ICOS
International Cooperation On Semiconductors

Challenges in Advanced Computing and Functionalities
International Cooperation on Semiconductors

Economic landscape analysis to identify opportunities for cooperation ICOS WP2

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DECISION Etudes & Conseil

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Presentation of WP2: Economic Landscape Analysis

Goals

Economic analysis of the EU semiconductor ecosystem

- Economic / industrial strengths & weaknesses
- Identification of strategic dependencies

=> Identify opportunities for cooperation with 7 countries:

The USA, China, Japan, South Korea, Taiwan, India and Singapore

=> Including photonics-based semiconductors analysis from UGent

Table of contents of the report D2.1
World and the EU

1) Overview of the semiconductor industry in the world

a) Overall context
b) The global semiconductor landscape
c) Worldwide leading players in the value chain
d) Frontend production capacities

2) The EU semiconductor industry

a) Overall environment and strategic objectives
b) The EU semiconductor market
c) The EU semiconductor industry
d) International trades
e) Ongoing investments in the EU
f) Strengths and dependencies
g) Existing cooperation in which the EU is involved

→ **Same content for 7 countries**

Agenda – today's presentation

1) Overview of the global semiconductor industry
2) Overview of the global electronics industry
3) Overview of the EU semiconductor ecosystem
   - Industry, Market, trades, skills, dependencies, roadmap for cooperation
4) Snapshot – Japan semiconductor ecosystem
5) Snapshot – South Korean semiconductor ecosystem
6) Snapshot – US semiconductor ecosystem
7) Snapshot – Indian semiconductor ecosystem

Overview of the global semiconductor industry

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Semiconductor front-end manufacturing in 2023

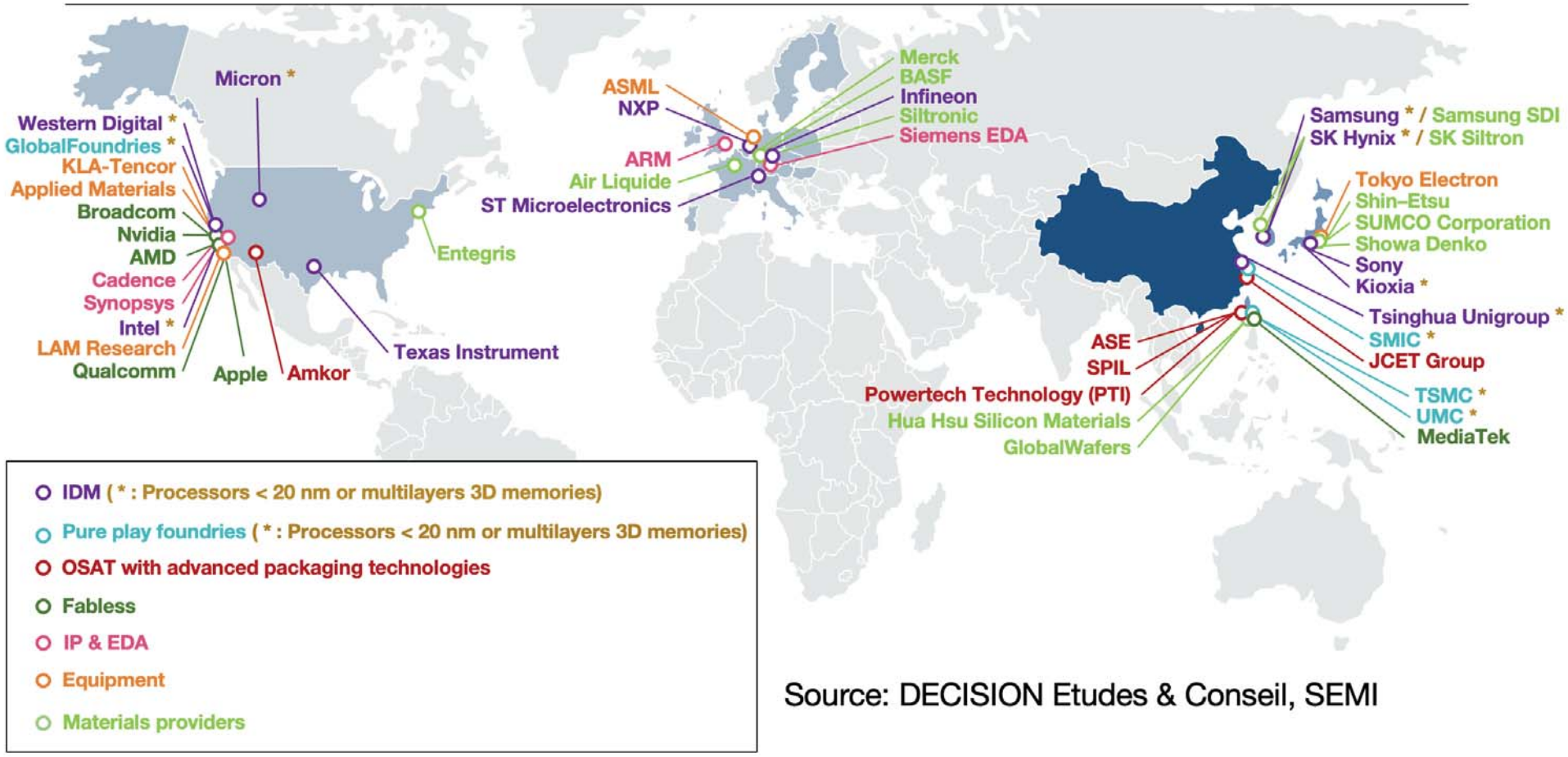
Main countries where semiconductor production is located (Front-end) (% of world production, Q4 2022)

- China ~23%
- South Korea ~19%
- Taiwan ~18%
- Japan ~15%
- The USA ~10%
- Europe ~7%
- Rest of the World ~7%

➢ Asian regions counting for 75% of global capacities

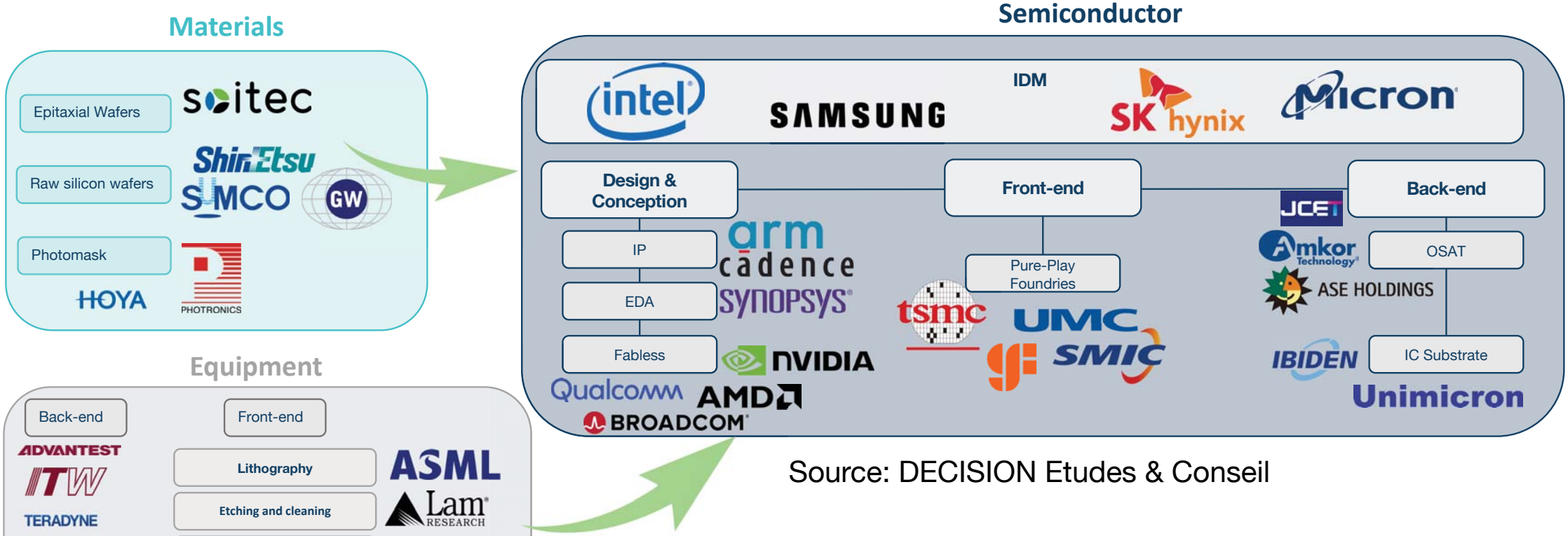
Source: DECISION Etudes & Conseil, SEMI

Semiconductor landscape in 2023



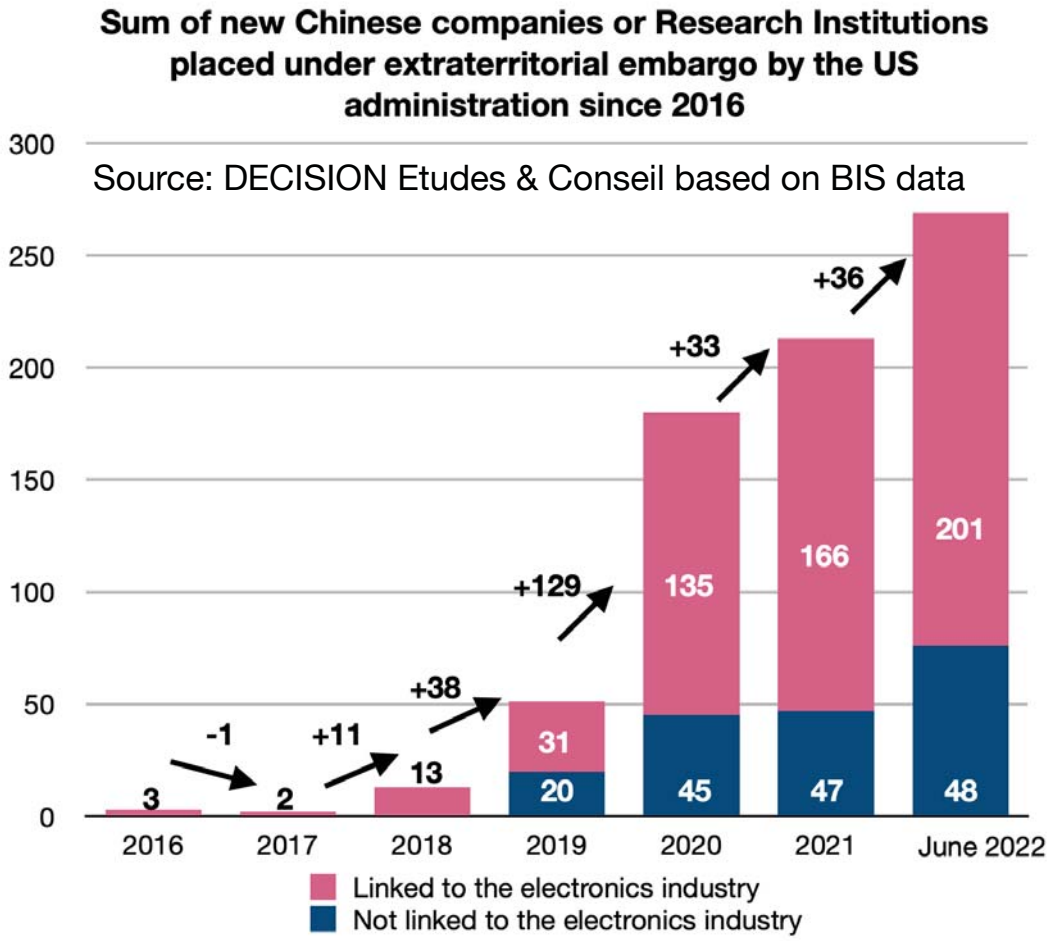
Source: DECISION Etudes & Conseil, SEMI

Leading companies in the semiconductor value chain



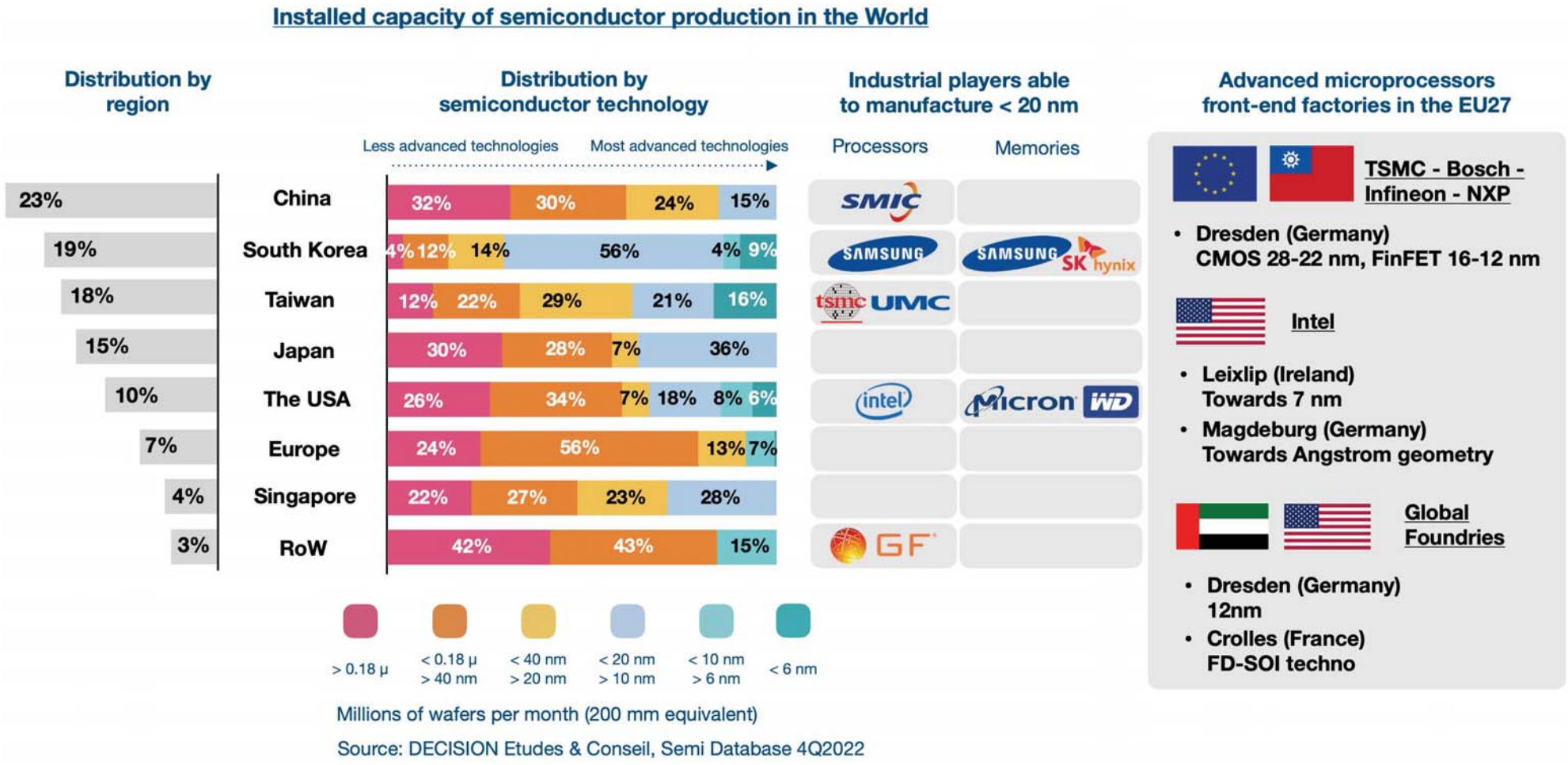
Source: DECISION Etudes & Conseil

Summary of the export ban list on China from the US



- Increasing every year

Frontend production capacities in 2022



Overview of the global electronics industry

DECISION Etudes & Conseil

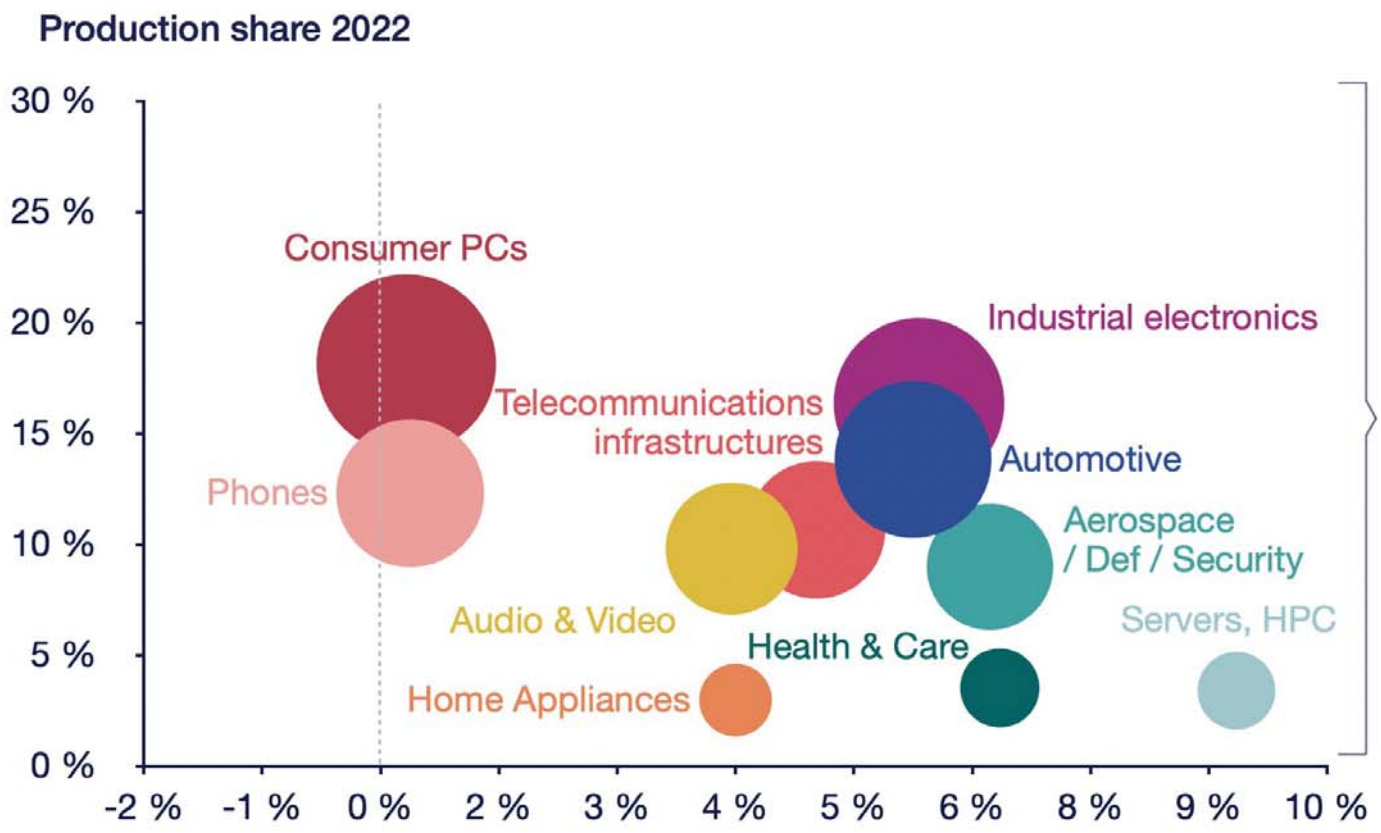
From components to systems

World Electronic manufacturing value chain in 2023

Source : DECISION Etudes & Conseil

CONFIDENTIAL

Compared growth of the electronics segments in the World

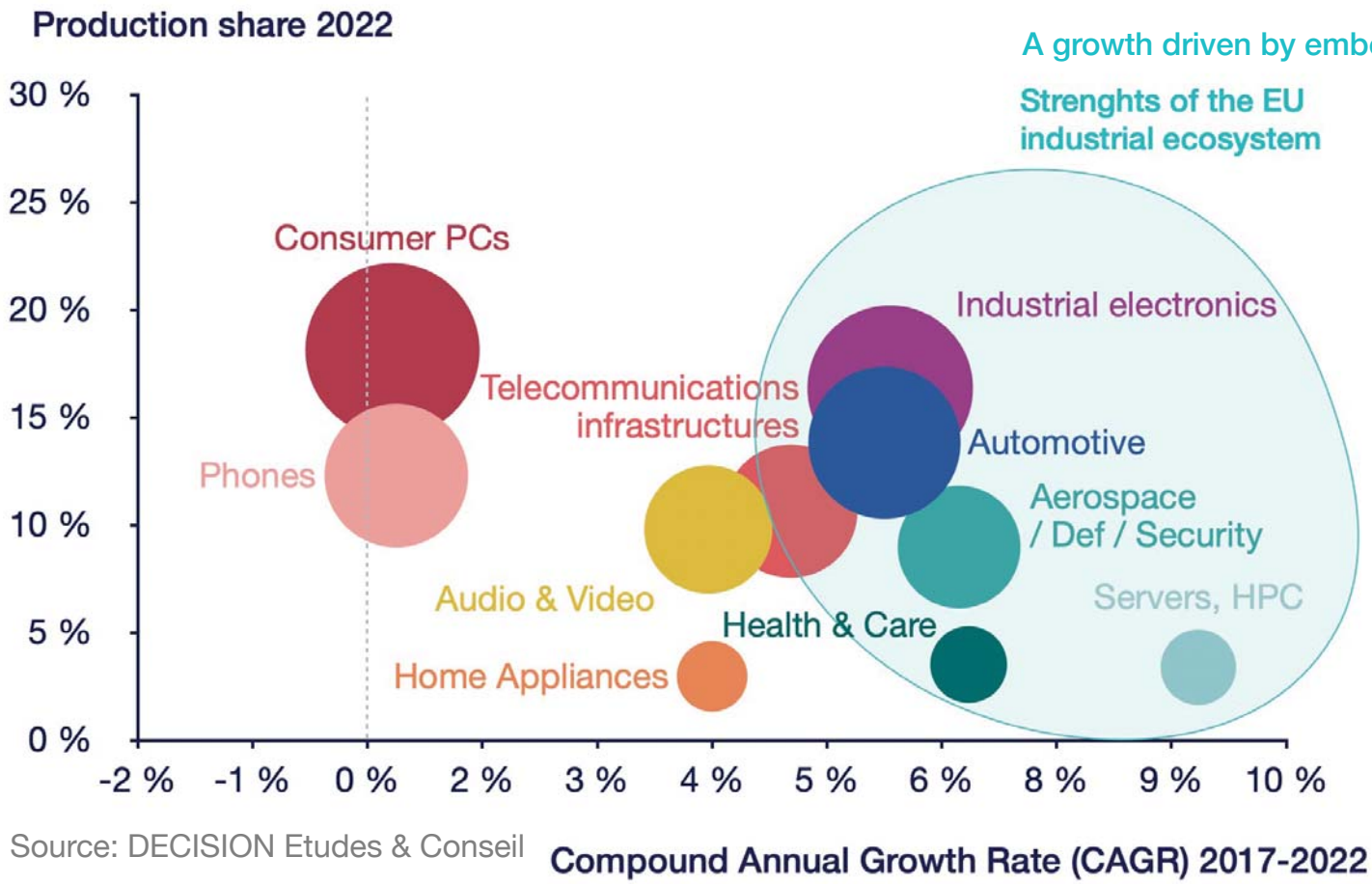


MARKET DRIVERS

- Industry 4.0
- E-mobility / Infotainment / Autonomous driving
- Safe city / Border control / Digital Identities
- Wearable, positive impact of COVID
- AI, Big data applications, positive impact of COVID
- 5G / Lora / Sigfox…
- Smart home
- 5G Phones, foldable

Source: DECISION Etudes & Conseil

Compared growth of the electronics segments in the World



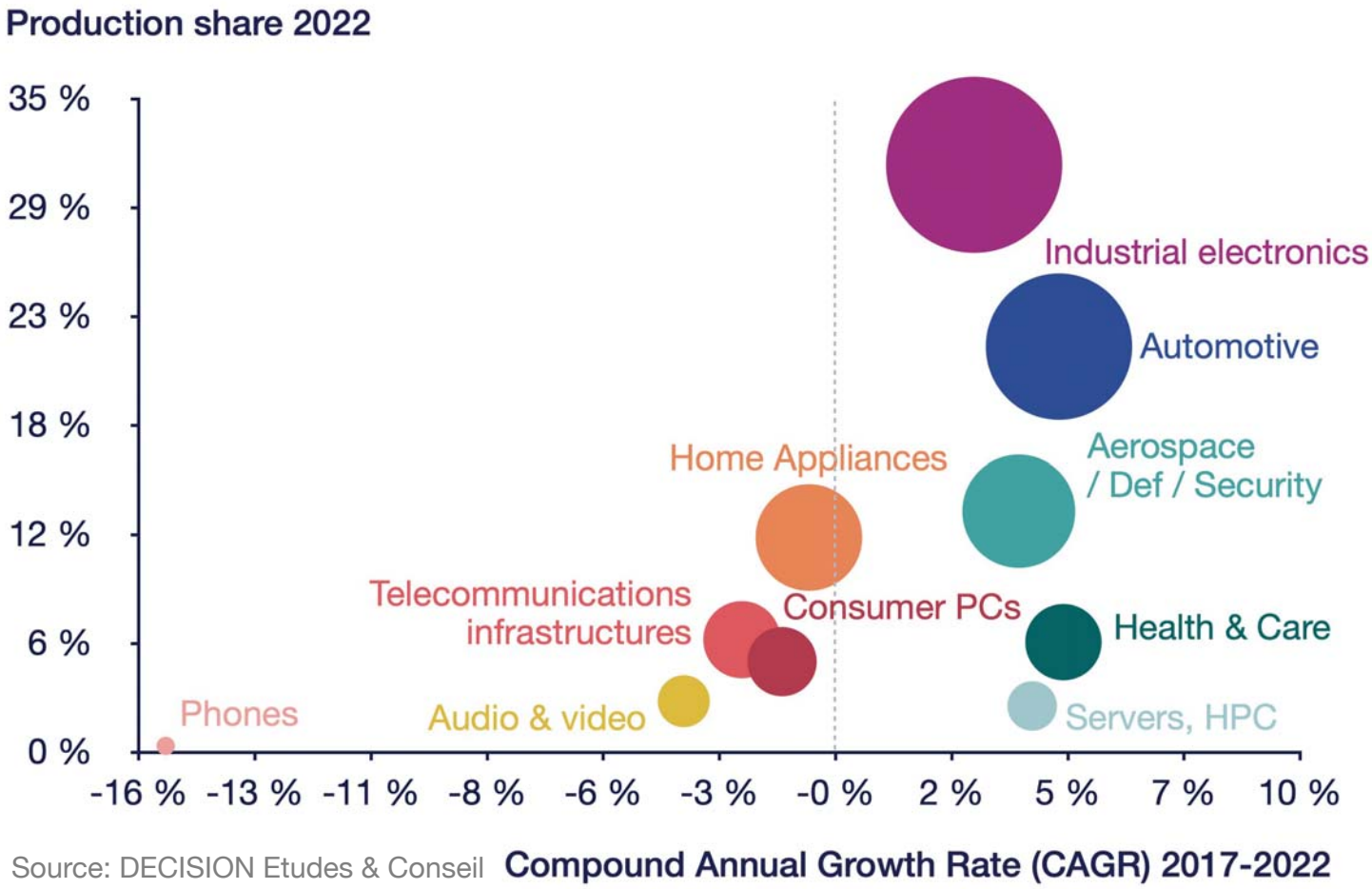
Source: DECISION Etudes & Conseil

A growth driven by embedded industries

- **77%** of the production of electronics systems on EU soil is made of embedded systems.

SIEMENS, Continental, PHILIPS, ZF, BOSCH, Schneider Electric, Valeo, AIRBUS, FORVIA, THALES, EVIDEN

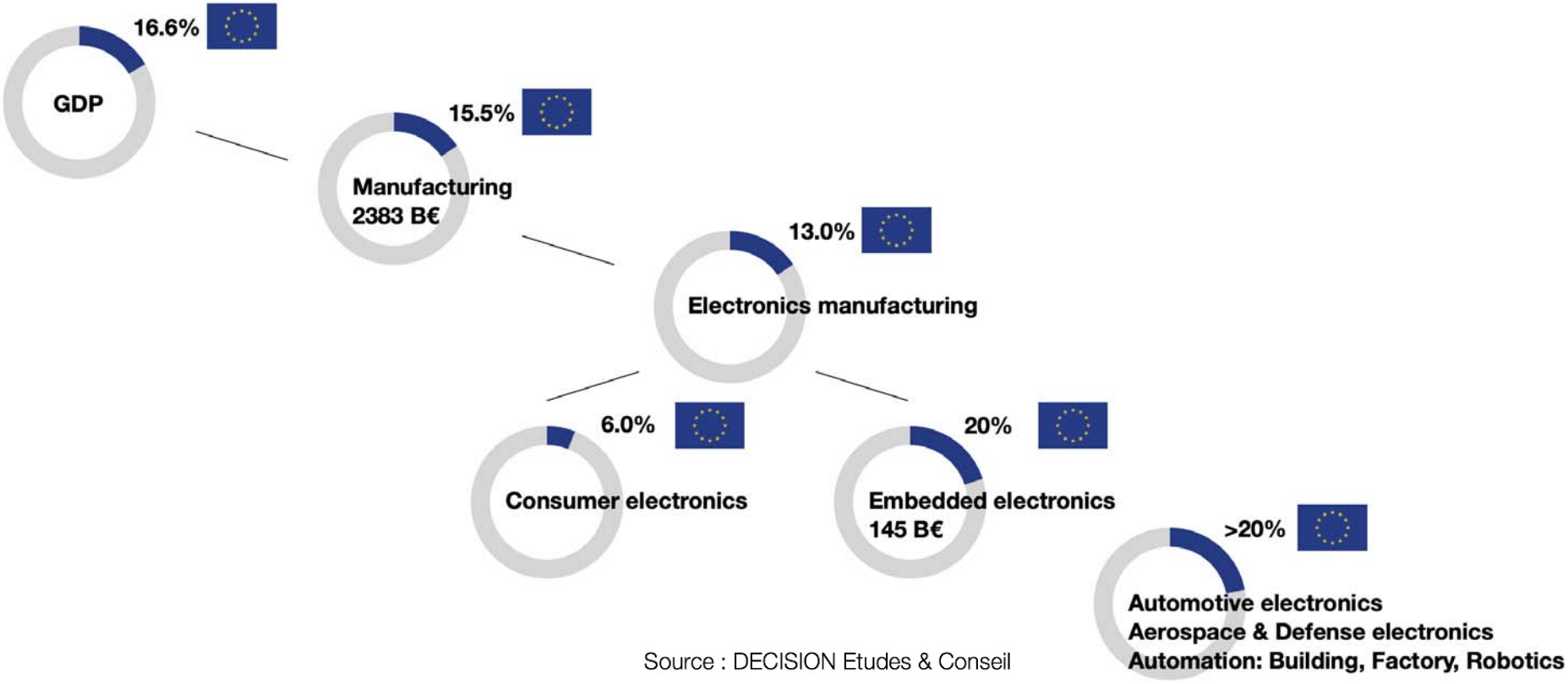
Compared growth of the electronics segments production on EU soil



Source: DECISION Etudes & Conseil

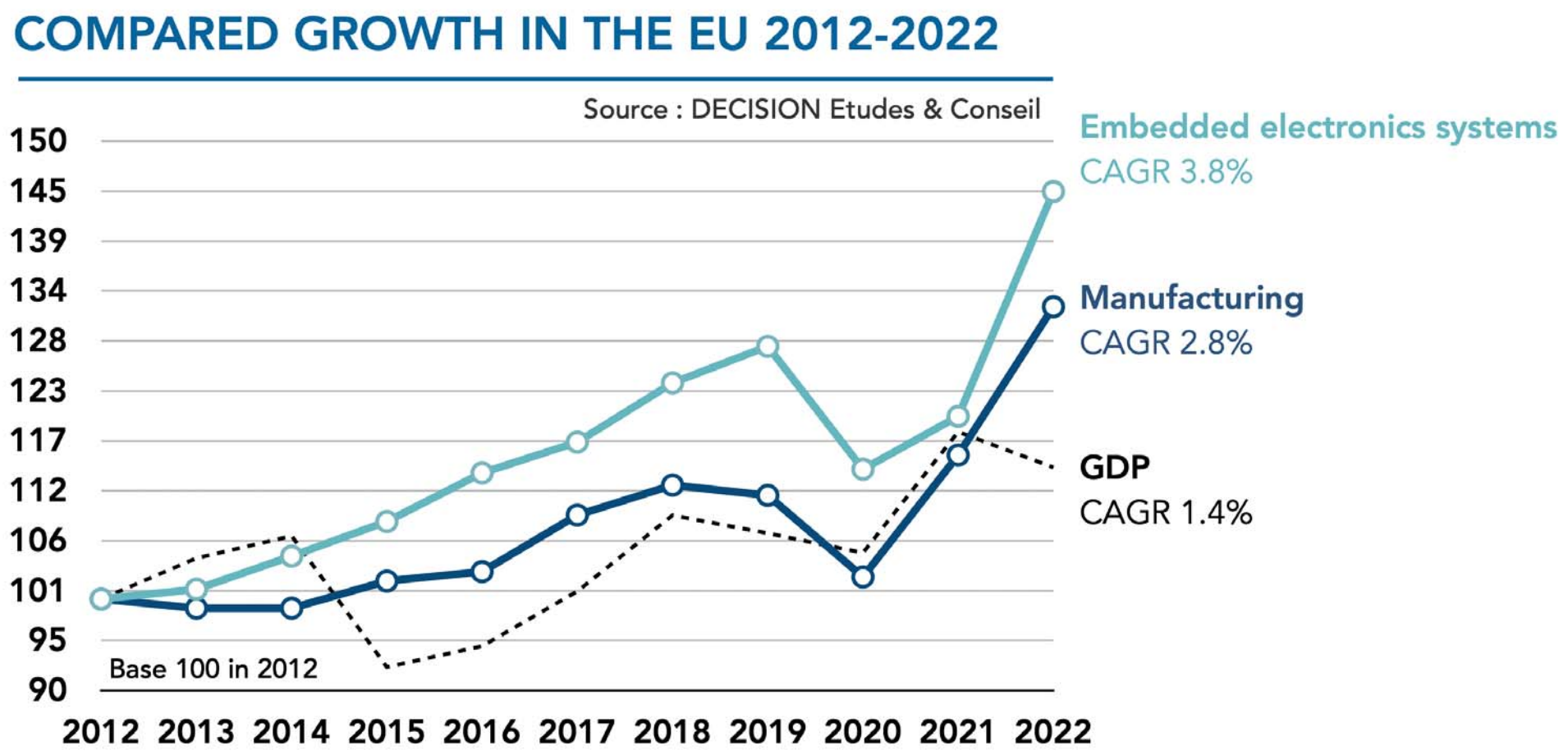
The historical strength of the EU in embedded electronics

Production on EU soil in % of the World in 2022



Source : DECISION Etudes & Conseil

The Union's growth driven by embedded electronics systems



Overview of the EU semiconductor ecosystem

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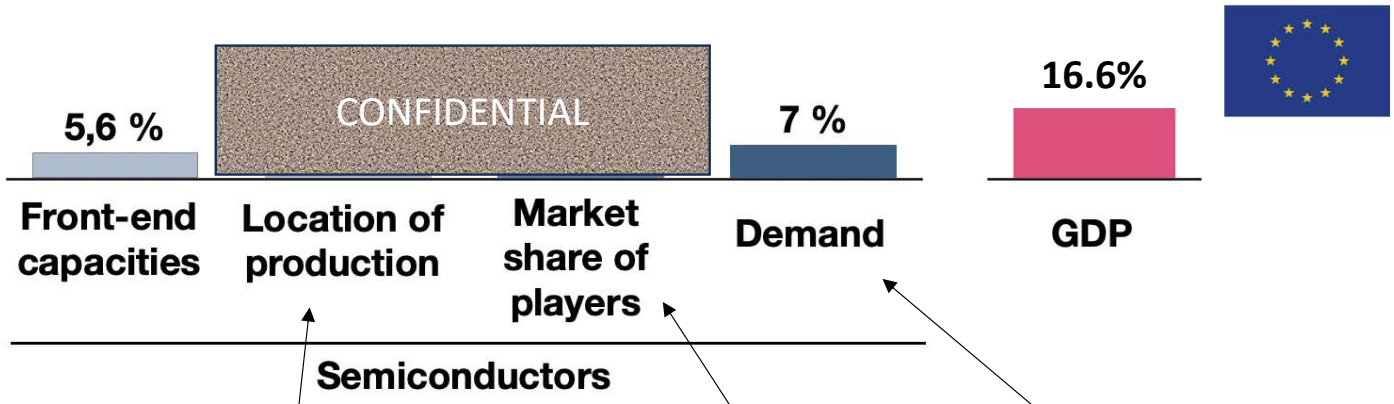
Economic context of the industry in the EU

Position of the EU in the World, 2022



Installed front-end capacities of wafers (200mm equivalent) on EU27 soil

Source: SEMI

Percentage of employees on EU soil from any company, from raw wafers manufacturers to fabless.

Example: Intel's share of employees on EU soil

Source: DECISION Etudes & Conseil

Market share of companies EU-owned, from raw wafers manufacturers to fabless.

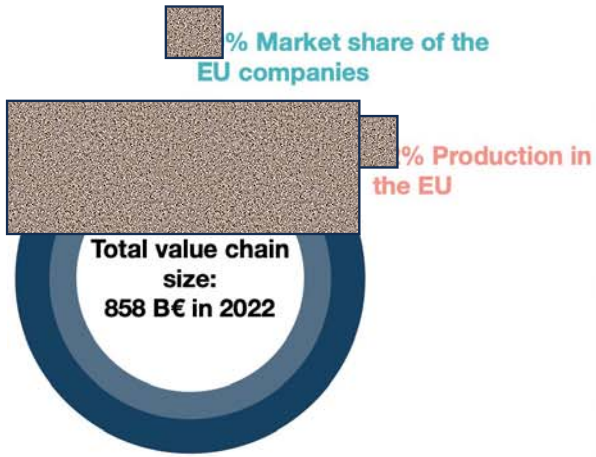
Example: ST Micro's global market shares

Source: DECISION Etudes & Conseil

Semiconductors purchased from EU soil

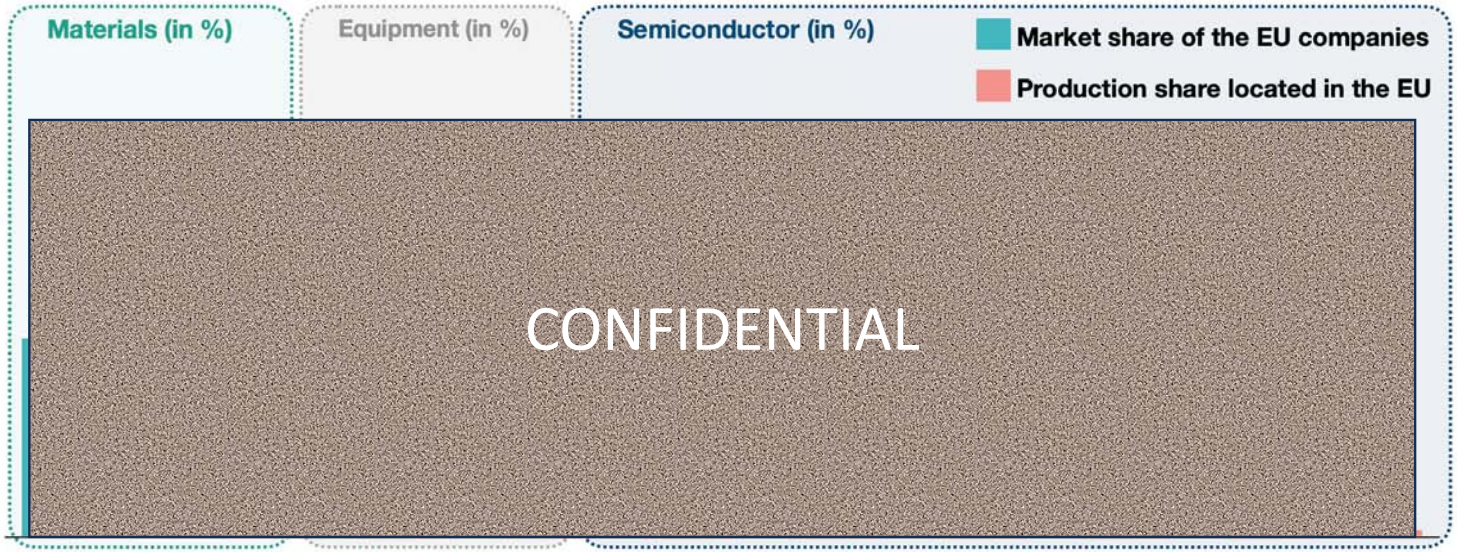
Source: WSTS

Market and production shares of EU players in 2022



Source: DECISION Etudes & Conseil

Total value chain: Market share and Production share of the EU



	Raw wafers	Photomask	Front-end equipment	Back-end equipment	IP	EDA	Fabless	IDM	Pure-Play Foundries	OSAT
Global market size	16 B€	2.5 B€	96 B€	12 B€	6 B€	8 B€	168 B€	377 B€	127 B€	44 B€

The EU semiconductor market

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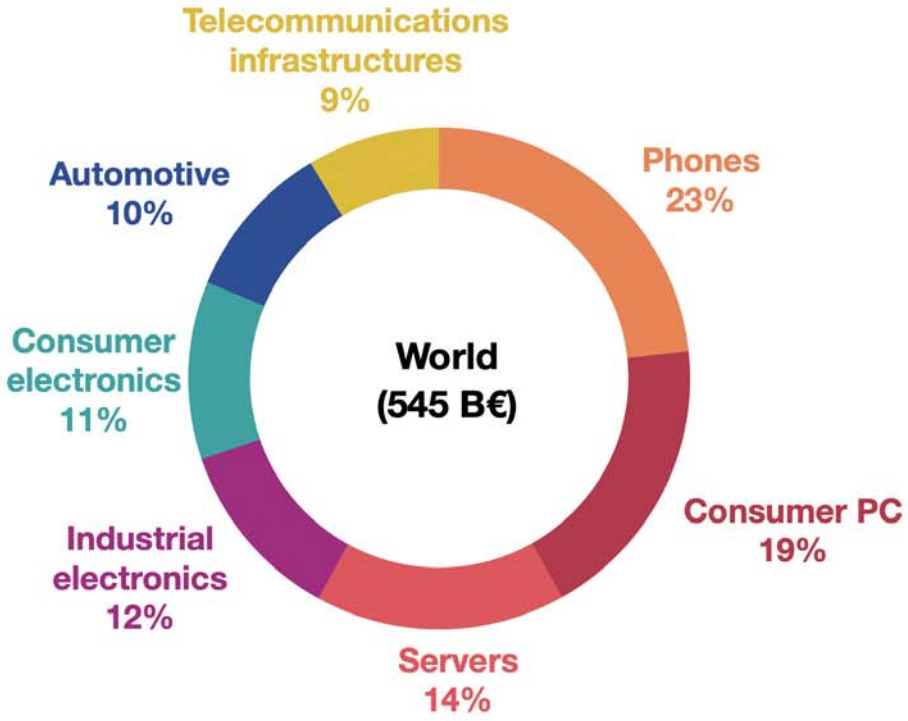
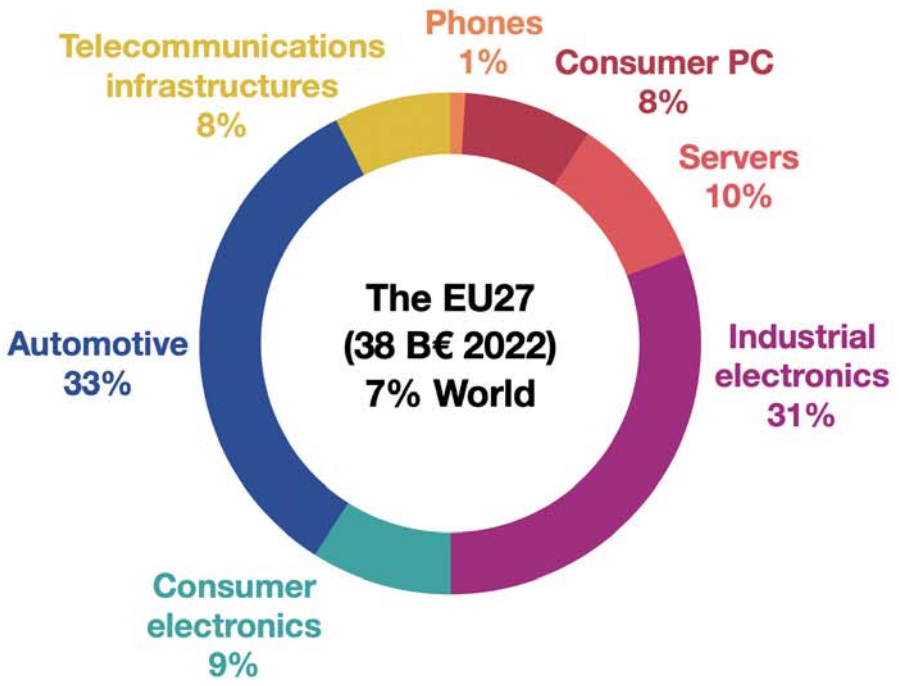
Description of the semiconductor demand in the EU by application

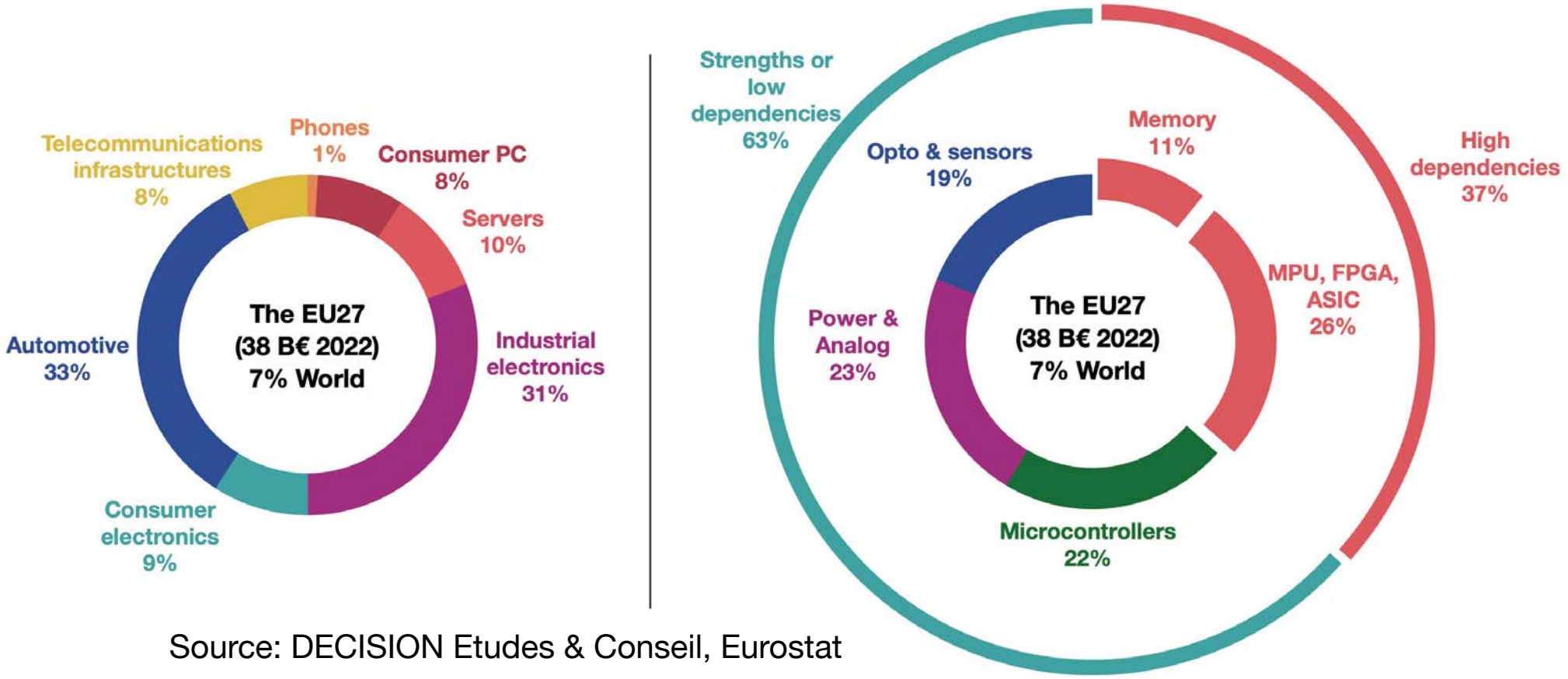
- Historical strengths in automotive and Industrial electronics
- Weak presence in ICT segments (Information and communication technologies)





Source: DECISION Etudes & Conseil, WSTS, Eurostat

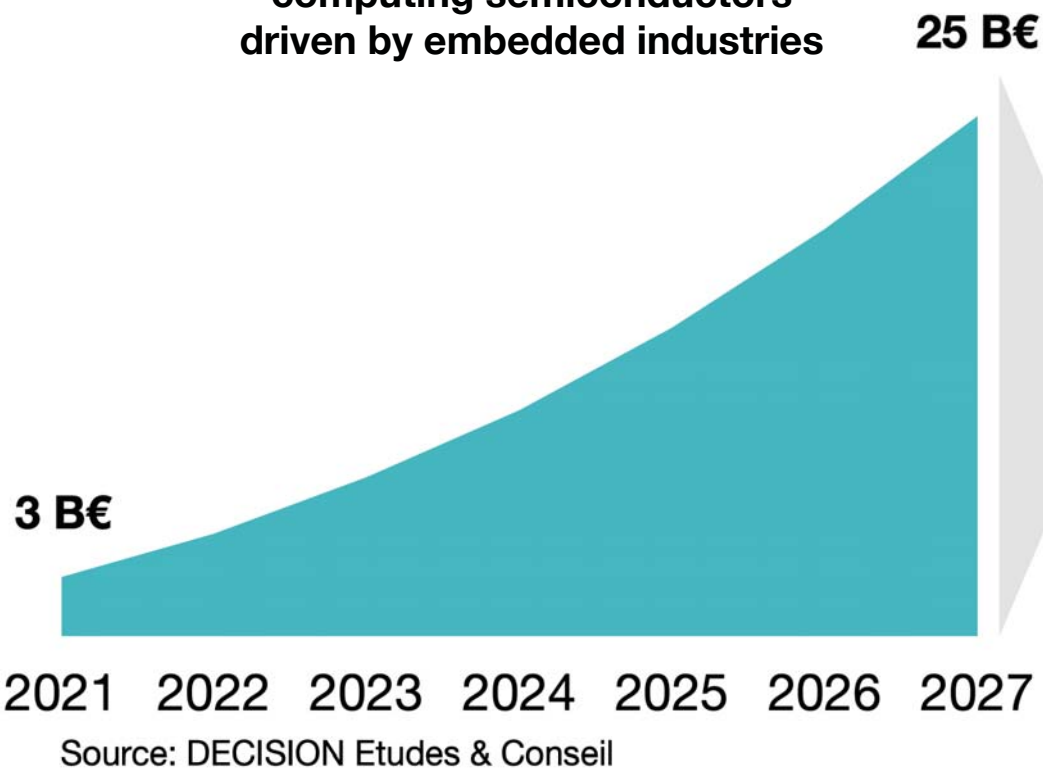
Description of the semiconductor demand in the EU by application and products



Source: DECISION Etudes & Conseil, Eurostat

Towards a strategic dependence on the US in terms of thick computing semiconductors

The EU market for thick computing semiconductors driven by embedded industries



Source: DECISION Etudes & Conseil

EU industries demand for:

- Processors: MPU, logic, SoC, SiP
- Memories: Flash NAND, DRAM

Driven by embedded industries:

- Automotive
- Industrial & robotics
- Health & Care
- Aerospace / Defense / Security

EU dependence towards the US

intel NVIDIA AMD Qualcomm

The EU semiconductor industry

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EU leaders in the semiconductor value chain

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Material

- Epitaxial Wafers: soitec
- Raw silicon wafers: siltronic (perfect silicon solutions)
- Photomask: Ø
- Raw materials: Merck, BASF (We create chemistry), Air Liquide, Atlas Copco, umicore, Linde

Equipment

- Back-end: Ø, Besi
- Others: exyte, TRUMPF, ZEISS
- Front-end:
  - Lithography: ASML
  - Etching and cleaning: Ø
  - Diffusion, implantation & Deposition: Ø, ASM AIXTRON
  - Methrology & quality control: Ø
  - Other Front-end: Ø

Semiconductor

IDM: ST (life.augmented), Infineon, NXP, amn, Ø, BOSCH, nexperia

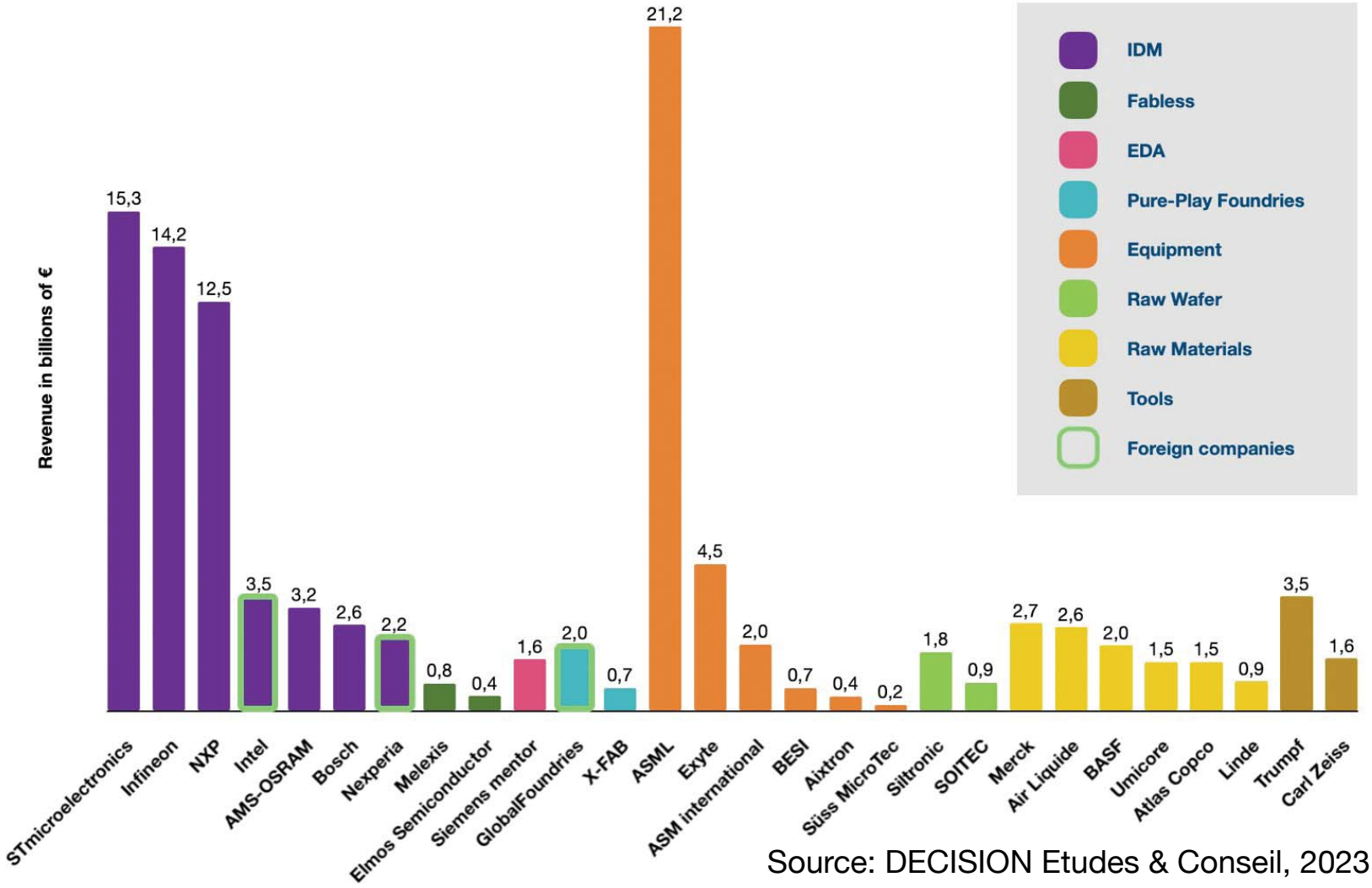
- **Design & Conception**
  - IP: Ø
  - EDA: SIEMENS
  - Fabless: Ø, Melexis (INSPIRED ENGINEERING)
- **Front-end**
  - Pure-Play Foundries: Ø, xfab
- **Back-end**
  - Ø, OSAT
  - IC Substrate
  - Ø, AT&S

Source: DECISION Etudes & Conseil, 2023

Research & Technology Organizations

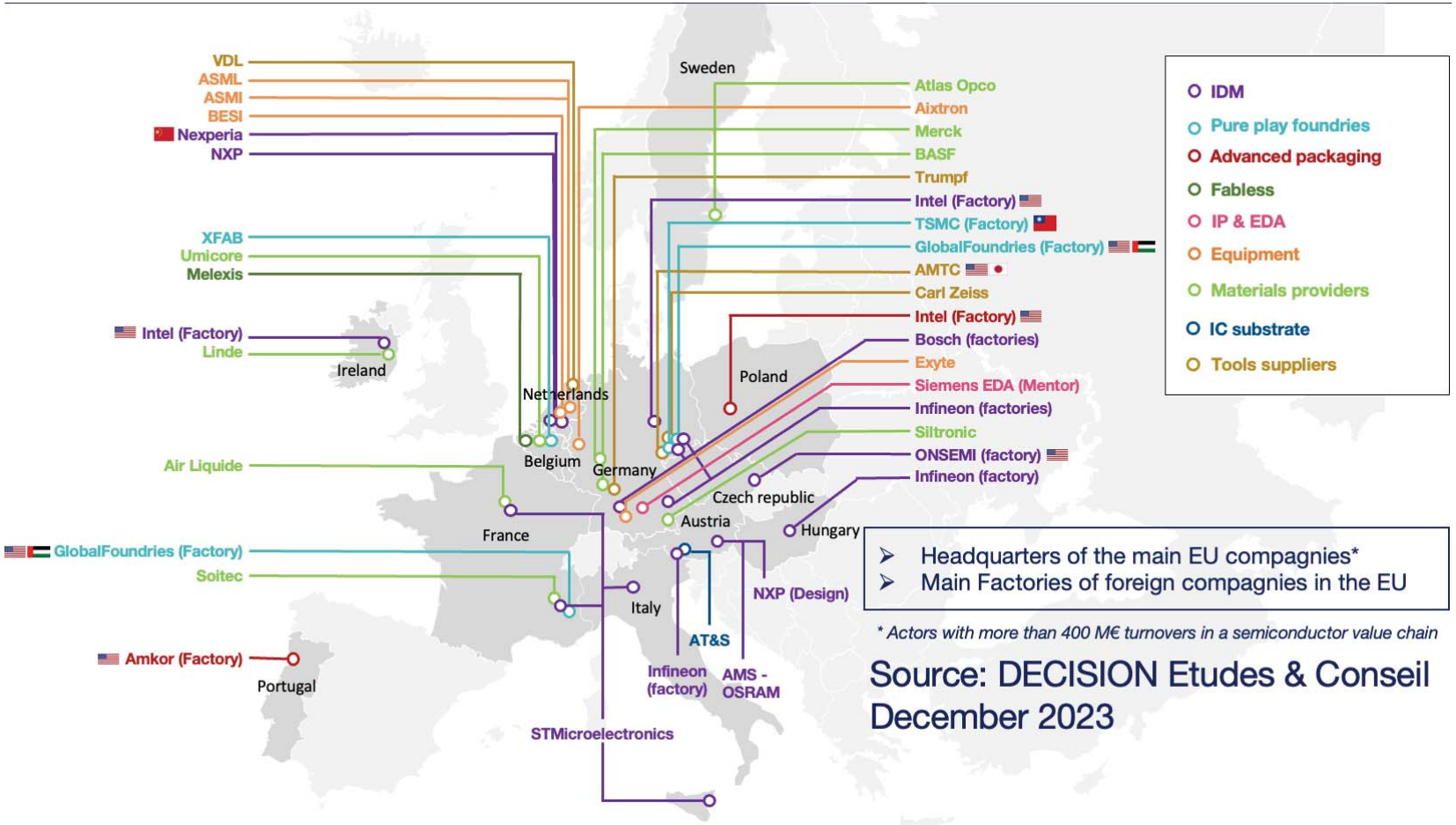
imec, Fraunhofer, cea leti

EU leaders in the semiconductor value chain, 2022



Source: DECISION Etudes & Conseil, 2023

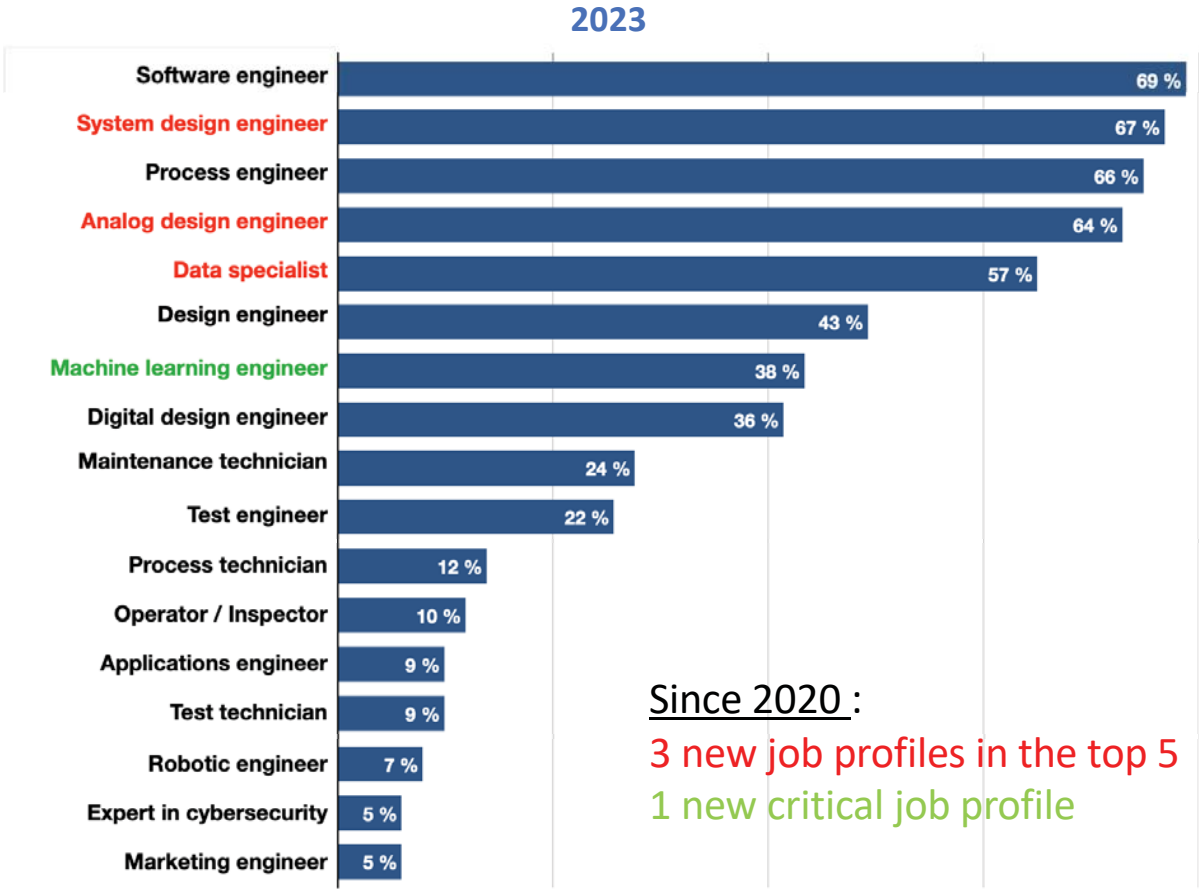
Main semiconductor clusters in the EU



EU Skills shortage

ECSA

Profiles the most sought-after and difficult to fill on the European job market



Since 2020 :

3 new job profiles in the top 5

1 new critical job profile

Source: DECISION Etudes & Conseil

Take the survey for 2024

EU International trades of semiconductors

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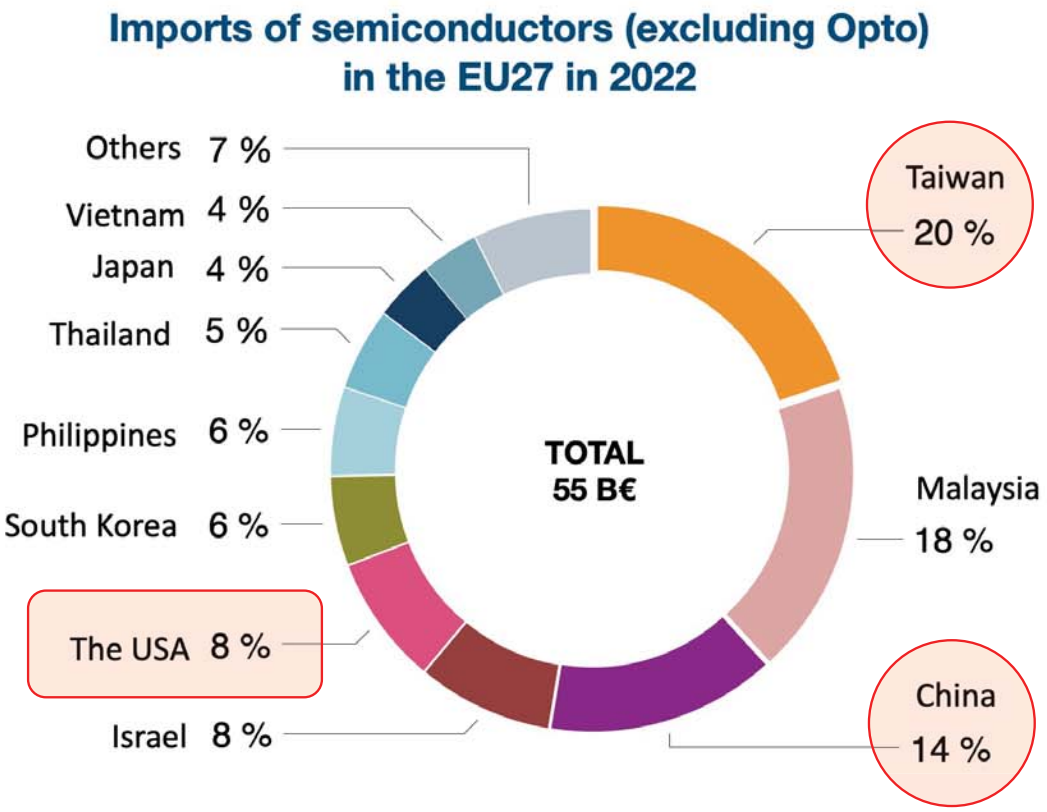
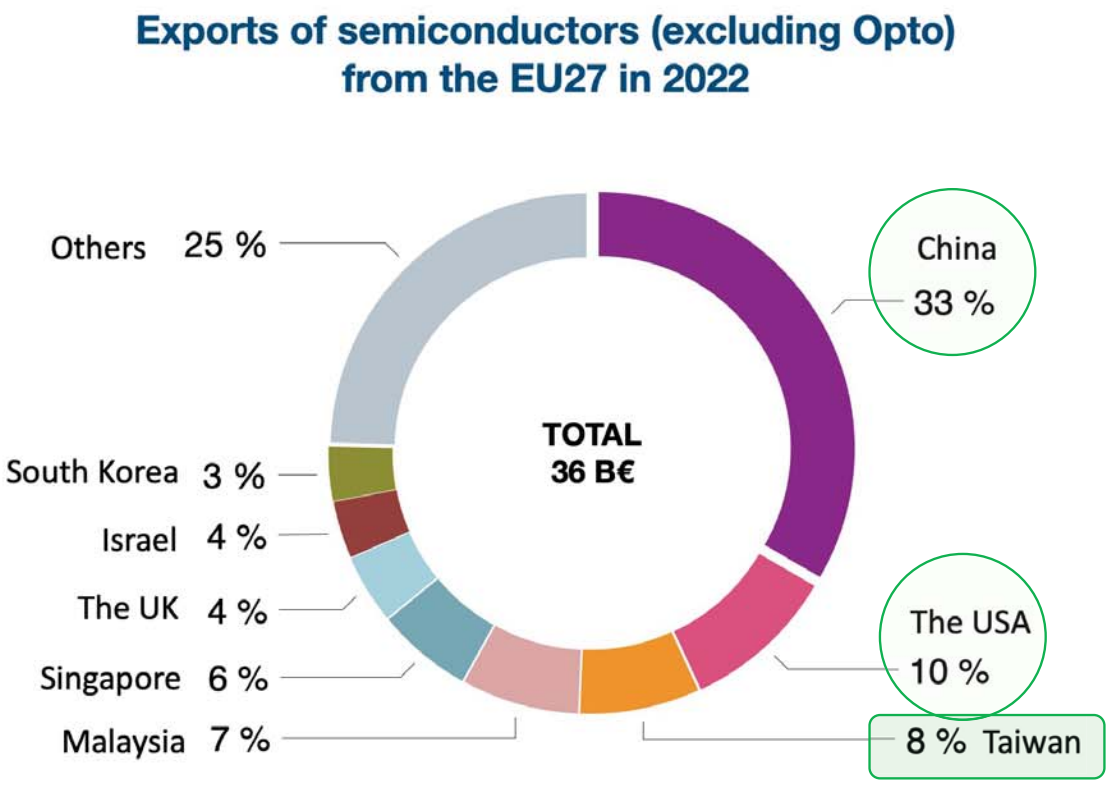
Semiconductor trade partners of the EU (by location)





Source: DECISION Etudes & Conseil, Eurostat, 2023

Ongoing investments in the EU

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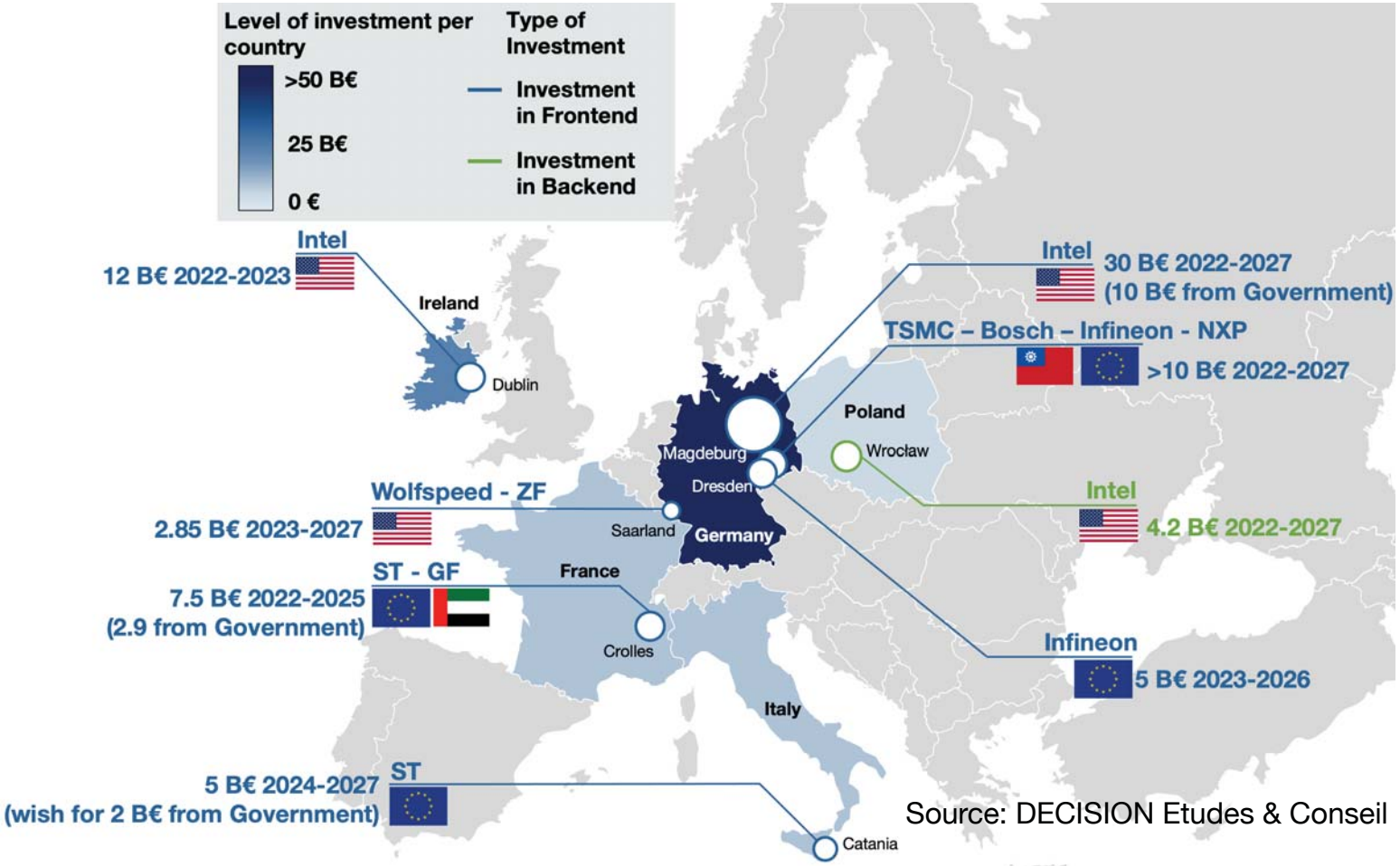
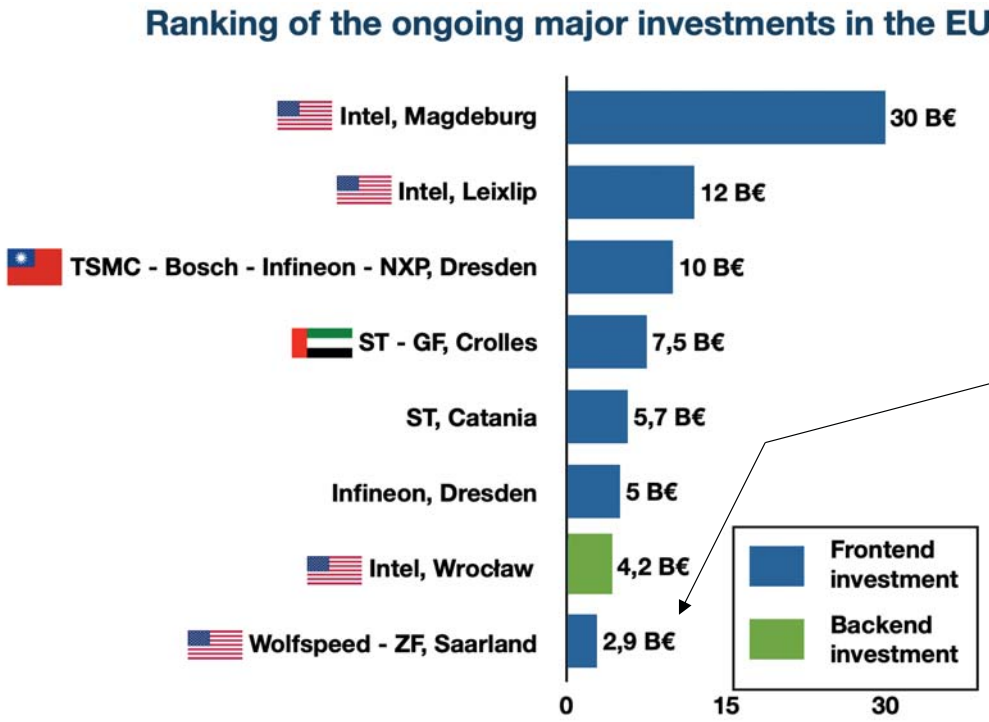
Key investments in the EU



Source: DECISION Etudes & Conseil

- 58% of investments from US companies

Key investments in the EU from 2023



+3.2 B€ in Italy from the Taiwanese Silicon Box

Back-end

Source: DECISION Etudes & Conseil

Strengths and dependencies

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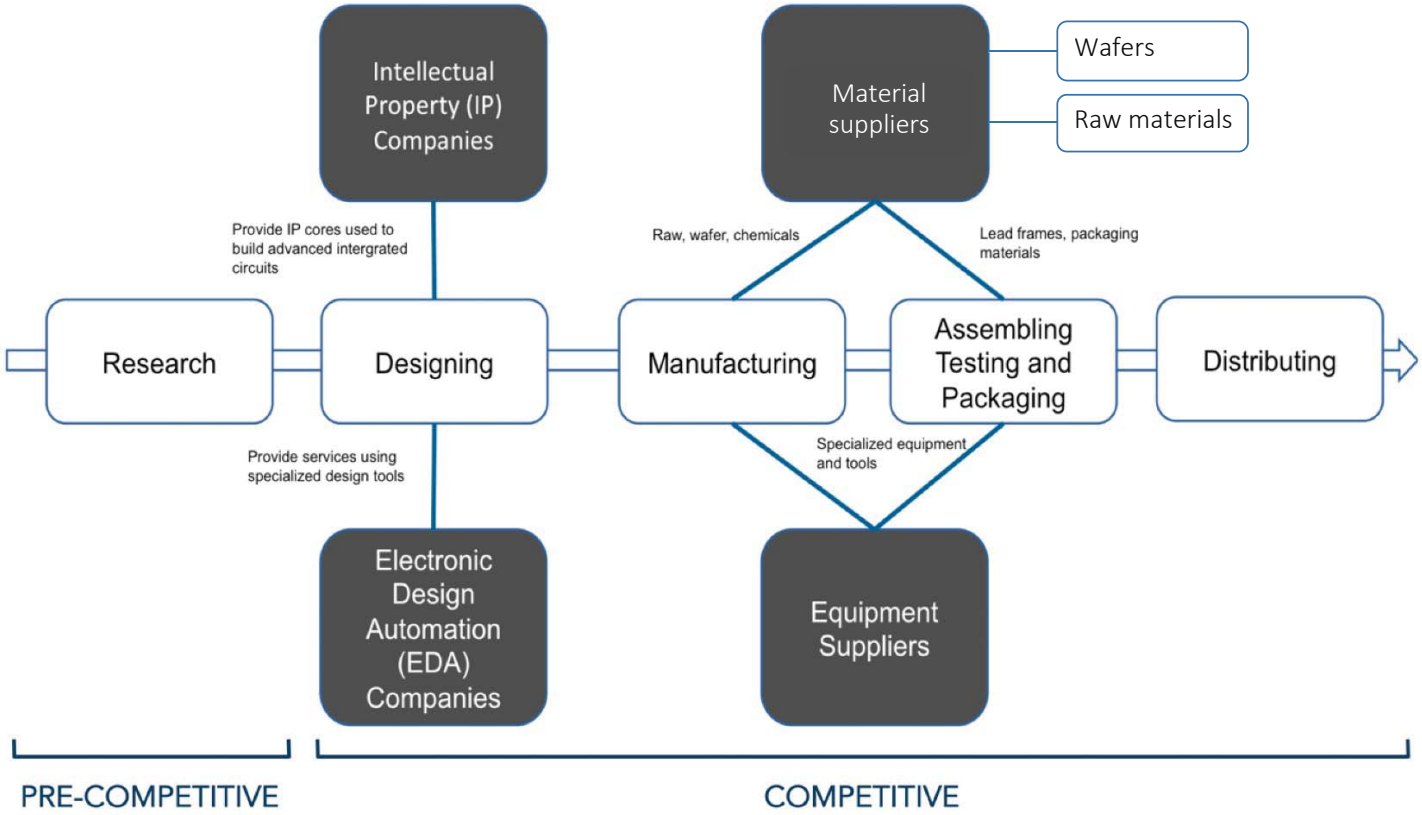
EU strategic dependencies



Source: DECISION Etudes & Conseil, ESIA

Weaknesses

Strategic dependencies

Main market opportunities for the EU by 2030

Applications

- Industrial & robotics
- Aerospace / Defense
- Automotive
- Health & Care
- Security
- Renewable energies / PV

Products

- Sensors & MEMS / Smart
- MCU / Secure MCU
- Power
- Analog
- RF
- Far edge computing

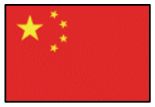
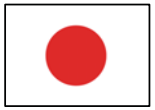
Markets

- China
- The EU
- The USA

Which criteria use to identify areas for bilateral R&D cooperation?

Baseline - Review per country & region




Qualitative Review ● ● ●

Quantitative Review Key figures ● ● ●

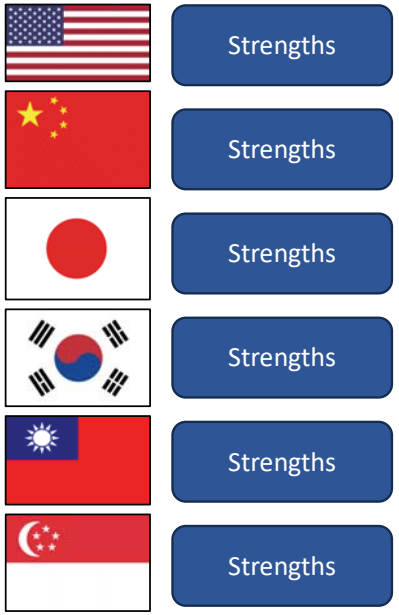
Strengths & Dependencies ● ● ●

Approach - Criterium 1: Leverage mutual strengths

Strengths

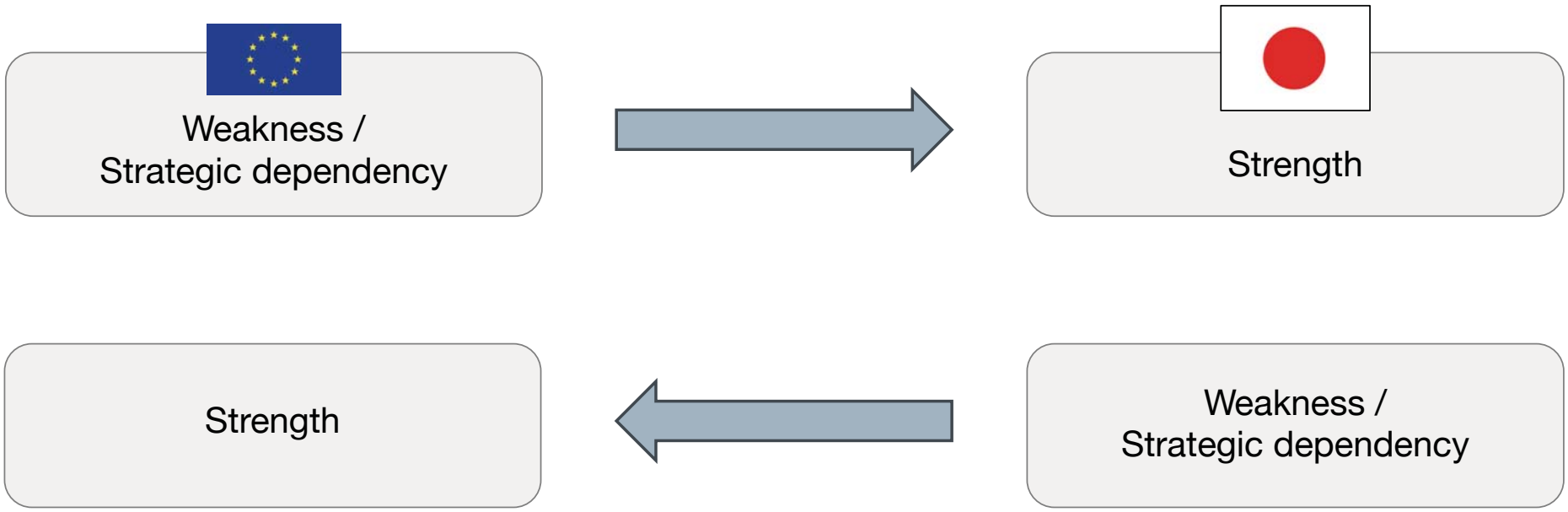
- ❑ High end lithography equipment
- ❑ Leadership in sensors, power electronics, nano optics, and imaging
- ❑ SOI wafer materials
- ❑ …

Leveraging mutual strengths

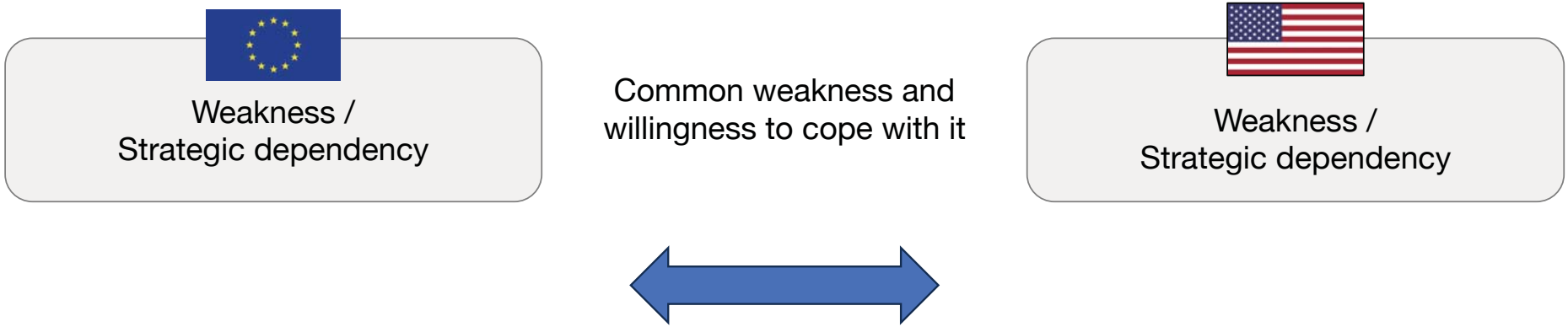


- Which region/which country ?
- Which part of the value chain ?
- Which product/technologies ?

Approach - Criterium 2: Crossed cooperation



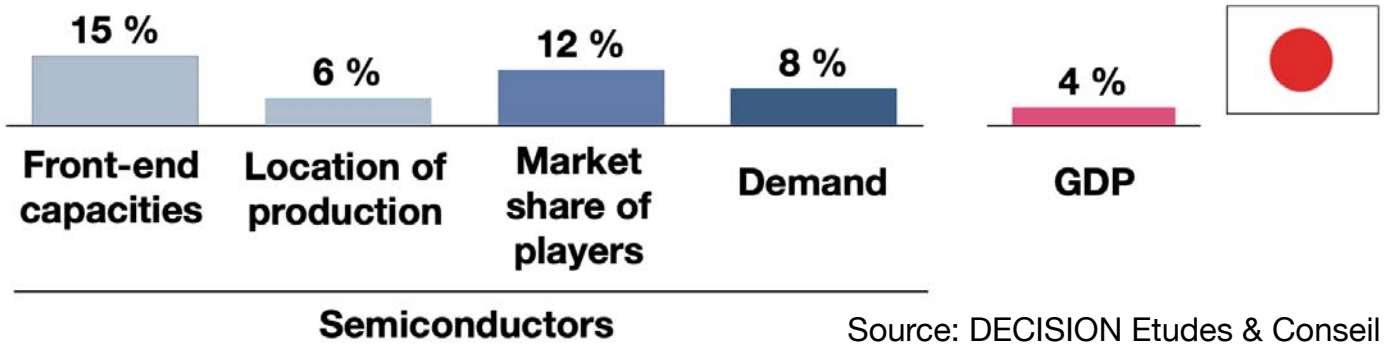
Approach - Criterium 3: Bridge mutual weaknesses



Snapshot on Japan's semiconductor ecosystem

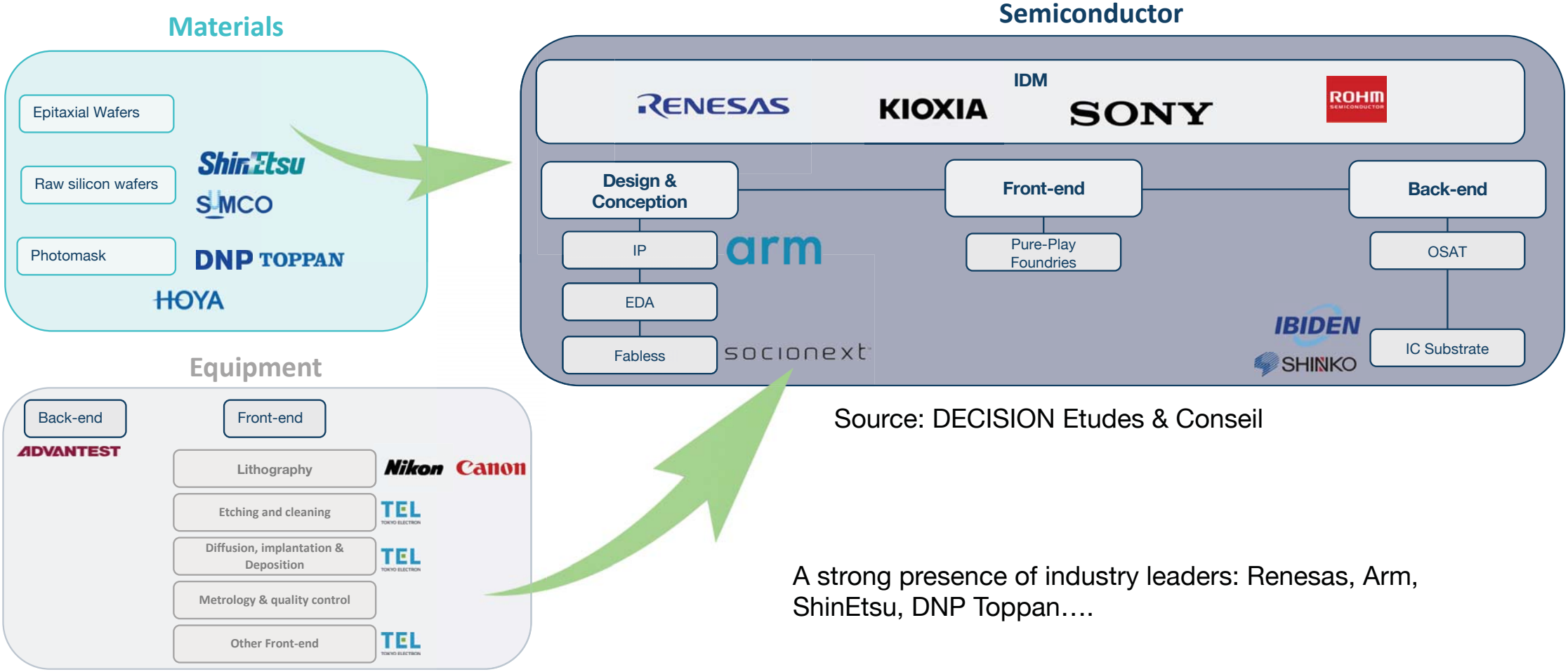
Economic context of the industry in Japan

Position of Japan in the World, 2022



Source: DECISION Etudes & Conseil

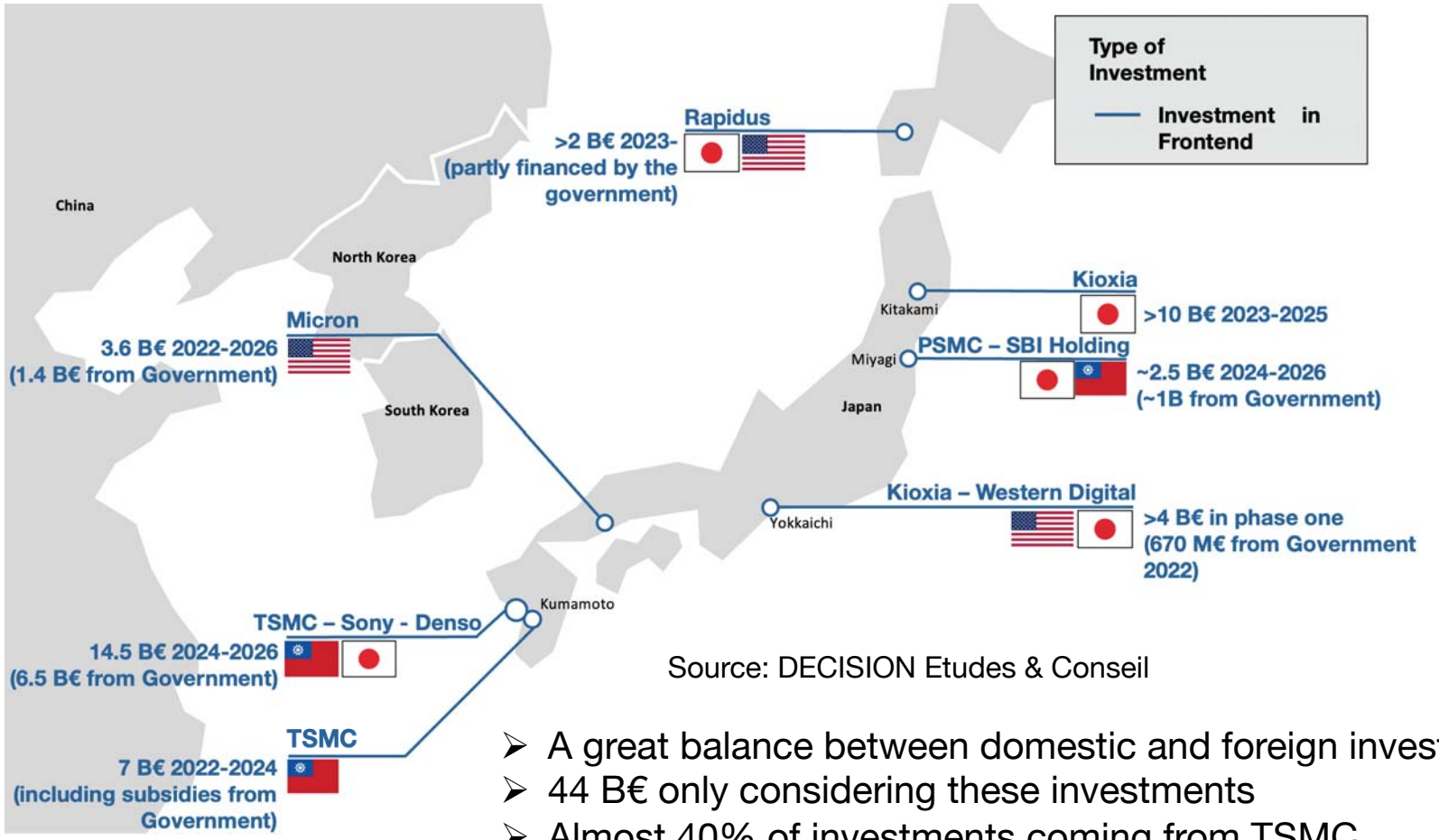
Japanese leaders in the semiconductor value chain



Source: DECISION Etudes & Conseil

A strong presence of industry leaders: Renesas, Arm, ShinEtsu, DNP Toppan….

Map of investments in Japan



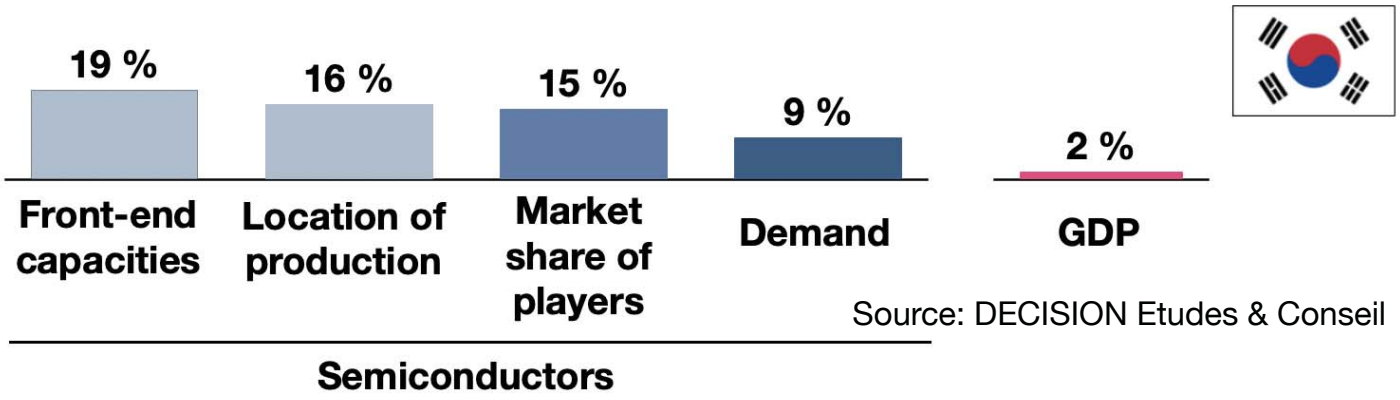
Source: DECISION Etudes & Conseil

- A great balance between domestic and foreign investments
- 44 B€ only considering these investments
- Almost 40% of investments coming from TSMC

Snapshot on South Korea’s semiconductor ecosystem

Economic context of the industry in South Korea

Position of South Korea in the World , 2022

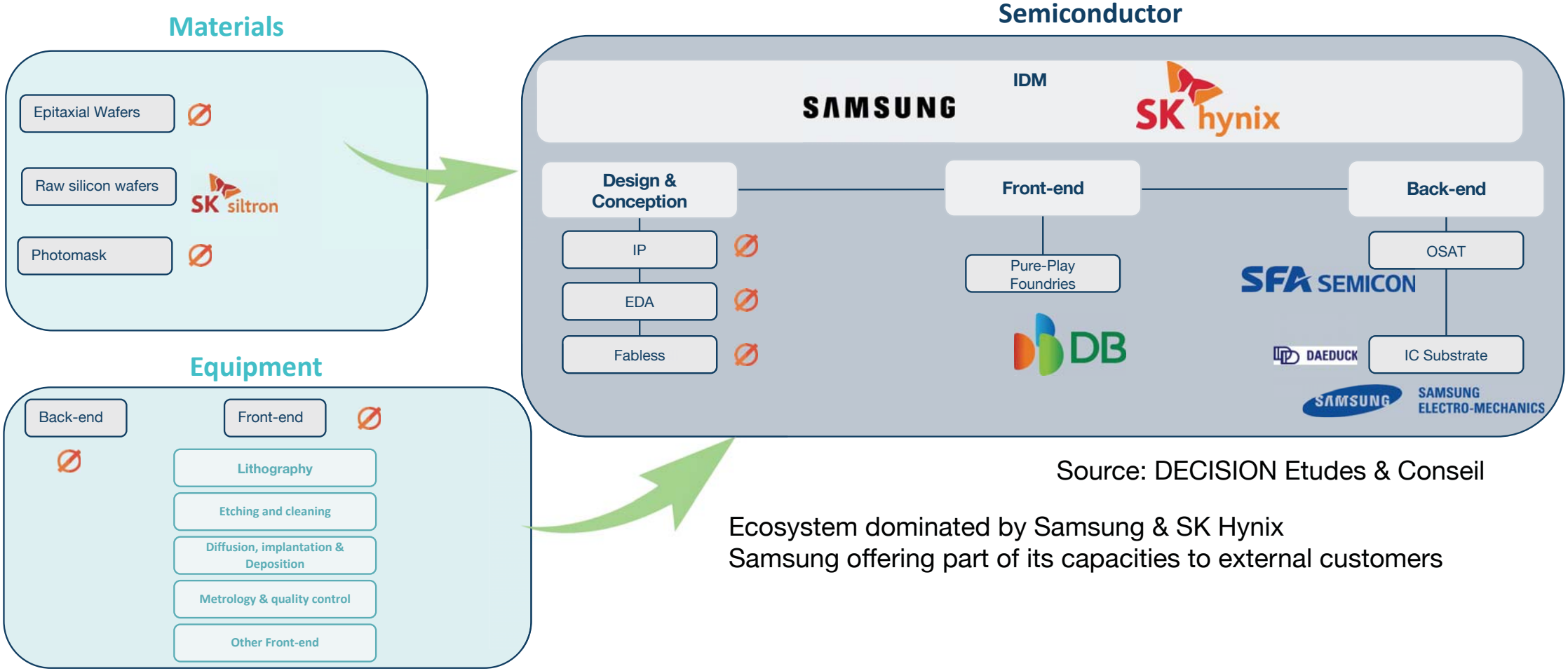


Source: DECISION Etudes & Conseil

Overall environment

- One of the largest semiconductor industries dominating the memory sector. Samsung / SK Hynix expanding into other segment to reduce their dependencies
- Semiconductors accounted for 18.7% of total exports in 2022.
- Strong presence in advanced processes with production of 3 nm chips with plans for 2 nm by 2025 and 1.4nm by 2027
- Government support through tax incentives, subsidies, and training centers.

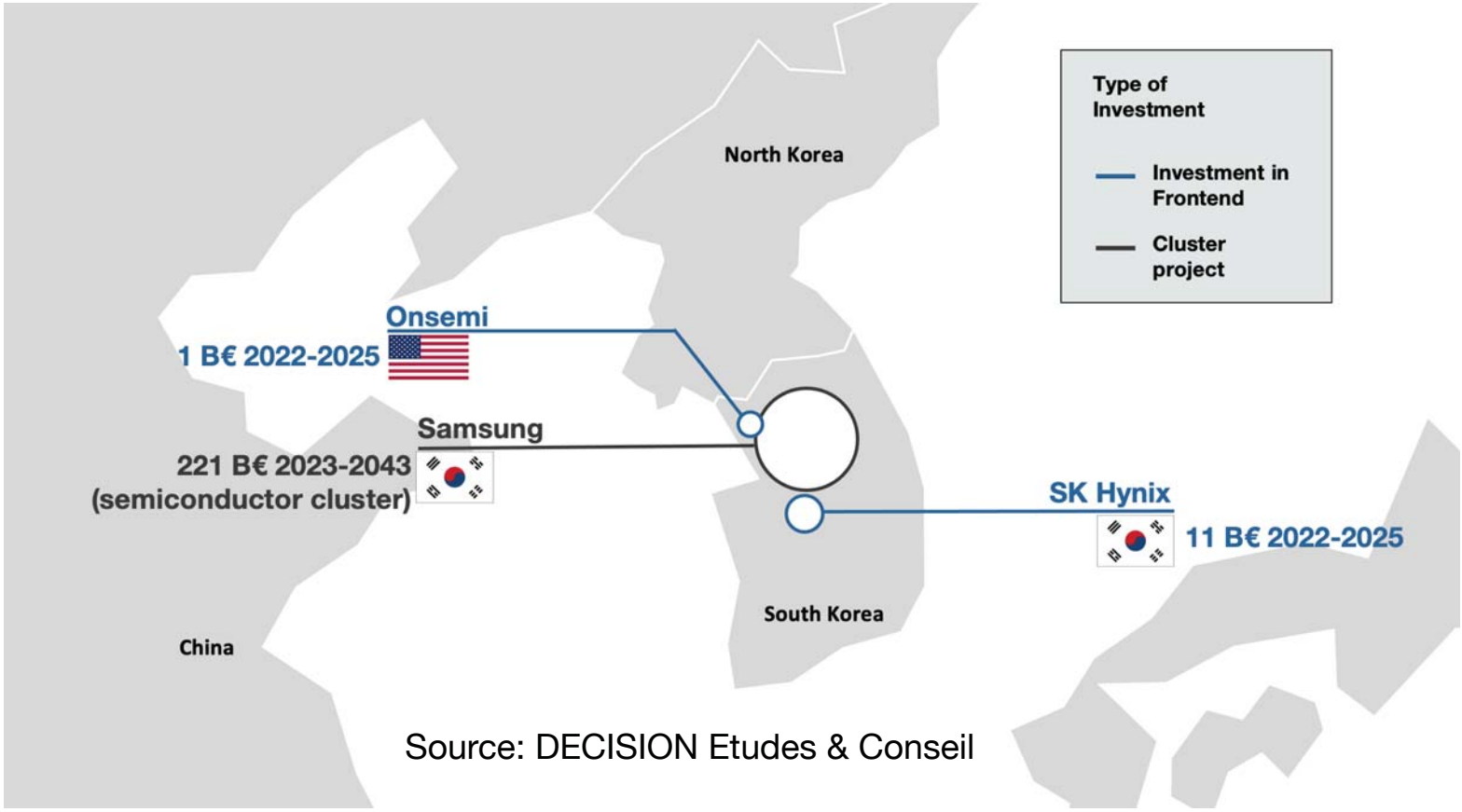
South Korean leaders in the semiconductor value chain



Source: DECISION Etudes & Conseil

Ecosystem dominated by Samsung & SK Hynix
Samsung offering part of its capacities to external customers

Map of investments in South Korea

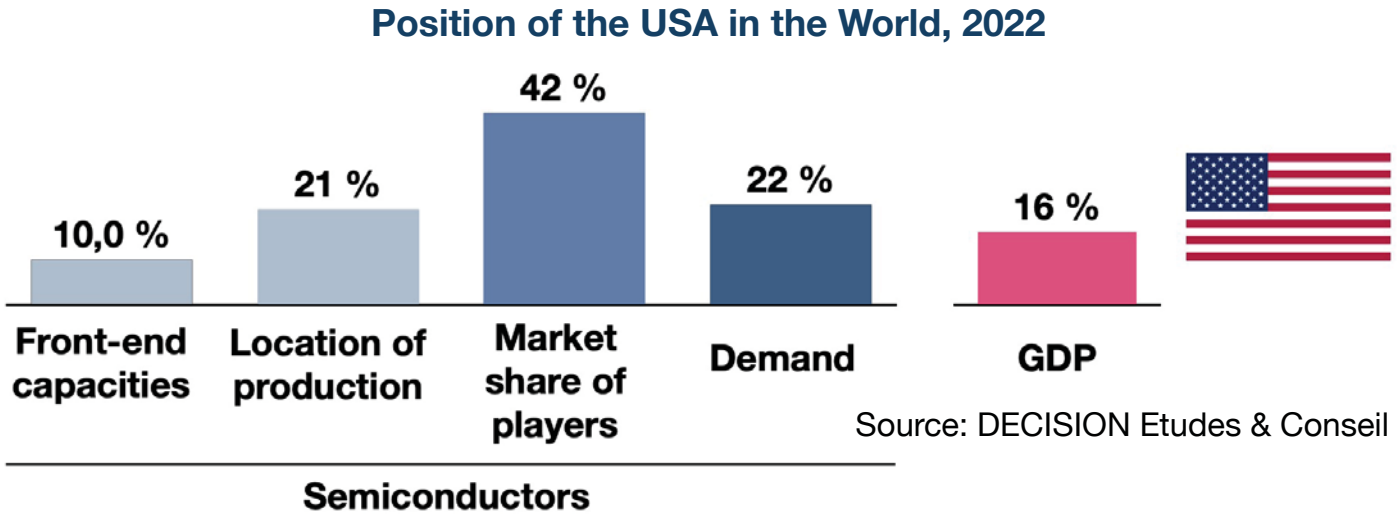


Source: DECISION Etudes & Conseil

- A very ambitious 20 years plan for semiconductor cluster

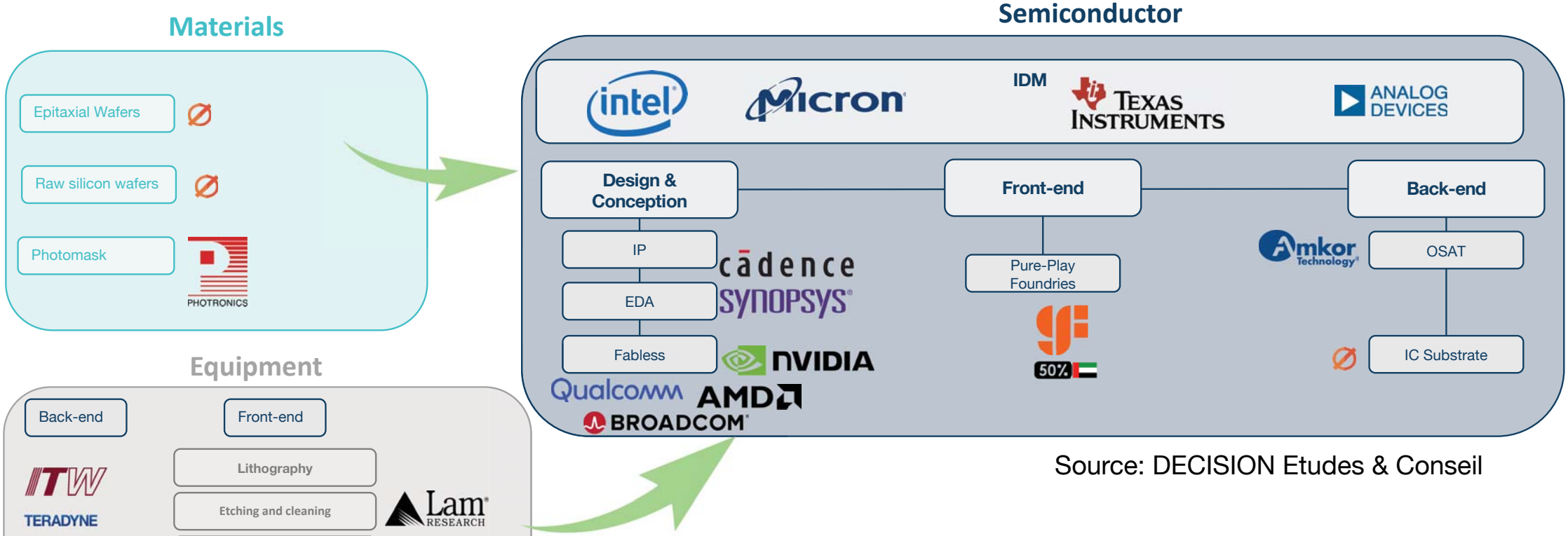
Snapshot on the US semiconductor ecosystem

Economic context of the industry in the USA



Source: DECISION Etudes & Conseil

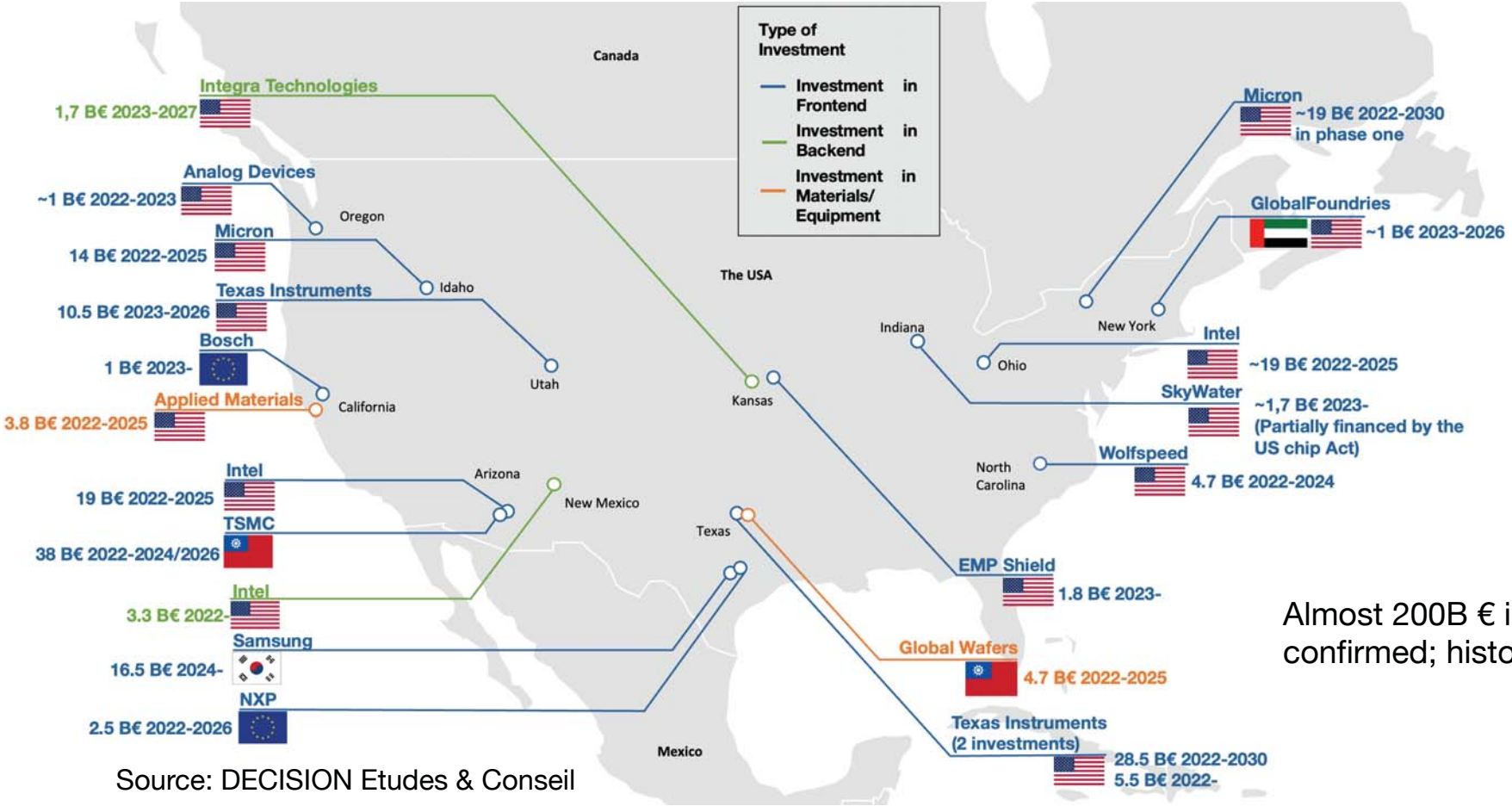
The US leaders in the semiconductor value chain



Source: DECISION Etudes & Conseil

- A rich ecosystem with leading IDM and Fabless companies
- A strong presence in equipment

Map of investments in USA



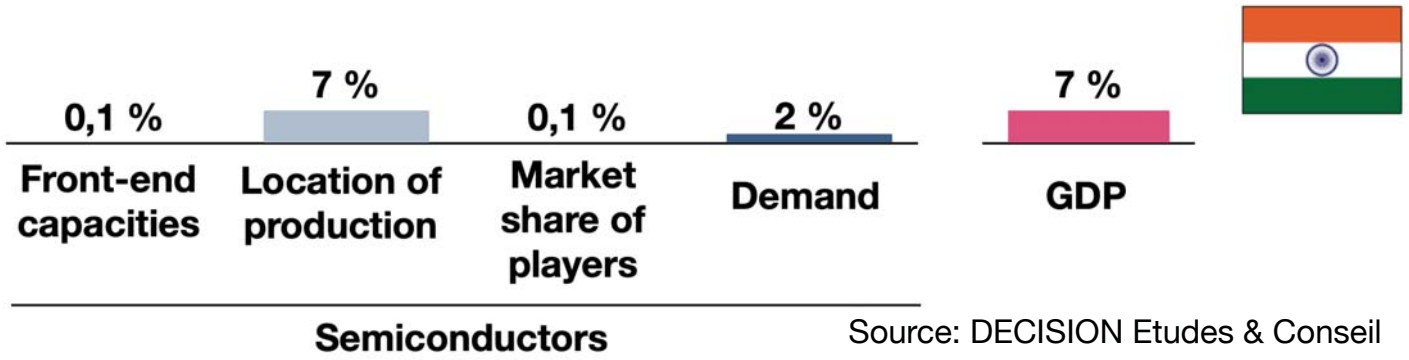
Source: DECISION Etudes & Conseil

Almost 200B € investments already confirmed; historical record

Snapshot on the Indian semiconductor ecosystem

Economic context of the industry in India

Position of India in the World, 2022



Source: DECISION Etudes & Conseil

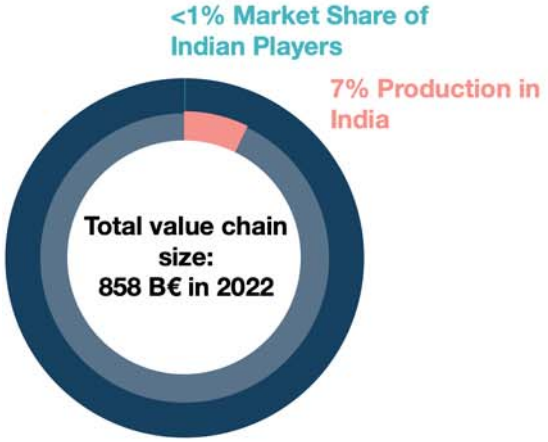
Background

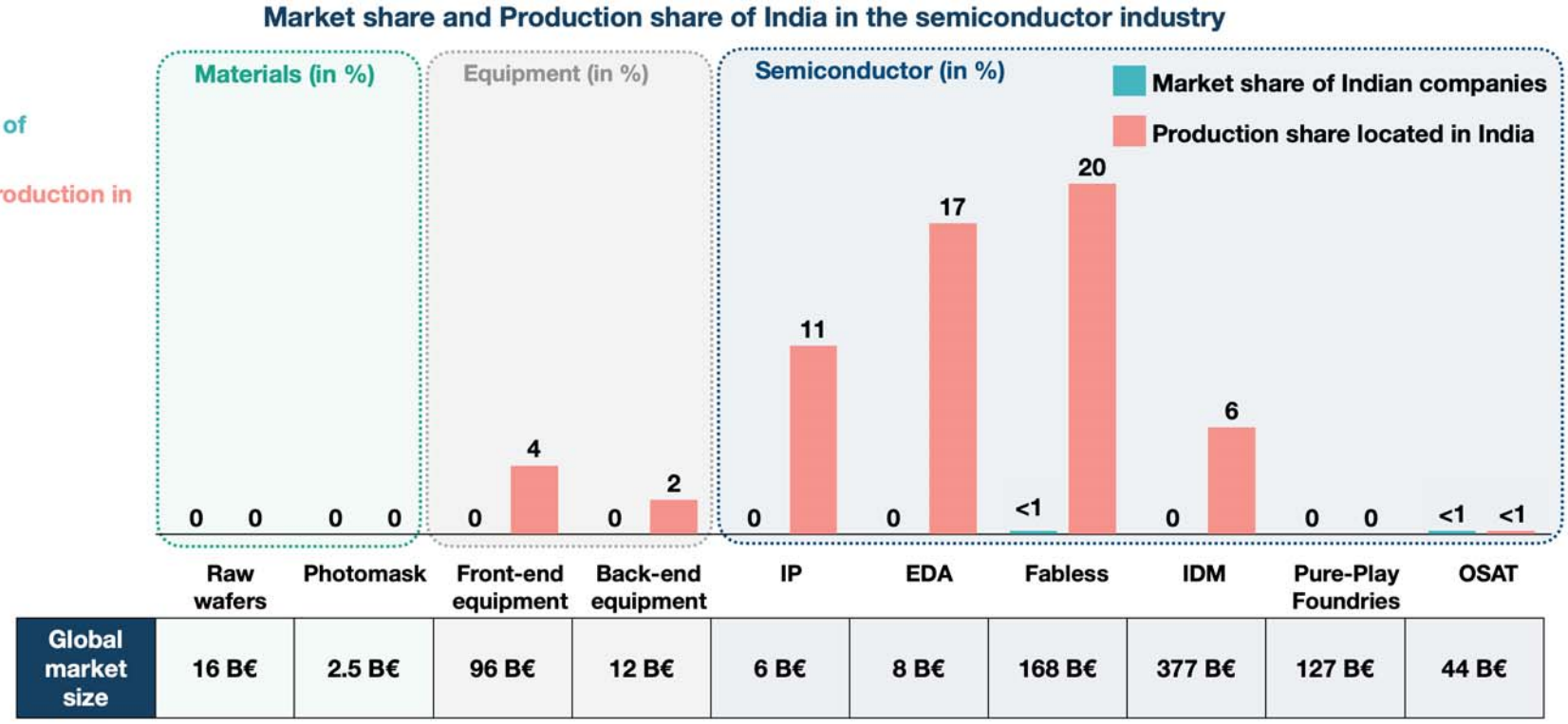
- Doing quite well in terms of chip design, with few startups emerging
- Historical challenges in setting up fabs units
- Nascent ecosystem in back-end manufacturing
- Indian semiconductor market accounts for €11 billion in 2022
- Indian GDP: 7%

Objective

- Plan to establish a strong semiconductor hub
- Reviewing the ambition to have access to advanced technologies, and focus on mature technologies

Market and Production share of India





	Raw wafers	Photomask	Front-end equipment	Back-end equipment	IP	EDA	Fabless	IDM	Pure-Play Foundries	OSAT
Global market size	16 B€	2.5 B€	96 B€	12 B€	6 B€	8 B€	168 B€	377 B€	127 B€	44 B€

Source: DECISION Etudes & Conseil

- Strong presence of foreign companies in IP, EDA and Fabless

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