GSA

# TECHNOLOGY SYMPOSIUM

BOSTON CONSULTING GROUP

# Semiconductor Industry Challenges Industry Resilience

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A challenging three years

Rethinking global semiconductor supply chains

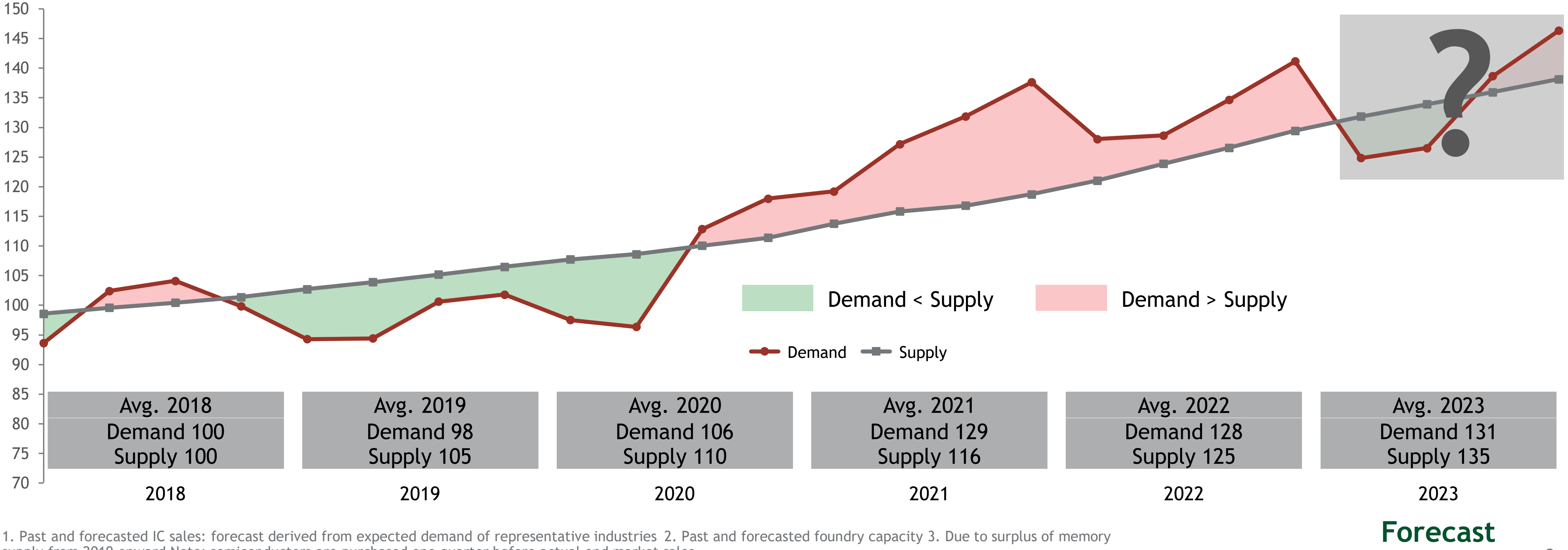
Rising environmental concerns

Challenges and opportunities

# During the pandemic we experienced an unprecedented scarcity of chips

2018/2019: “normal” market cycle | Q1 2020: demand contraction | 2020-Today: demand shock | 2023: return to “normal” market cycle

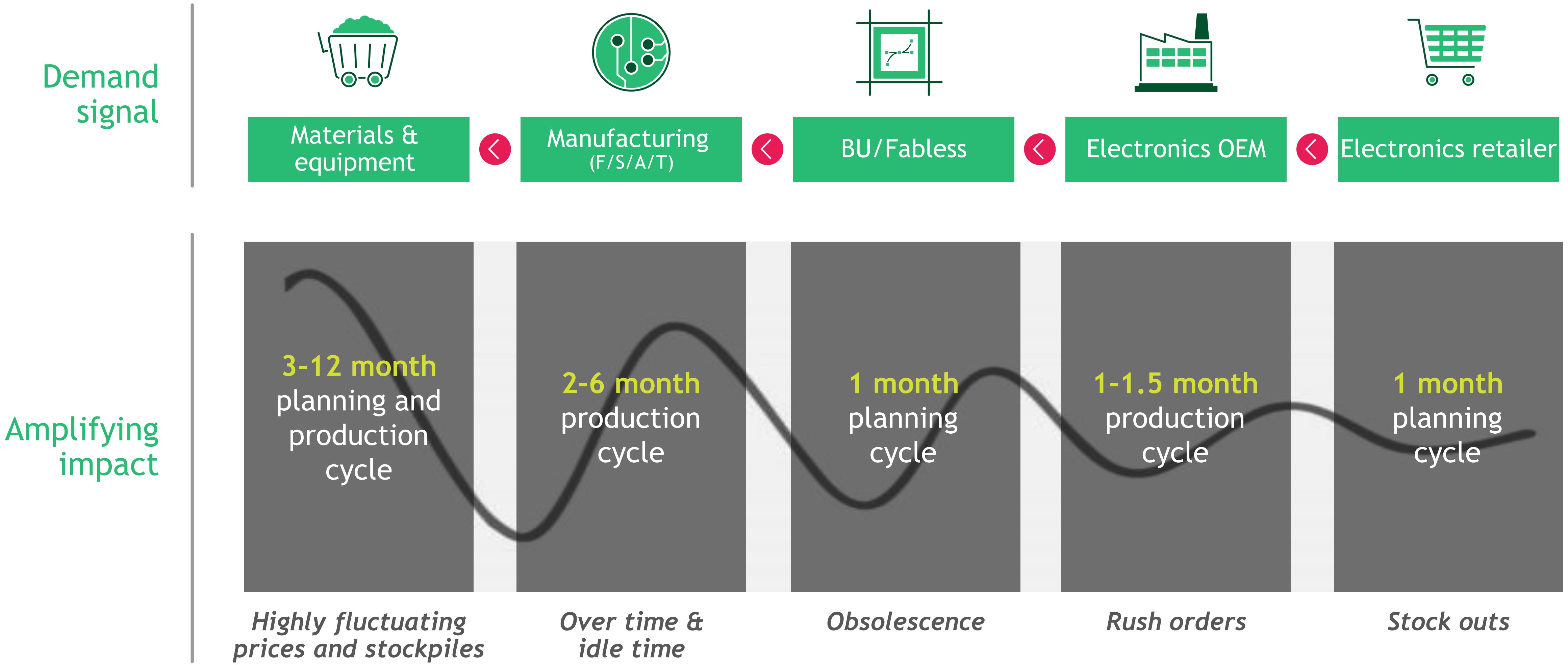
Demand[1] & Supply[2] for semiconductors excluding memory[3]
Indexed to 2018 average quarter



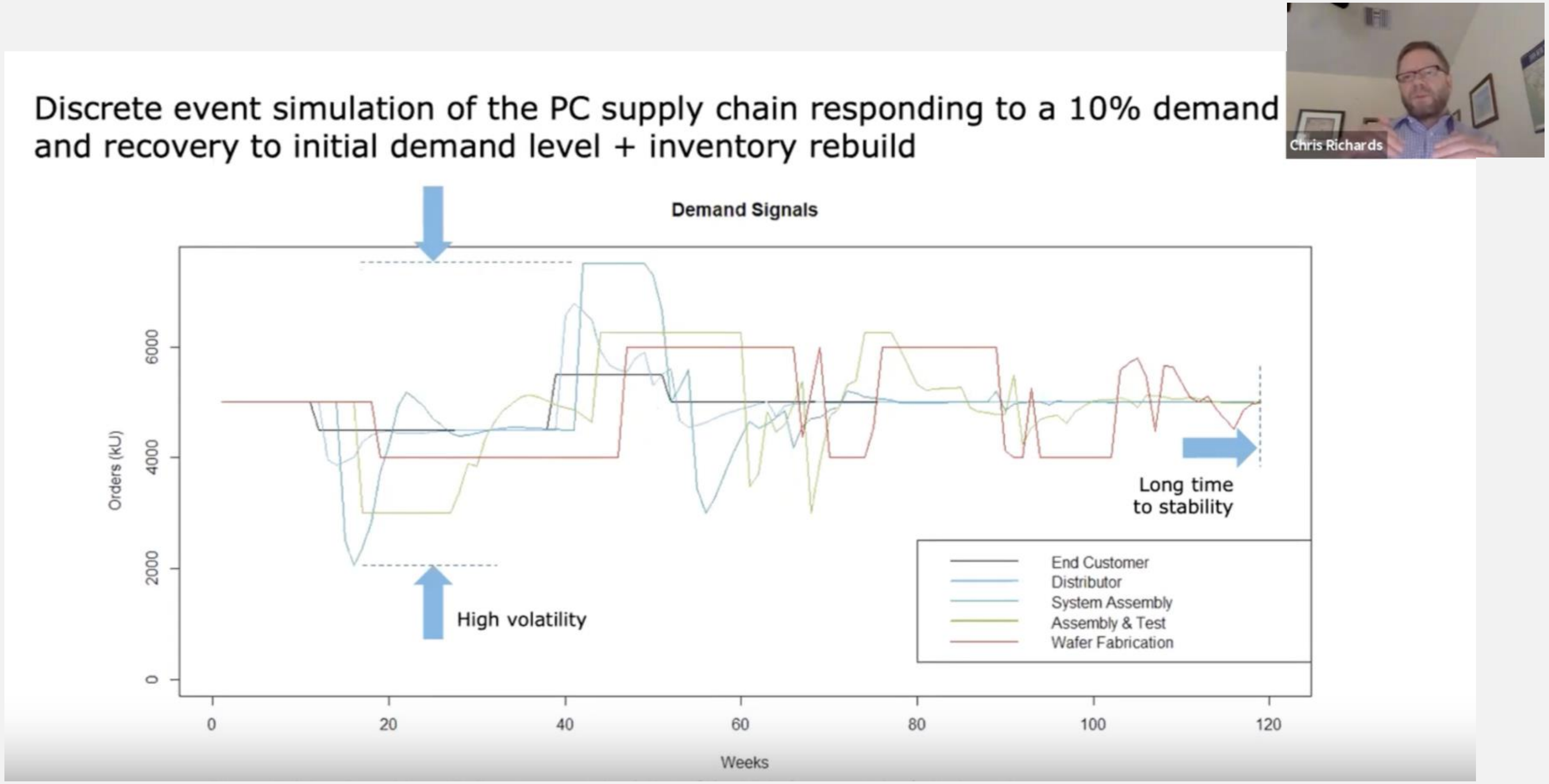

1. Past and forecasted IC sales: forecast derived from expected demand of representative industries 2. Past and forecasted foundry capacity 3. Due to surplus of memory supply from 2019 onward Note: semiconductors are purchased one quarter before actual end-market sales
Source: BCG IC Model Forecast, BCG analysis (November 2022)

# The world now knows that supply chains and chips are important to daily life

Long production cycles make the bullwhip effect pronounced in our industry



# In April 2020 I simulated the PC supply chain dynamics for a GSA webinar



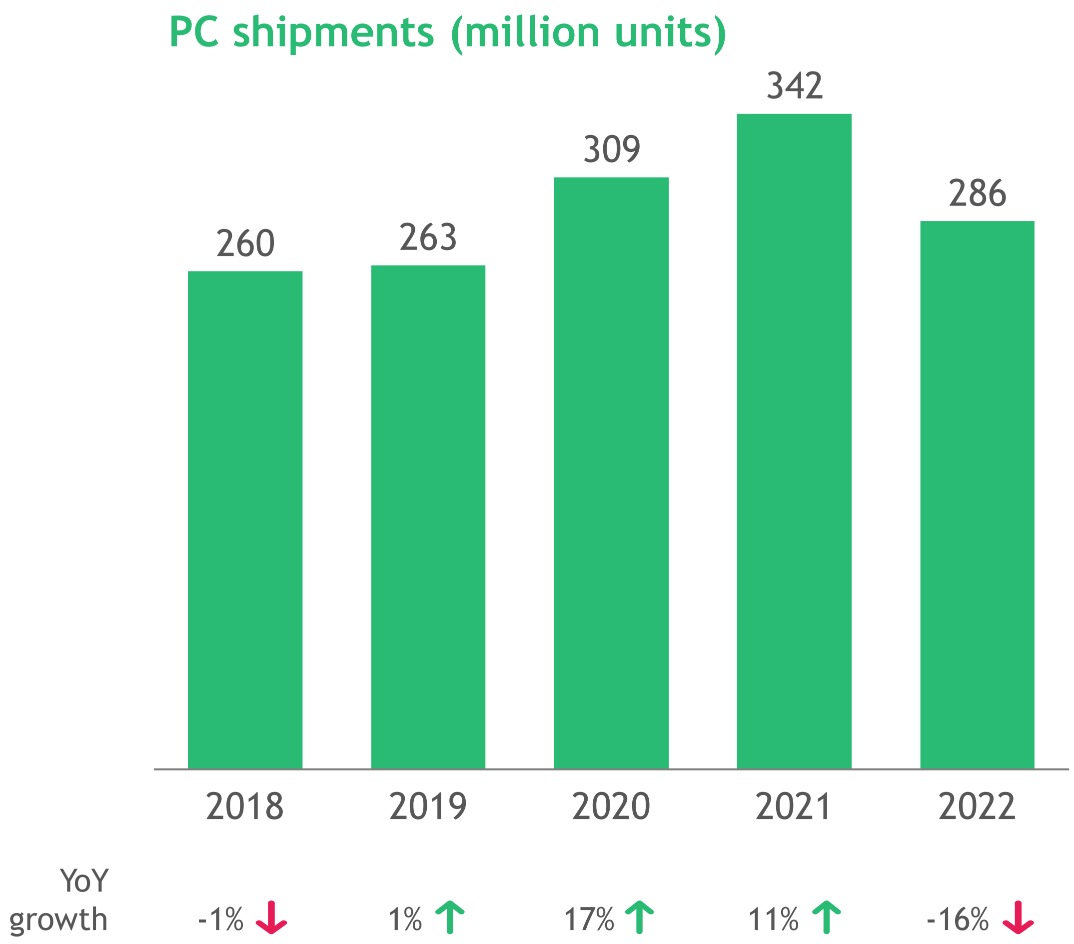

### Assumptions

- 10% drop in demand for 26 weeks
- 110% recovery for 13 weeks

### Conclusions

- A 10% disruption could cause 2+ years of supply chain disruption
- Be careful about cutting production too much

# But PC demand *increased*, making the supply chain challenges greater

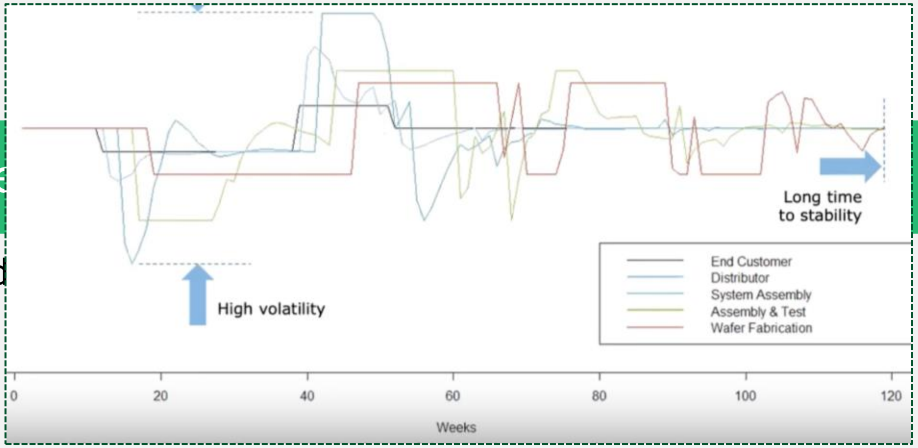



Work from home practices reversed the downward trend of client PC shipments

Wafer fabs were taxed to support unforested client demand on top of growing data center demand

Source: Statistia; BCG analysis

# We experienced widespread shifts in demand that continue to impact us today




2018/2019: "normal" market cycle

2023: return to "normal" market cycle

Demand[1] & Supply[2] for semiconductors exclud
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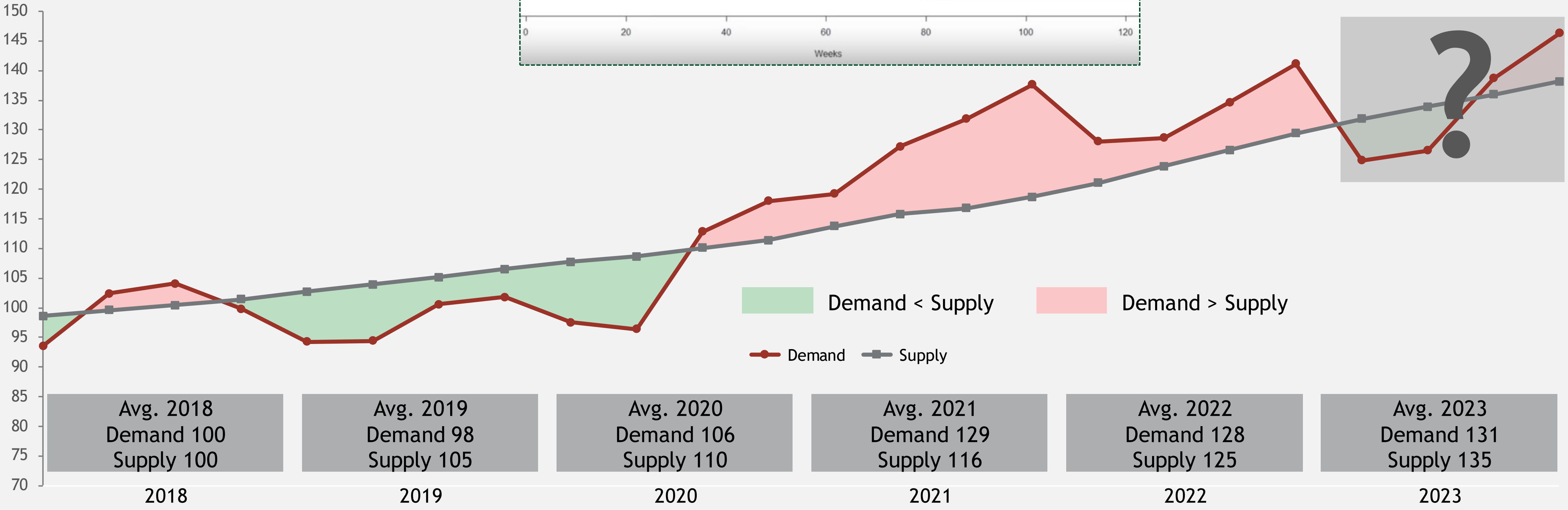
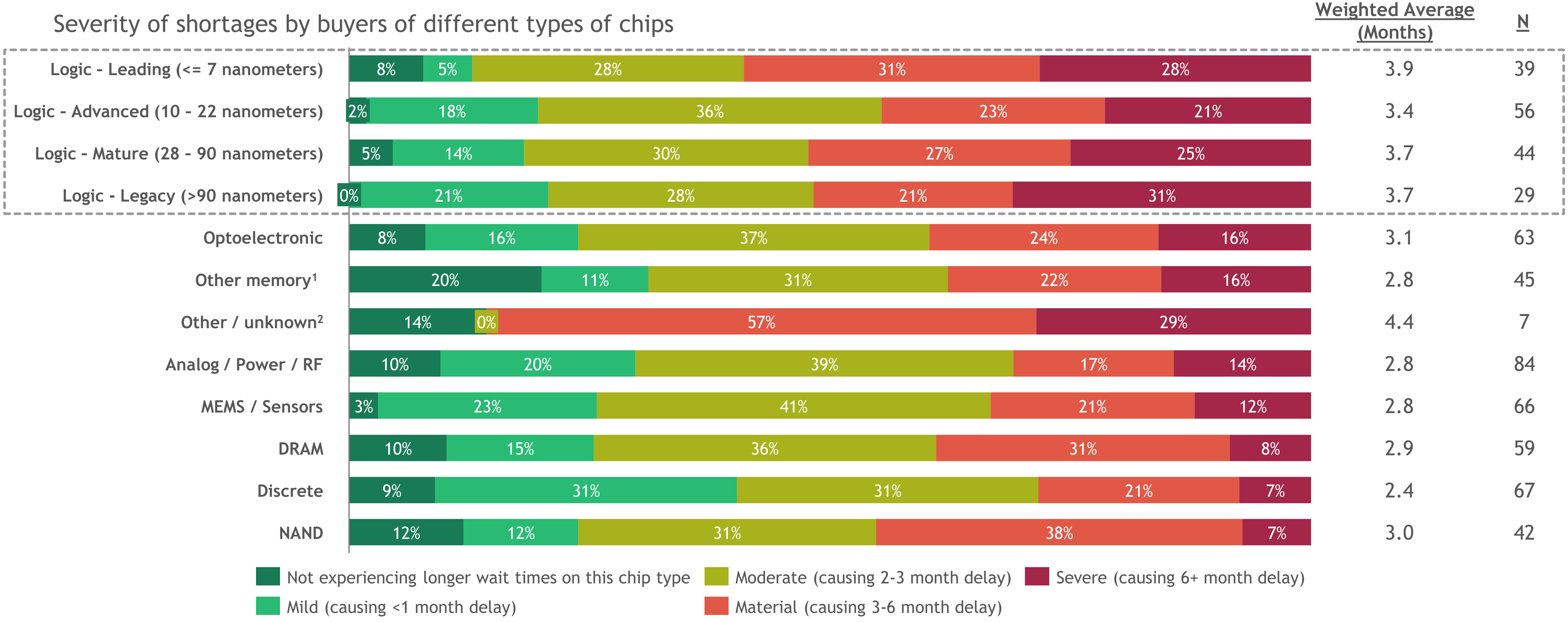


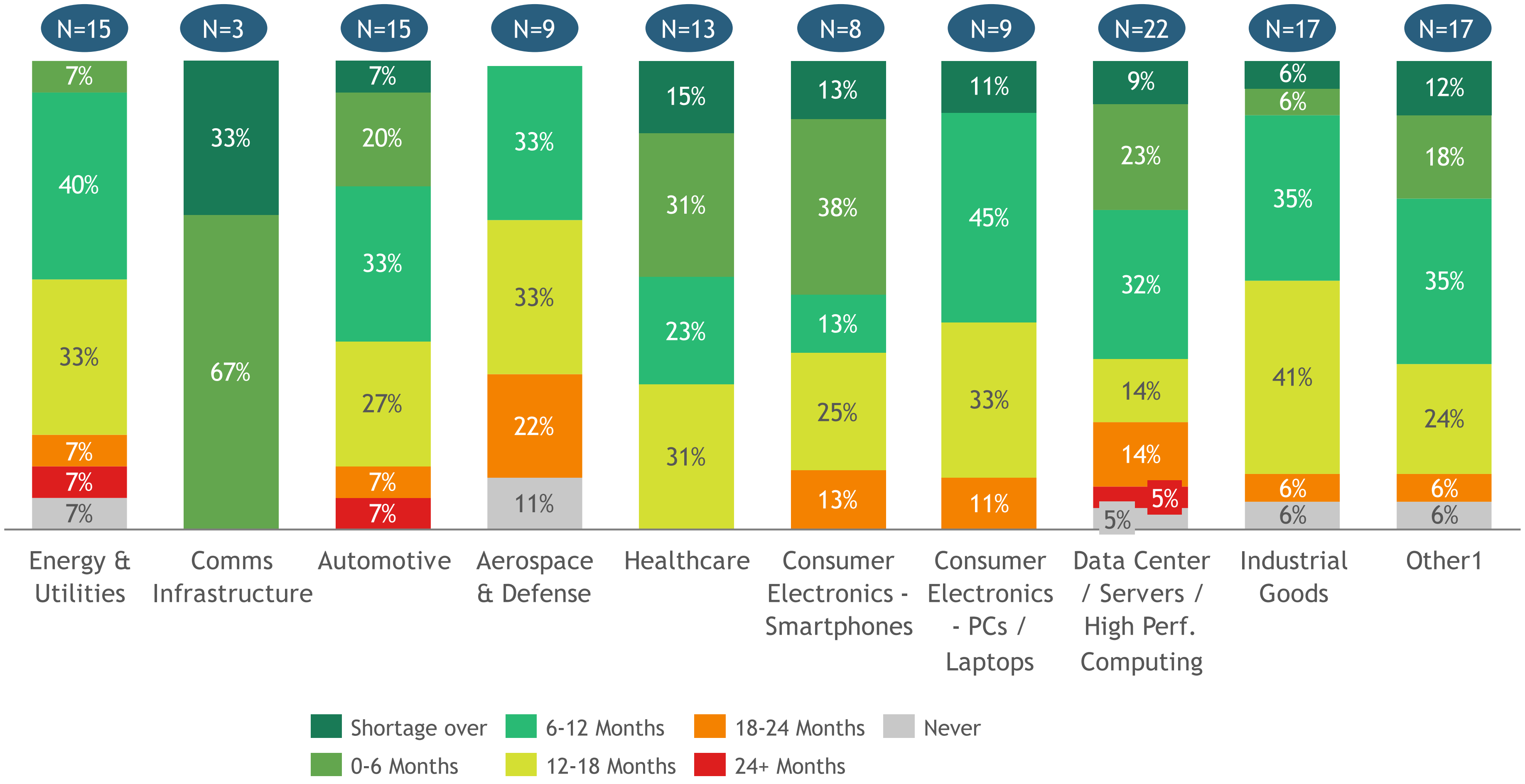
# Devices of all types became short of supply




1. "Other memory" was described as including EEPROM, NOR flash, SRAM 2. "Other" chips include MOSFETs, Wafers for PV panels
Source: BCG Study on Semiconductor Purchasing (February 2023); n = 128

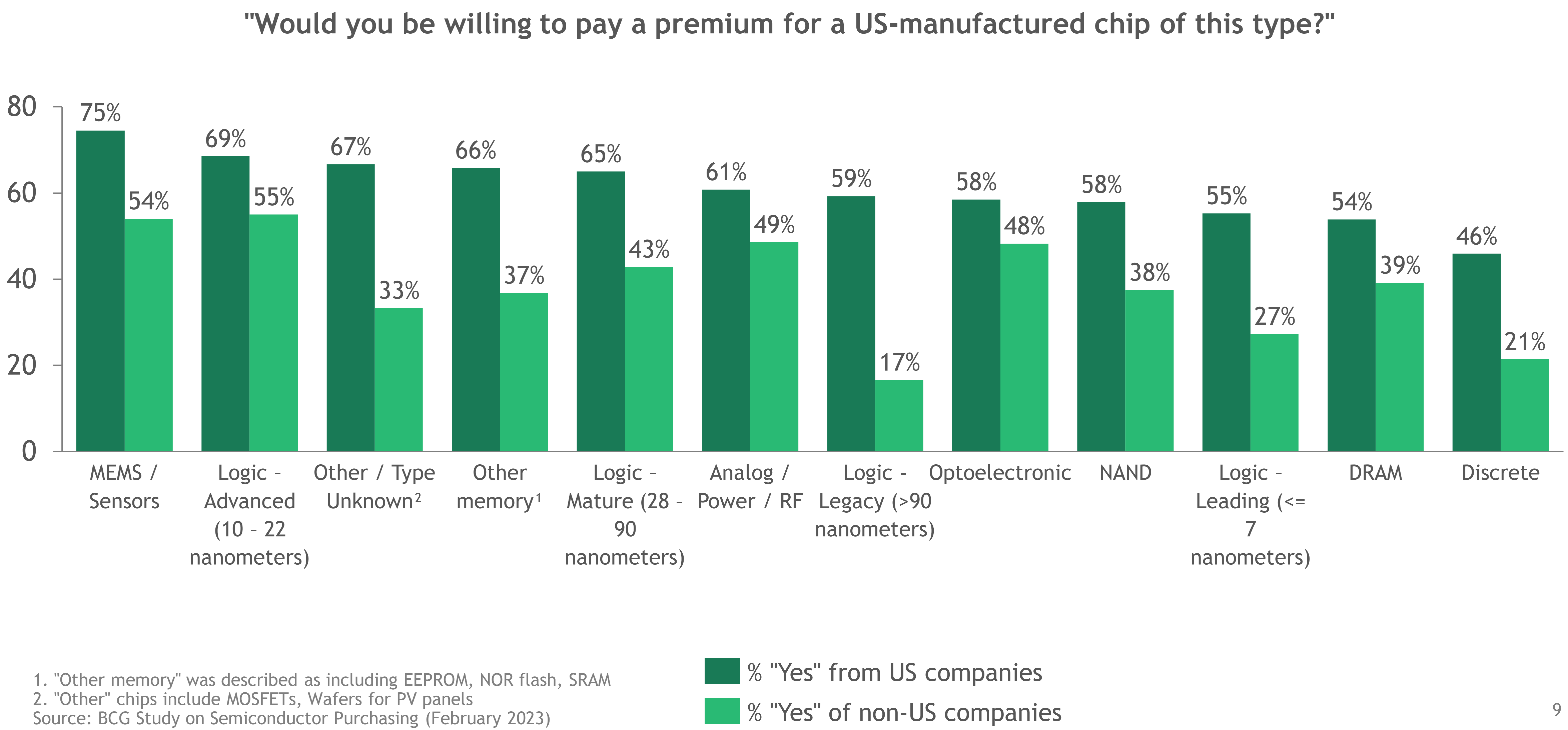
# Almost every industry was impacted by the shortages

Abatement period for semiconductor shortages, by industry



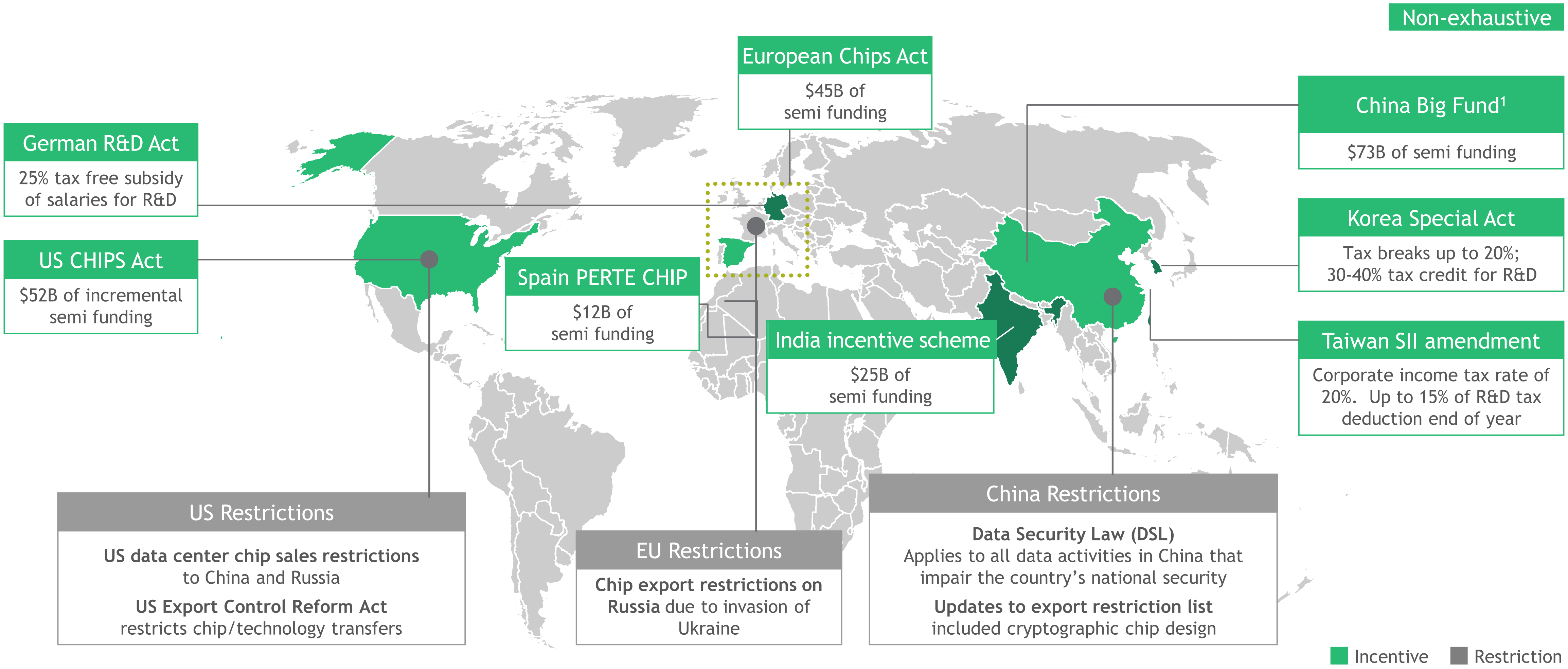

1. Other industries included: Gaming, Memory Manufacturer, Beverage, Food Manufacturing, Real Estate, Consulting;
Source: BCG Study on Semiconductor Purchasing (February 2023); n=128

# Many companies are now thinking differently about cost-resiliency tradeoffs




1. "Other memory" was described as including EEPROM, NOR flash, SRAM
2. "Other" chips include MOSFETs, Wafers for PV panels
Source: BCG Study on Semiconductor Purchasing (February 2023)

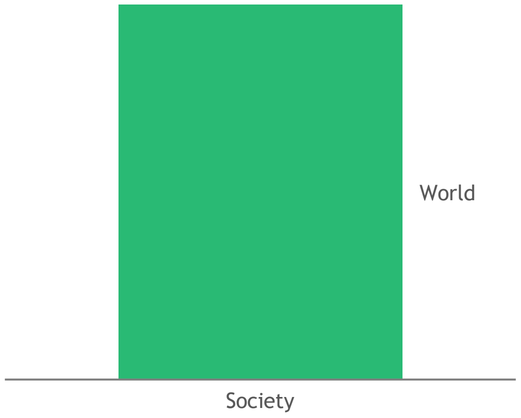
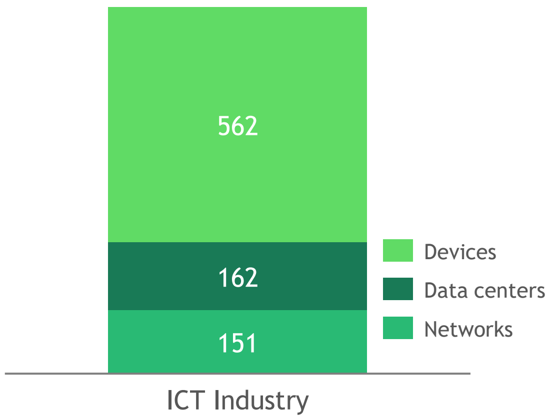
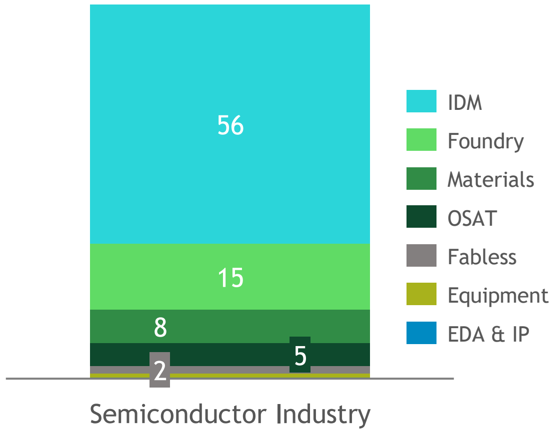
# Semiconductors are increasingly becoming more central to global geopolitics



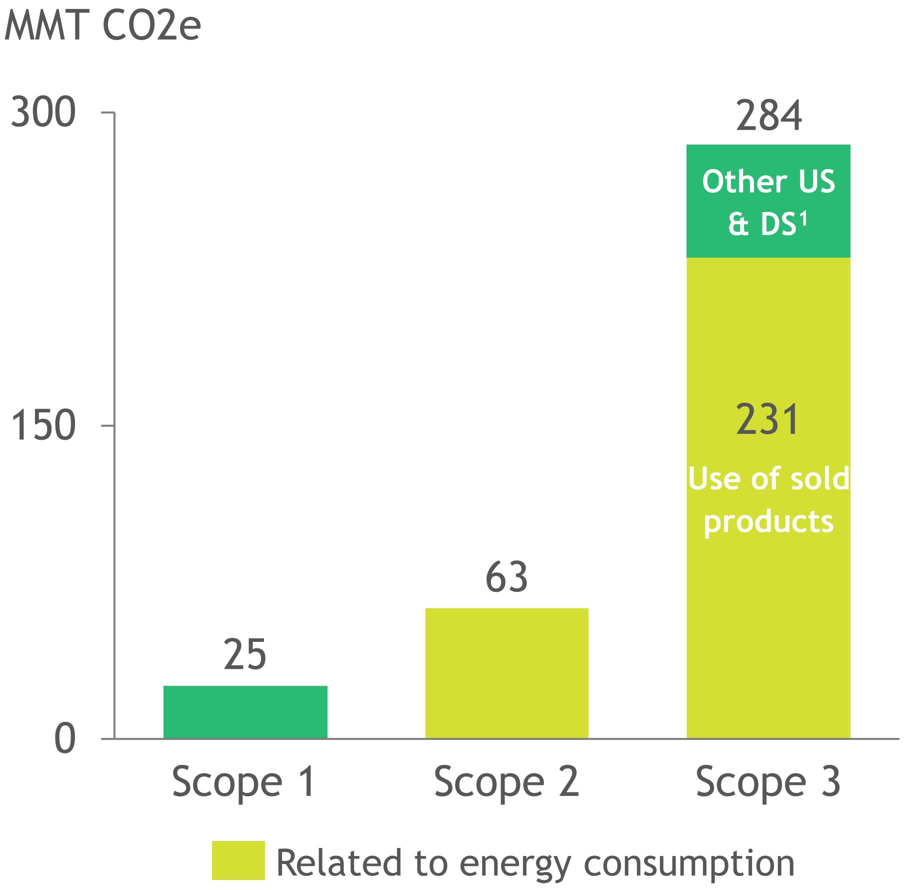

1. Big Fund = National Integrated Circuits Industry Development Investment Fund. Note: Capacity plans are rounded estimates; SII = Statute for Industrial Innovation; PERTE = Strategic Project for Economic Recovery and Transformation

Source: NPR, Reuters, Business Journal Daily, Forbes, EETimes, SeekingAlpha, FierceElectronics, WeForum, Skadden, CNBC, Semiconductors.org, BBC, TechCrunch, The Korea Herald, BCG Analysis

# The semiconductor industry directly produces ~0.2% of global emissions

| | Society | Info & Comms Tech (ICT) | Semiconductor Production |
|---|---|---|---|
| Total greenhouse gas emissions (CO2e) | ~ 50,000 MMT<br>100% of global emissions | ~ 1,000 MMT<br>2% of global emissions | ~ 100 MMT<br>0.2% of global emissions |
| Distribution of greenhouse gas emissions (CO2e) |   Source: UN Environment Programme, excl. impact land use change, OurWorldinData |   Source: ITU, ghg trajectories for ict sector compatible with UNFCCC Paris Agreement, Andrae |   Source: CDP, SEMI FAB, Gartner, BCG analysis |
| Data quality | | | |

# Vast majority of Semiconductor industry emissions are tied to electricity use




**Scope 1**
Direct emissions that occur from sources that are owned or controlled by the company

**Scope 2**
Indirect emissions from generation of electricity purchased by the company

**Scope 3**
Emissions resulting from activities of the company, but from sources not owned or controlled by the company, such as lifetime use of sold products

1. Emissions from other upstream and downstream sources
Source: GHG Protocol, CDP, SEMI FAB, Gartner, BCG analysis

# Challenges and opportunities abound!

## Challenges

- Autonomous/EVs
- Generative AI workloads
- C&S pressures
- Geopolitics
- Leading node yields and costs

## Opportunities

- Increasingly regionalized supply chains
- Increased focus on power consumption & device efficiency
- Advanced node technology
- Chiplet-based architectures

Source: BCG research

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