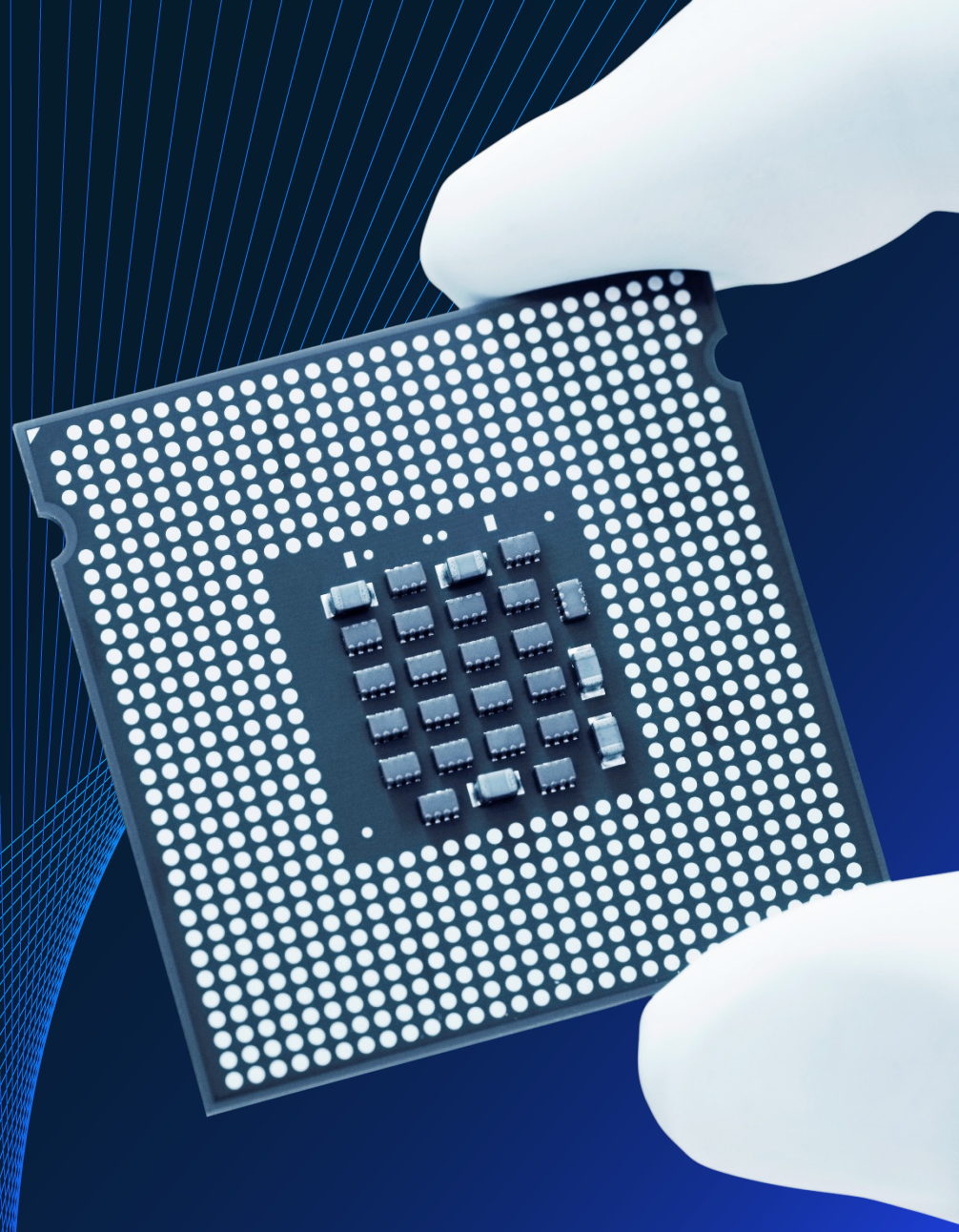
Perspectives on the semiconductor industry

Bayerischer Halbleiter-Kongress, 2024

June 3, 2024



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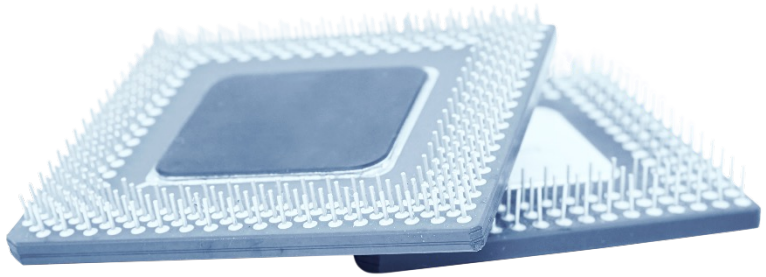

Despite recent market weakness, the semiconductor industry is growing robustly and healthily, with economic profit increasing multifold in past decades

Growth in semicon is fueled by fundamental trends incl. electrification, tech advancements like compound semiconductors and new killer applications like GenAI

As global trade flow growth slows down, the semi industry is increasingly shaped by regulatory actions, leading to unprecedented fab construction also in Europe

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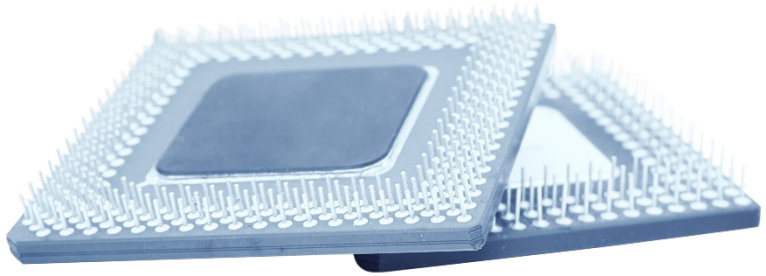

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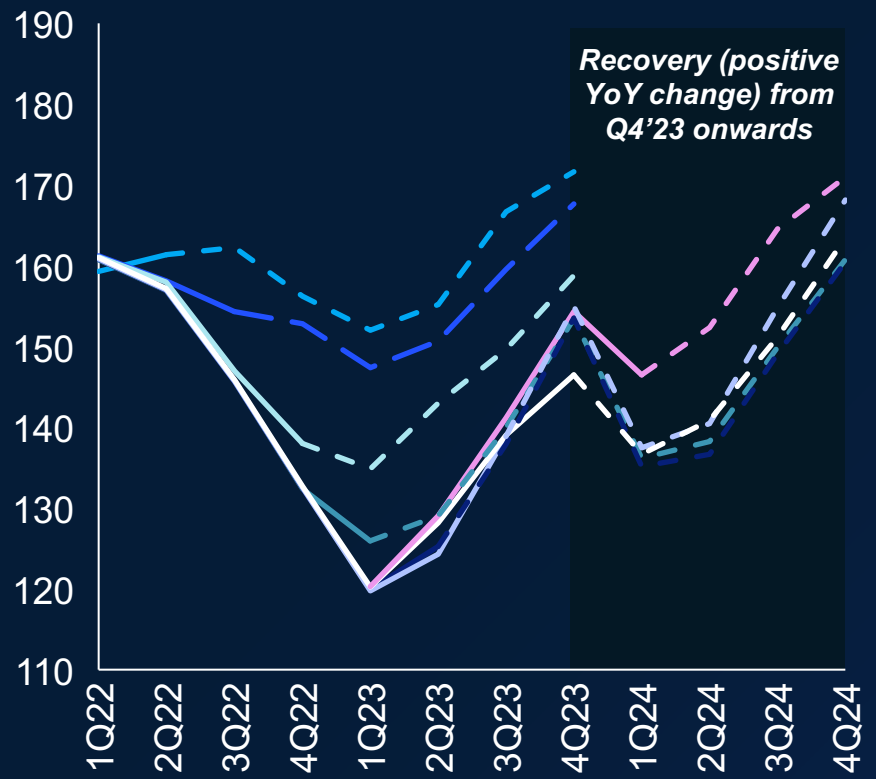
Recent economic downturn brought up questions regarding the industry's health and growth outlook

OMDIA semiconductor industry growth projection comparison

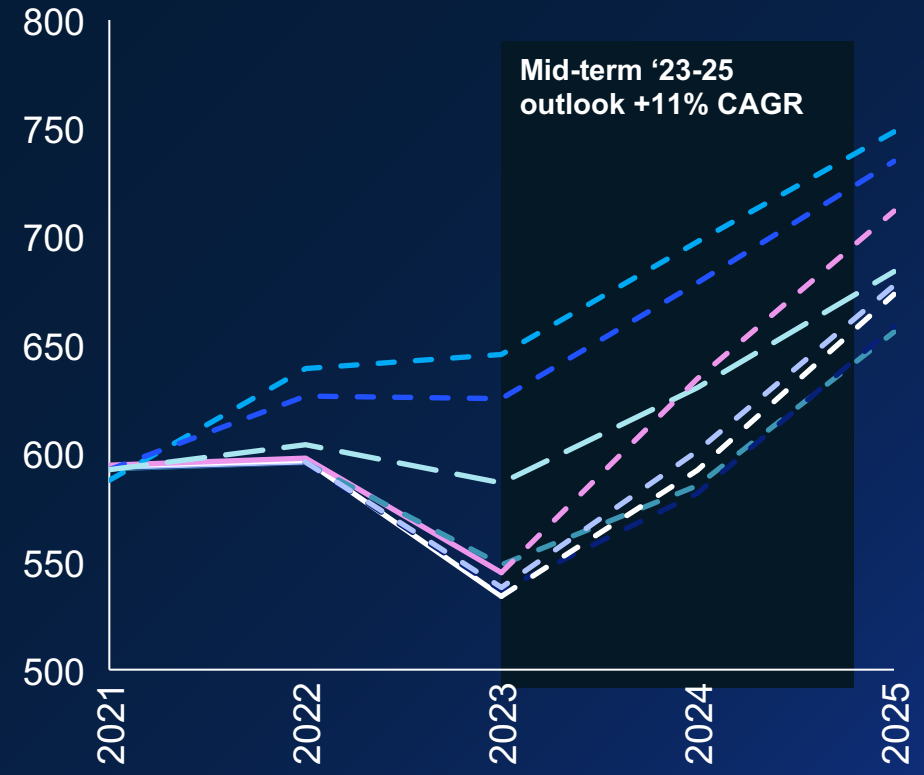
Semiconductor quarterly industry sales

USD bn

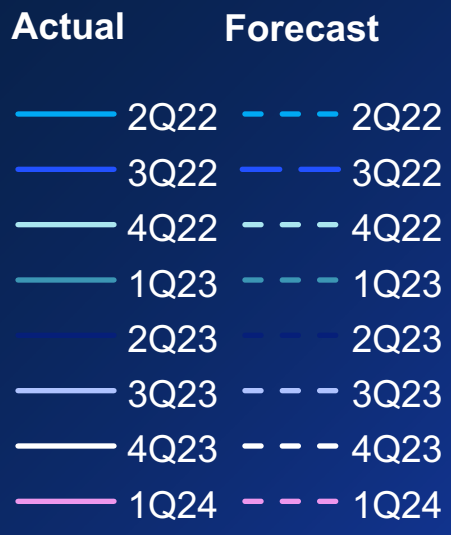


Semiconductor annual industry sales

USD bn



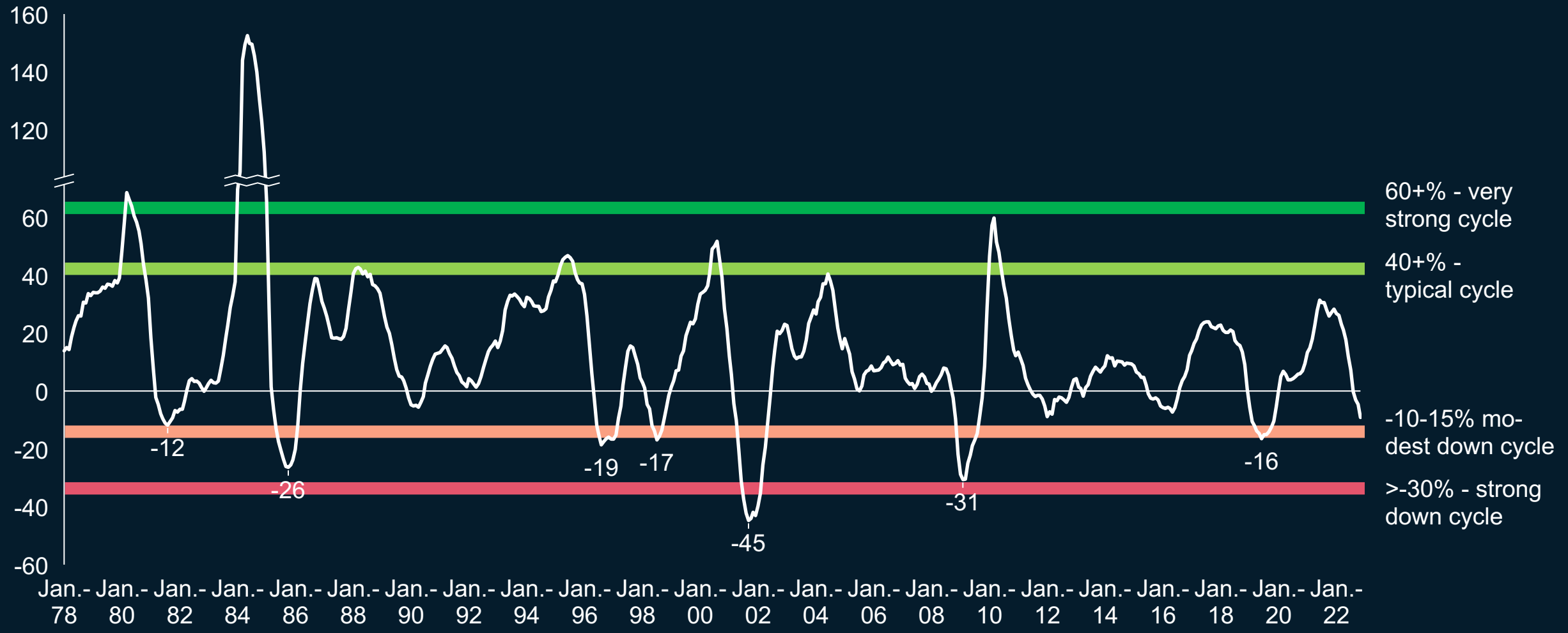
Market data from different points in time



Source: OMDIA AMFT (2Q22-1Q24)

… yet, strong market volatily has been a persistent pattern over decades…

YoY global semiconductor sales growth, Percent (3-month moving average)



Source: SIA

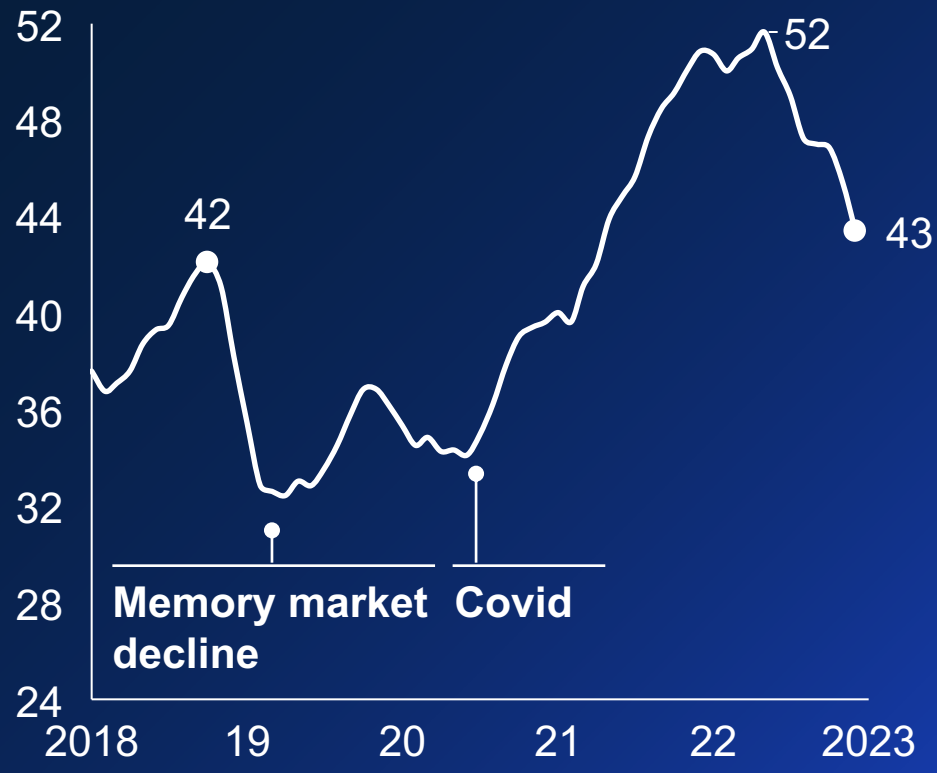
McKinsey & Company

…and the semiconductor industry has historically shown strong, continued growth

Monthly global semiconductor sales, bUSD (3-month moving average)

Despite healthy long-term growth, demand has been volatile …

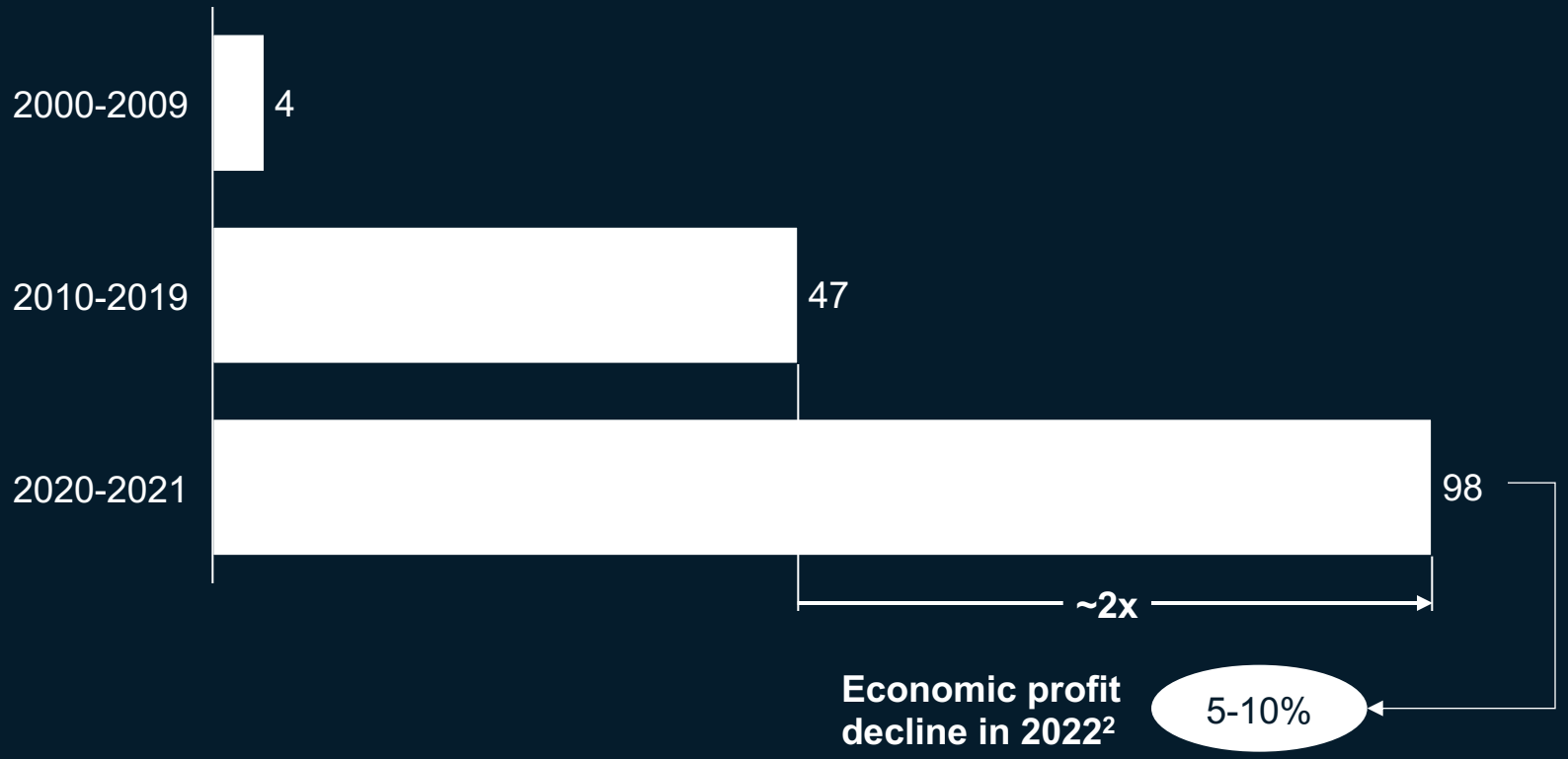
… with recent downturn after all-time Covid-induced peak



Source: WSTS, SIA, McKinsey Analysis

In the last decades, the semicon industry economic profit has increased multi-fold

Average annual economic profit[1] (including goodwill), USD bn



Key insights

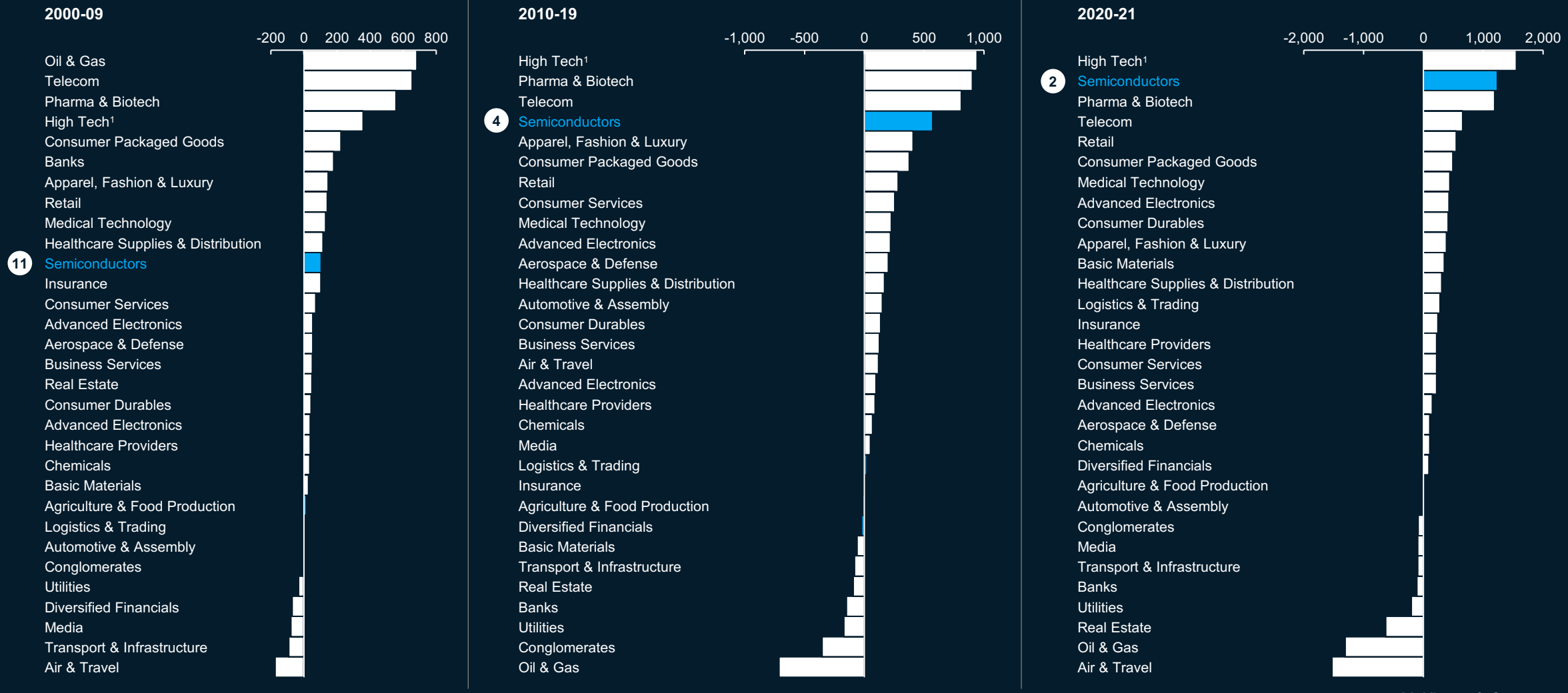
Strong global economic growth, rise of technology sector and recent innovations like AI and IoT has propelled revenue growth and created new opportunities across the value chain for semiconductor companies.

1. Economic profit is calculated as NOPLAT - (capital charge, where capital charge is invested capital including goodwill at previous year end * WACC); Figures may not add due to rounding; based on a sample of ~ 380 companies
2. Based on performance of top 10 players by market capitalization as of Feb 28, 2023

Source: McKinsey semiconductor CaaS, McKinsey Corporate Performance Analytics, S&P Global

The semiconductor sector leapfrogged several other sectors on economic value created in the last 2 decades

Average economic profit by industry
USD millions



1. Examples for high tech companies include i.e., Apple Inc., Samsung, Hon Hai Precision Industry (HNHPF), Microsoft Corp., Dell Technologies Inc.or Sony Corp.

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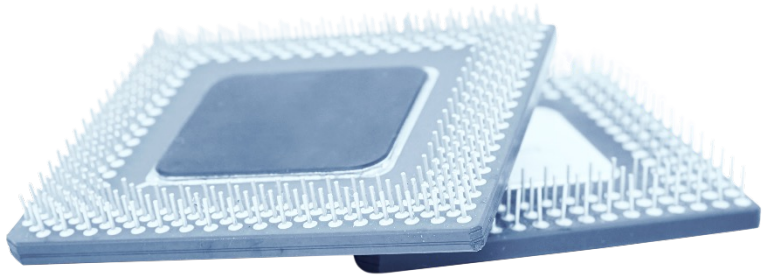

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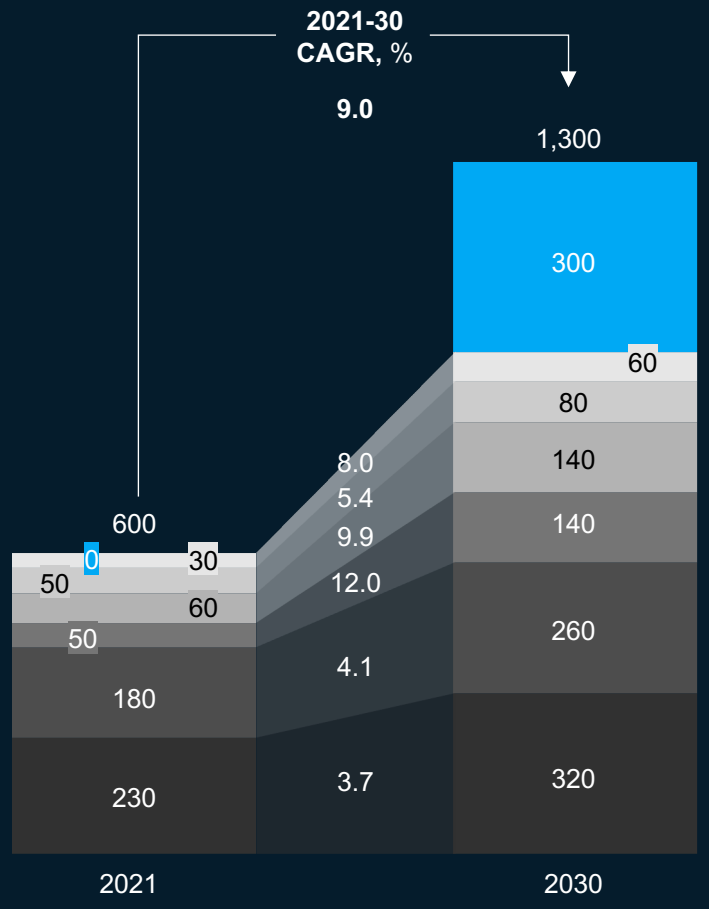
Base case scenario

~50% of overall semiconductor market growth could be driven by GenAI until 2030

Global semiconductor market, $B



Growth contribution 2021-2030, $B (%)

GenAI[1]	**$300bn** (43%)
Wired[2]	**$30bn** (4%)
Consumer[3]	**$30bn** (4%)
Industrial[4]	**$80bn** (11%)
Automotive[5]	**$90bn** (13%)
Wireless[6]	**$80bn** (11%)
Computing[7]	**$90bn** (13%)

1. GenAI market based on leading edge & memory and base case scenario; 2. Switches & routers, aggregate equipment, CPEs; 3. TVs, Consoles, Smart watches, Home appliances, etc.; 4. Automation, Medical, Test & Measurement, Security, Buildings, Lighting, Power & Energy, Military, Other; 5. Connectivity, Telematics, Infotainment, Drivetrains, Powertrains, ADAS, Chassis, Body & Convenience, Other; 6. Mobile phones, smartphones, tablets, communications infrastructure; 7. Data Center Servers, Notebook + Desktop PCs, Flash Storage, Hard-Disk and Solid-State Drives, Other (*before GenAI upside potential*)

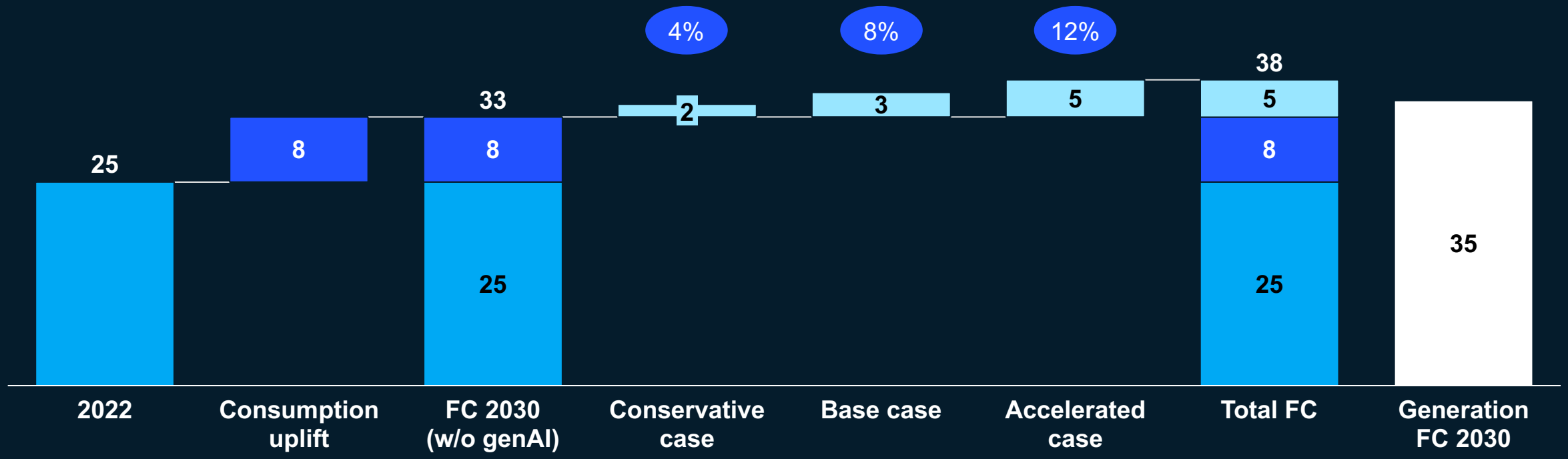
Source: McKinsey Analysis, OMDIA

Depending on the scenario, GenAI might consume up to 12% of the global electricity demand by 2030

Global electricity consumption, thousand TWh[1]

X% Share of total electricity

Generation, thousand TWh



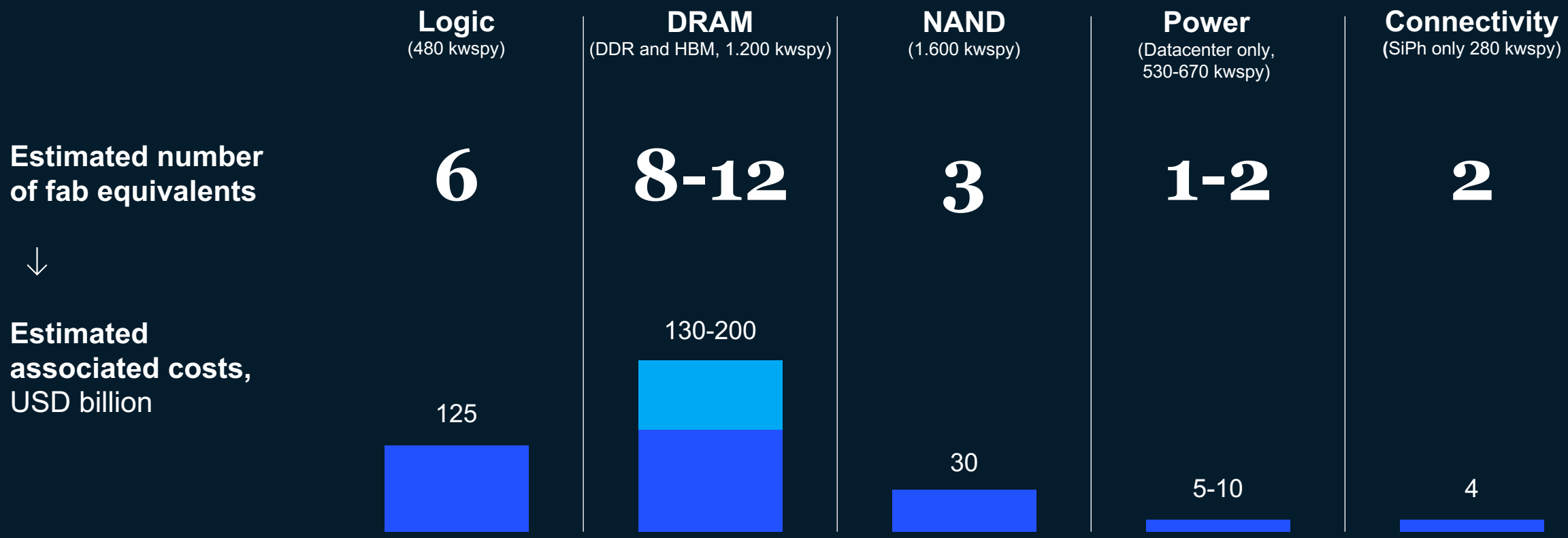
1. Excluding T&D losses and pumped hydro or storage charting

Source: McKinsey Global energy perspective 2023: Power Outlook

New fabs needed for additional wafer demand

GenAI demand corresponds to 20-25 additional 12"-equivalent fabs in 2030

Base case scenario



Source: McKinsey

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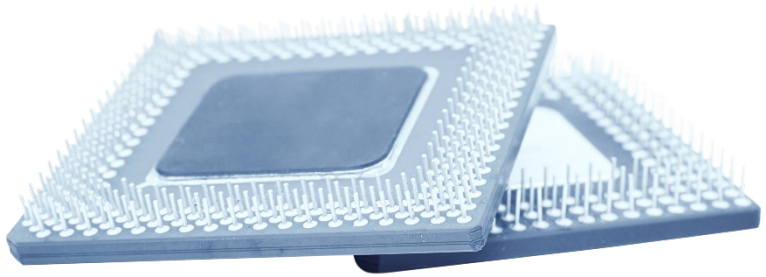

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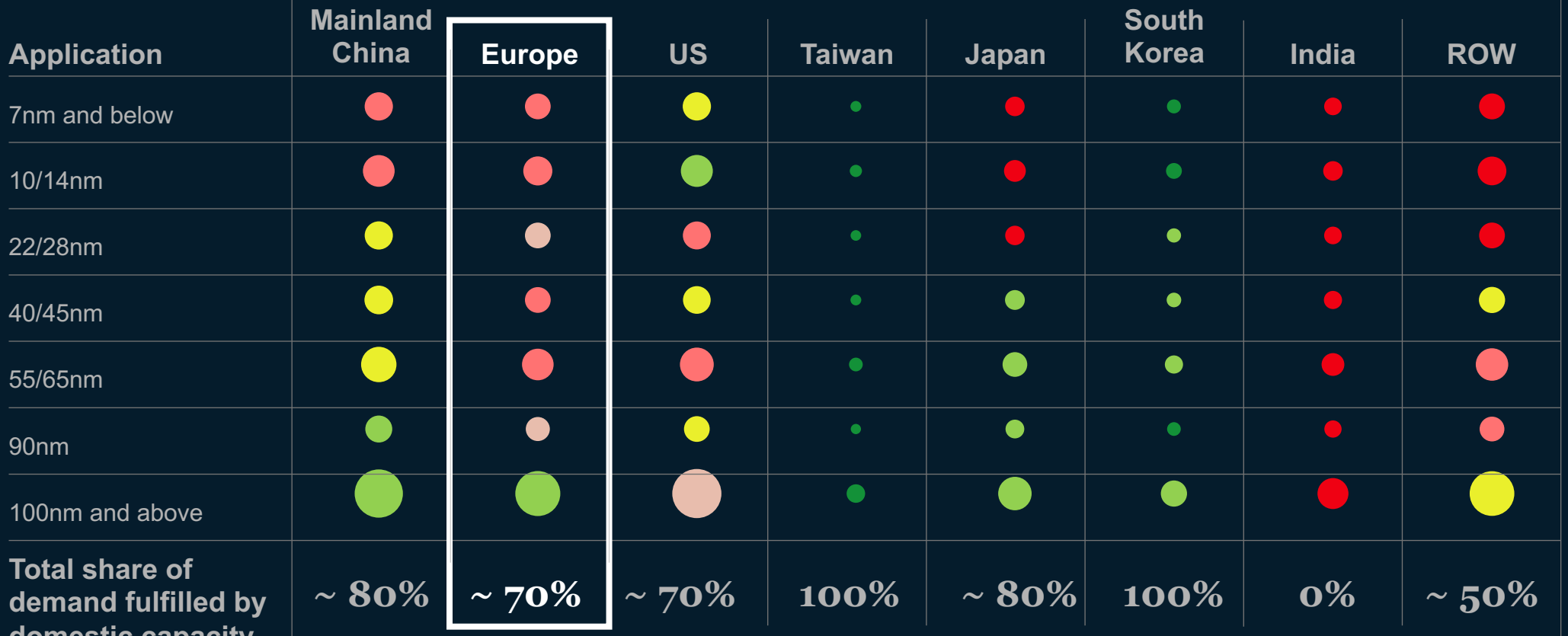
With exception of Taiwan, regions cannot be considered self-sufficient today from a manufacturing capacity point of view

Ratio of Frontend manufacturing capacity to demand by end customer region
Non-memory devices only, 2023



Demand
million 300mm eq. wafers

~0.1 ..... ~10.0

Regional demand covered by regional capacity

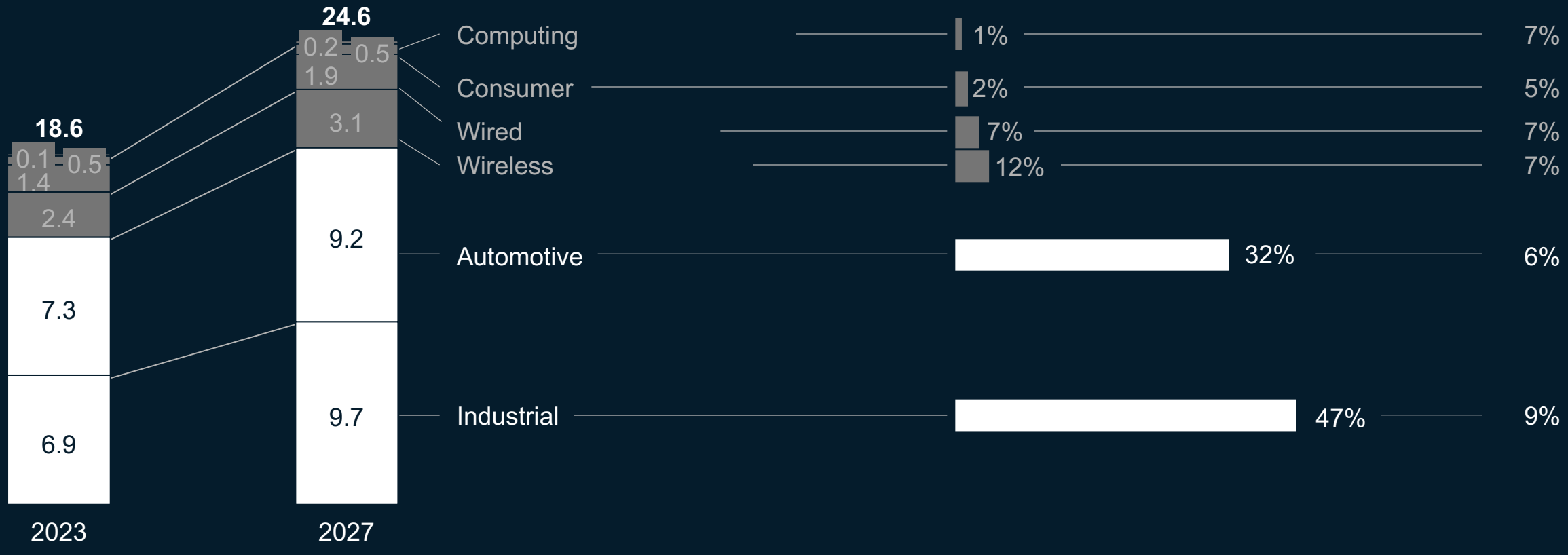
- < 10%
- 11-50%
- 51-70%
- 71-100%
- 101-500%
- > 500%

Source: Omdia (4Q 2023), SEMI WFF (December 2023), McKinsey analysis

European customers mainly demands Automotive and Industrial semiconductors

EMEA semiconductor demand (not considering additional (Gen)AI uplift)

Semiconductor wafer demand EMEA (by OEM / Tier-1 demand)
in million 300mm wafer equivalents

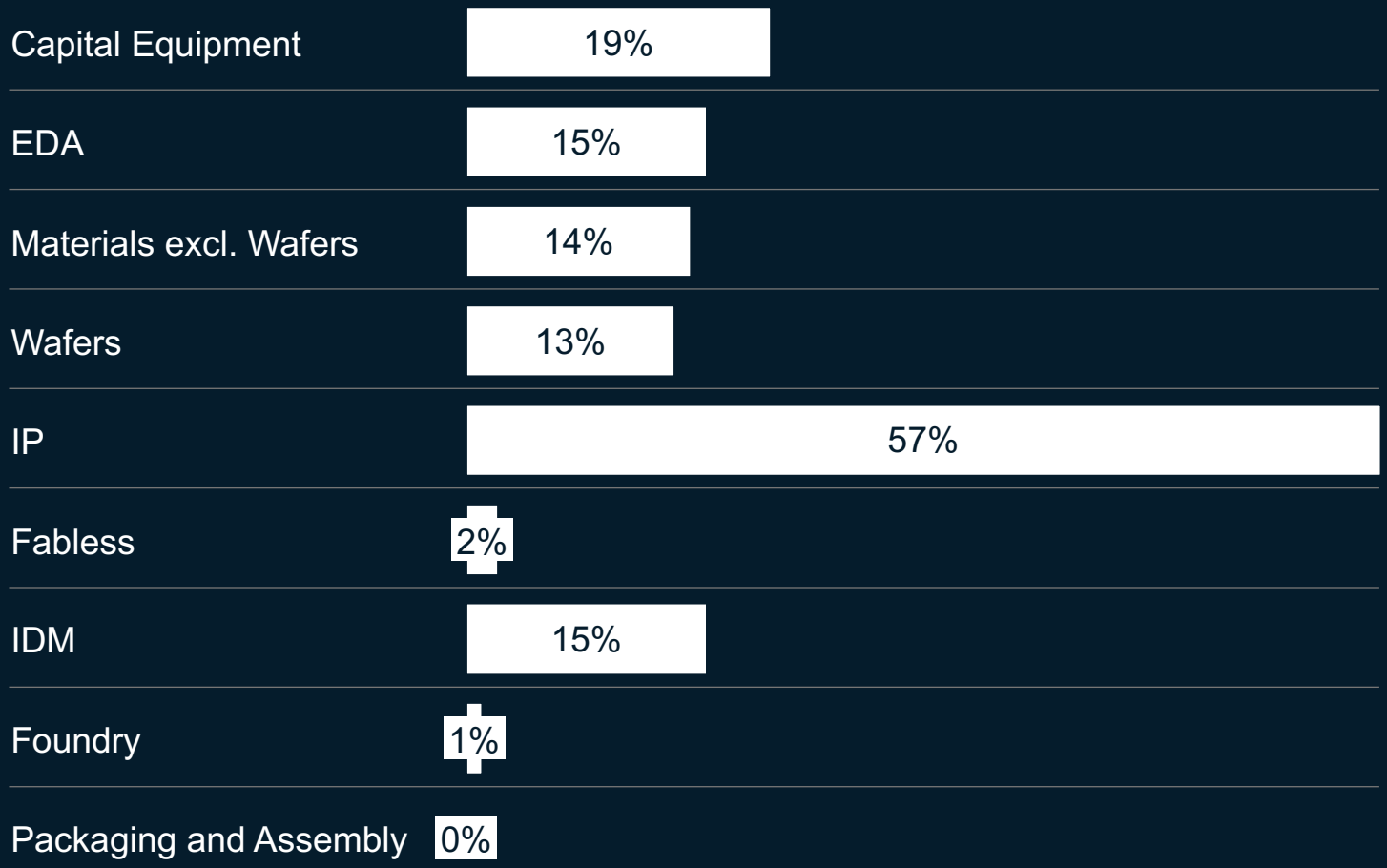


~1/6th of global demand

Source: (Q4 2023), McKinsey

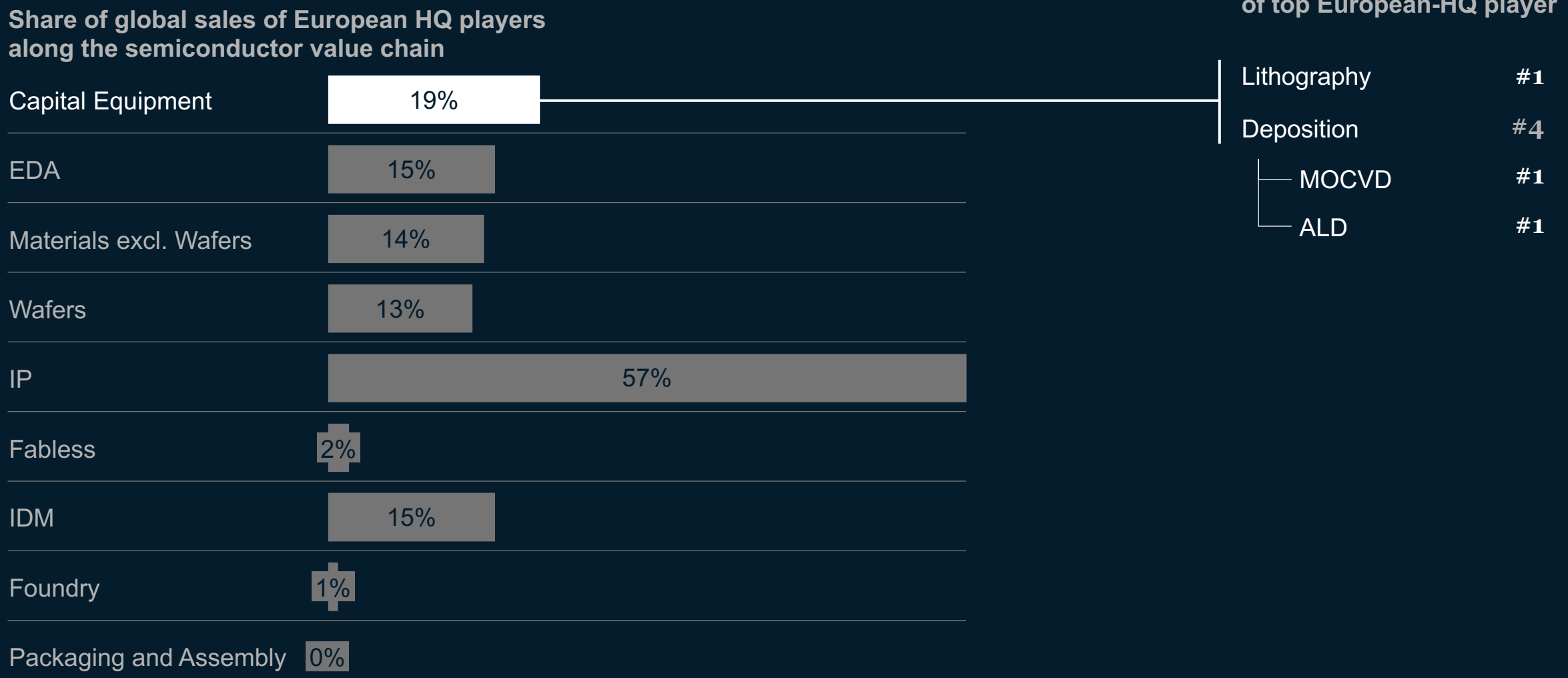
European players with global leadership positions across a range of steps in the semiconductor value chain

Share of global sales of European HQ players along the semiconductor value chain



Source: IHS; Gartner; Strategy Analytics; McKinsey

European players with global leadership positions across a range of steps in the semiconductor value chain



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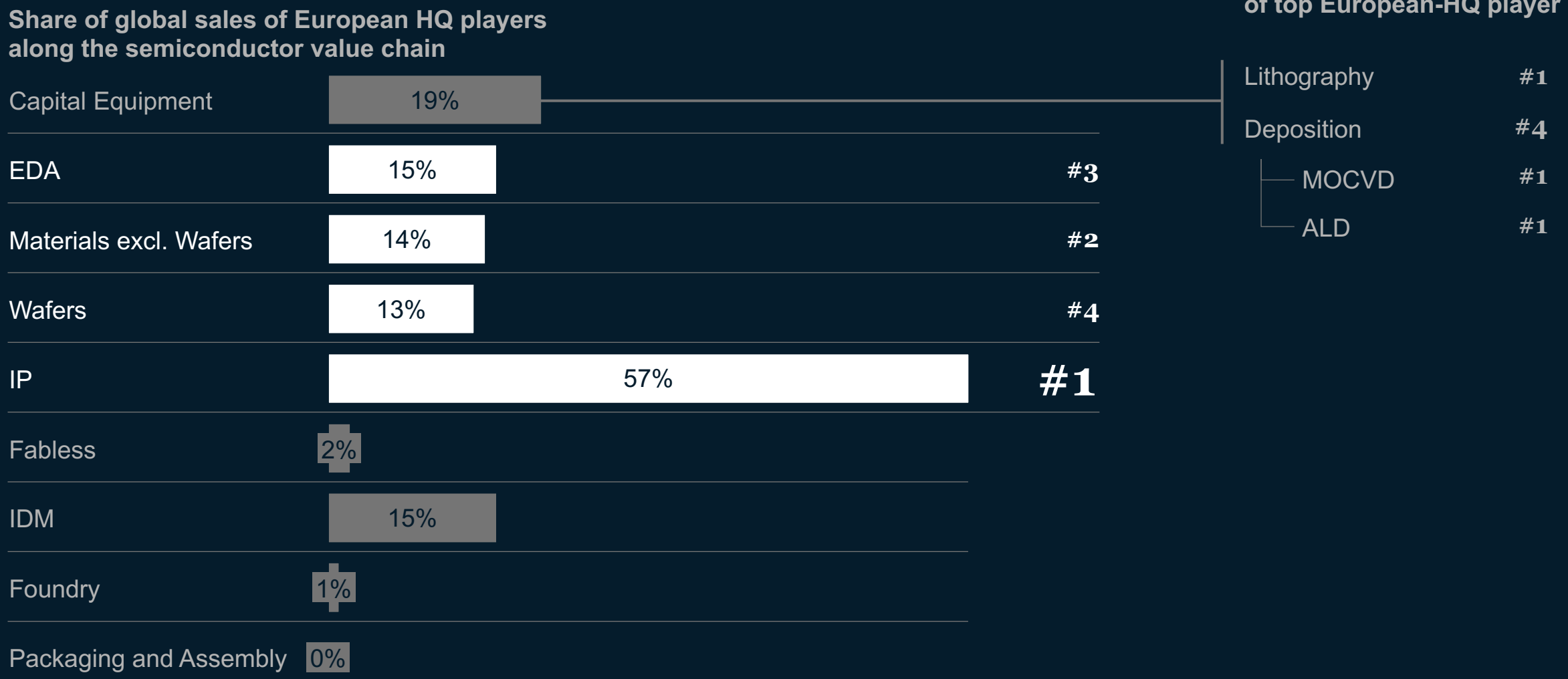

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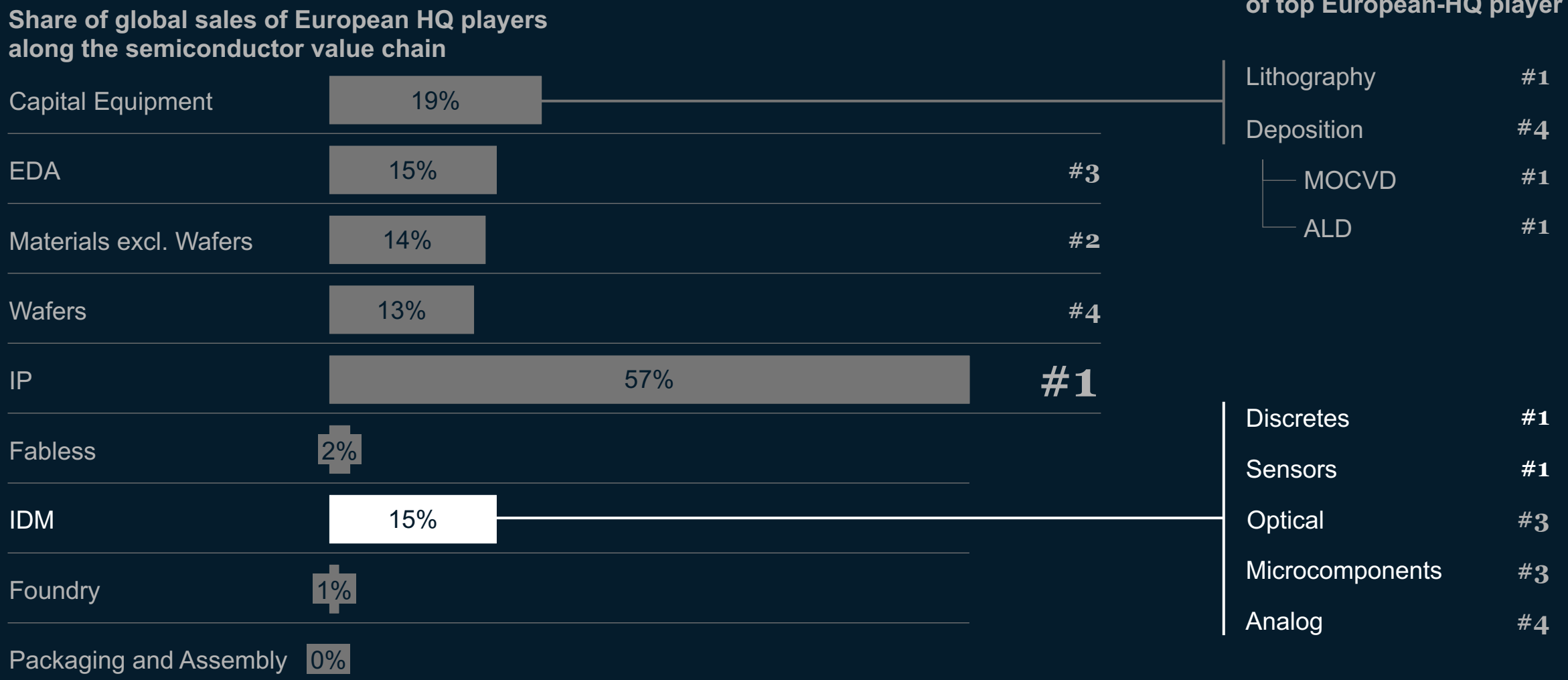


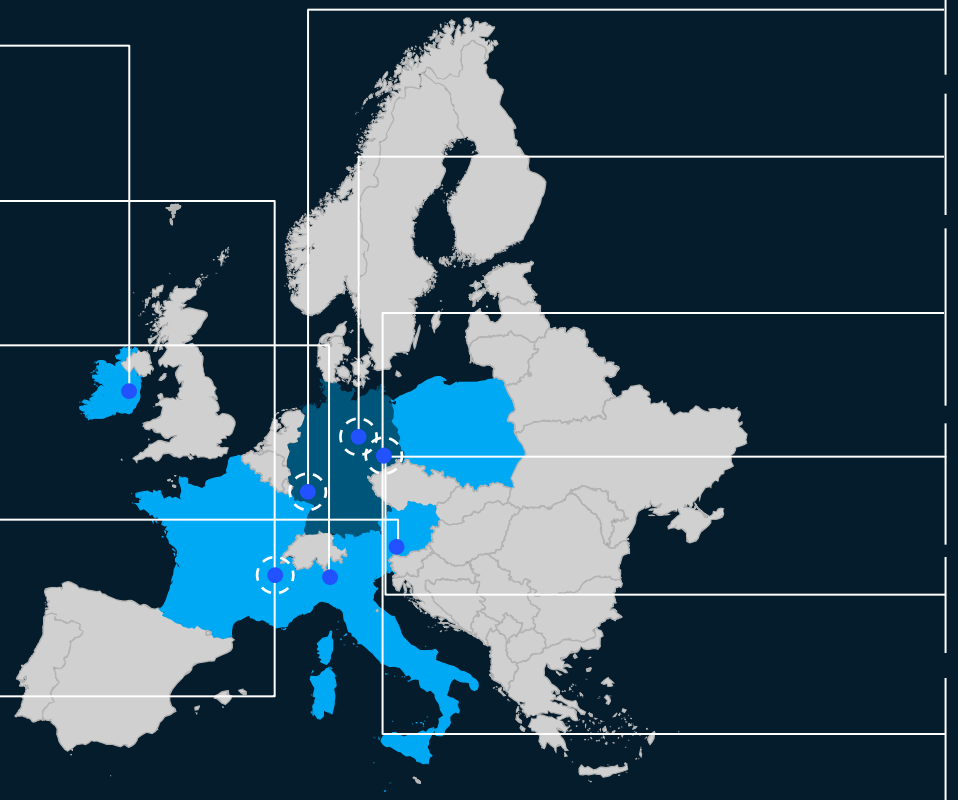
Source: IHS; Gartner; Strategy Analytics; McKinsey

Germany leads new semiconductor fab construction activities in Europe – fueled by the EU Chips act

EMEA forecast to account for ~14% of global semiconductor CapEx through 2027

Co-funded by the EU Chips Act

Not Exhaustive | As of June 2023



Limerick (IRE) — Analog Devices — $1B

Champagnier (FR) — Aledia — $<1B

Agrate Brianza (IT) — STMicroelectronics life.augmented — $2B

Villach (AUT) — Infineon — $1B

Crolles (FR) — STMicroelectronics life.augmented, GlobalFoundries — $6B

Ensdorf (GER) — Wolfspeed — $3B

Magdeburg (GER) — intel — $30B

Dresden (GER) — tsmc, Infineon, NXP, BOSCH — $10B

Dresden (GER) — Infineon — $5B

Dresden (GER) — GlobalFoundries — $4B

Dresden (GER) — BOSCH — $<2B

Regional semiconductor capex forecast, $B USD, 2022-2027E

South Korea	Taiwan	Americas	EMEA	China	Japan	ROW	
238	192	183	102	97	73	48	932
26%	21%	20%	14%	10%	8%	5%	

Comments

Most of the $bn projects based on 300mm wafer

Product portfolio spread over multiple areas, e.g., Logic, Power, Analog and specialty technologies (SiC)

Germany established as core European country for new wafer FAB activities

Mega-projects will have sizable impact on labor, materials and equipment:

- Intel: bleeding-edge technology operations in multiple phases with pro-duction start ~2025-26
- Dresden: sizable green- and brownfield projects of Infineon, Bosch, GF and TSMC (JV)

Source: Semiconductor Industry Association; Gartner; company reports; press release search

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