to improve firms' material efficiency and profitability. Recycling, using products for longer and increasing the use intensity of goods (e.g. through sharing economy approaches like car-sharing, leasing) are some of the areas in which these business models operate. Some of these models have existed for a long time, but at a relatively small scale; others have started to emerge more recently. Such activities could become drivers of re-industrialisation, job creation and economic growth, and create economic opportunities in sectors such as secondary material production, repair and remanufacture, and services.

11. A successful transition from the current linear economic models to more circular ones requires efforts on many different fronts and raises a number of questions for policy makers that differ from those associated with traditional waste and materials management. It brings about stronger demands for reliable information on the life-cycle of materials and products, the underlying drivers and the associated economic and environmental implications. And it raises questions as to the adequacy of the statistics (data, accounts, indicators) currently available for effectively supporting national policies and international work. It also depends on awareness, by producers and consumers, on how changes in behaviour can help foster progress towards the circular economy. Circular economy statistics help with explaining to policy makers, researchers, and the general public the potential impacts from a transition to a circular economy.

A. What do we understand as circular economy?

Concept and definition

12. The concept of a CE relates to other concepts such as resource productivity or efficiency, the 3Rs "reduce, reuse, recycle" and sustainable materials management. But it goes beyond these as it builds on a systemic approach and focuses on maximising the economic, social and environmental benefits that arise from a CE. CE also depends on changes in design, business models and the behaviors of producers and consumers.

13. There is no single or internationally agreed upon definition of a circular economy. But the definitions used by countries, international institutions and NGOs have many common elements. In all definitions the notion of material circularity is key. The definitions also tend to include reduced demand for certain natural resources and the materials and products derived from them.

14. A circular economy and a linear economy differ from each other in the way in which value is created or maintained. In a linear economy, materials are extracted, processed, used and become waste at the end of their life. Value is created by producing and selling as many products as possible. A circular economy seeks to (i) maximise the value of the materials, products and other resources (e.g. water, energy) that circulate in the economy by maintaining them in the economy for as long as possible, and (ii) minimise the consumption of materials – paying particular attention to virgin materials and hazardous substances – and the generation of waste. A CE further seeks to minimise negative environmental impacts along the life-cycle of materials. In practice, businesses, industries, and economies act on a spectrum of linear vs. circular activity, and the relatively circular activities are more efficient with respect to waste (less waste per output).

15. The Ellen MacArthur Foundation lists three principles as the basis for circular economy: 1) design out waste and pollution, 2) keep products and materials in use and 3)

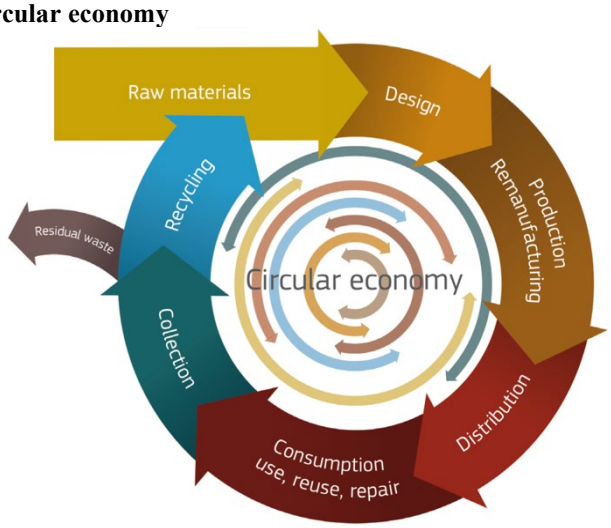
regenerate natural systems. According to the first principle, the environmental impacts of our production and comsumption must be considered already at the design stage and thus minimize the use of virgin raw materials and production of waste. The second principle aims to make the life cycle of products and materials longer. This can be achieved by reusing, repairing and remanufacturing. Third principle states that the aim should not be merely on not damaging the environment but we should be more ambitious and instead seek to actively improve the state of the environment and return valuable nutrients to ecosystems.

16. The following Figure 1 illustrates the main differences between a classical linear economy and an ideal circular economy. In practice, there are many variations possible between the two extremes.

Figure 1: Linear and circular economy diagrams (source: European Commission, DG Environment (2014))

Linear economy

Circular economy



Scope

17. The scope of CE initiatives and policies is often broad. Beyond waste management, they cover production and consumption patterns, eco-design, extended producer responsibility, markets for secondary raw materials (domestic and external), public procurement, innovation and technology development, finance and investment, employment, and the management of specific waste and material flows (e.g. plastics, food waste, critical raw materials, construction and demolition materials, biomass and bio-based materials). They can also cover changes in environmental pressures in terms of air pollution, climate, natural assets, ecosystems, etc.

18. When it comes to integrated policies and to circular economy models, there is room to further clarify the borderline between waste, materials and products. Many CE

initiatives focus on waste and materials, where the term "materials" designates metals and non-metallic minerals such as construction minerals, energy carriers such as fossil fuels, and biotic resources such as timber, fish or other biomass in line with the material categories used in material flow analysis. By extension the term also applies to the products containing these materials and can apply to resources such as energy and water.

19. The following Figure 2 presents the material flows in a circular economy.

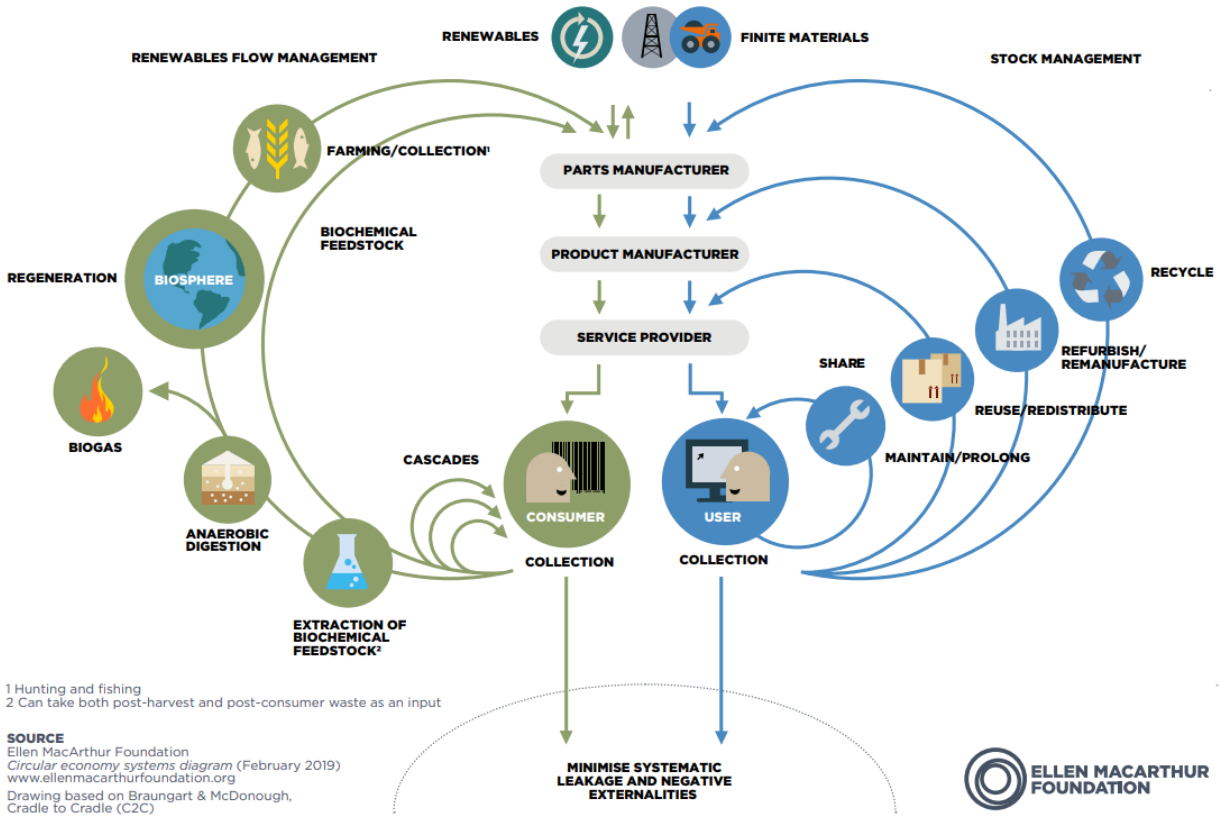
20. According to Ellen MacArthur Foundation, *A circular economy seeks to rebuild capital, whether this is financial, manufactured, human, social or natural. This ensures enhanced flows of goods and services. The system diagram* (see Figure 3) *illustrates the continuous flow of technical and biological materials through the 'value circle'*. The flows are separated into technical and biological as these differ from each other and there exists a need to develop different indicators and policy instruments for them.

Text Box 1: The three Circular Economy Mechanisms (see Bocken et al. (2016))

The literature distinguishes three CE **mechanisms** that help reduce material consumption and the associated negative environmental impacts: closing resource loops, slowing resource loops, and narrowing resource flows.

- **Closing resource loops:** prevent waste from being generated by substituting virgin materials and new products by secondary raw materials (i.e. from recycled waste) and second-hand, repaired or remanufactured products.
- **Slowing resource loops:** slow down consumption and demand for virgin materials by extending the life of existing goods through more durable product design (i.e. products that are designed for being long-lasting, easy to repair and recycle, and that can at the end of their life-cycle be broken down into components, which can be used again in production chains).
- **Narrowing resource flows:** increase resource efficiency by decreasing the total amount of resources used per unit of output, making better economic use of existing resources and assets, developing and diffusing new production technologies, or shifting consumption behaviour away from material intensive goods and services. To note that narrowing a resource flow does not per se imply circularity in the form of loops.

Figure 2: Material flows in circular economy (source: The Ellen MacArthur Foundation[1])



B. Information needs and measurement challenges

21. Statistics on waste and material flows often serve as a starting point for measuring the CE, but their quality and scope are insufficient for supporting CE policies. What is needed is information that reflects all aspects of the material life cycle and of circular business models, including product design, production patterns, consumption patterns. This is to be complemented with socio-economic information (use of economic instruments, public procurement, employment, costs, expenditure, value-added), information on innovation and technology development, information on the sharing economy, and information on the international and trade dimensions of the transition towards a circular economy (global value chains, trade in second-hand goods, end-of-life products, secondary materials and waste).

22. The types of statistics to be used and integrated with each other for measuring CE include (non-exhaustive list):

a) Demographic and social statistics

[1] https://www.ellenmacarthurfoundation.org/circular-economy/concept/infographic

- Labour (employment)
- Income and consumption (of households)

b) Economic statistics

- Economic accounts (value added)
- Business statistics (number of enterprises, revenue)
- Trade (second-hand trade)
- Prices
- Labour costs
- Science, technology and innovation

c) Environment and multi-domain statistics

- Environment statistics and SEEA (material stocks and flows, product life-spans, waste, secondary raw materials, etc.)
- Information society
- SDGs

23. Measuring progress and producing reliable statistics on the CE entails a number of challenges.

a) CE is a cross-cutting concept whose scope is not easy to delimit in statistical terms.

b) CE strategies and policies cover many aspects that are more difficult to capture statistically and whose measurement relies on different statistical sources, including official statistics and other data sources.

c) the cross-cutting nature of CE policies calls for information that can easily be inter-linked and combined, hence the need for coherent classifications and statistical frameworks.

24. Measuring progress thus calls for step-wise improvements in monitoring and measurement, based on a commonly agreed upon statistical framework for the CE (definition, reporting boundaries, accounting framework, etc.).

III. Overview of international statistical activities in the area

A. European Environment Agency (EEA)

25. EEA does not produce the relevant statistics but uses them in combination with policy analysis to provide assessments on the circular economy which aim to support policy and decision making. Since 2016, EEA has published a series of four circular economy reports along with briefings focused on specific waste streams and materials including waste electrical and electronic equipment (WEEE), construction and demolition, plastics and textiles. EEA has also published two reports which provide an

overview of the policies, approaches and targets of 32 European countries on circular economy initiatives in a broader resource efficiency context.

26. EEA has developed a conceptual framework for the circular economy which can be applied at the European, national or local levels, as well as to specific sectors or materials. In the 2016 circular economy report (EEA, 2016), EEA identified the key characteristics and main enabling factors of a circular economy and also proposed metrics for measuring progress. In the 2019 circular economy report (EEA, 2019a), EEA analysed available knowledge and identified knowledge development needs across these key characteristics and enabling factors. The latest country level analysis (EEA, 2019b) revealed that there are widely differing approaches and degrees of development regarding indicator frameworks. This can be partly explained by the absence of a broadly accepted framework for monitoring circularity.

27. EEA in partnership with the Italian Institute for Environmental Protection and Research (ISPRA) are taking forward an initiative called the Bellagio process which aims at building consensus on 'What to Monitor' and use best-practice examples as well as innovative ideas to identify shared principles on 'How to Monitor'. These principles will then form the basis for further developments around indicators and monitoring frameworks in support of the European Green Deal.

B. Eurostat

28. In 2015, the European Commission adopted an ambitious Circular Economy Package[2]. The main element is an *EU Circular Economy Action Plan* (European Commission, 2015) outlining actions that cover the entire product life cycle: from production and consumption to waste management and the market for secondary raw materials. On 11 March 2020, the European Commission adopted a new Circular Economy Action Plan (European Commission, 2020) - one of the main blocks of the European Green Deal[3], Europe's new agenda for sustainable growth. The new Action Plan announces initiatives along the entire life cycle of products, targeting for example their design, promoting circular economy processes, fostering sustainable consumption, and aiming to ensure that the resources used are kept in the EU economy for as long as possible. It introduces legislative and non-legislative measures targeting areas where action at the EU level brings real added value.

29. The circular economy has strong synergies with the other EU policies, in particular the EU objectives on climate and energy and with the Commission's package on *Clean Energy for all Europeans*[4]. The circular economy is also instrumental in supporting the EU commitments on sustainability, as outlined in the Communication *Next steps for a sustainable European future* (European Commission, 2015) and in particular to reach Sustainable Development Goal 12 (responsible consumption and production).

30. As part of the 2015 Action Plan, the European Commission adopted a *Monitoring Framework for the Circular Economy*[5] and it was first published in 2018. Eurostat publishes and maintains it. Eurostat produces most but not all of the indicators in the

[2] Website "Towards a circular economy": https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/towards-circular-economy_en

[3] Website "A European Green Deal": https://ec.europa.eu/info/node/123797

[4] Website "Proposed new rules for consumer centred clean energy transition": https://ec.europa.eu/energy/en/news/commission-proposes-new-rules-consumer-centred-clean-energy-transition

[5] Website "EU Circular Economy monitoring framework": https://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework

monitoring framework. Some indicators are sourced from other services of the European Commission. Few indicators are based on SEEA and there is potential for more SEEA-based indicators. The monitoring framework is a dashboard of indicators and sub-indicators, structured in 4 areas:

a) production and consumption;

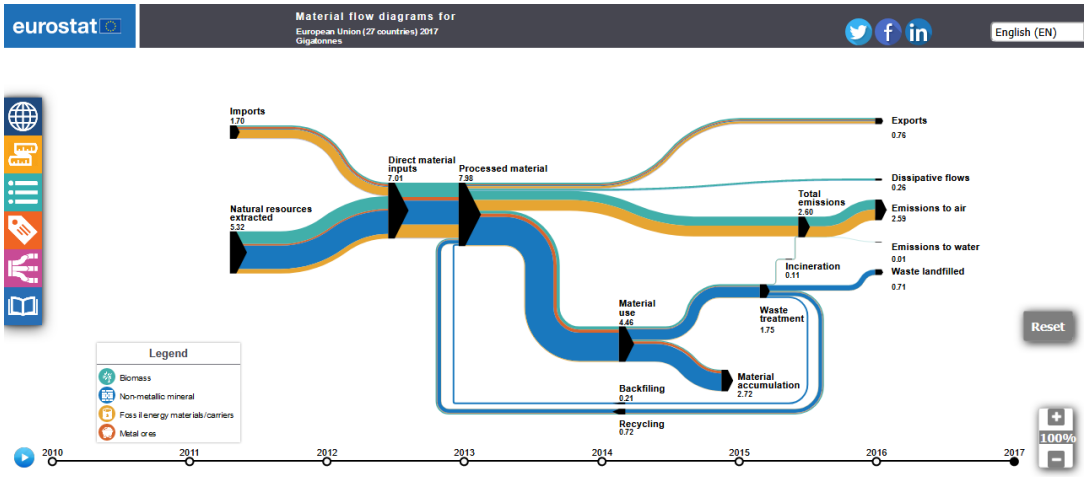
b) waste management;

c) secondary raw materials;

d) competitiveness and innovation.

31. Furthermore, Eurostat developed a *Sankey Diagram of Material Flows*[6] (see following Figure 3) plus the underlying datasets. This is meant to be both a visualisation tool and an information integration system to underpin the interrelations between materials, waste, energy use, greenhouse gas emissions, imports and exports. It was first published in early 2018. In March 2020 the diagram was improved: it is now interactive, and it includes new features, such as time graphs, pie charts and animations to visualise changes over time. The user can display or hide data values and labels, and choose between different units (tonnes per capita, billion tonnes, and other). Eurostat issued an online article explaining how to interpret the diagram[7].

Figure 3: Eurostat Sankey Diagram of Material Flows



32. Eurostat developed the indicator *circular material use rate*[8] (also called *circularity rate*). This is one of the indicators in the *EU Monitoring Framework for the Circular Economy*. This indicator measures the share of secondary raw materials in the total use of materials in the economy. This indicator integrates data from SEEA (material flow accounts), waste statistics, and external trade. It maps the classifications of flows in

[6] Experimental Sankey diagram of material flows for European Union: https://ec.europa.eu/eurostat/cache/sankey/circular_economy/sankey.html

[7] Statistics explained "Material flows in the circular economy": https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Material_flows_in_the_circular_economy

[8] The final methodology is documented at https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-18-013

these three sources, which is a necessary condition for integrating the data. The mapping is done at the level of the four broad groups of flows in material flow accounts: biomass, metals, non-metallic minerals, fossil fuels. However, it has insufficient breakdown detail to identify e.g. plastics, glass, paper, etc. Eurostat considers the circularity rate a good attempt to integrate sources.

33. Eurostat also produces estimates of material footprints. They are based on SEEA (material flow accounts in raw material equivalents) and input-output modelling. Material footprints represent the amount of material extractions required to produce the products demanded by final users. Eurostat publishes EU-wide estimates, including product breakdowns, in its online database[9]. Nine European countries are already producing raw material equivalent estimates and transmitting to Eurostat on voluntary basis[10].

34. Eurostat also makes available a compilation tool for countries wanting to produce their own material footprint estimates[11]. Material footprints are widely recognised as highly relevant for the circular economy, but they are not part of the EU monitoring framework because of insufficient data availability and certain controversy about the input-output modelling methodology. Eurostat also publishes footprints of air emissions and energy.

35. Eurostat improved the product detail of manufacture statistics (‘PRODCOM statistics’) as to disclose 'metal secondary raw materials' and 'non-metal secondary raw materials' out of the corresponding primary raw materials. This is an important improvement to have better statistics of secondary raw materials. Data with such breakdowns are collected starting in summer 2020.

36. Eurostat aims to further develop the circularity rate and Sankey diagram in the next 2-3 years. Eurostat is developing an accounting approach for EU-wide waste accounts on the basis of data already available in Eurostat and produce experimental estimates of material stocks, to supplement the estimates of material flows. Detailed estimates for plastics are sought too. Once this project is complete and the data set available, the Sankey diagram could be enhanced with additional details and breakdowns: primary/secondary raw materials; details by plastics, NACE breakdowns, etc. The project will assess feasibility and reliability of supplementing hard data with models. This project is scheduled to end in late 2021.

37. Eurostat is also developing improved measures of the circular economy sector (growth, jobs, investments) based on SEEA. These measures would improve the quality of the corresponding indicators in the EU monitoring framework. The approach sought is developing accounting frameworks similar to the SEEA ones for environmental goods and services sector (EGSS) and environmental protection expenditure account (EPEA), but with an alternative scope for the circular economy sector rather than the scope in SEEA CF, chapter IV. This project is scheduled to end in early 2023.

38. In addition, Eurostat maintains several data collections about waste. First, there is a data collection every second year on waste statistics (waste generation and treatment) according to Regulation (EC) 2150/2002, with breakdowns by waste categories, hazardousness and economic activity. Secondly, there is an annual questionnaire on municipal waste jointly with OECD. Finally, there are data collections on several waste

[9] Eurostat database: https://ec.europa.eu/eurostat/data/database, data code env_ac_rmefd

[10] Eurostat database : https://ec.europa.eu/eurostat/data/database, data code env_ac_rme. This online article explains the results: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Material_flow_accounts_statistics_-_material_footprints.

[11] Eurostat methodology (environment): https://ec.europa.eu/eurostat/web/environment/methodology, section IO modelling and tools

streams: packaging waste, waste electric and electronic equipment, end of life vehicles and batteries.

C. Organisation for Economic Co-operation and Development (OECD)

39. OECD has several work streams related to the monitoring of waste, materials and resource productivity. Work specifically dedicated to the transition towards a circular economy started in 2017, building on earlier work on sustainable materials management and the 3Rs. The work responds among others to two Recommendations by the OECD Council (2004, 2008). It encompasses both statistical work and policy work.

40. Statistical work includes:

a) Regular data collection on waste through a section of the OECD state of the environment questionnaire (joint with Eurostat, fully coordinated with UNSD and UN Environment, quasi-global country coverage, quality assurance process with countries).

b) Regular data collection on expenditure for waste management through the questionnaire section on environmental protection expenditure (aligned with the SEEA; joint with Eurostat). Efforts to better cover expenditure on cross-cutting activities and objectives, including climate, biodiversity, water and circular economy have been initiated. This requires a broadening of the classifications currently used and closer connections to environmental goods and services accounts.

c) Regular data collection on economic instruments related to waste and materials management, through the OECD Policy Instruments for the Environment (PINE) database; and through a questionnaire on environmentally related tax revenue accounts (aligned with the SEEA; joint with Eurostat).

d) Regular compilation of official accounts on stocks of mineral and energy resources, which are used to calculate reductions of non-renewable resources in those countries.

e) Continued development and calculation of indicators. Selected waste and material flow indicators are included in the OECD Core Set of environmental indicators and in the OECD set of green growth indicators. A complete set of material flow and resource productivity indicators was developed in 2011.

f) The development of guidance on measuring material flows and resource productivity. The current focus is on the development of a methodology to produce harmonised data and indicators on demand-based material flows (or material footprints) for use in international work (with links to the SDGs 8 and 12)[12]. This is done in cooperation with Eurostat and UN Environment. The methodology developed uses an input-output based approach and the OECD Inter-Country Input-Output (ICIO) database13 to estimate raw materials embodied in international trade. It is currently being tested and

[12] Material productivity (production-based and demand-based) is one of the OECD green growth headline indicators and is in the global list of SDG indicators.
[13] Coordinated with Eurostat's FIGARO project.

refined. Related guidance is planned to be included in the Global Material Flow Manual (UN Environment with Eurostat and OECD).

g) Modelling work. A global material resources outlook to 2060 was published in 2019 (coordinated with related work by the International Resource Panel). A global plastics outlook will be prepared in 2021-22. It will provide insights into demand for plastic materials, waste generation and recycling; and project economic drivers of plastic use, production, disposal and pollution. Other processed materials like chemicals and textiles will also be part of the analysis.

41. Most OECD data and indicators are accessible on the OECD statistical platform and disseminated through the OECD data portal and the interactive online Environment at a Glance platform[14].

42. In 2018, work to strengthen the information base for circular economy and resource efficiency policies and move towards a new generation of information on waste and materials was initiated. A small expert group was set up in 2019 to (i) reflect on the information needed and available to support integrated waste and materials management, and resource efficiency and circular economy policies; (ii) assess existing indicators and suggest new ones; and (iii) provide guidance on how best to mobilise related data in countries and at international level and on how linkages among datasets could be facilitated[15]. A broader discussion and exchange of experiences and good practices will take place at the meeting of the WPEI in November 2020. Work in 2021-22 will encompass the development of a conceptual framework for circular economy metrics for policy making, and the preparation of guidance on information and indicators needed for the transition to a resource-efficient and circular economy.

43. The information produced supports OECD policy analysis and evaluation. Waste and materials management, the circular economy and resource productivity are among the issues systematically covered in country environmental performance reviews. Several reviewed countries have chosen these topics for an in-depth review in the past years.

44. Policy work to better understand the challenges in the transition to a circular economy and the policy measures to address them includes projects on the potential of digital technologies and the role of economic instruments in the transition to a circular economy, the circular economy in specific sectors (i.e. textiles and the construction sector), trade and the circular economy, and the greening of the mining sector and extended producer responsibility in Eurasia. Work in 2021-22 will have a strong focus on plastics and the macro-economic consequences of a circular economy transition, and include an analysis of the impact of the COVID crisis on the circular economy, related activities and production and consumption patterns.

D. UNECE/FAO Forestry and Timber Section

45. The work of the UNECE/FAO Forestry and Timber Section on circular economy was kicked-off with two raising awareness sessions on forests sector's link to the circular

[14] Website "Environment at a Glance – OECD Indicators": http://www.oecd.org/environment/environment-at-a-glance/

[15] The expert group is composed of delegates to the Working Party on Environmental Information (WPEI) and the Working Party on Resource Productivity and Waste (WPRPW). The following countries and institutions are represented: Belgium, Canada, Chile, France, Germany, Japan, Luxembourg, the Netherlands, Sweden, the United States, and the European Commission, including Eurostat.

economy. The sessions were organised during the UNECE Committee on Forests and Forest Industry and the FAO European Forestry Commission, in 2018 and in 2019 (see UNECE, 2018 and 2019). Business and member states representatives attended these sessions.

46. Currently the Forestry and Timber Section is working on a study on forest and the circular economy, planned for issue in 2021 and other related stock-taking documents on how the circular concepts relate to the forest-based sector.

47. Various communication materials and events on the role of the forest sector in the circular economy have been prepared. These includes the two events "5t^{h} European Forest Week"[16] and an exhibition on "Forests for Fashion" at the 4th Session of the United Nations Environment Assembly[17].

48. The main data sources for work on forest and circular economy are

a) the Joint Forest Sector Questionnaire (JFSQ)[18], which since 2017 includes the collection of data on recovered post-consumer wood. Forestry and Timber Section coordinates its work on JFSQ with EUROSTAT, ITTO and FAO to make it a joint global collection tool covering all the regions according to the same principles. Around half of the UNECE countries provide data under this category. The data are publicly available in the UNECE database[19];

b) the Joint Wood Energy Enquiry (JWEE)[20], which includes figures on volumes of wood energy produced from recovered wood.

c) These questionnaires are the basis for exploring the issue of wood-based value chains in a circular economy. Some data is not collected by member states but calculated based on inputs and outputs from connected processes.

d) In addition, the section has just initiated the work on the development of a wood waste classification for the UNECE region, because there are no internationally recognised definitions and classifications on wood waste. Currently, the Forestry and Timber Section uses its own definitions for JFSQ and JWEE.

E. UN Environment Programme (UNEP)

49. At the fourth session of the UN Environment Assembly in March 2019, a resolution on sustainable consumption and production was adopted as a holistic approach to minimizing the negative environmental impacts from consumption and production systems while promoting quality of life, and therefore achieve sustainable consumption and production through circular economy and other sustainable economic models. UNEA

[16] News release: http://www.unece.org/info/media/news/forestry-and-timber/2019/exhibition-at-the-palais-des-nations-showcases-how-wood-based-materials-offer-solutions-for-recycling/doc.html

[17] News release: http://www.unece.org/info/media/news/forestry-and-timber/2019/forests-for-fashion-initiative-sets-new-trends/doc.html

[18] Joint Forest Sector Questionnaire: https://www.unece.org/forests/forestsfpmonlinedata/jfsq.html

[19] UNECE/FAO timber database, 1964-2018, as of July 2019: https://www.unece.org/fileadmin/DAM/timber/statsdata/flatfile-2019-08-english-no-russia.xlsx

[20] Website "Joint Wood Energy Enquiry": https://www.unece.org/forests/jwee.html

4. Resolution 1 (UNEP/EA.4/Res.1) specifies that a circular economy is 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. According to this definition, measuring the circular economy relies on a detailed understanding of material use through material flow accounts and circular economy cuts across the SDGs, particularly SDG 2, 6, 7, 8, 11, 12, 13 and 17.

50. UNEP's work on measuring the circular economy is focused on global material flow accounts and the areas that link to SDGs where UNEP is the custodian, namely, the following: SDG 8.4.1 and 12.2.1 on domestic material consumption; SDG 8.4.2 and 12.2.2 on material footprint; SDG 12.1.1 on Sustainable Consumption and Production mainstreaming; SDG 12.3.1 on food waste; SDG 12.4.1 on chemical and waste conventions; SDG 12.4.2 on hazardous waste; SDG 12.5.1 on recycling; SDG 12.6.1 on corporate sustainability reporting; SDG 12.7.1 on sustainable public procurement; SDG 12.c.1 on fossil fuel subsidies; and SDG 17.7.1 on investment in environmentally sound technology.

51. UNEP and Eurostat with the International Resource Panel have recently finalized a global manual on economy-wide material flow accounts (EW-MFA). This first edition of the global EW-MFA manual represents an important step towards a global accounting standard. Its objective is to provide guidance to environmental statistics experts in national statistics offices across the globe to build capacity for EW-MFA at the national level and to report progress towards SDG targets 8.4 and 12.2.[21] The manual also provides information on the needs in terms of improving the demand-based measures for material flows which would be needed to develop the material footprint.

52. UNEP is supporting OECD in their research agenda on demand-based measures. This work has been recognised through the SDG process and in the SDG metadata for SDG 8.4.1, 8.4.2, 12.2.1 and 12.2.2. UNEP, through the International Resource Panel, also maintains a Global Material Flows Database[22] with material flows and resource productivity data and indicators providing a comprehensive understanding of linkages between the world economy, population and material use for more than four decades; a concrete operational application of the database in relation to measuring the circular economy is the Sustainable Consumption and Production Hotspots Analysis Tool[23], which provides powerful visual analysis of the material footprints and other environmental, social and economic pressures and impacts to point at hotspots of unsustainable consumption and production in sectors of any economy.

53. In a circular economy due attention should be given to keeping chemicals of concerns away or easy-to-separate from recycled streams, to ensure there is no damage to health and the environment. In addition, in order to promote the circular economy, there is a need to reduce use and maximize reuse (i.e. prevent waste) and minimize the generation of waste. The International Resource Panel is advancing awareness and knowledge of the circular economy and value retention process (VRP) products that are capable of further decoupling economic growth and resource consumption. Adoption of VRPs (such as reuse, repair, refurbishment and remanufacturing) could extend products' lives and reduce raw material by 80-99%, decrease GHG emissions in some sectors by 79-99% and generate green jobs, reduce costs and stimulate innovation (see IRP, 2018).

[21] The global manual will be released by July 2020. A draft is available from UNEP upon request.
[22] Global Material Flows Database: https://www.resourcepanel.org/global-material-flows-database
[23] SCP-HAT: http://scp-hat.lifecycleinitiative.org

54. UNEP has been working with UNSD, UN-Habitat and other partners and experts to promote the work on waste statistics. Particularly, for monitoring SDG 11.6.1 on municipal solid waste, SDG 12.3.1 on food waste, SDG 12.4.1 on chemicals and waste multilateral environment agreements, SDG 12.4.2 on hazardous waste and SDG 12.5.1 on recycling. The development of these methodologies has been through a series workshops and consultations[24]. UNEP is currently finalizing a global manual on measuring waste in the context of the SDGs.[25]

55. UNEP has worked with governmental officials, experts, UN colleagues and One Planet Network partners to develop, pilot test and collect data on SDG 12.1.1 on SDG 12.1.1 on Sustainable Consumption and Production (SCP) mainstreaming and SDG 12.7.1[26] on sustainable public procurement (SPP). These methodologies aim to measure the policy frameworks which underpin a Government's effort towards achieving SCP through circular economy approaches and SPP.[27]

56. Corporate sustainability reporting is important for encouraging companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle. UNCTAD and UNEP have developed a methodology for measuring SDG 12.6.1 which builds upon existing corporate sustainability reporting standards and frameworks as a basis for a minimum standard of core reporting indicators.[28] In this context, UNEP and UNCTAD have developed guidance which facilitates the assessment of the quality of these reports through the integration of targeted sustainability information into the annual reporting cycle of companies, and which highlights progress in sustainability practices by companies.

57. Reducing fossil fuel subsidies is essential for promoting a green economy and reducing carbon emissions. UNEP has developed a methodology to measure fossil fuel subsidies to provide guidance to UN member countries reporting on this indicator (see UNEP, OECD and IISD, 2019). In order to measure fossil fuel subsidies at the national, regional and global level, three sub-indicators are recommended for reporting on this indicator: 1) direct transfer of government funds; 2) induced transfers (price support); and as an optional sub-indicator 3) tax expenditure, other revenue foregone, and under-pricing of goods and services. Reducing fossil fuel subsidies facilitates the transition to a circular economy.

58. The importance of Environmentally Sound Technology was first emphasized during Rio Earth Summit in 1992 and then was re-emphasised in the Addis Ababa Action Agenda. The purpose of SDG 17.7.1 is to track the total amount of approved funding to promote the development, transfer, dissemination and diffusion of environmentally sound technologies.[29] UNEP is working to analyse Harmonized System (HS) codes to better understand trade in environmentally sound technology and developed a methodology for countries wishing to track domestic investment in environmentally sound technology (with similarities to the methodology for measuring the Environmental Goods and

[24] See information on expert consultations here: https://uneplive.unep.org/egm/international.

[25] The global manual will be released by August 2020. A draft is available from UNEP upon request.

[26]

[27] More information on the methodologies for SDG 12.1.1 is available at: https://uneplive.unep.org/indicator/index/12_1_1 and for SDG 12.7.1: https://uneplive.unep.org/indicator/index/12_7_1

[28] For more information on the methodology see: https://uneplive.unep.org/indicator/index/12_6_1

[29] For more information on the methodology see: https://uneplive.unep.org/indicator/index/17_7_1

Services Sector). Moving forward towards material circularity and the vision of a circular economy, life-cycle considerations must be taken into account in the promotion of Environmentally Sound Technologies.

F. United Nations Statistics Division (UNSD)

59. UNSD has been collecting waste statistics through the UNSD/UNEP Questionnaire on Environment statistics since 1999 from over 160 countries and areas not covered by OECD and Eurostat in their data collection. Both data collection processes are well coordinated, and the questionnaires are fully compatible using identical definitions and classifications. Given the importance of providing official waste statistics for international reporting, and that UNSD is co-custodian for SDG 11.6.1 (Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal waste generated, by cities), SDG 12.4.2 ((a) Hazardous waste generated per capita; and (b) proportion of hazardous waste treated, by type of treatment on hazardous waste) and SDG 12.5.1 (National recycling rate, tons of material recycled on recycling), as well as contributes data for SDG indicator 12.3.1 ((a) Food loss index and (b) food waste index), several modifications have taken place in, and additional variables have been added to, the biennial UNSD/UNEP Questionnaire in the most recent data collection rounds. For example, more detailed variables on electronic waste were added to the ongoing 2020 data collection round, and plans for expanding to include, inter alia, more variables on food waste, recycling of electronic waste, as well as controlled recycling, composting and incineration, in addition to 'controlled landfilling', are being considered for future rounds. Data are disseminated in the form of Indicator Tables[30], Country Files[31] and Country Snapshots[32].

60. Although a response rate of over 50 per cent has been reached in the latest two data collection rounds, there is still much scope for improvement in response rates. Data completeness and data quality also remain a challenge, especially for developing countries, and national capacity constraints (financial, human, technical) continue to be a concern. Given the importance of producing national data on waste for quality and informed decision-making, for the measurement of the circular economy, and the fact that these data are extremely pertinent to the monitoring of several SDGs, it is critical to improve the production of waste statistics, as well as increase training and capacity-building in this area. More details on the results of past data collections and plans for the UNSD/UNEP Questionnaire can be found in the Report of the Secretary-General on Environment Statistics (Part C) and the Background Report (Part 1) submitted to the fifty-first session of the Statistical Commission (New York, 3-6 March 2020) (see United Nations, 2020a and 2020b).

61. In terms of methodological work related to waste statistics, UNSD produced the Framework for the Development of Environment Statistics (FDES, United Nations, 2013) that is a flexible, multi-purpose conceptual and statistical framework that marks out the scope of environment statistics. Component 3 on Residuals of the FDES is closely related to the physical flow accounts (flows from the economy to the environment) of the SEEA-CF on which the terms and definitions are based, where relevant. This component contains statistics on the amount and characteristics of residuals generated by human production and consumption processes, their management, and their final release to the environment and includes a Sub-Component 3.3 dedicated to the Generation and Management of Waste. Furthermore, the Manual on the Basic Set of Environment

[30] Website "UNSD Environmental Indicators": https://unstats.un.org/unsd/envstats/qindicators

[31] Website "Country files from the UNSD/UNEP data collection on environment statistics": https://unstats.un.org/unsd/envstats/country_files

[32] Website "Country Snapshots": https://unstats.un.org/unsd/envstats/snapshots/

Statistics, and specifically its methodology sheet on the Generation and Management of Waste, offers detailed and in-depth methodological guidance including definitions, classifications, statistical methods for collection and/or compilation, dissemination and main uses of statistics on generation and management of waste[33].

62. UNSD has promoted the use of the SEEA for circular economy through two initiatives on the policy applications of the SEEA. The first is the production of a set of forthcoming papers on the policy applications of the SEEA under a BMZ-funded project, Enhance Natural Capital Accounting Policy Uptake and Relevance (EnhaNCA). This set of papers comprises an overview paper on the overall policy applications of the SEEA and individual issue papers on the use of the SEEA for biodiversity, climate change and macroeconomic policies. In particular, the overview paper highlights the use of the SEEA for circular economy and includes the aforementioned *Sankey Diagram of Material Flows,* produced by Eurostat. A set of e-Learning courses based on these papers will also be produced, aimed towards policy makers and analysts.

63. In addition, UNSD and the United Nations Committee of Experts on Environmental-Economic Accounting (UNCEEA) are working on a publication highlighting narratives and use cases for the SEEA's application to policy. This publication will be aimed towards policy makers, with the goal of raising the profile and increasing demand for the SEEA. A narrative and/or use case on the application of the SEEA for circular economy will likely be included.

IV. Country practices

A. Belarus

64. Belarus belongs to the group of countries that have just begun to consolidate the issues of the circular economy at a high political level. In particular, the need for a transition to a circular economy is reflected in the draft *National Strategy for the Sustainable Development of the Republic of Belarus until 2035* (Government of the Republic of Belarus, 2018), which outlines the issues of efficient use of available resources, waste management and production of goods from secondary raw materials.

65. At the national level, particular importance is attached to waste management. As part of the implementation of the strategy for the management of municipal solid waste and secondary raw materials[34], it is expected that by 2035 the share of municipal solid waste used in their generation will reach 50.2%. Also in January 2020, the decree "On a phased reduction in the use of polymer packaging" (Council of Ministers of the Republic of Belarus, 2020) came into force.

66. In terms of borrowing experience on issues of the circular economy, Belarus finds support in international projects. For example, currently with the support of Germany, the country is implementing the project *Capacity Building for Strategic Planning and Management of Regional Structural Transformations in Belarus in the Context of the Circular Economy* (2019-2020), the main result of which will be the preparation of a draft

[33] Website "Manual on the Basic Set of Environment Statistics": https://unstats.un.org/unsd/envstats/fdes/manual_bses.cshtml

[34] Website "National strategy for the management of municipal solid waste and secondary material resources in the Republic of Belarus for the period until 2035": http://www.mjkx.gov.by/vtorichnye-mat-resursy/item/481-natsionalnaya-strategiya

program for the development of the circular economy in the Brest Region (one of the seven regions of Belarus) for 2021-2025. See Wuppertal Institut (2020).

67. In turn, Belstat contributes to the monitoring of the circular economy in Belarus: physical flow accounts for water and timber have been formed; environmental protection expenditure accounts and environmental taxes accounts are under development; estimation of the E-waste generated at the national level is underway. Together with the Ministry of Housing and Utilities Services and the Ministry of Natural Resources and Environmental Protection, work is underway to improve the statistical reporting forms for collecting data on waste and secondary raw materials.

B. Canada

68. With the view of developing relevant indicators and data products to measure Canada's transition to a more circular economy, Statistics Canada has been meeting with other federal departments on a regular basis to discuss current and upcoming policy priorities and how to potentially measure various aspects of circularity to assess the effectiveness of these policies.

69. In response to *Canada's zero plastic waste initiative*[35], Statistics Canada has been working with Environment and Climate Change Canada to develop relevant indicators as well as a material flow account for key plastics in the Canadian economy. This project is currently in its developmental stage, with an aim to produce a preliminary material flow account table in the fall of 2021.

70. In preparation for the next phases of development, Statistics Canada has also been conducting general research and has opened discussions with Natural Resources Canada, and a regional municipality regarding other aspects of the circular economy that may become a future priority (e.g., circularity of metals and food). Statistics Canada will also be represented at the next World Circular Economy Forum, planned for September 2021.

71. Over the past two years, Statistics Canada has also been working to improve data on business expenditures related to environmental protection, including measures aimed at increasing circularity (e.g., materials recycling and water recirculation).

C. Colombia

72. Recognizing the relevance and impact of the circular economy, Colombia has established its commitment to move towards it under the *Sustainability Pact of the National Development Plan 2018-2022*. The transition to the circular economy model must be accelerated through the reduction, reuse and recycling of waste and materials; as well as the efficient use of resources. To implement this objective the Ministry of Environment and Sustainable Development (MADS) assisted by other entities formulated the *National Strategy for the Circular Economy* (ENEC), which defines instruments for achieving the country's short and medium-term goals in this area. See Government of Colombia (2019).

73. ENEC advocates a for the creation of a new model of economic development that includes the continuous valorisation of resources, the closing of material, water and energy cycles, the creation of new business models, the promotion of industrial symbiosis and the consolidation of sustainable cities, with the aim, among others, of optimizing

[35] Website "Zero plastic waste: Canada's actions": https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/zero-plastic-waste/canada-action.html

efficiency in the production and consumption of materials, and reducing the water and carbon footprint. The Strategy establishes six priority lines of action that focus its development and help to structure the work plan: i) flow of industrial materials and mass consumption products; ii) flow of packaging materials; iii) biomass flows; iv) energy sources and flows; v) water flows; and, vi) flow of construction materials.

74. By initiative of the National Administrative Department of Statistics (DANE), the development of a *Circular Economy Information System* (SIEC) was established as a strategic pillar of the ENEC. The system is conceived as an articulated set of components that interact with each other to collect, consolidate, process, produce and disseminate statistical information related to the circular economy. Thus, the SIEC will integrate the statistical information that meets quality requirements and that can be used as input for the public policy decision-making process.

75. In order to contribute to the consolidation and development of the SIEC, in May 2019 the *Table of Circular Economy Information* was launched, with the purpose of articulating the entities of the National Statistical System, around the identification, strengthening and generation of relevant and timely information required for decision making and evaluation of public policy associated to the circular economy. The creation of this mechanism has revitalized a process that before was framed under the Table of Environmental Statistics, which was created in 2017 to generate articulation and agreements on the production of statistics on environmental matters.

76. As a result of the work carried on the Roundtable of Circular Economy Information, and within the framework of the SIEC design, the *Circular Economy First Report 2020* was launched on August 5th, 2020 (DANE, 2020). This report illustrates the state and opportunities of Colombia to move towards the model of production and consumption proposed by the circular economy. To this end, it initially has 44 indicators, of which 28 are taken from the *Environmental Satellite Account (CSA)*, 14 from economic, environmental, and household surveys, and 2 from the *Institute of Hydrology, Meteorology and Environmental Studies (IDEAM)*. These indicators are classified into 4 components: i) extraction of environmental assets, ii) production of goods and services, iii) consumption and use, and iv) closure and optimization in the life cycles of materials and products.

D. Finland

77. *Circular Economy Roadmap for Finland*[36] by The Finnish Innovation Fund Sitra was published in 2015 and updated to version 2.0 in 2019. The Roadmap includes policy actions, key projects and pilots to facilitate transformation from linear to circular economy and has also been a driver behind many measurement initiatives. One action included the Roadmap is to 'Develop a comprehensive set of indicators that describe the development of Finland's circular economy'.

78. *CIRCWASTE*[37] is a seven-year (2016-2023) LIFE IP project that promotes efficient use of material flows, waste prevention and new waste and resource management concepts. All actions contribute to implementing the national waste management plan and directing Finland towards a circular economy. The project is coordinated by the Finnish Environment Institute. As part of the CIRCWASTE project, the Finnish Environment

[36] Website "Finland's Road Map to the Circular Economy 2.0": https://www.sitra.fi/finlandsroadmap

[37] Website "CIRCWASTE: Finland towards circular economy": https://www.materiaalitkiertoon.fi/en-US

Institute is compiling social circular economy indicators, such as waste sorting and recycling accessibility for households.

79. Statistics Finland is contributing to CIRCWASTE project by compiling Circular Economy Business indicators. Indicators are planned to be published by end-2020 for years 2016 – 2018. The indicators may be monetary, physical or a combination of these and will be collected from existing statistical data. The focus on national level data and indicators but search also for possibilities to produce regional indicators and data as the demand for them is very high in political decision making. The work is still ongoing but, among others, Structural Business Statistics, Waste Statistics and Material Flow Accounts will be used as source data for the indicators.

80. Natural Resource Institute Finland is working on recycling and other circular issues in agriculture and in food production chains. In addition, they have many research programs in their new strategic objectives, including Climate smart carbon cycles and Circular bioeconomy. Finnish Environment Institute has assessed nutrient cycles within a project Nutrients, energy and livelihood for the countryside from a biogas plant (BioRaEE). Also, they have studied water and harmful substances in circular economy context. In VTT Technical Research Centre of Finland, the circular economy related research include circular plastics and redesigning mineral and metal loops.

E. The Netherlands

81. The Dutch government has set a goal for the Dutch economy to be completely circular by 2050, with an intermediate goal aiming at a 50 percent reduction in the amount of primary abiotic material use by 2030. To achieve this, the *Government-wide Programme for a Circular Dutch Economy by 2050* was developed[38]. This programme outlines how the Dutch economy can be transformed into a sustainable, fully circular economy by 2050. It describes what needs to be done to ensure the use of raw materials, products and services in a smarter and more efficient way.

82. The central government's approach is to work closely together with other public authorities, knowledge institutions and environmental organisations, industry, trade unions, financial institutions and other civil-society organisations. An example is the *National Raw Materials Agreement*, a document that contains agreements on having the Dutch economy operate on the basis of reusable raw materials. It was signed by more than 180 parties[39]. Key to this approach is also the establishment of five transition teams which include, among others, members of companies, environmental agencies and consumer organizations. Each team focuses on the development of a transition agenda for one of the five priorities set by the government. The priorities set are sectors and value chains of economic importance and high environmental burden, which are 1) biomass and food, 2) plastics, 3) manufacturing industry, 4) construction and 5) consumer goods. The transition agendas also give thought on how to measure progress and effects.

83. A monitoring system is required to determine whether the transition is progressing as planned, a first proposal was published in 2018 (PBL, 2018). The report presents a framework and baseline assessment for monitoring the progress of the circular economy in the Netherlands. In 2019 the *Circular Economy Implementation Programme* was presented by the government, which translates the five transition agendas in concrete actions and projects to be put into effect between 2019 and 2023. To monitor and evaluate

[38] Website "Circular Economy": https://www.government.nl/topics/circular-economy

[39] Website "National Raw Materials Agreement": https://www.government.nl/latest/news/2017/01/25/more-than-180-signatories-for-the-national-raw-materials-agreement

both the progress towards and the effects of a circular economy the *Work Programme Monitoring and Control Circular Economy 2019-2023* was developed. The monitoring is done by a consortium of eight knowledge institutions[40], among which are Statistics Netherlands (CBS) and the Environmental Assessment Agency (PBL).

84. One of the main outputs of the work programme will be a *biennial Integrated Circular Economy Report* of which the first will be published by the end of 2020. The main goal of this report is to measure the progress of the transition. However, the goals set by the government are formulated in general terms and to make them measurable further specification is required. Furthermore, the ultimate goal of a circular economy is not the reduction of material use, this is just a way to reduce environmental impact, to become less resource dependent and to create economic opportunities. These issues were discussed by the Environmental Assessment Agency (PBL), Statistics Netherlands (CBS) and The Netherlands Organisation for Applied Scientific Research (TNO) in a policy brief on the operationalization of the CE goals that was published in 2019[41].

85. Statistics Netherlands is mainly contributing to the Integrated Circular Economy Report by compiling indicators. The required data is obtained from various sources, among which are the Environmental Accounts (SEEA) and Environmental Statistics, but also other (external) data sources used. The Material Flow Monitor (MFM) (CBS, 2019) for instance, provides useful insights into the physical material flows (in kilos) to, from and within the Dutch economy. The MFM is for instance used to compile the Circular Material Use Rate. Similarly, a Bio-Monitor is currently being developed that focusses on the biotic flows within the economy. In addition to physical indicators on waste flows, material use and emissions, also socio-economic indicators such as employment and value added of the circular economy and compiled. Finally, also footprint indicators like the material and carbon footprint are compiled to get a better understanding of the environmental effects throughout the whole supply chain, including effects abroad.

V. Issues and challenges

86. There are various issues and challenges in measuring circular economy from a statistical standpoint. Topics discussed in this chapter are:

a) *measurement scope* – in order to successfully measure the circular economy and interpret the results, there needs to be a common understanding of the concept and what should be measured;

b) *definitions and classifications* – existing statistical classifications have been developed for the linear economy and thus require review and harmonization to enable the measurement of circular economy activities;

c) *data availability and fitness* – current knowledge of circularity largely concerns trends in energy, material flows and waste while there are important data gaps such as the effect of actions that relate to smarter product use and manufacturing, collection systems or extending the lifespan of products. Measurement and monitoring of the environmental, social and economic outcomes along the value chain requires improvements;

d) *Coordination across institutions and within the NSO* - official statistics can not provide data for all the different aspects of the circular economy and there should be engagement with other data providers and users particularly policy

[40] https://www.pbl.nl/monitoring-circulaire-economie/consortium (Dutch only)
[41] https://www.pbl.nl/publicaties/doelstelling-circulaire-economie-2030 (Dutch only)

makers, civil society, companies and research communities to develop the knowledge base;

e) *Demand and expectations by users* (e.g. policy makers, research etc.) – the need to react quickly at times to new data needs is a challenge for a NSO, particularly if it requires launching new content on surveys or producing new accounts;

f) *Dissemination* – in addition to producing relevant data on the circular economy, new methods and tools are needed to understandably and efficiently communicate to users;

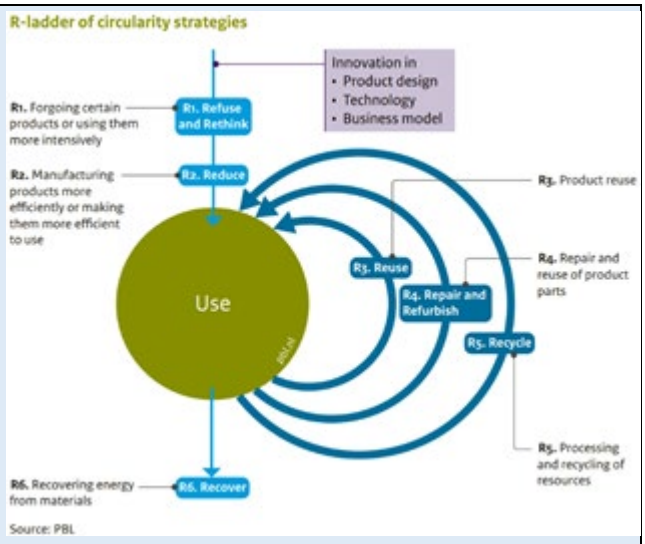
g) *Other* - measures are also needed for the interlinkages between circularity, climate neutrality and pollution as well as the social domain.

A. Measurement scope

87. In order to measure the circular economy, there needs to be a common understanding on what is to be measured, how to interpret the results and what is to be included when compiling economic indicators for the circular economy. Some economic activities, such as recycling, are widely accepted as being integral aspects of circularity. However, for many activities especially in the services field, this is less clear. Such activities are for instance design, leasing and maintenance.

Text Box 2: "R-ladder"

This circularity ladder was set up by PBL (2019), based on various R-ladders in the literature. The R-ladder describes various strategies that contribute to a reduction in the use of materials and to a more circular economy. One of the final goals is to reduce the environmental burden.



The strategies are:
• R1: Refuse and Rethink. This strategy concerns forgoing certain products (Refuse) or using them more intensively by sharing them or through multifunctionality (Rethink).
• R2: Reduce. Reduce concerns a more efficient manufacturing of products or making them more efficient to use.
• R3: Reuse. The lifespan of products can be extended by using them again (reuse).
• R4: Repair and Refurbish. This strategy is also about extending the lifespan of products, but in this case by repairing them (Repair) or, reusing certain parts (Refurbish), or adapting them to new standards.
• R5: Recycle. This strategy concerns the processing and reusing of resources (Recycle). This includes processing and separation of so-called residual flows (or waste flows) and reusing them.
• R6: Recover. The Recover strategy concerns recovering energy from certain materials.(PBL, 2019)

As a rule of thumb, strategies higher up on the ladder (such as those for rethink, reduce, reuse and repair) require fewer resources. Recycling and recovering energy from materials only become options when other 'higher' R-strategies are no longer possible.

R-strategies can be combined with innovations such as new product design, technologies and business models. Generally speaking, the largest environmental benefits are obtained if resource-reduction innovations are considered early in the production chain. Product design, for example, has an impact on lifespan and repair options, as well as on the possible use of secondary resources (recyclate) and how easily products can be recycled. (PBL, 2019)

88. The lack of an agreed definition of the circular economy means that existing statistical sources only provide part of the picture. These sources provide fragmentary pictures, lack detail or, in some cases, have imperfect quality. SEEA can have a role in integrating existing statistics and aligning classifications and definitions. Moreover, the experience from SEEA Environmental Goods and Services Sector (EGSS) and Environmental Protection Expenditure Accounts (EPEA) can be useful but must be adapted to the scope of the circular economy sector.

89. At a European level, statisticians have focused the development of CE measures mostly on physical flows of materials. This has led to developing indicators for a more limited scope rather than the broader scope of the circular economy concept. In addition to these flows of materials, more information is also needed about economic aspects of the circular economy. A conceptual framework for is needed to measure growth, jobs, investments, etc. of the CE sector.

90. Is there a need for common definition? Eurostat sees that the CE paradigm has taken been taken up by policy makers partly because it is a vague concept that diverse audiences can make their own by interpreting it differently. If statisticians establish a tight CE definition, this risks leaving out potentially relevant users. On the other hand, if there is no common understanding, it can lead to each country and international organization developing their own indicators which are not comparable. This may also result in inefficiency in data usage and overlapping data collections.

91. Since many countries have recently started to incorporate the concept of the circular economy in the development of policy measures, an internationally accepted definition would help facilitate the development of internationally comparable statistics to measure the effectiveness of these policies. It could be difficult to adapt the national data products to meet international standards, if the later appear after countries begin compiling data using their own definitions.

B. Definitions and classifications

92. Circular economy is a phenomenon that is present across most of the sectors and kinds of activities. Various existing statistics ranging from business to education and social well-being and environment to industries can be utilized to develop indicators for circular economy. However, sometimes the definitions of the existing statistical sources are not aligned.

93. Eurostat has created a list of circular economy industries based on NACE/ISIC classification. The list covers well the 'traditional' sectors involved in circular economy, such as recycling and waste management. However, circular economy is present in all stages of the product life cycle from design to use, recycle etc. To drive circular economy, all activities leading to circularity should be measured. For example, sustainable design and efforts to lengthen product life cycle to minimize waste are essential parts of

circularity. It is questionable if NACE/ISIC classification can be utilized to measure all these activities.

94. On product level, there are various classifications, such as CN for trade statistics, PRODCOM for production of manufactured goods, List of Waste for waste statistics and CPA for products. The product classifications are not fully consistent with each other making following material flows through different statistical domains difficult or impossible. In addition, product classifications rarely distinguish between using virgin or secondary raw materials or re-/upcycled intermediate inputs.

95. In order to combine statistics to capture the whole picture of circularity and track flows of materials, there needs to be a way to link all classification. In practice, this may also mean figuring out how to fit together different statistical units. Many of the physical flows are collected in kilograms or tonnes. In addition, energy is in terajoules, air emissions in tonnes or kilograms, financial flows in national currencies, etc.

96. One example of the lack of internationally recognized definitions and classifications is on wood waste where the definitions used by UNECE, Eurostat and the World Customs Organization differ from each other.

97. In general, there is a great need for harmonization and coordination of classifications. In order to measure the flow from extraction of raw materials to product to recycling and new products and eventually to waste, there needs to be traceability and links between statistical classifications of different stages of product life cycles. An important step forward would be the alignment of classifications regarding material flows and wastes. In addition, calculation of MFA by sector would also enable improved integration of environmental and economic data.

C. Data availability, data fitness

98. More information is needed about the characteristics of the circular economy and key enabling factors. Existing indicators focus primarily on physical parameters and current knowledge of circularity largely concerns trends in energy, material flows and waste. Important data gaps such as the effect of actions that relate to smarter product use and manufacturing, collection systems or extending the lifespan of products, are key enabling factors for the circular economy. Measurement and monitoring of the environmental, social and economic outcomes along the value chain requires clear improvement.

99. For many SEEA accounts, the source data is collected from other statistics and it is aggregated already to a certain level. This lack of disaggregated statistics can hinder developing new kinds of analysis. Additionally, the source data can be collected from companies in (local) kind of activity or company level or from for example companies that manage others waste. In the latter case it is very difficult to make analysis on the waste producers because the information is lost during the waste collection. If register data is used as the source data, the content is fixed and usually there is no possibilities for big changes in data collection and substance.

100. Waste and materials statistics collected to support policy implementation are largely volume based rather than value based. There is a lack of information on the quality of recycled materials produced and market price is currently used as a proxy. In order to support circular economy objectives there is a need to develop data on waste and material recovery from the angle of value retention.

101. One sometimes suggested, but not very practical option, would be to measure circular economy by making company lists of the most significant circular economy companies. In principle, Enterprise ID enables tracking flows of money and products throughout several statistics. However, this is very labour intensive and often circular economy is done within large enterprises that take part in many kinds of activities. Circular economy activity which may be only a support activity for a company, can be of great significance in national indicators if the company in question is large enough. However, based on existing statistics it is quite difficult to separate circular activities and personnel from the total. Different kinds of circular activities can exist within all types of kind of activity units.

102. Some flows are better covered in existing statistics. For example, statistics on resource extraction are relatively well covered, but waste statistics and material flows within production chains are not covered that well, especially in developing countries. Data gaps also exist in recording use of secondary materials vs. other materials. SEEA material flow accounts and waste accounts are cornerstone to measurement of the circular economy. Many countries have yet to develop the statistics need to produce these accounts, as, for example described in paras. 59 and 60 for the case of waste statistics. Other relevant SEEA accounts are air emission accounts, energy accounts, forest accounts (for biomass), land accounts, etc. However, SEEA is not well placed to cover several aspects of the CE, e.g. waste prevention, reparability of products, environmental footprint of individual products, innovation, patents, eco-design, green public procurement, local aspects (e.g. city mobility), etc.

103. Contrarily to material flow statistics, there are hardly any data on material stocks statistics, e.g. volume of physical stocks of buildings, infrastructure, etc. This is an important data gap. Every year our societies accumulate more stock, in the EU circa 33% of the extractions of natural resources are used to accumulate stock.

104. Only about half or UNECE member states provide data on recovered post-consumer wood and volumes of wood energy produced from recovered wood.

105. In the future there will be demand for more detailed specific topics and material breakdowns which are not possible with current data classifications. Even now, more detailed data about plastics, chemicals and pollutants are needed. Statistics Canada has done initial work on plastics that has highlighted several data gaps that will need to be filled. Some of the data gaps can be filled with added survey content, while others will be filled by creating a new national material flow account. These additions will be time consuming and costly but are required to provide a clear picture on relevant changes in the circularity of various plastic resins in the Canadian economy over time.

D. Coordination across institutions and within NSOs

106. Policy relevant assessments involve bringing together a range of information so indicators and statistics will always need to be complemented by qualitative information and policy analysis to provide a broader perspective of developments. This means official statistics will not provide data for all the different aspects of the circular economy and there should be engagement with other data providers and users particularly policy makers, civil society, companies and research communities to develop the knowledge base. Circular economy has also other aspects than environment, such as social, education, equality.

107. In a global economy where many companies are multinational and materials flow between countries, there is also need for NSO level cooperation especially when it comes to foreign trade data. In order to understand the full life span of products it often needs to

be tracked outside of national limits. Often it is easier to exchange views and sometimes even data directly between NSOs and international organisations could work on facilitating and coordinating the data exchange.

108. More estimates of material footprints are needed. This work requires SEEA accounts and more input-output tables for more countries around the world. In turn this requires international cooperation. Developing IO modelling, i.e. environmentally extended multi-country input-output tables for as many countries as possible around the world needs further coordination across international institutions and with NSO (there is ongoing work but not achieved yet).

109. There is a need for coordination and cooperation at all levels. On the grassroot level, experts from different statistical domains need to join forces within NSOs. NSOs need to coordinate efforts both with other national operators, such as research institutions, as well as internationally amongst each other. In addition, facilitation and international guidelines are required from international organisations both for coordinating the development efforts and harmonizing data as well as further developing Sankey diagrams and similar dissemination tools.

E. Demand and expectations by users (e.g. policy makers, research etc.)

110. Given that the concept of the circular economy is a relatively new focus for our partners, policy departments have only recently begun to discuss and research a common definition and policy outcomes related to a more circular economy. It is a challenge for a NSO to react quickly at times to new data needs, particularly if it requires launching new content on surveys or producing new accounts. This process can be costly, time consuming, and increases response burden.

111. Official statistics shed some information on the circular economy, albeit imperfectly. As previously noted, for various reasons statisticians cannot provide data for all the dimensions of the CE. For some areas other communities are better placed to produce estimates, e.g. about individual critical raw materials, life cycle of individual products, innovation, etc. Coordination with other data providers is needed.

112. For policy purposes, timeliness and regional dimension are often in high demand especially when it comes to aspects of circular economy that are location specific and resource/labour intensive, such as waste management. This puts pressure on measurement and indicator development since many of the existing statistics and data have been originally developed to serve different purposes. There may be a need to accept that sometimes the perfect indicator will not be available to serve all needs and proxies may need to be developed to describe some aspects of the CE.

F. Dissemination

113. In order to communicate efficiently, the main users of data must be identified. Different kinds of dissemination tools and methods may be needed for different user groups. For some users the data needs to be highly processed and analysed and served in forms of graphs, visualisations and infographics. On the other hand, some users will prefer raw data in an open data format. In addition, explaining complicated concepts such as final demand and intensities to the general public can be challenging.

114. There is a need for new statistical indicators and communication tools to be adapted to the circular economy. EEA has used various infographics and visualisations in

circular economy assessments to try and present data in an engaging and accessible way. These include the overall visualisation of the circular economy concept and recently visualisation of the material flows through the EU economy, plotted on the EEA circular economy framework (EEA, 2019).

115. Eurostat has actively developed metrics, methodologies and dissemination tools for circular economy, including a Sankey diagram (see paragraph 31 and Figure 3) and infographics (see Figure 4) for material flows and circular material use rate (CMU, see Figure 5). Some these indicators have already been produced on country-level by NSOs, such as the material flow Sankey diagram by CBS Netherlands (see Figure 6).

Figure 4: Eurostat infographics on material flows in the EU (2017, Gt/year)

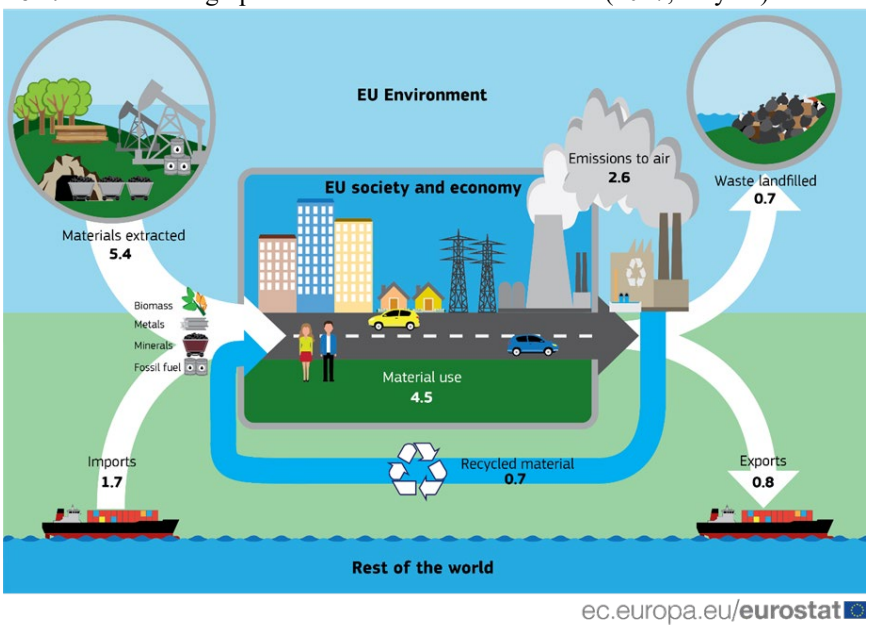


Figure 5: Eurostat infographics on circularity rate in EU (2017)

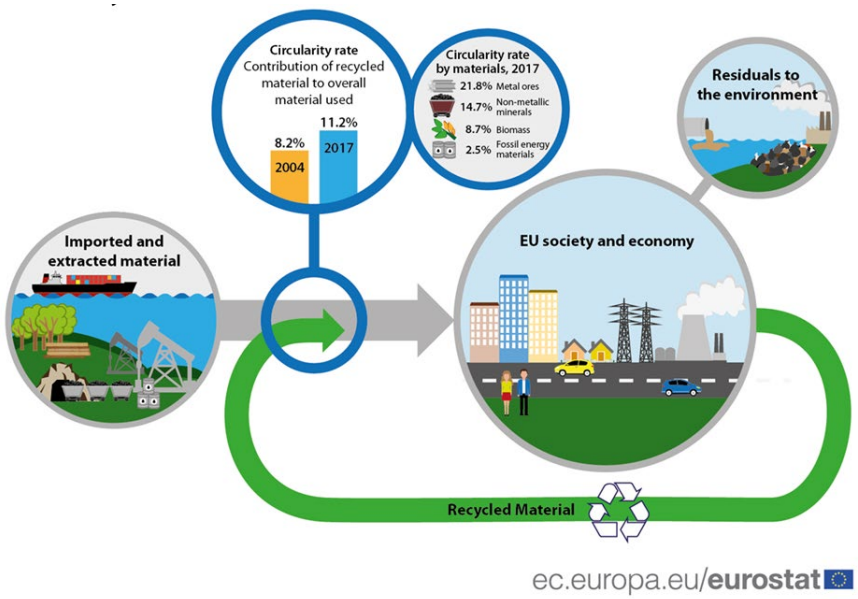
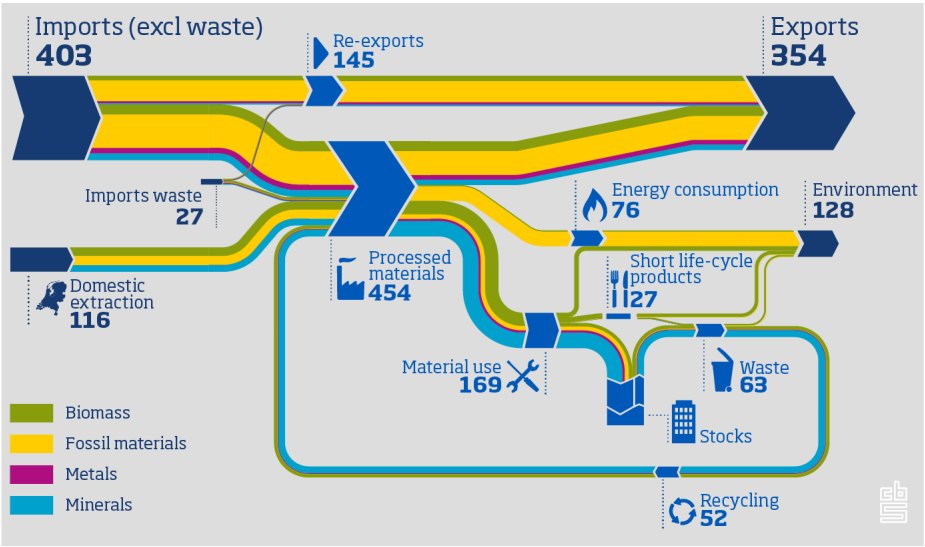


Figure 6: Sankey diagram of material flows in the Netherlands (2016)



G. Other

116. An important consideration is the relationship between policies for circular economy, bioeconomy and climate-neutral economy and their potential synergies and trade-offs. Better measures are needed for the interlinkages between circularity, climate neutrality and pollution. In terms of measurement this will require better measures of the interlinkages between material flows, waste, energy and emissions to air and water. SEEA has a role to play in further integrating these data and also better understanding of economy-environment interactions.

117. Furthermore, the linkages with the social domain are to be taken into account. For example, a CE may contribute to the creation of green jobs, and also the informal sector usually plays an important role in waste reduction and recycling.

VI. Conclusions and recommendations

118. Circular economy is an emerging topic of high political relevance. However, there is no single or internationally agreed upon definition of a circular economy.

119. The definitions used by countries, international institutions and NGOs have many common elements, but measuring the circular economy from a statistical point of view is still not possible in a comprehensive and fully internationally comparable manner. There are various issues and challenges which require further methodological work, coordination and practical guidelines, including:

a) Clarification of the measurement scope;

b) Harmonisation of definitions and classifications;

c) Improvement of data availability and fitness, including the use of SEEA;

d) Coordination across institutions and within NSOs;

e) Understanding the demand and expectations by users (e.g. policy makers, research etc.);

f) Use of new tools to efficiently communicate data relevant for circular economy;

g) Consideration of interlinkages with other social, economic and environmental domains such as informal waste handling, green jobs, climate change and sustainable development.

120. Several international expert groups exist which are addressing or plan to address some of those issues:

a) The „Bellagio process": EEA in partnership with the Italian Institute for Environmental Protection and Research (ISPRA) are taking forward this initiative which aims at building consensus on 'What to Monitor' and use best-practice examples as well as innovative ideas to identify shared principles on 'How to Monitor'. These principles will then form the basis for further developments around indicators and monitoring frameworks in support of the European Green Deal.

b) Eurostat's work related to the "EU Monitoring Framework for the Circular Economy", including methodological development on measuring the circularity rate and improvements of Sankey diagrams;

c) OECD's "Expert Group on a new Generation of Information on Waste and Materials": This small expert group, in its work program 2020-2021, will encompass the development of a conceptual framework for circular economy metrics for policy making, and the preparation of guidance on information and indicators needed for the transition to a resource-efficient and circular economy.

d) The United Nations Committee of Experts on Environmental-Economic Accounting (UNCEEA) is working on a publication highlighting narratives and use cases for the SEEA's application to policy. This publication will be aimed towards policy makers, with the goal of raising the profile and increasing demand for the SEEA. A narrative and/or use case on the application of the SEEA for circular economy will likely be included.

e) UNECE's and FAO's work streams related to exploring the issue of wood-based value chains in a circular economy.

f) UNEP's methodological work related to economy-wide material flow accounting in the context of sustainable production and consumption.

121. The main recommendations are:

I. **Strengthening coordination and communication** of work of international organisations and their expert groups working on different issues related to measuring the circular economy.

II. **Drafting of practical guidelines**, including

i. Clarification of key terms and definitions;

ii. Presenting key statistics and indicators needed from the policy point of view;

iii. A description of the role of SEEA versus other data sources;

iv. A discussion of required institutional collaboration.

It is proposed to set up a task force or expert group for this purpose. In view of the high priority of circular economy in many countries of the world, the group should collaborate closely with UNSD and other international organisations (such as EEA, Eurostat, OECD, UNECE/FAO, UNEP, etc.). The work of this group has to take into account the outcomes of the *CES Task Force on Waste Statistics*.

III. **Providing platforms for exchange of experience and knowledge:** Given the central role of SEEA in measuring CE, it is suggested to use existing platforms for supporting SEEA implementation to share experience and good practices, and to support coordination of work of international expert groups working on this topic. For the UNECE and OECD regions it is recommended to discuss countries' work and activities of international organisations on CE at the annual "Joint OECD/UNECE Seminars for SEEA implementation". This will also contribute to the above recommendation I (strengthening coordination and communication) and will provide a community of practice for discussing drafts of the practical guidelines (recommendation II) and its implementation.

VII. Discussion and conclusions by the CES Bureau

122. The Bureau discussed measuring circular economy at its October 2020 meeting, and raised the following issues:

(a) The paper summarizes well the main international activities and measurement challenges in this area and should be shared widely;

(b) There are many international and national activities on measuring circular economy and it is not easy to find common ground. Coordination and alignment of activities of the various actors is important, including with communities outside official statistics;

(c) Measuring circular economy is a cross-cutting area which requires harmonization across statistical systems and statistical domains. Using the SEEA-Central Framework as a starting point for this was considered useful;

(d) A special challenge is the harmonization of terms and definitions used;

(e) The work on measuring circular economy should prioritize the information requirements of important policies, such as the EU Green Deal, climate change, innovation, plastic waste, etc. Circular economy is also the topic of the next UNECE Commission session in spring 2021;

(f) Establishing a repository of good practices and providing practical guidance on the measurement would be useful, e.g. on how to use the existing tools and questionnaires to obtain the necessary data;

(g) Further work should build upon the outcomes of the UNECE Task Force on waste statistics;

(h) The Bureau recommended to set up a Task Force on measuring circular economy and invite experts and organizations who contributed to the in-depth review to participate. To the extent possible, the activities of the Task Force should be aligned with the related work of UN Committee on Environment Economic Accounts (UNCEEA) to ensure global relevance.

123. The Bureau agreed with the recommendations for further work proposed in the paper. The paper should be widely shared.

124. The Bureau decided to create a Task Force on measuring circular economy. Authors of the in-depth review paper are invited to participate, and all other interested countries and organizations are welcome to join. Statistics Finland will chair the Task Force.

125. The terms of reference of the Task Force were reviewed and approved by the CES Bureau at its February 2021 meeting.

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