ECONOMIST IMPACT

Scoring Decarbonization Progress

How companies across four industries are reducing emissions

Manufacturing sector report

SUPPORTED BY Microsoft

Manufacturing

- Increasing the uptake of renewable energy and supporting R&D of low-carbon feedstocks are key decarbonization levers for chemical manufacturers, collectively among the world's largest emitters.
- Pharmaceutical manufacturers are critical players in the healthcare sector, responsible for a small but growing pool of emissions.[1] To address these proactively, manufacturers are piloting green chemistry solutions to decarbonize drug production. They now need to invest in scaling and mainstreaming these solutions to enable operational emissions reductions.
- Currently making up 2–4% of the global carbon footprint,[2] emissions from the electronics manufacturing industry are likely to grow as the demand for low-carbon technologies and solutions increases. Electronics manufacturers can take early action to manage these by placing a stronger emphasis on decarbonization-focused innovation in their operations and value chains.

Chemicals & Pharmaceuticals Manufacturing[i]

Goods and services purchased from upstream suppliers constitute the largest pool of emissions for the chemical sector. However, all chemical and pharmaceutical manufacturers assessed in our benchmark are yet to divest from their most carbon-intensive suppliers.

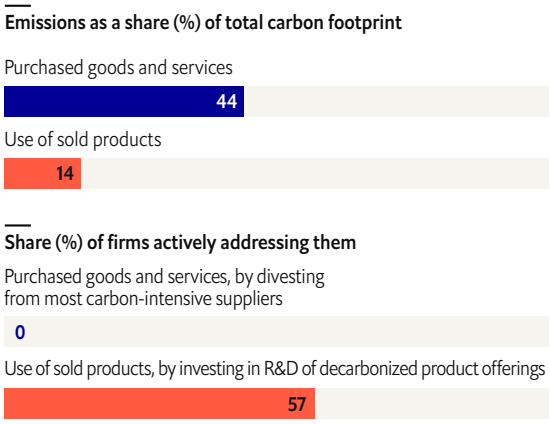
For both the chemical and pharmaceuticals industries, emissions are largely tied to the value chain, particularly purchased goods and services.[3] The chemicals industry, for example, is one of the top three emitting industries in the world,[4] with 44% of those emissions deriving from purchased goods and services.[5] While both industries span a wide variety of products, each with their own value chains and production processes, there are commonalities among chemical firms, as well as among pharmaceutical firms, when it comes to major sources of emissions and opportunities for decarbonization. For instance, in the chemicals industry, organic chemicals are typically derived from a series of basic building

i. In the Decarbonization Progress Benchmark, the Chemicals & Pharmaceuticals Manufacturing sub-sector consists of the five largest chemical, specialty and generic drug, and biotechnology manufacturers by market capitalization in North America, Latin America, Asia, and Europe. As per market capitalization data from Pitchbook (April 2023). https://my.pitchbook.com/dashboard

blocks,[ii] the production of which accounts for roughly two-thirds of the sector's energy usage.[6] Manufacturing these products generally requires carbon-based feedstocks such as coal, oil or natural gas. The use of these feedstocks, together with the need for high heat and large volumes of energy in production processes, comprises a large portion of the emissions of organic chemicals.

Firms are starting to work with upstream suppliers to encourage their decarbonization, for instance through measures such as greenhouse gas reductions embedded in supplier codes of conduct and supporting suppliers' access to renewable energy.[7] Even so, we find that all firms in the Chemicals & Pharmaceuticals Manufacturing sub-sector in the benchmark are yet to divest from their most carbon-intensive suppliers, perhaps in part because existing cleaner sources of non-renewable feedstocks can only provide so much benefit for decarbonization (see Figure 1). In addition, the current policy regime underprices fossil fuels, which is not conducive for the shift

Figure 1: Chemical manufacturers are yet to meaningfully address their largest pools of emissions



Source: CDP (2023), Economist Impact's Decarbonization Progress Benchmark (2023)

from traditional feedstocks.[8] As a result, pathways for decarbonization in the sub-sector focus largely on the use of renewable energy in production processes or the development of alternative, environmentally friendly feedstocks, including e-methanol, bio-methanol, and energy itself (for simpler hydrocarbons).[9] When it comes to energy usage, our findings show that, currently, only just under 28% of the electricity used across the sub-sector is produced from renewable energy sources.[iii] This aligns closely with the average share of renewables in the energy mix across all sub-sectors examined, as well as with the global figure.[10]

To increase their uptake of renewable energy, chemical firms can enter into power purchase agreements with renewable power generators and expand their self-generation capacity through onsite renewable installations. Developing and scaling renewable feedstock will require collective action from across the chemical manufacturing value chain and regulators. Here, chemical manufacturers can support upstream feedstock providers by investing in the research and development (R&D) low-carbon alternatives. Regulators can create market incentives by providing tax breaks or investment subsidies for piloting and scaling alternative feedstocks.[11]

Chemical manufacturers evaluated on the benchmark are lagging in researching, developing and commercializing decarbonized product offerings to manage emissions from the use of sold products. Emerging market forces are likely to pressurize firms to increase the share of such offerings in their product portfolios.

Significant emissions in this sub-sector are tied to the use of sold products. In chemical manufacturing these account for 14% of the

ii. Methanol; the olefins ethylene, propylene, and butadiene; and the aromatic compounds benzene, toluene, and xylene.

iii. Firms in the Chemicals & Pharmaceuticals Manufacturing sub-sector, on average, score 28/100 on indicator 2.4: *Operational transformation: Reducing Scope 2 emissions, which measures the share of renewables in a firm's energy mix*. Firms that do not report their renewable energy use or report using no renewable energy are scored 0 on Indicator 2.4.

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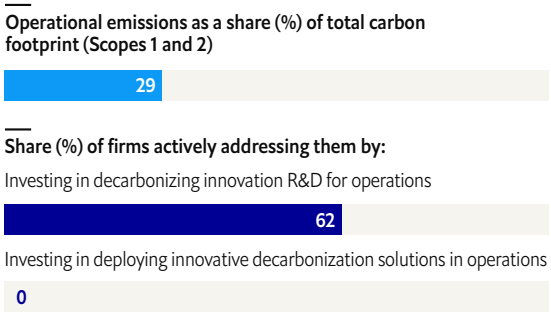
total.[12] Currently, only four out of the seven chemical firms analyzed are actively investing in R&D for decarbonized product offerings, that could reduce emissions from the use of sold products, such as bioplastics,[13] hydrogen fuel or feedstock,[14] and next-generation refrigerants (see Figure 1).[15] But all chemical manufacturers should consider diversifying their product portfolios towards decarbonized offerings in advance of shifting market demands. Some firms, such as LG Chem, are already reporting a decline in the sale of their most carbon-intensive key offerings, suggesting that producers who fail to decarbonize their products will eventually hit demand-side barriers—especially as downstream value chain partners engage in more sophisticated decarbonization efforts.[16] To address these emissions, chemical manufacturing leaders in our benchmark are beginning to conduct life-cycle assessments to measure their products' environmental impact, adopting circular product design principles and commercializing their low-carbon product offerings.[17] These steps will need to be adopted industry-wide, cross-organizationally, and at scale, however, in order to accelerate the industry's decarbonization.

Pharmaceutical manufacturers are actively investing in R&D for decarbonizing drug production. However, they are yet to apply these solutions at scale.

Pharmaceuticals constitute a smaller proportion of global emissions (about 4.4%[18]), but nonetheless also face barriers to decarbonization. Just over 60% of pharmaceutical firms that Economist Impact evaluated are already investing in R&D for decarbonizing their drug manufacturing processes through green chemistry.[iv] However, the application of green chemistry remains limited, with firms either using this synthesis process for only a select few pharmaceuticals in their product portfolio, or only at some operational sites. This limitation is reflected in a low sub-sector-wide score on *Scaling up decarbonized key product offerings* (see Figure 2).[v]

The use of drug delivery products can also be surprisingly carbon intensive. Researchers in the UK, for example, estimate that 3–4% of the entire National Health Service's emissions are tied to propellants used in metered dose inhalers.[19] Reducing the emissions from the use of these and other high-impact products through existing (such as dry powder inhalers[20]) and novel solutions should be an additional focus for pharmaceutical manufacturers (see Figure 2).

Figure 2: Pharmaceutical manufacturers are lagging in reducing their operational emissions



Source: Health Care Without Harm (2019), Economist Impact's Decarbonization Progress Benchmark (2023)

iv. A suite of solutions enabling greener manufacturing of pharmaceuticals through, for example, "green solvents (preferably water), alternative reaction media, and consideration of one-pot synthesis, multicomponent reactions (MCRs), continuous processing, and process intensification approaches for atom economy and final waste reduction." https://pubs.acs.org/doi/10.1021/acs.chemrev.1c00631#:~:text=The%20US%20EPA%20has%20defined,%2C%20use%2C%20and%20ultimate%20disposal.

v. The Chemicals & Pharmaceuticals sub-sector scores 20/100 on Indicator 3.3.2: *Scaling up decarbonized key product offerings on the Decarbonization Progress Benchmark*.

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Next steps for decarbonizing the chemicals and pharmaceuticals manufacturing industries

- **Supporting the development of new, renewable feedstocks and investing in increasing renewable energy uptake and innovative solutions for operations can drive decarbonization of chemical manufacturers.** Firms can reduce value chain emissions from purchased goods and services by investing in R&D of low-carbon feedstock alternatives. In addition to increasing their renewable energy uptake, manufacturers can integrate innovative solutions such as carbon capture, utilization, and storage (CCUS), the use of electrolytic hydrogen, and direct electrification technologies such as high-temperature heat pumps to further decarbonize operations.[21]

- **Active investment in R&D of decarbonized product offerings can allow firms to reduce Scope 3 emissions from the use of sold products.** To align with changing market demand, leaders in the sub-sector are already shifting their product portfolio to decarbonized offerings. For example, LG Chem is diversifying its product portfolio towards low-carbon alternatives such as post-consumer recycled (PCR) plastics, low-emission battery cell cathodes, and bio-balanced building materials.[22]

- **Firms should redirect investment from carbon-intensive suppliers to those committed to decarbonization so the industry can reduce its Scope 3 footprint from purchased goods and services.** Leading firms from the chemicals & pharmaceuticals manufacturing industry in the benchmark are running campaigns to educate suppliers about climate change, and are also working with them to explore corporate renewable energy sourcing options. In addition, they require network partners to set science-based emissions reduction targets through their supplier contracts.[23] Industry peers should follow suit and update their supplier codes of conduct to mandate emission reporting and setting reduction targets. Furthermore, leaders who are already engaging with suppliers that consistently deliver a sup-par performance can consider redirecting their investment to other suppliers who are making an effort to transition to a low-carbon pathway.

- **Pharmaceutical firms can unlock the decarbonizing potential of green chemistry by promoting the scaling pharmaceuticals produced via such processes.**

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Leader Case Study: AstraZeneca

AstraZeneca, the British-Swedish biopharmaceutical company, is the top performer on the decarbonization scorecard from the manufacturing sector. Among all manufacturers analyzed, the firm has made one of the most ambitious net-zero commitments. It has set out a science-based target to achieve net-zero Scope 1,2, and 3 emissions by 2045.[vi]

To deliver on its net-zero commitments, the firm is making headway in managing its operational emissions. At its core R&D sites, it is improving material efficiency in active pharmaceutical ingredient (API) syntheses and reducing its water and energy use. Notably, to conserve energy, AstraZeneca uses a Switch-off Optimisation Plan, wherein it categorizes laboratory equipment that can be turned off without significantly impacting workflows.[24] The firm is also addressing the emissions from waste generated in operations by recycling it and reducing the amount of waste sent to landfills. AstraZeneca also aims to electrify 100% of its fleet by 2025, although electric vehicles currently make up only 1.6% of its road fleet. The firm also leads its manufacturing peers in the benchmark in renewable energy uptake. As of 2021, 88% of its total electricity use came from renewable sources.[25]

AstraZeneca is also decarbonizing drug manufacturing by investing in R&D of green chemistry solutions such as cleaner and greener photocatalytic reactions, opting for more sustainable building blocks for chemical reactions, and increasing the efficiency of drug discovery processes.[26] However, the firm is yet to apply these innovative approaches to the manufacturing of the majority of pharmaceuticals in its product portfolio.

The company is ahead of most manufacturers in the benchmark in addressing its value chain emissions. To reduce the emissions footprint from the use of respiratory inhalers, it is working to commercialize next-generation near-zero global warming potential inhalers.[27] However, it is yet to effectively manage upstream emissions from purchased goods and services, which constitute 73% of its total Scope 3 footprint. AstraZeneca encourages suppliers to decarbonize operations through its Positive Sourcing Program but, as with industry peers, it has not cut ties with its most carbon-intensive value chain partners.

vi. Science-based target approved by SBTi (Science-based targets initiative).

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Electronics Manufacturing

Most electronics manufacturers in the benchmark are yet to take the very first step towards decarbonization: setting out their net-zero commitments.[vii]

The electronics manufacturing industry, on the whole, has come late to the decarbonization imperative. The annual reports of some major electronics manufacturers started to seriously address issues of sustainability and decarbonization only in 2019, and even now the sector is taking a more reactive approach to emissions reductions than others. Only 20% of firms in our benchmark have a complete action plan for operational transformation. Moreover, 65% of firms evaluated do not have any Scope 1 and 2 net-zero commitments in place, and 80% have not laid out a full commitment to net-zero value chain emissions. An estimate from McKinsey reaffirms that many major electronics manufacturers fall far short of the needed emissions reductions to meet a net-zero target in 2030.[28] Persistent global demand for electronics and a lack of policy enforcement have thus far created few incentives for meaningful long-term reductions in emissions across the full value chain.[29] However, an emerging and stringent regulatory landscape in climate-related disclosures,[30] new government incentives in large markets including the US,[31] and pressure from value chain partners and end-consumers are changing this.[32]

Value chain emissions constitute about 93% of electronics manufacturers' total carbon footprint. Most firms in the benchmark are not even taking stock of their relevant sources of emissions, let alone acting on them.

While all sub-sectors show substantial room for improvement, the Electronics Manufacturing sub-sector ranks lowest overall on the benchmark,[viii] and particularly lags in addressing its value chain emissions.[ix] 95% of the firms in the sub-sector are measuring and tracking only some relevant sources of value chain emissions, if any at all. There have been some practical barriers to tracking these emissions: limited reporting of emissions data from suppliers; bad data quality; and lack of regulatory requirements to enforce disclosure. However, corporate requirements for supplier sustainability reporting by manufacturers, and regulations such as the Corporate Sustainability Reporting Directive (CSRD) in Europe, are gradually changing the stocktaking landscape.[33] Despite an improving enabling environment, limited reporting on emissions has resulted in firms showing limited progress in areas such as developing low-carbon products, phasing out high-emitting value chain partners, and investing in related innovation.

vii. In the Decarbonization Progress Benchmark, the Electronics Manufacturing sub-sector consists of the largest five semiconductor, electronic hardware, and medical devices and instruments manufacturers by market capitalization in North America, Latin America, Asia, and Europe, per market capitalization data from Pitchbook (April 2023). https://my.pitchbook.com/dashboard

viii. The Electronics Manufacturing sub-sector receives an aggregate score of 25/100 on the Decarbonization Progress Benchmark, compared with the average aggregate score of 37/100 for all sub-sectors.

ix. The Electronics Manufacturing sub-sector scores 21/100 on Pillar 3: *Value chain transformation*, below the average score of 37/100 across all sub-sectors for this pillar.

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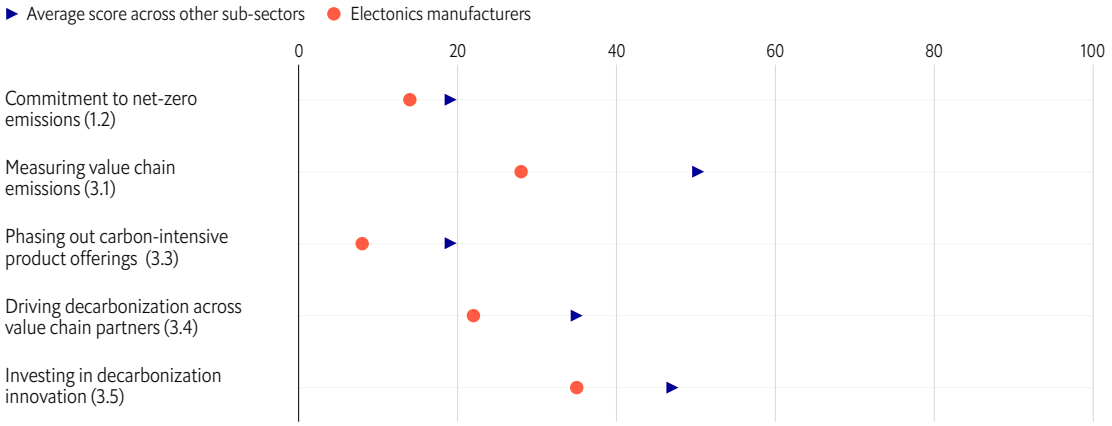
Figure 3: Electronics manufacturers should aim to catch up in decarbonizing
Score of electronic manufacturers vs all sub-sector average on the following decarbonization metrics



Source: Economist Impact's Decarbonization Progress Benchmark (2023)

Despite a relatively strong performance on *Operational transformation*, several electronics manufacturers are yet to address their PFC emissions, a key source of direct operational emissions.

As with other sectors, progress in operational emissions reduction is more advanced than progress towards value chain decarbonization, with almost all firms measuring and tracking relevant sources of operational emissions. Still, many firms that lag on Scope 1 emissions reductions have not implemented measures to curtail emissions from perfluorochemicals (PFCs) and other byproducts of manufacturing semiconductors, micro-electromechanical systems, and photovoltaic cells.[34] Given that the 100-year global warming potential of PFCs can range from 7,390 to nearly 13,300 times that of carbon dioxide,[35] reducing PFC emissions can significantly lower the Scope 1 footprint of electronics manufacturers.

A stronger emphasis on decarbonization-focused innovation could promote both operational and value chain emissions reductions.

Despite its operational emissions reduction potential, investment in innovation is particularly low among evaluated electronics manufacturers. Electronics manufacturers need to ramp up investment in decarbonizing operational R&D that allows them to gain energy, material, and water use efficiencies and reduce their Scope 1 footprint. While certain outliers in the benchmark are investing in innovations to improve water usage in wafer-cleaning tools and reducing air-conditioning burden in data centers,[36] the sub-sector as a whole delivers a weak performance on *Investment in developing decarbonizing innovation*.[x]

Innovation around decarbonized product offerings is also needed. Most firms have yet to embrace circular and sustainable product

x. The Electronics Manufacturing sub-sector scores 20/100 on Indicator 2.5.1: *Investment in developing decarbonizing innovation*, compared with the cross sub-sector average of 62/100 on the indicator.

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designs or to find ways to reduce electronic waste (generated by the short life cycles of some electronics),[37] both of which are critical for reducing the Scope 3 emissions throughout the value chain, including emissions from purchased goods and services, the use of sold products, and the end-of-life treatment of sold products.[38] For example, one study from researchers at the British Geological Survey and the University of California, Irvine, suggests that increasing the life cycle of electronic devices by 50–100% could reduce total emissions by up to half.[39]

However, achieving circularity can be tricky. According to Daniel Reid, Senior Director, Environmental and Circularity, Responsible Business Alliance, limited traceability in the recycling and recovery supply chains may sometimes deter electronics manufacturers from relying on e-waste recyclers to manage their waste and using recovered materials in production. Despite strong international and national regulations governing e-waste movement and recycling,[40] there is scope for leakages. At the end-of-product life-cycle stage, electronics often end up managed within the informal sector, typically in low- and middle-income economies for recycling, which has contributed to negative social and environmental outcomes due to a lack of oversight and regulation.[41] Similarly, at the sourcing stage, firms may be importing materials that were recycled without proper social and environmental due diligence. Digital solutions such as blockchain technology offer a way forward by allowing comprehensive, end-to-end tracking of waste flows.[42] Electronics manufacturers need to integrate innovative solutions that can help them navigate barriers of limited traceability and due diligence, and prioritize circular product design.

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Next steps for decarbonizing the electronics manufacturing industry

- **Improve corporate governance and accountability structures through a specialized sustainability committee at board level.** This requires commitment at the highest organizational levels. Executives should be empowered to oversee their organizations' decarbonization strategy and provide adequate budgets and human resource allocations for its execution.

- **Set out their net-zero commitments as a first step.** Firms can begin their journey on the decarbonization pathway by setting out their net-zero commitments and interim emission reduction milestones. To do so they need to take a comprehensive stock of their all material sources of operational and value chain emissions, including those from purchased goods and services in their upstream value chain and the downstream use of sold products. Notably, measuring value chain wide emissions will require collaboration with suppliers to ensure that they are equipped with the tools and expertise to collect accurate and granular data from all relevant pools of emissions. Firms can organize training sessions for suppliers with third-party specialists in GHG mitigation.[43] Once firms have this data, they can run Life Cycle Assessments on their portfolios to estimate total emissions generated from a particular offering across various phases from production to disposal.[44]

- **Laggards need to reduce their PFC footprint.** Reducing PFC emissions can significantly lower the Scope 1 footprint of electronics manufacturers, and is a much-needed action.

- **The industry can support an economy-wide low-carbon transition through decarbonized product designs and manufacturing processes, focusing on innovation.** When it comes to decarbonizing product offerings, circular design can offer a promising way forward. Firms need to navigate challenges of limited traceability in their recycling and recovery supply chains by investing in technological solutions that enable comprehensive end-to-end waste-flow tracking. Digital innovations that offer resource efficiencies in operations, such as the use of digital twins and additive manufacturing, can reduce the direct emissions footprint of electronics production.

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Chemicals & Pharmaceuticals Manufacturing Sub-Sector

In order to assess the progress that different sectors of the economy are making on decarbonization, Economist Impact's Decarbonization Progress Benchmark evaluated a total of 160 of the largest publicly listed firms across four sectors of the economy (40 in each): Energy, Financial Services Industry, Retail, and Manufacturing. One of the two underlying sub-sectors of Manufacturing is Chemicals & Pharmaceuticals Manufacturing. It consists of the five largest chemical, specialty and generic drug, and biotechnology manufacturers by market capitalization in each of the four regions under study: North America, Latin America, Asia, and Europe.

Chemicals & Pharmaceuticals Manufacturing sub-sector emissions split (%)*

Operational emissions (Scopes 1 and 2) | Value chain emissions (Scope 3)

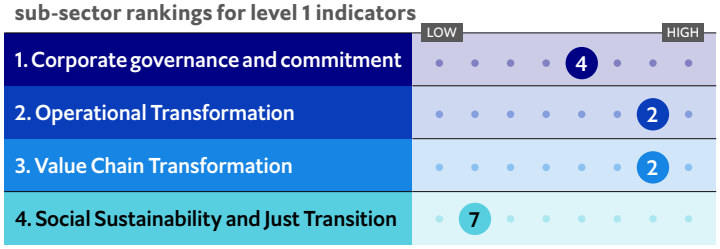
Overall score

43.4 /100

Overall ranking

2 /8

Overall Chemicals & Pharmaceuticals Manufacturing sub-sector rankings for level 1 indicators



Sector summary

#	Level	Indicator	Score /100	Overall ranking /8
1	**1**	**Corporate governance and commitment**	35.4	4
1.1	2	Corporate governance	53.5	2
1.2	2	Commitment to decarbonization	18.8	4
1.3	2	Policy outlook and influence	50.0	4
2	**1**	**Operational Transformation**	71.9	2
2.1	2	Measurement and tracking	90.0	2
2.2	2	Action plan for operational transformation	82.5	2
2.3	2	Operational transformation: reducing scope 1 emissions	90.8	1
2.4	2	Operational transformation: reducing scope 2 emissions	27.7	4
2.5	2	Decarbonization innovation in key operations	55.0	3
3	**1**	**Value Chain Transformation**	42.7	2
3.1	2	Measurement and tracking	65.0	1
3.2	2	Action plan for value chain transformation	42.5	1
3.3	2	Phasing out carbon-intensive product offerings	10.0	3
3.4	2	Driving decarbonization across value chain partners	39.8	3
3.5	2	Investing in decarbonization innovation	71.4	3
4	**1**	**Social Sustainability and Just Transition**	8.0	7
4.1	2	Impact assessment, targets and planning	0.0	5
4.2	2	Implementation strategy	0.0	7
4.3	2	Policy outlook and proactive collaboration with the government on just-transition issues	40.0	1

* These particular figures represent the emissions splits for chemical firms. The split between Scope 1 & 2 and Scope 3 emissions presented here informs the relative weightage assigned to Pillar 2: Operational Transformation and Pillar 3: Value Chain Transformation on the benchmark for the Chemicals & Pharmaceuticals Manufacturing sub-sector. A larger share of Scope 3 emissions in total carbon footprint translates into a higher relative weight for Pillar 3: Value Chain Transformation in the overall benchmark score for a sub-sector. This approach ensures that scores for firms and sub-sectors broadly represent the magnitude of effort needed to address a particular pool of emission, and enables comparison of sub-sectors that may have extraordinarily diverse paths to decarbonization.

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Regional data

#	Level	Indicator	North America	Latin America	Europe	Asia	Global
1	**1**	**Corporate governance and commitment**	**36.7**	**27.9**	**52.1**	**25.1**	**35.4**
1.1	2	Corporate governance	71.0	45.0	64.0	34.0	53.5
1.2	2	Commitment to decarbonization	12.8	14.7	35.8	11.8	18.8
1.3	2	Policy outlook and influence	45.0	35.0	75.0	45.0	50.0
2	**1**	**Operational Transformation**	**75.7**	**63.1**	**79.9**	**68.7**	**71.9**
2.1	2	Measurement and tracking	90.0	90.0	90.0	90.0	90.0
2.2	2	Action plan for operational transformation	90.0	50.0	100.0	90.0	82.5
2.3	2	Operational transformation: reducing scope 1 emissions	90.0	80.0	100.0	93.3	90.8
2.4	2	Operational transformation: reducing scope 2 emissions	27.7	23.1	50.7	9.3	27.7
2.5	2	Decarbonization innovation in key operations	70.0	55.0	50.0	45.0	55.0
3	**1**	**Value Chain Transformation**	**43.4**	**37.8**	**51.6**	**38.0**	**42.7**
3.1	2	Measurement and tracking	60.0	80.0	80.0	40.0	65.0
3.2	2	Action plan for value chain transformation	40.0	40.0	50.0	40.0	42.5
3.3	2	Phasing out carbon-intensive product offerings	0.0	10.0	20.0	10.0	10.0
3.4	2	Driving decarbonization across value chain partners	46.7	23.3	46.7	42.0	39.8
3.5	2	Investing in decarbonization innovation	N/A	75.0	100.0	50.0	71.4
4	**1**	**Social Sustainability and Just Transition**	**10.0**	**4.0**	**10.0**	**8.0**	**8.0**
4.1	2	Impact assessment, targets and planning	0.0	0.0	0.0	0.0	0.0
4.2	2	Implementation strategy	0.0	0.0	0.0	0.0	0.0
4.3	2	Policy outlook and proactive collaboration with the government on just-transition issues	50.0	20.0	50.0	40.0	40.0

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Electronics Manufacturing Sub-Sector

In order to assess the progress that different sectors of the economy are making on decarbonization, Economist Impact's Decarbonization Progress Benchmark evaluated a total of 160 of the largest publicly listed firms across four sectors of the economy (40 in each): Energy, Financial Services Industry, Retail, and Manufacturing. One of the two underlying sub-sectors of Manufacturing is Electronics Manufacturing. It consists of the five largest semiconductor, electronic hardware, and medical devices and instruments manufacturers by market capitalization in each of the four regions under study: North America, Latin America, Asia, and Europe.

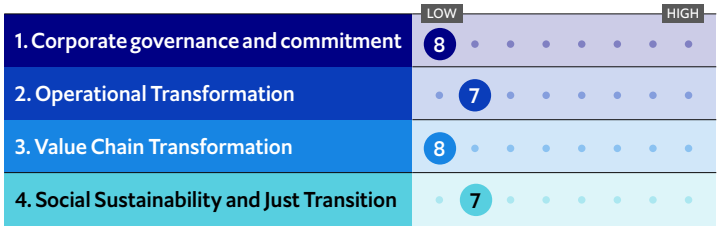
Overall score

24.6 /100

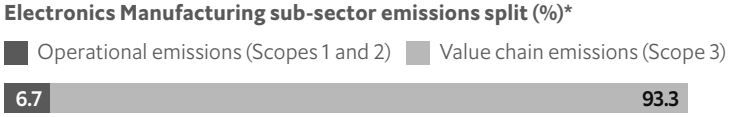
Overall ranking

8 /8

Overall Electronics Manufacturing sub-sector rankings for level 1 indicators



Electronics Manufacturing sub-sector emissions split (%)*



Sector summary

#	Level	Indicator	Score /100	Overall ranking /8
1	**1**	**Corporate governance and commitment**	25.1	8
1.1	2	Corporate governance	31.8	8
1.2	2	Commitment to decarbonization	13.6	6
1.3	2	Policy outlook and influence	43.8	6
2	**1**	**Operational Transformation**	49.0	7
2.1	2	Measurement and tracking	82.5	5
2.2	2	Action plan for operational transformation	47.5	7
2.3	2	Operational transformation: reducing scope 1 emissions	62.5	8
2.4	2	Operational transformation: reducing scope 2 emissions	35.5	2
2.5	2	Decarbonization innovation in key operations	23.8	4
3	**1**	**Value Chain Transformation**	21.2	8
3.1	2	Measurement and tracking	27.5	8
3.2	2	Action plan for value chain transformation	25.0	6
3.3	2	Phasing out carbon-intensive product offerings	7.5	4
3.4	2	Driving decarbonization across value chain partners	22.2	6
3.5	2	Investing in decarbonization innovation	35.0	7
4	**1**	**Social Sustainability and Just Transition**	8.0	7
4.1	2	Impact assessment, targets and planning	0.0	5
4.2	2	Implementation strategy	0.0	7
4.3	2	Policy outlook and proactive collaboration with the government on just-transition issues	40.0	1

* The split between Scope 1 & 2 and Scope 3 emissions presented here informs the relative weightage assigned to Pillar 2: Operational Transformation and Pillar 3: Value Chain Transformation on the benchmark for the Electronics Manufacturing sub-sector. A larger share of Scope 3 emissions in total carbon footprint translates into a higher relative weight for Pillar 3: Value Chain Transformation in the overall benchmark score for a sub-sector. This approach ensures that scores for firms and sub-sectors broadly represent the magnitude of effort needed to address a particular pool of emission, and enables comparison of sub-sectors that may have extraordinarily diverse paths to decarbonization.

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Regional data

#	Level	Indicator	North America	Latin America	Europe	Asia	Global
1	**1**	**Corporate governance and commitment**	**21.9**	**7.1**	**37.3**	**33.9**	**25.1**
1.1	2	Corporate governance	28.0	7.0	64.0	28.0	31.8
1.2	2	Commitment to decarbonization	13.1	0.0	16.3	25.1	13.6
1.3	2	Policy outlook and influence	35.0	25.0	50.0	65.0	43.8
2	**1**	**Operational Transformation**	**52.4**	**24.3**	**68.6**	**50.9**	**49.0**
2.1	2	Measurement and tracking	100.0	40.0	100.0	90.0	82.5
2.2	2	Action plan for operational transformation	50.0	0.0	70.0	70.0	47.5
2.3	2	Operational transformation: reducing scope 1 emissions	70.0	20.0	90.0	70.0	62.5
2.4	2	Operational transformation: reducing scope 2 emissions	31.6	39.0	63.1	8.4	35.5
2.5	2	Decarbonization innovation in key operations	20.0	10.0	25.0	40.0	23.8
3	**1**	**Value Chain Transformation**	**27.7**	**0.0**	**27.3**	**29.7**	**21.2**
3.1	2	Measurement and tracking	40.0	0.0	40.0	30.0	27.5
3.2	2	Action plan for value chain transformation	30.0	0.0	40.0	30.0	25.0
3.3	2	Phasing out carbon-intensive product offerings	10.0	0.0	5.0	15.0	7.5
3.4	2	Driving decarbonization across value chain partners	23.3	0.0	37.3	28.0	22.2
3.5	2	Investing in decarbonization innovation	50.0	0.0	30.0	60.0	35.0
4	**1**	**Social Sustainability and Just Transition**	**10.0**	**4.0**	**10.0**	**8.0**	**8.0**
4.1	2	Impact assessment, targets and planning	0.0	0.0	0.0	0.0	0.0
4.2	2	Implementation strategy	0.0	0.0	0.0	0.0	0.0
4.3	2	Policy outlook and proactive collaboration with the government on just-transition issues	50.0	20.0	50.0	40.0	40.0

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References

1 https://www.statnews.com/2022/10/27/health-care-hospitals-climate-pollution/
2 https://www.cell.com/patterns/pdf/S2666-3899(21)00188-4.pdf
3 https://cdn.cdp.net/cdp-production/cms/guidance_docs/pdfs/000/003/504/original/CDP-technical-note-scope-3-relevance-by-sector.pdf?1649687608
4 https://www.brookings.edu/wp-content/uploads/2021/06/FP_20210623_industrial_gross_v2.pdf
5 https://cdn.cdp.net/cdp-production/cms/guidance_docs/pdfs/000/003/504/original/CDP-technical-note-scope-3-relevance-by-sector.pdf?1649687608
6 https://www.brookings.edu/wp-content/uploads/2021/06/FP_20210623_industrial_gross_v2.pdf
7 https://assets-dam.takeda.com/raw/upload/v1662720393/legacy-dotcom/siteassets/system/corporate-responsibility/reporting-on-sustainability/annual-integrated-report/Takeda_2022_annual_integrated_report.pdf; https://www.astrazeneca.com/content/dam/az/Sustainability/2023/pdf/Ambition-Zero-Carbon.pdf
8 https://www.iea.org/energy-system/industry/chemicals
9 For instance: https://pubs.rsc.org/en/content/articlelanding/2023/ee/d3ee00478c; https://www.science.org/content/article/can-world-make-chemicals-it-needs-without-oil
10 https://iea.blob.core.windows.net/assets/255e9cba-da84-4681-8c1f-458ca1a3d9ca/ElectricityMarketReport2023.pdf
11 https://www.epa.gov/green-power-markets/summary-inflation-reduction-act-provisions-related-renewable-energy https://www.nortonrosefulbright.com/en/knowledge/publications/b01d19d5/eu-scales-up-green-subsidies-how-you-can-benefit-from-new-support-for-clean-investments
12 https://cdn.cdp.net/cdp-production/cms/guidance_docs/pdfs/000/003/504/original/CDP-technical-note-scope-3-relevance-by-sector.pdf?1649687608
13 https://www.lgchem.com/upload/file/sustainability/2022_LETZero_Product_book_en.pdf
14 https://www.lindeus.com/gases/buy-compressed-hydrogen-gas-or-liquid-hydrogen
15 https://www.orbia.com/4a435e/siteassets/6.-sustainability/sustainability-reports/2021/orbia-cdp-climate-change-response-2022.pdf (p. 8-9)
16 https://www.lgchem.com/upload/file/sustainability/LGChem_2021_Sustainability_Report_ENG.pdf
17 See, for instance: https://www.linde-engineering.com/en/sustainability/index.html; https://www.lgchem.com/upload/file/sustainability/LGChem_2021_Sustainability_Report_ENG.pdf
18 https://prod.ucwe.capgemini.com/fr-fr/wp-content/uploads/sites/6/2023/05/2023-FR-PoV-Scope-3.pdf
19 https://www.bmj.com/content/366/bmj.l4930.long
20 https://pubmed.ncbi.nlm.nih.gov/35131893/
21 https://link.springer.com/article/10.1557/s43577-021-00243-9
22 https://www.lgchem.com/upload/file/sustainability/LGChem_2021_Sustainability_Report_ENG.pdf; https://www.lgchemon.com/s/petrochem/esg?language=en_US
23 https://cdn.pfizer.com/pfizercom/Pfizer_Inc-CDP_Climate_Change_Questionnaire_2022.pdf (pp. 97-100)
24 https://www.astrazeneca.com/what-science-can-do/topics/sustainability/creating-culture-sustainability-across-labs.html
25 https://www.astrazeneca.com/content/dam/az/Sustainability/2022/pdf/Sustainability_Data_Summary_2021.pdf
26 https://www.astrazeneca.com/what-science-can-do/topics/sustainability/Striving-for-sustainable-drug-discovery-using-Green-Chemistry.html
27 https://www.astrazeneca.com/content/dam/az/Sustainability/2022/pdf/Sustainability_Data_Summary_2021.pdf (p. 21)
28 https://www.mckinsey.com/industries/semiconductors/our-insights/keeping-the-semiconductor-industry-on-the-path-to-net-zero
29 https://www.cell.com/patterns/pdf/S2666-3899(21)00188-4.pdf
30 https://www.sec.gov/news/press-release/2022-46; https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022L2464
31 https://business.edf.org/insights/leading-companies-are-using-ira-tax-credits-for-clean-manufacturing-and-technology-are-you/; https://www.nortonrosefulbright.com/en/knowledge/publications/b01d19d5/eu-scales-up-green-subsidies-how-you-can-benefit-from-new-support-for-clean-investments
32 https://www.mckinsey.com/industries/semiconductors/our-insights/keeping-the-semiconductor-industry-on-the-path-to-net-zero
33 https://www.asml.com/-/media/asml/files/investors/financial-results/a-results/2022/2022-annual-report-based-on-us-gaap-jder53.pdf?rev=77b35a285dc440cf85fded7cbbb0e48b. https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en
34 https://www.epa.gov/ghgreporting/ghgrp-electronics-manufacturing
35 https://climatechangeconnection.org/emissions/co2-equivalents/
36 https://esg.tsmc.com/en/update/greenManufacturing/caseStudy/67/index.html; https://csrreportbuilder.intel.com/pdfbuilder/pdfs/CSR-2021-22-Full-Report.pdf
37 https://ugupta.com/files/ChasingCarbon_HPCA2021.pdf
38 https://esg.tsmc.com/en/update/greenManufacturing/caseStudy/67/index.html; https://csrreportbuilder.intel.com/pdfbuilder/pdfs/CSR-2021-22-Full-Report.pdf
39 https://www.sciencedirect.com/science/article/pii/S2773167722000115
40 https://www.itu.int/hub/publication/d-gen-e_waste-01-2020/ (p. 52)
41 https://news.un.org/en/story/2021/06/1094052; https://pirg.org/edfund/articles/how-e-waste-is-creating-a-growing-environmental-and-health-crisis-across-the-world/
42 https://onlinelibrary.wiley.com/doi/10.1002/bse.3028
43 https://www.samsung.com/global/sustainability/media/pdf/Samsung_Electronics_Sustainability_Report_2022.pdf (p. 82)
44 https://www.sony.com/en/SonyInfo/csr/library/reports/SustainabilityReport2022_E.pdf (p. 46)

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