



**Strategy Paper
for Circular
Economy:**
Mobile devices

GSMA™

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ethos

Ethos is a Swedish consultancy focusing solely on corporate sustainability. Ethos helps businesses of all sizes and industries with sustainable business development. The team of experts have competences across all areas of sustainability (human rights, labour rights, environmental protection and anticorruption) which are applied to business cases from a value chain perspective as well as from an interdisciplinary perspective. Ethos possesses deep understanding of the necessary interplay between sustainability and long-term business success. Learn more at www.ethos.se

About this report

Sustainability challenges can only be addressed at a systemic level, and this is why the GSMA is proud to play a role in helping the mobile industry become more sustainable.

In 2016, the mobile industry was the first industry to commit fully to the 17 United Nations Sustainable Development Goals and, in 2019, the GSMA Board set a climate ambition on behalf of the industry to reach net zero carbon emissions by 2050 at the latest.

Earlier this year, the GSMA published its first Strategy Paper on the Circular Economy, which focussed on how network equipment can evolve towards more circular business models. Continuing the exploration of circularity, this paper looks at the largest environmental impact of the mobile industry – mobile devices.

The paper has been developed with Ethos, a Swedish management consultancy specialising in sustainability, in collaboration with Tele2, as the Project Group lead, and Project Group members from the GSMA.

Acknowledgments

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Executive Summary

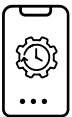
Consumption of natural resources is already at an unsustainable rate and is increasing. Scientific evidence indicates this will lead to a collapse in the natural systems upon which humans depend. However, existential challenges such as climate change, waste, pollution, resource scarcity and biodiversity loss can be solved by moving to a more circular economy, and this idea is gaining recognition globally.

For the telecommunications industry, one of its biggest environmental impacts is from customers accessing connectivity through connected devices. This strategy paper therefore focusses on the opportunities to transition both mobile devices and customer premises equipment such as routers to more circular business models.

In developing a circular approach for the industry, the research has referenced widely agreed principles of a circular economy as well as existing frameworks and metrics that are already being used, both within the industry and in other sectors. There has been consideration of current and proposed circular economy policies that governments around the world are implementing.

The circular model includes a vision for 2050 to help drive the industry towards a sustainable future. This is defined as a future where devices have as long a lifetime as possible, where they are made with 100% recyclable and recycled content using 100% renewable energy and where no device ends up as waste.

There are two key principles to support this vision:



Increasing longevity of devices



Zero waste.



The strategy paper explores how telecommunication operators can understand their current position within the circular economy, how they can accelerate the circular transition by engaging with key stakeholders in the value chain and how to measure progress by using circular metrics and actions covering both 'entry-level' participation and 'leadership-level'.

The benefits of this approach are broad, being environmental, social and economic:

- Extending the lifetime of all smartphones in the world by just one year has the potential to save up to 21.4 million tonnes of CO₂ emissions annually by 2030¹, equal to taking more than 4.7 million cars off the road².
- A reduction in the 30m adults and children currently experiencing adverse health impacts from informal e-waste recycling.
- A refurbished mobile device market predicted to be worth more than \$140bn by 2030, compared to \$50bn in 2020.

This strategy paper further explores the barriers to achieving a circular economy for devices, along with circular incentives and existing examples of best practice. The paper outlines four immediate opportunities to improve circularity:

- 1 Understand product flows**, increase the number of devices collected from consumers and create a foundation to measure reclaimed devices and treatment method by share of recycled, repaired, reused and reclaimed devices.
- 2 Increase consumer awareness**, based on understanding consumption habits in terms of end-of-life treatment and incentives to increase longevity of devices.
- 3 Engage with suppliers** to improve eco-design and sustainable production leading to greater reparability and durability of devices, which will increase their lifespan.
- 4 Engage with repairers and recyclers** to increase the number of devices that are reclaimed, repaired and recycled to maximise value retention within the economy.

Positioned between consumers, device suppliers and repairers/recyclers, telecommunication operators have a fantastic opportunity to contribute to a circular transition for devices, both from a direct control perspective as well as through influence and partnerships.

By moving to a circular business model for the industry, negative environmental and social impacts will be reduced. This means the industry can meet its demand for materials without depleting the global supply of finite resources. It will also create new market and employment opportunities and will support a just transition given supportive government policies and incentives.



¹ The calculations have been made using the estimation from the European Environmental Bureau, 2019. The total stock of smartphones in the EU is estimated to be 632.4 million units, while the number of smartphones in the world in 2021 has been estimated at 6.45 billion based on GSMA Intelligence.

² Assuming a typical passenger vehicle emits about 4.6 metric tons of carbon dioxide per year EPA 2022 - Greenhouse Gas Emissions from a Typical Passenger Vehicle).

Scope

Two product groups are included in the scope of this strategy paper: mobile devices and customer premises equipment. The term 'devices' will be used hereafter to describe both product groups.

Mobile devices

The product category 'mobile devices' includes smartphones, tablets and feature phones, which may be similar in material content but can vary in size.

Customer premises equipment

The customer premises equipment (CPE) product category includes in-home devices such as set-top boxes, internet routers, Wi-Fi hubs and access points.

The strategy paper was developed through:

- Desktop analysis of new and existing research on the circular model and the circular economy within the telecommunications industry.
- Interviews with industry experts and circular economy practitioners and dialogues with project members.



Introduction



Currently, the global population is using natural resources corresponding to 1.75 Earths³. This means that the global economy uses resources at a rate faster than nature can regenerate, causing resource depletion. The consumption of resources is also accelerating – by 2060, global GDP is projected to triple in size and the world's resource consumption is estimated to double⁴.

If these trends continue, the environmental and socioeconomic consequences will be severe. The effects of resource depletion will be seen not only through a reduced ability to mitigate and adapt to climate change, but also through its impact on biodiversity and ecosystems. Disruption of planetary systems is already seen through global warming and more extreme weather such as heatwaves, storms and flooding⁵.

The environmental impact of the telecommunications sector is derived from activities throughout the value chain, from raw material extraction and processing, production and assembly of electronic devices to packaging and transportation, as well as by the energy consumed through use of devices and in waste management.

By...

2060



**the world's resource
consumption is
estimated to double**

³ www.footprintnetwork.org/our-work/ecological-footprint

⁴ OECD, 2019 - Global Resources Outlook to 2060.

⁵ www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

The use of connected devices is expected to grow, and this digitalisation can enable the future low carbon economy and a more resilient society. Mobile technology is already harnessing the Internet of Things (IoT) and artificial intelligence (AI) to create solutions that allow societies not only to mitigate emissions, but also to adapt and become more resilient to the impacts of climate change.

At the same time, demand for these solutions will further accelerate the consumption of raw materials⁶ required to manufacture devices such as mobile phones and routers. Currently, around two billion phones are sold annually⁷ and more than 90% of the global population owns a mobile phone⁸. In 2021, there were an estimated 7.78 billion active smartphones and feature phones around the globe⁹.

The global router market is predicted to almost **double from...**


2020
to
2030



Around...

2 billion

phones are sold annually, and more than...

90% 

of the global population owns a mobile phone

This number is projected to increase; by 2030, the total number of smartphones and feature phones is predicted to reach nine billion¹⁰. A similar trend is seen in the global router market, which is predicted to almost double from 2020 to 2030¹¹.

80%

of the climate impact from a smartphone comes from the **production stage of the device and its components**

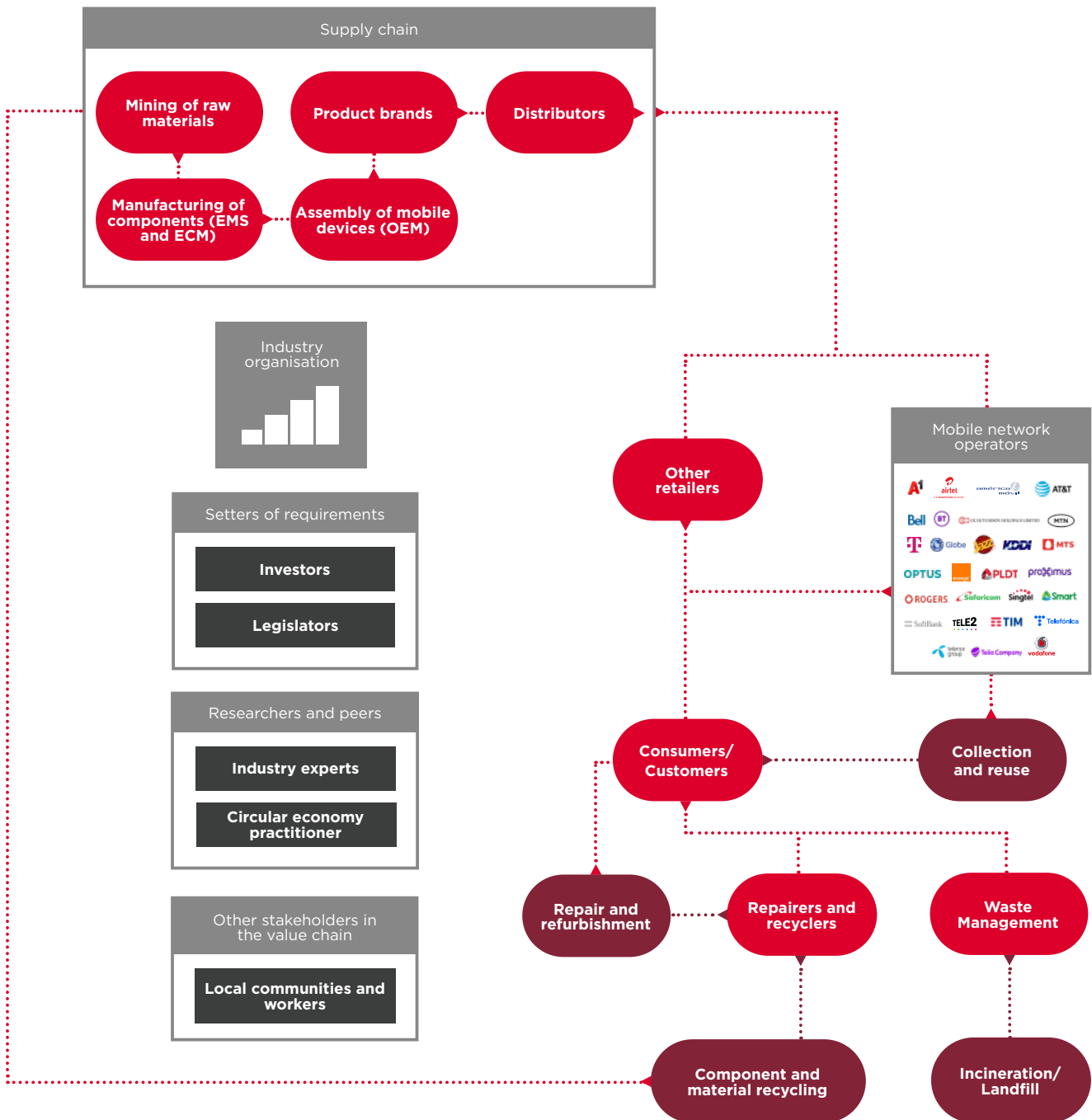


6 pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf
7 www.gartner.com/en/newsroom/press-releases/2022-03-01-4q21-smartphone-market-share and www.counterpointresearch.com/more-than-a-billion-feature-phones-to-be-sold-over-next-three-years/
8 www.bankmycell.com/blog/how-many-phones-are-in-the-world
9 Estimation and forecast from GSMA Intelligence
10 Estimation and forecast from GSMA Intelligence
11 Allied Market Research, 2021. Router Market.

The value chain of devices

The value chain of devices is long and complex, with hundreds of businesses involved.

Figure 1 | A simplified version of the value chain of devices. Depending on countries and business model, the value chain can vary to some extent.



■ Value chain actors ■ Waste management activities ■ Indirect value chain actors

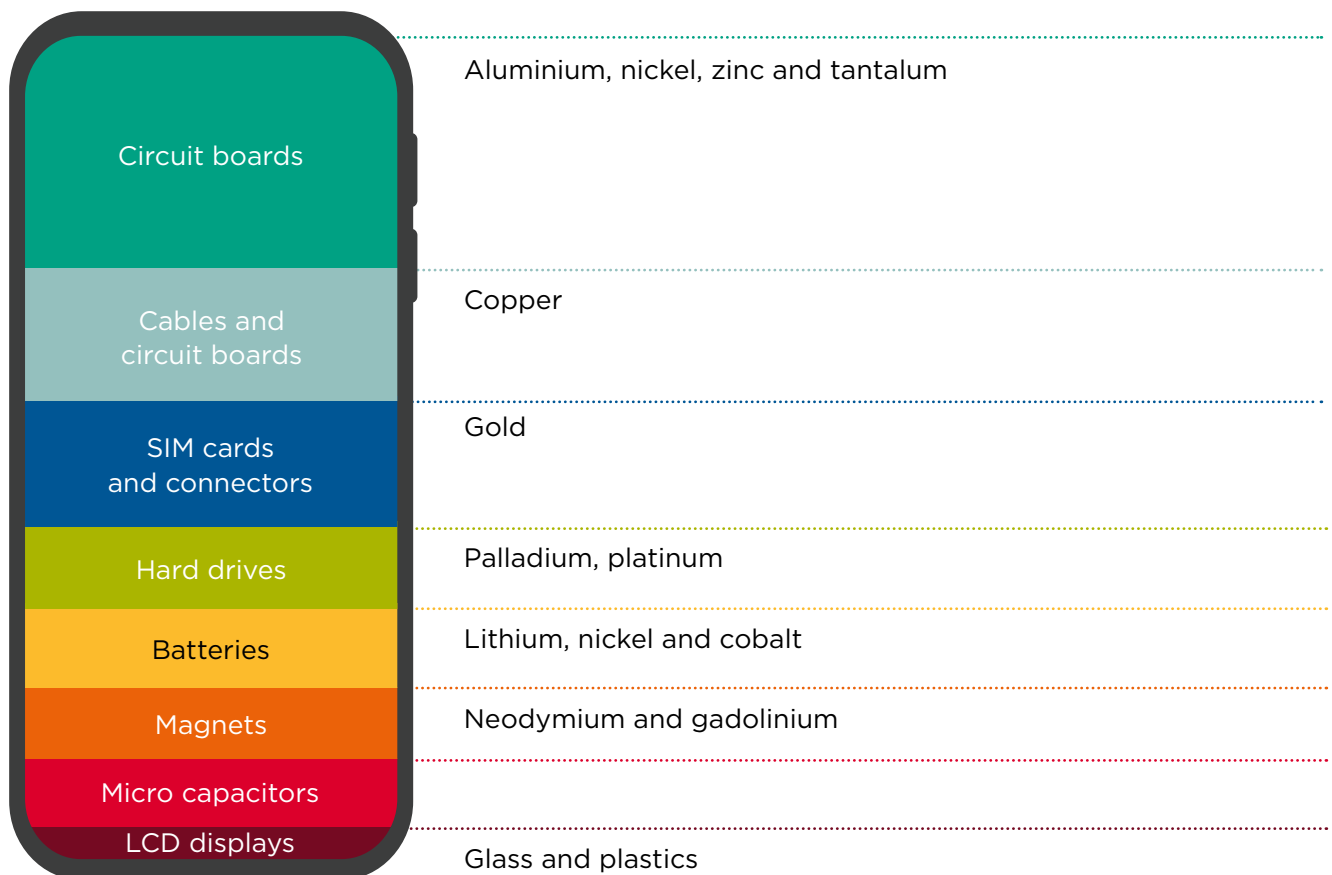
As an example, an iPhone contains components from more than 200 suppliers¹². Each step of the value chain entails circular economy-related challenges and opportunities. Simplified, the manufacturing of devices consists of three main areas: raw material extraction, component manufacturing and assembly.

More than 50 different materials could be found in an average smartphone, such as: 29% plastic, 16% ceramics, 15% copper and compounds, 10% silicon plastics, 10% other metals, 9% epoxy, 8% other plastics and 3% iron¹³. The material in all 7.78 billion smartphones and feature phones around the globe could contain an estimated 124,000 tonnes of copper, 2,721 tonnes of silver, 264 tonnes of gold and 117 tonnes of palladium^{14, 15}.

Raw material extraction, primarily mining practices, has negative environmental and social impacts due to contamination of air, soil and water by chemicals, heavy metals or acidic minerals when these are emitted or mixed with wastewater. Mining activities can cause soil erosion and loss of biodiversity as the practices include modification or destruction of habitats.

Production and assembly of components is not only material-intensive, but is also energy-intensive. It often uses fossil fuel energy sources, which is why approximately 80% of the climate impact from a smartphone comes from the production stage of the device and its components¹⁶. According to the United Nations Environmental Programme (UNEP), resource extraction and processing of fossil fuels, metals and minerals make up 36% of global greenhouse gas emissions and 7% of global biodiversity loss¹⁷.

Figure 2 | An example of materials in a mobile phone



¹² www.apple.com/supplier-responsibility/pdf/Apple-Supplier-List.pdf

¹³ World Economic Forum, 2019 - A New Circular Vision for Electronics, Time for a Global Reboot.

¹⁴ The estimate has been made based on the US Environmental Protection Agency that estimates that for every million cell phones that are recycled, around 15.9 tonnes of copper, 350kg of silver, 34kg of gold and 15kg of palladium could be recovered (www.epa.gov/recycle/electronics-donation-and-recycling, as well as estimates of the number of mobile phones in use from GSMA Intelligence)

¹⁵ www.bankmycell.com/blog/how-many-phones-are-in-the-world

¹⁶ Ercan, Mine and Malmodin, Jens and Bergmark, Pernilla and Kimfalk, Emma and Nilsson, Ellinor. (2016). Life Cycle Assessment of a Smartphone. 10.2991/ict4s-16.2016.15.

¹⁷ IRP 2019 - Global Resource Outlook 2019: Natural Resources for the Future We Want.

The average use time of a phone is around three years¹⁸. However, the technical lifespan is between four and seven years¹⁹ and the optimal lifetime for a mobile phone in terms of minimising its climate impact could be at least 25 years²⁰. However, extending the lifetime of all smartphones in the world by one year has the potential to save up to 21.4 million tonnes of CO₂ emissions annually by 2030²¹, equal to taking more than 4.7 million cars off the road²².

The current rate of consumption of devices contributes to the growing generation of e-waste (electronic waste such as discarded electrical or electronic devices), with a considerable amount of it being outside of formal waste management. It is estimated that as much as 86% of global e-waste is estimated to be treated outside of formal waste management, with small IT and electronics such as devices constituting around 9% of the total e-waste generated²³.

The final destination of many of these e-waste streams is unknown, but can end up in regular waste collection, dumped in landfills or burned in both formal and unregulated settings²⁴. There are data and knowledge gaps across all electronic waste streams, including devices such as routers and mobile phones.

As an example, where specific regional data is available, official take-back rates of mobile phones rarely exceed 15%, meaning that 85% of mobile phones are not formally recycled²⁵. However, this data does not include mobile phones stored in people's homes or those which are either passed on or sold to other consumers.

As significant amounts of e-waste are handled outside formal systems²⁶, fully functional devices could be discarded or recycled instead of collected and reused or repaired, losing the full potential of their useful lifecycles as well as the embedded value in components, materials and energy.



Samsung's Environment Strategy

Samsung has recently committed to be net zero by 2050 and to switch to using 100% renewable electricity. The company plans to develop new technologies to significantly reduce process gases - a byproduct of semiconductor manufacturing - and install treatment facilities to its semiconductor manufacturing lines by 2030.

Samsung Electronics plans to tap new low-power technologies to reduce energy consumption in everyday consumer electronics. This includes development of new ultra-low power memory chips that aim to significantly reduce the annual power consumption of memory products used in data centres and

mobile devices by 2025 compared to current products.

The company plans to lower power consumption levels by an average of 30% across consumer products including smartphones by 2030 compared to products with the same specifications in 2019. Samsung Electronics has created a new Circular Economy Lab to conduct comprehensive research on material recycling technologies and resource extraction processes from waste, and plans to establish a system in which minerals extracted from all collected waste batteries can be reused by 2030.

18 www.statista.com/statistics/786876/replacement-cycle-length-of-smartphones-worldwide/

19 Miliute-Plepiene, J. and Youhanan, L. (2019) - E-waste and raw materials: from environmental issues to business models. IVL Swedish Environmental Research Institute.

20 EEB. 2019. Coolproducts don't cost the earth - full report. Brussels: EEB. and Miliute-Plepiene, J. and Youhanan, L. (2019). E-waste and raw materials: from environmental issues to business models. IVL Swedish Environmental Research Institute.

21 The calculations have been made using the estimation from the European Environmental Bureau, 2019.

22 Assuming a typical passenger vehicle emits about 4.6 metric tons of carbon dioxide per year (EPA, 2022 - Greenhouse Gas Emissions from a Typical Passenger Vehicle).

23 The Global E-waste Monitor, 2020.

24 The Global E-waste Monitor, 2020.

25 EPA, 2008, New Tech Recycling, 2022, South China Morning Post, 2021, The European Economic and Social Committee 2019, J. Li et al., 2017

26 The Global E-waste Monitor, 2020.

Social impacts

Apart from environmental impacts, the life cycle of devices is also associated with social issues that impact individuals and communities. Evidence has been uncovered of extraction of much-needed minerals present in mobile devices being associated with human rights risks^{27, 28}.

For example, in raw material mining of conflict minerals and cobalt, there are recorded instances of child labour, such as in mining of gold in Ghana and mining of cobalt in the Democratic Republic of the Congo^{29, 30, 31}. Poor labour conditions including the lack of safety equipment or deficient security practices have also been documented in several countries such as Bolivia and Bulgaria, where materials such as tin, silver and copper are sourced for devices³².

Mining of raw materials may also lead to the release of toxic metals and contamination of soil or freshwater, not only affecting workers' health, but also local communities in proximity to mining areas or dumpsites³³. Moreover, communities that can be affected by proposed mining activities or which are in proximity to planned projects within the value chain are at risk of being neglected from the planning process. In Armenia, the planning of a gold mine failed to include local residents in the Environmental Impact Assessment, resulting in a number of protests³⁴.

Freedom of speech can be negatively impacted in the value chain of devices. In gold and copper mining in Bulgaria, cases of intimidation and silencing workers from speaking up regarding poor working conditions have been reported. Similar issues are also visible in manufacturing, for example in China and Vietnam, where workers can be exposed to poor working conditions related

to (for example) long working hours and excessive overtime, lack of worker representation and trade union rights as well as insecure contracts³⁵.

The increasing generation of e-waste, with significant amounts processed in the informal sector, also pose a risk to people's health and safety. For example, as many as 18 million children and adolescents and 12.9 million women could be at risk from adverse health outcomes associated to e-waste recycling³⁶. Poor e-waste management may also lead to contamination of nearby areas³⁷. Much of the informally treated e-waste is estimated to be illegally traded or dumped, predominantly in Ghana and Nigeria³⁸.



What are conflict minerals?

Conflict minerals as defined by both EU and US legislation includes gold, tin, tungsten and tantalum – sometimes associated with financing armed conflicts, hence impacting communities' existence^{39, 40}. However, other initiatives include more minerals such as The Responsible Minerals Initiative, which also includes minerals such as cobalt⁴¹. The internationally recognised OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas has an even wider scope and covers all minerals⁴².

27 www.ed.ac.uk/files/atoms/files/human_rights_risks_in_the_ict_supply_chain_0.pdf

28 www.gsma.com/betterfuture/wp-content/uploads/2020/05/GSMA_Introduction-to-human-rights_report_2019.pdf

29 www.amnesty.org/en/wp-content/uploads/2021/05/AFR6231832016ENGLISH.pdf

30 Human Rights Watch 2015. Precious metal, cheap labour.

31 European Parliament [2017-03-21]. www.europarl.europa.eu/news/en/headlines/world/20170314STO66681/conflict-minerals-the-bloody-truth-behind-your-smartphone

32 www.ed.ac.uk/files/atoms/files/human_rights_risks_in_the_ict_supply_chain_0.pdf

33 www.ed.ac.uk/files/atoms/files/human_rights_risks_in_the_ict_supply_chain_0.pdf

34 www.ed.ac.uk/files/atoms/files/human_rights_risks_in_the_ict_supply_chain_0.pdf

35 www.ed.ac.uk/files/atoms/files/human_rights_risks_in_the_ict_supply_chain_0.pdf

36 World Health Organization. (2021). Children and digital dumpsites – E-waste exposure and child health.

37 World Health Organization. (2021). Children and digital dumpsites – E-waste exposure and child health.

38 Lerpold, L. and Brytting, T. (2020). The Sustainable Development Goals and Corruption Dilemmas. ICC Telecommunication Union (ITU) and International Solid Waste Association (ISWA), Bonn/Geneva/Rotterdam.

39 European Parliament [2017-03-21]. Conflict minerals: the bloody truth behind your smartphone

40 www.responsiblemineralsinitiative.org/about/faq/general-questions/what-are-conflict-minerals/

41 www.responsiblemineralsinitiative.org/minerals-due-diligence/cobalt/ www.oecd.org/daf/inv/mne/OECD-Due-Diligence-Guidance-Minerals-Edition3.pdf

42 www.oecd.org/daf/inv/mne/OECD-Due-Diligence-Guidance-Minerals-Edition3.pdf

The way forward

With these negative environmental and social impacts in mind, there is an urgent need to accelerate the circular transition of the economy to be able to meet the demand for materials without depleting the global supply of finite resources. This would also reduce both the environmental and social impact of devices. The devices in scope should be used for longer and resource efficiency, reuse, repair and recycling rates should increase.

While demand for new devices remains high, there is already evidence of a budding circular economy – 11% of smartphones sold worldwide today are refurbished and the market is increasing⁴³. Consumers are also becoming more interested in second-hand products as well as sustainability at large^{44, 45}.

Devices are being used for longer. In the past seven years, the mobile phone replacement cycle has increased by 10 months, from 24 months in 2014 to 34 months in 2021 worldwide⁴⁶. This trend is expected to continue, with the refurbished mobile device market predicted to be worth more than \$140bn by 2030 compared to \$49.9bn in 2020⁴⁷. To put this into context, the global telecommunications market was valued at \$1,708bn in 2021⁴⁸.

The environmental, social and economic benefits of moving towards a more circular economy for devices are clear. The purpose of this strategy paper is therefore to explain how the industry stakeholders can take leadership in working towards a sustainable telecommunications industry in general, and to improve the circularity and long-term sustainability of telecommunication devices in particular.

The refurbished mobile device market is predicted to be worth more than

\$140bn

by 2030



⁴³ www.persistencemarketresearch.com/


⁴⁴ CapGemini 2021, Circular Economy for a Sustainable Future.

⁴⁵ www.simon-kucher.com/sites/default/files/studies/Simon-Kucher_Global_Sustainability_Study_2021.pdf

⁴⁶ www.statista.com/statistics/786876/replacement-cycle-length-of-smartphones-worldwide/

⁴⁷ www.persistencemarketresearch.com/mediarelease/global-refurbished-and-used-mobile-phones-market.asp

⁴⁸ www.grandviewresearch.com/industry-analysis/global-telecom-services-market

An aerial night view of a city street, showing modern buildings, cars, and streetlights. The image is framed by a large red circle. The text "A circular economy" is overlaid in the center of the circle.

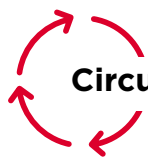
A circular economy

A circular economy

A circular economy is defined as an economy that retains the value of materials and products for as long as possible, moving from a linear economy (take-make-dispose) to a system where resources are used more efficiently and waste is reduced⁴⁹.

Moving from a linear to a circular economy requires transformation to a system that uses less material, extends the longevity of products, increases product use and recirculates products, components and resources back into the material flows of the economy.

In 2020, the global economy was estimated to be 8.6% circular, meaning that more than 90% of the world is still stuck in a linear economy where material and products do not get recycled or reused, but end up being wasted⁵⁰.



Circularity principles



The Ellen MacArthur Foundation

The Ellen MacArthur Foundation leads on developing approaches to the circular economy. The foundation defines the principles of circular economy as:

- **Design out waste and pollution:**

A circular economy aims to recycle materials from waste and create closed material loops. Waste disposal should be phased out to the greatest extent. Where it cannot be avoided, the waste must be adequately controlled to be safe for human health and the environment, for example via the incineration of waste with energy.

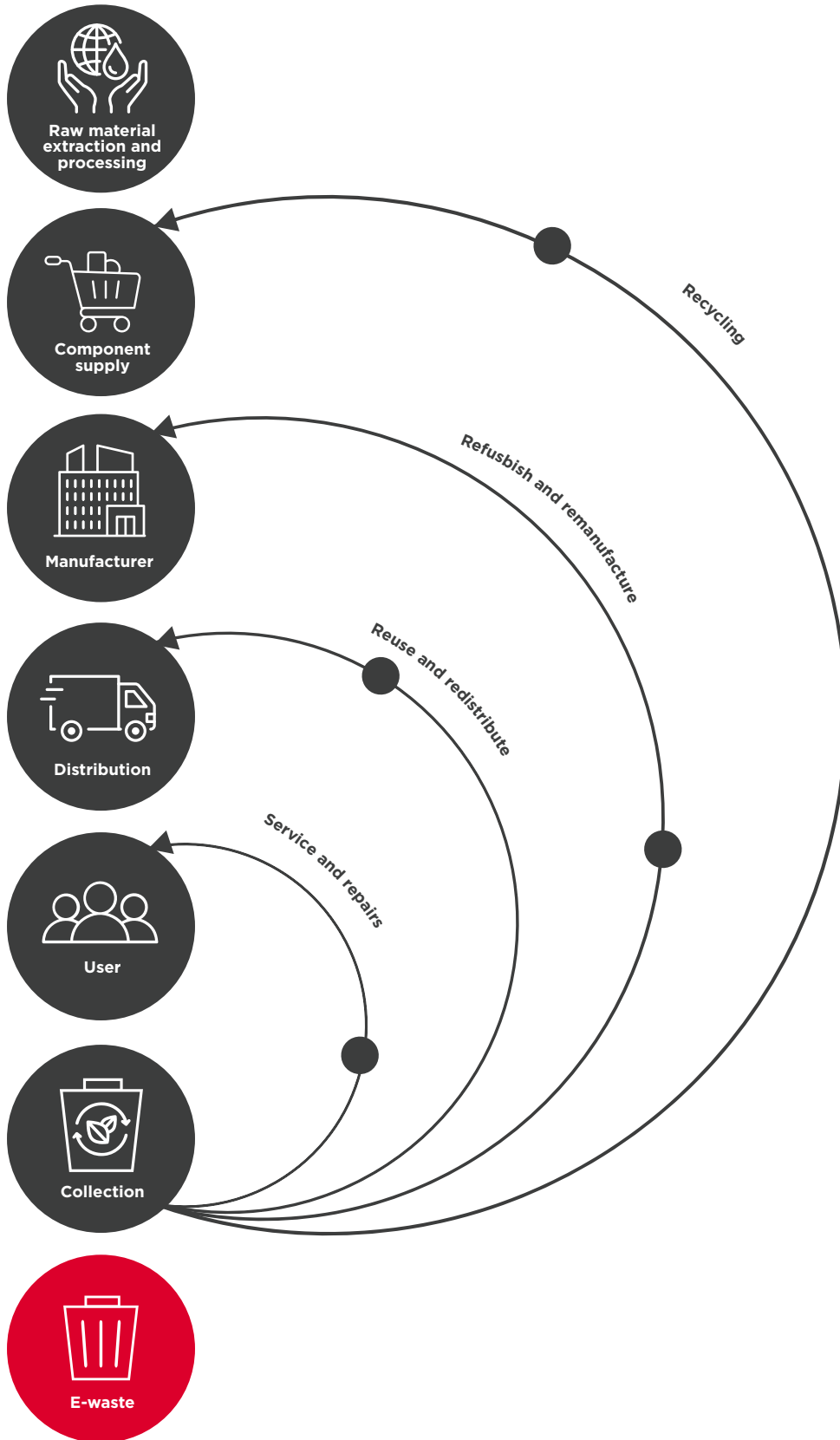
- **Keep products and materials in us:**

A circular economy prioritises activities that preserve value in the form of materials, energy and resources. This includes designing for durability, reuse, remanufacturing and recycling to circulate products, components and materials in the economy.

- **Regenerate natural systems:**

A circular economy includes avoiding the use of non-renewable resources and preserves or enhances renewable resource – for example, by using renewable energy instead of fossil fuels.

Figure 3 | Circular economy based on Ellen MacArthur Foundation



Circular economy policies

The circular economy is beginning to be embedded in policy across several continents:

- The EU's Green Deal⁵¹ and the Circular Economy Action Plan⁵²
- The US's National Recycling Strategy⁵³
- China's Development Plan for the Circular Economy⁵⁴
- Africa's African Circular Economy Alliance⁵⁵
- Latin America's Circular Economy Coalition Latin America and the Caribbean⁵⁶

However, the focus on how to deal with circular devices varies, from increasing recycling rates to prolonging the lifetime of devices or empowering consumers with the right to repair. There is a need to have an agreed approach for the circular economy of devices to achieve a system shift in the global economy.

By exploring best practice across these regions, along with what individual businesses are doing, this strategy paper proposes a globally relevant approach. In response to national strategies and action plans, as well as to boost circular economy overall, numerous organisations and companies have published frameworks on the topic.

Circularity frameworks and metrics

Circular economy frameworks and indicators are widely discussed topics by internationally acknowledged organisations, such as the 'Circular Transition Indicators' by the World Business Council for Sustainable Development (WBCSD), 'Circulytics' by the Ellen MacArthur Foundation, 'CIRCelligence' by Boston Consulting Group and 'the Circular Gap Metric' by Circle Economy. The GSMA also recently published the ESG Metrics for Mobile, including metrics connected to waste, repair, reuse and recycling.

In addition to metrics developed by industry initiatives, emerging regulation and internationally developed standards are also incorporating the circular economy – for example, European regulations such as the Corporate Sustainability Reporting Directive (CSRD), the Sustainable Finance Disclosure Regulation (SFDR) and the EU Taxonomy. Internationally adopted standards like Global Reporting Standards (GRI) and Sustainability Accounting Standards Board (SASB) also have metrics regarding circular economy.

⁵¹ ec.europa.eu/info/sites/default/files/european-green-deal-communication_en.pdf

⁵² ec.europa.eu/environment/pdf/circular-economy/new_circular_economy_action_plan.pdf

⁵³ www.epa.gov/recyclingstrategy

⁵⁴ www.china-briefing.com/news/chinas-circular-economy-understanding-the-new-five-year-plan/

⁵⁵ www.aceafrica.org/

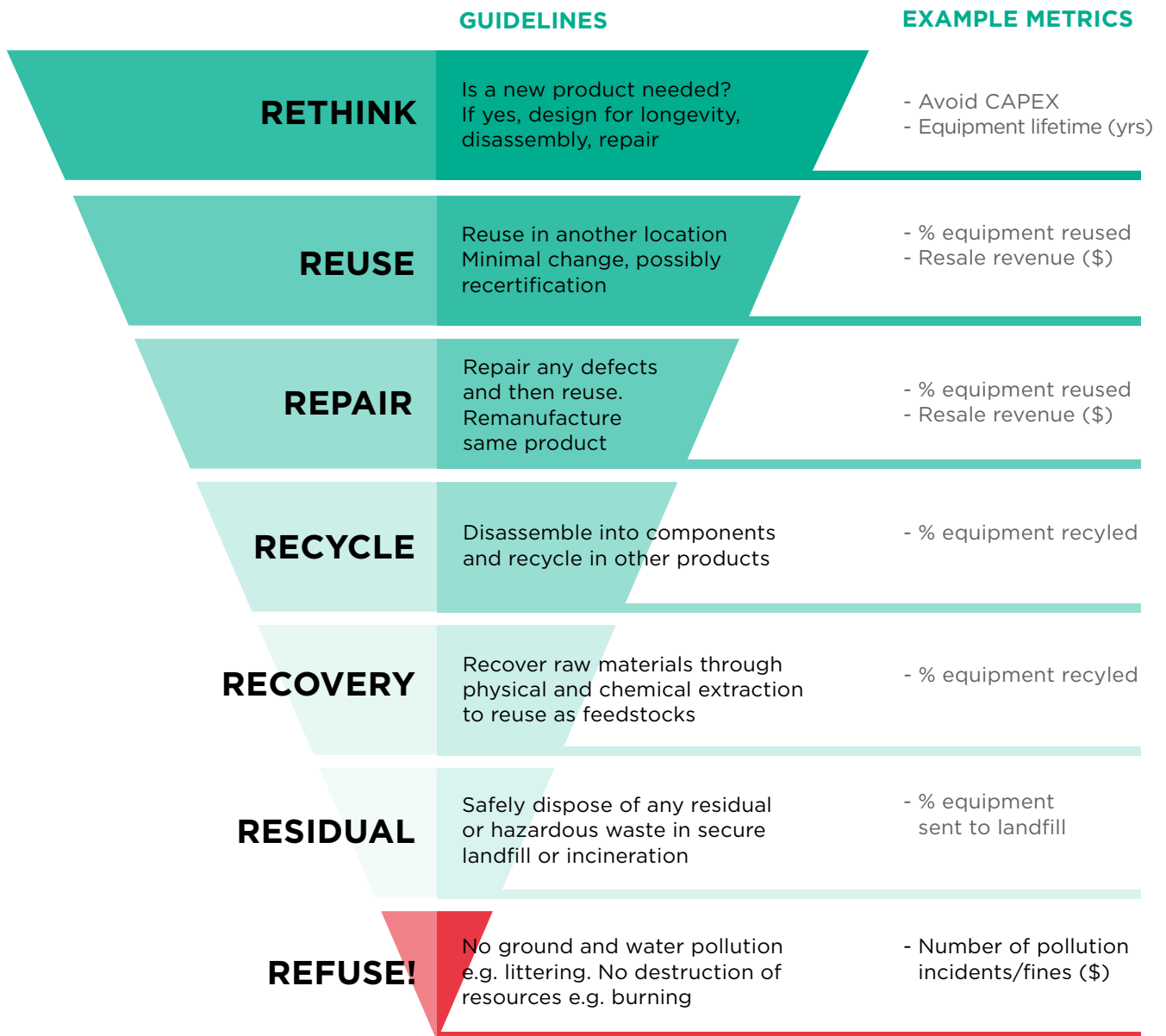
⁵⁶ coalicioneconomicircular.org/

Waste and resource hierarchy

The waste and resource hierarchy, which is illustrated in the figure below, is a model developed in the GSMA Strategy Paper *Circular Economy: Network Equipment*⁵⁷ that can be used as a guide in the transition towards a circular economy.

The bottom of the hierarchy covers activities, such as residual waste and material recovery, which are focused on handling waste through landfill or incineration and should be avoided to a greater extent. The further up in the hierarchy, the better, as value retention and creation are increased from recovery and recycle to repair activities.

Figure 4 | The waste and resource hierarchy developed in the GSMA Strategy Paper *Circular Economy: Network Equipment*⁵⁸




Source: GSMA

57 www.gsma.com/betterfuture/wp-content/uploads/2022/02/Strategy-Paper-for-Circular-Economy-Network-Equipment.pdf
 58 www.gsma.com/betterfuture/wp-content/uploads/2022/02/Strategy-Paper-for-Circular-Economy-Network-Equipment.pdf

Activities at the top are focused on making sure that products and resources are reused, with their original function, to minimise the environmental impact and resource constraints, while ‘Rethink’ activities deal with transforming business ideas such as moving away from individual ownership of products to a ‘shared economy’. These activities facilitate the retention of value by the preservation of products, extending their lifetime and making use of the embedded value.

The circularity model for devices builds upon existing indicators and metrics, circularity principles and the waste and resource hierarchy as well as the ESG key performance indicators for the mobile industry defined by the GSMA in the recently published ESG framework⁵⁹.



A large circular image showing a close-up of a hand holding a smartphone. The hand is positioned as if about to tap the screen. The background is blurred, suggesting an indoor setting with light. A red decorative line with a circular dot at its end curves across the bottom left corner of the page.

Circularity model for devices

Circularity model for devices

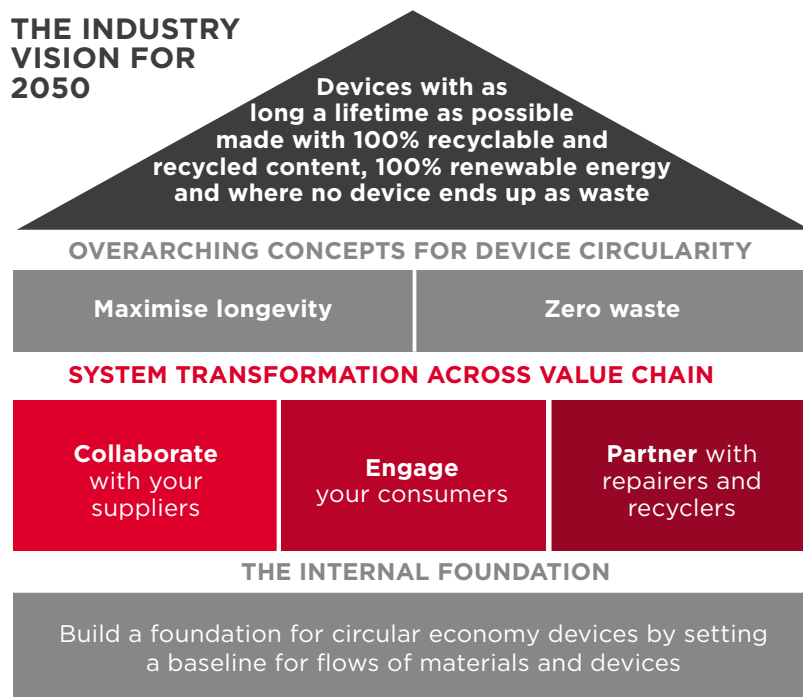
To materialise the potential of circular devices, the GSMA has defined a shared industry vision to 2050. All actors in the telecommunication ecosystem will need to work together to achieve this vision:

“Devices with as long a lifetime as possible, made with 100% recyclable and recycled content, 100% renewable energy and where no device ends up as waste”

To achieve the vision, a circularity model has been developed. The model includes two overarching concepts of ‘maximised longevity’ and ‘zero waste’, which permeate the four solutions to commonly observed

barriers related to a circular economy for telecommunication operators. As circularity is not achieved in isolation, the solutions entail collaboration with stakeholders across the value chain.

Figure 5 | The circular model displaying the circular transition for devices.



Maximising longevity and zero waste

Two concepts permeate the roadmap and metrics – the concepts of zero waste and maximising longevity – and these can be seen as a bridge to realise the vision for circular devices.

Maximising longevity is associated with the activities at the top of the resource hierarchy (rethink, reuse and repair) that results in a higher value retention. For the value chain to become more circular, several flows such as collection and take-back rate of used devices, maintenance and repairment of devices, refurbishment and replacing of broken components must increase. Consequently, device flows such as recycling may decrease in the long term, with component and material recycling only taking place when devices no longer can function as intended.

Zero waste is associated with activities at the bottom of the resource hierarchy (recycling, recover and residual) and is used when other options are limited. The flow of devices ending up in landfill or being incinerated (with or without energy recovery) needs to decrease the most and should only be used to securely dispose non-recyclable content such as toxic materials.

Extending the lifetime of all smartphones in the world by one year has the potential to save up to...

21.4

million tonnes of CO₂ emissions annually by 2030 – equal to taking more than 4.7 million cars off the road.



Maximise longevity of devices

A crucial part of circular devices is enabling a longer lifespan for the devices, as consumers currently use devices for shorter durations than their actual lifespan.

This means that the durability of the devices must increase, as well as the possibilities to repair and reuse them. Apart from MNOs reselling old devices, MNOs can also develop services including repair and leasing to contribute directly.

Indirectly, and out of MNO control, are the design from manufacturers and consumer habits promoting prolonged lifespan. While not in direct control, the MNOs are still in the position to influence and collaborate with both manufacturers and consumers.



Zero waste

In a circular economy, materials are seen as resources rather than waste. This means that the valuable materials contained in devices should be retained in the economy to all extent possible.

The zero waste concept is twofold, both from a resource depletion perspective as well as a solution to issues related to improper waste management. As such, no devices should end up in landfill or be incinerated (with or without energy recovery).

If devices contain hazardous materials or are unfit to maintain in cycle, they should be securely disposed of. The devices and the materials within them should be considered as valuable resources to be retained in the economy. This concerns both the more network operator-controlled waste from collected devices, as well as the consumer waste outside of operator control.

Figure 6 | The different end of life scenarios for a mobile phone.



Source: GSMA



Apple's Environment Plan

Apple has been carbon neutral since 2020 and has committed to all its products being carbon neutral by 2030. Apple plans to achieve this through a combination of measures including:

- Low carbon design - increasing recycled content, using material more efficiently and reducing the energy products use.
- Renewable electricity - by 2030, clean energy will be used to make every Apple product.
- Energy efficiency - increasing energy

efficiency across data centres, manufacturing sites, retail stores and offices.

- Carbon removal - investing in nature to remove unavoidable carbon emissions while supporting local communities and biodiversity.

Apple has also stated that it is aiming to make every product with 100% recycled or renewable materials, but has not yet given a timeframe.

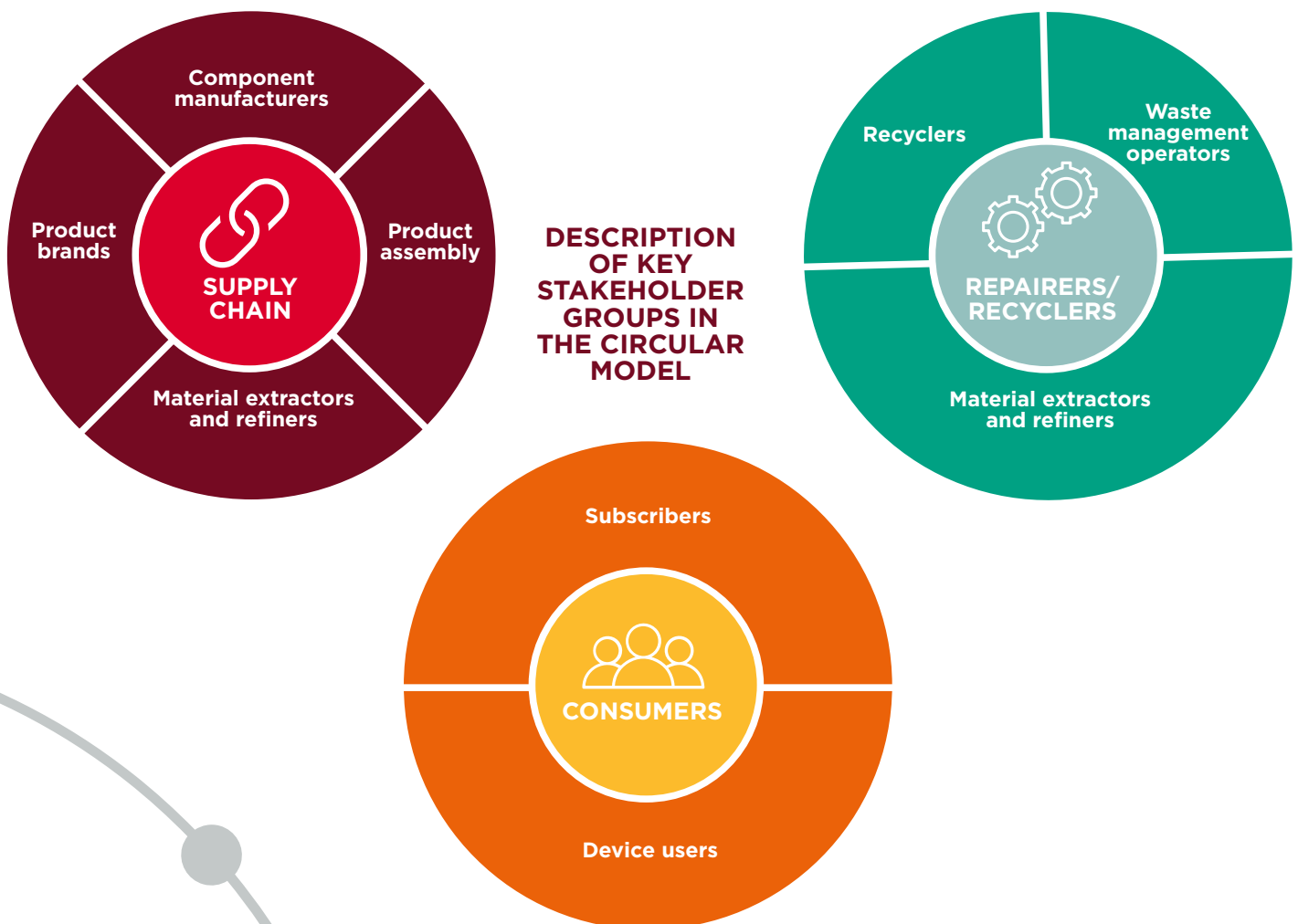
Introduction to the model

The model includes actions and metrics to guide telecommunication operators on their journey towards circular economy for devices. Given that several barriers to circular devices lies outside the direct control of operators, the model is designed with a whole value chain approach, including practical steps covering both direct control measures as well as indirect control measures.

The foundation of the model is the starting point for a company’s circular transition and provides the company with elements needed to understand its current position in terms of impact, control and preconditions to advance

the circular economy of devices. The next step consists of a roadmap of solutions through engagement activities targeting three key stakeholder groups upstream and downstream in the value chain of devices: the supply chain, consumers and repairers/recyclers.

Due to the variety of maturity of the circular economy in various parts of the world, the roadmap may be executed sequentially or in order of preference. Actions will take time to execute, and companies may need to assess the efficiency of executed actions continuously and adjust accordingly.





BT Own Brand Device Refurbishment and Recycling Programme

BT has set up a successful own-brand device refurbishment programme for Wi-Fi hubs/routers, television set-top boxes etc., to extend their life. Refurbished devices are repackaged with accessories and documentation ready for use. The business model was changed with BT retaining device ownership and leasing to the customer. A unique device asset number is assigned to a specific customer to enable tracking and to optimise the return process and customer communication.

Device refurbishment is wholly in the UK, avoiding the carbon footprint of a round trip journey to Asia, along with saving time and cost. Typically, a refurbished device is a third of the cost of a comparable new device.

The Carbon Trust has verified the BT result. BT refurbish more than 400,000 broadband hubs and TV boxes per year as well as recycling half a million more - saving 11,400 tonnes of CO₂ emissions (equivalent to 6,000 flights from London to Tokyo). This is equivalent to 168 tonnes of WEEE and 160 tonnes of avoided plastic.

Proximus: Strategic actions and circular business models

Proximus has set a target to become truly circular by 2030 and the company is focusing on further developing their circular business models, both for fixed and mobile devices. For its fixed devices, Proximus relies heavily on ecodesign. Even before the production stage, Proximus designs its devices (such as internet boxes, TV boxes and WiFi-boosters) to reduce their energy consumption, minimise the use of raw materials and facilitate their refurbishment. In order to reduce electronic waste, Proximus repairs its devices, refurbishes them and resells them. In its Courcelles logistics center, Proximus is now able to refurbish 90% of its modems and decoders and put them back into circulation four times.

Since the start of these activities in 2014, more than three million devices got a new life.

For its mobile devices, Proximus collects old mobile phones for refurbishing or recycling. Refurbished smartphones are put up for sale. Mobile phones that can no longer be used are recycled by partners Umicore, Recupel, Out of use and Brainscape. Since September 2021, the Proximus shops and online shop offer customers refurbished smartphones as an alternative to new devices. These devices are thoroughly checked and are sold with a two-year warranty, just like new mobile phones. In addition to offering these devices, Proximus publishes information online on refurbishing and recycling to make it available for its customers. For enterprises, Proximus offers leasing services of smartphones and tablets. During 2021, Proximus entered into agreements for another 12,500 active packs, with a total number of active packs of 17,000.

Tele2: Device as a service

Tele2's Device as a Service solution is a circular service offering centred around the combined offering of leased hardware and services. Since 2021, Tele2 offers the service to its large B2B Enterprise customers and, today, one in five mobile phones are sold as a service in the segment. The circular offer enables a closed loop for reuse and recycling of mobile phones. More than 99% of the devices are returned, of which 95% can be repaired and reused while the remaining devices are recycled. For every reused mobile phone,

around 50kg of carbon dioxide can be saved, corresponding to the production of a new unit, according to Tele2's recycling partner. By offering this service, Tele2 are meeting a growing customer demand and reducing e-waste, thus creating both business and sustainability value. Circular economy is one of the cornerstones of Tele2's sustainability strategy and, by 2025, Tele2 will develop winning offerings for relevant customer segments in B2B and B2C based on a circular business model with reduced climate impact.



Boosting Circularity: barriers and opportunities

Boosting circularity: barriers and opportunities

The roadmap to a circular economy for devices introduces four steps to incentivise the transition towards maximised longevity and zero waste. Actions are both directly for telecommunication operators as well as in cooperation with others. Given that every telecommunication operator is embarking on the circular economy journey from a different starting place, each step of the roadmap consists of both 'entry-level' and more advanced 'leadership-level' actions.



Lack of data on end-of-life of devices

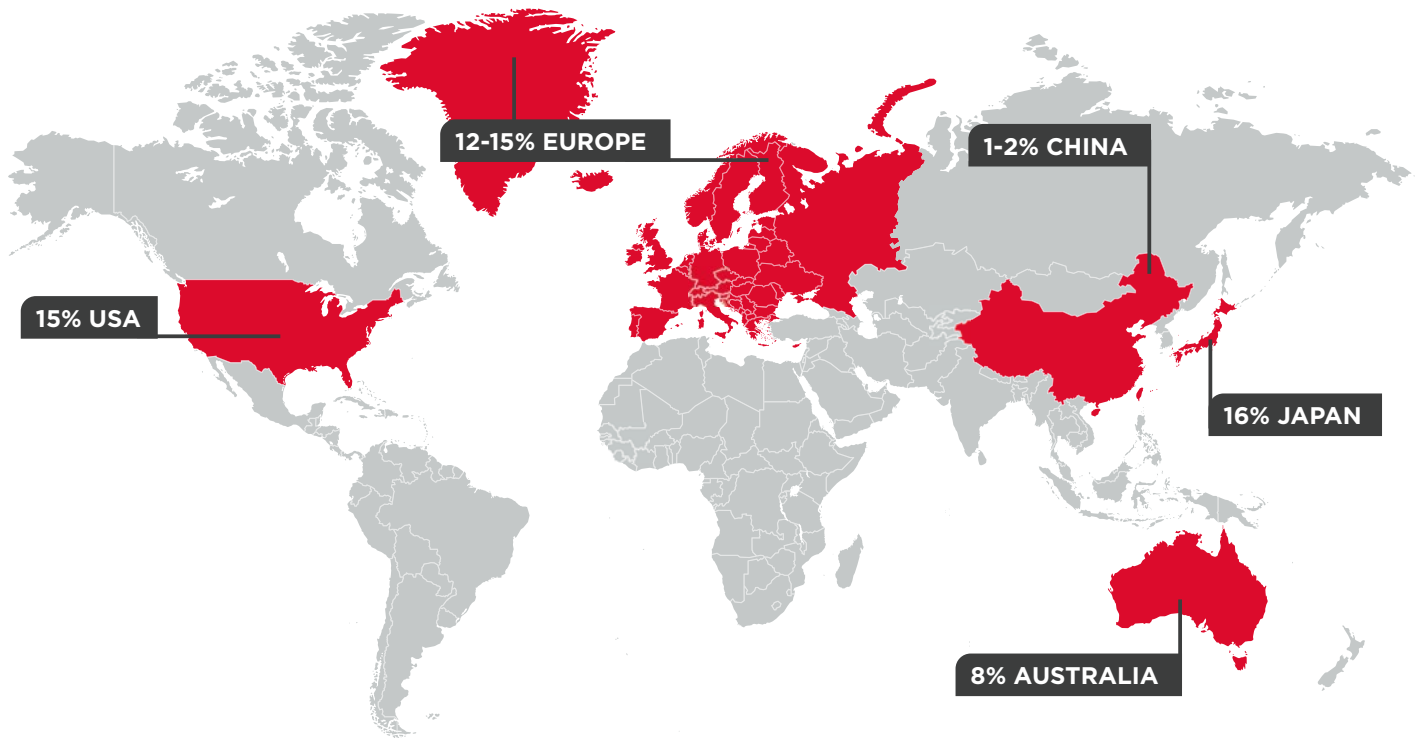
The data of global take-back rates of devices varies in availability and, where data is available, the take-back rates rarely exceed 15%. Available data only concerns devices that have been handed into a formal recycling facility and do not consider the secondary market that exists among customers. There is an evident data gap on what happens to the device when the first consumer no longer needs the device but does not return it to a telecommunication operator.

In many parts of the world, data is lacking and this could have several explanations. For example, there are limited organised or formal systems for the take-back of e-waste and devices in many countries in Africa⁶⁰. However, the data are estimates and, as an example, MobileMuster – accredited under the Australian Government's Recycling and Waste Reduction Act 2020 – reported a 98% recycling rate of the collected mobile phones⁶¹.

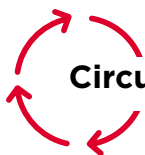
⁶⁰ African Circular Economy Alliance, 2021.

⁶¹ MobileMuster Annual Report 2021

Figure 7 | Estimated mobile recycling rates. The map displays the share of formal collection and recycling of mobile phones in regions where data is available⁶².



Source: GSMA



Circularity principles

Formal and informal recycling schemes

In certain countries, formal recycling is tightly linked to the Polluter Pays Principles, where the liability for costs for waste disposal or waste management is allocated to the final holder of the waste, or the previous holders of the waste.

For example, in the EU this principle has been incorporated into legislation concerning electrical and electronic equipment: the WEEE (Waste electrical and electronic equipment) Directive. The directive includes ‘Producer Responsibility’ meaning that producers should

finance, at a minimum, the collection from collection facilities and the treatment, recovery and disposal of WEEE (the producers’ own products). A producer can include reselling equipment produced by other suppliers.

In other countries where formal recycling is limited, the destination for devices could involve manual recycling and dismantling by hand under poor working conditions or that devices end up in open waste sites or being burned.

⁶² newtechrecycling.com/cell-phone-recycling-facts/ - South China Morning Post, 2021, The European Economic and Social Committee 2019, J. Li et al., 2017, EPA 2008, Telecommunications Carriers Association in Japan, 2021, The Sydney Morning Herald, 2017

Choosing suitable metrics to measure device flows

By gathering data on the flow of devices, a foundation for circular economy for devices can be built and actions can be targeted to improve circularity. There are two sets of actions and metrics recommended: 'entry-level' and 'leadership'. Measuring device flows will help operators understand their current circular status for devices, and also improve the understanding across the industry.

Entry-level actions and metrics will help to understand what proportion of devices are wasted, recycled and refurbished. Leadership-level actions and metrics go a step further and measure overall device reclamation rates, and what devices are composed of.



Tele2 'Mapping of material flows'

As a result of Tele2's ambitious efforts to reduce emissions by 90% in their own operations in two years, the majority of Tele2's emissions lie within its value chain today. Transitioning to a more circular economy has the potential to decrease the environmental impact of Tele2's value chain and is one of four key focus areas of Tele2's sustainability strategy.

In the autumn of 2021, Tele2 mapped out the most important material flows of its operations and identified key questions for moving forward in the circular transition. The material flow analysis included both

network infrastructure, offices and stores as well as customer products in B2B and B2C offers. Material inputs of around 3,000 tonnes were identified. Excluding the network equipment, the largest material flows in terms of weight concerned plastics and different metals such as aluminium and copper.

The analysis showed that around 8-15% of all procured mobile devices are either reused or recycled. To close the loop for mobile devices, the number of reclaimed devices must increase. The insights from the material mapping will be used to further develop Tele2's understanding and implementation of circular economy for devices.

Entry-level action:

- Set up a structure (e.g. system tool or Excel) to collect data regarding devices.
- Quantify number of collected devices and number of devices being incinerated or landfilled, recycled, repaired and reused.

Entry-level metrics:

- Mobile device and CPE waste generated in tonnes per fiscal year.
- % of mobile devices and CPEs recycled by unit sold per fiscal year.
- % of mobile devices and CPEs recycled by purchase price per fiscal year.
- % mobile devices and CPEs repaired and reused by unit sold per fiscal year.
- % mobile devices and CPEs repaired and reused by purchase price per fiscal year.

Leadership-level action:

- Based on the entry-level data, conduct an assessment on data gaps, how to improve data quality and leverage points.
- Estimate material content (plastic, metals, critical minerals, etc.) of procured and reclaimed products to understand the material value of input and output flows.

Leadership-level metrics:

- Percentage of mobile devices and CPE collected from consumers of total units sold in fiscal year.
- Weight and share of renewable, reused and recycled material in procured devices and CPEs.



Optus: Modem Recycling

Optus are passionate about providing options for their customers and often get receive the question from consumers on how they should recycle their old modems. In reaction to this, Optus proudly launched their new Modem Recycling programme in 2020 which enables Optus customers to recycle all old

Optus modems (except 5G models) in any of their retail stores. Together with e-waste management partners, Optus ensures that more than 95% of the modem components are extracted and recycled. Optus invites all their customers to bring in any unwanted modems and cables to their retail stores for recycling.

Telia: Smarter return-logistics of devices

For their Swedish operations, Telia has designed a new carton box for delivering and taking back devices such as routers and mobile phones. The box is made of no other material than 100% recycled FSC (Forest Stewardship Council) carton and includes information on why and how to return the device and what happens with the device afterwards. The purpose of this compact, all-recycled

FSC carton box for delivery and return, which includes simple messaging and a link to more information, is to make it easy and fun for customers to return equipment to Telia for repair and reuse. The new cartons have resulted in a 15% reduction in material consumption, 19% of air savings and more efficient packaging. The initiative will hopefully lead to more consumers returning their devices.

Bell: National take-back programme

To increase customer participation in recovery, Bell has implemented an effective e-waste programme for recovery, reuse, recycling and disposal of electronic devices distributed to customers. The programme includes national take-back programmes, drop boxes and mail-in instructions simplifying recovery

of end-of-life consumer electronics. Devices such as modems and WiFi-pods are included in the programmes. Thanks to customer participation in the recovery programmes, Bell diverted more than 2,997 metric tonnes of customer-facing electronics from landfill during 2021.

Orange: Launch of the 'Re' circular economy initiative throughout Europe

Each year, more than 1.5 billion mobile phones are manufactured worldwide but just 1-2% of these phones are recycled globally. Since 2020, Orange France launched the 'RE' initiative, based around four pillars: REcycling, REturns (=Buy Back), REfurbishment and Repair, followed in 2022 by European countries in Luxemburg, Belgium, Poland, Moldova, Slovakia and Romania, thus consolidating Orange's commitment to the circular economy in all its activities and practices.

Since its launch in France, the 'Re' initiative has ramped up the collection rate (recycling and returns) of used mobiles, from 13.4% in

2020 to 22.3% in 2021, in line with the 30% target Orange has set for 2025. In total, around 1.9 million mobiles have been returned and recycled since the initiative launched.

The 'Re' initiative allows Orange customers to trade in their phone in-store for a discount or credit voucher and buy a range of refurbished phones as an alternative to a brand-new phone. Orange recycles phones that no longer work and/or have no cash value and offer repair services. In France, recycling profits are donated to the Emmaüs International network, as well as two euros for each return. With Orange, all of its customers can give a second life to their phone(s).

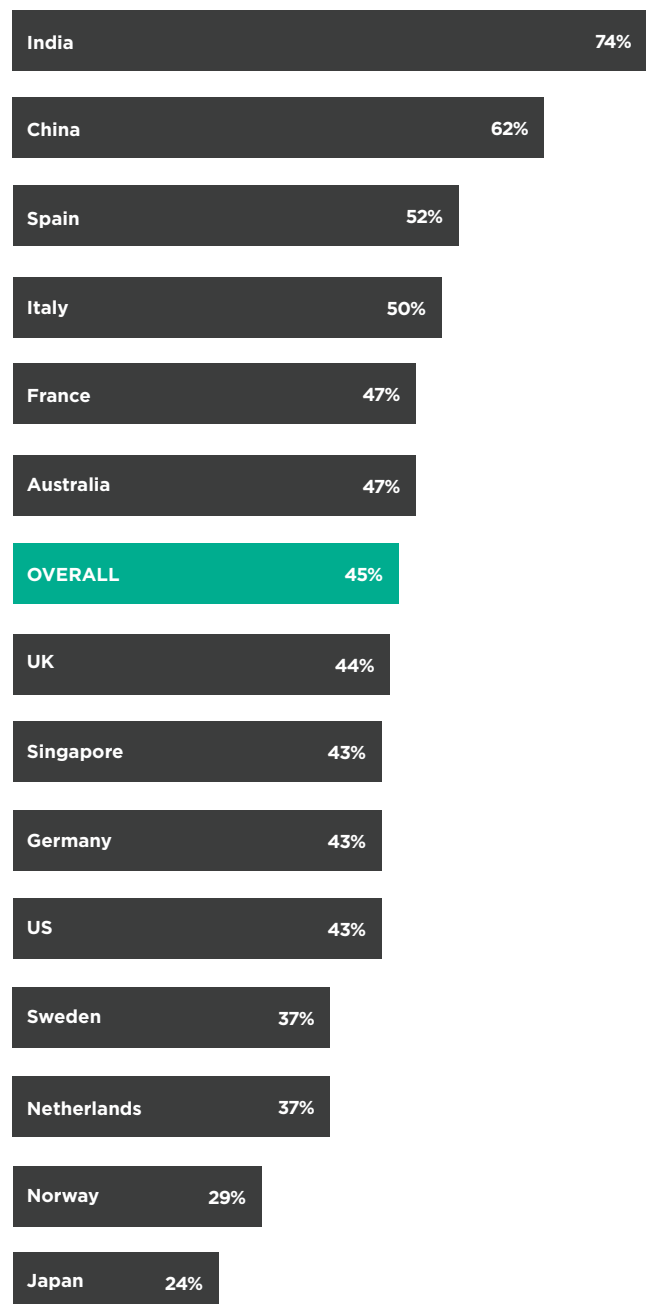
Consumers want to do more, but need information

Consumers are critical to achieving a circular transition for the devices because, once the devices are sold, the consumer is in control of the device. Understanding consumer behaviour is a difficult and complicated task, and aspects such as affordability, information availability, social norms and preferences can all affect the final behaviour of the consumer⁶³.

However, consumer awareness of sustainability and circularity is on the rise. For example, 51% of consumers globally think that the consumer electronics sector is not doing enough to reduce, reuse and recycle waste. In addition, 72% of consumers would like to buy products that are more durable and 47% want to buy second-hand instead of brand-new items. Also, 53% of consumers are comfortable with using second-hand phones⁶⁴.

When it comes to purchasing a device, consumers feel less engaged and aware. A majority (80%) of EU citizens think it is hard to find information on durability and repairability, and 64% think that it is hard to tell how long a device will last⁶⁵.

Figure 8 | Consumer interest in buying exclusively from brands that practice circularity. Percentage of respondents who say they are interested in buying exclusively from brands that concentrate on circular and sustainable practices



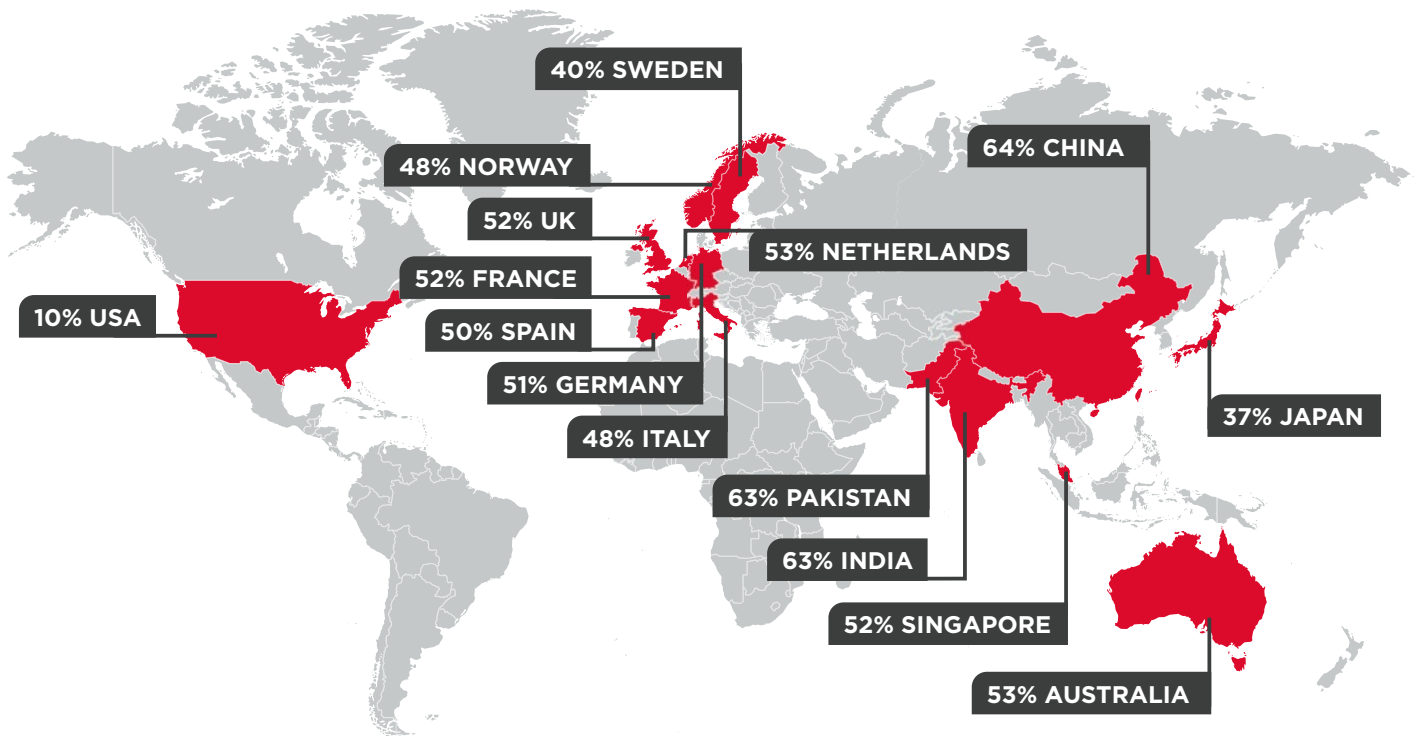
Source: Capgemini Research Institute, circular economy survey, August-September 2021, N=7,819 consumers.

⁶³ European Environment Agency, 2022. Enabling consumer choices for a circular economy.

⁶⁴ CapGemini 2021, Circular Economy for a Sustainable Future.

⁶⁵ An online consumer survey was conducted in Austria, the Czech Republic, Germany, Spain, France, Hungary, Ireland, Latvia, the Netherlands, Portugal, Romania and Sweden with approx. 1,000 respondents each (ca 12,000 in total). ec.europa.eu/info/sites/default/files/ec_circular_economy_final_report_0.pdf

Figure 9 | Percentage of consumers saying they do not trust sustainability claims made by organisations regarding their recycled/refurbished products⁶⁶. *The Pakistan figure has been provided by the Pakistan-based operator Jazz⁶⁷.



Source: GSMA

Moreover, consumers are concerned with how data security and integrity are ensured when a device is collected, creating a barrier to returning the device⁶⁸. Around the world, consumers are still holding on to old devices; an estimated 700 million second-hand mobile phones are left unused in the EU alone when they could be recycled, refurbished or even reused by someone else⁶⁹. A majority save the devices as a spare but, for others, either concerned regarding data security or not knowing where to hand in old devices, they just end up in peoples' drawers⁷⁰.



AmericaMovil: 'Container collection and stakeholder communication'

In Mexico, within the GSMA and ANATEL 'Green Programme' (Programa Verde), Telcel, owned by AmericaMovil, have placed around 500 collection containers in their stores and corporate offices, enabling its customers and employees to properly dispose of their old mobile phones and other used electronic devices. During 2020, Telcel collected more than 87,000 devices and more than 482,000 accessories. Telcel communicates of awareness in social networks to strengthen the culture of recycling and to encourage all their stakeholders to join forces to achieve a circular economy.

⁶⁶ CapGemini 2021, Circular Economy for a Sustainable Future.

⁶⁷ The 33% figure was provided by the Pakistan-based operator Jazz, and the result was based on a computer-aided telephonic interview survey with 263 random respondents conducted in 2022 – see Appendix 2

⁶⁸ Royal Society of Chemistry (2019), www.rsc.org/new-perspectives/sustainability/elements-in-danger/

⁶⁹ European Economic and Social Committee (2019), Identifying the impact of the circular economy on the Fast-Moving Consumer Goods Industry: opportunities and challenges for businesses, workers and consumers – mobile phones as an example.

⁷⁰ Royal Society of Chemistry (2019), www.rsc.org/new-perspectives/sustainability/elements-in-danger/

Surveying customers and helping them make sustainable choices

Consumers must have the knowledge and opportunity to care for devices while in use to maximise longevity and also return devices they no longer need so the device can be reused or recycled.

Telecommunications operators can provide consumers with the information needed to promote them into a change of behaviour. To measure consumer engagement, telecommunication operators can use not only descriptive and qualitative metrics,

but also estimations of the destination of the fate of devices based on findings from consumer surveys.

Once the company has gathered information on consumer habits and mapped the potential destination, the next step involves communicating with the consumer to potentially affect their behaviour – for example, through communication campaigns to raise awareness on how to turn in devices, caring for devices or promoting the use of ecolabels.

Entry-level action:

- Research consumer habits and preferences through a survey including topics such as:
 - Average lifetime per device.
 - Current repair and recycle habits.
 - Preferred incentives to extend product use, e.g. price, sustainability awareness, availability of refurbishment options, take-back schemes, product as a service etc.

Entry-level metrics:

- Share (%) of consumers that dispose of their device.
- Share (%) of consumers that recycle their device.
- Share (%) of consumers that repair/reuse their device.
- Share (%) of consumers that sell/give away their old device.
- Share (%) of consumers that keep their old device unused.
- Share (%) of consumers that repurpose their old device.

Leadership-level action:

- Develop consumer communication material with the purchase of the device, on websites and in stores regarding, for example;
 - Guidelines on how to care for devices to prolong their lifetime.
 - Take-back schemes and device recycling.
 - Data security at disposal etc.
 - Target marketing on ecolabels such as Eco Rating to support consumers to make sustainable choices when buying devices.

Leadership-level metrics:

- Share of consumers using their device for 1-3 years, 4-7 years, >7 years.
- Number and description of circularity initiatives and/or projects offered to customers according to the various steps in the resource hierarchy.

ESG Metrics

For more details on industry-wide metrics for waste and recycling, as well as supply chain engagement, please see www.gsma.com/betterfuture/esg-metrics-for-mobile



Circularity principles

Eco Rating Initiative

Apart from information campaigns and similar initiatives, product labels could also be used – for example, the labelling method developed by the Eco Rating consortium led by Deutsche Telekom, Orange, Telefónica (operating under the O2 and Movistar brands), Telia Company and Vodafone.

The Eco Rating, launched in May 2021, evaluates the environmental impact of the entire process of production, transportation, use and disposal. The label displays the product's Durability, Recyclability, Repairability, Climate Efficiency and Resource Efficiency. The evaluation is made by combining 13 different environmental indicators and six different material efficiency criteria to obtain a single score for each device.

The Eco Rating method is based on a number of international standards (e.g. ITU-T L.1410, L.1015, EN 4555X series on material efficiency, Product Environmental Footprint) as well as on industry knowledge and best practice gathered through previous environmental labelling. Currently, 17 vendors are participating and more than 250 devices have been evaluated⁷¹. More telecommunications operators joining this could spark increased incentives for more vendors to join.

ITU-T Standard L.1023 Assessment method for circular scoring

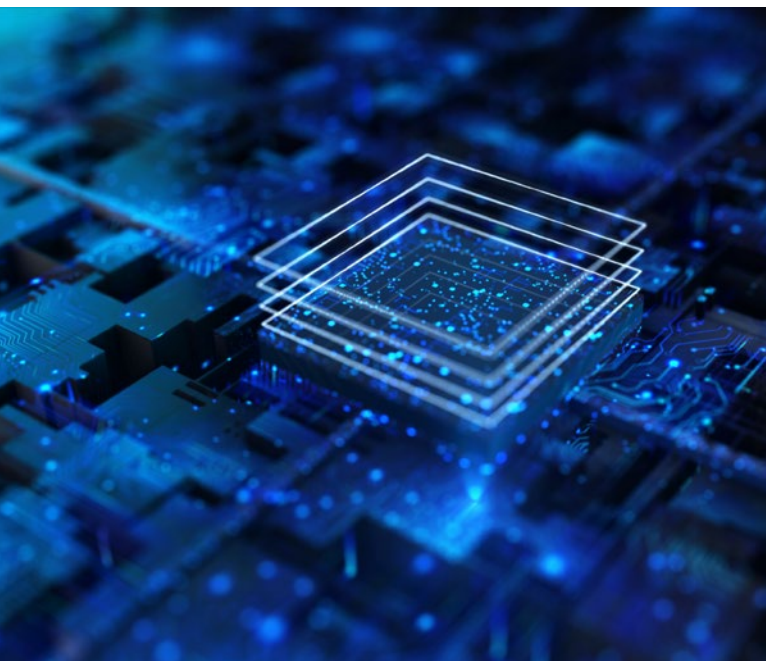
In addition, the ITU-T standard L.1023 can also be used to as method to assess the circularity of different devices and not only mobile phones but also CPE. The standard contains various circularity criteria (for example, including product durability and the possibilities to refurbish, reuse or upgrade the ICT product). The assessment includes estimating the relevance of each criterion, determining the scoring of the product and calculating the total circularity score.

The supply chain for devices is complex

To achieve a circular economy for devices, there is a need for collaboration and communication within the value chain. A recent study shows that 49% of telecommunication operators see the complexity of supply chains as a barrier for circular economy. At the same time, 84% believe that a circular economy can help solve challenges within the supply chain⁷².

Stakeholders in the supply chain, such as manufacturers and product brands, play a key role in terms of the circular performance of the devices, with the possibility to design devices to prolong their life, increase recyclability and keep them free from hazardous materials.

It is also important to consider possible vulnerable stakeholders within the supply chain, such as workers and local communities. In order to ensure a fair transition of the industry towards a circular economy, manufacturers can play a key role to ensure that violations against human and labour rights are avoided within their supply chains.



Telefónica: Accelerating Circular Economy through innovating supply chain processes.

Regarding CPE, Telefónica has developed and deployed VICKY in Brazil, an initiative that has been recognised for its innovation by the industry (i.e: Gartner, Forbes). This platform, based on Blockchain, is now tracing millions of CPE yearly, from components manufacturing to distribution, installation and reverse logistics across the E2E value chain. Telefónica uses this initiative to lead the transition to circular economy, while creating business value through a more efficient, faster, simpler and sustainable supply chain. With more than 100 different companies involved in the process, placing more than 15 million pieces of equipment on the market each year, it has drastically improved product recovery rates (up to +25p.p.), refurbishment processes, product lifespan, product design and recycling and scrapping rates, intending to collect 100% of the uninstalled or inactive equipment, both in customer premises and in collecting points.

In addition, for mobile devices, Telefonica uses MARA, a fully omnichannel process that allows consumers to automatically assess their devices and access the Telefónica trade-in programmes anywhere, providing instant and real value added to customers without risks (0% discrepancies rate) and, at the same time, defining the best device destination (reuse, resell, repair or recycle) before collecting them.

Targeted and specific supplier engagement is needed

Preconditions to prolong product lifecycles such as repairability and durability lie outside telecommunication operators' direct control as such factors are defined in the design phase of a product. Nevertheless, operators jointly hold significant purchasing power as retailers of devices around the world.

There are also technical limitations on the longevity of devices (for example, software upgrades, lifetime of components such as the battery or the availability of replaceable components). The technically useful lifetime is limited because these obstacles prevent use of the device after a certain number of years. These limitations should be considered when telecommunications operators have ownership over the design process, such as white-labelled CPE.

All forms of industry initiatives and partnerships are key to creating a systemic change towards a circular economy for devices. Telecommunications operators may engage with suppliers and product brands to target the barriers created by complex supply chains. By requesting brands to design and produce devices with longer lifespans, higher repairability and more recycled components and materials, the telecommunications operators have the potential to positively influence the market.

Three metrics are suggested in the engagement with suppliers. The first and second relate to criteria set towards suppliers to increase circularity of devices. The second metric enables the organisation to further comprehend the circularity of their flow of devices in terms of aspects that could result in a longer lifetime for devices. The third metric concerns procedures for following up suppliers.

Entry-level actions:

- Develop and adopt a 'Sustainable Procurement Policy' including purchasing criteria concerning circular products. For example:
 - Does the device have an ecolabel, such as Eco Rating, or similar?
 - Does the device have an energy label, such as Energy Star?
 - Have eco-design principles* been taken into consideration when designing the device?
 - Percentage of recyclable content
 - Recyclability of device
 - Percentage of renewable energy used in production
 - Durability of device
 - Develop and adopt a Supplier Code of Conduct, covering the 10 principles of the UN Global Compact to ensure sustainable manufacturing. Include the supplier code of conduct in supplier agreements.

Entry-level metrics:

- Sustainable Procurement Policy has been implemented in the company (Y/N).
- Number and share (%) of devices that comply with purchasing criteria.
- Number and share (%) of strategic suppliers being screened through self-assessment and physical site visits or audits.

The difference between a Sustainable Procurement Policy and a Supplier Code of Conduct is that the former is an internal document to guide the procurement department in purchasing decisions, whereas the latter is an external document communicated and signed by suppliers as part of an agreement.

Leadership-level action:

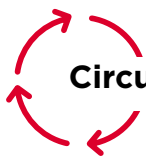
- Collaborate within industry initiatives to share best practice, increase circularity of devices and/or promote a transparent industry – for example, through the Circular Electronics Partnership, Eco Rating Consortium, Joint Audit Cooperation etc.
- Ensure compliance with Supplier Code of Conduct through dialogues or audits by the company or a third party.

Leadership-level metrics:

- Number and description of circularity initiatives and/or projects offered in collaboration with suppliers according to the various steps in the Waste and Resource Hierarchy.

**Circular Electronics Partnership**

The Circular Electronics Partnership has combined their private sector members who collectively developed a roadmap based on six pathways across the value chain. The roadmap consists of 40 actions responding to shared barriers that all companies encounter in their circular transition and which need to be addressed on an industry level. The CEP partners and members are now starting directed projects and initiatives to address the actions one by one. See more at cep2030.org

**Circularity principles**

In 2017, the Ellen MacArthur Foundation launched the Circular Design Guide which helps businesses and designers to adopt the principles of circular economy. The guide includes several methods and examples from the industry. Learn more at www.circulardesignguide.com/get-started

What are principles of eco-design?

Eco-design principles as defined in the proposed Eco-design Directive from the EU:

1. Product durability and reliability
2. Reusability
3. Upgradability, reparability, maintenance and refurbishment
4. Presence of substances of concern in products
5. Product energy and resource efficiency
6. Recycled content in products
7. Product remanufacturing and high-quality recycling
8. Products' carbon and environmental footprints
9. Products expected generation of waste materials

Untapped potential in secondary markets

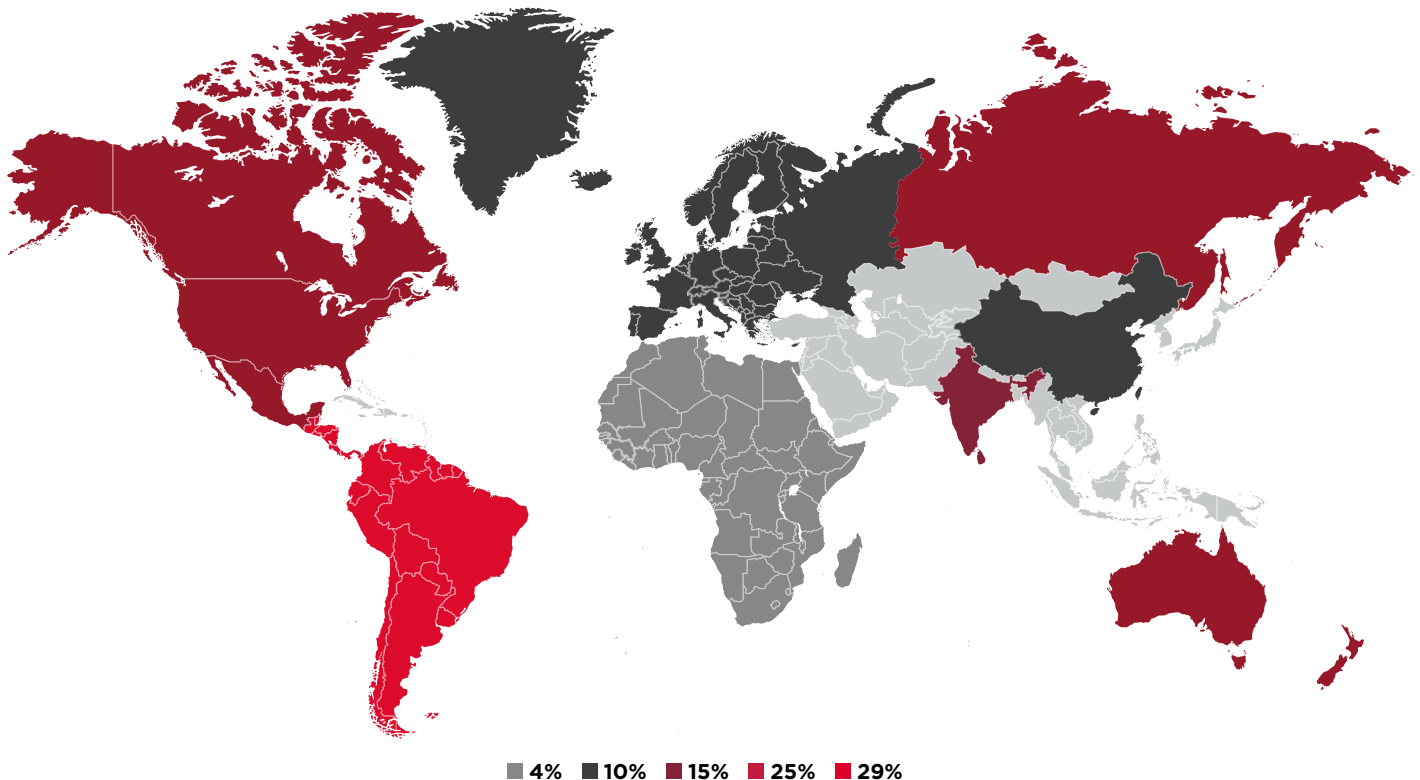
Although the market demand for second-hand and refurbished devices is starting to increase, only 11% of smartphones sold worldwide are refurbished⁷³. A global circular transition will move employment from primary production, such as resource extraction, to secondary and tertiary production, such as the recycling and refurbish sectors. Estimations predict a loss of eight million jobs globally within industries such as mining and manufacturing⁷⁴, but these can be relocated within new growing sustainable businesses, if given the right incentives.



Nokia

Aligned to its circular strategy, Nokia offers a ‘circular subscription’ to customers in Great Britain. Firstly, customers are incentivised to hold on to their mobile device for longer, and then if a device is accidentally lost, damaged or stolen, Nokia will arrange a replacement. When the customer is done with the phone, Nokia will collect it, delete any data stored and give it a second life or recycle it⁷⁵.

Figure 10 | The map displays the market growth rate of refurbished smartphones in 2020-2021⁷⁶. The market growth rate for refurbished smartphones rose by 15% in 2021 from 2020, with Latin America and India as frontiers.



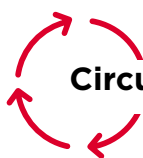
* Figures for Oceania and Russia are based on the global average as data is unavailable

Source: GSMA

73 www.persistencemarketresearch.com/
 74 International Institute for Sustainable Development. (2020). Effects of the Circular Economy on Jobs.
 75 https://www.nokia.com/phones/en_gb/subscription
 76 www.idc.com/getdoc.jsp?containerId=prUS47258521

Forecasts show that the world market for second-hand smartphones has the potential to grow by 11% each year from 2019 to 2024⁷⁷. However, economic feasibility and cross-border legislative challenges hinder the secondary markets to tap into more of the value from circular devices. Currently, the economic feasibility of repairing a broken smartphone ends before the device reaches three years of use⁷⁸.

Affordability is another aspect that needs to be included to incentivise purchases of second-hand or circular devices. Currently, the cost of a second-hand phone is, on average, about half the cost of a new one⁷⁹, but the cost depreciation varies depending on model and where in the world the phone is given a new life.



Circularity principles

Current cost of repair

For a broken iPhone, repair is no longer economic after a little less than three years. For an Android, the equivalent is not even 1.5 years. For a broken iPad or Android tablet, repair is no longer economic after around 2.5 years.

For an iPhone with cosmetic damages, repair is feasible until around six years. For an Android, this figure is around three years. For an iPad or Android tablet with cosmetic damages, repair is feasible until a little over four years; for an Android tablet, it is around 3.5 years⁸⁰.



Safaricom: 'Training of the informal sector'

To address environmental issues associated with Safaricom's operations, the company continues to take centre stage of focus areas. As an organisation, Safaricom have implemented an e-waste take-back system that encompasses collection, reuse, refurbishment and recycling.

In 2020, Safaricom entered a partnership with NEMA (National Environment Management Authority in Kenya) to support the informal sector of e-waste management. As part of the programme, e-waste collectors and electronic repairers who handle substantial amounts of e-waste in urban centres will receive training on various best practices. Safaricom completed the training for 86 participants who learned about (for example) health and safety practices and compliance with statutory requirements. The training is also connecting them to formal recyclers and potential markets, contributing to increased sustainability and a cleaner environment.

In addition, for mobile devices, Telefonica uses MARA, a fully omnichannel process that allows consumers to automatically assess their devices and access the Telefónica trade-in programmes anywhere, providing instant and real value added to customers without risks (0% discrepancies rate) and, at the same time, defining the best device destination (reuse, resell, repair or recycle) before collecting them.

⁷⁷ www.idc.com/getdoc.jsp?containerId=prUS47258521

⁷⁸ Green Alliance, 2015. A circular economy for smart devices.

⁷⁹ Green Alliance, 2015. A circular economy for smart devices.

⁸⁰ Green Alliance, 2015. A circular economy for smart devices.

It is important to ensure that second-hand or circular devices are not too expensive because the most common barrier to owning a mobile phone, according to people in both low- and middle-income markets, is the cost⁸¹. The global average cost of a smartphone is around 26% of an average monthly income. However, there are large differences and the cost can be more than double in some regions⁸².

In addition, the industry must also understand and overcome logistical and legislative challenges related to exporting functional second-hand devices to enable cross-border export – for example, within the EU, where the WEEE regulation prevents e-waste from being transported across EU countries⁸³. This also concerns second-hand devices when it comes to shipping refurbished products from one country to another.



KDDI: Waste service collaboration

KDDI has established a policy for waste treatment and has infiltrated it into all of the internal sections which do business with waste service companies. KDDI only works with companies fulfilling the criteria which are based on the Japanese ‘Green Purchasing Act’. The criteria include, for example, the status of ISO certification, the history of incidents and accidents, administrative disposition and avoidance of conflict minerals. The policy for sustainable procurement enables KDDI to obtain the information from main suppliers by means of questionnaires to see the level of conformity with KDDI’s policy.

KDDI also request recycle companies to take apart used mobile terminals by hand instead of by machines and, to the greatest extent, avoid incineration in order to maintain KDDI’s ambition with material cycle rate of 99.8% for used mobile phones. To calm user anxiety about terminal theft and use of personal data, KDDI punches one small hole in the terminal in front of the customer before sending them to the recycling companies. From April 2021 to March 2022, 1,144,832 used mobile phones were collected.

Safaricom: E-waste process at WEE centre

To handle the issue of e-waste, Safaricom has an active partnership with WEEE Centre, a NEMA (National Environment Management Authority in Kenya) licenced e-waste handler. In 2008, the recycling facility ‘Waste Electrical and Electronic Equipment Centre WEEE’ in Nairobi was launched. E-waste is collected across Kenya and brought to the recycling centre, where it is weighed, registered and sorted for reuse, refurbishment or for dismantling for recycling. Some fractions are recycled locally and others are shipped abroad. Each month, the centre in Nairobi processes

up to 10 tonnes of e-waste and, to date, Safaricom have been able to collect more than 1,626 tons of e-waste to circular economy through the support of WEEE Centre.

In addition, Safaricom has, since 2018, partnered with the Ministry of Environment and Forestry, East Africa Communications Organisation (EACO) and other stakeholders to commemorate International E-Waste Day with aim of creating awareness on the importance of safe disposal, handling and recycling of e-waste.

⁸¹ GSMA (2017). Accelerating affordable smartphone ownership in emerging markets.

⁸² Alliance for Affordable Internet (2021). 2021 prices and affordability of smartphones and feature phones by country [database].

⁸³ environment.ec.europa.eu/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee_en

New and expanded partnerships with repairers and recyclers

All actors that either recycle, refurbish, repair or enable the reuse of devices are retaining resources and value in the industry. Many opportunities to enable the cascading use of devices lie in the secondary market. With a variety of offers, devices can be used several times with new consumers, ideally within the same country, but also in others.

Repairers, recyclers, and other waste management operators are vital partners in the transition towards a circular economy because they enable the transitions of the material flows from being linear to become circular. Waste management operators are also important to be able to safely discard hazardous waste that needs to be disposed of.

Telecommunication operators can develop partnerships with repairers to overcome and capitalise on barriers to second-hand markets and to ensure the quality of refurbished and repaired devices – for example, by incorporating quality warranties of refurbished devices.

Entry-level action:

- Engage with repairers, recyclers and waste management operators to gain insight to challenges and opportunities related to extended longevity of devices such as:
 - Warranty issues
 - Security/integrity issues
 - Price and availability
 - Leasing schemes
 - Second-hand markets

Leadership-level action:

- Partner with independent repair and refurbishment companies to increase the longevity of devices by finding business synergies in various steps of the resource hierarchy.

Metric to measure engagement with repairers and recyclers (applicable to both entry and leadership-level):

- Number and description of circularity initiatives and/or projects offered in collaboration with repairers, recyclers and waste management operators according to the various steps in the resource hierarchy.

A large circular graphic with a gradient from light orange to dark grey. Inside the circle is a black silhouette of a woman in profile, looking down at a smartphone. In the background of the circle, a city skyline is visible. A red curved line with a dot starts from the bottom left and curves towards the center of the circle.

Conclusions and recommendations

Conclusions and recommendations

This strategy paper outlines a model telecommunications operators can use to increase circularity for devices and contribute to the vision for 2050. The model includes actions and metrics both for 'entry' and 'leadership' levels, as well as how to engage with key stakeholders in the value chain.

To implement the actions presented in this strategy paper, both company-wide and industry-wide collaboration is vital. Implementation will be strengthened and accelerated by support from senior management within and between companies.

As telecommunications operators learn more about the circular economy for devices, implementation of actions must be continuously evaluated and adjusted. This includes consideration of operators' unique business models and markets.

To contribute to the industry reaching the common vision by 2050 and to go further in the circular transition for devices, telecommunications operators will need to develop more interventions than those presented in this strategy paper.

In addition, a circular transition requires a unified industry with consistent methodologies and communication. Even though individual companies incorporate the circular economy and work towards more circular devices, all actors within the industry and the value chain are needed to create a circular economy for devices. Aspects include, for example but not exclusively:

- **By operators:**

- Develop common regional take-back schemes within the industry with a focus on transparency.
- Evaluate circular services and refurb/recycling methods.
- Lead by example – apply circularity principles for own-branded CPE.

- **International collaboration with actors upstream in the value chain**

- For example, by deciding on a harmonised method and criteria to classify circular products both to use for eco-labelling as well as procurement criteria.

- **Engaging with downstream actors such as consumers and waste operators:**

- Further understand consumer incentives at national levels by conducting cross-operator consumer surveys about successful consumer incentives.
- Promote the development of industry accreditation standards for recycling stakeholders to ensure the maximum economic and sustainable benefits are consistently derived from devices.

- **Within the GSMA community:**

- Promote the findings of this strategy paper by launching training to put the entry and leadership actions into practice.
- Promote and facilitate a global approach to collaboration between the telecommunications industry and other actors within the industry – for example, to initiate research projects.



Appendices

Appendix 1:

The value chain of devices

The value chain of devices is long and complex, with hundreds of businesses involved.

- **Extraction of raw materials**

Includes the sourcing and depletion of virgin raw materials (e.g. gold, tin, tantalum, indium, cobalt etc). Materials from recycled sources reduce environmental impacts.

- **Design**

New devices are designed and factors improving technical performance as well as environmental performance such as energy efficiency and eco-design (e.g. durability, reparability) can be considered.

- **Manufacturing**

Includes the manufacture of components and assembly of devices. Longevity of devices depend on the product design and specification for both hardware and software.

- **Distribution and retail**

Devices are distributed and then sold or rented to customers. Retailers can offer reused/refurbished devices or repair services, leasing services or incentives to return/trade back used devices when customers buy new devices.

- **Use phase**

Consumers purchase and use devices and can create a positive impact by taking informed decisions and taking care of the device to prolong longevity. Customer may also use devices through leasing services.

- **Collection of old devices**

Unwanted devices can be reclaimed through formal take-back schemes from retailers and other businesses. Collected devices can be sorted into those suitable for immediate resale, those first needing repair/data removal and those that it is not economically feasible to repair.

- **Repair, refurbish and reuse**

Devices go through secure data removal, are repaired or refurbished, then repackaged and sent back out to retailers or direct to customers. Devices are resold both through formal and informal channels.

- **Recycling**

- **Component recycling**

Devices that cannot be repaired can still be valuable in terms of reusing components or parts to repair other devices.

- **Material recycling**

If components cannot be reused, the devices are dismantled, shredded or processed for the recovery of raw materials by specialised companies. The recycled materials can then be used to displace finite virgin raw materials at the manufacturing stage.

- **Disposal**

Non-recyclable material, such as toxic materials, must be securely disposed.

Appendix 2: Circular economy standards and frameworks

Table 3 | An overview of different standards and frameworks which to a varying extent have metrics associated with circular economy.

Standard	Description
CIRCelligence	CIRCelligence is a proprietary metric and tool developed by Boston Consulting Group (BCG) to support organisations in becoming circular. Together with Circle Economy, the report Circular Metrics for business outlines the basics of circular metrics for business.
Circular Transition Indicators v2	Circular Transition Indicators (CTI) v2.0 is a framework developed by the World Business Council for Sustainable Development and 30 companies to support businesses working with circular economy.
Circulytics	Circulytics is a tool that helps companies understand the true extent of their circular economy performance, with supporting insights and commentary from the Ellen MacArthur Foundation.
ESRS E5 Resource use and Circular Economy	SRS E5 Resource use and Circular Economy is the European Sustainability Reporting Standards (only exposure draft available as of April 2022, the draft was open for comments until August 2022) act as a tool for the Europe's proposed Corporate Sustainability Reporting Directive (CSRD) outlining reporting requirements across 13 ESG issues.
Global Reporting Initiative	Global Reporting Initiative (GRI) is an international independent standards organisation that helps businesses, governments and other organisations understand and communicate their sustainability impacts.
SASB	Sustainability Accounting Standards Board (SASB) is a non-profit organisation which was founded in 2011 to develop sustainability accounting standards. Currently available for 77 industries.
GSMA ESG Metrics for Mobile	GSMA ESG Metrics for Mobile GSMA ESG Indicators is a mobile sector ESG reporting framework, developed with partners from EY, Yale Center for Business and the Environment, and mobile operators. The framework covers key environmental and social metrics including those related to the circular economy.

Appendix 3:

Jazz Customer Survey

Jazz surveying customers and helping them make sustainable choices

Jazz conducted a Computer Aided Telephonic Interview (CATI) at the request of Ethos with reference to the GSMA Strategy Paper on Circular Economy of Devices. The purpose of this survey was to understand the customer's awareness on circularity and sustainability choices regarding their mobile devices.

The sample size was 683; 77% of the interviewed customers were using smartphones while 23% were using featured phones. The sampled population was 79% male and 21% female, while 83% of the total interviewed customers were under the age of 50.

- Only 40% respondents believed that the Original Equipment Manufacturers (OEMs) such as Samsung, Apple, Huawei, Xiaomi etc. reduce, reuse and recycle their electronic devices.
 - Three out of four respondents prefer durable (long-lasting) products. Among them, 81% like to buy brand-new mobile phones while 69% of these customers inquire regarding the durability of new devices.
 - Regarding the life of mobile device, the majority of customers stated that their mobile hand-sets last for one to three years while 45% agreed that brand new mobile handsets tend to last longer than the used ones.
 - Half of all customers hold on to their old mobile handsets. This is more common among those customers who prefer to buy durable products and/or if they are in working condition after three years of usage.
 - 59% of the customers don't know the difference between recycled/repaired/refurbished and used mobile handsets.
 - 53% respondents believe in the sustainability claims made by OEMs regarding recycled/refurbished products, while 33% do not believe in them.
 - The majority of customers do not want to give-up their old mobile handset without any incentive, such as either an exchange with a new phone, an upgraded phone at a discounted price or a fee for exchange.
 - The majority of those customers who hesitate to recycle their mobile handset are either afraid of data security or they simply don't feel the need to recycle their devices.
 - Only 20% of customers are willing to recycle their mobile devices without any incentives in return.
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