

Towards a Semiconductor Industry Value Proposition

Opportunities for Dutch companies in Vietnam

Report – for external use

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Corporate clients

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

Profile

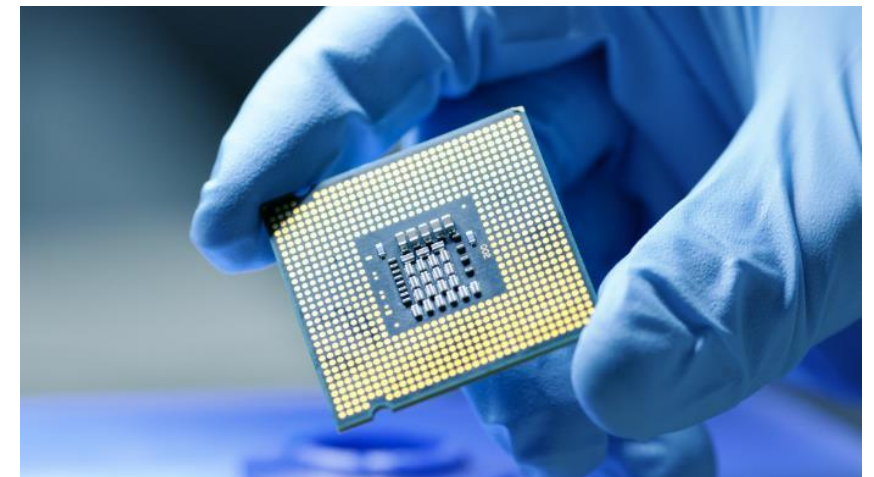
- Established in Nijmegen, the Netherlands in 1985
- Offices in
 - Europe: The Netherlands, Frankfurt
 - Asia: Singapore, Shanghai
 - US: Atlanta, San Mateo, Los Angeles, Dallas
- Performed studies in more than 50 countries worldwide
- 75 professionals



Client Base (Examples)



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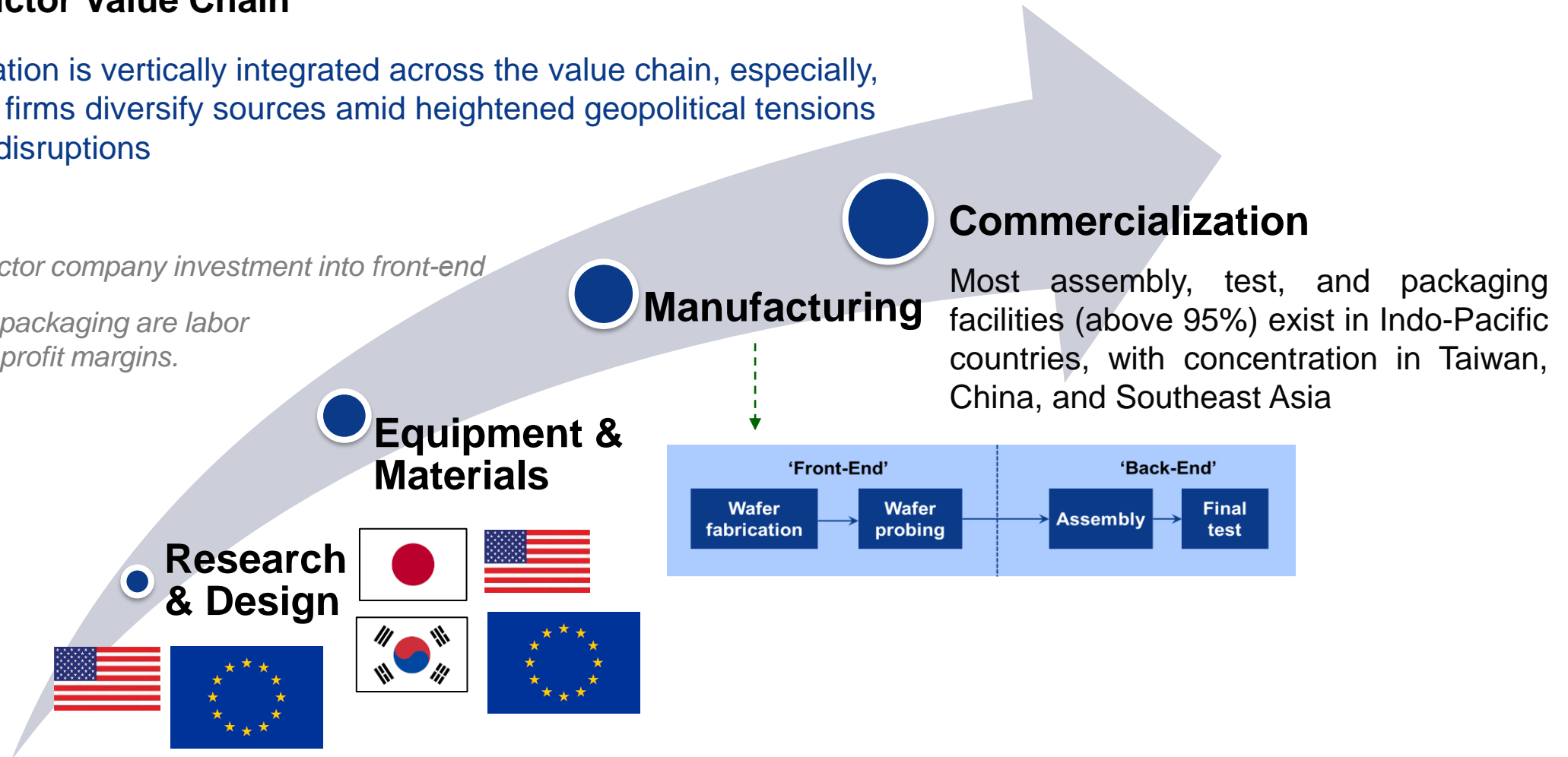
1 The Southeast Asia Regional Perspective

The Semiconductor Value Chain
















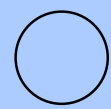

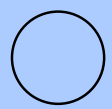






No company or nation is vertically integrated across the value chain, especially, as semiconductor firms diversify sources amid heightened geopolitical tensions and supply chain disruptions

~70% of semiconductor company investment into front-end

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



The Southeast Asia Regional Perspective

Value Chain	Vietnam	Singapore	Malaysia	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

Challenges



- **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



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

Singapore

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

- **Global foundries** 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




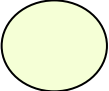
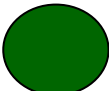
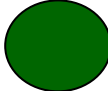
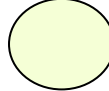



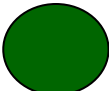
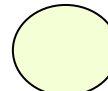
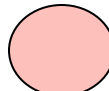
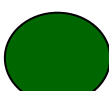

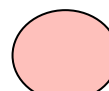





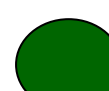
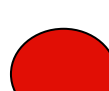




Vietnam

- **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)

Comparison of Malaysia, Singapore, and Vietnam

Semiconductor Key Location Criteria

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

-  Key strength
-  Strength
-  Neutral
-  Weakness
-  Sign. weakness

2 The State of the Vietnamese Semiconductor Industry



Notable growth in recent years

Vietnam's semiconductor industry has experienced notable growth and development in recent years, and it has been attracting significant interest from major companies in the industry. Although the current market is still immature, it is growing with a year over year growth rate of 5.76% (2023) which is projected to result in a market volume of \$26.20 BN by 2027.



Developing on a local scale

Vietnam is actively working to develop its design and packaging capabilities to increase its influence in the global semiconductor industry, but its current contributions remain minor when to the entire supply chain is considered. Vietnam primarily participates in the first and the final phases of semiconductor production, focusing on design, R&D, assembly, testing and packaging. This role, while crucial, represents the lower-value end of the supply chain.

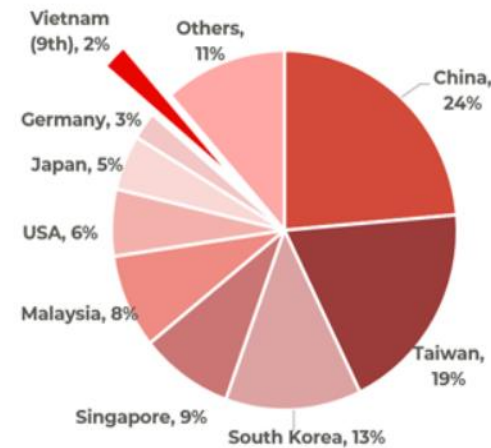


Recent Key Developments in Vietnam Semiconductor Industry

In a significant move in 2023, the US has offered its support to Vietnam's semiconductor industry recognizing the country's potential, the U.S. is collaborating with Vietnam to bolster its microchip production. This collaboration includes technology transfer, financial investment, capacity-building initiatives and a focus on creating a secure and sustainable semiconductor ecosystem in Vietnam

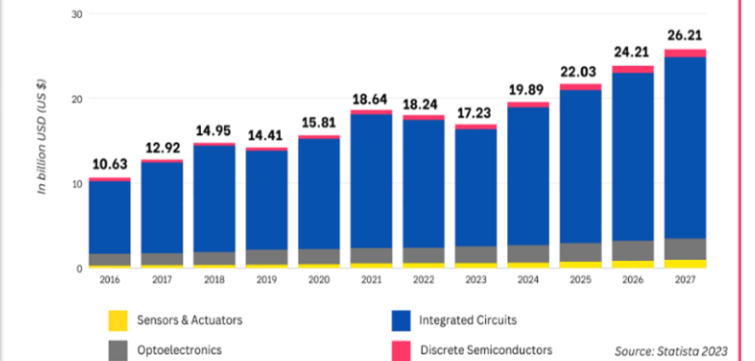
As per information reported in 2023 by the U.S. Census Bureau, there was a notable 75% surge in chip imports from Vietnam within February, making Vietnam the third country in Asia in terms of semiconductor exports to the US, after Malaysia and Taiwan. This increase pushed the import figure to \$562.5 million, up from \$321.7 million in the same period a year prior

2021 Exports of Semiconductor Devices* and IC**, %Shares by Country.

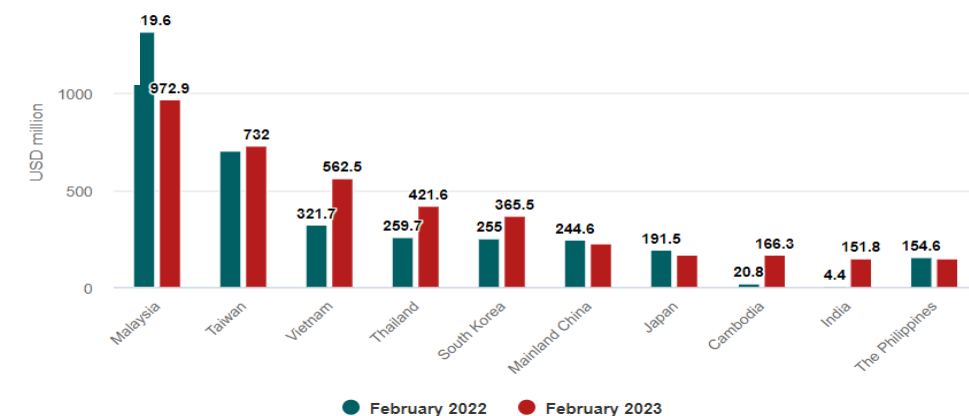


Source: OEC

Revenue by segment



Chip exports to the US



Source: FDI intelligence

Recent notable FDI in Vietnamese semiconductor industry



Bac Giang Province



Hana Micron

- Opening its first semiconductor plant in Bac Giang Province,
- \$600 M investment: 4,000 jobs



Bac Ninh Province



Amkor Technology

- Starting operations at a new \$1.6 Billion factory



Ho Chi Minh City



Synopsys

- Investing in semiconductor design and incubation center



Hanoi Province



Intel Products

- Expansion at the current assembling, packaging and testing chips manufacturing hub



Thai Nguyen Province



Samsung Electronics

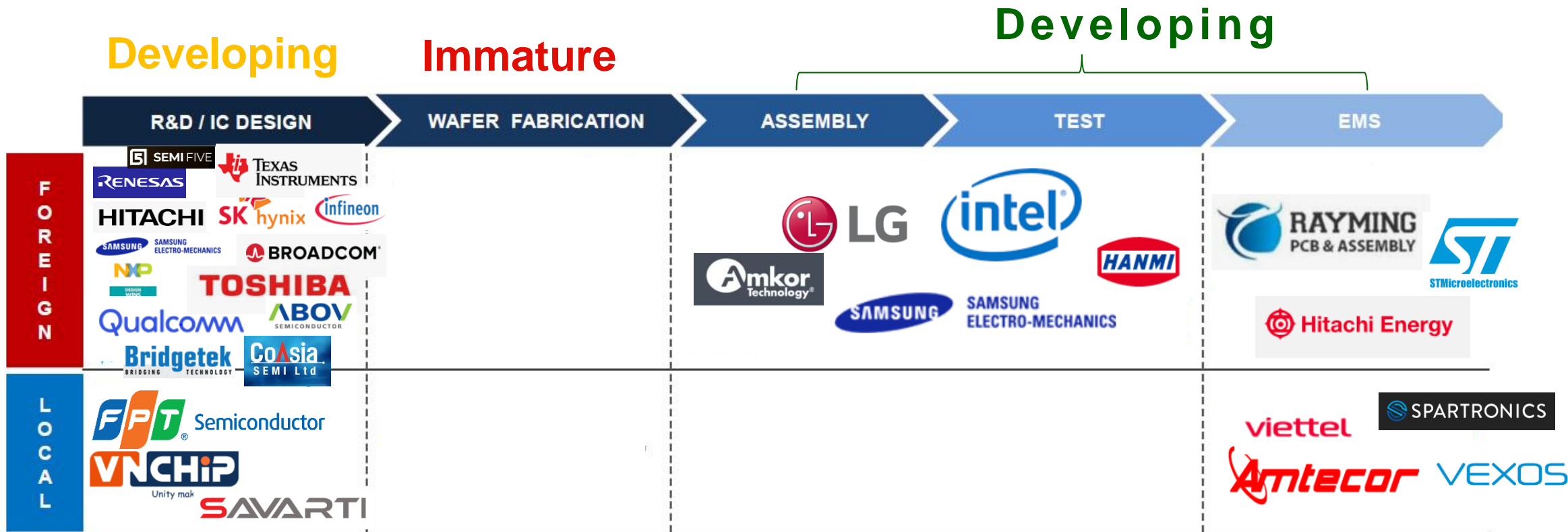
- \$850M investment to manufacture semiconductor components in Thai Nguyen province



Marvell

- Establishing a global-level design centre in Ho Chi Minh City
- 4,000 jobs

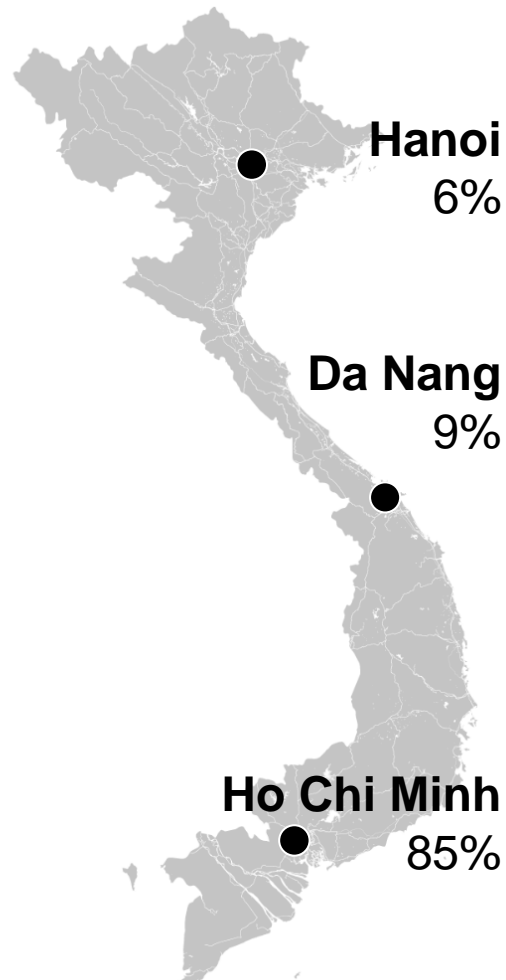
Focus on Vietnam's Semiconductor Ecosystem



Vietnam currently takes part in the R&D, design, assembly, testing, packaging and EMS (electronics manufacturing services) parts of the value chain

Hotspots in Vietnam for Semiconductor Investment

Hanoi, Da Nang and Ho Chi Minh are the key locations for Semiconductor companies



- Vietnam has formed its National Innovation Center (NIC) and three hi-tech parks in Hanoi, HCMC, and Da Nang City, well-equipped with modern infrastructure satisfy the demands of investors. These locations are an important factor for the creation of an ecosystem for the domestic semiconductor industry in Vietnam



Semiconductors Market in Vietnam



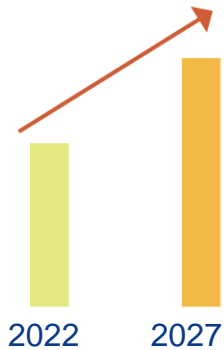
Market growth expected
(2023-2027) to
ACCELERATE at a **CAGR**
of

6.12%



Year-over-year
growth
rate for **2023**

5.76%



Incremental growth
(\$B)

1.65



The market is **FRAGMENTED**
with several players occupying
the market

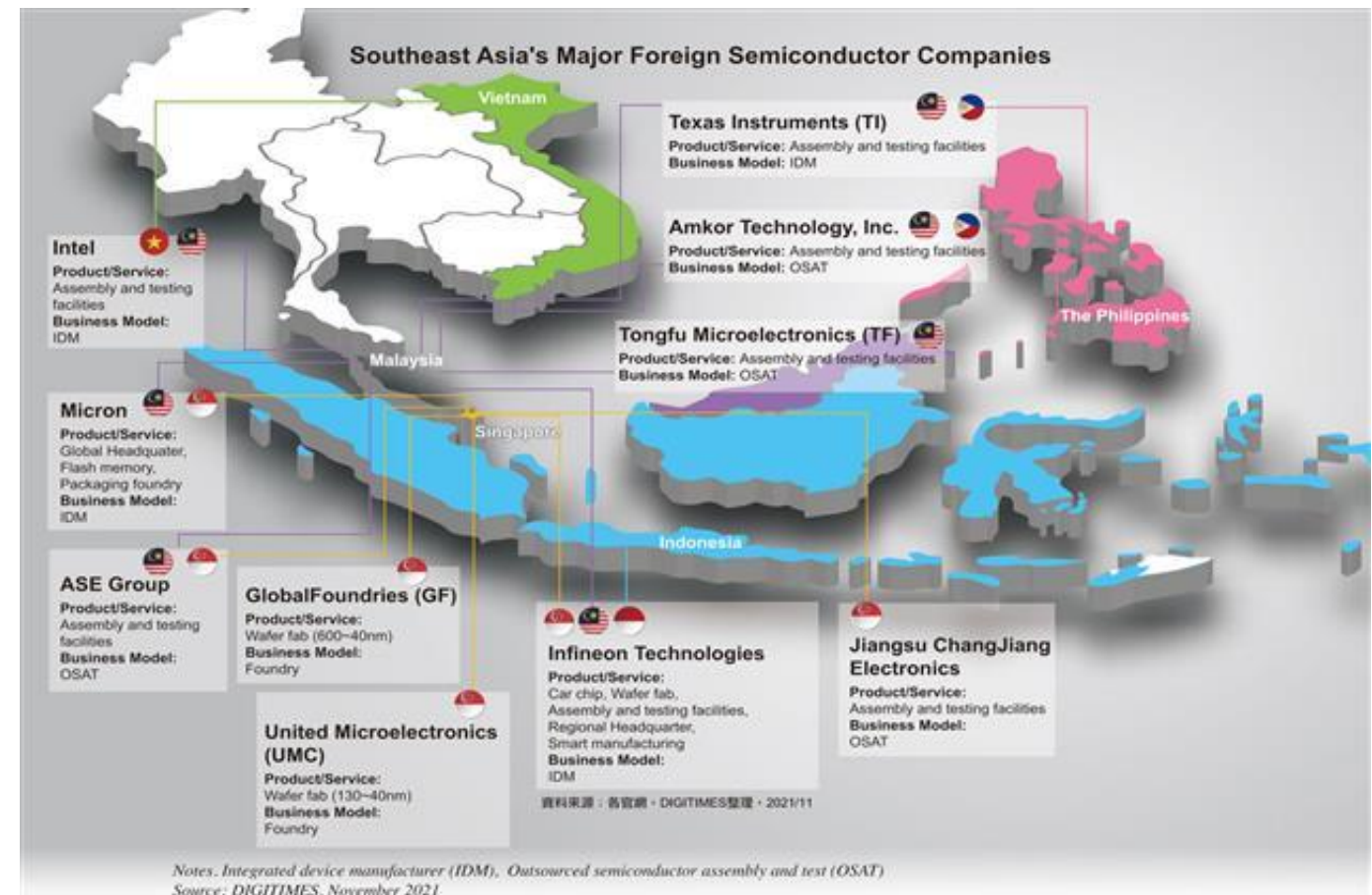


Vietnam attracts giant investments in semiconductor industry

In Southeast Asia, Singapore and Malaysia stand out as hotspot locations for the semiconductor industry. Vietnam, while currently trailing with a minor market share, is poised to catch up rapidly due to increasing FDI

Vietnam's progress in the semiconductor industry can be largely attributed to its success in drawing substantial foreign direct investment (FDI)

Foreign Investment Agency in Vietnam, a division of the Ministry of Planning and Investment, reported that Vietnam received over 25 billion USD in FDI during the first 10 months of 2023, up nearly 15% year-on-year



Source: FDI intelligence

Fostering International Alliances: US-Vietnam Partnership

Vietnam's semiconductor industry is currently marked by a significant trend of collaboration and strategic partnerships, with the current recent United States –Vietnam alliance taking center stage

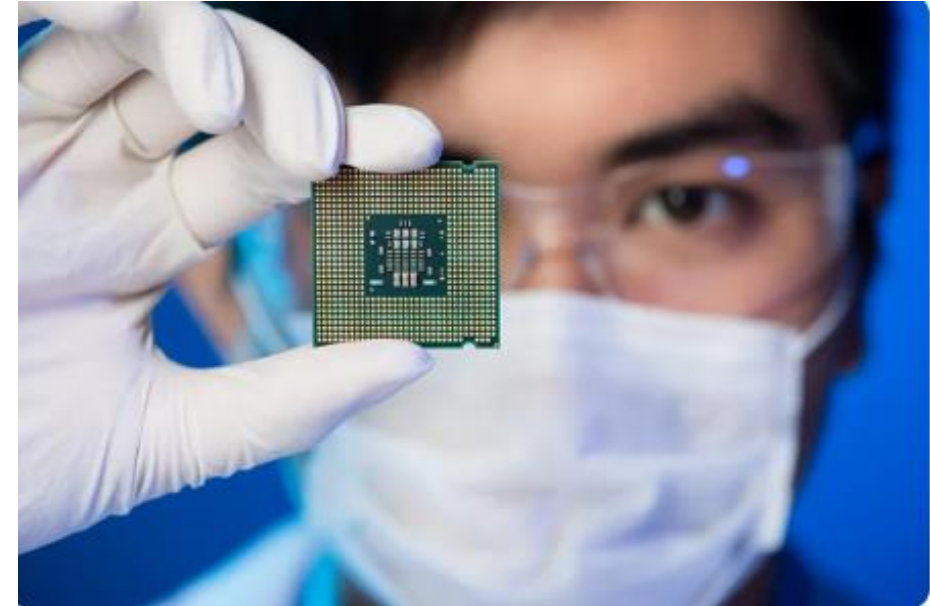
- ✓ **The U.S. and Vietnam have signed a Memorandum of Cooperation on Semiconductor Supply Chain, Workforce and Ecosystem Development, which aims to strengthen Vietnam's current semiconductor ecosystem, regulatory framework, workforce and infrastructure needs**
- ✓ **To prepare human resources for this strategic industry, Vietnam and the U.S. will launch comprehensive workforce development initiatives, such as hands on teaching labs, support research programs at the universities and training courses for semiconductor assembly, testing and packaging**
- ✓ **Creating a model of training and incubation center for semiconductor circuit design in Vietnam and form training & research programs for the semiconductor industry at Vietnamese universities**



Source: BCI and Orissa International

Fostering International Alliances: EU-Vietnam Partnership

- ✓ **EU's Strategic Interest in Southeast Asia:** The EU recognizes Vietnam's importance as a gateway to the ASEAN region, a dynamic economic bloc with a growing market of over 600 million people. EU investment in Vietnam aligns with its broader strategy of strengthening ties with Southeast Asia
- ✓ **EU-Vietnam Free Trade Agreement (EVFTA):** The landmark EVFTA, which entered into force in 2020, has significantly liberalized trade and investment between the EU and Vietnam. The agreement has reduced tariffs, eliminated non-tariff barriers, and facilitated the movement of goods, services, and capital



The Netherlands is the largest EU direct investor in Vietnam with a cumulative investment of US\$13.71 billion at year end 2022. It also remains the largest EU export destination in 2022 and ranks 6th worldwide. Exports to the Netherlands reached US\$10.43 billion in 2022, an increase of 36 percent compared to 2021. In March 2023, it was widely reported that Dutch chip suppliers were weighing new manufacturing factory possibilities in Vietnam and Malaysia for up to US\$1.5 billion

Fostering International Alliances with Top Global Companies

Top global semiconductor companies are currently investing in building human resources for semiconductor chip industry in Vietnam

SYNOPSYS®

- ✓ Synopsys Management Board signed a cooperation agreement on establishing SHTP Chip Design Center, under which Synopsys will give 20 Synopsys licenses for three years to serve chip design training
- ✓ Synopsys cooperates with schools in Ho Min Chi City organize ToT (training of trainers) on IC design

MARVELL™

- ✓ Synopsys and Marvell are cooperating to offer training in semiconductor chip design
- ✓ Marvell provides an excellent scholarship program to help develop essential technological skills to talented students majoring computing science at the universities

SAMSUNG

- ✓ Ministry of Industry and Trade has partnered with Samsung Electronics to provide training programs for semiconductor workers at Samsung's factories in Vietnam

Specifics of example companies active in Vietnam



- Intel first invested in the semiconductor chip industry in Vietnam project in 2006
- Activity: Assembly and testing factory, the largest of Intel's network is inaugurated. To prepare for the inauguration of the factory more than 150 workers of Intel, including engineers and technicians were sent to Malaysia, China and the US for two years
- After 17 years of operation, the number of workers at Intel's chip factory has risen to 4,000; and makes Raptor Lake, the 13th generation microprocessor and Meteor Lake, the next-generation microprocessor. Estimated 50% of Intel Global's assembling and testing output is undertaken in Vietnam
- Real estate: facility with a built-up area of 70,000 sqm on a 20-acre site dedicated to manufacturing
- Intel remains the only US company to set up a chip manufacturing factory in Vietnam



- FPT Semiconductor is the subsidiary of Vietnamese company FPT Software and operating since 2022
- Activity: FPT Semiconductor released its first integrated circuits which were designed in Vietnam and manufactured in South Korea
- FPT Semiconductor plans to supply 25 Million chips globally in seven types to meet diverse needs and contribute to the development of the fast-growing semiconductor industry in Vietnam

Several Dutch semiconductor companies and suppliers are operating in Vietnam



Development of software solutions for the high tech / semiconductor manufacturing industry



Highly active on the Vietnamese market, innovating lighting solutions across the economy



Investing in first manufacturing capacity in Vietnam (Saigon High Tech Park)



Was announced to be starting to invest in production capacity in Vietnam

The STEM talent base in Vietnam

- **Vietnam has an abundant workforce in technology, suitable to the semiconductor industry. It has research institutes and training establishments, including the Hanoi and HCM City National Universities, Hanoi University of Science and Technology**
- **Vietnam will step up the training of high-quality workforce in semiconductor industry, with the goal of training 50,000 workers by 2030**

International Universities and Institutes



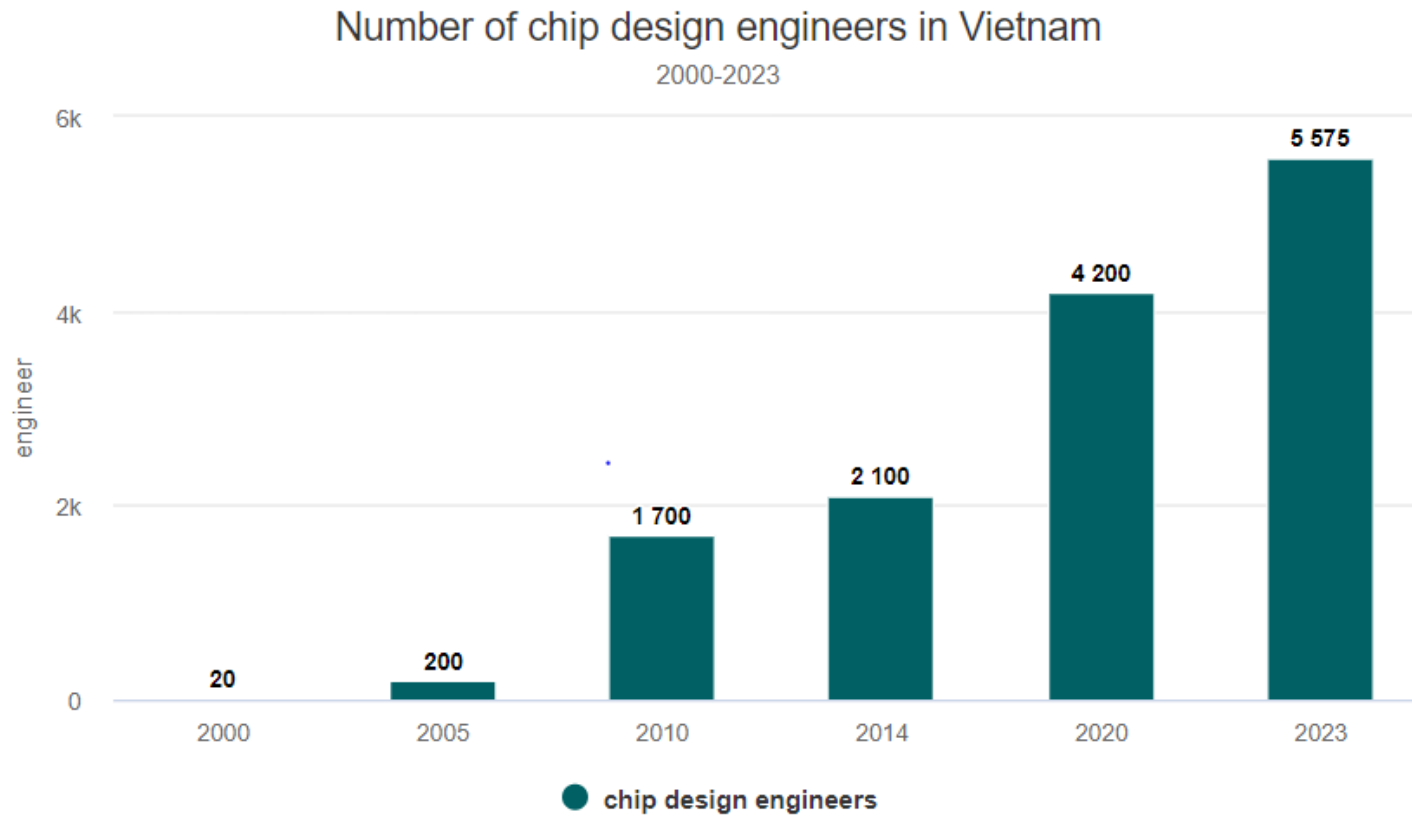
**INTERNATIONAL
SCHOOL**
VIETNAM NATIONAL UNIVERSITY, HANOI



**HANOI UNIVERSITY
OF SCIENCE AND TECHNOLOGY**

- ✓ **Vietnamese government offers short courses, bachelor and master's degrees, PHD programs in semiconductor engineering and related disciplines**
- ✓ **Ministry of Industry and Trade has partnered with Samsung Electronics to provide training programs for semiconductor workers at Samsung's factories in Vietnam**

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



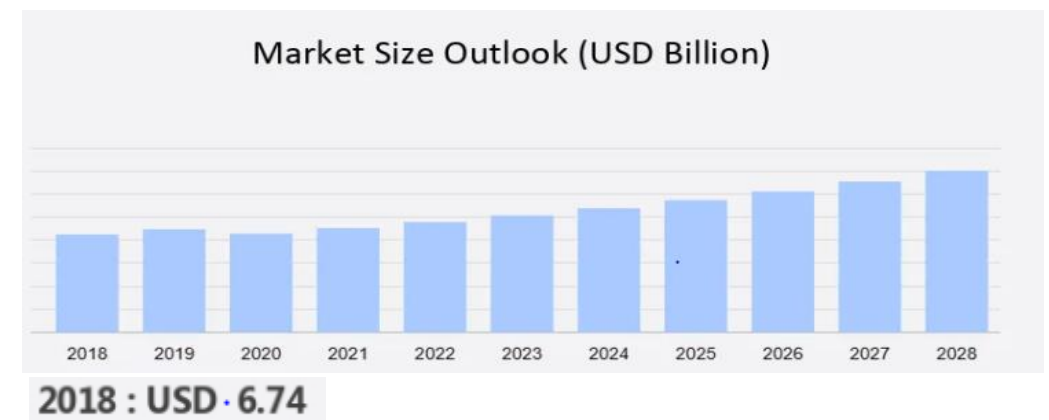
In terms of microchip design, Vietnam has about 5,000 engineers who can undertake work in all stages of the design process. The workforce for semiconductors is mostly in Hoh Chi Minh City (85%), Hanoi (8%) and Da Nang (7%)

Vietnam has recently announced that it is working on human resource initiatives with the ambitious target of producing 50,000 engineers by 2030

Source: Department of Statistics Malaysia, 2023

What is Vietnam doing to support semiconductor industry?

- Establishing specialized semiconductor training programs at universities and vocational colleges
- Providing training programs for semiconductor workers in collaboration with industry partners
- Attracting foreign semiconductor companies to invest in Vietnam with high and attractive incentives.
- Various tax incentives are implemented as a strong will of Vietnam authorities to attract foreign companies



3 Opportunities for Dutch Companies

A General areas of opportunity in Southeast Asia

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

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

Opportunities for Dutch Companies in Vietnam

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

A Vietnam as supply / partner base

- Vietnam can leverage its existing strengths in electronics manufacturing and assembly to move up the value chain and participate in more complex and high value stages such as design, testing and packaging.
- Vietnam has recently attracted many foreign semiconductor companies such as Intel, Marvel, Qualcomm, Amkor etc. These companies can share their knowledge and expertise with local partners and support development of the value chain



B Vietnam as market

- Companies can take advantage of growing demand for semiconductors in various sectors such as 5G, Internet of Things (IoT), artificial intelligence (AI), smart cities, etc., These sectors require advanced and customized semiconductor solutions that can create new market niches for Vietnamese firms

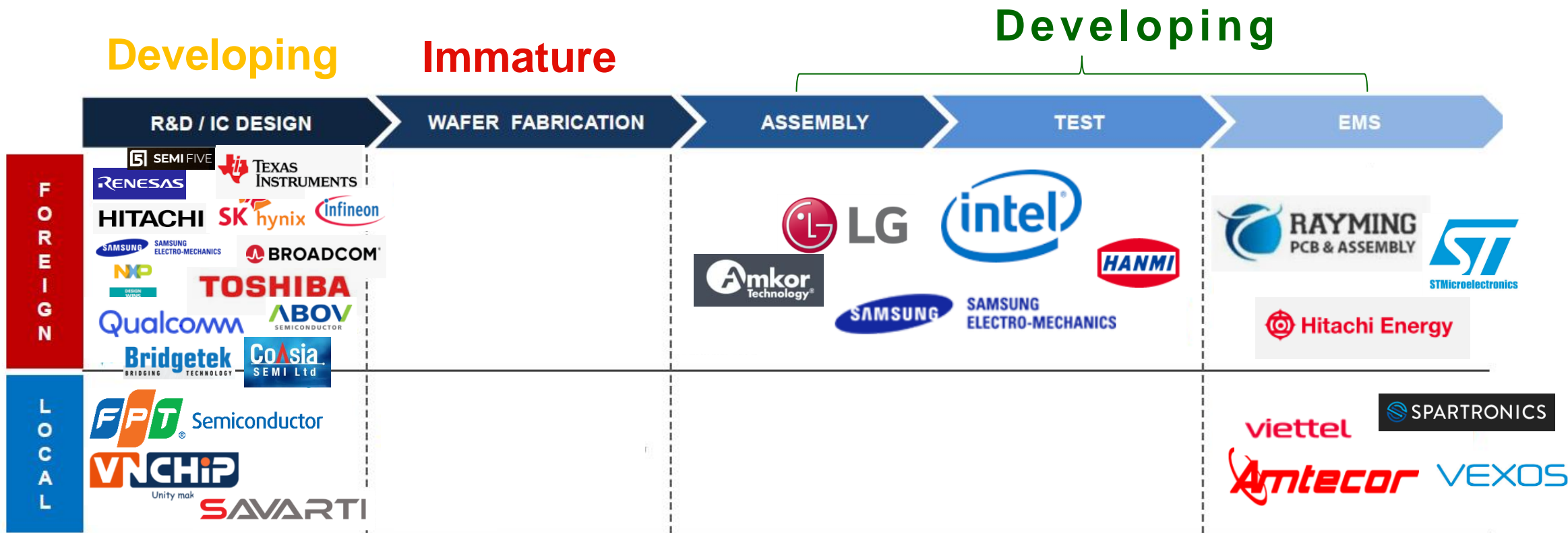


C Vietnam as a potential new location

- Vietnam has a stable political system, a favorable geographical location, abundant human resources in engineering and technology and a growing digital infrastructure.
- Vietnam government supporting foreign investments with high incentives



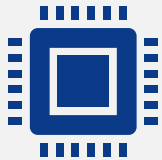
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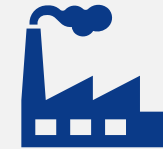
2% of total global semiconductor exports of devices and IC flows through Vietnam



**5.76% Year over Year
growth rate of 2023 in
semiconductor industry**



**High labor
availability and low
labor cost**

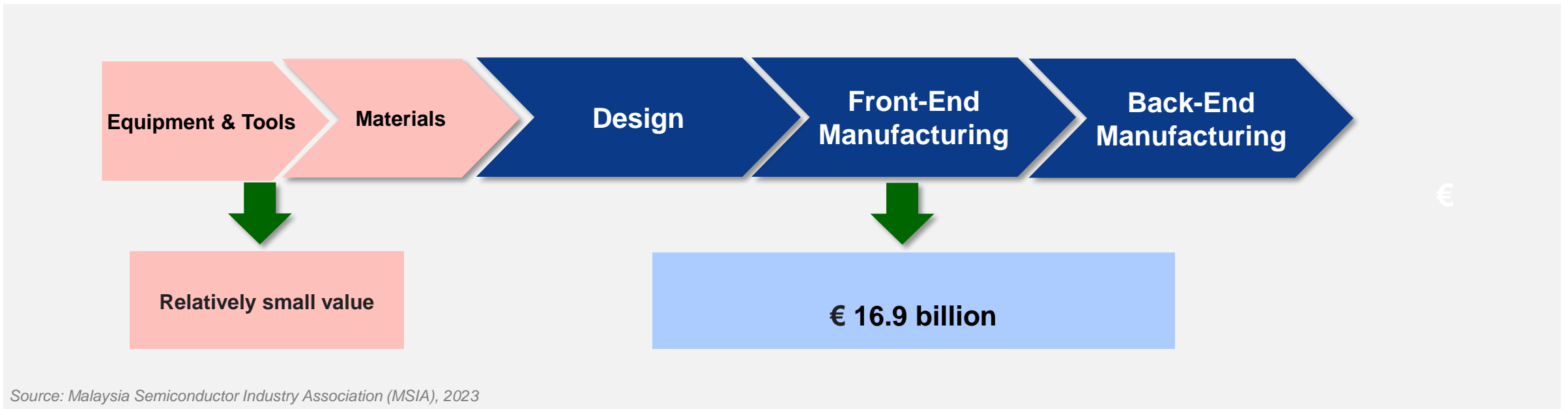


**13 Free Trade
Agreements and
US-Vietnam Partnership**

- The semiconductor market in Vietnam is expected to grow by \$1.65 billion at a compound annual growth rate, of about 6.12% in the next 5 years
- Vietnam has one of the highest labor availability and lowest labor cost in the region
- US signed a strategic partnership agreement with Vietnam

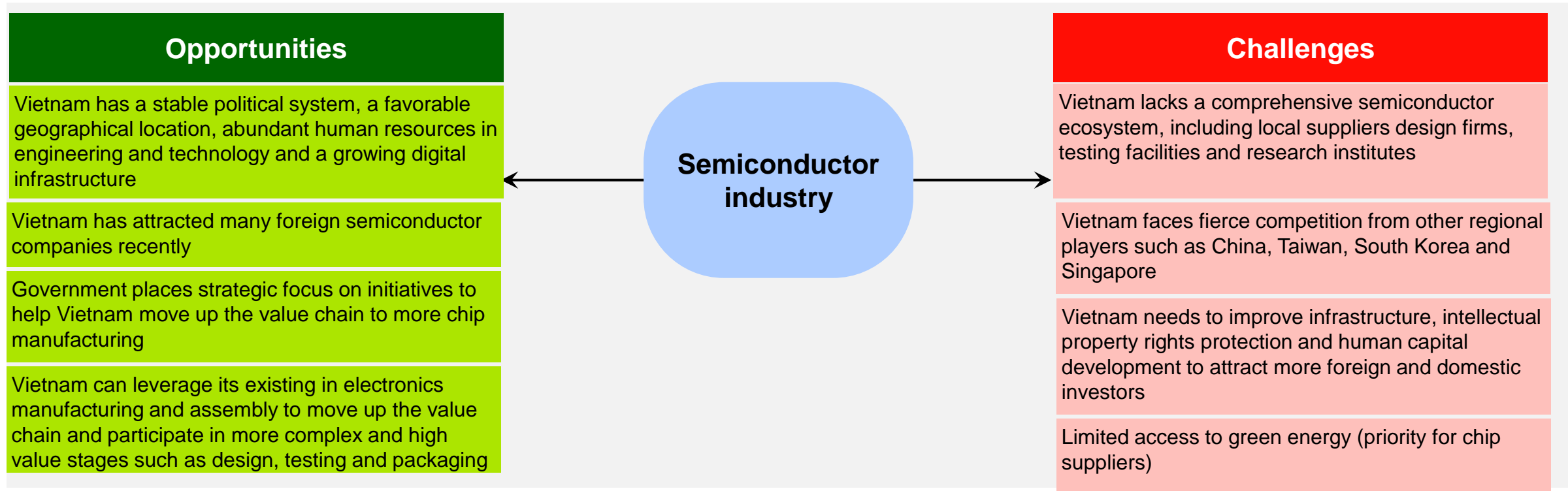
Industry breakdown

Production value in 2022



- Over the past decade, Vietnam's semiconductor industry has seen remarkable growth. Statista reported a 7.1% compound annual growth rate (2016-2021), propelling the market value to over €16.9 billion in 2022.

Market opportunities in Vietnam



- Vietnam wants to increase their share in the value chain of chip manufacturing and advocates building a national semiconductor ecosystem with the participation of various stakeholder, including the government, businesses, support organizations, universities, research institutes and financial institutions
- Vietnam has the goal of training high-quality workforce in semiconductor industry, with the goal of training 50,000 workers by 2030

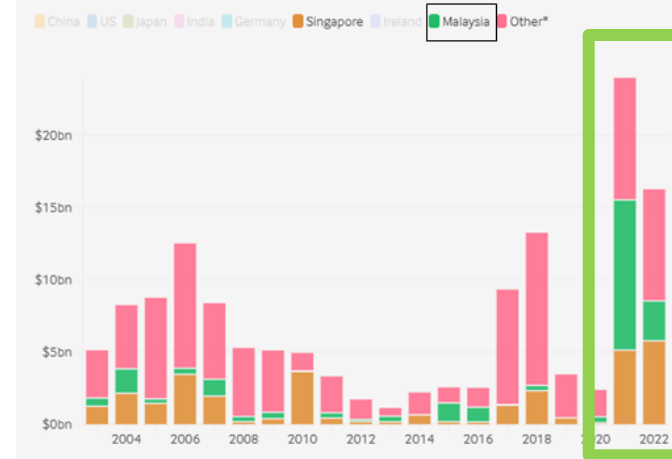
C Vietnam as a potential new location for Dutch companies

Several Dutch semiconductor companies and suppliers are planning investments in Vietnam.
Besi's investment is expected with plans to build its new manufacturing hub in Vietnam within the next four years

- Scarcity of space / capacity / labor in the Netherlands
- Trend towards decentralizing / de-risking end to end supply chains, risk mitigation
- 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

About \$175bn has been invested in semiconductors globally in the last two years
Foreign direct investment in the semiconductor sector by destination country, 2003-2022



Source: FDI intelligence



Besi



Classification of opportunities

	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				✓		

4 Take Aways on Vietnam's Case

Developing value chain in the region

- Vietnam's main focus is on the R&D, IC design and backend parts of the chip manufacturing meaning assembly, testing, packaging
- Vietnam is taking steps to position itself as a one-stop-shop by actively seeking to attract foundries

Attractive base

- High government incentives and grants
- Rapidly developing ecosystem with high FDI flow
- Big semiconductor firms have their eyes on Vietnam amid China tensions
- US-Vietnam and EU-Vietnam partnerships

Opportunities for Dutch companies

Opportunities in:

- Achieving risk mitigation
- Low cost, high labor availability
- Establishing partnerships with the new semiconductor investors in Vietnam