THE SHIFT

THE ROLE OF TELCOS IN THE CIRCULAR ECONOMY

A report by Telia Company
and Accenture

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Telia Company

Telia is the leading communications company in the Nordics & Baltics. Our 20,000+ team are experts in connectivity, technology and business solutions and work to constantly re-invent better connected living and societies. With a strong sustainability agenda, thoroughly integrated in our business strategy, we take responsibility for our impacts and are committed to empower our customers – big and small – through high-quality connectivity and digital solutions.

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FOREWORD

The need for a circular shift

The release of this report happens at a time when the world is fighting two battles: one against the COVID-19 pandemic, and one against accelerated global warming. Our front-page news is populated by stories of the continued challenges caused by the pandemic, increasing numbers of extreme weather events and the overall need to build back better. Both crises have severe impacts on human lives and our economies. The future will be defined by how we tackle these challenges.

In the past century we have reached the moon, fought diseases, ended wars and forcefully fought extreme poverty. Now we need to ensure we can add "reversing the ecological crisis" to that list of achievements. That's why Telia Company reviewed its environmental agenda in 2019, determined to achieve zero CO_2 and zero waste by 2030. These goals mean that we need to explore and expand the circular economy agenda. Circularity presents a new way of looking at waste and the resources that we have, both within our operations and in our business ecosystem.

When looking at the industry that Telia Company belongs to through a circular economy lens, it is clear that we are both part of the problem and the solution. The connectivity and digital solutions we provide are already enabling societies to tackle many of today's environmental challenges. Digitalization can speed up the transformation from a linear to a circular economy by fully using the power of the Internet of Things and data driven solutions. The time has come to seize these opportunities, while simultaneously addressing our own negative environmental impact. Addressing the global e-waste flows and ensuring reductions of greenhouse gas emissions are two of the most important environmental aspects for our industry to take responsibility for.

With this report, we would like to invite our stakeholders – consumers, business customers, peers, suppliers, legislators and others – to join us on the road to zero. The report illustrates why the circular economy is a must-win for humanity and how it can help our industry – and the societies that we support – to unlock untapped values. Opportunities for such a shift are increasing as traditional telcos of the past are evolving into digital and converged players that will play a central role in the digital transformation of our societies.

Indeed, there is a challenge ahead and stakes are high, however, the opportunities are plentiful. History shows that when this is the case, humanity rises to the challenge and resolves the seemingly impossible. Together, we hold the future in our hands; we have the knowledge, the technologies and the capabilities required to act. I hope you will join us on the road to zero!

Allison Kirkby
President and CEO of Telia Company

EXECUTIVE SUMMARY

The ongoing ecological crisis constitutes one of the most urgent challenges of our time. The growing global population, combined with improved living standards and the increasing levels of consumption that accompany this, are pushing the environmental limits of our planet. In 2019, resource consumption was on a level that required the capacity of 1.75 earths,[1] which means we consume ~75% more than our planet is able to provide on an annual basis. The shift to a circular economic system has the potential to change the way we produce and consume resources, thereby limiting both greenhouse gas emissions and generation of waste. But as of today, only 9% of material inputs in the global economy are cycled back,[2] which shows that we are just at the beginning of an urgently needed transformation.

The telecommunications (telco) industry is both part of the problem and the solution. As a resource intensive industry, telcos have the responsibility to reduce waste streams connected to network infrastructure, e-waste from data centers and devices, and office waste. At the same time, telco companies are uniquely positioned in the ecosystem to act as an enabler for other industries to deploy circular solutions that reduce resource consumption, waste, and emissions through connectivity and digitalization. In fact, the impact that telcos have on other industries globally is estimated to be up to 10-times higher compared to its own greenhouse gas (GHG) emissions.

Accenture has defined five circular business models that can help organizations identify ways to systematically address inefficiencies in the current linear system and capture new circular business opportunities: *Circular Inputs, Sharing Platforms, Products as a Service, Product Use Extension and Resource Recovery.* Based on those models, three potential roles with concrete activities for telcos were identified in this study.

Altogether they present the opportunity to globally unlock significant value that amounts to $45-80 billion annually by 2030:[3]

• **Embedding circularity in operations:** $20-30 billion through e.g. resale of infrastructure and waste mitigation in infrastructure installation

• **Offering circular products and services:** $15-20 billion through e.g. selling devices as a service and devices that are refurbished

• **Enabling a circular ecosystem:** $10-30 billion through e.g. selling real time monitoring or asset tracking capabilities to utility providers and the construction industry

Applying and expanding circular business models will be key to untapping this value. While the telco industry has started this journey, efforts need to be accelerated. True change will require extensive collaboration within and across industries, as well as deep engagement with consumers, business customers, academia, Non-Governmental Organizations, investors and suppliers to co-create a circular future. Policymakers have a key role to play to incentivize the shift through circular policies that match the urgency of the situation and ensure planetary boundaries are respected.

To promote the transformation, there is a need for municipal, national and regional circularity plans to create a joint vision and align stakeholders around a target state. Such plans can clarify the roles of various players, identify areas for innovation as well as the knowledge and recycling capabilities that need to be built. Telcos will have a key role to play when putting these plans into action.

1. CIRCULAR ECONOMY – A SHIFT TO RESPECT PLANETARY BOUNDARIES

The past few decades have brought progress within many areas of human development, as well as a ten-fold growth in global GDP.[4] However, these achievements have come at a high environmental price. Global warming, pollution of oceans, loss of species and biodiversity, resource depletion and unprecedented volumes of waste going to landfill, are pushing the environmental limits of our planet. That's why creating a circular economy is a must-win for humanity.

In the linear economy, resources are extracted in the form of materials or energy that are transformed into products which are used until they are disposed of as waste. This "take-make-waste" approach has a severe impact on ecosystems and depletes, rather than responsibly manages, the natural capital needed to support future generations.

Scientists have defined nine planetary boundaries in which humanity can continue to develop and thrive for generations to come. Nearly half of these boundaries have already been surpassed, running the risk of irreversible environmental damage.[5] Our current trajectory on climate change (one of the nine boundaries), involves the risk of increasing global temperatures in an uncontrollable way. That is why scientists continue to reiterate the criticality of not going beyond a maximum rise of 1.5°C (compared to pre-industrial levels), by halving global greenhouse gas (GHG) emissions each decade.[6]

Meanwhile, an unevenly distributed but growing population with increasing purchasing power is intensifying the pressure on our common resources. Since the beginning of the 20th century, the annual global extraction of materials has increased ten-fold and is set to double again by 2030 compared to 2010.[7]

Global resource consumption compared to earth's capacity[8]
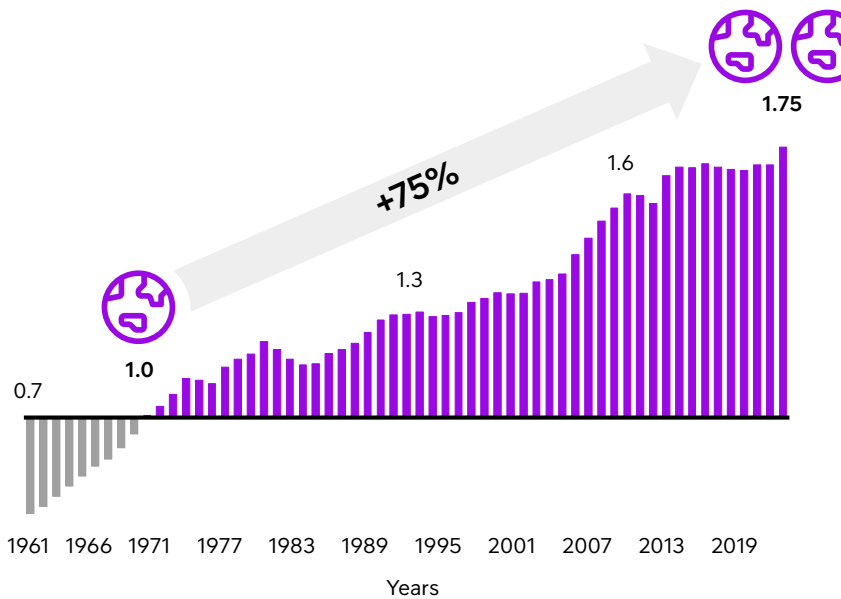
Growth drivers

Population Growth:

9.2

billion people expected on the planet 2050

Rising Consumption:

1.75

**x rate** of consumption above the earth's bio-capacity already today

Reducing resource consumption is required to reach climate goals

To tackle the major environmental challenges ahead of us, we must fundamentally change the way we produce and use products by deconstructing the logic of the linear economy in order to pave the way to a circular one. This will require the fastest transition in our economy's history and businesses need to play a key role to get there.

Switching to renewable energy and increasing energy efficiency will not be enough to reach the climate goals. An assessment of the CO_2 reduction potential along the lifecycle of four materials;

steel, aluminum, plastics and cement, shows that an additional 40% is linked to the use and reuse of materials in production as well as in the use phase (see illustration below).[9] The "waste hierarchy" of *reduce, reuse, recycle* provides orientation and establishes an order of preference when tackling wastage.[10] Traditional recycling is often connected to downgrading material to something of less value (downcycling). To prevent this, waste generation should be reduced to a minimum or materials should – as far as possible – be reused in higher-value applications (upcycling).

Potential of energy and material-based measures to reduce global CO_2 emissions from four key materials[11]

Billion tons CO_2 per year
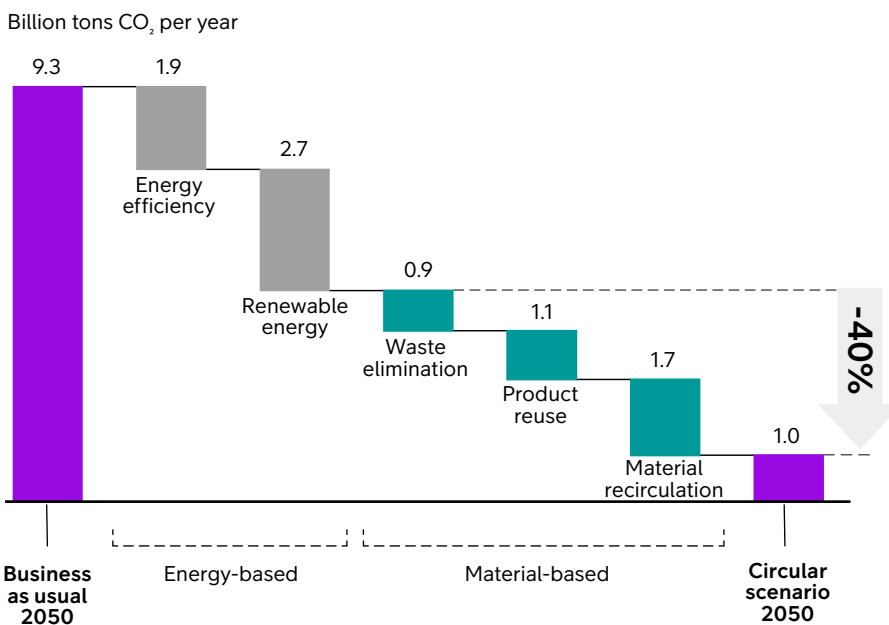
Policymakers are taking action

In line with the European Commission's (EC) definition, a "circular economy aims to maintain the value of products, materials and resources for as long as possible by returning them into the product cycle at the end of their use, while minimizing the generation of waste".[12] As of now, the global economy is roughly 9% circular, meaning that each year less than one-tenth of all material inputs in the global economy are cycled back.[13] This illustrates that we are just at the beginning of the journey.

However, the circular economy movement is gaining momentum – in fact, it is expected that the circular economy will be the dominant economic model in just 10 years.[14] The move towards this is showcased by leading countries, who have determined national circular strategies, as well as the European Commission who, in 2020, presented its Circular Economy Action Plan, which includes legislative measures to enable the union to deliver on the EU Green Deal.[15] 51% of supply chain professionals expect a greater focus on circular economy strategies within the next two years.[16] This pivot in focus will enable the urgent shift away from "take-make-waste" linear value chains, to a circular system of "prevent-reduce-reuse-recycle".
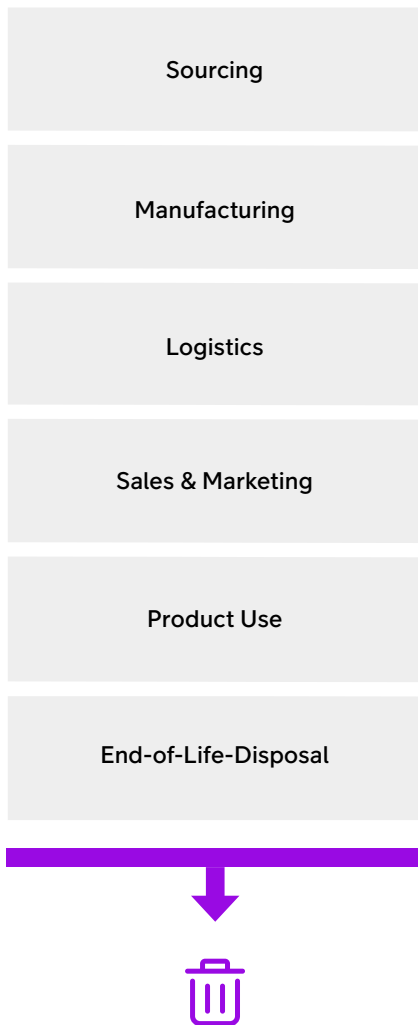
The basics of the circular economy

The circular economy means transforming value chains
to create low-waste and restorative systems, moving from
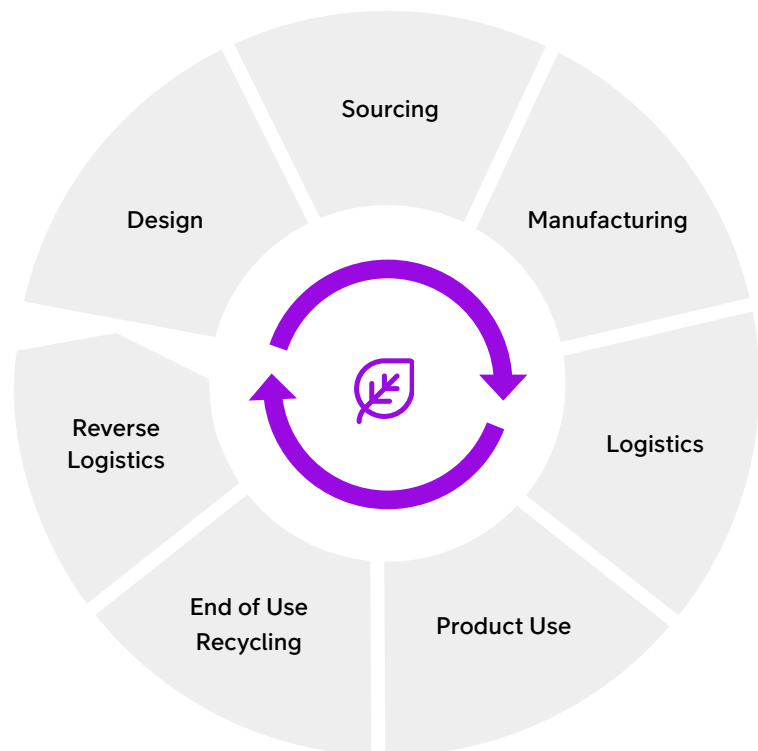a linear to a circular logic (illustrated below).[17]

Linear

'Take, make, waste'

Sourcing

Manufacturing

Logistics

Sales & Marketing

Product Use

End-of-Life-Disposal

Circular

'Prevent-reduce-reuse-recycle'

Sourcing

Design

Manufacturing

Reverse
Logistics

Logistics

End of Use
Recycling

Product Use

Four inefficiencies in resource use are addressed through circularity

The waste problem goes beyond what is generated at the disposal of products and materials at end-of-use. To move towards circularity, societies need to address a wider range of resource inefficiencies that create unnecessary pressure on the world's ecosystems. There are four main types of inefficiencies that can

be identified across the linear value chain.[18] To illustrate
the inefficiencies, we share examples from the telco industry:

1 **Wasted resources:** Use of materials and energy that cannot
   be continuously regenerated over time (example: energy made
   from fossil sources used in operations and non-recyclable
   plastics for packaging)

2 **Wasted capacity:** Underutilized products and unused assets,
   which stand idle in the use phase (example: excess heat from
   data centers and core sites that's just emitted and chilled)

3 **Wasted lifecycles:** Product lifecycles that are shorter than they
   have to be, since products become unwanted early and are
   disposed as waste (example: routers, mobile phones and lap-
   tops that are fully functional, but for various reasons are dis-
   carded instead of reused)

4 **Wasted embedded values:** Components, materials and energy
   that are not recovered from waste as they are disposed (exam-
   ple: precious metals like gold and palladium that are used in
   electronics and not recovered at end of life)

Besides the environmental benefits, there is a clear economic logic
for circularity and resource efficiency, as will be broken down in
chapter 4. In addition, continuing linear business practices can
lead to unanticipated losses due to volatility in price and resource
supplies or supply chain disruptions.[19] The changeover towards
circularity requires new types of collaboration and strategic part-
nerships across the ecosystem to unlock the full potential and
value of a circular system. Furthermore, leveraging new digital,
physical and biological technologies will be key as they enable
greater efficiencies, help drive innovation and increase
information transparency needed to achieve
a circular economy.

2. TELCOS' ROLE AND OPPORTUNITY

Telcos can directly influence waste streams in their own value chain to reduce waste, with network infrastructure showing the biggest potential. At the same time, telcos have the possibility to influence waste streams of other industries by providing resource-efficient solutions and enabling new ways of working.

Inefficiencies along the value chain

As more customers become connected and served, more and more ICT-devices and infrastructure equipment are entering the market. In a business as usual scenario, global e-waste is estimated to increase by 140% between 2020 and 2050.[20]

The analysis of typical material and waste streams for telcos along the whole value chain considers four main business areas: network infrastructure, data centers, electronics devices, and office operations (e.g. office waste). Taking the average waste statistics of Telia in Sweden as an example, network construction waste (soil, stone and gravel from excavations) is by far the largest waste category, representing 96% of total waste. Excluding this waste stream from the assessment leaves metals (especially iron) and cables (especially copper cables) as main material flows. Customer equipment only makes up less than 1% of the recorded waste and office waste is a minor waste flow.

The key action areas for the industry are:

- **Network infrastructure:** The largest impact originates from excavation of soil, stone and gravel arising during construction of networks as well as retired infrastructure containing valuable materials. The direct impact is especially high for legacy infrastructure, while technical and economic challenges are significant barriers. Inefficiencies within this business area also relate to energy management when running the networks.

- **Data centers:** The number of data centers is increasing globally, but not all of them are running at their maximum capacity.[21] Furthermore, servers become outdated every 5-8 years on average. Better capacity management (virtualization) as well as circular design/identification of re-use or upgrade options could save valuable resources. A further inefficiency to address globally is energy wastage connected to unused, excess heat.

- **Electronics devices:** There is a need for increased collection and recycling throughout the whole value chain. While collection rates are relatively high in the Nordics with e.g. 74% in Norway, 69% Sweden and 55% in Finland,[22] the global average collection and recycling rate was 17.4% in 2019.[23] Inefficiencies also relates to hardware and devices not being designed and optimized for second-use options (e.g. repair, upgrades, reuse and recyclability).

- **Office operations** (e.g. office waste): Different types of waste is generated in offices and stores (paper waste, e-waste from employee devices etc). These waste streams are important to address but minor compared to the others.

The illustration below highlights issues and actions in different parts of the value chain, where telcos either have a direct or an indirect impact to address. The value chain steps with the most inefficiencies are the *End of Use* phase followed by *Design* and *Distribution, Installation & Retail*.

Inefficiencies in different parts of the telco value chain[24]

Design

Key activities: Design of hardware and physical product properties

Key inefficiencies: Missing design for upgradeability, repair and second-use options, e.g. for electronic devices and servers, and selection of renewable/recyclable materials.

Level of influence for Telco: Indirect via procurement

Sourcing

Key activities: Procurement of raw materials or equipment and components

Key inefficiencies: High volume sourcing of virgin materials

Level of influence for Telco: Indirect via procurement

Production & Packaging

Key activities: Production of physical network infrastructure/cables, data centers/servers and devices and packaging

Key inefficiencies: Energy and resource intensive production processes for equipment, devices and packaging waste

Level of influence for Telco: Indirect via procurement

Reverse Logistics

Does not create waste but is included as part of a circular value chain.

Inefficiencies along the Telco Value Chain

Inefficiencies from 1 (little) to 3 (many)

1 2 3

End of Use

Key activities: End of use for infrastructure, servers, devices and employee IT

Key inefficiencies: Premature disposal of devices and limited material recovery for recycling and upcycling, e.g. retired (underground) network infrastructure, servers in data centres and device waste (e.g. phones)

Level of influence for Telco: Direct impact in own operations and through business models

Product Use & Service

Key activities: Provision of connectivity and use of connectivity and digital services (e.g., cloud)

Key inefficiencies: Energy footprint of infrastructure, data centres and devices during use

Level of influence for Telco: Direct impact in own operations

Distribution, Installation & Retail

Key activities: Delivery of products to operators, installation of network infrastructure and data centers and operation of retail channels

Key inefficiencies: Material waste from excavations during network infrastructure construction

Level of influence for Telco: Direct impact but limited lever
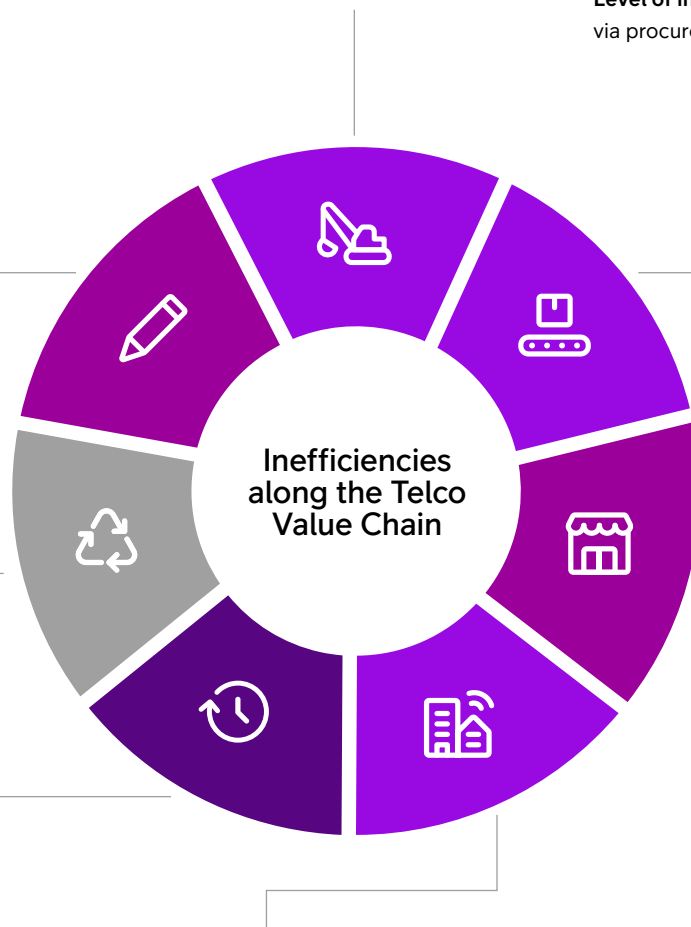
The telco industry as part of the solution

It is clear that addressing waste across the telco value chain will reduce the pressure on scarce resources. In addition to this, the telco industry provides many of the enabling solutions that can reduce resource consumption and emissions through connectivity and digital solutions across industries. For example, the global telecom sector is estimated to enable GHG emission reductions in other industries that can be up to ten times higher than its own emissions.[25]

Technological advancements have been a game changer for sustainable development and have the potential to accelerate change and bring positive impact in the years to come. New technologies, such as artificial intelligence, 5G, cloud computing and Internet of Things (IoT), are transforming value chains and have high potential to enable more resource-efficient and sustainable solutions if applied in a conscious way.

For a telco, the opportunity is twofold: to apply new technologies across its own value chain to make smarter use of resources, and to act as an enabler across other industries by providing customers the foundational network connectivity and related digital solutions. Data-driven solutions in connected buildings and transportation, as well as remote working and monitoring services, can enable a sustainable shift across industries. If, for example, 30 million people worked from home, emissions could be reduced by 75-100 Mt CO_2 emissions by 2030,[26] which is equivalent to the yearly emissions of Sweden and Finland combined.[27] Another example is the enablement of remote and predictive maintenance of assets, both in client industries and in the telco's own operations. Besides extending the usage of assets, this has additional indirect environmental benefits, such as reduced fuel consumption for field workers.

Telco enablement cases

Telia Company helps digitalize the power grid by providing IoT solutions to Heimdall power. Through Telia connectivity, data is sent from power lines to the cloud, enabling real-time visibility of the capacity of different parts of the grid. This lets them increase the capacity of their lines by up to 25 percent while energy streams from renewable sources can be prioritized over fossil energy streams.[28]

Nordic public transportation leader Nobina has connected over 3,000 buses in Sweden using Telia Company's solution. What started in 2010 with basic metrics such as fuel consumption and positioning has grown to include more advanced services such as real-time eco-driving feedback for drivers, smart depot heating and real-time fleet management information for managing overall logistics more efficiently. Nobina's calculations show that the eco-driving service alone has been able to deliver fuel savings of up to 15 percent.[29]

To streamline property management and provide a better experience for tenants, Rikshem is digitalizing its buildings with connectivity and a new set of digitalization tools from Telia Company. Rikshem is connecting all of their 30,000 apartments with sensors to monitor temperatures, humidity, real-time trends and to enable comparisons with historical data. To improve management of buildings, all facility IT, network and building management systems will be connected via one integrated solution. The solutions will help Rikshem to reduce both emissions and costs.[30]

3. CIRCULARITY THROUGH NEW BUSINESS MODELS

To shift from a linear, extractive economy to a circular, regenerative and restorative economy, businesses will need to adopt new business models that support such a direction. Five circular business models can support telco companies in systematically addressing inefficiencies from the linear system and capturing new business opportunities.

The circular business model framework by Accenture offers a systematic approach for addressing linear wastes and unlocking untapped value potential. The five models - *Circular Inputs, Sharing Platforms, Product as a Service, Product Use Extension* and *Resource Recovery* - complement each other and address different parts of the value chain.[31]
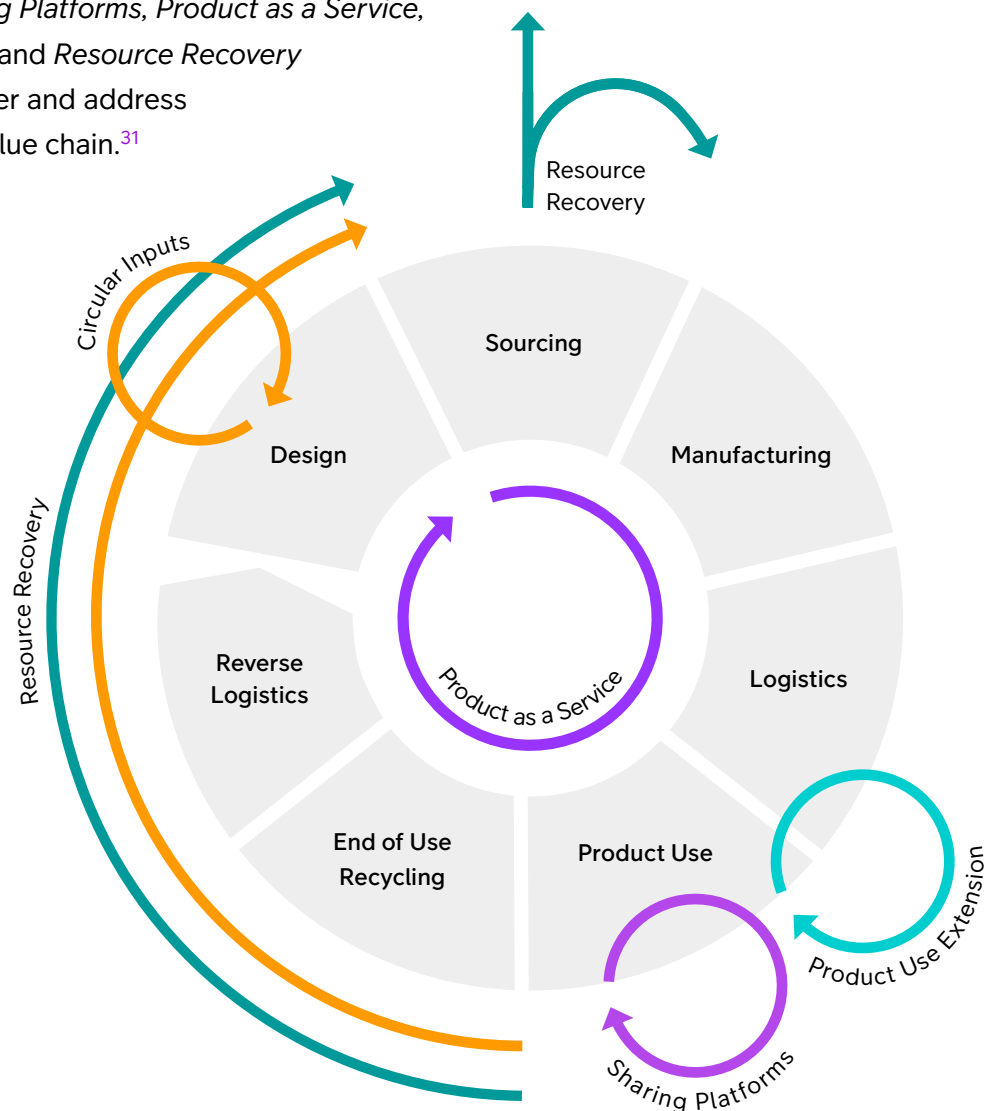
Circular Inputs

Circular Inputs focuses on the material and energy inputs, both direct and indirect, that go into products at the design, sourcing, and manufacturing stages. Non-circular inputs can either be reduced or completely replaced with circular alternatives. Reduction of materials can be achieved through improved product design and use of advanced technology in the production process, such as e.g. 3D-printing, robotics and data-driven operations.

There are various circular alternatives for non-circular materials:

- Renewable resources, such as solar and wind energy, are resources that are abundant and replenished naturally, so can be used continuously

- Bio-based materials derived from living organisms, sometimes also processed by chemistry, e.g. vegetable based inks

- Specifically engineered non-organic materials, such as metals or glass, that ensure best properties for recycling, e.g. durables and packaging material that can be easily recovered and reintroduced for use in new products in its raw form

As mentioned above, design principles are a crucial area for this business model. For example. 'built to last' is one exemplary design principle which prolongs the usage of a product to allow for more than one lifecycle. By considering circular design principles at the product development stage, activities like repair, upgrade and recycling will be facilitated.

Examples

Telia Company uses 100% renewable electricity as input in all operations to help reach its zero CO_2 target. This includes the full network infrastructure globally, as well as all data centers and offices.[32]

British Telecom uses packaging design that allows for routers to be fitted into letterboxes. This avoids additional transportation for second deliveries or trips to the post office. The packaging material is minimized and contains recyclable materials.[33]

Telefonica's Router Smart Wifi has been designed with eco-design principles in mind. The weight of the router was reduced by 40%, significantly lowering emissions from manufacturing. In addition, the routers consume 30% less energy during the use phase, which also results in less emissions.[34]

Sharing Platforms

Many products in our everyday lives are only used to a fraction of their potential. For example, cars are parked roughly 95%[35] of the time and idle time for construction equipment represents for 40–50% of total running time.[36] This has boosted the popularity of **Sharing Platforms**, which allow owners to maximize the use of their assets, while users can access products and services in a cost-efficient, environmentally effective and convenient manner. Through sharing platforms, the total utilization of existing products is increased, meaning the production of new products using raw materials can be reduced.

This business model has reached high acceptance in the general public and made its way into numerous industries such as cars (Uber), living space (Airbnb), fashion (Rent the Runway), and machinery and construction equipment (eRent), to name a few.

By providing connectivity — the backbone of digital solutions — telcos enable sharing platforms and the emerging "sharing economy". Telcos also have the opportunity to apply sharing platforms within their own operations, for instance, by sharing fixed infrastructure such as towers and sites, especially in rural areas where it can decrease both investment costs and the environmental impact. Further business model development and initiatives are needed, as current examples are nascent and often still need to prove themselves.

Examples

In Denmark, Telia and Telenor are sharing a network through the commonly owned TT network to enable wireless technologies ranging from 2G to 5G. Through network sharing, the roll out of mobile networks such as 5G can happen at scale and at lowest costs, since efforts do not need to be replicated per operator. As a result, fewer physical sites are needed while ensuring fast deployment of new broadband offers.[37]

AT&T launched the sharing platform Indigo for businesses and organizations to facilitate exchange of trusted data and collaborate on analytics. Such data-sharing communities can be the basis for smart city initiatives.[38]

Product as a Service

In a **Product as a Service** business model, products are provided through a lease or pay-for-use arrangement. Companies retain the ownership of the product in order to sell its benefits on a service basis. These offers simplify the lives and operations of consumers and business customers while enabling companies to extend the use of products through repair, upgrade and reuse. Since ownership stays with the company, this business model also secures responsible recycling as customers need to return the product at the end of the lease period.

Telcos can facilitate product as a service models through asset tracking. By enabling remote condition monitoring, for example for heavy duty equipment, vehicles and high value assets, utilization and use cycles can be tracked in real time. The live data makes it possible to plan activities such as product returns, billing instances, and maintenance/repair schemes.

Examples

Telia provides a Device as a Service offering for phones, tablets and computers for business customers for a 24 to 36-month period. Insurance and repair services are optional add-ons. This allows Telia to maximize reuse potentials.[39] At the end of the service agreement, Telia Company ensures appropriate treatment and safe recycling**.**

Lenovo provides Device as a Service solutions for smart phones, PCs, tablet and data centers. Lenovo partners with Intel to offer a pay-per-use infrastructure solution for data services, e.g. cloud services, based on a flexible subscription model.[40]

Product Use Extension

Product Use Extension focuses on prolonging the use of a product. Through repair, re-use and ugrades, products are kept in their original form with their intended application, instead of being recycled or, in less mature markets, landfilled. Product Use Extension does not require changing the conventional sales model of a company but is rather an extension of existing recovery capabilities and re-marketing channels on a second market.

Telcos can support technologies such as Digital Twins to enable continuous data gathering throughout entire product lifecycles especially in the industrial context. This will allow for making realistic estimates about residual product value and potential reuse cases at end-of-use.

Examples

Telia allows its customers to sell back or hand in their used phones in exchange for a discount when purchasing a new phone. Phones that are in a good condition are data wiped and refurbished, then offered to the secondhand market at a lower price. Phones that cannot be reused are properly recycled. In 2019, this helped reduce 6,000 tons of CO_2 emissions.[41] It also enabled waste reductions since each new phone generates 86 kg of waste during manufacturing.

Inrego buys and refurbishes used professional IT equipment, such as smartphones and laptops, from organizations. Afterwards the equipment is either sold or rented out to new organizations. This leads to the life extension of 300,000 products and savings of 5,580 tons CO_2 per year.[42]

Resource Recovery

Resource Recovery is a model that becomes relevant once a product is at its end-of-use and is no longer functional in its current application. In practice, materials and resources inside the product can be recovered – preferably in a way that maintains highest resource value for as long as possible. Examples of this are component harvesting for spare parts, or recovery of raw materials such as steel for reuse in new products. In order to create value from end-of-use products, the waste hierarchy – *reduce, reuse, recycle* – helps to maintain resource value as high as possible before considering downcycling into lower-value products or incineration. Although Resource Recovery is the most widely adopted circular economy business model[43] – as it is an extension on traditional recycling – large waste amounts are still not being collected. In 2019, for example, more than 80% of global e-waste was not collected properly, which means lost material value is sitting in drawers or managed in other waste streams. It also poses significant environmental risks, if the e-waste ends up in landfills.[44]

Examples

Telia Company's network equipment re-use/resell program helps reduce both waste and costs but also to generate revenue. Used network equipment is primarily re-allocated within Telia Company or secondly sold to another company. In total, around 120 tons of equipment were resold in 2020.[45]

British Telecom partners with recyclers and suppliers, such as N2S, to recover and purchase used equipment like servers. Within one year roughly 319 tons of used equipment were processed, of which 315 tons were recycled and 4 tons reused. This helped to reduce over 952 tons of CO_2 emissions.[46]

Nokia recovers network infrastructure during network upgrades and expansions, with 99% of equipment ultimately reused and recycled. Useful parts are re-sold as spare parts at a Nokia re-sell shop. Through asset recovery, Nokia's customers can save up to 20% operational expenditures while ensuring environmental compliance for decommissioned equipment.[47]

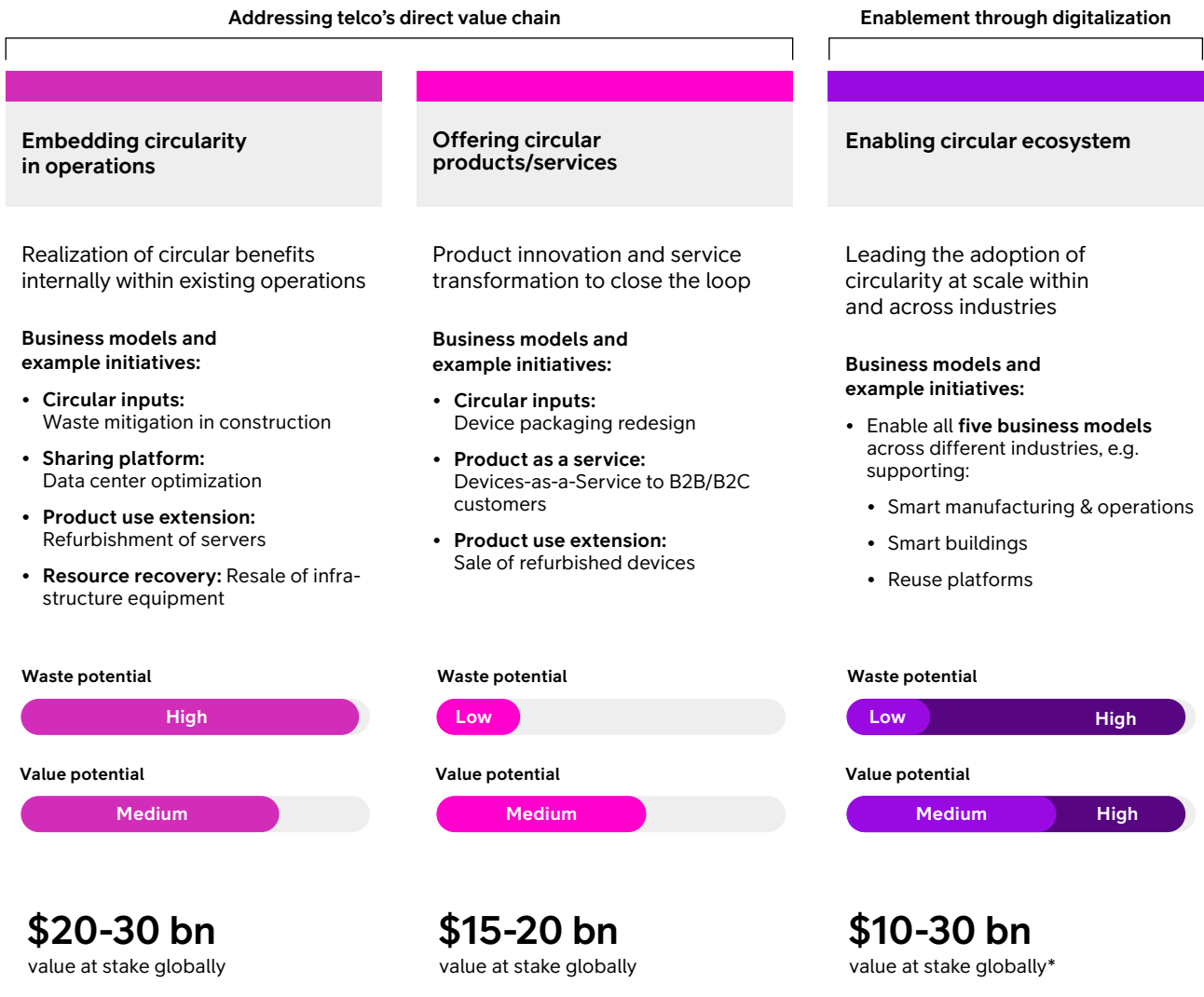# 4. OPPORTUNITIES TO UNLOCK $45-80 BILLION WORTH OF VALUE GLOBALLY

Circular business models are gaining traction among telcos, but the industry is still at the beginning of its circular journey. Accenture's findings indicate that billions of dollars of value can be unlocked globally, if public and private investments are made in the circular shift.

Leading players in the telco industry have started to adopt circular approaches, as the examples in this report show. There are three roles that telcos can take:

1 **Embedding circularity in operations:** Realization of circular benefits internally within existing operations – including network infrastructure, buildings, IT equipment and data centers

2 **Offering circular products and services:** Product innovation and service transformation to close the loop – including B2B and B2C devices such as phones, tablets, laptops, etc.

3 **Enabling circular ecosystem:** Leading the adoption of circularity at scale within and across industries – including providing connectivity and digital solutions

By 2030, these three roles can unlock a total value of an estimated $45-80 billion a year globally in the telco industry, and an additional ~$500 billion across other industries. The five circular economy business models were used as a lens to determine potential opportunities. The value potential "by 2030" relates to an assumed market growth until 2030 and a ramp up of initiatives which will be fully implemented by 2030. To capture the full value potential, upfront costs and investment will be needed, which were not assessed for this report.[48]

Potential global value to unlock by 2030

Addressing telco's direct value chain		Enablement through digitalization

Embedding circularity in operations

Realization of circular benefits internally within existing operations

Business models and example initiatives:

- **Circular inputs:** Waste mitigation in construction
- **Sharing platform:** Data center optimization
- **Product use extension:** Refurbishment of servers
- **Resource recovery:** Resale of infra-structure equipment

Waste potential

`High`

Value potential

`Medium`

$20-30 bn
value at stake globally

Offering circular products/services

Product innovation and service transformation to close the loop

Business models and example initiatives:

- **Circular inputs:** Device packaging redesign
- **Product as a service:** Devices-as-a-Service to B2B/B2C customers
- **Product use extension:** Sale of refurbished devices

Waste potential

`Low`

Value potential

`Medium`

$15-20 bn
value at stake globally

Enabling circular ecosystem

Leading the adoption of circularity at scale within and across industries

Business models and example initiatives:

- Enable all **five business models** across different industries, e.g. supporting:
  - Smart manufacturing & operations
  - Smart buildings
  - Reuse platforms

Waste potential

`Low`   `High`

Value potential

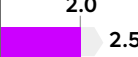`Medium`   `High`

$10-30 bn
value at stake globally*

As an enabler, telcos can help customers achieve high waste and value potential (represented as dark purple bar). That in turn builds brand and new revenue streams for telcos. Assessment is based on circular business cases from 8 different industries that are enabled through Internet-of-Things, digital platform and cloud services. Value and waste potential are detailed in the following sections.

Embedding circularity in operations: $20-30 billion opportunity

Fixed and mobile network infrastructure, as well as data centers, IT equipment and office buildings, make up the backbone of a telco's operations. From a resource consumption perspective, construction activities for installation, maintenance of infra-structure and technical sites must also be managed.

Although the industry already places a strong focus on reducing costs and driving efficiencies of its operations, the circular economy can add a new lens for achieving improvements and unlocking new value. It is an opportune time to incorporate circular principles into decision-making: for example, large investments to replace legacy infrastructure with modern equipment are currently being made. Furthermore, new regulations on material and waste management are on the rise, as a consequence of the EU's Circular Economy Action Plan, which is likely to necessitate action, e.g. around electronics, ICT, construction and buildings. The biggest value potential – in line with the biggest material volumes connected to network infrastructure – lies in retired infrastructure. However, extracting these values, especially related to legacy cable networks, comes at a cost. These costs are associated with excavation of gravel, asphalt, and soil that has not been calculated nor included in this study. The resale of infrastructure assets and waste mitigation in infrastructure installation hold an annual potential of $5.0-8.0 billion and $5.5-8.0 billion respectively by 2030.

Opportunities from circular operations[49]

Circular business model	Name of initiative	Waste potential (1: low, 4: high)	Value potential MIN-MAX (billion $)
Resource Recovery	Resale of infrastructure assets	Valuable metals	5.0 – 8.0
Circular Inputs	Waste mitigation in infrastructure installation	Construction waste	5.5 – 8.0
	Sourcing of sustainable materials	Raw materials	1,5 – 2,5
Product Use Extension	Resale company-owned hardware	E-waste	2.5 – 4.0
	Design for refurbishment – servers	E-waste	2.0 – 3.0
Sharing Platforms	Avoid overcapacities in data centers	E-waste	2.0 – 2.5
Total			**~$20-30 bn**

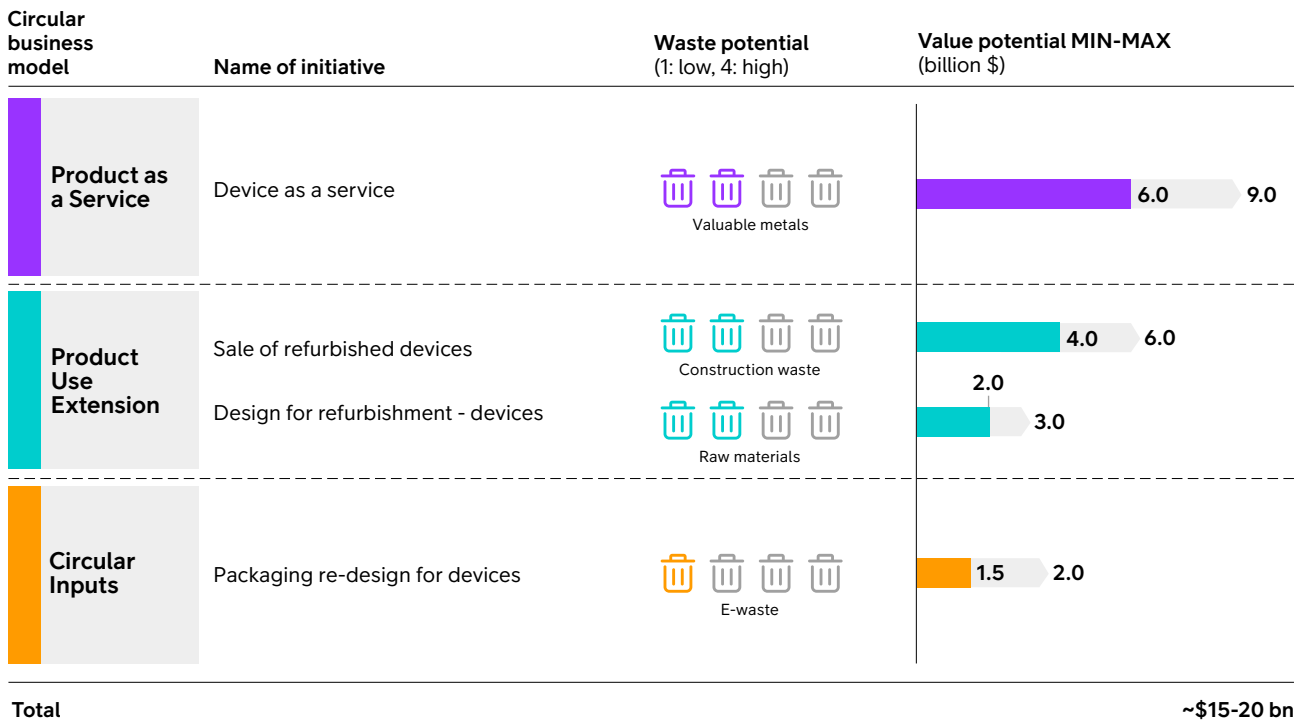## Offering circular products and services: $15-20 billion opportunity

Besides supporting environmental sustainability, circular economy principles can also foster innovation in customer centricity. This is especially true for Product as a Service models that focus on delivering outcomes for consumers. In those models, ownership is retained by the producer or the retailer, while customers only pay per use or for the functionality of a product. The idea is simple: "why sell a drill if the customer need is a hole in the wall?".[50] Translated for the telco industry the question might be: "why sell a phone if the customer need is the latest technology platform to stay connected?"

By offering Devices as a Service, telcos can maintain control of their devices and ensure they are returned and re-purposed at the end of use for as long as possible, before being safely recycled. In addition, the model can help to improve customer experience, by ensuring continuous engagement and add-on services during use, such as refurbishment and maintenance services. The value potential for Devices as a Service within the global telco industry is estimated to be annually $6-9 billion by 2030. Sales of refurbished devices and design for refurbishment constitutes another opportunity area which can bring an annual potential of $4-6 billon and $2-3 billon respectively, by 2030.

The business models mentioned above are expected to be included in upcoming regulations as an outcome of the EU's Circular Economy Action Plan published in 2020. The Action Plan stipulates e.g. a "right to repair" for customers with a particular focus on ensuring availability of spare parts and access to repair and calls out the environmental benefits of Products as a Service.[51]

Opportunities from
circular product & services[52]

Circular business model	Name of initiative	Waste potential (1: low, 4: high)	Value potential MIN-MAX (billion $)
Product as a Service	Device as a service	🗑 🗑 🗑 🗑 Valuable metals	6.0 — 9.0
Product Use Extension	Sale of refurbished devices	🗑 🗑 🗑 🗑 Construction waste	4.0 — 6.0
	Design for refurbishment - devices	🗑 🗑 🗑 🗑 Raw materials	2.0 / 3.0
Circular Inputs	Packaging re-design for devices	🗑 🗑 🗑 🗑 E-waste	1.5 — 2.0
Total			**~$15-20 bn**

Enabling a circular ecosystem: $10-30 billion opportunity

As described in Chapter 2, besides implementing circular business models itself, the telco industry is also enabling circular business models and practices for other industries and can continue to do so with even greater impact. To assess the value opportunity within this area, Accenture considered case studies from eight industries where telcos can enable circularity (see illustration on next page). Utilities, personal mobility, information and communications technology (ICT), oil & gas, fast moving consumer goods, machinery & industrial equipment, fashion and white goods & furniture.

Accenture research, which is used as basis for this report, estimates that telcos can capture 2-6% of the overall circular economy value potential of those industries. Legislation is expected to provide a significant push in this field. Due to the EU Circular Economy Action Plan several industries, including ICT and personal mobility, are expected to face new regulations. Moreover, EU's recovery package, announced during the pandemic in 2020, will specifi-

cally direct money to digitalization and initiatives supporting the ambitions of the EU Green Deal. A large share of the €1.8 trillion package will support fair climate and digital transitions via the Just Transition Fund and the Digital Europe Program. 30% will be spent to fight climate change, representing the highest share of the European budget ever dedicated to that purpose.[53]

From an industry perspective, Utility, Mobility and Machinery & Industrial Equipment make up for about 85% of the total value potential illustrated below. Examples of key enabling capabilities that telcos can provide are real-time monitoring and tracking of assets.

Opportunities from enabling a circular ecosystem[54]

Circular business model	Industry	Enabling role	Industry value potential MIN-MAX, of which telco can address 2-6% on average (billion $)[55]
Sharing Platforms	Utilities Mobility	• enable real time tracking of grid usage and collection of user consumption data • enable communities of users through platforms to allow easy access and product exchange	95.0 — 375.0 $5.0-13.0 bn
Circular Inputs	Mobility ICT Oil & gas Fast-moving consumer goods	• enable remote real time monitoring of production processes to generate insights and initiate automated action • enable other ecosystem partners to use less or different materials in products	67.5 — 170.0 $3.0-7.0 bn
Resource Recovery	Machinery & industrial equipment Oil & gas	• enable asset tracking throughout lifecycle stages and gathering of lifecycle data • enable remote collection of production equipment lifecycle data for easy end-of-life recovery	60.0 — 145.0 $2.0-6.0 bn
Product Use Extension	ICT White goods & furniture Fashion	• enable communities of users through platforms to facilitate reuse/resale for end-of-use products	20.5 — 40.0 $0.5-1.5 bn
Product as a Service	Machinery & industrial equipment	• enable remote real time tracking of equipment use	5.0 — 40.0 $0.5-1.5 bn
Total			**$248-770 bn** of which addressable by telcos 2030: ~$10-30 bn

5. JOINT ACTION TO DRIVE CIRCULARITY AT SCALE

As this report outlines, moving towards a circular economy is about new ways of looking at what we already have and the resources we use. It is about releasing the untapped value that the linear system currently prevents us from touching.

Applying and expanding circular business models will be key to capitalizing on this value. However, scalable change will also require extensive collaboration within and across industries, as well as deep engagement with consumers, business customers, academia, NGOs, investors, and suppliers, to co-create a circular future. Policymakers need to incentivize the shift through circular policies and investments needed that match the urgency of the situation.

The pivot of industries is based on a transformation of the core of the business, while simultaneously growing the "new". New technologies and services can enable and speed up the circular shift, both within the sector's own operations and in society as a whole. With 5G – the new digital infrastructure for the connected society – existing opportunities can be scaled, and new ones can be added.

The combination of IoT, Artificial Intelligence, and 5G will create opportunities to radically reduce wasted resources and capacities through asset and process optimization, sharing, and by matching resource demand with precise supply of, for example, energy to grids and buildings. Overall, it will allow both companies and policymakers to make well-informed decisions based on data and

real-time information, which can facilitate the shift to a circular economy. While capturing such opportunities, efforts to address the waste generated from infrastructures and hardware must be accelerated in the sector when new infrastructures and devices are entering the market. Such efforts need to involve all parts of the value chain, with infrastructure and hardware **suppliers** playing a key role in the years to come.

Circular transformation journey [56]
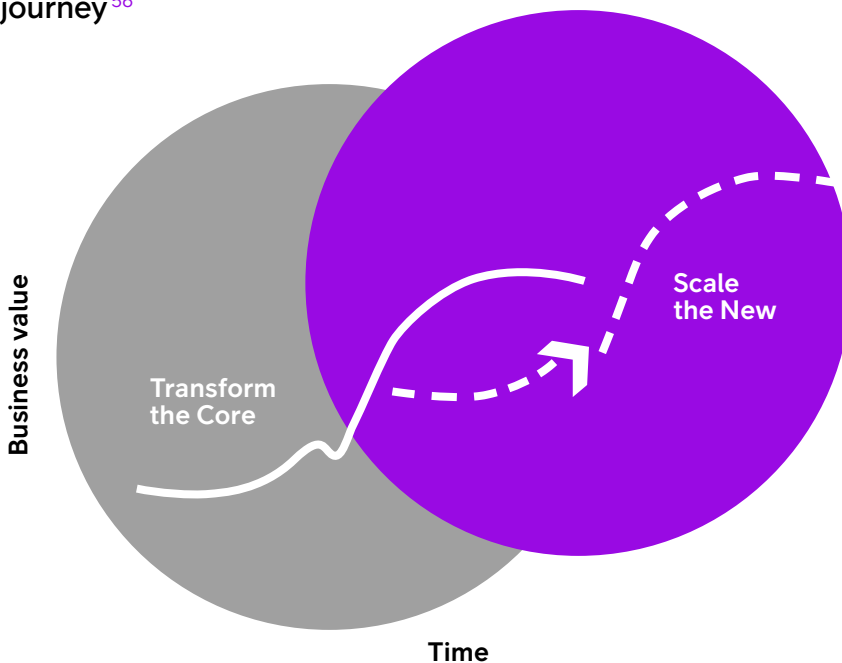
Other industries also need to transition towards circular business models. New technologies have proven to be successful in helping all industries reduce costs and negative environmental impacts by addressing inefficiencies. However, the potential is much larger than what companies have harnessed so far. A study from the European Investment Bank shows that only 30% of companies in the EU have adopted digital technologies like IoT, big data and robotics.[57] Further uptake of digitalization in societies as well as the effects of disruptive players, will influence the pace and impact going forward.

Consumers are increasingly eager to go green and reduce their environmental footprint. The awareness and willingness to act on it varies between regions and countries but the trend is clear. The need for behavioral changes constitutes a barrier. Consumers need to be invited to join the circular journey since significant volumes of

electronics are still left idle due to a lack of knowledge, incentives and privacy concerns. As this report shows, an increased willingness to lease rather than owning a phone would be a true gamechanger.

Business as usual is not an option and neither is policy-making that does not support a circular shift. **Policymakers** in different municipalities, countries and regions, and most promisingly the EU, have started to take action. To ensure that planetary boundaries are respected, national and regional circularity plans should complement the ones countries already have in place for climate action and GHG emission reductions as a response to the Paris Agreement.

Such plans must be concrete, create a joint vision, and align stakeholders around a target state. They can clarify the roles of various players, identify areas for innovation and investments, and support development of new competences and recycling capabilities. With the joint action from different stakeholders a transition towards a circular economy can be successful. In such a process, the telco industry can and will have an instrumental role to play in accelerating the circular economy agenda and driving action.

APPENDIX – METHODOLOGY

Two different analyses were conducted to assess the potential of the three telco roles in a circular economy. The value potential for the roles "embedding circularity in operations" and "offering circular products/services" was assessed based on telco market data and value drivers. Then, the estimated value potential for the role "enabling a circular ecosystem" was derived based on secondary data for different industries.

Value potential of operations and circular business models
(pages 28-31)

The value potential was estimated based on financial information of the telco industry (see next paragraph) and value drivers for each of the identified circular initiatives. The value is stated by 2030. The telco market size is assumed to grow with a CAGR of 0.5% from $1.64 trillion in 2020 to $1.73 trillion in 2030. Another underlying assumption is that the listed initiatives are fully implemented by 2030 in order tap into the value potential. Necessary investments or upfront cost potentially needed to realize the value potential were not included in the study and require additional analysis.

The telco profile used was created using publicly available financial data from Wall Street Journal for the 10 largest telcos globally, which make up roughly 60% of the total global market in terms of revenue. Data points considered were contribution margins, COGS, CAPEX and property, plant & equipment data. To assess the value drivers, different assumptions that influence revenue, cost and expenditures were made. Examples: Changes in contribution margin and COGS when introducing new products (like Device as a Service of refurbishment offers); reduction of CAPEX due to new waste mitigation practices (e.g. infrastructure installation).

Value potential calculation approach

Financial information				**Value drivers**		
Contribution margin	COGS	Property plant & equipment	CAPEX	Revenue	Costs	Investments

Circular business model
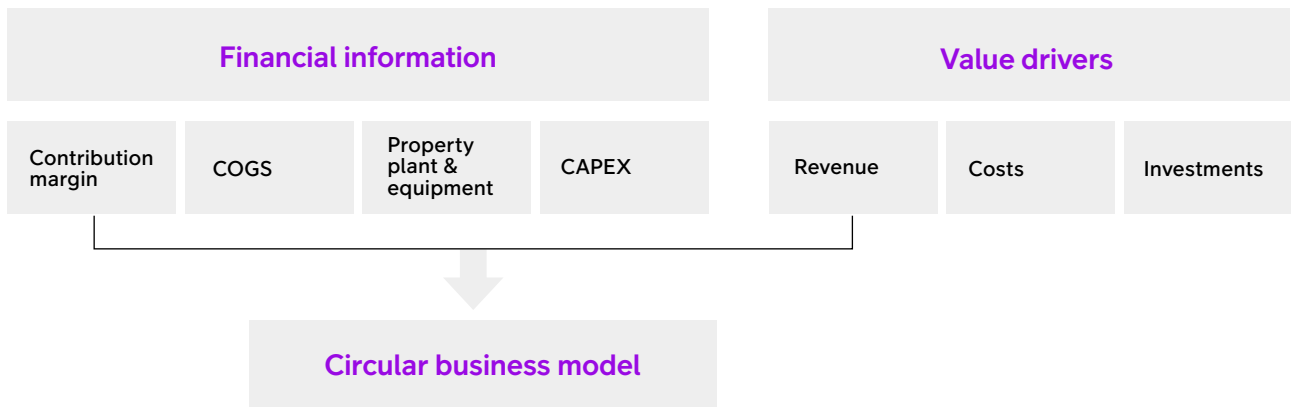
Value potential of enabling a circular eco system
(pages 31-32)

In order to estimate the value potential of digital enablement through telcos, case studies from eight industries were used from "The Circular Economy Handbook" (2020) by Accenture. The scope of the analysis included circular business cases that were enabled by Internet of Things, digital platforms and/or cloud services. Through secondary sources, desktop research and expert interviews, the addressable telco potential was estimated with 2-6% considering two factors:

1   Additional telco sales from delivering enablement services to other industries that are related to circular business models

2   Brand value increase based on enabling other industries to become circular

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