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MSCI Thematic Insight

Subject Area: **Circular Economy**

Transitioning to a Circular Economy

Opportunities for Growth and Societal Transformation

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Introduction

Around the world, there is growing interest and momentum behind a transition from a linear "take-make-use-dispose" approach and towards a "circular economy." [1, 2, 3, 4, 5] This is an economy that, by design, better embraces an economic model of production and consumption that seeks to eliminate waste and pollution, keep materials at their highest economic value, recirculate products and materials through the value chain, and create regenerative systems. The concept is not new, but over the last several years, activity related to circularity has increased markedly — and at scale, this circularity would transform how the world interacts.

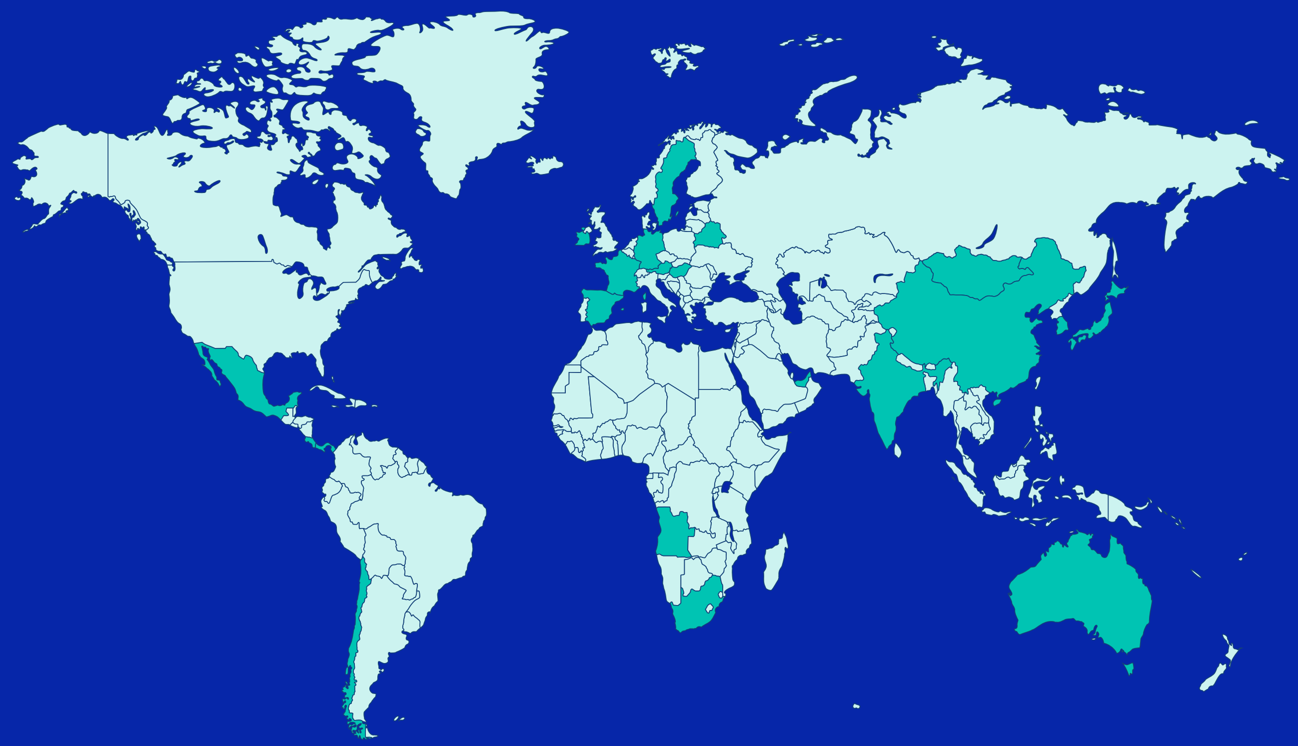
From its initial focus on minimizing waste generation, the circular economy has been gradually evolving into a broader-based approach to make resource-use more efficient and sustainable with the hope of reducing energy and resource expenditures. A central appeal of a circular economy is the opportunities it may create, not only for resource savings and improved social well-being, human health and environmental outcomes, but also for trade and economic diversification. In a still globalized world and as commercial interest in scaling up the circular economy grows, it will be more important that policies are designed and implemented with the goals of a circular economy in mind.

Several drivers have helped accelerate progress towards a circular economy. Increased consumer awareness on waste and pollution has shifted preferences for sustainable and eco-friendly products. Brand owners, industries and governments are adapting to these consumer preferences and have announced voluntary sustainability commitments that are themselves changing the structure and the dynamic of existing markets and demand. There is also an ongoing transformation in investment criteria of debt and equity investors, making access to capital more challenging for companies that do not alter their sustainability strategies. [6, 7, 8, 9, 10, 11] A range of new companies, investors and other actors are entering the market throughout the value chain with innovative technologies, tools and offerings in pursuit of emissions reduction pathways. The establishment of a broad range of public and private initiatives continue to expand worldwide in an effort to contribute to the delivery of the United Nations Sustainable Development Goals. All of these changes are taking place against a backdrop of increasing policies and regulation in both developed and emerging economies, such as bans, recycling quotas, taxation and extended producer responsibility schemes.

The number of sovereign states with circular economy related initiatives and the variety of policies and regulation has increased significantly leading to a heterogeneous, fragmented landscape. As the circular economy builds, several major gaps have emerged that are potential opportunities for future research and investment: insufficient funding to meet targets and financial risks, inadequate and fragmented policy frameworks, awareness and cultural barriers, and capacity deficiencies.[12]

Exhibit 1:
Countries with national circular economy legislation*

Source: Generated as a part of ongoing research for Rice University, Baker Institute for Public Policy



* Depicts countries with explicit national circular economy legislation. Map does not include countries with implicit laws or regulations that may or may not represent activities towards the circular economy, e.g., product-specific bans, taxes, waste management or recycling laws.

1 https://news.un.org/en/story/2021/06/1093802
2 https://www.environmentalleader.com/2021/11/circular-economy-to-grow-rapidly-in-the-next-five-years-says-abi-research/
3 Closing the loop – the circular economy, what it means and what it can do for you 9 circular economy tools 70+ corporate case studies Industry 4.0 outlook. PwC. 2018.
4 Intelligent Industry: The rise of circularity. 2022. Capgemini. https://www.capgemini.com/insights/research-library/intelligent-industry-the-rise-of-circularity/
5 Organisation for Economic Co-operation and Development. (2021). Towards a more resource-efficient and circular economy: The role of the G20.
6 Boffo, R., and R. Patalano (2020), "ESG Investing: Practices, Progress and Challenges", OECD Paris, www.oecd.org/finance/ESG-Investing-Practices-Progress-and-Challenges.pdf
7 Hartzmark, S. M., & Sussman, A. B. (2019). Do investors value sustainability? A natural experiment examining ranking and fund flows. The Journal of Finance, 74(6), 2789-2837.
8 Cheng, Beiting, Ioannis Ioannou, and George Serafeim. "Corporate Social Responsibility and Access to Finance." Strategic Management Journal 35, no. 1 (January 2014): 1–23.
9 https://kogod.american.edu/news/sustainability-more-investment-capital
10 https://www.ey.com/en_lu/ipo/why-successful-investors-focus-on-sustainability-pre-and-post-ipo
11 https://www.morningstar.in/posts/65105/esg-access-capital.aspx
12 Organisation for Economic Co-operation and Development.2020. The Circular Economy in Cities and Regions: Synthesis Report https://www.oecd.org/regional/the-circular-economy-in-cities-and-regions-10ac6ae4-en.htm

Merging the circular economy **with the sustainability agenda**

In a pure sense, sustainability aims to ensure long-term prosperity while contributing towards social and economic development, a healthy environment and a thriving society for current and future generations.

In comparison, the model of a circular economy offers a regenerative framework for creating long-term economic prosperity and improved natural and human systems through resource efficiency. The circular economy encompasses a rethink of production and consumption models, services, technologies and infrastructure and is based on three principles: i) design out waste and pollution; ii) keep products and materials in use; and iii) regenerate natural systems.[13] Clearly, the circular economy has significant sustainability potential. However, a limited conceptual grounding and weak connection to sustainable development have allowed a wide array of circular economy "solutions" to be presented which have adverse effects on sustainability.[14]

Exhibit 2:
Sustainability schematic

Source: Rachel Meidl

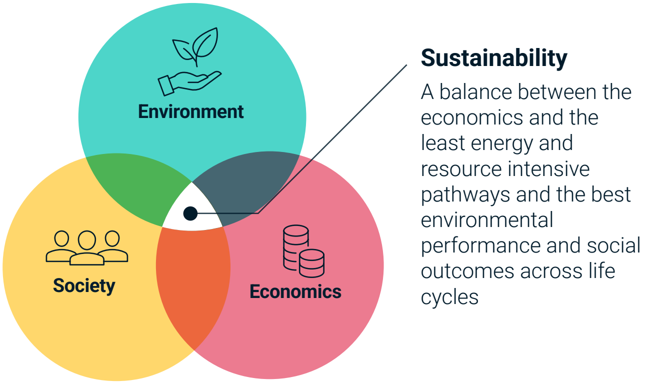
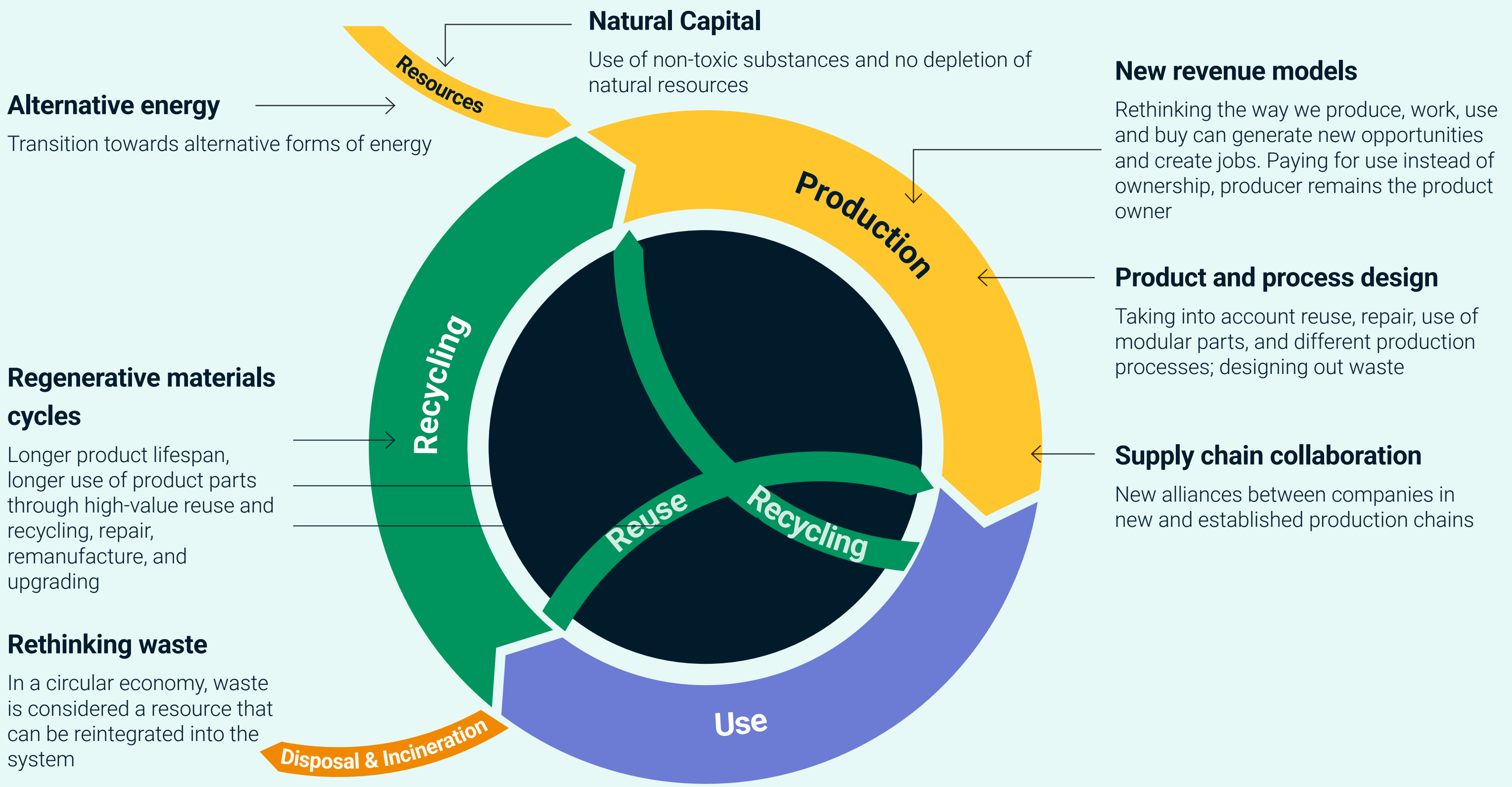


Exhibit 3:
Elements of a CE Diagram

Source: Adapted from PBL Netherlands Environmental Assessment Agency

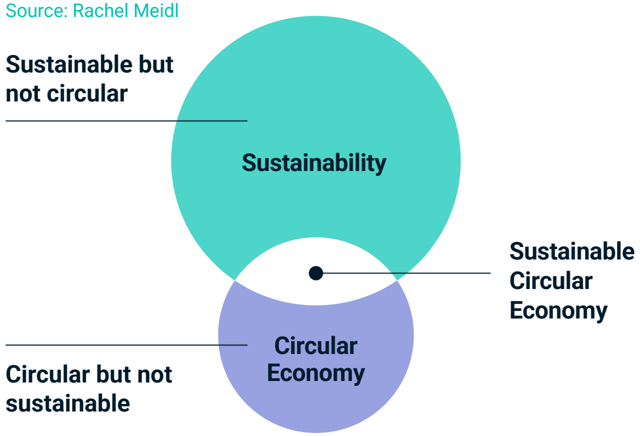


13 The Ellen MacArthur Foundation (EMF). (2021). What is a circular economy? London: The Ellen MacArthur Foundation. Retrieved from: EMF website
14 Velenturf, A. P., & Purnell, P. (2021). Principles for a sustainable circular economy. Sustainable Production and Consumption, 27, 1437-1457.

For example, batteries are seen as an enabler of the shift to a circular economy and low-carbon society. While electric vehicles are driving 90% of the global demand for lithium-ion batteries,[15] collaborative networks and supply chains capable of efficiently recovering, recycling, reusing, repurposing, and refurbishing materials to maximize their lifespan or tracking to verify circular practices have yet to develop. The batteries in an electric car is made of materials including cobalt, copper, lithium and nickel whose complicated geopolitics and mining and processing carries harsh environmental and social costs. Many mineral deposits are located in developing economies with corrupt and fragile governments that lack labor, health, safety and environmental laws. The majority of emissions of a new battery stem from the mining and refining processes that occurs primarily in China (or in other countries where China has primary ownership of the mines), and where processing is oftentimes fueled by coal. At the battery end-of-life, recycling technologies for the variety of battery chemistries rapidly entering the market are not yet economically feasible or commercially viable. Therefore, batteries are destined for incineration, landfill or export where deficient tracking and international classification as a hazardous waste through the Basel Convention creates further sustainability challenges and associated costs. In order to align with the principles of a sustainable circular economy, capacities need to be established along the entire electric vehicle value chain with comprehensive battery life cycle management at its core. Similarly, alternative energy technologies such as wind and solar are a core foundation of a circular economy, yet the lack of accounting for upstream material inputs and processes coupled with limited recycling or reuse options at the end-of-life inhibits the sustainability and circularity of the renewable industry. For those products or wastes being exported to secondary markets under the umbrella of circularity, inability to trace end-of-life accountabilities shifts the economic, environmental and social burdens on developing countries that lack recycling infrastructure or proper waste management capabilities. A full life cycle accounting that includes upstream and downstream activities provides a more realistic profile of sustainability, yet these metrics are largely absent in circular strategies and corporate sustainability reporting.

Exhibit 4:
Sustainability-Circular Economy Nexus Diagram

Source: Rachel Meidl



Over the last several years, many entities around the world have embedded circular strategies directly into their sustainability agendas with the assumption that activities or projects labeled as circular yield sustainable results.[16,17,18] But the assumed benefits of a circular economy are not yet understood in theory or practice.[19] No consensus in academia or practice exists on how to measure environmental and social sustainability in a circular economy.[20]

There is a relationship between sustainability and a circular economy but these two concepts differ greatly with distinct policy pathways, time horizons and end states that can conflict.

Sustainability can enable a circular economy and a circular economy can be a means towards achieving sustainability-minded goals, but transitioning towards circularity does not guarantee positive environmental, social and economic outcomes across life cycles.[21] A circular economy should not be interpreted as an end itself, but a necessary tool to achieve global sustainability goals. Concerns are rising regarding some circular practices being promoted as 'sustainable' yet resulting in detrimental impacts on environment and society.[22] Thus, three distinct relationships are transpiring between the circular economy and sustainability: 1) Conditional: the circular economy as a condition for sustainability, 2) Beneficial: circular economy and sustainability being mutually beneficial, or 3) Trade-off: the circular economy having both positive as well as negative sustainability impacts.[23]

What is also coming into greater focus is multi-criteria decision-making and the importance of systems-level thinking and life cycle-based assessments that holistically captures all three facets of sustainability—the social, economic and environmental impacts across economic value chains. In order to achieve a *sustainable* circular economy that is equitable, inclusive, resilient and balanced across global economies, circular actions and initiatives need to be systematically measured to help avoid risk-shifting, rebound effects and unintended future consequences that could potentially offset sustainability gains.

15 World Economic Forum. 3 challenges en route to electric vehicle batteries driving the circular economy. December 2022. https://www.weforum.org/agenda/2022/12/electric-vehicle-battery-circular-economy/
16 Opferkuch, K., Caeiro, S., Salomone, R., & Ramos, T. B. (2021). Circular economy in corporate sustainability reporting: A review of organisational approaches. Business Strategy and the Environment, 30(8), 4015-4036.
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18 Stewart, R. M. M., & Niero, M. (2018). Circular economy in corporate sustainability strategies: A review of corporate sustainability reports in the fast-moving consumer goods sector. Business Strategy and the Environment, 27(7), 1005-1022. https://doi.org/10.1002/bse.2048
19 Corvellec, H., Stowell, A. F., & Johansson, N. (2022). Critiques of the circular economy. Journal of Industrial Ecology, 26(2), 421-432.
20 Kristensen, H. S., & Mosgaard, M. A. (2020). A review of micro level indicators for a circular economy–moving away from the three dimensions of sustainability?. Journal of Cleaner Production, 243, 118531.
21 Meidl, Rachel. 2021. Disentangling Circular Economy, Sustainability, and Waste Management Principles. Issue brief no. 07.29.21. Rice University's Baker Institute for Public Policy, Houston, Texas.
22 Velenturf, A. P., & Purnell, P. (2021). Principles for a sustainable circular economy. Sustainable Production and Consumption, 27, 1437-1457.
23 Walker, A. M., Opferkuch, K., Roos Lindgreen, E., Raggi, A., Simboli, A., Vermeulen, W. J., ... & Salomone, R. (2022). What is the relation between circular economy and sustainability? Answers from frontrunner companies engaged with circular economy practices. Circular Economy and Sustainability, 2(2), 731-758.

Opportunities for measuring **the circular economy**

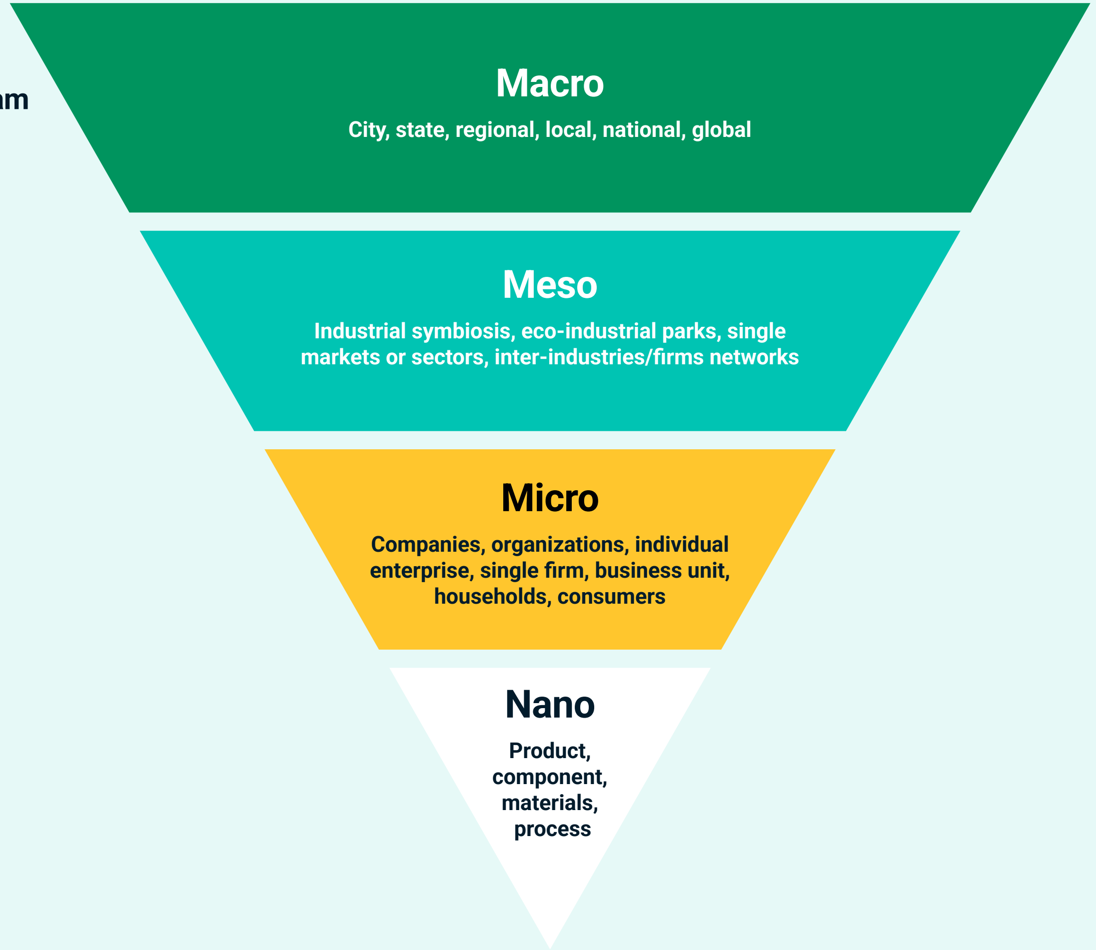
If the circular economy is to build on its early momentum with governments and business, then preparations for the circular transition need to be based on systematic insights into performance and associated risks and opportunities. To achieve this, a transparent and consistent language with standardized methodologies to measure circularity performance and progress would be of great assistance. It would encourage cohesion and assist the monitoring of progress and evaluation of impact. For system-level change to occur— change that could align with a global sustainability agenda—establishing a baseline and setting circular economy targets monitored by clear key performance indicators seems necessary at governmental and industry levels and across geographies. Circularity metrics could address how the principles of the circular economy are being characterized and implemented and provide future benchmarks. They would support the formulation of data-driven strategy, guide decision-making, assess potential business cases and avert "circular greenwashing."

To date, the majority of circular economy assessments have taken place in China and Europe.[24] The Chinese Government has actually been a global leader in circular economy implementation by instituting regulations and investing in initiatives since 2008 through the Law on the Promotion of Circular Economy. It was the first country in the world to develop and propose national circular economy evaluation indicators with the aim to obtain factual and valuable data about development and operationalization in the country.[25] The indicators are a concrete system of measurement that support policy and decision-makers in achievement of circular economy objectives.

The European Union (EU) has also adopted circular measures beginning in 2015 through the EU's Circular Economy Action Plan, a comprehensive body of legislative and non-legislative actions aimed at transitioning the European economy from a linear to a circular model.[26] The circular economy monitoring framework is the European Commission plan for assessing circularity in the EU.[27] Numerous EU member states have indicators and metrics in various stages of development, and there exist other examples outside of Europe, such as Colombia, Canada, the United Kingdom and Japan.[28] Additionally, there are many stakeholders from national and supranational groups, statistical agencies, standards bodies and various countries around the world that are proactively collaborating on analysis, development and alignment of circular indicators and their frameworks, methodologies and data.

Although in recent years there has been appreciable interest in the circular economy and positive developments in identifying a diverse range of metrics and indicators for evaluating circularity, research and application is nascent in both scientific literature and public and private initiatives.[29] Currently there exists no structured or standardized methodology or framework for circularity measurement,[30] particularly to its application and implementation of circular economy at different spatial levels (micro, meso, macro)[31] where challenges in translation between economic levels are becoming more prevalent.[32]

Exhibit 5:
Tiers of CE Diagram
Source: Rachel Meidl



24 Vinante, C., Sacco, P., Orzes, G., & Borgianni, Y. (2021). Circular economy metrics: Literature review and company-level classification framework. Journal of cleaner production, 288, 125090.
25 https://ec.europa.eu/newsroom/env/items/618580/en
26 https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en
27 EU, 2018. Raw Materials Scoreboard, European Innovation Partnership on Raw Materials. Publications Office of European Union, Luxembourg. Available online at: https://op.europa.eu/en/publication-detail/-/publication/117c8d9b-e3d3- 11e8-b690-01aa75ed71a1.
28 https://acehub.org.au/documents/measuring-the-circular-economy-an-australian-perspective
29 De Pascale, A., Arbolino, R., Szopik-Depczyńska, K., Limosani, M., & Ioppolo, G. (2021). A systematic review for measuring circular economy: The 61 indicators. Journal of Cleaner Production, 281, 124942.
30 Kristensen, H. S., & Mosgaard, M. A. (2020). A review of micro level indicators for a circular economy–moving away from the three dimensions of sustainability?. Journal of Cleaner Production, 243, 118531.
31 De Pascale, A., Arbolino, R., Szopik-Depczyńska, K., Limosani, M., & Ioppolo, G. (2021). A systematic review for measuring circular economy: The 61 indicators. Journal of Cleaner Production, 281, 124942.
32 https://pacecircular.org/sites/default/files/2021-04/CircularIndicatorsForGovernments_FINAL.pdf

Metrics and indicators reflect primarily macro-level perspectives and seldom represent all three dimensions of sustainability. A detailed understanding of how to measure, document progress and report on circular economy is largely absent, especially on a micro level.[34] This is a barrier for both producers who want to provide circular products and services, and for the consumers and other actors along the value chain who request transparency in understanding the circularity and sustainability of the products and services they are purchasing. Given the complexity of circular systems and the need to align with sustainability, multi-criteria measurement methods that integrate multiple dimensional indicators of all three pillars of sustainability (economic, environmental, and societal)[35] need to be applied across complete life cycles and supply chains. The circular economy would then be an approach based on broader systems-level thinking which could address not only the challenges of waste management and resource efficiency but impacts to society.[36] Any deficiency of a measurement framework limits the understanding of circular contributions and progress towards a circular economic system. The lack of international consensus and standardization on measurement criteria and tools, as well as the disparate understandings of what should be considered when assessing a circular economy, stems from the diverse and often inconsistent spectrum of definitions and principles covered under the broad circular economy umbrella.[37, 38] Despite the broad scope and categories of a circular economy, current progress indicators often consider very few circular principles.[39] Circular paradigms are naturally an amalgamation of ideas from different fields like industrial ecosystems, industrial ecology, material flows, biology, environmental economics, ecological economics, human geography, etc. This multi-disciplinary nature is one cause of the divergence in principles, definitions and metrics.[40] The large number of existing, overlapping and conflicting metrics can also be attributed to different interpretations of circular economy and the degree of intersection with the concept of sustainability.[41]

Data is the evidence-base needed to inform and shape practical policies, attract and direct public and private investment and guide behavior changes throughout value chains. Absence of a common and coherent mechanism for defining and measuring, thus, understanding the risks and opportunities of a circular economy, it will be challenging to determine whether circular solutions will move society on the right trajectory consistent with global sustainability goals.[42] Despite the current limitations and continuing debate on the meaning of a circular economy, its practicality, assessment, and application, the circular economy idea continues to gain traction. Therefore, it seems imperative to engage in future research now about indicators, metrics and frameworks for evaluating implementation and effectiveness at all levels [43] so as to assess progress toward the circular model, especially for developing countries and in the context of sustainability.

34 Kristensen, H. S., & Mosgaard, M. A. (2020). A review of micro level indicators for a circular economy–moving away from the three dimensions of sustainability?. Journal of Cleaner Production, 243, 118531.
35 dos Santos Gonçalves, P. V., & Campos, L. (2022). A systemic review for measuring circular economy with multi-criteria methods. Environmental Science and Pollution Research, 1-15.
36 Martínez-Sánchez, V., Valls Val, K., & Bovea, M. D. (2022). Sustainability reports as a tool for measuring and monitoring the transition towards the circular economy of organisations: Proposal of indicators and metrics.
37 De Pascale, A., Arbolino, R., Szopik-Depczyńska, K., Limosani, M., & Ioppolo, G. (2021). A systematic review for measuring circular economy: The 61 indicators. Journal of Cleaner Production, 281, 124942.
38 Vinante, C., Sacco, P., Orzes, G., & Borgianni, Y. (2021). Circular economy metrics: Literature review and company-level classification framework. Journal of cleaner production, 288, 125090.
39 Kristensen, H. S., & Mosgaard, M. A. (2020). A review of micro level indicators for a circular economy–moving away from the three dimensions of sustainability?. Journal of Cleaner Production, 243, 118531.
40 Ibid.
41 Vinante, C., Sacco, P., Orzes, G., & Borgianni, Y. (2021). Circular economy metrics: Literature review and company-level classification framework. Journal of cleaner production, 288, 125090.
42 Kristensen, H. S., & Mosgaard, M. A. (2020). A review of micro level indicators for a circular economy–moving away from the three dimensions of sustainability?. Journal of Cleaner Production, 243, 118531.
43 Martínez-Sánchez, V., Valls Val, K., & Bovea, M. D. (2022). Sustainability reports as a tool for measuring and monitoring the transition towards the circular economy of organisations: Proposal of indicators and metrics.

Leading circular business **models and emerging themes**

Waste management and recycling

Rapid population growth, industrialization, urbanization and the accelerated global consumption of goods and services has resulted in the overexploitation of natural resources and increasing waste volumes. The circular economy seeks to disassociate the consumption of finite resource demands from economic growth and consists of four essential components: 1) circular design principles, 2) resource management, resource efficiency and materials, 3) closed-loop systems and infrastructure, and 4) the nine circular Rs at every stage of the life cycle (rethink, refuse, reduce, reuse, redesign, remanufacture, repair, refurbish, repurpose, recyclable resources and recovery of materials).

The circular economy is often primarily understood and applied as a waste management and recycling strategy.[44, 45] This is commonly reflected in corporate business strategies and sustainability reports, government policies and initiatives [46, 47,] as well as in the funding of and focus on measuring waste management and recycling activities vs. other aspects of the circular economy, e.g., redesigning materials to eliminate waste. This is unsurprising given that municipal solid waste is a pressing global urban challenge, with growing public health, environmental, social, and economic costs.[48] Historically, the causes and effects of municipal solid waste were considered local or regional, but with increasing volumes, changing and complex waste compositions, globalization and intertwined supply chains, waste has become a universal challenge for both developed and developing countries [49] that can benefit from circular solutions.

Focusing on waste management is, of course, important: a circular economy does not necessarily account for the volumes of waste already in existence or the materials already circulating that will be reaching their end of life and migrating to the waste management and recycling sectors e.g. built environment, electronics, vehicles, alternative energy systems such as solar, wind, etc. Moreover, the transition to a circular economy should provide multiple opportunities to develop cooperative models, technologies, product and processes and platforms that can transform the recycling and waste management sectors. However, an overly strong waste-centric and 'end-of-pipe' narrative may limit the social, economic and environmental opportunities, such as those related to business models promoting dematerialization and greater resource optimization. For circularity, the focus shifts from solely measuring waste to keeping materials circulating in the economy and at their highest economic value for as long as possible. After all, in an ideal circular economy, products and processes are designed to *avoid* the creation of waste in the first place.

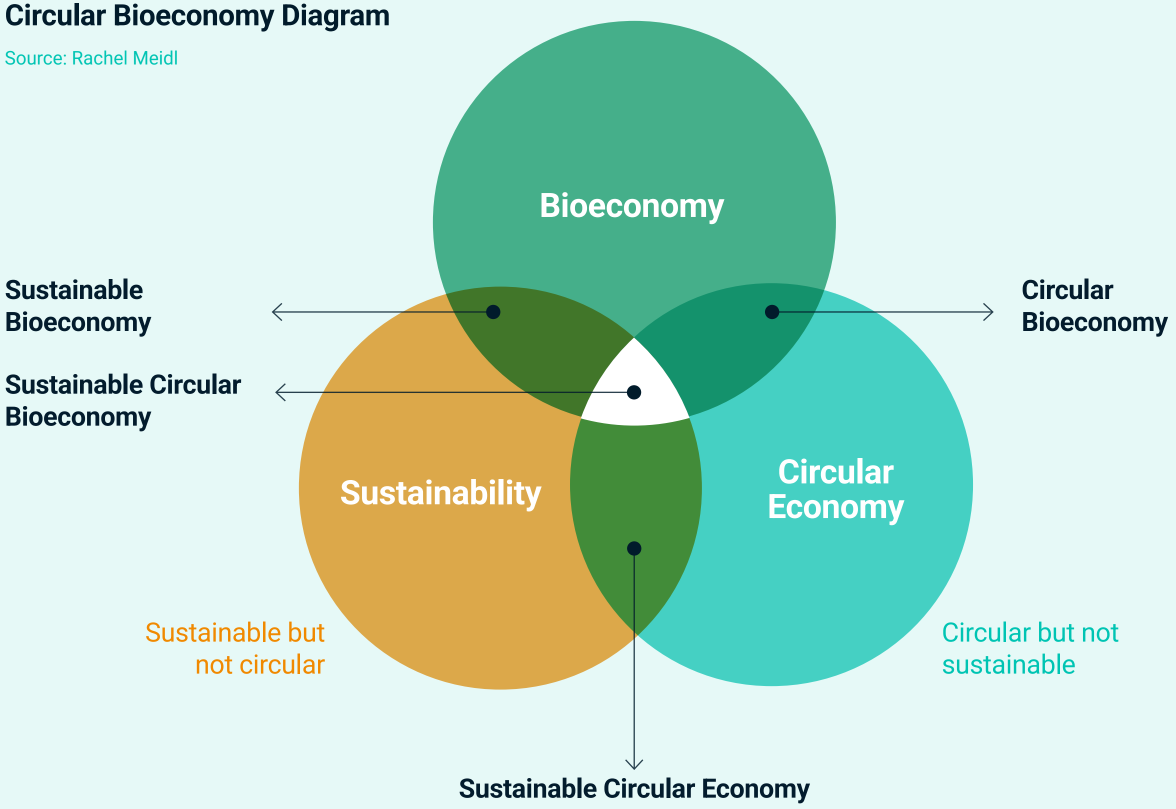
44 Ibid.
45 Kristensen, H. S., & Mosgaard, M. A. (2020). A review of micro level indicators for a circular economy–moving away from the three dimensions of sustainability?. Journal of Cleaner Production, 243, 118531.
46 https://www.epa.gov/recyclingstrategy/national-recycling-strategy
47 https://acehub.org.au/documents/measuring-the-circular-economy-an-australian-perspective
48 World Bank. 2022. Transitioning to a Circular Economy: An Evaluation of the World Bank Group's Support for Municipal Solid Waste Management (2010–20). Independent Evaluation Group. Washington, DC: World Bank.
49 Ibid.
50 World Economic Forum. Why the world needs a 'circular bioeconomy' - for jobs, biodiversity and prosperity. October 2020. https://www.weforum.org/agenda/2020/10/circular-bioeconomy-nature-reset/#:~:text=A%20circular%20bioeconomy%20offers%20a,wellbeing%20in%20harmony%20with%20nature.

Circular bioeconomy and nature-based solutions

A "circular bioeconomy" is a framework for using renewable natural capital to transform and manage land, food, health and industrial systems into value-added products, with the goal of achieving sustainable wellbeing sympathetically with nature.[50]

Exhibit 6: Circular Bioeconomy Diagram

Source: Rachel Meidl



A circular bioeconomy can be applied throughout the life cycle: designing materials that use biological resources (e.g. biomass) to create circular bio-based products (food, feed, fuel, textiles, plastics); manufacturing and production that leverages biological resources as an energy source; cascading products throughout value chains using circular business models (sharing, reuse, repair, product-as-a-service); and biowaste and products at the end-of-life are used as a resource or recycled back into the system. While the circular bioeconomy combines advanced technologies with traditional knowledge, it ultimately relies on biodiversity.[51] By definition, biodiversity determines the capacity of biological systems to adapt and evolve in a changing environment and is thus key to the resilience and sustainability of biological resources. In a circular economy, the central role of biodiversity is recognized through conservation measures as well as with regionally-tailored market-based instruments to provide incentives for farmers, forest owners and bio-based companies.[52] Circular economy principles can be applied across different industry sectors, allowing for biodiversity benefits economy-wide. At the same time, a circular transformation can unlock other environmental, economic and social benefits, to provide opportunities for better growth, prosperity to societies, and to enable nature to thrive.[53] A recent study argued that by leveraging a circular economy strategy in the four sectors that have the largest impact on biodiversity loss (food and agriculture; buildings and construction; textiles and fibers; and forests) biodiversity loss could be halted by 2035.[54]

Moving towards a climate- and nature-positive economy translates to supplementing fossil energy with alternative energy, as well as integrating fossil-free materials: substituting carbon-intense products like plastics, concrete, steel and synthetic textiles with lower carbon alternatives. For instance, carbon nanotubes are one of the most promising materials. With their unique electrical, thermal, mechanical, and optical performance, they have the potential to decarbonize two of the hardest sectors: industrial and transportation.[55] The synthesis of nanomaterials from green hydrocarbons or renewable bio-materials can outperform and replace carbon-intense materials [56] and in some cases, co-produce hydrogen that has a range of end-use sectors from transportation to electric power to industry.[57] Research, development and deployment in the field of sustainably produced advanced carbon materials is growing and gaining much interest and investments globally.[58,59]

By leveraging a range of biomass feedstocks, including biowaste, “biochar” has gained significant popularity in the environmental sector as a versatile material for waste reduction and increasing the efficacy of the circular economy.[60,61,62] Biochar has a wide range of applications, including being a means for sequestering atmospheric carbon dioxide (CO_2) in soil, agricultural soil amendment, wastewater treatment, manufacturing of cement and for the remediation of contaminated soils.[63] The versatility of biochar systems is promising in targeted regions where biowaste is abundant and typically landfilled or incinerated, such as throughout the Latin American region.

Bio-based circular carbon economy pathways that invest in clean energy technologies to capture, store, and/or use CO_2 emissions to optimize biological and industry processes is another emerging business model. For example, biogenic carbon capture and utilization routes apply new technologies to capture CO_2 for reuse as fuels, bioenergy, chemicals, building materials, food and beverages or via recycling where CO_2 is chemically transformed into new products such as fertilizer or cement, or synthetic fuels.[64] Employing biogenic/renewable carbon offers new and circular avenues to achieve net-zero emission targets, especially in hard-to-decarbonize industries like petrochemicals.[65]

Nature-based carbon storage solutions are also on the rise.[66,67] Removing atmospheric CO_2 through photosynthesis and storing it in the soil via the plant’s root system can help attain net-zero goals, strengthen rural economies, transform ranching and farming, and support environmental co-benefits including soil regeneration, restoration of natural water cycles, improvement in drought resistance, and rebuilding of local biodiversity. It can be a lower-cost carbon capture and storage option designed for landowners, businesses and soil carbon storage buyers to catalyze ecological restoration and regeneration in native prairies, grasslands and forests. To monetize the CO_2 removal, credits can be issued to landowners who sequester CO_2 in the soil and are then eligible for soil storage payments.[68]

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68 https://bcarbon.org/

Social equity and the circular economy

A future circular economy has the potential to provide new opportunities for engagement, economic diversification, value creation and skills development.[69] However, a circular and sustainable transition would not be socially just or inclusive by default. The wide range of environmental and economic challenges would need to be addressed in a way that protects livelihoods and upholds the workers' rights and actually enable job creation. An equitable and just circular transition relies on the acknowledgement of international labor standards, labor market institutions and active engagement with communities and the workforce to help determine the pathway to greater circularity.

A circular transition as a societal transition includes re-skilling/up-skilling employees where appropriate, ensuring the creation of quality jobs with career progression and jobs that are accessible to diverse people. It necessarily considers how benefits and burdens are distributed. In a circular future, there will likely be a high demand for a wide range of skills to implement and steer circular business models and to disassemble, repair, remanufacture, maintain, and refurbish materials, products and systems. Bridging the gap between current and future skills via training, education, outreach and policy support is key if the transformation towards a sustainable circular economy is to be successful.

Current policy prescriptions have largely failed to address global social equity issues and often perpetuate social problems in lower income countries. Oversights related to power, trade and the role of high-tech solutions contribute to that inequity.[70] The predominant focus of most initiatives has been confined to a small subset of environmental and economic dimensions, whereas the social aspects highlighted above have only been intermittently and peripherally mentioned.[71] Further, not all social sustainability concerns are explicitly and equally considered in the tiers of the circular economy.[72] Employment opportunities, education and awareness, health and safety, and government involvement are more commonly identified social issues.[73] However, a more diverse and complete consideration of the social dimension will be required to attain an equitable and just pathway. Ultimately, the circular economy must be perceived as an integral component of society and the ecosystem in which it is embedded.

Over the years, little attention was given to the circular economy concept as it relates to quality of life for underserved and marginalized communities and low-income and middle-income countries. Despite this, there has been progress in circular economy case studies in developing countries like India, Brazil, Kenya and Ghana, which demonstrate how circular economy business models can contribute to improved quality of life in developing economies[74] while also benefitting the greater global economy. For example, the large informal sectors in developing countries and emerging markets practice "circular" activities in waste collection and recycling with the potential to engage in higher-value circular economy supply chains. As global centers of production, they are well-placed to take advantage of new opportunities and, moreover, are also set to become global drivers of consumption. For example, Africa is transforming into a vast potential free trade area with a population projected to reach 1.1 billion by 2040.[75] It could have the largest workforce globally. Thus, just as China is currently the manufacturing center of world, developing economies like Africa could become global centers of remanufacturing, refurbishing, recycling and repair, a key role in a global network. Developing countries are well-positioned to 'leapfrog' developed countries in digital and materials innovation to embed sustainable circular production and consumption at the heart of their growing economies.[76]

The convergence of emerging digital technologies with those in the physical and biological spheres could play a central role in enabling a sustainable circular economy.[77] The circular transition has been strongly linked to the 'fourth industrial revolution' theme, drawing on 'distributed ledger' blockchain technology, cloud computing and big data analytics, artificial intelligence/machine learning, robotics, Internet of Things, etc. to track supply chains, input materials provenance and product life cycles, for example.[78] Too much reliance on OECD-centric high-tech infrastructure could be a barrier to lower-income countries, hence the need to identify a range of geographically, economically and culturally appropriate technology options[79] Technologies aligned with local conditions, that utilize locally available materials and energy resources, and with local operational control are likely to experience greater success.[80,81]

Several technological trends seem likely to have an impact on the role of trade in a just circular transition: (1) increasing supply chain transparency and product life cycle information, (2) tracking and traceability across life cycles to verify circularity of products, goods and services, e.g. repair, secondary material recovery, and (3) tools and systems to standardize and measure the performance of circular economy. Each trend has the potential to reconfigure global trade in a way consistent with just and inclusive circular economy principles and can aid in the understanding of how trade and trade policies can support a circular economy.[82]

69 Preston, F., Lehne, J., & Wellesley, L. (2019). An inclusive circular economy. Priorities for Developing Countries.
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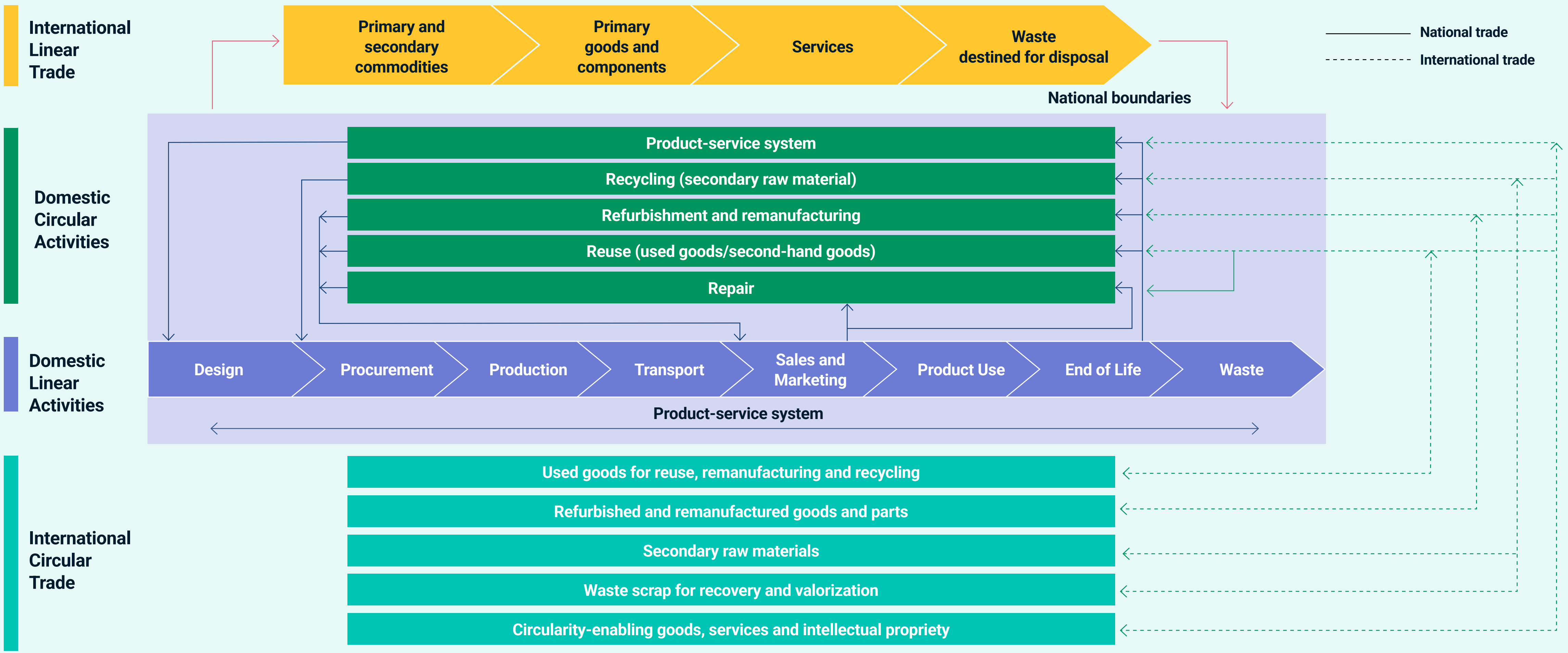
77 World Bank Group. Circular Economy and Emerging Technologies. https://olc.worldbank.org/content/circular-economy-and-emerging-technologies
78 País Circular (2020), 'The circular economy brings together the productive and environmental agendas', translated interview with Manuel Albaladejo, UNIDO Representative for Uruguay, Chile, Argentina and Paraguay, 9 March 2020, Santiago de Chile, https://www.greengrowthknowledge.org/blog/circular-economy-brings- together-productive-and-environmental-agendas.
79 Circle Economy. Thinking beyond borders to achieve social justice in a global circular economy. Actions for governments and multilateral bodies. June 2022
80 Patnaik, J., & Tarei, P. K. (2022). Analysing appropriateness in appropriate technology for achieving sustainability: A multi-sectorial examination in a developing economy. Journal of Cleaner Production, 349, 131204.
81 Circle Economy & Shifting Paradigms. (2020). Climate mitigation through the circular economy. (pp. 1-142, Rep.). Amsterdam: Circle Economy.
82 XXXX

Trade

A functional circular economy naturally relies on trade and access to global markets through trade in primary and secondary materials, end-of-life goods, recyclable waste, second-hand products, technology, intellectual property and services.

Exhibit 7: International trade and circular economy

Source: Adapted from OECD International Trade and the Transition to a Circular Economy

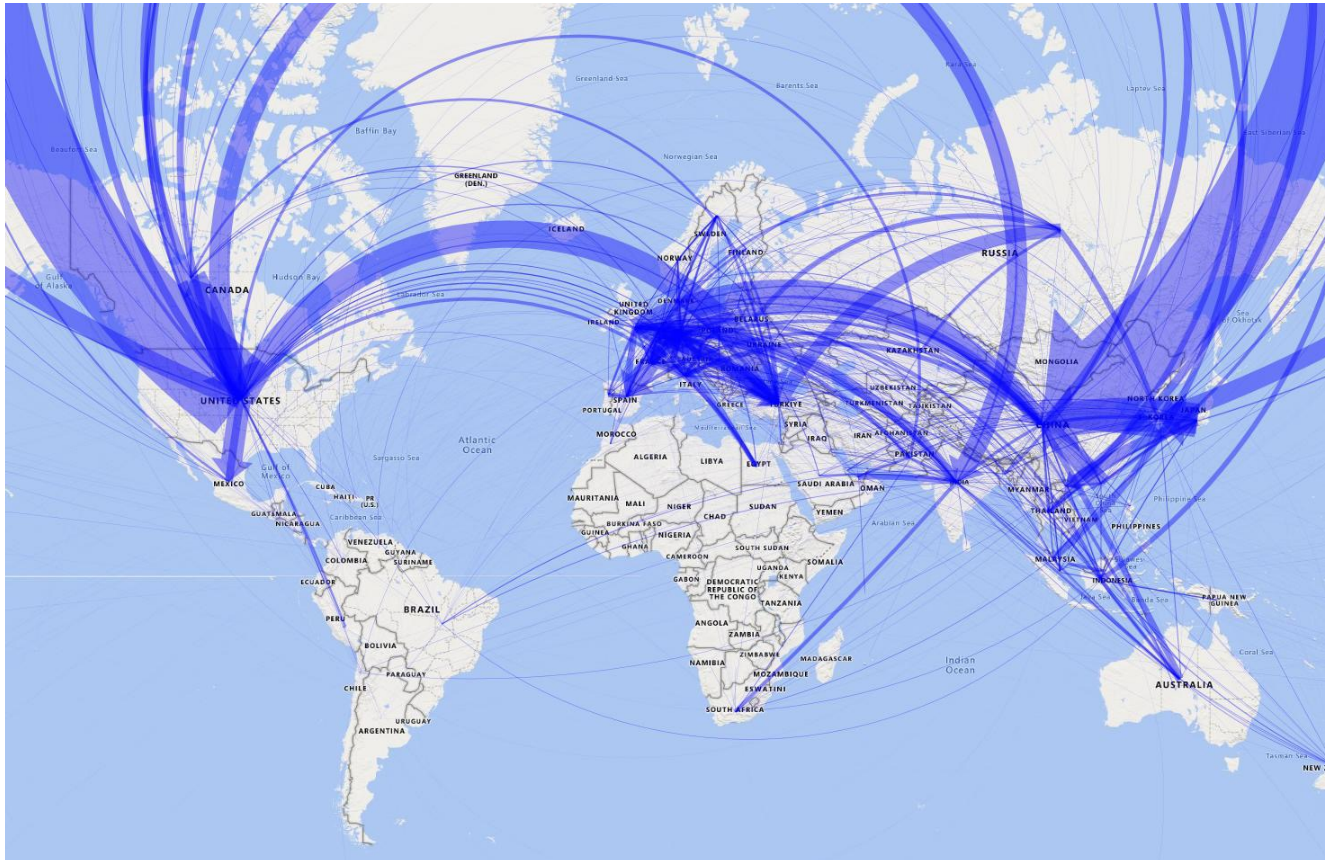


Global trade enables the economies of scale required to make circular activities economically viable. Planning for a circular economy transition needs to account for the role of international trade at different stages of the value chain, because the structural economic shift will reconfigure trade relations, supply chains and flows of materials and services between and within countries.[83] Import and export demand for primary materials, secondary materials and waste may decrease in certain economies, partially dependent on competitive advantage. Demand for certain new products and raw materials (or intermediary goods) exported from lesser developed economies may decrease as developed countries turn to sourcing local materials and rates of reuse, repair and high-value recycling increase.[84] The effects on low- and middle-income countries deeply reliant on extractive industries, for example, and dependent on resource exports for their economy and tax revenue are likely to be significant in the medium to long term.[85]

If the shift to a circular economy encompasses a social dimension then it should be aiming towards a more balanced and equal distribution of power and wealth across and within countries. The geographical inequity of circular trade flows is distributed unevenly across the world where ~99 percent (USD 287 billion) of the total value of trade in secondary goods, materials, waste, scrap and residues in 2020 was traded between and among high- and middle-income countries (China, Europe and the US being most prominent)[86] and around 45 percent (USD 131 billion) of the total trade value was exchanged solely between high-income countries.[87] Conversely, trade to and from low-income countries comprised only approximately 1 percent (USD 4 billion) of the total value.[88] This indicates the inequity in value-capture from circular trade, as high- and middle-income countries typically have the capacity to develop and deploy technologies and manufacture and control the associated intellectual property rights. The direction of trade tends to flow from high- and middle-income countries to low-income countries and may exacerbate environmental and social costs in developing economies where waste burdens are transferred [89,90]

Exhibit 8:
Waste trade flows, 2010-2021

Source: Generated as a part of ongoing research for Rice University, Baker Institute for Public Policy, using data from UN Comtrade database.



83 Bellmann, C., & Draper, P. THE CIRCULAR ECONOMY AND INTERNATIONAL TRADE.
84 Circle Economy. Thinking beyond borders to achieve social justice in a global circular economy. Actions for governments and multilateral bodies. June 2022
85 Schröder, P. (2020). Promoting a just transition to an inclusive circular economy. Royal Institute of International Affairs.
86 China being the predominant middle-income country with imports of secondary goods, materials and waste, scrap and residues valued at $38 billion, and exports valued at $12.7 billion in 2020.
87 The Royal Institute of International Affairs Chatham House. 2022. The role of international trade in realizing an inclusive circular economy.
88 Chatham House circulareconomy.earth (2022), 'Trade flows'
89 UNEP and IRP (2020), 'Sustainable Trade in Resources: Trade, Global Material Flows, Circularity, and Trade', https://www.resourcepanel. org/reports/sustainable-trade-resources
90 Waste trade imports were defined as all six-digit Harmonization System categories where waste and/or scrap was the only categorization of a product or material. In 2010-2021 map, the largest flow was 161.6 million tons from USA to China. In 2021, 6.1 million tons were traded from USA to Mexico.

Second-hand trade in the reuse and recycling markets where high-income countries can undermine the quality of jobs of lower-income countries is an illustrative example of how a circular economy transition could shift impacts across geographies. Current resource trading practices are characterized by imbalances in power dynamics where global value chains source inexpensive raw materials from lower-income countries for the manufacturing of higher-value products for wealthier consumers,[91] only to export low-value waste and products back to lower-income countries. This practice is often promoted under the banner of charitable and circular reuse or recycling schemes, irrespective of the actual and final fate of the materials. In many cases, such as solar panels and electronic waste, the materials may be unsuitable for reuse and are incinerated or landfilled[92] or valuable fractions are retained for reprocessing in high-income countries.[93] Parallels can therefore be drawn where value creation from resource use is accrued in the Global North and environmental and social impacts are accumulated in the Global South, creating a circular trade divide [94] and exacerbating accusations of trade colonialism.[95]

Social equity and environmental justice are not confined to specific borders, particularly when accounting for full life cycles and the entire value chain. Complex and intertwined global value chains with cross-border trade in raw materials, intermediate goods, and final products including accompanying end-of-life circular activities (repair, refurbishment, remanufacturing, recycling, etc.) enables associated environmental and social impacts to emerge in locations different from where initial production and final consumption occurred. A fair and equitable transition and environmentally and socially sustainable supply chains are vital to ensure the circular economy does not produce new disadvantages for countries in a future circular trading system.[96]

While general trends show volumes of global trade in waste and scrap increasing over the past two decades from USD 90 billion to USD 294 billion between 2000 and 2020,[97] new restrictive trade measures have been introduced either multilaterally – i.e. under the Basel Convention, or unilaterally – e.g. Chinese National Sword import restrictions on plastics, unsorted paper, and other waste and scrap. Reducing trade barriers would allow circular activities better access to a larger supply of recovered goods, components and materials for recirculation and promote the expansion of global supply chains and services needed to create a more efficient circular economy. Trade restrictions or non-trade barriers, such as strict control of intellectual property, may prevent lesser developed countries from reaping the benefits new technologies could offer in a circular economy.[98] Multilateral solutions and international cooperation that addresses trade barriers and promotes responsible and fair trade would ensure circular activities are optimized in terms of cost, quality, skills and other location-specific advantages. Multilateral organizations (such as the World Trade Organization, the International Labour Organization, United Nation agencies and development banks) could help facilitate dialogue and cooperative trade policies that increase data collection, enhance transparency and standards for trade in secondary materials, incentivize extended producer responsibility, establish circularity metrics and targets, and encourage product life extension pathways.

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94 The Royal Institute of International Affairs Chatham House. 2022. The role of international trade in realizing an inclusive circular economy.
95 Referred to by representative of Luxembourg at the February 13, 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.
96 Yamaguchi, S. (2022), "Securing reverse supply chains for a resource efficient and circular economy", OECD Trade and Environment Working Papers, No. 2022/02, OECD Publishing, Paris, https://doi.org/10.1787/6ab6bb39-en.
97 OECD Quarterly International Trade Statistics, Volume 2022 Issue 1
98 United Nations Industrial Development Organization. September 2021. Trade, technology and a just circular transition. https://iap.unido.org/articles/trade-technology-and-just-circular-transition

Conclusion

The circular economy is at a critical juncture between real systemic change and merely a rebranded business-as-usual. Despite the current gaps and limitations of a circular economy, it has the potential to transform how society interacts with itself and the natural environment, providing the transformation takes place with a global perspective. Innovation towards circularity will also require a robust and vastly different measurement and metric framework than the systems developed to monitor the linear economy and will need to leverage new technologies and the global trade network to fully unlock the benefits for a more inclusive, sustainable and circular economy.

The circular economy has been estimated to embed a commercial opportunity of up to USD 4.5 trillion linked to the evolution of new industries as well as create jobs, reduce climate impacts and improve the efficient use of natural resources.[99] However, transitioning to a circular economy that works in the best long-term interest of society would require cross-border networks, partnerships and participation from all stakeholders across the value chain.

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99 World Business Council for Sustainable Development (WBCSD). "CEO guide to circular economy" available at < https://docs.wbcsd.org/2017/06/CEO_Guide_to_CE.pdf >

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