BOSTON CONSULTING GROUP

SIA SEMICONDUCTOR INDUSTRY ASSOCIATION

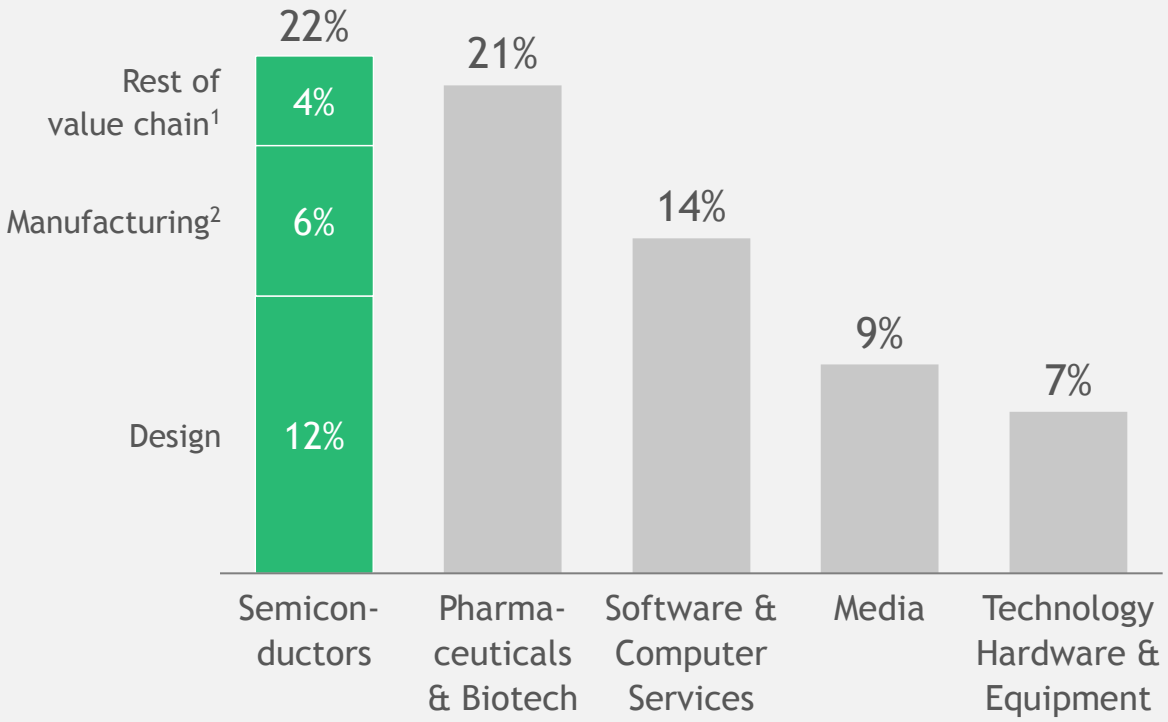
Strengthening the Global Semiconductor Supply Chain in an Uncertain Era

Slides for webinar

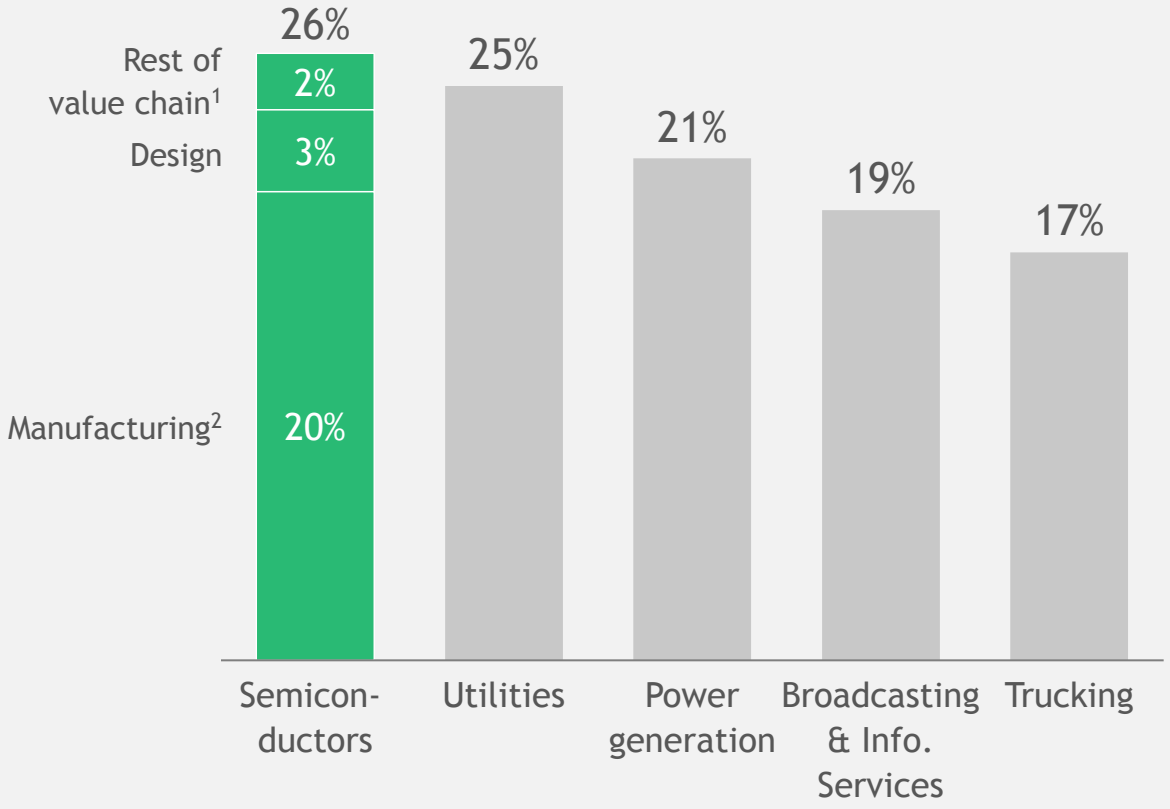
APRIL 6, 2021

The semiconductor industry ranks high simultaneously in both R&D and capital intensity

R&D as % of Revenues, 2019



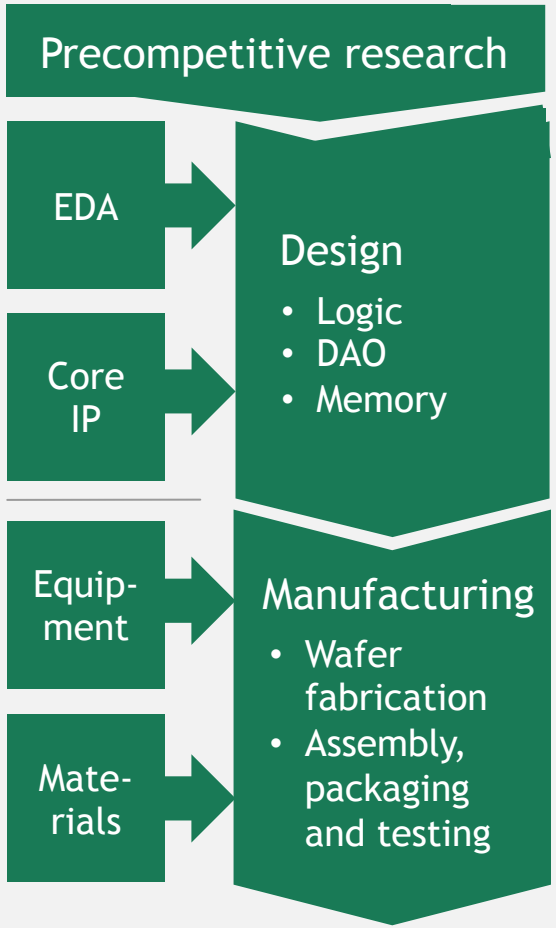
Capital Expenditure as % of Revenues, 2019



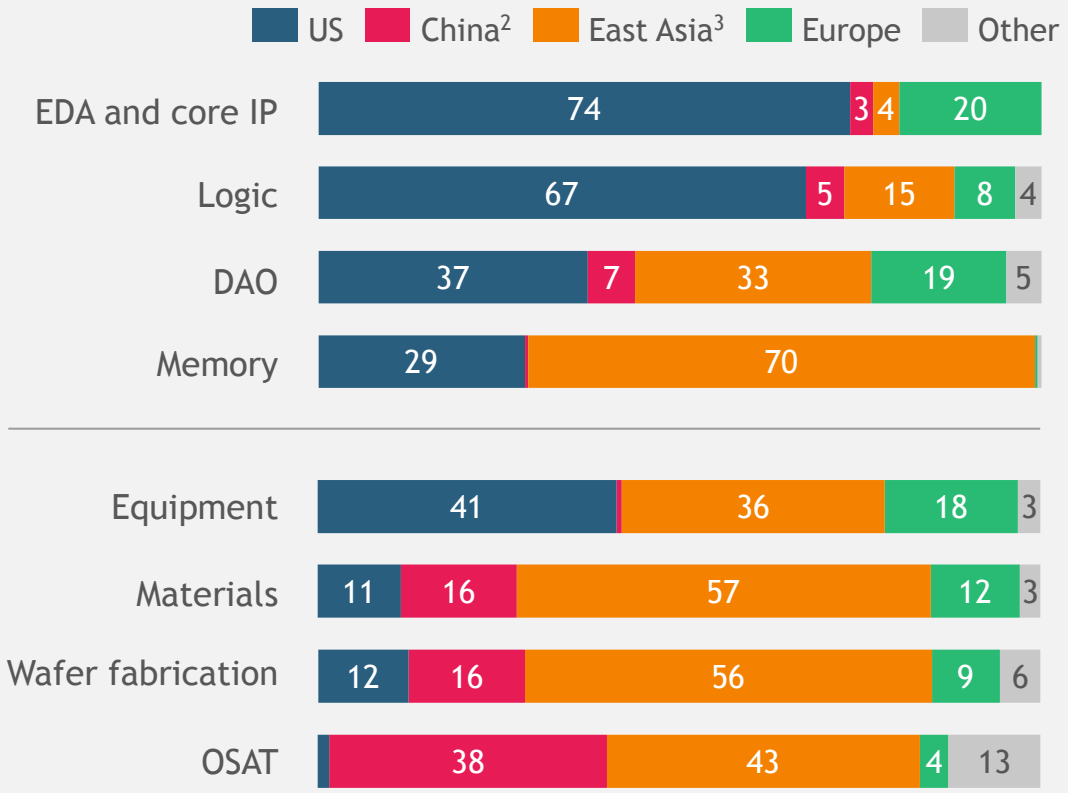
1. Includes EDA and Core IP, Equipment and Materials 2. Includes Wafer Fabrication and Assembly & Test
Sources: BCG analysis based on Capital IQ data

The global semiconductor supply chain based on geographic specialization has delivered enormous value for the industry

Semiconductor Supply Chain



Share by region[1] (% of worldwide total, 2019)



Costs savings vs. fully localized "self-sufficient" supply chains:

$0.9-1.2T
avoided upfront investment

$45-125B
annual cost efficiencies

35-65%
enabled reduction in semiconductor prices

Source: BCG analysis
Note: DAO = discrete, analog, and other (including optoelectronics and sensors); EDA = electronic design automation; OSAT = outsourced assembly and test
1. For EDA and core IP, design, manufacturing equipment and raw materials the regional breakdown is based on company revenues and company headquarters location. For wafer fabrication and OSAT is based on installed capacity and geographic location of the facilities 2. Mainland China 3. East Asia includes South Korea, Japan, and Taiwan

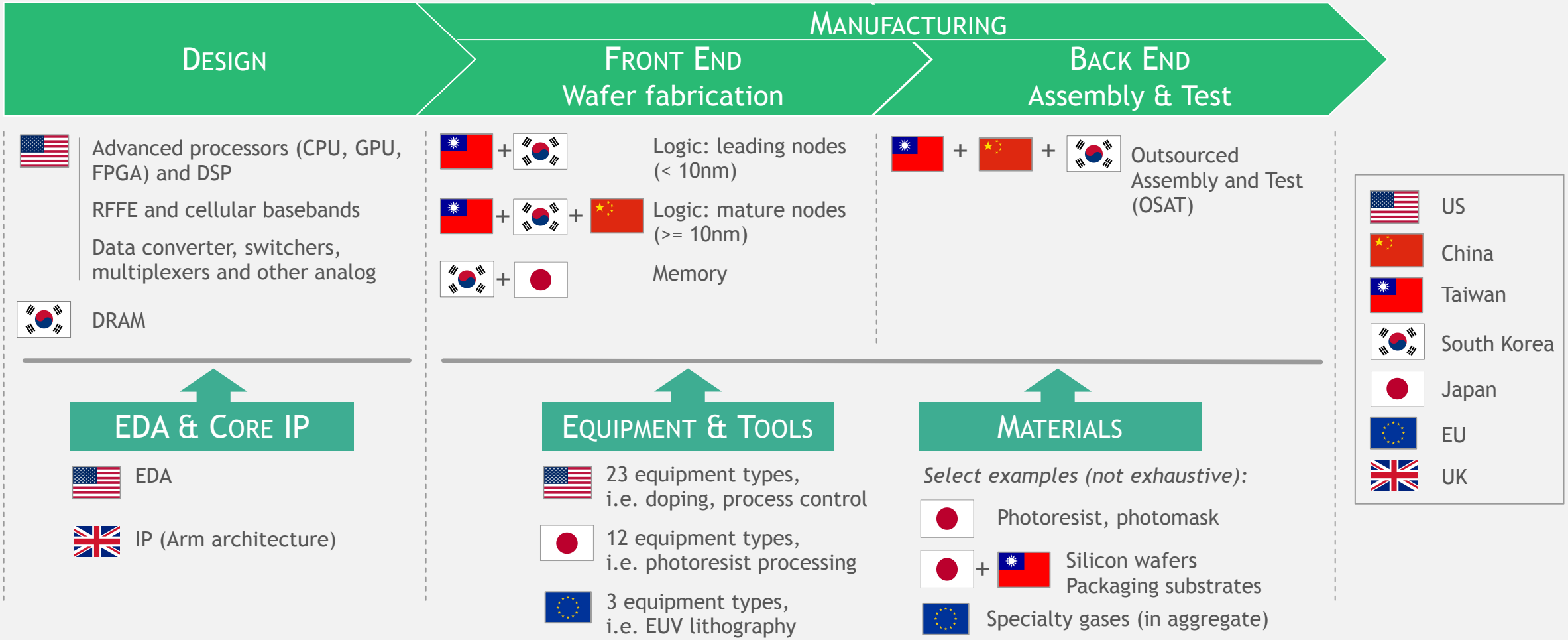
Five key vulnerabilities identified in the semiconductor supply chain

Risk factor	Description	Current examples
 High geographic concentration of some activities	Single points of failure which may be disrupted by natural disasters, infrastructure failures, cyberattacks or geopolitical frictions	• Wafer fabrication • Assembly, packaging & testing • Some specialty materials FOCUS AREA IN REPORT
 Geopolitical frictions	Broad export controls over inputs or technologies with no viable alternative suppliers in other countries	• US-China frictions • Japan – S. Korea frictions
 National self-sufficiency policies	National industrial policies that seek broad import substitution or broadly discriminate against foreign suppliers, leading to distortion in global competition and risk of overcapacity	• China policies in pursuit of "self sufficiency" across the semiconductor value chain
 Talent constraints	Current growth in talent pool of Science & Engineering graduates is insufficient to meet the industry demand for technical talent	• All countries, but US in particular given leadership in R&D intensive activities and reliance on attracting & retaining global talent
 Stagnation in funding of basic research	Government programs and funding play a critical role in basic research, which is essential for the semiconductor industry	• US government-funded R&D in semiconductors has stagnated and is below overall level across all sectors

GEOGRAPHIC CONCENTRATION

50+ points of high geographical concentration across the supply chain (but not all with the same level of associated risk)

VALUE CHAIN ACTIVITIES WHERE ONE SINGLE REGION ACCOUNTS FOR ~65% OR MORE OF GLOBAL SHARE[1]



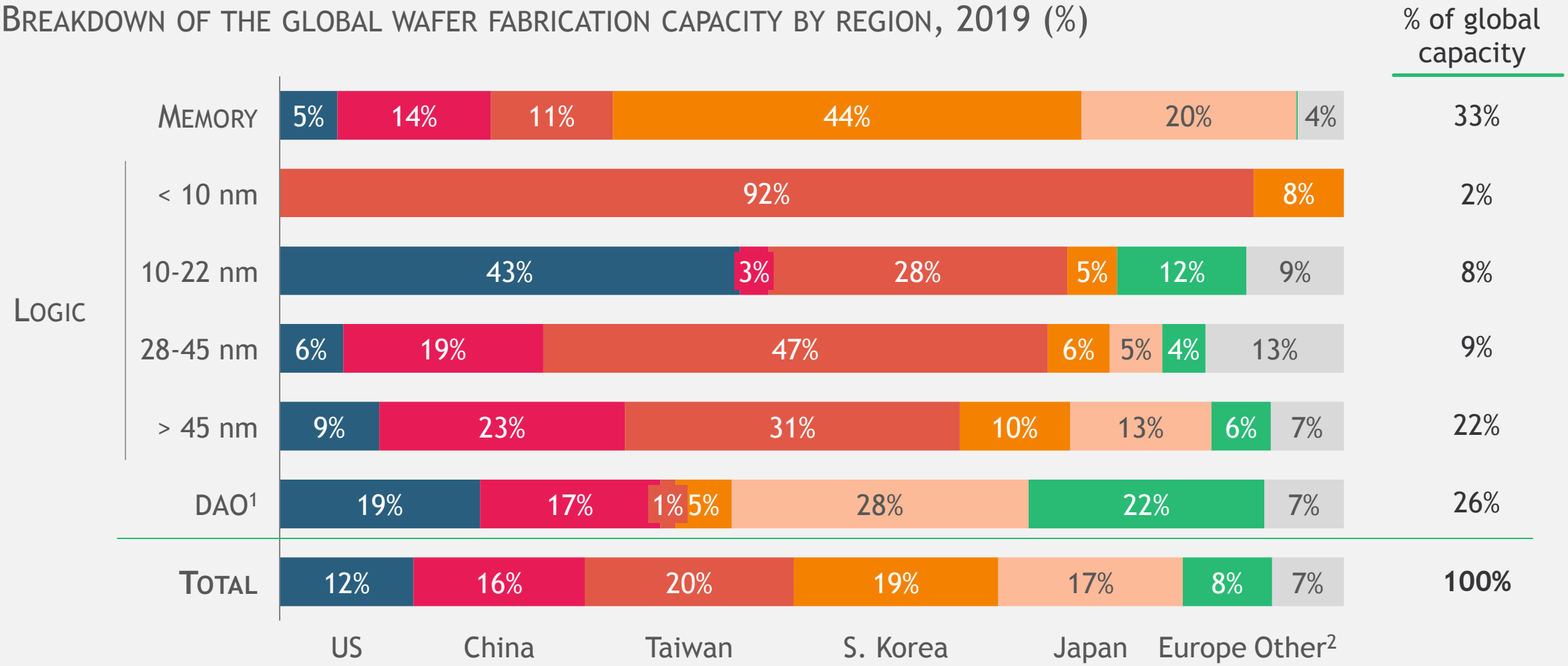
1. For Design, EDA & Core IP, Equipment & Tools and Raw Materials: global share measured as % of revenues, based on company headquarter location. For Manufacturing (both Front End and Back End) measured as % of installed capacity, based on location of the facility

Sources: BCG analysis with data from Gartner, SEMI, UBS; SPEEDA

GEOGRAPHIC CONCENTRATION

East Asia + China concentrate ~75% of the wafer fabrication capacity; in particular, ~90% of advanced logic capacity <10 nm is located in Taiwan

BREAKDOWN OF THE GLOBAL WAFER FABRICATION CAPACITY BY REGION, 2019 (%)

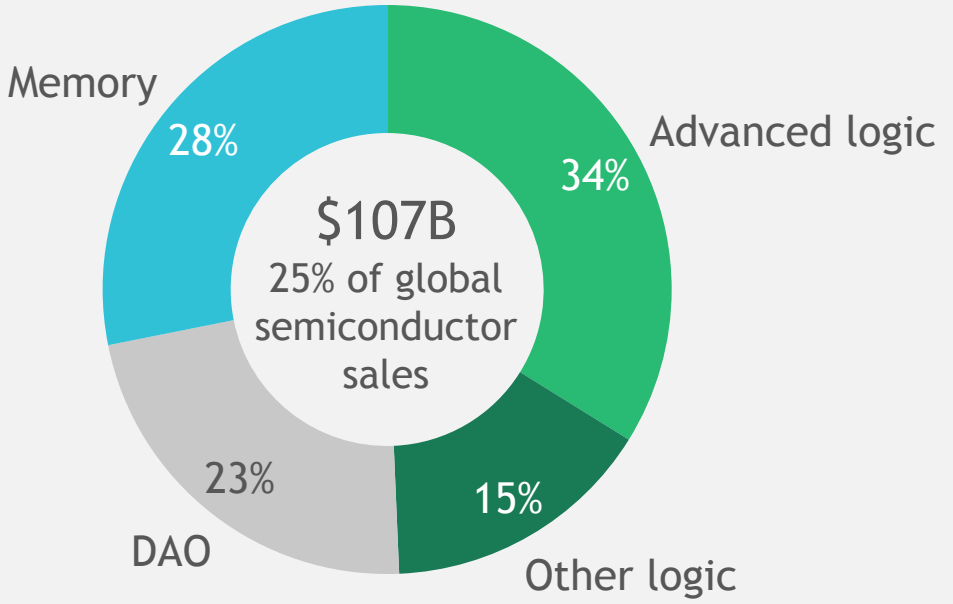


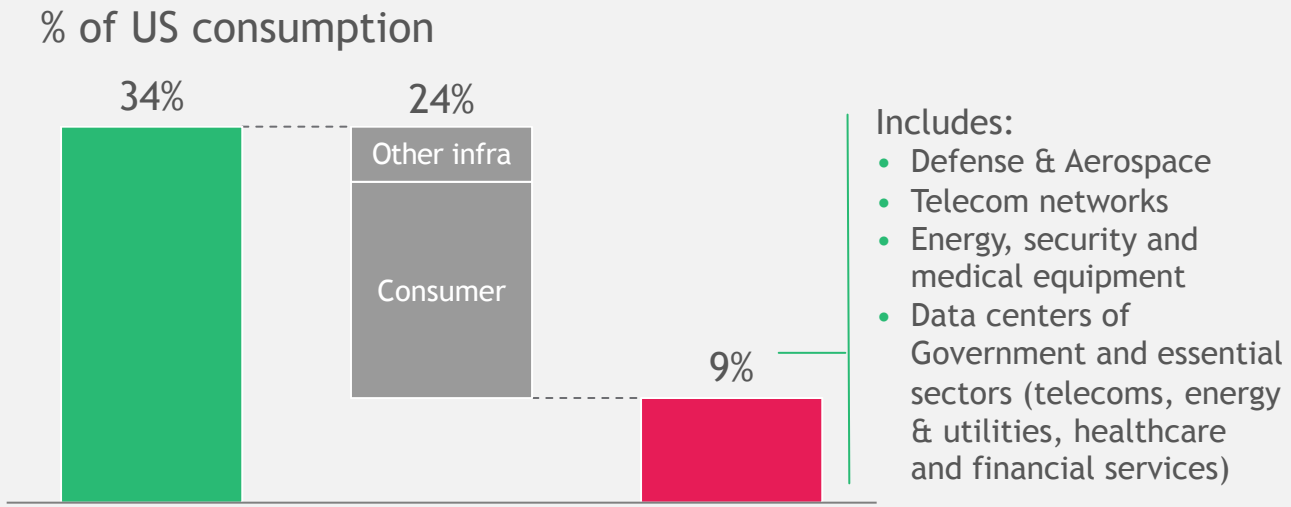
1. Discrete, analog and optoelectronics and sensors 2. Other includes Israel, Singapore and the rest of the world
Sources: BCG analysis with data from SEMI fab database

GEOGRAPHIC CONCENTRATION

Enhancing the supply chain resilience through a focused approach: example of US minimum viable capacity for advanced logic (< 10nm)

Breakdown of Total US Semiconductor Consumption, 2019





	Total US advanced logic consumption	Other applications	Critical infrastructure
% US Capacity / Consumption	49%	0%[1]	0%[1]
10-year investment[2] in new fabs for onshore coverage in 2030 ($B) (Private sector + Government incentives[3])	980+420 *60-65 new fabs*	140+60 *6-7 new fabs*	45+18 2-3 new fabs of 20-35 kwpm

1. Considering only leading node capacity (< 10nm) 2. Total Cost of Ownership – includes capex and 10 years of opex, before government incentives 3. Includes both existing local/state incentives and potential new federal incentives Sources: BCG analysis

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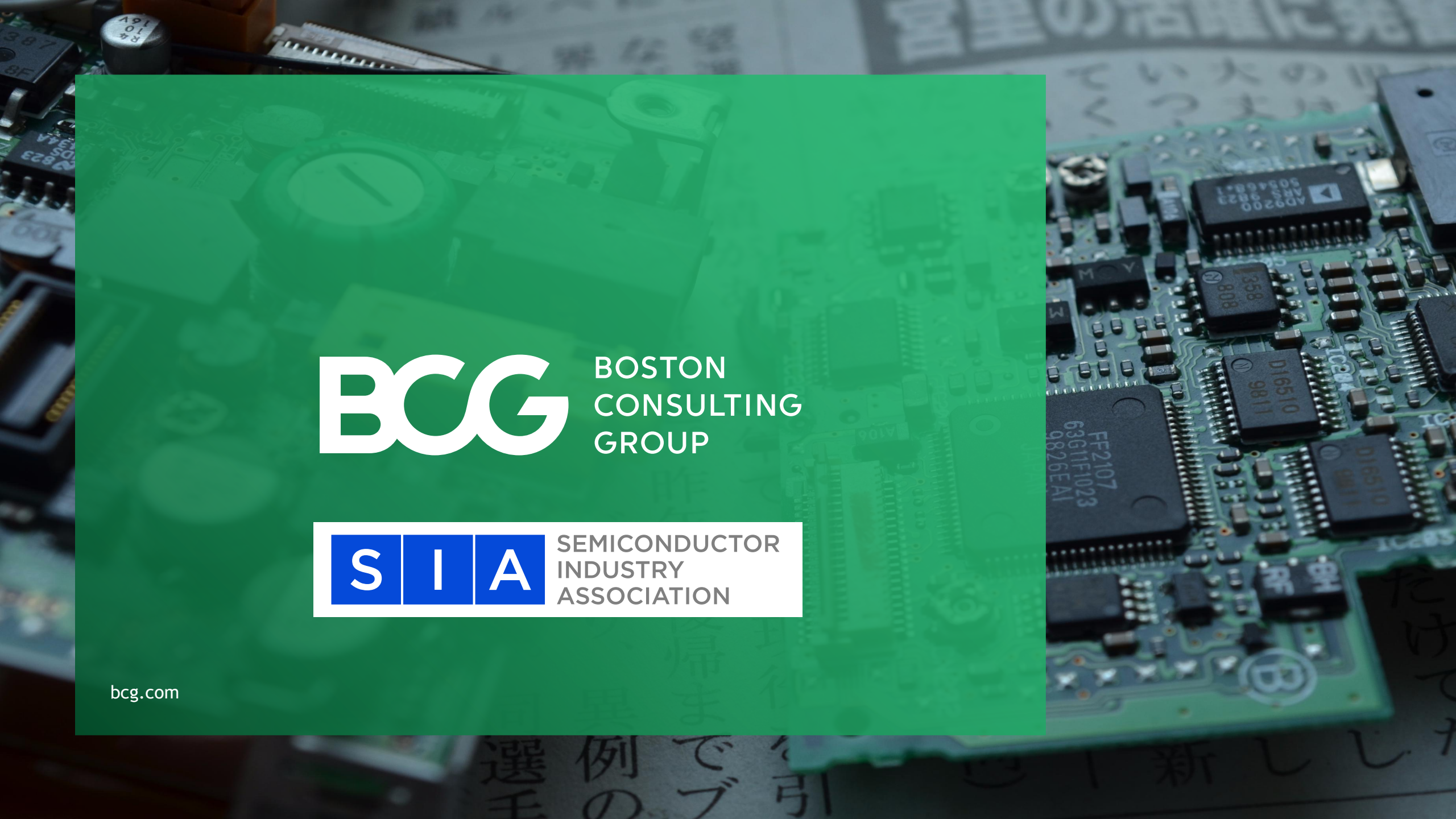

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