

CIRCULAR ECONOMY IN THE INDUSTRIAL GOODS SECTOR

A FRAMEWORK FOR UNDERSTANDING PRIVATE SECTOR PROGRESS AND INNOVATION

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Introduction

A circular economy is an economic system “fundamentally based on closing the loops around systems of extraction, production, and consumption.”¹ Individual participants in a circular economy reduce, reuse, and recycle. They strive to consume less. They minimize waste, especially by producing and using longer-lasting goods that do not need to be replaced often. And as much as possible, they recycle goods that can no longer be used back into the production loop, minimizing the need to extract new resources and materials from the natural world.² Some definitions of a circular economy also emphasize the idea of minimizing harm to the natural environment and taking meaningful actions to restore it.³

Since the idea of a circular economy describes an entire economic system, it is not primarily framed around the specific, near-term behavior of individual companies within the existing economy. No complex business can attain perfect circularity within the context of our emphatically non-circular global economy. Systemic progress towards a circular economy would require strong and coherent government action in the form of regulation, support and incentives. State action would ultimately need to shape the behavior of actors across the entire breadth of the economy.

The literature details more comprehensive and detailed visions of circularity and the synergies between circular economy, climate and environmental goals. Generally speaking, that literature describes the larger system and not the immediate steps companies should take to align with and support progress towards a more circular economy.⁴ However, individual companies can take meaningful steps forward, both alone and in collaboration with others. This paper contributes to a wider understanding of what such efforts look like in practice by studying the circular economy goals, efforts and claims of about 50 companies across the industrial goods sector. It breaks down essential elements of circular economy innovation and good practice into five distinct categories of company action—outlined below—and describes practical examples of each based on companies’ publicly-articulated claims.

The universe of companies this research examined is described in the appendix. They are not, in any sense, a representative sample. Rather, they are a diverse cross-section of industrial goods companies that span a broad range of sizes, geographies and product lines. The paper examines the circular economy efforts of these firms in order to put forward strong examples of what leading and/or innovative practices look like in the industrial goods sector. It does not seek to imply that the companies used as examples are more or less successful than peer companies that may be pursuing similar initiatives. Nor does it assess the degree to which companies’ efforts are sincere or successful. In other words, the paper seeks to describe actual state-of-the-art practices that industrial goods companies have embraced or say they are working towards, but not to assess the performance of any particular company relative to others. When we describe “company practices,” it should be understood to mean “practices companies claim to have adopted.” The examples cited should be taken primarily as a tool to help understand, more concretely, what comparable companies might reasonably strive to accomplish.

1 Oxford Institute for Energy Studies, [Beyond Energy: Incentivizing Decarbonization Through the Circular Economy](#), 2021.

2 See, for example, Julian Kirchherr, Denise Rike, and Marko Hekkart, [Conceptualizing the circular economy: An analysis of 114 definitions](#) (2017) and OECD, [The Circular Economy in Cities and regions: Synthesis Report](#) (2020). Some of the more interesting and pragmatic efforts to offer a straightforward definition of the circular economy ideal include the work of [Circle Economy](#), the [Ellen MacArthur Foundation](#), the US [National Institute of Science and Technology](#), and [Goldman Sachs](#).

3 The Ellen MacArthur Foundation, for example, [describes](#) the circular economy as “a system where materials never become waste and nature is regenerated. In a circular economy, products and materials are kept in circulation through processes like maintenance, reuse, refurbishment, remanufacture, recycling, and composting. The circular economy tackles climate change and other global challenges, like biodiversity loss, waste, and pollution, by decoupling economic activity from the consumption of finite resources.”

4 See *supra* 2.

For the purposes of this paper, CCSI embraced an expansive definition of “industrial goods companies.” Here, the term should be understood to include firms that produce goods that are either used as components in other products or construction processes, or deployed in the service of other manufacturing processes. From a circular economy perspective, the particular challenge of this sector is that industrial goods firms often have no direct contact with the ultimate end user of the product their own goods help make possible. This makes it harder to undertake efforts to encourage the reuse or recycling of the goods they produce, for example. In many other respects, industrial goods companies are similarly situated to other kinds of manufacturers when it comes to circular economy imperatives and opportunities.

This report was commissioned by Stewart Investors, a long-term investor that looks to drive sustainable development progress through its portfolio. Stewart Investors’ approach to stewardship includes engagement with portfolio companies on key issues of mutual interest around sustainability performance. This report provides a framework to assess the circular economy performance of industrial goods companies broadly, and was also used to support a separate assessment of the circular economy performance of several companies across Stewart Investors’ portfolio.

Our analysis describes company claims of good circularity practices across five key areas:

- 1) Circular design and production.** This includes a company’s efforts to design products for greater longevity as well as ease of repair, retrofitting and recycling. It also includes a company’s efforts to reduce the volume of materials needed for production, eliminate waste, and utilize recycled and/or regenerative materials in all production processes.
- 2) Facilitating life extension and recycling of company products.** This goes beyond the question of design, to consider a company’s practical efforts to facilitate the actual repair, refurbishment, reuse or recycling of its products by direct customers or other end users.
- 3) Direct collaboration with other firms.** Some companies are collaborating to achieve circular economy gains, and in some cases to develop and pilot new circularity approaches. Particularly relevant to the industrial goods sector, this includes a company’s efforts to achieve better circularity outcomes with regard to an ultimate end product it produces only some components of.
- 4) Standard setting and policy engagement.** This speaks to a company’s efforts to contribute to wider, societal progress towards a more circular economy. This includes a company’s participation in effective multi-stakeholder collaborations and its posture towards lobbying around law and regulation that aims to advance circularity goals.
- 5) Public reporting.** This includes a company’s steps to publicly articulate ambitious and concrete circularity goals and measure progress against those targets in a way that is credible and transparent. While less important than the substance of a company’s real-world actions, clear public reporting around circularity commitments is a useful accountability tool and contributes to the larger field’s understanding of what is possible.

Each of these key areas is described in a corresponding section below, with an emphasis on describing relevant, real-world examples across the companies we studied.

A Note About Motivation

Many companies have straightforward commercial incentives to engage in some of the circularity practices laid out in this paper. A company that touts the durability of its products or its comprehensive network of repair centers as evidence of its commitment to circularity might simply be repackaging efforts it has undertaken for business reasons. In other cases, a company's good circularity practices might partly be a function of straightforward regulatory compliance efforts in jurisdictions where legal expectations are relatively advanced, such as some EU countries or Japan.

This paper makes no effort to consider the true motivations of good circularity practices, or to screen them for purity of intent. If anything, circularity efforts that also speak to commercial incentives, consumer interest in circularity, and/or legal imperatives are the most easily replicable and scalable.

However, these larger questions of motivation do help explain the stark geographical concentration of this paper's leading practice examples among EU and, to a lesser extent, Japanese and American companies. This at least partly reflects the influence of relatively progressive state regulation as well as the presence of well-established voluntary communities of circularity practice that let companies learn from and inspire one another. On another level, it signals the central importance of larger regulatory and voluntary frameworks as a driver of circular economy progress.

Circular Design and Production

Product design and production are the most straightforward facets of good circularity practice. Broadly speaking, good practice on this front can be broken down into two categories: (1) improving the design of products in order to advance circularity imperatives; and (2) reducing material consumption and waste, including by increasing the use of recycled materials in production processes.

Improving Product Design

Key elements of good circular design practice include the following:

- ▶ Improving product designs so that their production requires fewer resources.
- ▶ Improving product designs so that they use less energy.
- ▶ Designing products that last longer.
- ▶ Designing products that can more easily be repaired, retrofitted, or refurbished. This includes a deliberate rejection of planned obsolescence.
- ▶ Designing products that are more recyclable and, where possible, entirely recyclable.

Circular design is an area of rapid progress and learning. Many leading companies are helping to set the pace of technological change. Many invest heavily in research and innovation. Not all firms have the capacity to lead in this way, however, and firms that engage in more pedestrian efforts to incorporate good practices set by others also deserve recognition.

Examples of relevant company practices include the following:

Siemens Gamesa is a Spanish wind power company that is majority owned by Siemens. In 2022, it launched the world's first [fully recyclable wind turbine blade](#). The company has also set a goal of developing wind turbines that are fully recyclable by 2040. This is a key circularity imperative because existing wind turbines have many components that are not recyclable at end of life.

Eaton Corporation is an American-Irish manufacturer of power management systems, headquartered in Dublin. As part of its circularity commitments, the company is working to develop new solutions for second-life batteries. This entails refurbishing batteries to extend their lifespan before they need to be recycled or discarded. The company's [xStorage Home battery systems](#) repurpose second-life Nissan Leaf car batteries as power storage systems for households.

Daikin Industries is a Japanese company that is the world's largest manufacturer of air conditioners. It has established [13 assessment criteria](#) around environmentally conscious design, and commits that all of its commercialized products will demonstrate tangible progress against those criteria over time. Several of these center circular design imperatives, including: improved product durability; greater ease of repair; increased use of recyclable plastics; and increased proportion of recyclable or otherwise reusable materials.

ESAB is a manufacturer of welding equipment, originally Swedish but now American-owned. The company [touts as a circularity success](#) its redesign of a welding wire drum so that it can hold 22 percent more wire; the redesign also facilitates better targeting and less waste during the welding process. This is included as an example of how relatively modest product innovations can yield relevant (if not exceedingly ambitious) circularity gains that dovetail with goals around [marketing](#) and consumer value. The company has also committed to the “substantial use” of recycled steel in its manufacturing processes.

Delta Electronics is a Taiwan-based company that is a major producer of power and thermal management systems, and has significant businesses in automation and infrastructure as well. Delta Electronics has only recently taken up the broad goal of circular product design, but appears to be making a methodical effort. It is taking a “staged approach” to setting design goals, methodologies and metrics. In 2021 and 2022, the company selected 17 products to pilot a new “circular economy evaluation meeting” process. Through these meetings, the company discussed more than 60 potential circular economy solutions related to those products.

Reducing Material Consumption, Increasing Recycling, and Reducing Waste

Key elements of good company efforts to reduce the material and waste footprints of their products include the following:

- ▶ Setting up systems to track the material intensity of production, including the proportion of recycled materials used, and identifying opportunities for improvement.
- ▶ Adopting ambitious commitments around waste generation. Some firms have committed to achieving zero waste to landfill by specified dates. However, leading companies are defined less by targets and more by strong, ongoing progress towards waste reduction that is measurable and reported.
- ▶ Increasing the proportion of recycled materials used in production processes.
- ▶ Reducing the material intensity of and the amount of waste generated by product packaging. Leading firms pursue these targets by making packaging more recyclable and by reducing the volume, weight and complexity of packaging.
- ▶ Exercising influence or leverage over suppliers or authorized manufacturers, to require or incentivize better circularity practices.

Examples of relevant practice include the following:

Carrier is a leading American manufacturer of HVAC equipment. The company aims to minimize the material intensity of its products and has set up a system to track relative improvements in material intensity over time. It is also working to create “material passports” for all of its products. These passports track the material composition of every product and are used to target and track efforts to increase the proportion of recycled materials used in a given product’s manufacture. Carrier also [requires](#) all manufacturers of its products to implement a range of practices designed to reduce waste associated with production over time.

Mitsubishi Electric is a Japanese company that manufactures electrical equipment as well as electronic goods. The company operates a recycling plant in Ichikawa City and feeds data from that plant back into its product design process. The company says this has allowed it to improve the recyclability of its product designs. The plant also breaks recycled products down into reusable plastics and Mitsubishi Electric claims that innovation has allowed it to increase the plant’s recycling of plastics [from 6 to 80 percent](#). Some of those recycled plastics are then fed back into Mitsubishi Electric’s own production processes.

Elgi Equipments is an Indian firm that primarily manufactures air compressors. The company has [set a target](#) of zero waste to landfill by 2027. It claims that it recycles some 70 percent of the waste scrap generated through its production processes, and 72 percent of its foundry sand waste into bricks used in construction.

Ansaldo Energia is an Italian company that produces thermoelectric power plants, turbines and other related products. The company has adopted a policy of requiring suppliers of various raw materials to continuously increase the average proportion of secondary or recycled materials sold to Ansaldo. The company asserts that up to 95 percent of the steel it uses in production is now secondary material, along with 50 percent of its purchased cast iron.

BASF SE is a German chemical company that produces industrial goods including fluids used in construction. The company works with partners who transform plastic waste into pyrolysis oil, which the company then uses to produce feedstock.

Tata Steel is a leading Indian manufacturer of steel. The company has established a facility to weather [slag that is a byproduct of steel](#) production so it can be used in [road construction](#) and other products. The company asserts that this weathered slag has been used in construction and maintenance of national highways and achieved market acceptance for other applications as well.

Doosan Fuel Cell is a leading Korean manufacturer of fuel cells. The firm has developed processes to extract and reuse raw materials from fuel cells, including platinum, graphite and nonferrous metal. It has also replaced several components classified as harmful with substitute, non-harmful materials.

Facilitating Life Extension and Recycling of Company Products

Industrial goods companies can take steps to ensure that their products are not only circular in theory, but that this potential translates into reality after the products leave their control. Good practice on this front is clustered around two broad themes: (1) steps companies can take to help prolong the life of their products and (2) steps companies can take to facilitate end users' recycling of products that might otherwise become waste.

Prolonging Product Life

Some companies set up programs to ensure that opportunities to repair, reuse or refurbish their products are accessible and widely utilized in practice. Good practices include the following:

- ▶ Setting up centers customers or other end users can use to repair or refurbish products.
- ▶ Offering modular replacement services that allow customers to replace particular components of a product with upgraded modules, rather than replacing the entire product with a new model.
- ▶ Allowing customers to turn in products that are no longer functional and exchange them for refurbished units for free or at reduced cost.
- ▶ Setting up programs that collect products customers would otherwise discard even though they are still functional. These programs then facilitate the products' re-sale to other buyers, giving them a second life.
- ▶ Collaborating directly with customers to advance circularity outcomes, or encouraging customers to make decisions that advance circularity goals.

Examples of relevant practices include the following:

Fronius is an Austrian company that manufactures welding equipment as well as solar and battery technology. It operates repair centers where any of its products can be brought for repair. These centers can also replace defective parts of any product with original spare parts.

Hilti Corporation is a Liechtensteinian manufacturer of tools and other products mainly used in construction and building maintenance. Hilti maintains about 70 repair centers all over the world. It also uses these centers to facilitate a reuse program that allows customers to use tools that an original user has no further use for.

Schneider Electric is a French company that specializes in digital automation and energy management. The company's **EcoFit** program provides modular replacements and upgrades for a wide range of electrical, cooling, critical power and automation products. Explicitly framed as a circularity effort, the program estimates that it reduces waste by about 90 percent relative to a scenario where a customer replaced the entire product rather than a single component. The program also offers monitoring and repair services, extending overall product life by roughly 25 percent on average.

Ingersoll Rand is a US-based company that manufactures compressors, power tools and lifting/material handling systems. **Nash**, an Ingersoll Rand subsidiary that makes vacuum pumps and compressors, allows customers to exchange units that are losing performance

for identical, refurbished units for a fraction of the price of a new unit. Refurbished units are guaranteed under warranty to perform 95 percent as well as a new unit.

In Brazil, [Siemens Energy](#) is piloting an initiative, called Desapega, that provides a platform for customers to re-sell or give away products that would otherwise be sent for disposal.

[FANUC](#) is a Japan-based industrial robotics company that creates products that enable factory automation, such as computer numerical control (CNC) systems, servo-motors, and laser oscillators. It employs a “lifetime maintenance strategy” that guarantees all products will receive available maintenance and repair, even for models no longer in production. FANUC collects deteriorated parts that can be overhauled for reuse, digitizes old product manuals, and provides services at repair facilities in more than 100 countries.

Facilitating Collection and Recycling

Some companies make efforts to facilitate the collection and recycling of products that would otherwise face disposal. These include the following:

- ▶ Setting up buy-back programs or other systems to incentivize collection of obsolete products and ensure that their components are recycled.
- ▶ Direct operation of, or partnerships with, recycling facilities that keep collected products within a company’s own production loop.
- ▶ Piloting new approaches or technologies that look to create new avenues for the recycling of their products.

Examples of relevant practices include the following:

[Daikin Industries](#) is a Japanese company and the world’s largest manufacturer of air conditioners. The company instituted a circular economy priority of establishing systems for the [recovery and reclaiming of refrigerants](#). It is working to establish a [service in Europe](#) for the collection and recycling of refrigerants. This began with the establishment of a refrigerant reclamation facility in Germany, with plans for expansion across the rest of the EU. The company has a range of other programs that facilitate the reclamation and reuse or destruction of refrigerants in Japan and elsewhere.

[Hilti Corporation](#) has developed a global reverse logistics operation that offers [free collection](#) of used tools worldwide, which are then recycled.

[LG Electronics](#) is a leading Korean manufacturer of a wide range of consumer electronics, appliances and other goods. It operates a [state-of-the-art recycling facility](#) in South Korea’s Hamyang County, which collects a wide range of LG appliances that would otherwise be discarded, breaks them down and then recycles much of the resulting material back into LG’s own production processes. LG also has a global [take-back and recycling service](#) that is tailored to the regulatory requirements in jurisdictions that require such efforts, but also offers voluntary programs in some other jurisdictions with no such legal requirements.

[Fronius](#) not only operates a network of repair centers for its products (as noted above), but also uses those centers to collect products that cannot be repaired and pass them on to recyclers.

[Grundfos](#) is a Danish company primarily engaged in the manufacture of water pumps. The company has a long-running [Take Back program](#) that it casts as part of a larger effort to “make circularity an integrated part of the way [they] work.” The company actively seeks new recycling and reuse partnerships with customers, and dedicates resources to improving the integration of parts recovered through the program into its manufacturing processes. The program is primarily focused on recycling and reusing the rotors from used water pumps, but Grundfos hopes to expand it to other components in the years to come.

Collaboration with Other Companies

Some companies collaborate directly with one another to develop and pilot new circularity approaches that create synergies between their businesses and hold wider promise for the economy as a whole. The imperative to collaborate is particularly compelling when it comes to industrial goods companies, which often produce goods that are incorporated into other products, by other companies.

Promising approaches include the following:

- ▶ Partnering with individual suppliers or customers to make tangible progress towards a closed-loop production process.
- ▶ Deliberately partnering with unconventional suppliers in order to realize circularity gains.
- ▶ Partnering with firms that are able to take and recycle material byproducts of a company's manufacturing processes, in order to then feed that recycled material back into the production loop.
- ▶ Partnering with other, similarly situated firms to develop new circularity approaches that require investment or expertise beyond the capabilities of one firm alone.

Practical examples of these practices include the following:

Salzglitter AG is a German company and one of Europe's largest producers of steel and of various steel components. In 2022, it launched a [circularity partnership](#) with Orsted, a Danish company that constructs wind farms. Among other things, the partnership allows Salzglitter to (a) sell steel to Orsted and then (b) feed recycled scrap from decommissioned Orsted wind turbines back into its steel production process. In this way, the two companies are building a more closed loop production system between them.

Tenaris is a Luxembourg-based company that primarily manufactures steel pipes and provides services ancillary to their delivery and installation. The company has assembled a coalition that includes other steel companies to design, build and pilot two innovative new smelting and reduction [demonstration plants](#). These plants aim to allow for the useful recovery of more metals and minerals from steelmaking residue.

Ariston Group is an Italian company that produces heating systems and related products. The company sells steel scrap byproducts from its own production processes to several steel companies, buys them back as processed steel and uses that steel on its production line. It sees this effort as key to its larger efforts to "[close the loop on steel](#)."

Fronius engaged in a long-term partnership with the Muller-Guttenbrunn Group, an Austrian recycling company. A key goal was to improve the recyclability of one of its key products, inverters for photovoltaic systems. This partnership entailed a [long-term collaboration](#) and information exchange between the research departments of both companies. The conclusions then fed into Fronius' design process. This included a finding that given tradeoffs between recyclability and durability with regard to certain product components, the larger goal of circularity could be better advanced by focusing on lifespan rather than maximum recyclability with regard to those components.

Rockwell Automation is an American company that manufactures industrial automation

control systems as well as power management equipment. It developed a [sustainability calculator](#) customers can use to precisely calculate the gains in terms of energy, waste, water and greenhouse gas emissions if they opt to repair any given automation component, rather than replace it with a new one. The goal is to make it easier for customers to justify repair over replacement by providing metrics that benefit those customers' overall sustainability efforts.

As noted above, the **Eaton Corporation** [partnered with Nissan](#) to repurpose second-life Nissan Leaf car batteries as power storage systems for households.

Cero Recycling is a joint venture between Mahindra Accelo and MSTC Ltd., in India. Cero recycles end-of-life automobiles and sells their components back into industrial supply chains. Cero aims to “[bring hassle-free vehicle recycling experience to every doorstep](#)” and to this end it has opened 22 recycling centers across India, with plans for 14 more.

Inovance Technology is a leading Chinese industrial automation company with a strong focus on robotics. Inovance Technology has proposed a new model that would see them lease rather than sell industrial robots to customers. The idea is that under this model, Inovance would service, repair and upgrade these robots and would continue to own them. This thinking is largely driven by business considerations (the new model would guarantee a more stable revenue stream). However, Inovance believes that it could result in important circularity gains because it could keep robots in service for “decades” through careful maintenance and modular upgrades. This approach is still at the idea stage, but it is a novel and innovative effort worth being cognizant of.

Bosch is a German engineering and technology company that produces a range of industrial goods from servo motors to heating systems. Bosch participates in the [Power for All Alliance](#) with [ten other companies](#). The partner companies collaborate to produce a single battery that can be used across all of their tools and equipment. This creates direct circularity gains by freeing customers from the need to purchase multiple batteries if they use more than one company's product line.

Standard Setting and Policy Engagement

Ultimately, real progress towards a more circular economy requires coordinated, economy-wide changes— not just innovation and progress at the level of individual companies and their particular value chains. Leading companies recognize a responsibility not just to strive towards best practices in their own operations, but to contribute towards systemic, societal progress. Good practice in this area can be broken down across two general themes: (i) participation in multistakeholder forums that aim to drive wider, collective progress; and (ii) deliberate efforts to support legal and regulatory frameworks that are likely to advance circularity imperatives.

Multistakeholder Efforts

Many companies have joined broad, inclusive forums that seek to advance good circularity practices across particular geographical regions, economic sectors or more broadly. Some of these include a wide array of stakeholder groups, putting companies alongside civil society representatives, policymakers or others to develop common goals and standards, create healthy competition towards better practices, and map out essential steps towards wider societal progress.

Other companies have joined multistakeholder platforms that are focused on climate or other issues that may offer synergies with good circularity practices. Notable examples of such platforms include the following:

[The Ellen MacArthur Foundation](#) is among the most respected nonprofit organizations working to advance the wider goal of a circular economy. The Foundation has created a sprawling [network](#) of thousands of organizations that support the goal of a circular economy. The network has a tiered approach to membership. Almost any organization or company can join this “community,” but the Network’s [formal members](#) consist of about 250 organizations, companies, city governments and other entities who the Foundation sees as genuine leaders in the circularity space. Of the client portfolio companies analyzed in connection with this research, only one is a [member](#). The Foundation makes decisions about access to different tiers of membership based on “factors such as organization size, influence, ambition level, and involvement with our key areas of focus.” Formal members include several leading companies in the industrial goods sector.

[The ASEAN Circular Economy Stakeholder Platform](#) was created in 2018 under the auspices of the [EU-ASEAN partnership on Circular Economy](#). The platform serves as a repository of good practice and as a platform for dialogue across business, government and civil society lines in ASEAN states.

[Textiles 2030](#) is an initiative of the UK organization [WRAP](#). It aims to “harnes[s] the knowledge and expertise of UK leaders in sustainability to accelerate the UK fashion and textiles industry towards a circular economy.” It offers a platform for UK companies to collaborate at varying levels of commitment, but all signatories commit themselves to pursue a set of [concrete circular economy goals](#). The group’s members work on plans to facilitate economy-wide progress towards a more circular economy, and WRAP also maintains a “[knowledge bank](#)” of resources useful to those efforts.

[The European Circular Economy Stakeholder Platform \(ECESP\)](#) is a joint initiative of the European Commission and the European Economic and Social Committee. It convenes businesses, governments and civil society actors for discussions around better circularity practices, and it helps drive European Commission efforts to identify circular economy [targets](#).

[The Science Based Targets Initiative \(SBTi\)](#) is an initiative that provides a clear pathway for the reduction of corporate greenhouse gas emissions in line with Paris Agreement goals. While not at all aimed at circular economy outcomes, it carries significant, mutually-reinforcing synergies with good circularity practices. In particular, SBTi requires companies with significant scope 3 emissions to articulate acceptable plans for their reduction over time.⁵ [Acceptable scope 3 targets](#) can include strategies to (1) influence the behavior of end-users, (2) drive the adoption of science-based targets by its customers, (3) shift practices related to the extraction and production of purchased materials, (4) modify the ways in which purchased materials or goods, sold products, and waste are transported, and (5) alter business practices with regard to the disposal of waste and sold products at the end of their life, among others. These strategies line up remarkably well with many of the good circularity practices described above.

[The Platform for Accelerating the Circular Economy \(PACE\)](#) is a collaborative multistakeholder platform whose [members](#) collaborate to identify avenues of progress on key circular economy issues, including a focus on particular sectors as well as an emphasis on the theme of integrating climate and circular economy goals. The organization also provides guidance on good [metrics](#) relevant to circular economy practices.

Constructive Policy Engagement

Any company committed to circularity practices should ensure that its direct lobbying and any other efforts to influence policy discourse and thinking are consistent with the need for wider societal progress towards circularity. At a minimum, this means that companies should not adopt postures of blanket opposition to new, circularity-positive regulation. They should also report transparently on any lobbying activity around circularity-relevant law and regulation.

Leading companies have gone further than this “do no harm” approach to lobbying, however. They are proactively engaged in the work of thinking through and supporting models of good, pragmatic government policy.⁶

Practical examples of this kind of constructive policy engagement include the following:

[Salzgitter AG](#) is a German company and one of Europe’s largest producers of steel and steel components, such as steel tubes. The company has rolled out an [initiative to produce low-carbon steel](#). In tandem with this, the company has lobbied “at all political levels” in favor of regulations that will help push the entire sector towards lower-carbon steel production.

[Schneider Electric](#) chairs an [EU-wide initiative](#) to develop voluntary standards around circular product design. The initiative is a joint committee set up under the auspices of the European Committee for Standardization ([CEN](#)) and the European Committee for Electrotechnical Standardization ([CENELEC](#)), two EU-wide bodies that work towards the creation of pan-European standards across a wide range of issues and sectors. The coordination group chaired by Schneider Electric has “developed a set of published standards assessing factors such as durability, reparability, reusability, recyclability, and ability to be remanufactured, which fall within the scope of the [EU’s] [EcoDesign directive](#) and the new Ecodesign for Sustainable Product Regulation.”

5 In its [criteria](#), SBTi requires companies to set a scope 3 target if a company’s relevant scope 3 emissions are 40 percent or more of total scope 1, 2, and 3 emissions and that those targets align with a level of decarbonization that keeps the global temperature increase well below 2°C compared to pre-industrial temperatures.

6 There is no consensus view on what an ethical or responsible approach to corporate political engagement looks like. One recent and useful attempt at such a framework is the Erb Principles for Corporate Political Responsibility. The Erb Principles ask companies to commit to an approach that focuses not only on the nature of political engagement, but on whether companies have an “authentic basis” for engaging in efforts to influence public policy in the first place.

Bosch publicly articulates a clear [principled position](#) on lobbying, whereby it “supports political framework conditions that are conducive to innovation and endeavors to find possible solutions for the challenges facing society.” The company also commits to transparency regarding its lobbying activities, and publishes [detailed information](#) about its specific lobbying interventions. It also engages in regular stakeholder dialogue with “policymakers, NGOs and interested members of the public.”

Siemens Energy reports that it engages regularly with a variety of external partners to analyze new regulations and standards and assess their importance to the company. This extends beyond simply taking positions for or against new law and regulation. For example, the company participated in the German Federal Government’s Sustainable Finance Advisory Committee to support government efforts to make Germany into a leading global hub of sustainable finance.

It is also worth noting that an increasing number of global firms, particularly in Europe, are subject to laws that mandate various dimensions of responsible business practice. Some of these, such as Germany’s [Supply Chain Due Diligence Act](#), Norway’s [Transparency Act](#), and the United States’ [Foreign Corrupt Practices Act](#), have clear implications for companies’ lobbying and other interactions with foreign government officials. If these extraterritorial legal frameworks continue to gain traction, we may see a trend of companies adopting compliance-type approaches, even when they are not subject to these laws, simply because they come to represent “gold standard” models of ethical policy engagement.

Public Reporting

Quality public reporting by industrial goods companies on their circularity practices generally shares some or all of the following characteristics:

- ▶ **It articulates a clear vision of what circularity means to the business.** Circularity imperatives, challenges and opportunities are not the same across all sectors. Leading companies articulate a clear, ambitious vision of what they mean when they talk about circularity, and identify the parts of their business, production processes, etc. on which they intend to focus. On the other hand, some companies engage in good circularity practice but do not describe or think of it in those terms. Action is more important than language, but there is value in persuading such firms to explicitly embrace the circularity potential of their actions and build upon it.
- ▶ **It sets clear and meaningful goals or targets.** Leading companies describe circularity goals in detail, and those goals are not boilerplate. Rather, they reflect a clear perspective on the greatest circularity needs, challenges and opportunities facing their particular business.
- ▶ **It uses credible metrics to assess progress.** Leading companies develop metrics that credibly measure progress against circularity goals and report transparently on their progress against those metrics.⁷
- ▶ **It describes particular programs, innovations and other initiatives in detail.** Leading companies use their public reporting to describe– and often brag about– meaningful, innovative efforts to improve circularity outcomes. This allows for a clear distinction between a company that is simply setting targets for waste disposal and recycling, and a company that is deploying significant resources to make product lines more circular in potential and in practice.
- ▶ Merely integrating vague language on circularity into a larger sustainability report does not constitute good practice. However, leading companies **integrate circularity commitments into their core sustainability strategy rather than leave them siloed.**

While it is entirely feasible for a company to meet all of these reporting practices at the same time, at present leading industrial goods companies are more likely to display strong performance on only some of them.

Some examples of high-quality circularity reporting by industrial goods companies are as follows:

Bosch produces detailed and concrete [sustainability reporting](#), and circular economy goals figure prominently throughout. What particularly stands out are the detailed and carefully explained metrics, presented along with meaningful data that measure the company's progress against them. Circular economy is itself one of the company's key sustainability goals, and it reports not just on metrics but on its efforts to integrate circular economy analysis and improvement across dozens of discrete product lines and business units. The company also describes a [circular economy strategy](#) focused on three main imperatives that add up to a broad and comprehensive circular economy vision: materials efficiency, second life and recycled materials.

⁷ There are no universally accepted metrics at the cutting edge of circular economy practice, and the potential for standardization may be limited by the inherent diversity of different economic sectors and supply chains. However, the PACE initiative has produced [detailed guidance](#) on the process of developing sound circular economy KPIs and other metrics.

Hilti Corporation partnered with Boston Consulting Group and became the first company to implement the CIRCelligence method, which assigns a qualitative score across seven key overarching circularity goals. The company [reports](#) annually on its score across each goal and on whether performance improved, worsened or remained static relative to the prior year. It also reports on concrete implementation examples that illustrate what progress looks like in practice.

ABB is a Swedish-Swiss company that manufactures an array of products, including power management equipment, industrial robotics and automation technology. ABB is still developing metrics and targets but has publicly committed to a robust circularity approach across its entire business. Most importantly, it is developing “a clear set of Key Performance Indicators” that it will use to publicly evaluate circularity performance. It has pledged that 80 percent of the company’s products will be subject to clear circularity goals by 2030. That target date is far off, but the approach of using robust, transparent KPIs is worth emulating.

Daikin Industries has developed [13 assessment criteria](#) for circularity across all of the company’s products. The company’s public reporting also includes performance indicators linked to each of those criteria.

Grundfos publishes detailed [annual sustainability reports](#) that include a clear elucidation of the company’s overall approach to circular economy and detailed information on its approach to circular design, material use and facilitating reuse and recycling. The company’s overall sustainability efforts are framed around four “ambitions,” one of which is circular business. The other three are also closely aligned with circular economy goals—saving water, saving energy, and water access.

Overview: Breakdown of Companies Surveyed

The concrete examples of circular economy practices this paper puts forward are drawn from a survey of about 50 global companies' public reporting. Those companies are a fraction of a larger group of nearly 200 companies we scrutinized. The majority of those either did not produce public reporting of sufficient depth and detail to allow for a clear understanding of their circular economy approaches, or simply did not claim to be taking any steps to advance circular economy practices at all. Of the roughly 50 companies whose public reporting we examined in detail, 29 reported interesting examples of circularity practices that are described in this paper.

This is not in any sense a representative sample, and no quantitative results should be inferred from it. Nonetheless, it may be useful and informative to have some clearer sense of who these 29 companies are, how they are similar and how they are different. The chart below describes some basic facts about these firms—their estimated annual revenues and their geographical location.

The firms are striking in their relative lack of geographic diversity—of the 29 listed, 21 are based in the United States, western Europe or Japan, and all of the remaining 8 are based in either India, South Korea or Taiwan. One should be particularly cautious about drawing inferences on this basis, however. This paper's examples of interesting circular economy practices are drawn entirely from the public reporting of individual firms. For that reason, it skews naturally towards jurisdictions where there is a strong culture of, or regulatory demand for, robust public-facing sustainability reporting. In other words, this striking geographic concentration could simply reflect the emphasis companies in different countries place on robust sustainability reporting— if it signifies anything at all.

Company Name	Headquarters	Revenue 2022 (Converted from HQ Country Currency to USD, Approx.)
ABB	Switzerland	\$29.4 billion Source
Ansaldo Energia	Italy	\$1.3 billion Source
Ariston Group	Italy	\$2.6 billion Source
BASF SE	Germany	\$92.0 billion Source
Bosch	Germany	\$96.3 billion Source
Carrier	United States	\$20.4 billion Source
Daikin Industries	Japan	\$26.7 billion Source
Delta Electronics	Taiwan	\$12.7 billion Source
Doosan Fuel Cell	South Korea	\$36.9 million Source

Company Name	Headquarters	Revenue 2022 (Converted from HQ Country Currency to USD, Approx.)
Eaton Corporation	Ireland	\$20.75 billion Source
Elgi Equipments	India	\$366.8 million Source
ESAB	United States	\$2.7 billion Source
FANUC	Japan	\$5.7 billion Source
Fronius	Austria	\$391.4 million Source
Grundfos	Denmark	\$569.5 million Source
Hilti Corporation	Liechtenstein	\$7.2 billion Source
Ingersoll Rand	United States	\$5.9 billion Source
LG Electronics	South Korea	\$62.8 billion Source
Mahindra & Mahindra (Parent Company of Mahindra Accelo)	India	\$1.1 billion Source
Mitsubishi Electric	Japan	\$30.0 billion Source
MSTC Ltd	India	\$31.3 million Source
Rockwell Automation	United States	\$7.8 billion Source
Salzgitter AG	Germany	\$13.7 billion Source
Schneider Electric	France	\$37.3 billion Source
Shenzhen Inovance	China	\$2.7 billion Source
Siemens Energy	Germany	\$31.6 billion Source
Siemens Gamesa	Germany	\$10.7 billion Source
Tata Steel	India	\$29.4 billion Source
Tenaris	Luxembourg	\$11.8 billion Source

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