

Empowering Tomorrow

**Materials Intelligence Driving Sustainable
Innovation**

SEMICON Europe 2024

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Boosting Europe's position in global chip value chain by

- ➔ **strengthening supply chain resilience and driving innovation**
- ➔ **building the foundation for cross-industry collaboration**
- ➔ **fostering a strong tech ecosystem**

EU chips Act

Paving the way to a more competitive and resilient future



Our ever-evolving industry is facing two interrelated challenges



Innovation

How to evolve chip design and manufacturing while keeping up with the rapid pace of technology demand



Sustainability

How to secure our future as a sustainable and thriving industry

Collaboration is essential to address these systemic pressures!



Merck transformed from a local pharmacy in 1668 into a global science and tech company



Electronics

We are advancing digital living.



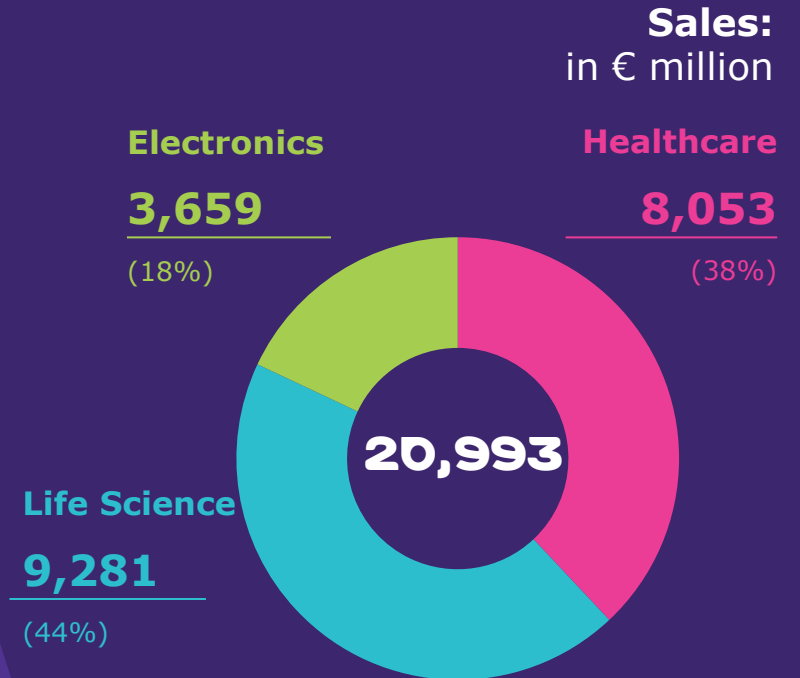
Life Science

Together, we impact life and health with science.



Healthcare

We help to create, improve and prolong lives.

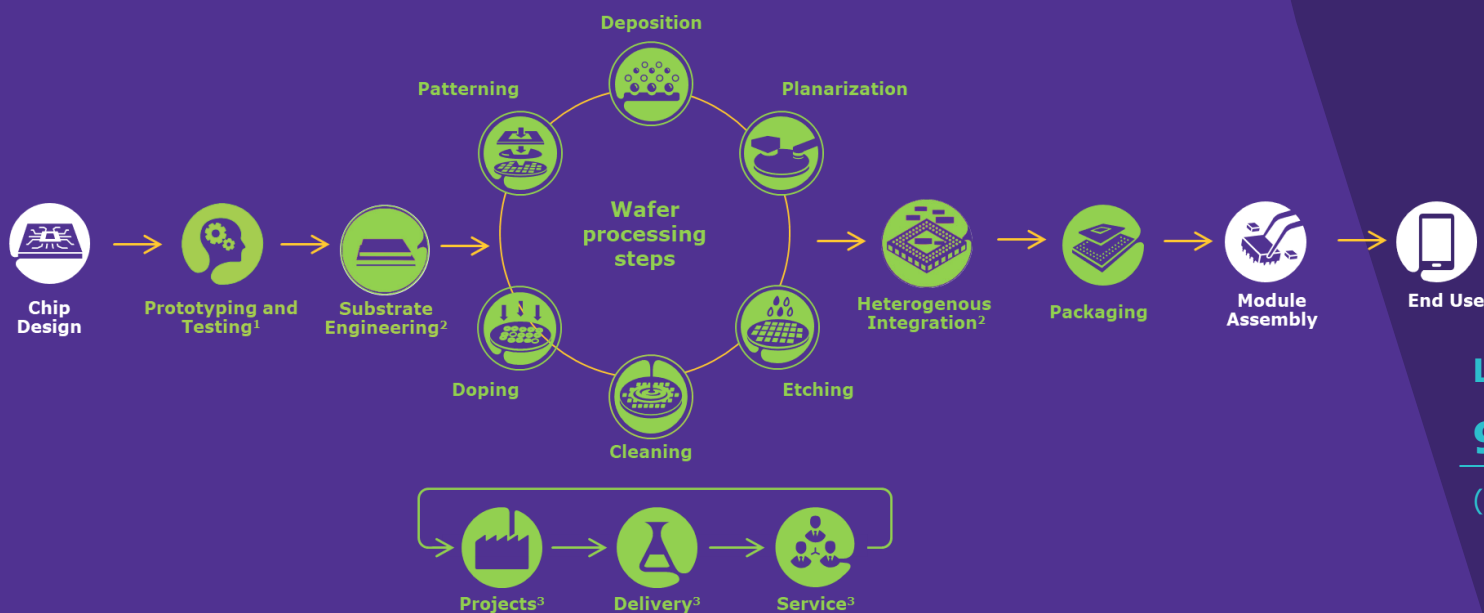


Source: Merck, Annual Report 2023

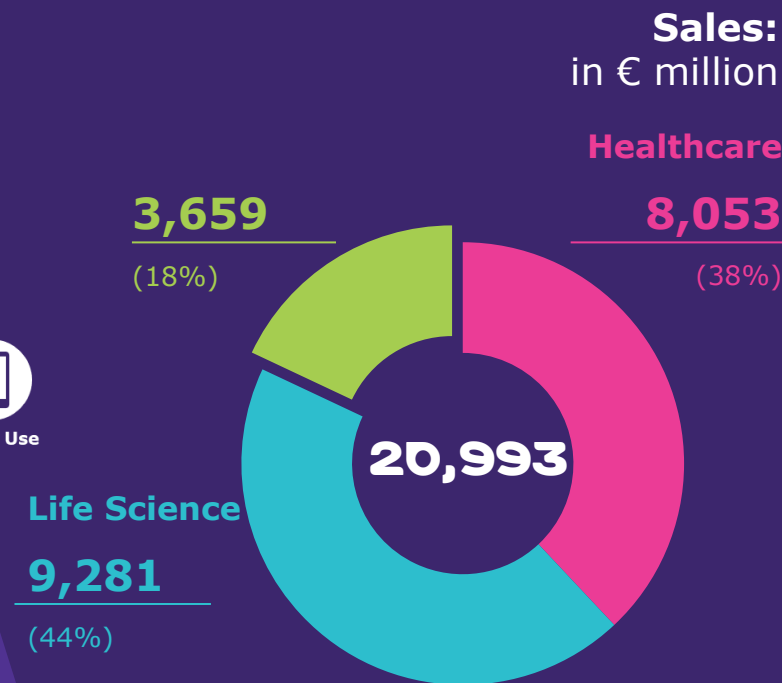


Merck Electronics covers the entire semiconductor value chain based on Materials Intelligence

Electronics



(1) Intermolecular® products & services
(2) Unity-SC metrology and inspection offering
(3) Delivery Systems & Services offering

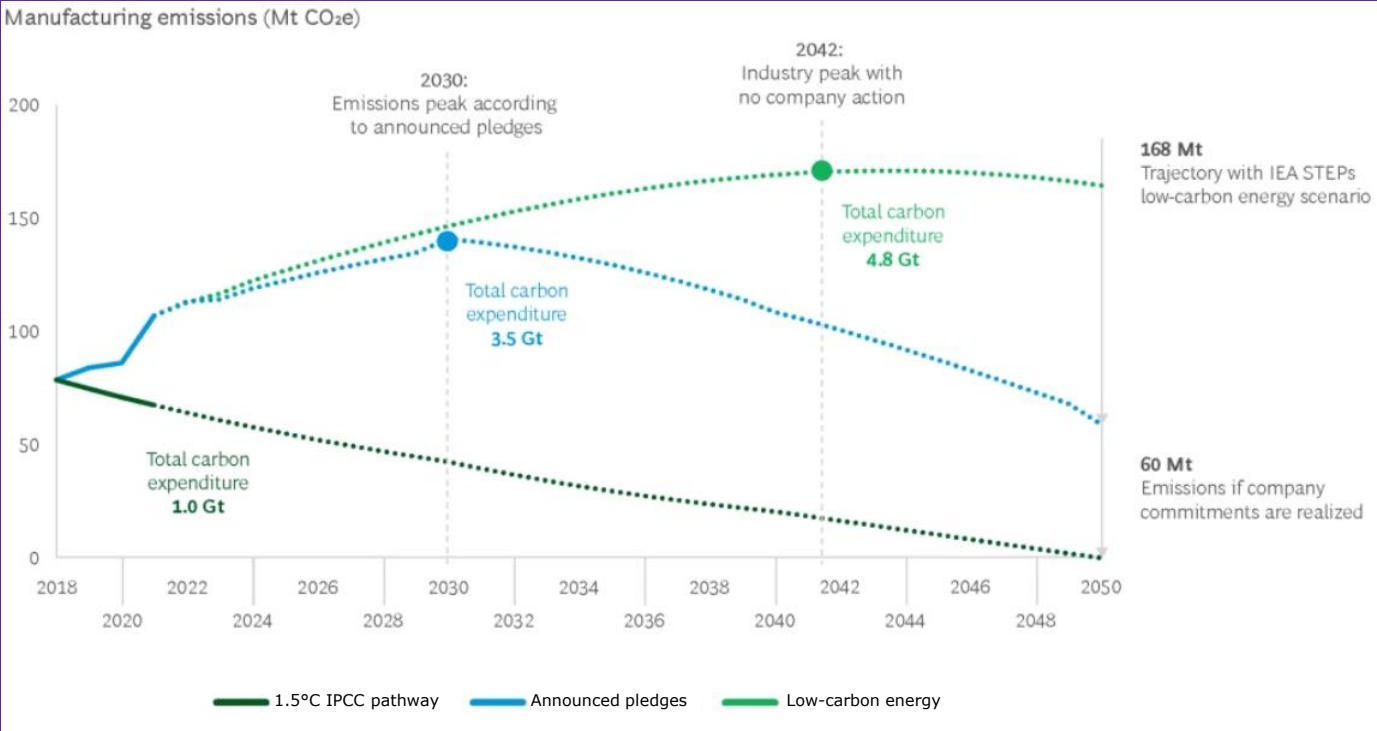


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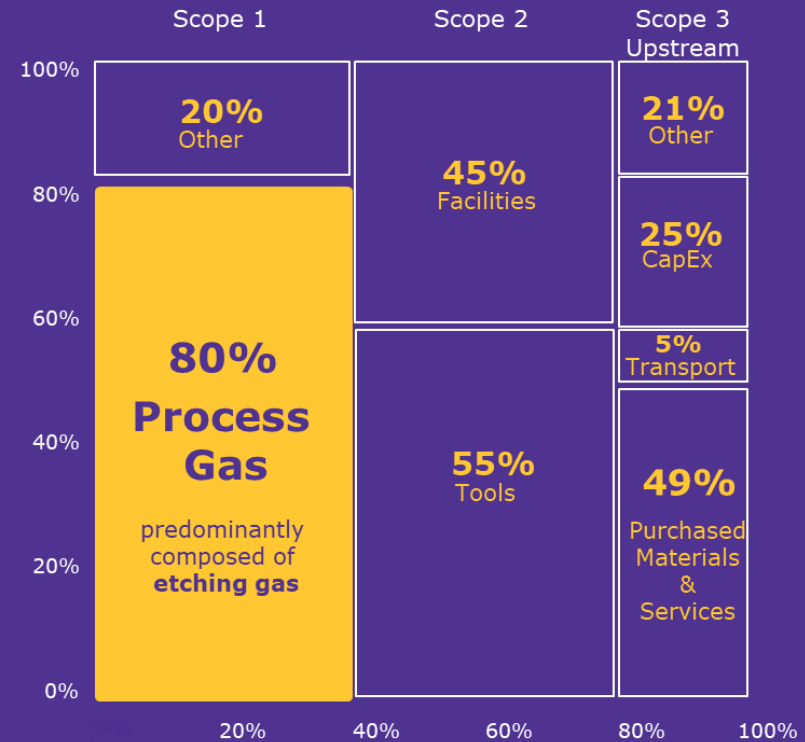


The industry must do more to reach net zero because announced pledges will not achieve the 1.5°C goal

Greenhouse Gas Emissions Forecasts



Process gases and materials drive emissions (CO₂-equivalent emissions for typical fab)



Source: BCG analysis of data from CDP, imec, SEMI, and IEA.

Note: Low-carbon energy scenarios use IEA STEPs for North America, Europe, and Asia Pacific. Emissions growth is based on projected capacity growth (3.25%) and average intensity growth (1.01%); all else is held constant. Mt = megatons; Gt = gigatons.

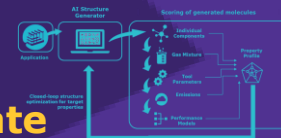
Source: McKinsey 2022: Sustainability in semiconductor operations: Toward net-zero production



Materials AI accelerates the development of high performing sustainable etch gases jointly with the customer

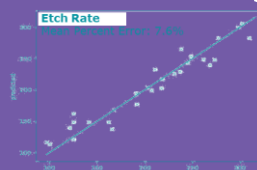
 **customer requirements**

Create



Predict

computational design and performance prediction including sustainability aspects

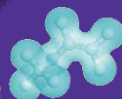


synthesis in small scale

evaluation of etch performance

data analysis & systematic correlation between structure and performance

Describe



Quantum chemical and structural descriptors
Mass spectrum simulations

Measure



Design of Experiments
Structured data sets
Molecular data library



quick scale-up for customer sampling



Systematic development resulted in sustainable solutions tailored to customer needs



Innovation



Sustainability



library of new highly performing etch gases

Performance requirements

- high aspect ratio etch ✓
- fast etch ✓
- selective etch ✓

Sustainability

- >90% reduction in emissions* ✓
- Fab compatible ✓
- Scalability at reasonable cost of ownership ✓

*compared to state-of-the-art etch gases, such as C_4F_8 and CF_4



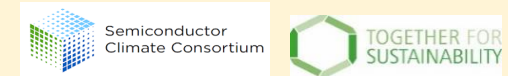
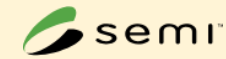
In a complex and globally interconnected industry sustainability requires transparent partnerships



Joined forces to develop gas solutions with a **low global warming potential** (GWP) to replace etching gases with high global warming potential.

Co-funded and Co-governed by Intel & Merck

A new **academic research program** to leverage AI and ML technologies for innovative breakthroughs for more sustainable semiconductor manufacturing.



Collaboration within the value chain to **achieve more together.**

Merck Electronics contribution

Replacing etch gases with high global warming potential by etch gases with low global warming potential

Leverage knowledge and research expertise to identify new more sustainable solutions

Supporting multistakeholder initiatives to leverage the power of the industry to transform the ecosystem



Connecting Industry Players to drive innovation and enhance manufacturing through secure data collaboration



highlights the immense value of data assets and provides a secure platform for rapid data structuring.



The semiconductor industry is ambitious to address sustainability and innovation challenges



Collaboration & Transparency

across the value chain
are indispensable to
solve the critical
sustainability challenge



Materials AI & Data Exchange

increase transparency and
enable navigating the
industry complexity to open
the door to true agility



Governance & Regulations

to balance high-tech
innovation with eco-friendly
practices will be key in
driving sustainable growth

