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Despite growing awareness of regulators, companies, and consumers alike, the global economy is consuming resources beyond the extraction limits of finite resources and the replenishment rates of renewable resources. If every person lived like the average citizen in the Nordic region, we would need approximately four Earths per year to satisfy our annual resource consumption. To compete in a world increasingly experiencing natural resource scarcity, the Nordic region needs to reevaluate its largely linear economy.

The regenerative and continuous cycling of resources within the closed loops of a circular economy provides a solution to the overexploitation of natural resources. In a circular economy, products are used and repaired for as long as possible. They are then deconstructed so that their original constituent materials can be utilized again to create new and similarly valued goods.

The circular economy in the Nordic region holds a large potential. Today, 6% of the economy is circular—meaning that ~6% of resources used for production come from recovered materials. By comparison, the EU average is at ~12% circularity, with an ambition to double the rate by 2030. Reaching the ambition offers a considerable upside and opportunity for the region. A transition toward a higher level of circularity is estimated to unlock ~€48 billion in annual economic opportunity in the Nordic region by 2030, similar to 3% of the Nordic region’s GDP in 2021.

On a company level, the circular economy mindset provides an opportunity to capture new top-line growth (up to 15% of net sales), realize cost efficiencies (up to ~15% of material cost reductions), and mitigate supply chain and regulatory risks (up to ~10% of net sales).

First, companies applying a circular economy mindset are found to identify, shift toward, and capture new, growing revenue pools. Companies unlock recurring revenue from product-as-a-service, leasing, and subscription-based models, while others capture value pools by shifting to the resale, repair, and remake markets, where used but perfectly good products are given a second life for price-sensitive or environmentally conscious consumers. And as demand for recycled materials increases, former waste streams are becoming new value pools.

Second, circular companies can achieve cost reductions through operational efficiency by eliminating material leakage, designing production in ways that require fewer resources, recirculating resources to maximize their economic value, and reducing costs from regulatory fees related to material use.

Third, a circular economy mindset is found to enable companies to foresee and mitigate supply chain and regulatory risks associated with competition for increasingly scarce natural resources and intensified regulation at European and country levels.

The highlighted circular economy value pools exist across industries, although their size and maturity are largely industry-specific and a product of shifting consumer preferences, increasing regulatory pressure, and resource scarcity. This report uncovers circular economy trends within five sectors in the Nordic region: packaging, consumer goods, machinery and industrial goods, metals and mining, and transportation.

Moreover, the circular economy holds a large untapped environmental potential. At the global level, the transition toward circularity has the potential to reduce material use and extraction by ~30%, cut greenhouse gas emissions by ~30%, and halt biodiversity loss by 2035. At a company level, the circular economy represents a powerful approach to decouple growth from adverse environmental impacts by keeping products and materials in continuous loops.

Despite these numerous advantages, many companies struggle to implement circularity and move beyond isolated circular actions with little economic and environmental impact. CIRCelligence by BCG provides a comprehensive holistic approach that enables businesses to integrate circularity into their core business strategy in a way that delivers economic benefits and also maximizes total societal value. CIRCelligence considers the whole value cycle, from input to end of life, and evaluates opportunities to place circular thinking at the heart of a company. Using a proprietary calculator, CIRCelligence evaluates a company’s current circularity baseline and provides fact-based recommendations on cost savings, future business cases, and initiatives to increase circularity. This approach supports companies in building a strategic foundation for their circular economy journeys and provides top management with required data and insights.

This report is intended to serve as a starting point for companies to explore the value pools that can be unlocked by applying a circular economy mindset.
The challenge: Overexploitation of natural resources

Despite growing awareness of resource consumption and its adverse environmental impact, the global economy continues to use natural resources at unsustainable levels. On average, humanity uses the resources of approximately two Earths per year; the European resource intensity equates to roughly three Earths should everybody consume as the Europeans. In the Nordic region, the level equates to four Earths per year, largely driven by consumption-rich lifestyles. (See exhibit 1.)

A continuation of current consumption levels is likely to put many of Earth’s resources at risk of being scarce by the mid- to late 21st century with a surge in demand for many materials. For example, the demand for lithium, nickel, and rare earth materials are set to rise 27, 26, and 11 times, respectively, by 2050 while valuable resources are wasted (for example, 30% of food production, 60% to 70% of polyethylene terephthalate [PET] and cardboard paper after first-use recycle, and ~30% of steel after first-use recycle).
To stay within the safe operating space of our planet, it is necessary to move away from the current linear consumption system where resources are extracted, used, and then thrown away, resulting in high waste levels and a continued need for extraction of virgin materials to meet rising demands.

To compete in a world increasingly experiencing natural resource scarcity, forward-looking companies are posing the question: How can we create economic value within the regenerative capacity of the planet?

**Exhibit 1 | Earths needed to meet the current per capita resource consumption in the Nordic region**

<table>
<thead>
<tr>
<th>Country</th>
<th>Earths Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>4.2 Earths</td>
</tr>
<tr>
<td>Finland</td>
<td>4.0 Earths</td>
</tr>
<tr>
<td>Sweden</td>
<td>3.9 Earths</td>
</tr>
<tr>
<td>Norway</td>
<td>3.6 Earths</td>
</tr>
<tr>
<td>EU average</td>
<td>2.9 Earths</td>
</tr>
<tr>
<td>World average</td>
<td>1.8 Earths</td>
</tr>
</tbody>
</table>

*Source: Global Footprint Network (2023), BCG analysis*

**The solution: Circular economy – operating within the limits of our planet**

For companies, the circular economy holds significant value as an enabler for growth within the boundaries of our planet. Businesses that apply the circular economy mindset can unlock significant value by capturing shifting revenue pools, increasing innovation, and realizing cost efficiencies and reductions, as well as by mitigating risks related to scarce resources, supply chain disruptions, and future legislation. And circular business practices have been shown to reduce adverse environmental impacts related to resource consumption, waste generation, pollution, water scarcity, land use change, and carbon emissions. (See chapter 4 for details on the potential of the circular economy mindset to generate corporate economic and environmental value.)

The circular economy is an established concept that moves beyond our current “take, make, waste” system and relies on the continuous cycling of resources in closed loops. In practice this means that once a product has reached the end of its useful life—that is, after multiple periods of reuse, repair, refurbishment, and remanufacturing—it is dismantled into its initial resources, which are then used for new products and goods. Companies should aspire to retain as much as possible of the embedded value of a product. This can be done by offering repair and maintenance services, reselling used products, introducing refurbishment and remanufacturing practices, or by disassembling and recycling product materials toward like-for-like applications. (See exhibit 2.)

As with all strategies to solve distinct environmental issues, the circular economy occasionally comes with potential trade-offs. For example, does the additional material applied to prolong product lifetime justify the extra content requirement? Or does the additional energy utilization offset the environmental benefits from recycling? Straightforward answers to such trade-offs rarely exist and companies need to identify the best available option by taking the specific context into consideration.
Exhibit 2 | Shifting from a linear to a circular economy requires changes to all five components of the value circle

Linear economy

Take
Extract raw materials

Make
Produce goods and sell (one-time transaction)

Waste
Discard products after use — the resources contained are lost
Circular economy

Raw materials
- Use renewable and recycled raw materials
- Phase out unsustainable substances
- Use 100% biodegradable materials

Product design
- Design for lightweight, longevity, repairability, disassembly, and end-of-life recyclability

End of life
- Use take-back systems and reverse logistics
- Recycle material inputs for production

Retained ownership models
- Offer repair and maintenance services
- Use retained ownership model (leasing, subscription, and product-as-a-service)
- Sell refurbished or remanufactured products

Production
- Increase material use rates
- Implement waste-free production
- Apply closed-loop water flows
- Use renewable energy sources

Not exhaustive
The Nordic countries are 6% circular today

Today 6% of the Nordic economy is circular, meaning 94% of resources consumed in the economy are derived from virgin material resources. The Nordic countries have been at this level of circularity for the past four years. This is below the European average of ~12% as well as the EU ambition of doubling the circularity rate by 2030, yielding a rate of 23.4%.

The difference between the Nordic and the average European circularity level is not explained by lower rates of recycling of secondary materials. Rather, it is driven by the Nordic region’s high domestic material consumption of primary virgin materials, which is among the highest in Europe and roughly a factor of two relative to the EU average measured in metric tons per capita.

References:
5. OECD (2020), Domestic material consumption
There are several reasons behind this and the presence of important material-intensive and extractive industries, demographics, and investments into material-intensive assets—such as infrastructure, buildings, and capital equipment—all come into play. For example in both Finland and Sweden we have several imperative extractive industries such as mining, which drive up and constitute a significant share of the countries’ domestic material consumption. This might be counterintuitive as most of this is exported. However, while the export of materials indeed is excluded in domestic material consumption, the processing of materials and the associated extractive waste is by the circularity definition included and hence naturally resulting in an increase of the overall material consumption. In Denmark and Norway more than 75% of domestic material consumption is driven by stock accumulation (that is, materials that become embedded in long-term and durable products such as buildings, infrastructure, and renewable energy infrastructure). This limits the material available for recycling in the short term and lowers the circularity rate today, despite offering a valuable source for secondary materials in the future when produced and designed in a circular manner.

### Improving waste infrastructure and recycling from a mature starting point

The Nordic countries are widely regarded as leaders within sustainability in general, and within waste collection and resource recovery in particular. A natural starting point to improve circularity, then, is to play to the region’s strengths and expand its current collection and recycling sector.

As shown in Exhibit 3, the region’s recycling rates for material flows such as metals (>90%), electric vehicle batteries (>90%), paper (>90%), e-waste (>90%), and biowaste (84%) are mature, while recycling rates related to materials such as plastics (46%) and concrete (37%) can be improved further to reach the highest technical feasible level. Wood, which accounts for ~23% of the Nordic region’s waste generation, has a recycling rate of 10%. Denmark and Norway have an opportunity to ramp up recycling within the concrete waste stream, with current rates at ~24% and ~36%, respectively, compared to leading countries such as the Netherlands and Switzerland with rates exceeding 90%. Similarly, Sweden and Finland are presented with an opportunity within wood and plastics recycling, with current rates at >5% and ~30%, respectively, compared to Denmark at ~80% recycling of wood and ~86% recycling of plastics.

**Exhibit 3 | The Nordic region has mature recycling rates for most material streams—with improvement potential in plastic, concrete, and wood**

<table>
<thead>
<tr>
<th>Recycle rates in the Nordics for each material type (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mature recycling practices</strong></td>
</tr>
<tr>
<td>Metal (&gt;90%)</td>
</tr>
</tbody>
</table>

**Sources:** Eurostat; Norwegian Statistisk Sentralbyrå; BCG analysis.

6. Excluding mineral and soil waste

7. Feasibility levels based on joint WBCSD and BCG publication, A “Paris Agreement” for Recycling the Earth’s Resources (2022)
While each of the Nordic countries has an opportunity to expand its recycling practices, it is important to recognize the structural differences between the economies as these affect feasible recycling levels. Finland and Sweden both have industries characterized by heavy waste-generating activities such as mining that reduce the overall recycling levels. For example, the current recycling rate of ~10% in Finland increases to ~40% if mineral and soil waste—which today mainly end up at landfills—are not taken into consideration.

**Going beyond recycling to transition toward a more circular economy**

The material consumption per capita in the Nordic countries is at ~23 metric tons, a factor of ~2 compared to the EU average, with 1.4 metric tons derived from secondary sources and the rest from virgin resources. While recycling helps improve the availability of materials from secondary sources, the Nordic region needs to deploy ways of decoupling value creation from virgin material use. The wider circular economy toolbox plays a crucial role. For example, material use efficiency is important to reduce consumption of virgin materials without decreasing value creation. The amount of materials used in the making of a product or in the delivery of a service is decreased through circular design or by increasing the usage rates of products, for example, through sharing and rental models, material lightweighting, multifunctional products or buildings, and energy efficiency.

Another important circular economy lever that companies can use is the optimization of the functional lifetime of products. Durable design as well as materials and service loops that prolong life—such as repair, refurbishing, retrofitting, and remanufacturing—drive value for customers and revenue opportunities for companies and contribute to slowing rates of virgin resource consumption. Companies can explore opportunities within durable material use, modular design, design for disassembly, repair, remanufacturing, refurbishing, and retrofitting. To enable more efficient, durable, and repairable products, circular design principles must be adopted on a large scale, as up to 80% of a product’s environmental impact is determined in the design phase.

The circular economy: An estimated ~€48B economic opportunity

To estimate the economic opportunity of the circular economy for the Nordic region by 2030 the growth of the sector—that is, recovery, sale, and use of materials as well as rental, repair and reuse—has been estimated based on its current growth trajectory and the additional gross value of circular activities required to double the current circularity level in the respective country in line with EU’s ambition to double its circularity level. Also the opportunity, should the Nordic countries reach the circularity ambition rate of 23.4%, has been estimated.

In 2021, the circular economy added around €21 billion in gross value to the Nordic economy. This contains economic activities from the recycling sector, the repair and reuse sector, and the rental and leasing sector—including activities such as: repair of electrical equipment; resale of secondhand goods; and waste stream collection, processing, recycling, sale and use of secondary materials. Assuming this trajectory holds steady, the Nordic circular economy would be worth €25 billion per year in 2030.

To achieve a circular economy aligned with the EU 2030 ambition, it is estimated that the use of circular material input and circular activities within EU must double. If the Nordic countries were to double their circularity levels, the circular economy is estimated to add an additional ~€24 billion in gross value by 2030 in the Nordics, excluding the GDP impact of less virgin resource consumption. (See exhibit 4.) This equals a total annual gross value from the circular economy of ~€48 billion, equivalent to ~3% of Nordic GDP in 2021. In the more challenging scenario where the Nordics reach the EU circularity ambition rate of 23.4%—that is a quadrupling in circularity level—this would translate into an estimated €72 billion in added gross value of €96 billion in total annual gross value, which equals 6% of Nordic GDP in 2021. These estimates are indicative and based on forecasts of the likely increase in activities from the circular economy—that is, the recovery, sale, and use of secondary materials as well as the rental and leasing and the reuse and repair sectors—reaching the circularity levels described in each scenario.

8. Eurostat
9. Circle Economy, Circularity Gap Report, Norway (2020)
10. Eurostat’s statistical indicator for circular economy sectors has been applied to estimate the size of the circular economy. The statistical indicator is monitored under the European Statistical System.
The economic potential of the Nordic circular economy in 2030
(Gross added value¹ in billion, €)

<table>
<thead>
<tr>
<th>Country</th>
<th>Gross added value circular economy 2021</th>
<th>Additional gross value existing growth trajectory by 2030</th>
<th>Additional gross added value by 2030</th>
<th>Annual gross value from the circular economy by 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>21</td>
<td>4</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>Norway</td>
<td>4</td>
<td></td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>Finland</td>
<td>72</td>
<td>24</td>
<td>48</td>
<td>96</td>
</tr>
<tr>
<td>Denmark</td>
<td>96</td>
<td>48</td>
<td>96</td>
<td>96</td>
</tr>
</tbody>
</table>

Doubling circularity in the Nordics

- ~48 Billion, €
  - Doubling the circularity rate could lead to €48 billion in gross added value in 2030, ~3% of Nordic GDP in 2021

Reaching the absolute EU circularity ambition rate

- ~96 Billion, €
  - Aligning towards the absolute EU circularity ambition rate could lead to €96 billion in gross added value in 2030, ~6% of Nordic GDP in 2021

Note: 1. Gross added value estimated as gross income adjusted for operating subsidies from circular economy sectors as defined by the Eurostat, 2. Each Nordic country double their current circularity rate, 3. Each Nordic country realize a circularity rate at 23.4% corresponding to 2X of EU’s average circularity rate. Source: Eurostat, SBB, BCG analysis

Exhibit 4 | The circular economy: A ~€48B opportunity, with a ~€24B added growth opportunity in 2030, by doubling the circularity in the Nordics

Upcoming regulation will accelerate Nordic companies’ transition toward circularity

To close the circularity gap and tap into the economic opportunity of the circular economy, policymakers at the EU level and in the Nordic countries are implementing new regulations. This is affecting companies in two ways. First, it increases the minimum thresholds that companies need to comply with. Second, it shifts value pools toward circular economy solutions, creating a value creation opportunity for companies moving into the space, while inaction can lead to value loss.

For example, the European Corporate Sustainability Reporting Directive is raising the minimum compliance requirement by making it mandatory for a large array of companies to report on circular economy and waste metrics such as circular material use rate, waste accumulation, and use of virgin raw materials. Also, the European Commission is proposing to implement digital product passports that share product information across a product’s life cycle. This will make the environmental impact of products visible, traceable, and accessible to all value chain actors. The EU Taxonomy highlights the circular economy as one of the environmental objectives that constitute sustainable activities likely shifting investment toward circular economy solutions. Another example of a regulatory piece set to shift value pools is the proposed Packaging and Packaging Waste Directive, which aims to reduce packaging waste and to increase reusable, refillable, and recyclable packaging solutions.

At the Nordic level, policymakers are also intensifying circular regulations. In Denmark, the extended producer responsibility for packaging will enter into effect in 2025, making producers responsible for costs related to recycling of packaging, while the Norwegian government is introducing mandatory secondary-material requirements in the industrial sector. In Sweden, financial incentives such as taxes to promote circular practices and tax deductions for increases in the reuse of materials are being introduced to accelerate the transition toward circularity. The Finnish government is developing sector-specific circular economy criteria as well as accessing legislation to provide financial incentives for recycling of certain materials.

11. The Danish Government, Circular economy action plan (2021)
14. European Environment Agency, Circular economy country profile - Finland (2022)
The adoption of a circular economy mindset can enable companies to capture significant value pools. The value capture derives from three primary sources. (See exhibit 5.) First, value is unlocked by increasing top-line growth (for example, capturing new revenue pools related to the circular economy). Second, companies can reduce their material, production, and regulatory costs through increasing operational efficiencies. And third, companies can mitigate future and current business risks by, for example, increasing supply chain resilience, reducing exposure to price hikes of high-demand scarce input materials, and staying ahead of the regulatory curve.
Exhibit 5 | The circular economy enables companies to identify, shift toward, and capture three types of value

Current business value

<table>
<thead>
<tr>
<th>Top-line growth</th>
<th>Cost reductions</th>
<th>Risk mitigation</th>
<th>Business value with CE mindset</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<td>+</td>
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</tbody>
</table>

Source: BCG analysis.

Circular economy value pools

Top-line growth

Increased top-line growth is captured through new business models, increased customer retention, competitive differentiation, and increased motivation.

Cost reductions

Cost reductions are established in three areas—material, production, and regulatory costs—by, e.g., reducing material waste, designing products, in ways that require fewer resources, and circulating resources, including energy.

Risk mitigation

Risk mitigation is realized through building more resilient supply chains to reduce exposure to price hikes of scarce input materials, and avoid regulatory risks by staying ahead of the regulatory curve.

Customer retention

Unlike linear business models that are focused on selling a product to a customer, circular business models often revolve around continuous interconnections between customer and company. Through the increase in interactions, companies can build stronger customer relationships, which has shown to drive higher customer retention and price realization as well as cross-selling opportunities.

Competitive differentiation

Companies that take leadership in circular economy business practices can achieve a unique position in the market. They differentiate themselves from less environmentally conscious competitors and, since circularity takes a more holistic approach to the planetary boundaries, from competitors that only focus on decarbonization. This allows circular companies to increase their appeal to eco-conscious customers and potentially gain a higher market share.

Circular economy value pools

Top-line growth

New business models

A circular mindset enables companies to identify and develop new business models that can unlock top-line growth. For example, former waste streams are becoming new value pools as demand for recycled materials increases and creates a shift toward circular business models. Companies are also experiencing business model shifts toward after-sale services such as resale, repair, and remake, where used but perfectly good products are given a second life for price-sensitive or environmentally conscious consumers. Other companies are unlocking recurring revenue from product-as-a-service, leasing, and subscription-based models.

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15. Builds and expands on It’s Time to Close Our Future Resource Loops (BCG, 2020)
**Cost reductions**

**Material costs**

Material costs can be reduced through two measures. First, material efficiency can be increased, for example, through design measures such as lightweighting (reducing the amount of materials needed in the product). Second, by increasing recycling, high-value and scarce input materials can be captured and used as production inputs, thereby decreasing the procurement costs for scarce resources.

**Production costs**

Circular economy initiatives go beyond cost reductions related to input materials and extend to the production setup. For example, by designing production to reduce material leakage and increase energy, water, and chemical efficiency, production costs are kept low.

**Regulatory costs**

Regulations with regard to circularity such as extended producer responsibility and taxes on waste generation have already been imposed and more are being developed. Companies that are proactive and have implemented circular practices are experiencing reduced expenses related to regulatory fees and taxes from material use compared with noncircular competitors.

**Risk mitigation**

**Supply chain resilience and access to scarce resources**

Supply chains are increasingly being disrupted by environmental damages and global crises. Since circular companies are less dependent on virgin resources, they face less risk from resource scarcity and rising prices when demand for virgin resources outpaces available supplies. They also reduce their supply chain risks since recycled materials often are available geographically closer than virgin sources.

**Regulatory risks**

The EU and the Nordic countries alike are ramping up policies and regulations needed to accelerate the transition toward a circular economy. Companies that stay ahead of the regulatory curve will have time to transition to circular economy requirements, but those that lag behind will risk disruptions to their revenue streams and lose out on scarce non-virgin material streams.
Circular economy value capture deep dives by sector

Across industries, companies can capture value by applying the various levers just described. However, the nature, maturity, and scale of the value pools are industry specific and vary based on: customer sentiment; regulation; technology; and level of competition for scarce resources.

Exhibit 6 illustrates the potential value capture by exemplary companies leveraging a circular economy mindset. These examples represent a distinct and non-exhaustive sample of opportunities within the circular economy.

### Exhibit 6 | Circular economy value capture within packaging, consumer goods, equipment and metal manufacturing, and transportation

<table>
<thead>
<tr>
<th>Industry</th>
<th>Top-line growth</th>
<th>Cost reductions</th>
<th>Risk mitigation</th>
<th>Exemplary company</th>
</tr>
</thead>
</table>
| Packaging | ~10% | ~7% | ~9% | • ~10% top-line growth opportunity by 2030 through capturing growth within the recycled plastic packaging market  
• ~7% production cost reductions achieved p.a. by strategic material sourcing, enhanced product design, and production waste reductions  
• ~9% net sales mitigation p.a. by 2030 through substituting packing materials toward reusable and refillable solutions |
| Consumer Goods | ~15% | ~14% | ~3% | • ~15% top-line growth opportunity for a fashion company by capturing growth within resale, rental, repair, remake market  
• ~14% material cost reductions achieved p.a. through material efficiencies, including lightweighting, zero-waste production practices, and increased energy efficiencies  
• ~3% net sales mitigation p.a. through reduction of overstock in production |
| Machinery & Industrial Goods | ~10% | ~8% | ~4% | • ~10% top-line growth opportunity by 2030 for an equipment manufacturer entering new business models such as refurbishment, remanufacturing, and product-as-a-service offerings  
• ~8% material cost reductions achieved p.a. by enhanced product design, increased process efficiency, zero-waste production, and strategic sourcing of materials  
• ~4% material cost mitigation p.a. by 2030 through reduced exposure toward increasing carbon prices, energy price fluctuation, and supply/demand imbalances of green materials |
| Metals & Mining | ~15% | ~6% | ~3% | • ~15% top-line growth opportunity by 2030 for an aluminum company by entering aluminum scrap market  
• ~6% cost reductions achieved p.a. through production efficiency improvements, including energy efficiencies  
• ~3% net sales mitigation p.a. by 2030 through reduced exposure toward increasing carbon taxes and energy price fluctuation |
| Transportation | ~15% | ~8% | ~5% | • ~15% top-line growth opportunity for an automotive company by 2035 through capturing recurring revenues from mobility-as-a-service solutions as well as leasing and subscription models  
• ~8% production cost reductions achieved p.a. by material savings through lightweighting, zero-waste production, recycling materials, and increased process efficiencies  
• ~5% cost mitigated p.a. by 2030 through shifting to closed-loop recycling and sourcing of critical input materials in EVs, mitigating future supply-demand discrepancies |

Source: BCG analysis.  
Note: The list of value pools are non-exhaustive and represent a distinct sample of opportunities within the circular economy.
One of the key drivers for the circular economy in packaging is upcoming regulation. The proposed EU regulatory scheme to prevent packaging waste and to increase reusable, refillable, and recyclable packaging solutions is set to shift value pools, with significant growth opportunities for companies that revise their packaging portfolios toward circularity. Take, for example, reusable and refillable packaging solutions within the take-out drinks and meals as well as e-commerce deliverable markets. Here, mandatory threshold limits for the share of packaging solutions that are reusable and refillable, such as 10% for take-out food and e-commerce and 20% for take-out drinks, are increasing the uptake of circular packaging solutions. Recycled content in plastic packaging is another growing value pool that many fast-moving consumer goods (FMCG) companies and value chain players are shifting to. Again, this trend is fueled by regulation setting mandatory rates of recycled content requirements of up to 35% by 2030, resulting in a likely 25% increase in recycled plastic packaging volume by 2030.

Adopting a circular economy mindset also benefits packaging companies’ ability to foresee and mitigate regulatory risks. Here, forward-looking companies can avoid net sales losses by shifting packaging materials to ensure alignment with upcoming mandatory reusability and recyclability targets. For example, numbers from the European Commission suggest that the EU corrugated cardboard market is at risk of declining by ~25% following implementation of the proposed Packaging and Packaging Waste Directive.

Finally, the ability to reduce costs through reduction of materials illustrates how packaging companies have applied a circular economy mindset to keep costs down. Circular design principles such as lightweighting translate into material efficiency as well as freight savings, an expense that has increased dramatically in recent years.

Within consumer goods, a subset of companies has been successful in exploring two specific circular economy strategies to capture top-line growth: entering the resale, rental, and repair markets and offering products with high rates of secondary materials. Zeroing in on the former, the market for resale, rental, repair, and remake in fashion is forecast to grow with a CAGR of 20% to 25%, with the potential to constitute a 23% market share in 2030. Resale and rental platforms Depop, Rent the Runway, The RealReal, Vinted, Poshmark, ThredUp, and Vestiaire Collective have all reached billion-dollar valuations, illustrating the value capture. Resale grew five times as much as the broader retail clothing sector in 2022, with online resale being the fastest-growing resale market segment and expected to surpass fast fashion by 2032. In addition, companies such as Nudie Jeans, Kavat, and Norrøna are offering repair services to prolong product lifetime. Other companies, such as Patagonia and Houdini Sports-wear, have transitioned a majority of their collections to recycled and sustainably sourced materials. By doing so, they differentiate themselves from competitors while also increasing their appeal to their eco-conscious customer segment.

The application of circular economy levers to reduce resource consumption and costs is another strategy that has proved to be effective. Circular design has enabled companies to reduce material inputs in FMCG by up to 20%. Further reductions are possible by increasing efficiency in water, energy, waste, and chemicals usage, which in the fashion industry can increase the EBIT margin by ~2 percentage points. Cost cutting is also being achieved by improving inventory stock management. For example, in the fashion industry an estimated 3% of all stock ends up in incinerators or landfills each year, providing an opportunity for cost reduction through solutions to reduce overstock.

18. Ibid.
21. ThredUp, Resale Report 2023
Within the machinery and industrial goods sector, examples of circular economy top-line growth value pools include product-as-a-service solutions, repair and maintenance services, and refurbished or remanufactured goods. Here, the product-as-a-service market is forecast to grow at a CAGR of ~7% to 10% toward 2030, propelled by developments in digitalization and the Internet of Things. Case examples include Hilti’s Tool Fleet Management services and Michelin’s “pay per kilometre” program. Service models also tend to showcase higher margins relative to product sales, benefiting the bottom line as well as the top line in the industrial goods industry while often contributing added benefits such as improved customer loyalty through continuous customer touch points and innovation through access to valuable product data points relative to linear value pools. For example, the adoption of equipment-as-a-service has shown to result in customer loyalty levels five times higher than prior to intervention. Another promising circular economy value pool is refurbished or remanufactured machinery, estimated to grow at a CAGR of ~5% toward 2030, enabling pric-sensitive or environmentally conscious customers access to used but perfectly fine equipment.

Cost efficiencies are also realized through circular economy levers. For example, circular design techniques such as lightweighting are used to reduce material input, while modular component design allows for reductions related to standardization. Maintaining product ownership by ensuring reuse/repurposing/remanufacturing of valuable parts or materials has also been shown to reduce material costs by ~8% to 12%, with some companies able to realize up to ~95% material recovery rates.

Within metals and mining, shifts toward circular value pools are also trending. Metal companies are experiencing increasing demand for recycled and sustainable materials as downstream customers seek to deliver on ambitious decarbonization and circular economy targets. The accelerating demand is translating into “green premiums” for companies that introduce low-carbon and recycled products, as showcased in our latest joint report with the World Economic Forum, Winning in Green Markets. For example, the price premium for green steel and aluminum is +30%, as demand exceeds supply. In addition, some mining companies are diversifying their revenue pools by selling by-products that otherwise would have counted as waste streams. Overburden and waste rock can be repurposed for buildings, road construction, and coastal protection, among other uses. One Swedish mining company is utilizing tailings in dam construction, while others have found use cases in flooring, road construction, and concrete blocks. The global mining waste management market was valued at ~$190 billion in 2021 and is expected to grow at a CAGR of 6% until 2029. Another key circular value pool that metal companies are exploring is integration along their value chain by acquiring waste management companies, which provides them better access to recycled materials. An example of this is the American steel producer Nucor, which has acquired multiple recycling and waste management assets in recent years.

Companies implementing circular initiatives have also been shown to reduce costs. For example, technology developments are reducing the amount of material needed to meet customers’ requirements. Over the past 50 years the strength and toughness of steel has increased significantly, reducing the weight of steel needed in applications by up to 40%. In addition, metal and mining companies are optimizing their energy and material use in operations. For instance, energy savings in production has been shown to be realized through transitioning to recycled aluminum and steel.

24. Market Study (2022): Equipment-as-a-Service market forecast and industry dynamics
25. Company analyses
28. Market Study (2022): Market forecast for refurbished and remanufactured construction machinery
31. Study supporting the elaboration of guidance on best practices in the Extractive Waste Management Plans - European Commission
32. Data Bridge Market Research, Global Mining Waste Management Market - Industry Trends and Forecast to 2029 (2022)
33. World Steel Association
34. Ibid
Driven by developments in consumer preferences, technology, regulation, and competition for scarce natural resources, the circular economy is anticipated to play an increasing role in transportation. Circular economy front-runners are looking to capture new revenue pools through, for example, leasing/subscription, car sharing, and mobility-as-a-service solutions, a market that is forecast to experience double-digit growth over the next decade. Case examples include Renault, which is forecasting a 20% revenue share allocated to mobility services by 2030. Through retained ownership and optimized use rate of products, these models reduce the material demand for the products or services delivered compared with linear models where, for example, an average car sits idle for more than 90% of the time. Electric vehicle (EV) battery recycling and battery reuse are two other examples of value pools that automotive value chain players are currently exploring as growth areas. The former holds promising growth with a CAGR of 15% to 18% from 2022 to 2040 and already showcases attractive economics (a 15% margin when deployed at scale). Repurposing used EV batteries for a second life is possible in less-demanding stationary storage applications such as utility-scale storage systems. This value pool has been pursued by some car manufacturers reusing the residual value of EV batteries for large-scale electricity storage, thus diversifying their revenue pools.

A circular economy mindset can also help automotive companies mitigate risks related to supply chain disruptions and regulatory tightening such as the proposed EU regulatory framework for batteries’ mandatory recycling content requirements, including cobalt (~20%), lead (~85%), lithium (~10%), and nickel (~12%). Zeroing in on supply chain disruptions, circulating critical materials in high-quality recycling loops can help decouple risk of access and limited supply to key input materials. It can also reduce impact from volatile metal prices—which increased between 15% (copper) and 102% (nickel) over the past year—and from the supply and demand imbalances forecast in lithium (supply estimated to cover 50% of demand), cobalt (supply estimated to cover 50% of demand), and copper (supply estimated to cover 80% of demand) by 2030.
The untapped environmental potential of the circular economy

At the global level, the transition toward circularity holds significant environmental potential as established through multiple studies in the circular economy literature. For example, the literature converges toward a material consumption and greenhouse gas reduction potential of ~30% while halting biodiversity loss by 2035. (See exhibit 7.) At a company level, the benefits can be equally substantial. By designing out waste and pollution, keeping products and materials in use, and regenerating rather than degrading natural systems, the circular economy represents a powerful unified approach to solve multiple environmental challenges. Consequently, companies that succeed with adopting a circular economy mindset often have a competitive advantage by decoupling growth from adverse environmental impacts related to resource consumption, waste generation, pollution, water scarcity, land use change, and climate mitigation.

Examples of environmental benefits from the circular economy

Cutting greenhouse gas emissions

The circular economy benefits extend to decarbonization. In the manufacturing industry, for example, circular economy levers have been estimated to hold an emission reduction potential of ~40% by 2050 compared to the current baseline scenario. Here, ~10% of the emission reduction potential derives from material efficiency measures that reduce the material input need as well as waste generation during construction. The remaining 30% reduction potential stems from circulation of materials and components through service-based business models (see section 4.2) and through increasing recycling rates. A similar reduction potential has been estimated in the automotive industry as well as in the electronic and electric equipment sector (EEE). In the former, the CO₂ reduction potential per passenger kilometer has been estimated as ~65% by 2030, and in the latter as ~40%. While circularity levers on average hold a large decarbonization potential, that may not always be the case. For some materials and recycling technologies, for example, the carbon impact may be negative relative to virgin materials at current maturity and scale levels.

43. Ellen MacArthur Foundation, Completing the Picture: How the Circular Economy Tackles Climate Change (2021)
Reducing natural resource use and extraction

The circular economy holds significant potential to reduce natural resource consumption and extraction. In the automotive industry, for example, virgin material usage and waste can be reduced considerably by increasing the circular resource consumption per passenger kilometer, with recent studies estimating a 40% to 80% reduction potential by 2030. Here, material use efficiency—for example, through sharing and rental models, remanufacturing, and high-quality recycling—as well as circular design principles are key levers to unlock the potential. Similarly, by shifting toward higher rates of reusable and recyclable packaging solutions, waste generation in the packaging industry has been estimated to be reduced ~30% by 2030. Increased material efficiency as well as recycling a larger share of material flows also means less waste accumulation at products’ end-of-life phase, including waste to landfill.

Reducing biodiversity and nature loss

The circular economy also holds untapped potential to mitigate biodiversity and nature loss. This can be exemplified within the fashion industry where—by leveraging business models such as resale, rental, and repair—products can be kept in use for longer, hence reducing the negative impacts on biodiversity associated with: extraction of natural resources; production; processing; and disposal. A preowned purchase is estimated to save ~1 kilogram of waste, ~3,000 liters of water, and 22 kilograms of CO2 compared to buying new. In addition, designing products with better fabric resistance can reduce the amount of microfibers that currently bioaccumulate with detrimental impacts on wildlife. The potential extends to the other sectors as well. For example, recycled plastics reduce the environmental impact by ~50% to 75% relative to their virgin counterparts, measured by water consumption, solid waste, acidification, and eutrophication. And the adoption of circular business models holds the potential to reduce the share of microplastics ending up in oceans.

Exhibit 7 | The circular economy holds potential to tackle some of the most significant environmental challenges of our time

Sources: Circular economy literature review; BCG analysis.

45. Ibid
49. WBCSD and BCG, A “Paris Agreement” for Recycling the Earth’s Resources (2022)
To capture the economic and environmental benefits of the circular economy, companies need a robust approach to circular economy strategy creation. CIRCelligence by BCG provides exactly that. CIRCelligence enables companies to embed the circular economy mindset into their core business, moving beyond isolated circular activities that have little economic and environmental impact, and to start anchoring circular economy concepts into their corporate strategies to achieve superior financial results. The framework provides a comprehensive and holistic perspective that enables top management to identify key value drivers and embed circular strategies within the whole company, from executive steering to final implementation.
CIRCelligence helps make circularity an integral part of the larger corporate strategy through three main steps. First, CIRCelligence creates the required transparency for top management to understand existing competitive advantages and potential gaps by quantifying the company circularity baseline across the value circle. Second, the circularity ambition level and required activities, including governance setup, are developed based on analysis and simulations of different circular economy scenarios. Third, CIRCelligence is applied to measure performance and track progress toward circularity goals on key circularity metrics. Moreover, CIRCelligence can be used for comprehensive internal and external stakeholder communication. Each of the three steps in the strategy development process is outlined below.

Exhibit 8 | CIRCelligence enables the development of holistic circular economy strategies through a robust, fact-based approach

**Measure circularity baseline**
Build transparency on the company’s share of circularity along the full value circle (input, product design, production, business models, end of life)

**Assess company readiness**
Assess degree of circular thinking, decision-making, and tools in each value circle step, in the business as a whole, and in its collaborations

**Define initiatives**
Identify key levers for improvement and develop a list of initiatives to improve company circularity

**Simulate & quantify impact**
Simulate the achievable circularity improvement by estimating the impact of each initiative on company baseline

**Holistic circular economy company strategy**
Based on value-driven and fact-based decisions and actions

**Prioritize & implement**
Define action plan to implement prioritized initiatives and periodically track progress

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**Strategy creation phase 1: Create transparency to understand a company’s circularity status quo**

To evaluate a company’s circularity status quo, CIRCelligence uses its proprietary CIRCelligence calculator. Through a customizable web-based survey, BCG collects answers to approximately 50 quantitative questions, with up to 2,500 data points, and 100 qualitative questions. The data is used to generate insights about the type of resources flowing into the company (inflow), the duration of the resource use (slow flow), and the type of resources flowing out at the end-of-life (outflow) phase as well as qualitative aspects to assess the degree of circular thinking within the company.

The extensive data gathering and analysis generates valuable quantitative and qualitative insights, allowing top management to make strategic choices and evaluate both the cost and business case implications of selected initiatives. Based on the gathered data, the CIRCelligence calculator generates quantitative and qualitative circularity scores for each value cycle step and business function. (See exhibit 9.) Quantitative results are displayed using a scale from 0% to 100% to demonstrate the theoretical ideal of 100% circularity. Both mass-based and value-based scores are derived from the analysis. This approach enables a quantified breakdown of a company’s circularity baseline into its component parts and a qualitative understanding of the factors driving the current circularity level.
Hard facts about a company’s circularity baseline via quantitative scores

Soft facts about governance and tools captured via quantitative survey

Quantitative scores measure the company’s circularity level for each step of the value cycle, enabling full transparency in circularity performance, gaps, and competitive advantages.

Qualitative scores reflect the governance, current efforts, and tool maturity to manage circularity. The score helps distinguish coincidental from intentional circularity.

Strategy creation phase 2: Set ambition level and develop an actionable roadmap

To develop an actionable roadmap that companies can use to improve their circularity mindset, BCG identifies and assesses the root causes behind specific circularity scores. The CIRCelligence calculator uses various “lenses” to evaluate the performance at different levels, such as product, product component, packaging, divisional, or company-wide. The flexibility of these lenses helps uncover the reasons behind specific circularity scores and identify possible solutions at an operational level. By analyzing the reasons behind the scores, BCG can help companies set realistic yet ambitious circularity goals that will satisfy stakeholders.

Based on a company’s specific ambition level, BCG evaluates the universe of possible circular initiatives that the company could consider to help reach future circularity goals while creating shareholder value. Leveraging both basic insights and deeper analysis, CIRCelligence identifies actions that are likely to produce quick wins, as well as strategic initiatives that could provide competitive advantage for the company over a longer timeline. Additionally, once the tool is set up, it can be used to simulate different improvement measures and evaluate potential future scenarios. (See exhibit 10.)

Circularity is just one factor that top executives should consider, alongside, for example, cost and technical feasibility, when making strategic decisions. The insights also support the company in determining where to focus its resources and attention to maximize the return on investment of circularity projects from both an economic and an environmental perspective. Executives can leverage BCG’s cost-benefit assessments to prioritize circularity initiatives and identify those that are likely to have the greatest beneficial economic impact for the company with the fewest trade-offs.
Strategy creation phase 3: Set up governance model and measure circularity performance

After prioritizing, BCG supports the implementation and provides a complete steering mechanism by setting out clear KPIs for a company to use at different organizational levels. These KPIs give the company a better chance of achieving success with high-priority circularity initiatives and further simplify the communication of progress on circularity in a clear and measurable way to various stakeholders, including investors, consumers, and governments. The CIRCelligence framework converts the circular economy into measurable and manageable units. By using CIRCelligence as a powerful communications tool, companies can demonstrate their future ambition level, share the success of their strategic circularity initiatives, and gain economic rewards from stakeholders who value such forward-looking behavior.

Ultimately, CIRCelligence provides the foundation for a company’s circular economy journey by measuring baseline performance, setting a future ambition level based on key strategic decisions, providing actionable recommendations on how a company can create the most value through circular initiatives, and supporting the implementation of these initiatives through: measurable goals; KPIs; and steering.

Exhibit 10 | Through scenario simulations, CIRCelligence estimates the optimal pathway to reach the desired circularity level

<table>
<thead>
<tr>
<th>Circularity component</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
<th>Scenario 4</th>
<th>Scenario 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total score</td>
<td>33%</td>
<td>43%</td>
<td>53%</td>
<td>63%</td>
<td>73%</td>
</tr>
<tr>
<td>Input</td>
<td>35%</td>
<td>45%</td>
<td>55%</td>
<td>65%</td>
<td>75%</td>
</tr>
<tr>
<td>Product design</td>
<td>25%</td>
<td>35%</td>
<td>45%</td>
<td>55%</td>
<td>65%</td>
</tr>
<tr>
<td>Production</td>
<td>50%</td>
<td>60%</td>
<td>70%</td>
<td>80%</td>
<td>90%</td>
</tr>
<tr>
<td>Business model</td>
<td>25%</td>
<td>35%</td>
<td>45%</td>
<td>55%</td>
<td>65%</td>
</tr>
<tr>
<td>End of life</td>
<td>30%</td>
<td>40%</td>
<td>50%</td>
<td>60%</td>
<td>70%</td>
</tr>
</tbody>
</table>
Hilti: Taking leadership position and identifying levers with highest potential

Hilti is a Liechtenstein-based supplier of technology to the global construction industry. To advance its sustainability performance and impact, the company wanted to leverage circular economy business opportunities.

CIRCelligence by BCG helped Hilti understand its current circularity performance and identify a set of initiatives at the product, business model, and company-wide levels that are most likely to provide both significant economic and environmental benefits.

The CIRCelligence methodology demonstrated that Hilti already performs strongly on multiple circularity dimensions such as its service offering with industry-leading repair services and Fleet Management, and the share of recycled input material used. To further strengthen Hilti’s position as an industry leader, BCG recommended that the company build on this performance by setting realistic and quantified ambition levels for circularity, communicating its ambitions externally, and working toward achieving them through concrete initiatives:

Product level

CIRCelligence identified the product groups with the highest potential for circularity improvements due to their design and material specifications. This allowed Hilti to focus on the initiatives with the highest possible impacts and translate the momentum for circularity within the company into a competitive advantage.

Business model level

CIRCelligence illustrated how Hilti can build upon its existing Fleet Management service, as it is a unique advantage and a driver for a high circularity score.

Company-wide level

CIRCelligence identified concrete initiatives that Hilti could use to leverage its existing circularity performance, make its entire product portfolio more circular, and embed circular thinking more deeply into the company’s processes.

Hilti continues to use the CIRCelligence methodology and calculator as part of its annual reporting to consistently measure and communicate its progress toward its circularity goals. The approach also supports the company in continuously qualifying, quantifying, and tracking potential circularity opportunities to remain an industry leader on circular business practices.
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