When the chips are down

ASEAN could be the answer to the semiconductor crunch
Geopolitical tensions, rigid supply chains, high barriers to entry and the shock of the COVID-19 pandemic has led to a global chip shortage that has hampered the production of everything from mobile devices to cars.

With long-term demand for chips also expected to rise, we have observed a range of responses from top-tier semiconductor manufacturers to expand production capacity, including investing in new facilities and building outsourced capacity buffers.

For suppliers in the right place at the right time, that growth will be automatic. But there will also be tough decisions that need to be made immediately for companies not already on preferred supplier lists. Coupling that with long-term considerations of resiliency and diversified production networks in the supply chain, complexity increases exponentially.

Against this landscape, attention increasingly turns to ASEAN and its diverse ecosystem of manufacturing competencies in this sector. This guide provides insights into factors driving the spotlight on ASEAN production options in the semiconductor industry.

We look forward to having a conversation with you to discuss more granular insights into investment opportunities across the region.
Long-term growth amid global chip shortages

How did we get here and what’s next?

Pandemic accelerated a shift in demand: as the world adjusts to remote working and doing more online, demand for chips that power devices, connectivity, databases and analytics has increased. However, the auto industry has recovered more quickly than anticipated, leading to an exacerbated shortage of both advanced and legacy node chips.

Techno nationalism: prior to the pandemic, governments across the world were increasingly cognizant that the chip sector is strategic, leading to greater market interventions, including industry protection, subsidies and trade disputes.

New growth and segmentation levels: demand for chips is now no longer driven by a single application (unlike PCs or smartphones in the past), but by a multitude of applications and end markets which go beyond PCs or smartphones including cloud, servers, internet of things (IoT), 5G, automotive and AI. With each application requiring different functionalities and manufacturing technologies, the industry is witnessing an unprecedented level of segmentation and trends pointing toward structurally higher semiconductor demand.

Overall recovery: demand is clearly outpacing supply now that application and end market segments are recovering. Although cyclical volatility in this sector is common, adding capacity to an already stretched supply chain will take careful planning.

Technology trends will drive R&D expenditure: new materials, innovative manufacturing processes for increasingly complex chip designs and advanced integrated circuit (IC) packaging technologies will continue to drive R&D expenditure. Market leaders are also gearing R&D initiatives toward high-growth end markets such as 5G, AI and IoT and have already begun to identify new ways to monetize their products.

“Although chip shortages are currently in the spotlight, we shouldn’t lose sight of the long-term trends in motion. We are seeing record levels of investment in manufacturing and R&D as the rise of 5G and next-generation technologies promises to sustain higher chip demand for years to come.”

Ken Englund
EY Americas Technology Sector Leader
Sustainable responses to meet immediate needs

What supply chain responses are we seeing today?

1. Addition of manufacturing capacity: Major manufacturers across the globe have scaled up their investment plans to meet long-term demand for advanced node technologies from 10nm and below that are needed for 5G, AI, advanced memory and high-performance server applications.

2. Sustainable investments and practices: The advent of environmental, social and governance (ESG) awareness and the risk of future climate-change-driven supply chain disruption, emphasized by the recent drought in Taiwan, has seen manufacturers in the wafer and energy-intensive semiconductor industry renew their focus on green management and sustainable practices.

3. Changed inventory and sourcing policies: The risk of a component shortage has fueled investments to permanently build up larger inventories of key components, which in turn has increased demand for improved warehousing and logistics solutions. Customers are adapting their sourcing policies and diversifying their supplier footprint to minimize dependency on single sources of supply.

4. Increased visibility through digital transformation: All companies want to gain better insights into the whole supply chain. Companies want visibility on the end-to-end supply chain. Data analytics and AI should help set up early warning systems.
ASEAN has strength and diversity across the value chain ...

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<th>R&amp;D and IC design</th>
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![Figure 1: Spread of semiconductor specializations across the region](image)

...and is deeply integrated within global value chains

- US$200b semiconductor exports from ASEAN\(^1\)
- Second-largest semiconductor exporter globally, commanding a 22.5% share of global semiconductor exports\(^1\)
- Five ASEAN nations in the world's top 15 semiconductor exporters\(^1\)

ASEAN is uniquely positioned as a neutral region with a well-established and diverse semiconductor ecosystem. Home to chip production since the 1970s, ASEAN knows semiconductors, and its governments continue to support investments in this sector.

Amarjeet Singh
EY ASEAN and Malaysia Tax Leader

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\(^1\) Based on HS8542 and HS8541; UN Comtrade
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Indonesia

Semiconductor sector landscape

- The electronics sector is one of Indonesia’s five targeted essentials sectors under the Making Indonesia 4.0 roadmap and has attracted foreign direct investment in excess of US$3.3b from 2010 to 2020.

- Although the consumer electronics segment is the most developed of the country’s electronics subsectors owing to the country’s vast and growing middle-class population, Indonesia’s semiconductor and electronic component manufacturing scene has been gaining increased attention from certain quarters. Indonesia’s Batam free trade zone for example, is home to a number of assembly and packaging operations for foreign-headquartered semiconductor and electronic component manufacturers and its proximity to Singapore enables manufacturers to leverage not only competitive cost structures but also advanced testing, manufacturing and distribution capabilities.

- Demand for semiconductors in Indonesia is only set to increase with the country’s ambitions to become an electric vehicle (EV) production hub and recent announcements from a consortium of South Korean automotive industry firms to build a US$9.8b EV battery plant in Indonesia.

Facts and figures

1. Fourth most populous nation globally and the world’s 10th-largest economy in terms of purchasing power parity

2. Largest manufacturing workforce in ASEAN with over 18 million employed in 2019 and over 170,000 in the electronics sector

3. Largest automotive market and second-largest production hub in ASEAN, fueling domestic demand for electronic components

4. US$9b exports of electronic components and equipment in 2020

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2. Indonesia Investment Coordinating Board, 20210907 Data realisasi investasi elektronik di Indonesia
3. The World Bank, Aspiring Indonesia: Expanding the Middle Class
4. ASEAN Secretariat, ASEAN Statistical Yearbook 2020; Ministry of Industry Indonesia, ‘Booklet Informasi Industry Edisi 1 – 2021’ (workforce numbers in the computer, optics and other electronic goods sectors in 2019)
5. Indonesia Investment Coordinating Board, The Increase of Investment in Manufacturing Sector in Indonesia During Pandemic
6. Indonesia Investments, Automotive Manufacturing Industry Indonesia
7. Indonesia Investment Coordinating Board, 20210907 Data ekspor nonmigas Indonesia – Kemendag
Indonesia

Key factors driving expansion opportunities

- Market and workforce: Indonesia’s large consumer market and young workforce are cited as a primary reason why multinationals establish operations in the country. The country boasts an expanding middle class, expected to grow to 140 million by 2030, with rising levels of disposable income and competitive labor costs (minimum monthly wages ranges from US$124 to US$312 depending on location).

- Location and connectivity: Indonesia has direct access to the Straits of Malacca and its sea toll (highway) program serves more than 100 ports from east to west Indonesia, connecting industrial parks, airports, seaports, toll roads and a planned 3,200-kilometer railway network on the islands of Sumatra, Java, Kalimantan and Sulawesi. Indonesia’s position as the largest economy and market in Southeast Asia supports its aim to become the gateway to ASEAN single market.

- Government support: Indonesia has identified the semiconductor sector as a priority industry that is generally eligible for tax incentives. In addition, there are 19 Special Economic Zones spread throughout the archipelago for eligible business activities that can also provides benefits such as tax, customs and excise exemptions as well as immigration and business licensing flexibilities. The Indonesian government also offers tailored investment facilities and incentives, and has developed a new integrated industrial park with benefits that include temporary rent-free leases.

Electronics is one of five priority sectors in Making Indonesia 4.0, with export value of US$9.2 billion in 2020. The key driver of manufacturing industry is the strong domestic demand of 64 million households in the middle income class. In addition, Indonesia offers an abundant working population, stable economic growth and ample resources. These factors, supported by improving investment climate, have propelled Indonesia into one of the top manufacturing destinations in ASEAN.

Muchammad Iqbal
Director, Indonesia Investment Promotion Center New York

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8 Indonesia Investment Coordinating Board, Higher Education Brochure 2020
9 ASEAN Briefing, Indonesia’s 2021 Minimum Wage: No Increases for Most Provinces
Malaysia

Semiconductor sector landscape

- Malaysia’s mature electronics and electrical sector (E&E) is home to over 1,700 companies and has attracted foreign direct investment in excess of US$35b over the last five decades.
- Foreign chipmakers have been establishing manufacturing operations in Malaysia since the 1970s, and the country has developed a position in the global supply chain as a major semiconductor assembly, testing and packaging location.
- The country’s mature semiconductor sector features activities across the supply chain from IC design to materials and equipment manufacturing. The sector continues to expand, particularly in the country’s northern states of Penang and Kedah, which have recently seen large investments from leading semiconductor equipment and materials manufacturers—a testament to investor confidence in meeting growing regional and global demand from Malaysia.

Facts and figures

1. Six of the 12 world’s largest semiconductor companies have operations in Malaysia

2. 6.3% Malaysia’s share of global semiconductor exports in 2020

3. Top 10 global semiconductor equipment exporters in 2020

4. 5% global semiconductor output from the northern state of Penang, the “Silicon Valley of the East,” in 2019

5. 49 approved investment projects in the electronic components subsector in 2020, with an estimated foreign investment value of US$2.5b

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10 Malaysian Investment Development Authority data  
11 Based on HS8542 and HS8541; UN Comtrade  
12 Based on HS8486; UN Comtrade  
13 Invest Penang, Department of Statistics Malaysia (DOSM) and UN Comtrade, Penang: The Silicon Valley of The East  
14 Malaysian Investment Development Authority: Malaysia Investment Performance Report 2020, Malaysia Investment Performance Report 2020
When the chips are down: ASEAN could be the answer to the semiconductor crunch

Malaysia

Key factors driving semiconductor expansion opportunities

• Talent: The E&E sector workforce is over 600,000 strong. Twenty public and 53 private tertiary institutions, in addition to over 1,400 technical and vocational education and training colleges, support the growth of Malaysia’s multilingual talent pool.

• Connectivity: The country is supported by seven seaports, a modern highway system and more than 500 business parks across the country, including specialist technology parks and 18 Free Industrial Zones. When complete, Malaysia’s East Coast Rail Link will create a land bridge between key ports on Peninsular Malaysia’s east and west coasts, expected to reduce shipping times from China Mainland to South Asia and beyond by more than a day.

• Government support and pro-business environment: Malaysia boasts a robust legal system, including intellectual property protection, and a well-developed financial sector. Industrial relations are harmonious with minimal trade disputes, and labor costs are globally competitive. Competitive investment incentives are available.

“Home to leading semiconductor companies for over 50 years, Malaysia provides a cost-competitive, secure and stable location from which advanced manufacturing and R&D activities can thrive. Our skilled talent pool and local supply chain have evolved in tandem with technological advances, propelling the industry up the value chain. Industry 4.0 technologies and a unique combination of local and international capabilities have further cemented Malaysia’s position as a hub for advanced manufacturing activities.

Nelson Samuel
Consul Investment and Director of Malaysian Investment Development Authority New York
Philippines

Semiconductor sector landscape

- The electronics sector has played an important role in the Philippines economy since the 1970s and forms the foundation of the country’s export basket today. In 2020, exports from the Philippines semiconductor and electronics manufacturing industries reached US$39.7b (62% of total commodity exports). Exports from semiconductors contribute to 70% of this total.

- The majority of the electronics sector operate out of four geographic areas: Metro Manila, Calabarzon, Cebu and Northern/Central Luzon. From a global perspective, while the Philippines is not the leading exporter in a specific semiconductor product category, the country is known for its significant number of semiconductor assembly and test facilities.

- In general, the sector has a low exit rate and companies that have invested in the Philippines have stayed. A number of semiconductor manufacturers have operations dating back to the late 1970s and 1980s that have grown and expanded in the country due to the quality of the workforce and satisfaction with the Philippine Economic Zone Authority (PEZA) environment.

Facts and figures

1. 43.6m: workforce in October 2020 and 796,576 graduates in 2018-2019 who are all highly skilled and cost-competitive

2. Fifth-largest English-speaking country in the world

3. US$22.01b: 2021 year-to-date (January-June) value of Philippines electronics exports

4. Top 5 electronics exports of the Philippines as of January 2021 are semiconductors, electronic data processing, office equipment, consumer electronics and telecommunication

5. Top 5 electronics export destinations as of January 2021 are Hong Kong, US, China Mainland, Japan and Singapore

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15 Philippine Statistics Authority, Table 1 Percent Distribution of Population 15 Years Old and Over by Employment Status, by Sex and Age Group – October 2020
16 The Commission on Higher Education, Table 1. Higher Education Data and Indicators: AY 2009-10 to AY 2019-20
17 Wikipedia, List of countries by English-speaking population
18,20 The Semiconductor and Electronics Industries in the Philippines Foundation, Inc., About the Industry
19 The Semiconductor and Electronics Industries in the Philippines Foundation, Inc., January 2021 Philippine Electronics Export Performance
Key factors driving semiconductor expansion opportunities

- Talent and workforce: The country’s biggest advantage is in its highly skilled and service-oriented labor force.
  - Workers and managers are English-proficient, which reduces the need for a middle layer of supervisors to translate the process specifications to the native language.
  - The young workforce has an average age of about 24, with a majority of them having completed high school or university degrees.
  - There is an adequate supply of managers, engineers and workers.
  - Most workers are flexible to varying shifts and work week schedules, and they welcome opportunities for overtime work.
- Government support: Relatively higher logistics and power costs compared with its ASEAN neighbors are mitigated through government fiscal and non-fiscal incentives afforded to companies registered at the Board of Investments, PEZA and other Investment Promotion Agencies.

“A highly skilled, service-oriented, English-speaking labor force and global connectivity are only some of the important reasons why top semiconductor companies and EMS providers chose to stay in the Philippines. Recently, the Philippines has put in place an innovation center and technology-based industrial policy to help companies navigate the 4th industrial revolution that is happening today. Competitive advantages in other sectors includes AI, integrated circuit design, robotics, smart wearables, IoT devices, smart sensors, 3D printers and electric vehicles.”

Benedict Uy
Philippine Department of Trade and Industry
Trade Commissioner and Director, Philippine Trade and Investment Center, New York
Semiconductor sector landscape

- Singapore’s semiconductor industry is an intrinsic part of the global supply chain – many devices used around the world are developed and manufactured in Singapore. Many global semiconductor companies have succeeded because of their presence in Singapore, where strong government support has enabled companies to pre-position themselves to capture growth opportunities.
- Singapore provides a conducive business environment comprising an end-to-end ecosystem for semiconductors. Companies undertaking chip manufacturing have harnessed a plug-and-play environment in Singapore to access a good base of talent and robust supplier network. In the equipment manufacturing space, leading equipment manufacturers entrust Singapore to undertake more than 80% of their global manufacturing, assembly and/or testing of equipment and tools in Singapore.

Facts and figures

1. 12.4% Singapore’s contribution to global semiconductor exports in 2020
2. 9.6% Singapore’s contribution to global semiconductor equipment exports in 2020
3. 17.4% Semiconductor wafer capacity from US headquartered firms in Singapore in 2019
4. 19% Singapore’s global market share for semiconductor equipment in 2021
5. 5% Global wafer fabrication capacity located in Singapore in 2021

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21 Enterprise Singapore Statlink - Based on HS8542 and HS8541; UN Comtrade
22 Enterprise Singapore Statlink - Based on HS8486, HS903082, HS90319010 and HS90314910; UN Comtrade
23 Semiconductor Industry Association: 2019 Factbook
24 Ministry of Trade and Industry Singapore: Transcript of speech by Alvin Tan, Singapore Minister of State for the Ministry of Trade & Industry
Key factors driving expansion opportunities

- Headquarter potential to capture growth in Asia: Companies have tapped into Singapore’s English-speaking population with Asian cultural roots to bridge the Asian market and western global HQs, suite of tax and non-tax incentives for manufacturing activities, and a stable political and business environment to base decision-makers for the region.

- R&D: The Singapore government has invested around US$580m to support semiconductor companies to undertake R&D projects in Singapore. In addition, Singapore has committed over US$260m for semiconductor public research institutes to fund the best semiconductor R&D ideas that emerge. The robust ecosystem of private and public players has led to many companies establishing product R&D teams in Singapore to undertake IC design, packaging and test engineering, and/or applications development activities.

- Talent: Businesses can access skilled labor by tapping into various talent development schemes. These schemes range from training grants for companies to scholarships for engineers who are keen on post-graduate studies aligned with their companies’ research interest to professional conversion programs aimed at re-skilling and placing workers from adjacent industries into the semiconductor industry.

"Singapore is heartened to have the longstanding trust and confidence from globally leading semiconductor companies. Many of them have sizable investments in Singapore, ranging from chips and equipment manufacturing to R&D to regional headquarters and supply chain activities. We are fully committed to provide companies with a conducive business environment featuring robust intellectual property protection, strong government support and ready availability of skilled talent. This in turn will allow companies to accelerate the development of new and differentiated capabilities and capture the imminent upsurge of growth opportunities in the region.

Jingxin Zheng
Regional Vice President, Americas
Singapore Economic Development Board

25 Exchange rate SGD1.35/US$1
For years, Thailand has attracted global investment in the electronics sector, establishing the country as the world’s 13th-largest exporter of electronic products. Thailand’s electronics industry possesses an extensive production capacity, from semiconductors to memory devices and now smart electronics.

As of 2020, 31% of the 615 electronics producers in Thailand are global manufacturers. The remaining 69% are highly capable subject-matter experts that add strength, flexibility and resilience to the local supply chain at all stages, from front-end to PCBA and box-built products, from assembly and packaging to testing.

The strength of Thailand’s supply chain is reflected in its exports of electronic components and equipment, the country’s top export category, which reached US$31 billion in 2020. In the PCB market alone, Thailand is the world’s seventh-largest exporter.

**Semiconductor sector landscape**

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**Facts and figures**

1. 2.7% contribution to the global exports in 2020; top exporter of electronic printed circuits among ASEAN members; valued at US$1.24b
2. 95%-99% of domestic integrated circuit production is exported to global markets
3. 14th-largest global exporter of electronic IC, valued at US$7.1b in 2020
4. 3% Thailand’s average semiconductor production growth is driven by domestic 5G and EV market demand
5. 230 companies have applied for the Board of Investment incentive program in the electric and electronics sector, with an estimated investment value of US$13.2b in 2020

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26 International Trade Center Trade Map (HS8534)
27 Krungsri Research, “Thailand Industry Outlook 2021-2023,” March 2021
28 International Trade Center Trade Map (HS8542)
29 Thailand Electrical and Electronics Institute, August 2021
30 Thailand Board of Investment, February 2021
Thailand

Key factors driving expansion opportunities

- **Location and connectivity:** Thailand’s export capability is enhanced by its strategic location at the heart of ASEAN, a market of over 600 million consumers. Its airports, seaports, highways and rapidly expanding rail network enable the country’s Eastern Economic Corridor (EEC) to serve as hubs to the region. In addition to the electronics industry, the EEC hosts Thailand’s automotive cluster, which strengthens demand for semiconductor products.

- **Workforce and talent:** currently, the E&E industry supply chain employs over 750,000 people. In terms of skill readiness, Thailand has a large pool of human resources. In 2020, there were almost 30,000 new engineering and technical graduates ready to serve the E&E industry. In addition, several public research institutions serve as the country’s R&D backbone, providing expertise and skill-training programs. The EEC of innovation (EECi) is readily equipped with research facilities and smart innovation ecosystems.

- **Government support:** the Thailand Board of Investment (BOI) has recently approved an enhanced investment incentives package for the semiconductor and related industries. Front-end capital and technology-intensive manufacturing will be given a 10-year tax exemption while advanced integrated circuits, IC substrate and printed circuit board projects with hardware investment of around US$45.5m will receive an 8-year tax holiday. Duty concessions are available to allow duty-free importation of machinery and raw materials. The BOI also assists companies in sourcing local supplies to help investors with an efficient supply chain in Thailand.

“Despite COVID-19, Thailand’s E&E industry has not only shown resilience but also has continued to grow strongly. The BOI offers attractive and competitive incentives and comprehensive support measures to attract more technology-intensive manufacturing such as IC substrate, advanced integrated circuits and communication network equipment. Given its well-established supply chain with a large number of global companies, strategic location and excellent connectivity, Thailand can definitely offer itself as a preferred investment destination for E&E-related investments.

Duangjai Asawachintachit
Secretary General of the Thailand Board of Investment
Closing

As reflected during the 2020–2021 chip shortage, a substantial amount of new capacity needs to be built globally in the coming years. The industry is expected to require a doubling of capacity by 2030 to meet and keep up with the expected 4% to 5% average annual growth in semiconductor demand. Now more than ever, a new paradigm for competitive resilience is necessary for companies to position their supply chains for the long haul without reverting to pre-pandemic practices.

As businesses reconsider the location of additional manufacturing capacity or secondary manufacturing sites and where they source their raw materials, components and/or parts, semiconductor executives should consider asking the following:

- How can the business minimize the cost impact from exiting current supply sources and potential disruptions?
- What other risks do we need to consider and mitigate?
- How can we transform at speed and still build value-led sustainability?

The key areas to understand include:

- Capital investment and timeline to upgrade or build new facilities
- Exit strategy from existing supply sources and potential disruptions
- Incentives opportunities for new locations/incentive implications for down-scaled locations
- Taxable presence, registration and compliance obligations for diverse range of taxes
- Revised transaction flows for customs, international trade and indirect tax purposes
- Impact of new supply chain and manufacturing capacity on current transfer pricing policy

Actions:

- Assess feasibility across portfolio and opportunity for expanding certain manufacturing activities abroad in alternative locations
- Evaluate risks and costs involved, including setup and exit from current location (if applicable)
- Benchmark anticipated incentive offers
- Create optionality based on possible scenarios
- Engage stakeholders in the organization
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