BOM Catalyzing Change

Rijksdienst voor Ondernemend Nederland

Buck Consultants International

Towards a Semiconductor Industry Value Proposition
Opportunities for Dutch companies in Southeast Asia

Report – for external use

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Profile BCI Global

Buck Consultants International

Corporate clients

- **Location advice**
- **Manufacturing footprint strategy**
- **Supply chain optimization**
- Business strategy development
- Real estate strategy and projects

Profile

- Established in Nijmegen, the Netherlands in 1985
- Offices in
  - Europe: The Netherlands, London, Frankfurt
  - Asia: Singapore, Shanghai
  - US: Atlanta, San Mateo, Los Angeles
- Performed studies in more than 50 countries worldwide
- 75 professionals

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Client Base (Examples)

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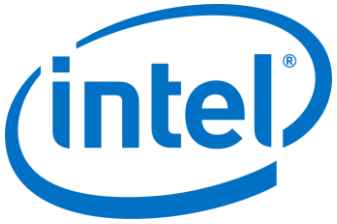

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Agenda

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2 The State of the Malaysian Semiconductor Industry

3 Opportunities for Dutch Companies

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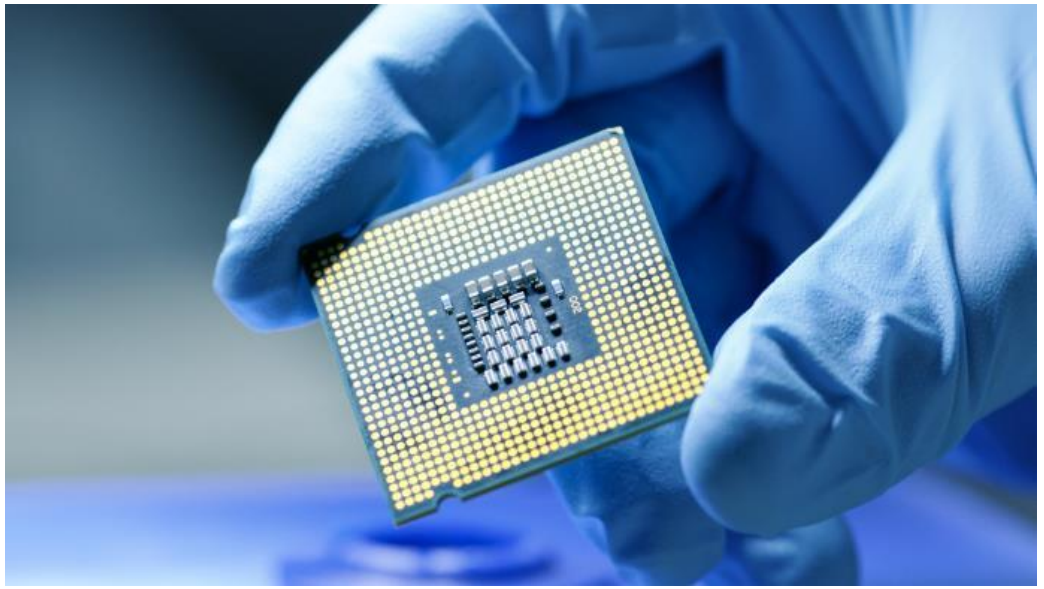

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1 The Southeast Asia Regional Perspective

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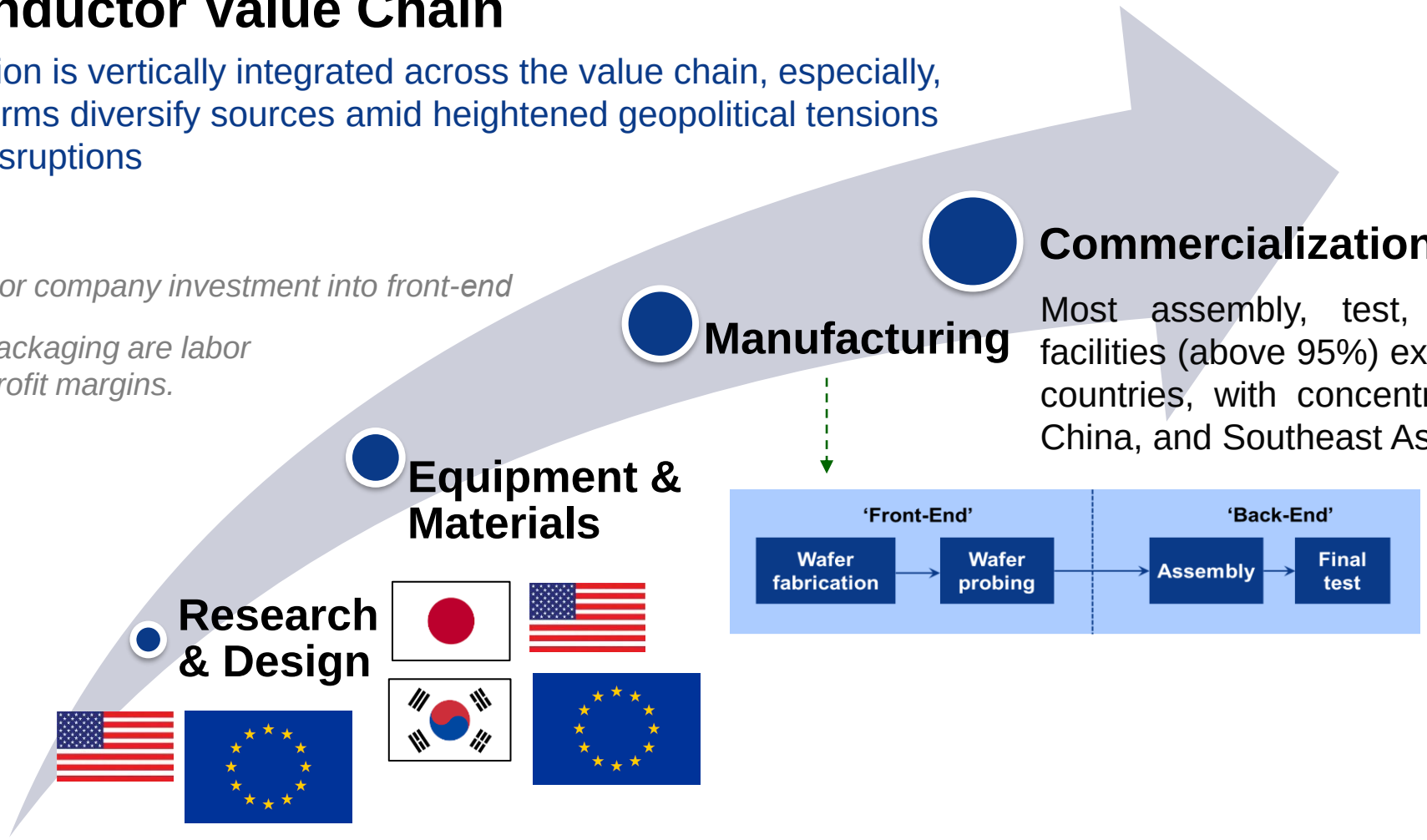
The Semiconductor Value Chain

No company or nation is vertically integrated across the value chain, especially, as semiconductor firms diversify sources amid heightened geopolitical tensions and supply chain disruptions

~70% of semiconductor company investment into front-end

Assembly, test, and packaging are labor intensive with lower profit margins.



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The Southeast Asia Regional Perspective

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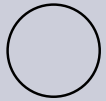
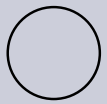
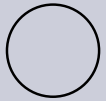
Value Chain	Malaysia	Singapore	Vietnam	Philippines	Thailand	Indonesia
R&D/ IC Design						
Equipment/ Material						
Front-end manufacturing						
Back-end manufacturing						

Only Malaysia and Singapore have the complete Semiconductor value chain, while the back-end manufacturing is strong in many Southeast Asian countries

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Challenges

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Going up the value chain, Malaysia and Vietnam face strong competition from Singapore and the big 4 in Asia "China, Japan, South Korea & Taiwan"

- **Relatively lower R&D budget and spending** than Singapore and other developed countries
- **Low labor cost causes human capital flight:** Malaysian scientists and technicians would often go to Australia, Singapore, or the United States to work due to higher wages

Going down the value chain, Malaysia and Singapore face strong competition from other Southeast Asian countries

- **Lower labor cost in other Southeast Asian countries**: the average salaries in Vietnam and Philippines are only one-third of Malaysia's, while Singapore is more than 150% than the rest of Southeast Asia
- **Bigger working population in other Southeast Asian countries**: the labor force of Malaysia is only about 40% of that of Thailand and 30% of Vietnam

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Singapore leads Southeast Asia in the high-end of the value chain, while Vietnam is a rising star

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Singapore

3 of the world's largest wafer foundries are present in Singapore

- **Globalfoundries** has five wafer foundries in Singapore
- **United Microelectronics Corporation and World Advanced Packaging Electronics** each have one 8-inch factory in Singapore
- **TSMC** has a wafer foundry in Singapore, which primarily focuses on 0.25-micron and 0.18-micron processes

Singapore's skilled workforce, political stability, business-friendly environment, and mature Semiconductor industry attracts Semiconductor companies from the higher-end of the value chain

Vietnam

- **Samsung** began making semiconductor parts in Vietnam, one of only four countries — alongside South Korea, China and the United States — that produce semiconductors for the world's largest memory chipmaker
- **Hanmi Semiconductor** opened a global branch office in the northern province
- **Amkor Technology** has so far invested $1.6 billion in Bac Ninh and will be among its biggest covering around 23 hectares in the Yen Phong II-C Industrial Park

Vietnam's abundant low-wage workforce and its proximity to the Chinese market are attracting global businesses (now both the lower and the higher end of the value chain, with the investment from Samsung)

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Source: Disk Manufacturer, EastAsiaForum, and BCI Global

Comparison of Malaysia, Singapore, and Vietnam

Semiconductor Key Location Criteria

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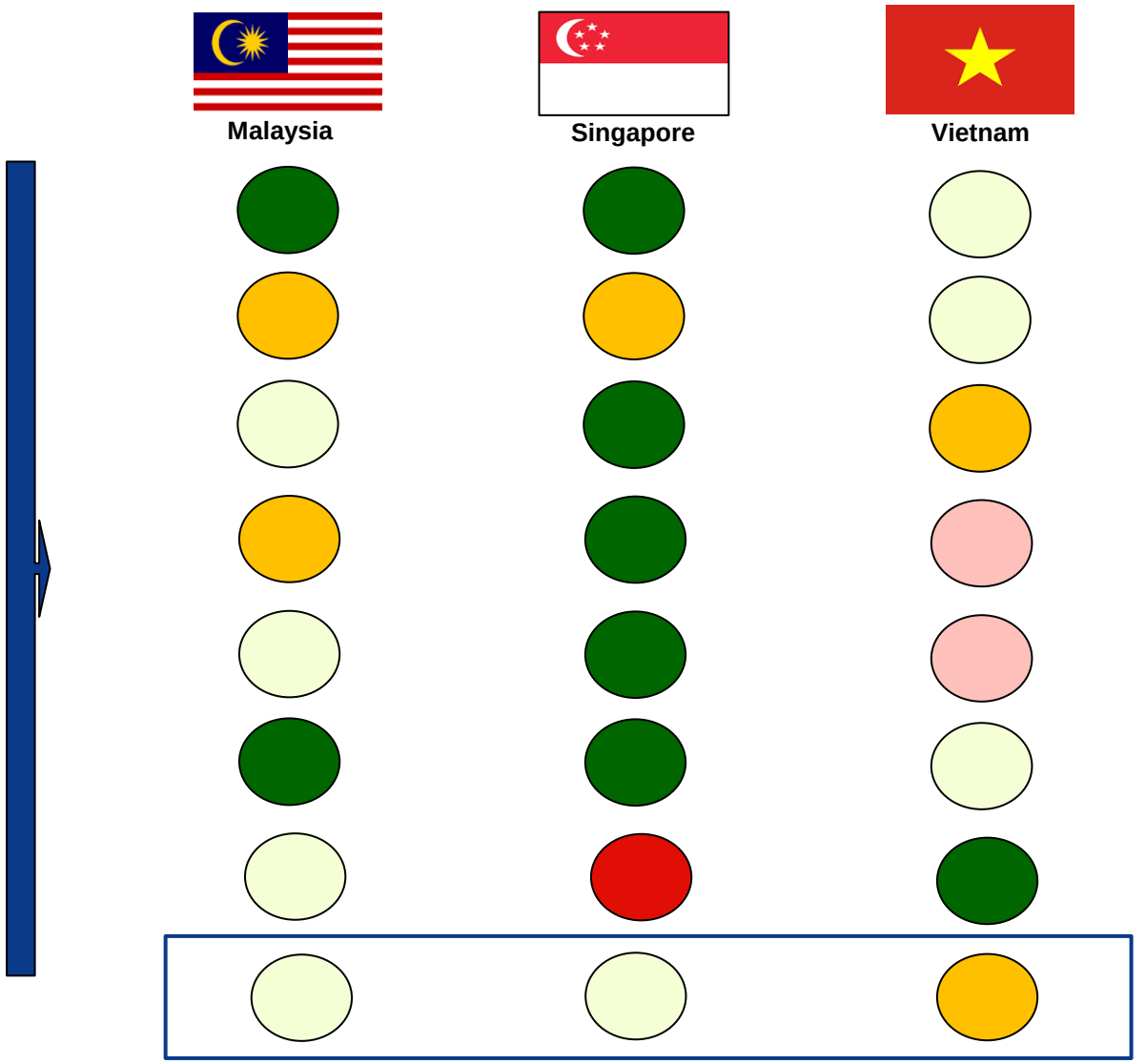
Factors
Ecosystem strength
Labor availability
Funding
R&D infrastructure
Value chain
Access to global markets
Labor costs
Conclusion



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2 The State of the Malaysian Semiconductor Industry

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Big on a a global scale

Malaysia is global player in the Semiconductor industry, Malaysia is the 7th largest exporter of semiconductors in the world, with a market share of 7% in 2023. Malaysia has served as a manufacturing center for electronics companies since the 1970s.

Big on a local scale

Malaysia has developed strong economic reliance on Semiconductor industry, as it counts on semiconductor production for huge parts of their GDP and exports: 6% of GDP and 40% of exports. Now the manufacturing sector has displaced commodities such as palm oil as the main export for Malaysia.

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Malaysia, a mature hotspot location for Semiconductor FDI (foreign direct investments)

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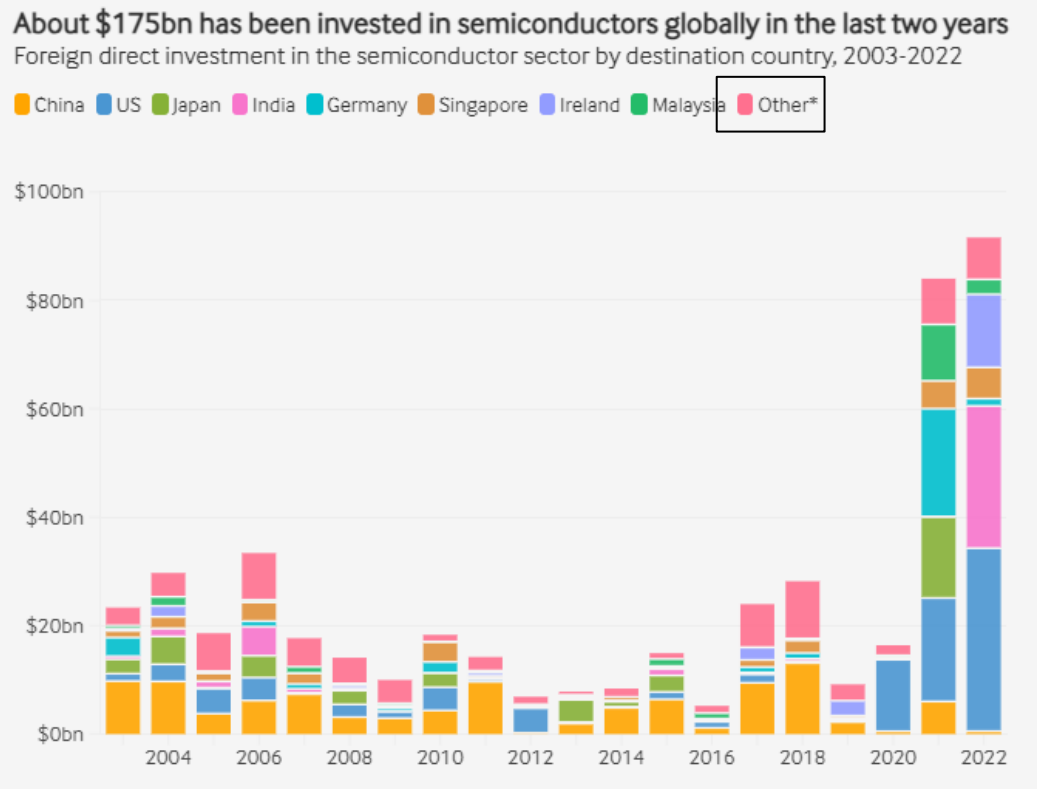
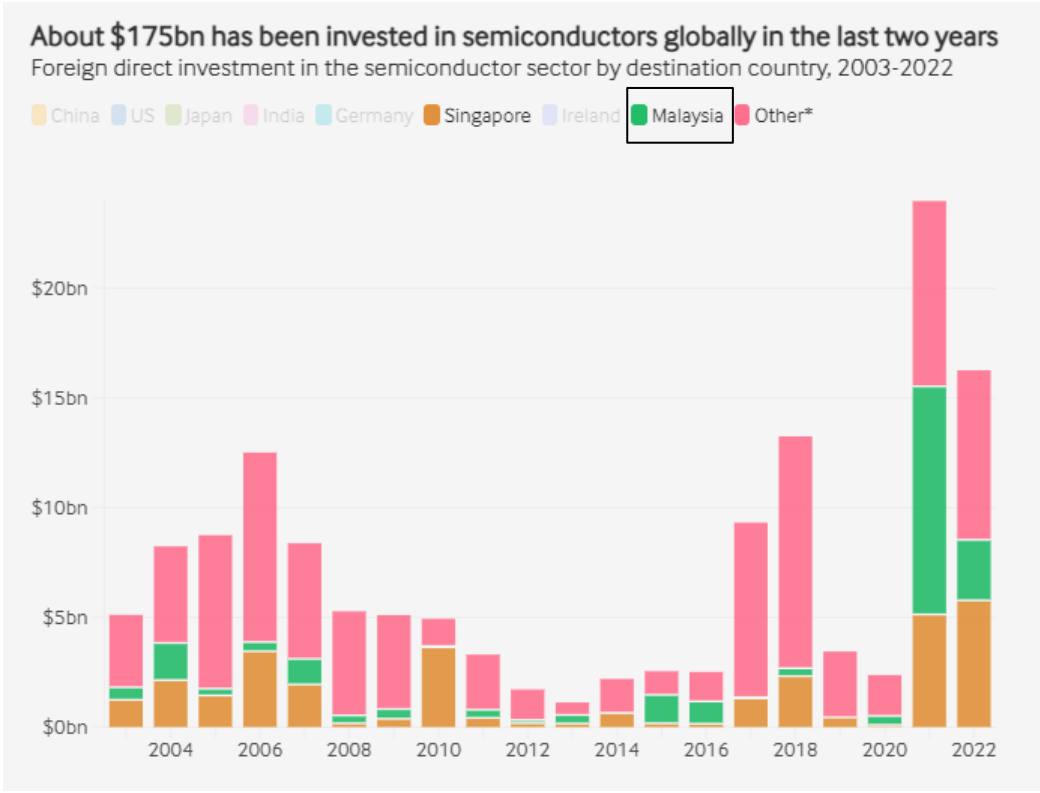
Malaysia is the 6th highest destination for FDI in the semiconductor industry in the world

Semiconductor production in Malaysia grew by over 175% from 2015 and 2022

In Southeast Asia, Singapore and Malaysia are the hotspot locations for semiconductor foreign direct investments





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Source: FDI intelligence

Recent notable FDI in Malaysian semiconductor industry

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Penang

GlobalFoundries
- Opening center of excellence in Penang, Malaysia to oversee global operations

TF-AMD
- €400 Million expanding manufacturing facility
- 3,000 jobs

Kulim

Infineon Technologies
- €2 Billion in additional production capacity
- 900 jobs

AT&S
- €325 Million in building, equipment and automation
- 6,000 jobs

Seremban

Nexperia
- €325 Million in building, equipment and automation
- 700 jobs

Penang and Kulim

Intel
- USD 6.5B, for assembly test manufacturing
- 4,000 jobs

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Focus on Malaysia's Semiconductor Ecosystem

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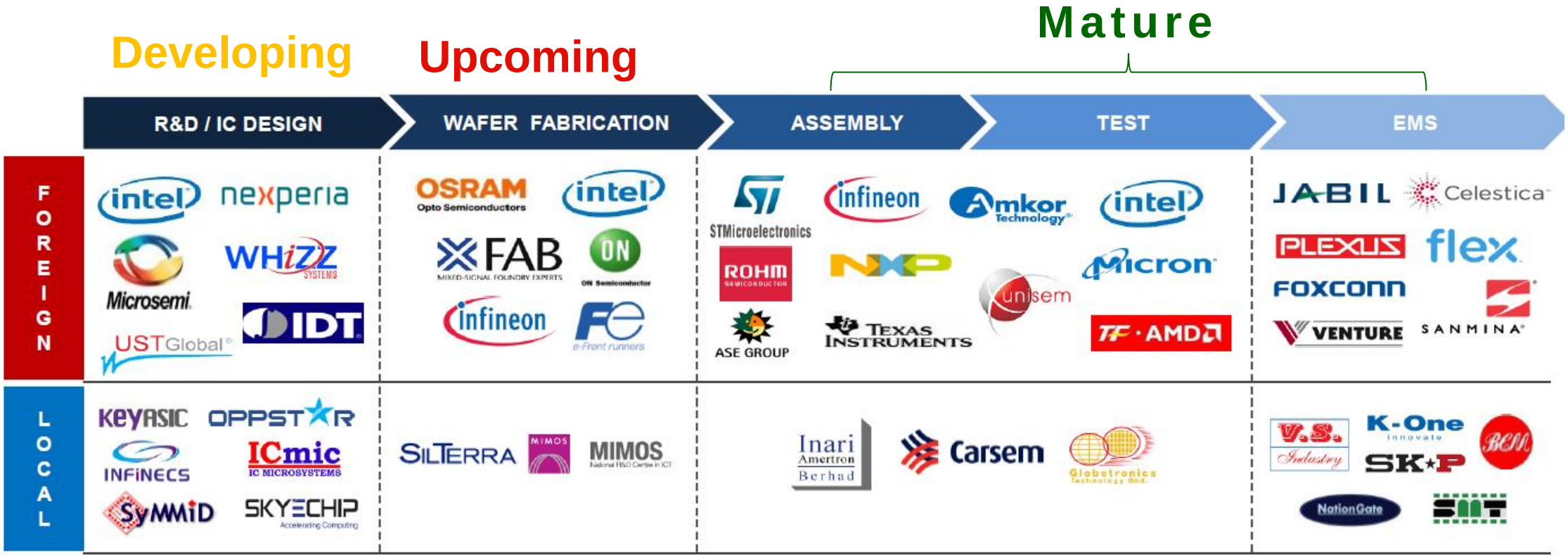

Malaysia has the complete semiconductor value chain from R&D, EMS (Electronic Manufacturing Services) to Assembly and Testing . **However, its expertise is mostly on Assembly, Testing, and EMS**. **Malaysia is still upcoming in the high-end wafer manufacturing.**

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Source: MSIA

Geographical focus of the Malaysian Semiconductor industry

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Most of Malaysia's electronics manufacturing facilities are in the Western part of the island.
The most critical Malaysian state for electronics manufacturing is Penang, followed by: Selangor & Johor

- **80% of Malaysia's global backend semiconductor output**
- **5% of worldwide semiconductor sales**
- **Since the 1970s, Penang has drawn semiconductor-related investments** mostly from Japan and China
- **Government has plans of expansion to Seberang Perai,** a city of the Penang state

Hotspot region: Penang, the "Silicon Valley of the East"

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Source: MSIA

Global Semiconductor companies diversify in Malaysia

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Top global semiconductor companies are currently operating in Malaysia

- ✓ There are over 50 semiconductor producers with factories in Malaysia.
- ✓ The country accounts for 13% of global chip assembly testing and packaging, and 7% of the world's semiconductor trade passes through Malaysia

- **The largest semiconductor manufacturer in the world, Intel, has committed to investing USD 15.8 billion** in Malaysia over a ten-year period.
- **Intel announced the construction of a new chip-packaging and testing factory in Malaysia in 2021**, and production will begin in 2024.
- **Intel was among the pioneers in the electrical and electronics industry in Malaysia, which started in 1972.**

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Source: BCI and Orissa International

Zooming in on notable Dutch companies in Penang, Malaysia

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Dutch companies in the semiconductor industry

KMWE designs, builds and continuously improves high tech components, modules and systems based on **precision engineering and machining**. As a contract manufacturer, KMWE supports industries such as medical, semiconductor, aerospace and many more.

Sempro is the expert in **trim & form and singulation solutions** for the semiconductor and microelectronics industries.

Nexperia R&D Malaysia is the **R&D centre** of Nexperia, a global semiconductor company that specialises in the design & production of discrete semiconductors, MOSFETs, analog & logic ICs. The Penang operation is focusing on developing new semiconductor products & improving existing products for the company's global market.

Dutch companies in other industries

Hittech Wemac in Penang is a fast-growing company for the **production of parts and the assembly of mechanical modules**. It takes full responsibility for ready-for-assembly parts, including surface treatment and CMM component qualification. The Penang plant forms an important part of Hittech's global production strategy and offers Asian OEM customers access to the competences of Hittech Group.

Actiforce Mechatronics is a state-of-the-art manufacturing division located in Penang, Malaysia. Mechatronics is responsible for the entire production process, from purchasing raw materials to product quality control to distribution. Actiforce is part of the world's largest manufacturers of **furniture fittings**, Hettich.

Enza Zaden Asia **develops vegetable varieties** and is responsible for the logistics of the seed of these varieties in Southeast Asia. The logistic in Penang, Malaysia has 4,000 cubic meter cold room and sufficient capacity to sort, pack and store the seeds.

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Source: Invest in Penang

Specifics of example companies active in Malaysia

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- Operated since 1972 in Selangor, Malaysia
- Activity: Assembly and testing of the broad NXP portfolio of microprocessors, microcontrollers, digital signal processors, mixed signal and radio frequency products
- Real estate: facility with a built-up area of 70,000 sqm on a 20-acre site dedicated to

- Opened recently with 1,000+ employees in Penang Malaysia
- Activity: R&D focusing on developing new semiconductor products and improving existing products for Nexperia's global market (discrete semiconductors, MOSFETs, analog * logic ICs)
- Will invest an additional USD 0.4 billion for chip production by 2026
- Real estate: four-story building with 11,000 sqm of cleanroom space and 20,000 sqm of build-up space (fully automated raw material warehouse)

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KMWE

- Operated since 2008 with 200+ employees in Penang, Malaysia
- Activity: Mainly labor-intensive modules and small systems are assembled for the medical and analytical and semiconductor market. KMWE Precision Systems Malaysia has all necessary facilities for (cleanroom) assembly, gluing of several materials and quality and function testing. In 2012 KMWE Malaysia started Components activities
- Real estate: facility with a built-up area of 2,000 sqm and a a cleanroom surface is 150 sqm (still expanding)

Besi

- Operated since 1980s in Selangor because its two important customers, Infineon and STMicroelectronics were in Malaysia
- Activity: Spare parts hub, in 2000 started building modules, then in 2010 started building machines, then in 2015 started plating production, and in 2021 hybrid bonding systems production (all equipment, tools, molds and mold kits are produced in Besi's Shah Alam, Malaysia and/or Leshan, China facilities)

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The STEM talent base in Malaysia

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- **Relatively high supply of STEM graduates, but also high demand**

  Malaysia has the highest percentage of STEM graduates in the world (44% of tertiary students in Malaysia graduate in a STEM field)—**but Malaysia said it wanted to raise its proportion of Stem students to as high as 60% to meet the future need** for science, engineering and tech professionals in the country.

- **Large number of international educational institutions support the country's STEM base**

International Universities

German Educational Institutions

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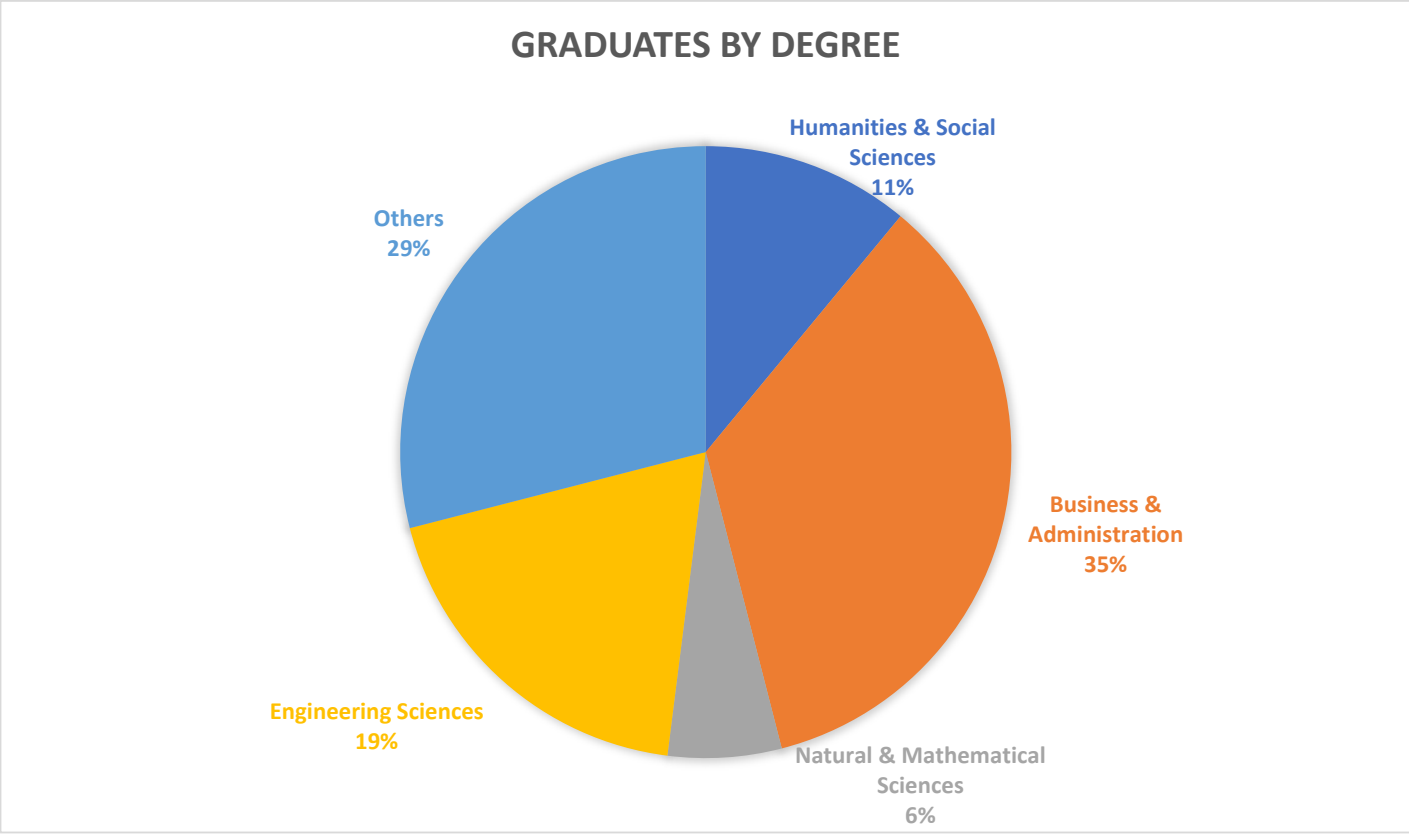
Source: MIDA & Department of Statistics Malaysia, 2023

Malaysia needs more engineers (low engineer-to-population ratio and percentage of graduates from Engineering Sciences)



Only 19% graduate from Engineering Sciences in 2022 (see graph below)**.** In the same year, there were around 187,900 engineers, in Malaysia making the **country's engineer-to-population ratio at one to 170—lower than in developed countries such as Germany and France, where the ratio is at one to 100**

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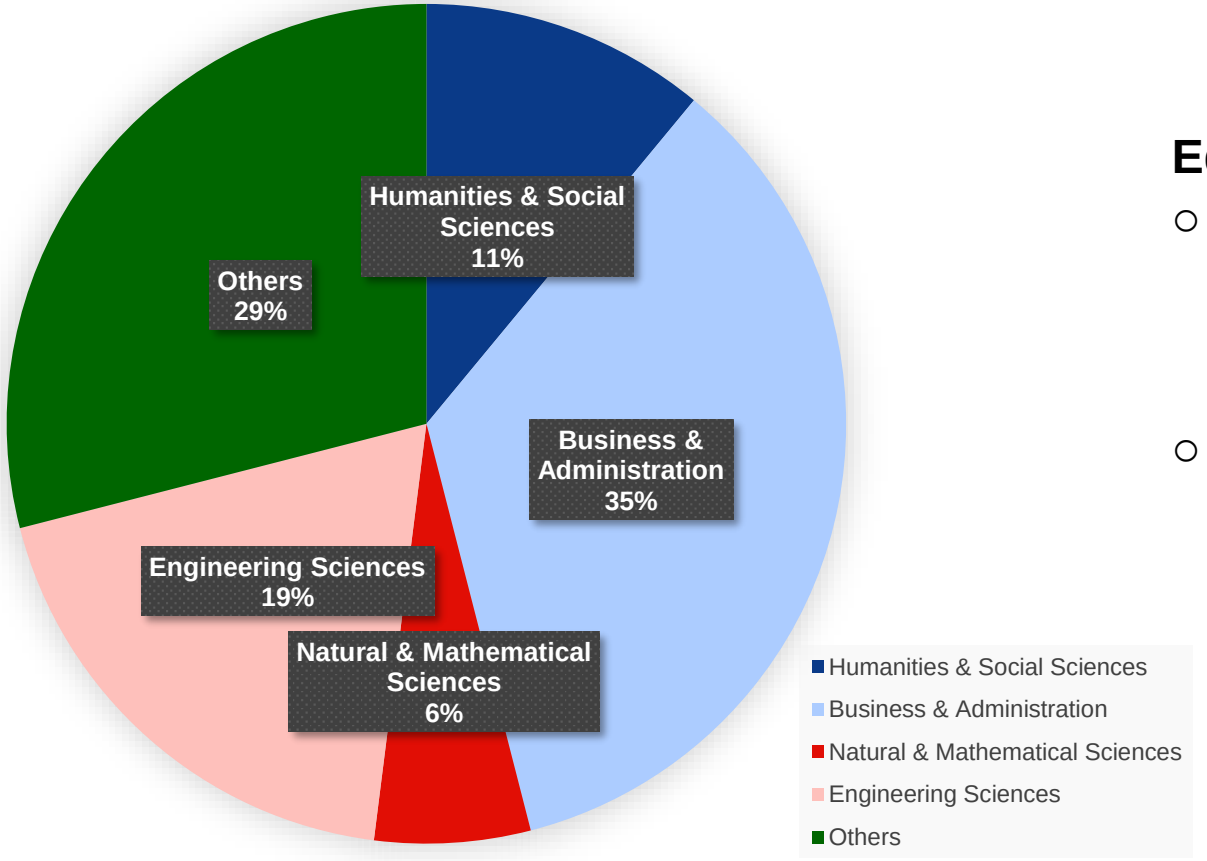
Source: Department of Statistics Malaysia, 2023

Majority of students in Malaysia study Business & Administration—only 19% are in Engineering Sciences and 6% are in Natural & Mathematical Sciences

Share of Graduates based on field of studies



Education programs specific to this industry

- Engineering courses in Institutes of Technical Education, polytechnics, universities: Electrical, Mechanical and Chemical engineering, Materials science, etc.
- Microelectronics engineering in Institutes of Technical Education, polytechnical institutions and universities

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Source: Department of Statistics Malaysia, 2023

3 Opportunities for Dutch Companies

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General areas of opportunity

1. **Labor-driven**
   - **Low labor cost in Malaysia and Vietnam:** EU salaries for production workers is more than 150% on average than Malaysia and Vietnam
   - **High labor quality in Malaysia and Singapore:**
     - Malaysia has a high percentage of STEM graduates: UNESCO data show that tertiary students in Malaysia tops the world with the most graduates in a STEM field with 43.5%
     - Singapore ranks globally in terms of research and development, integrated circuit design and sub-system equipment production

2. **Risk-driven**
   - **Political neutrality of Malaysia, Vietnam, and Singapore enable companies to diversify supply chain from geopolitical pressures (US-China trade war)**
     - Some Chinese players have been placed on the US trade blacklist “Entity List”, for example SMIC and Huawei, to create “China-free supply chains.” Third countries are pulled into geopolitical competition, Taiwan for instance stopped supplying to Huawei.

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3. Ecosystem-driven

- **Malaysia and Singapore have well-established and complete semiconductor ecosystem**
  - Top global semiconductor companies are currently operating in Malaysia and Singapore
  - Only Malaysia and Singapore in Southeast Asia have the complete Semiconductor value chain: from R&D to front-end and back-end manufacturing

4. Market-driven

- **Malaysia, Singapore, and Vietnam have market access to 3 large free trade groups**
  - **The ASEAN** (Association of Southeast Asian Nations), the 3rd largest market in the world with 622 million people (only behind China and India)
  - **The RCEP** (The Regional Comprehensive Economic Partnership), the world's largest free trade agreement, covering 15 countries with 2.2 billion or 30% of the world's population (10 ASEAN member countries + China, South Korea, Japan, Australia, and New Zealand)
  - **The CPTPP** (Comprehensive and Progressive Agreement for Trans-Pacific Partnership) will add new markets of Canada, Mexico, Peru, and Chile with combined market of 217 million

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Opportunities for Dutch Companies

There are opportunities for Dutch semiconductor / high tech related companies on three levels

A. Malaysia as supply / partner base

- Dutch companies can partner with relevant companies that are already present in the Malaysian semiconductor ecosystem (contract manufacturing, development, etc.)
- Dutch companies can source from specialized suppliers in Malaysia

B. Malaysia as market

- Malaysia offers market potential for Dutch companies: selling materials/components/ services to companies that are located in Malaysia

C. Malaysia as potential new location

- Malaysia offers a good investment climate for semiconductor related investments, e.g. into new manufacturing sites

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A Malaysia as supply / partner base

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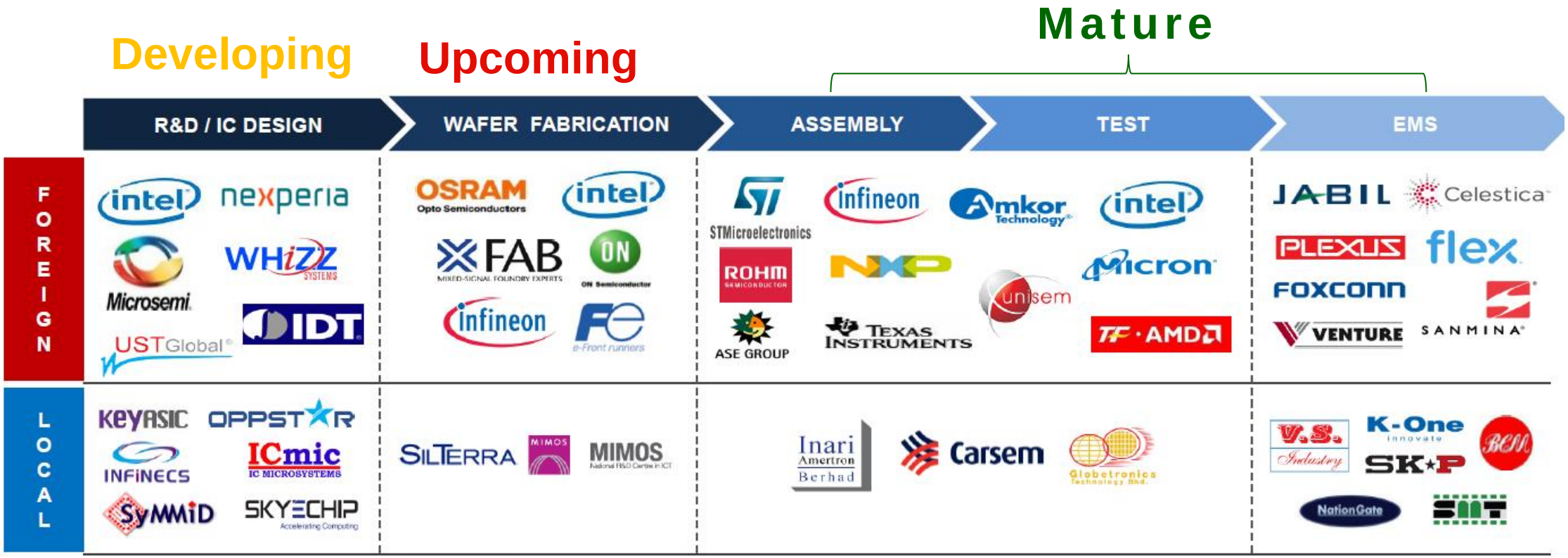

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B Malaysia as a market

7% of total global semiconductor trade flows through Malaysia

32.64 billion semiconductors produced in Malaysia

Employs nearly 600,000 Malaysians

Production value in 2022 was 45.6 billion euros

Source: Malaysia Semiconductor Industry Association (MSIA), 2023

- The semiconductor industry attracts the highest level of investment (FDI+DDI) into Malaysia with approximately 30 billion euros of investments in 2021
- Firms in Malaysia are mostly involved in mid- to lower-end of the value chain conducting assembly, packaging and testing (ATP) activities
- 13% of global chip assembly, testing and packaging is done in Malaysia

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Industry breakdown

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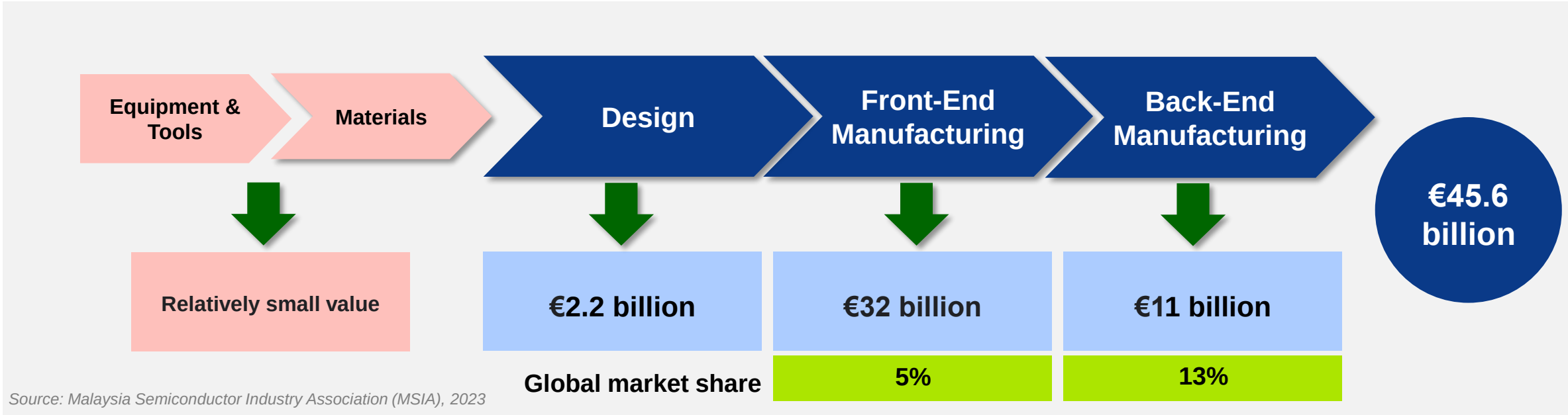
Production value in 2022



Source: Malaysia Semiconductor Industry Association (MSIA), 2023

- The Malaysian government plans to further strengthen the semiconductor ecosystem and achieve a 15% market share in the assembly, testing and packaging (ATP) activities by 2030, compared with 13% currently
- To attract investments, the government offers companies in priority sectors a five-year partial income tax exemption on 70% of their statutory income. For high-tech companies, they offer a full tax exemption for up to 10 years
- The government also provides allowances for re-investments and many other infrastructure and related input benefits

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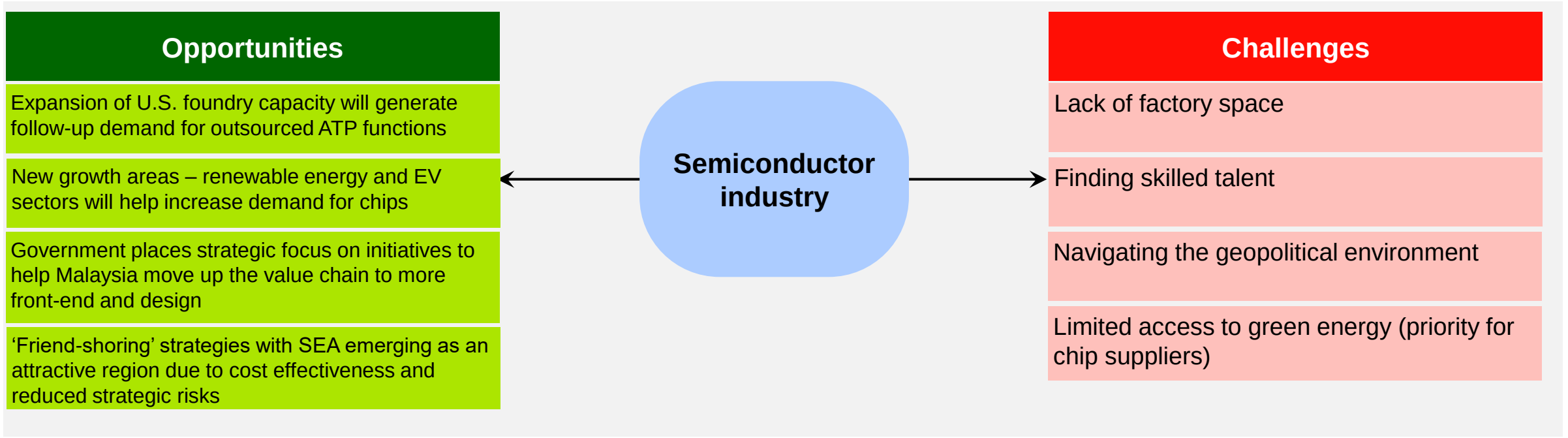
Market opportunities



- As Malaysia wants to increase their share of ATP business by 2030, this is a major focus of investment. Thus, if firms can address the challenges listed above, their back-end activities may still be of interest to invest in Malaysia
- The governments focus on attracting front-end design activities makes this a potentially good market opportunity for FDI. The government is working with universities to develop design curricula and partnering with industry players to provide on the job training

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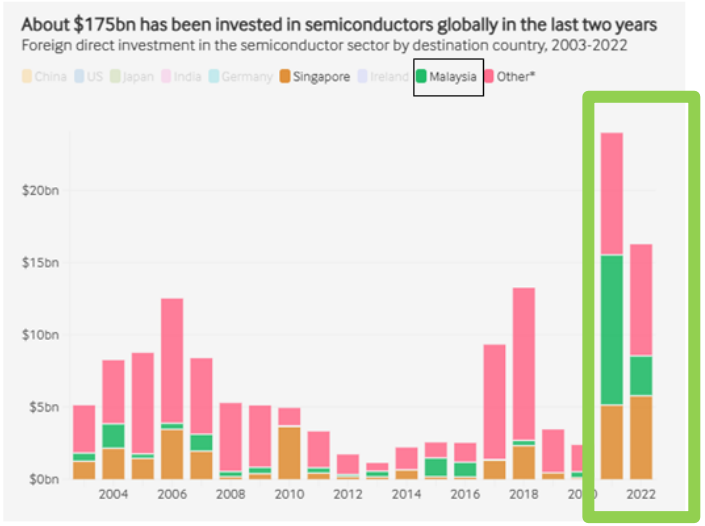
C Malaysia as a potential new location

- Scarcity of space / capacity / labor in The Netherlands
- Trend towards decentralizing / de-risking end to end supply chains
- China +1 strategy
- Decarbonization; e.g. reducing freight distances inbound and outbound
- ….

In Southeast Asia, Singapore and Malaysia are the hotspot locations for semiconductor foreign direct investments



Source: FDI intelligence

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Geographical focus of the Malaysian Semiconductor industry

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Hotspot region: Penang, the "Silicon Valley of the East"

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Source: MSIA

Classification of opportunities

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	Type	Opportunity	R&D / Design	Equipment / Material	Front end mfg	Back end mfg	Indication of opportunity scale	Remarks
Short term	A. Supply/Partner base							
	A1	New component suppliers		✓	✓	✓	●	
	A2	New contract manufacturers		✓	✓	✓		Back end / equipment focus
	A3	New R&D partners	✓				◑	
	B. Market							
	B1	Sales to local market	✓	✓	✓	✓	●	Opportunities across value chain
Mid-long term	C. FDI							
	C1	New design / R&D centers	✓				◑	
	C2	New mfg plants		✓	✓	✓	◕	

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4 Take Aways

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Developing value chain in the region

- Malaysia and Singapore cover the full value chain from R&D/IC Design, through equipment/material, front & back manufacturing and commercialization
- Other countries in South-East Asia for now focus on back end manufacturing

Attractive base

- Significant market, e.g. ~32 bln Euros front end production value in Malaysia
- Significant talent base
- Ecosystem → Mix of global and local companies, knowledge and education base, government support

Opportunities for Dutch companies

- Opportunities in:
  - Expanding supplier / contract manufacturing base
  - Expanding sales / market
  - Locating new facilities

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