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Article 1 in a series of 7
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Semiconductor sustainability trends

A summary of current sustainability pressures and next-generation sustainability strategies in the semiconductor sector

Context

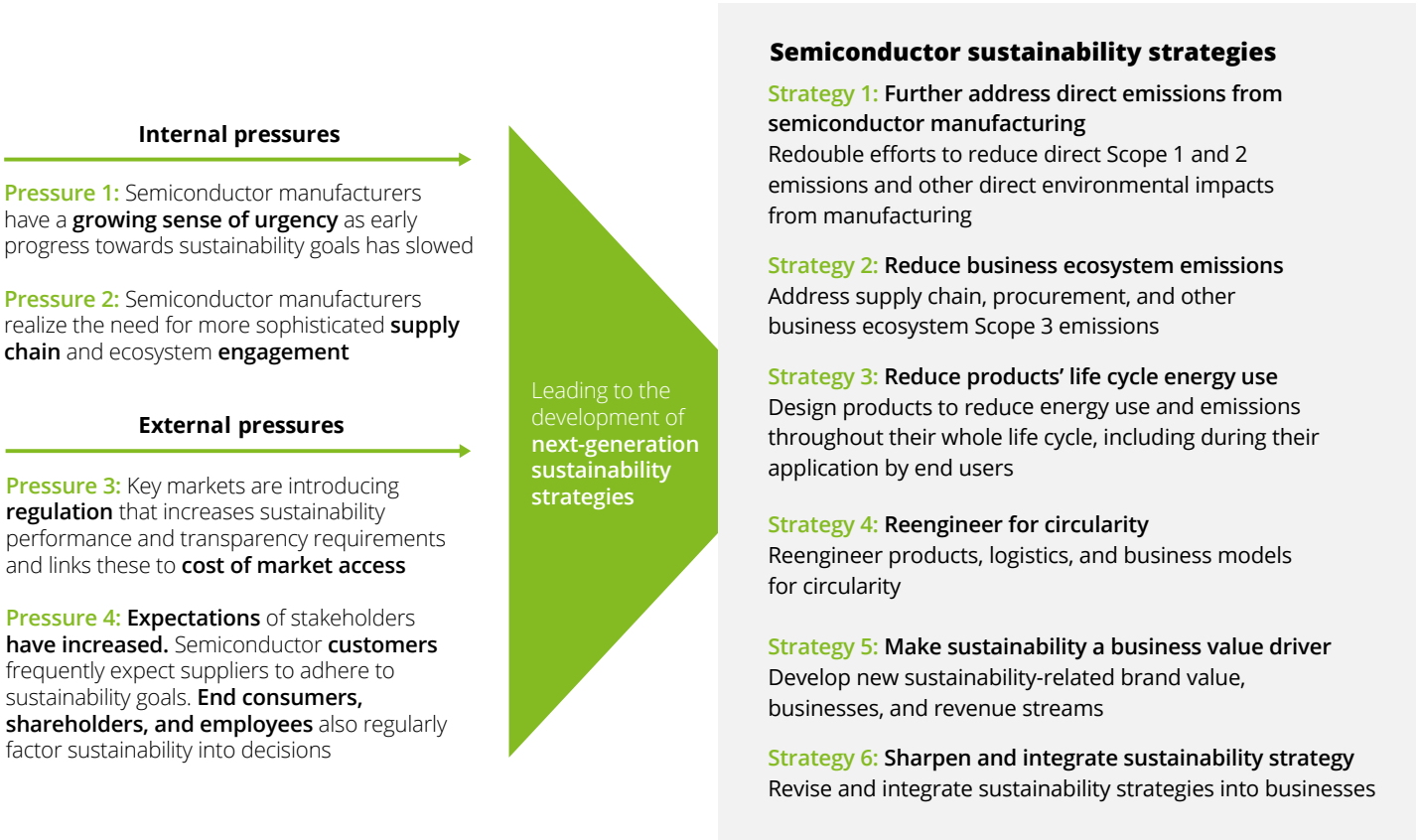
Commitment to transforming the social and environmental sustainability of our economy is present across many industries. Progress toward these objectives has been met with many challenges and successes as companies navigate their responsibilities in addressing business impacts on communities and climate while dealing with the economics, market structures, and incentives of their specific industry.

While the task is far from simple, the resolve of the majority of companies in the semiconductor sector to solve these challenges is strong: Addressing the industry's energy use during manufacturing, water consumption, labor conditions, limited supplier diversity, mineral and other raw material sourcing, as well as both its direct and indirect climate emissions,[1] is mission critical to the sector's continued growth and resilience—and arguably also to maintaining social acceptance of the ever more pervasive role that semiconductors play in our lives.

What are the overarching sustainability trends that Deloitte sees in the sector?

As illustrated in the graphic below, through our experience in the market Deloitte sees four broad sources of pressure toward increased sustainability in the semiconductor sector. Companies' responses are coalescing into six next-generation semiconductor sustainability strategies. This article summarizes the overall industry landscape of sustainability pressures and emerging sustainability strategies. Other articles in this series will discuss the specific drivers that semiconductor companies are responding to, and the distinct solutions that they are implementing, to pursue each individual strategy.

Sustainability pressures and strategies in today's semiconductor sector



Pressures for sustainability

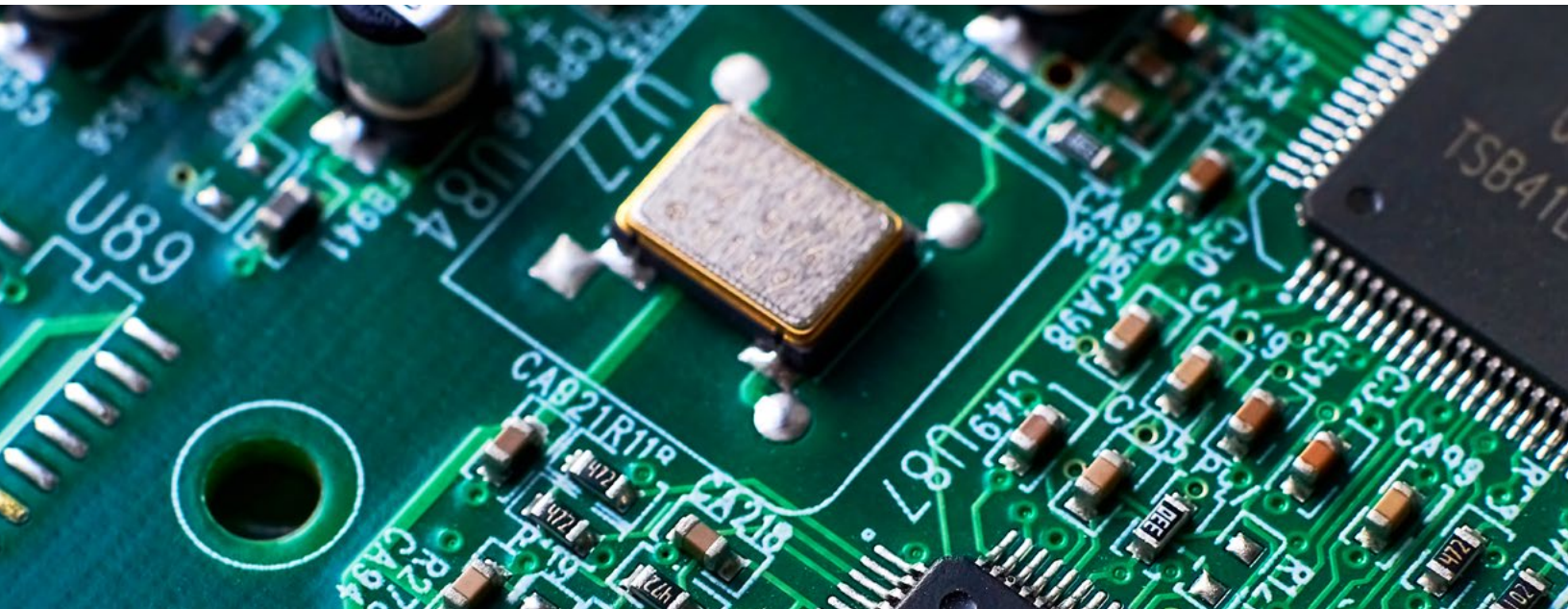
While there are varied pressures toward increased sustainability in the semiconductor industry, through our experience in the sector we see them coalescing around four dominant themes:

Pressure 1. A growing sense of urgency
From an internal perspective, many leading semiconductor companies announced sustainability goals several years ago and are working towards those goals currently; aiming for results usually between 2030 and 2040. In general, companies are setting these goals involving energy reduction, greenhouse gas (GHG) emissions reduction, and incorporating more renewable energy. Now having several years' experience pursuing those goals, companies are taking stock of early lessons (for example, the benefits of integrating sustainability programs into functions and businesses to drive deeper progress) and increasingly realize that they need to redouble their efforts.

Pressure 2. Supply chain
Recent shocks to supply chain security and shifting geopolitics have forced many semiconductor businesses to become more sophisticated in managing and engaging their broader industry ecosystem. This has been motivated by factors including the need to better understand and manage sustainability, as well as the need for greater supply chain resilience in support of business continuity.

Pressure 3. Regulation
External to individual semiconductor companies, with clear leadership from European regulators, regulation of both capital and product markets now provides a clear sense of direction and standard-setting, thus providing increased clarity to the industry in the standards that need to be attained, and reinforcing the need for a clear pathway to net zero emissions. The recently passed California Climate Corporate Data Accountability Act and the European Union's Corporate Sustainability Reporting Directive (CSRD) broadly require companies to publicly disclose and verify their greenhouse gas emissions, for example. Meanwhile, the US Inflation Reduction Act includes a wide range of incentives for increased energy efficiency such as grants and tax incentives for investment in clean energy infrastructure, clean manufacturing technologies and clean energy production—each of which can drive increased demand for efficiency-related semiconductor products.

Pressure 4. Market expectations
Additional stakeholders, including direct customers and end-consumers, staff, and capital providers have become much more sophisticated in their understanding of the direct and embedded sustainability challenges of semiconductor products. They are increasingly likely to factor this understanding into their decisions related to the sector. Sustainability is becoming a significant differentiating factor in semiconductor companies' brands.



Next generation sustainability strategies

Across the breadth of our engagement in the sector, we see six dominant strategies in how semiconductor companies are currently responding to these pressures to address their sustainability footprint:

Strategy 1. Further addressing the direct emissions from semiconductor manufacturing

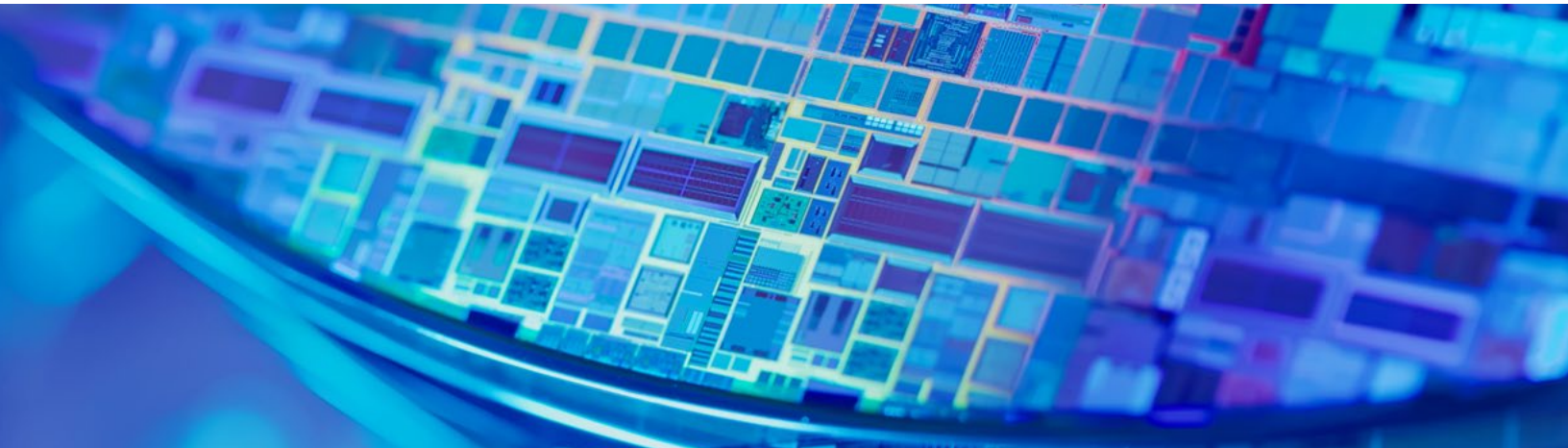
With many semiconductor companies having declared emissions reduction goals several years ago, some progress and sense of direction has generally been achieved in reducing Scope 1 and 2 emissions. (Scope 1 emissions are from sources directly owned by an organization, while Scope 2 emissions result from its purchase of energy). Opportunities invariably remain to further reduce environmental and social impacts, and climate emissions, from fabrication, assembly, and distribution operations as well as from energy sourcing. Having by-and-large addressed the easier initiatives such as facilities energy efficiency and purchasing of renewable energy supplies, semiconductor companies are redoubling efforts to reduce Scope 1 emissions and other direct environmental impacts that result from their core fabrication and packaging operations.

Strategy 2. Reducing Scope 3 business ecosystem and procurement emissions

In addition to furthering progress in reducing the direct Scope 1 emissions from their own manufacturing processes, leaders are now turning serious attention toward addressing the more difficult to control Scope 3 emissions category. This requires deeper engagement of the supplier ecosystem, coordinating commitments, incentives, and actions to reduce emissions throughout the web of corporations and facilities which participate in the design-source-fabricate-test-assemble-distribute chain—as well as during product use and at end-of-life. An example of this is the proposed collaboration by a global semiconductor equipment company, between engineers and procurement teams, to define emissions-focused metrics and criteria for supplier selection.[2] These efforts often go hand-in-hand with the objective of strengthening supply chain resilience and the resulting business continuity. Fortunately, advancement of mechanisms such as carbon insetting (capturing value from carbon emissions reduction within a company's own supply chain) markets and supply chain management capabilities have made Scope 3 emissions reduction more achievable now than ever before.

Strategy 3. Designing products to reduce energy use and emissions throughout their life cycle

The demand for semiconductor technology continues to grow over the longer term, driven by electrification in less developed countries and the proliferation of applications such as cloud computing, 5G communications and artificial intelligence in advanced economies. Without significant gains in the energy efficiency of computing power, direct and indirect emissions from the sector will likely grow as well. To reduce emissions and meet sustainability priorities of their customers, semiconductor manufacturers face intense pressure to develop highly efficient chips that reduce the energy consumption of the products into which they are incorporated. For instance, a large memory company recently announced the development of ultra-low power memory chips that aim to significantly reduce the annual power consumption of memory products used in data centers and mobile devices.

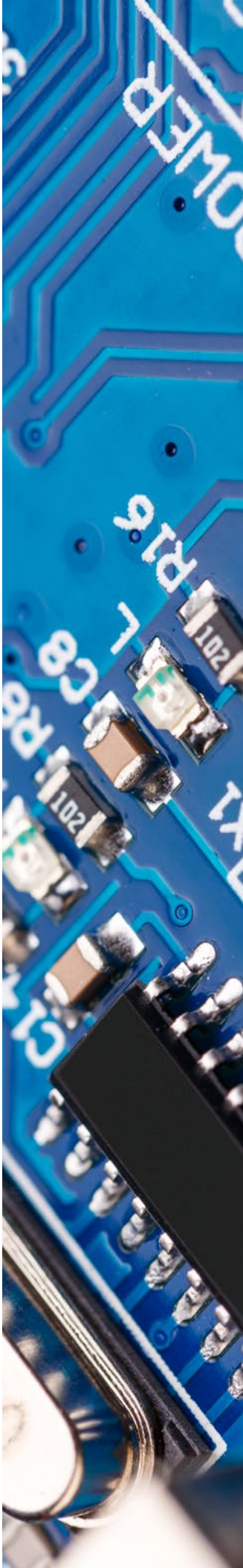


Strategy 4. Reengineering products, logistics, and business models for circularity
The environmental and social footprint of raw materials essential to semiconductor products, as well as growing uncertainty in their long-term availability, is now well understood. These raw materials include minerals, gases, chemicals, as well as spare parts for semiconductor equipment and consumables. The challenge of acceptably disposing of semiconductor products at end-of-life is also a growing concern for both business and consumer end-users.

Achieving better environmental performance and supply chain resilience demands new approaches to semiconductor products' end of life. Successful efforts to improve reusability and recyclability of semiconductor components are beginning to be incentivized by pricing differentials in consumer and secondhand markets, as evidenced by the creation of Trade-In programs by large consumer tech companies, to provide financial incentives to customers while reusing and/or recycling valuable materials. Manufacturers have also recognized material reuse as an essential capability for business longevity amidst growing uncertainty around finite (or politically acceptable/reliable) mineral supplies. This has implications for semiconductor design, manufacture, marketing, and logistics/reverse logistics that companies are increasingly addressing. For instance, semiconductor companies have been partnering with industry actors to launch product takeback pilots, as well as pilots to reuse materials traditionally treated like waste, such as scrap magnets in Hard Disk Drives (HDDs).

Strategy 5. Developing new, sustainability-related businesses and revenue streams
Semiconductor companies are exploring ways to harness consumer and corporate demand for sustainable products as a value driver in both product and service markets. Estimates suggest that around 40% of carbon reductions needed to achieve Paris commitment goals will rely on new technologies, indicating significant market potential.[3] In addition to entering carbon markets, leaders in semiconductor sustainability are creating new revenue streams such as emissions reduction advisory services, premium pricing for versions of their products with sustainable features such as use of recycled materials, and movement to "as a service" delivery of their products' capabilities which can reduce energy and transportation impacts while generating service-related revenue.[4]

Strategy 6. Sharpening sustainability strategies and integrating them into the business
In addition to pursuing individual sustainability strategies such as those summarized above, we are increasingly finding that as semiconductor corporations learn from both the successes and challenges in their sustainability journey, they are now sharpening their strategies against more rigorous goal setting and reporting expectations, clearer and more stringent regulatory compliance requirements (e.g. CSRD in Europe, California bills SG-253 and SB-261, and the proposed SEC climate rule), and the opportunity for greater integration of social and environmental sustainability objectives into the goals and plans of leadership and business units. Semiconductor leaders who have successfully undertaken initial sustainability efforts are revisiting the aspirations and governance of their sustainability programs, perhaps in preparation for meeting the higher expectations of, and greater opportunities afforded in their product, employee and capital markets.



In conclusion

A broad range of stakeholders increasingly expect companies to take responsibility for the climate and other sustainability impacts not just in their own direct operations, but across their full supply chain. Semiconductor companies acknowledge this expectation, and recognize the supply chain resilience and efficiency benefits that can flow from comprehensively responding. Fortunately, the range of approaches and supporting systems available to enable the tracking and reduction of supply chain emissions is greater now than ever.

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Fabian Pineda, Mackenzie Schnell, Pete Edmunds, Kayla Cherry, and Monroe Erle also contributed to the content of this article.

Endnotes

1. David Tsui et al., *S&P Global ESG industry report card: Technology*, accessed October 2023.
2. Chris Librie, "Semiconductor industry sustainability priorities – A systems engineering opportunity," Applied Materials, March 7, 2023.
3. International Energy Association, CO2 emissions reduction by type of abatement measure, 2050 (*GTCO2-e, %)*.
4. Rochak Sethi, "Unlocking new frontiers: How semiconductor companies leverage XaaS to drive value creation," Deloitte, April 2, 2023.

About Deloitte's *Semiconductor Sustainability* series of articles

Clients and other industry actors are interested in learning about the broad trends and patterns that we see in our work in the semiconductor sector, and interest is especially high in the critical task of driving sustainability through their operations and ecosystems.

Deloitte's series of short Semiconductor Sustainability articles responds to this interest by summarizing emerging sustainability strategies that Deloitte is seeing through our work with clients. Each article is intended to be a short, accessible summary that can be read in less than 20 minutes. We hope that the series proves useful to anyone interested in how the semiconductor sector is working to address its sustainability challenges.

Below is a list of all the articles in this series, in order of publication:

[This article] Series overview: Current sustainability pressures and next-generation sustainability strategies in the semiconductor sector

Strategy 1. Further address direct emissions from semiconductor manufacturing
Semiconductor companies are redoubling efforts to reduce direct Scope 1 and 2, greenhouse gas emissions, other environmental impacts from manufacturing.

Strategy 2. Reduce business ecosystem emissions
Semiconductor companies are addressing supply chain, procurement, and other business ecosystem Scope 3 emissions.

Strategy 3. Reduce products' life cycle energy use
Semiconductor companies are designing products to reduce energy use and emissions throughout their full life cycles.

Strategy 4. Reengineer for circularity
Semiconductor companies are reengineering products, logistics, and business models for circularity.

Strategy 5. Make sustainability a business value driver
Companies in the semiconductor sector are developing new, sustainability-related brand differentiation, businesses, and revenue streams.

Strategy 6. Sharpen and integrate sustainability strategy
Semiconductor leaders are strengthening sustainability strategies and integrating them into the businesses.

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