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LPEM FEB UI
Institute for Economic and Social Research

Indonesia's Semiconductor Industry

Towards Realising the Potential for Growth

Institute for Economic and Social Research
Faculty Economics and Business – Universitas Indonesia

Jakarta, July 23rd, 2025

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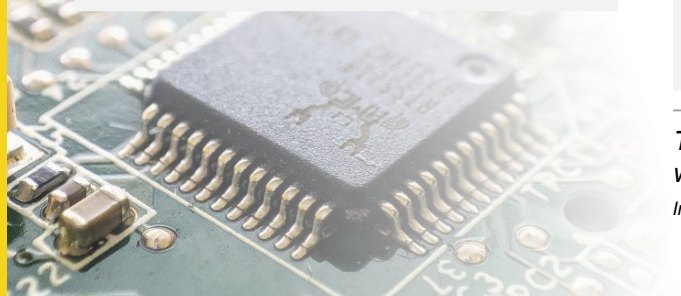


The in-depth interviews with semiconductor experts and key informants took place from December 2024 to February 2025. The consultative workshop was held in March 2025

Image source: https://www.repsol.com/en/energy-and-the-future/technology-and-innovation/semiconductors/index.cshtml

Scope and Methodology

Research scope in this study involves comprehensive landscape analysis of the semiconductor ecosystem, strategic pathways for sustainable growth, and foresight analysis on critical challenges, emerging trends, and future opportunities, while adopting three main methodologies to address the study objectives

Scope of the Study

This study explored the key factors, challenges, and opportunities shaping the growth of Indonesia's semiconductor industry and provides actionable recommendations to enhance its global competitiveness.

Landscape: Overview of Indonesia's Semiconductor Ecosystem

Demand and supply-side dynamics, key stakeholders, regulatory frameworks, and Indonesia's comparative advantages

Foresight: Identifying Trends and Overcoming Challenges

Examine critical challenges, emerging trends, and future opportunities over the next 5 to 10 years.

Recommendation: Recommendations for Indonesia's Semiconductor Ecosystem

Vision, roadmap, and potential collaboration with the UK

Methodology

Desk Study

In-Depth Interview

Consultative Workshop

Semiconductor Industry Structure and Global Production Value Chain

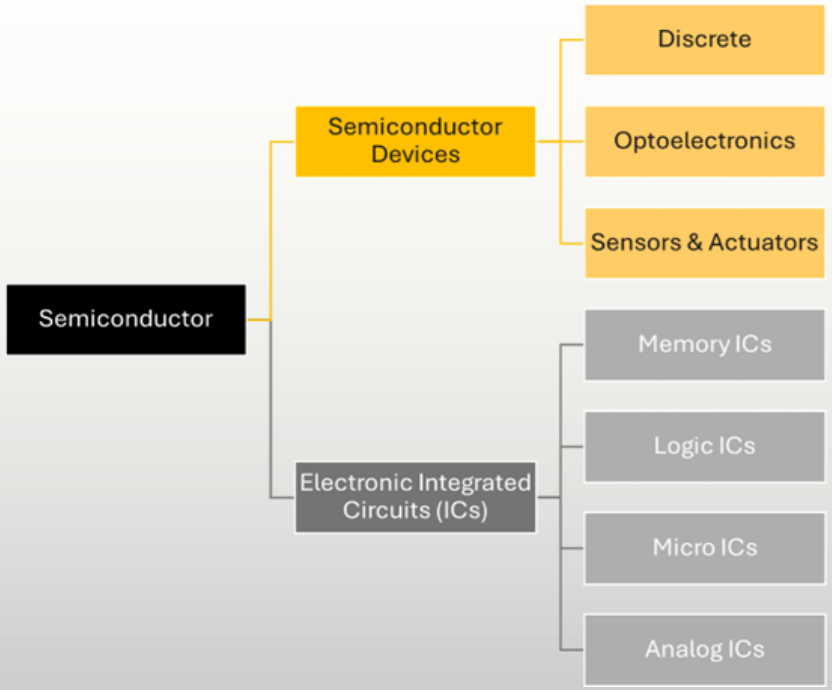
The semiconductor industry is highly complex and globally distributed, encompassing diverse components, production processes, essential supporting activities, and a vast, interconnected supply chain.

A semiconductor is defined as a material with electrical conductivity that falls between that of an insulator and a conductor, making it controllable for various electronic applications

Tatum (2016); BRIN (2024)

Types of Semiconductors

Source: Adapted from Kleinhans & Baisakova (2020) and Statista (2024)



Step of Production Process for Semiconductor

Design Process	The process that sets the chip's requirements, defines its architecture, and validates the design using a test bench.
Fabrication Process	Also known as front-end semiconductor manufacturing, involves wafer fabrication, which includes printing (etching) the integrated circuit onto the wafer.
ATP* Process	Also referred to as back-end semiconductor manufacturing, includes dividing wafers into individual chips, packaging chips into frames or resin shells, and conducting testing.

**ATP = Assembly, Testing, Packaging*

Production Process and Value Chain

Fabless	Companies that specialize in chip design
Foundries	Fabrication companies that manufacture the chips in their own facilities
OSAT**	Companies that handle the ATP process

Integrated Device Manufacturers (IDM) — Companies that cover the entire process

***OSAT = Outsourced Semiconductor Assembly and Testing*

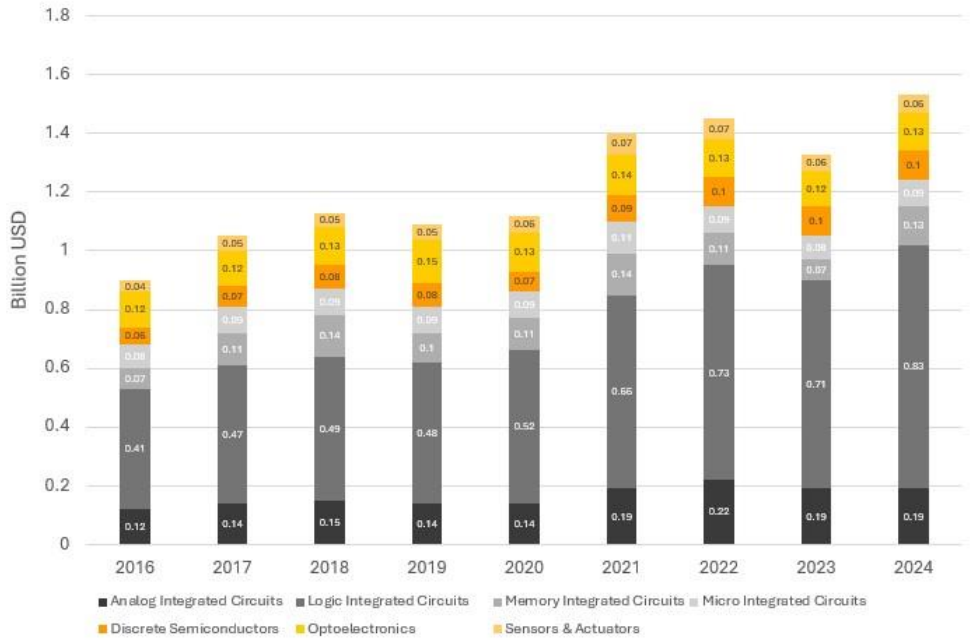
Semiconductor production also relies on supporting industries such as Electronic Design Automation (EDA), Intellectual Property (IP) cores, upstream semiconductor process (material processing), and semiconductor equipment providers.

Overview of Indonesia's Semiconductor Ecosystem

Indonesia's Semiconductor Industry: Towards Realising The Potential for Growth

Indonesia's role in the global semiconductor value chain remains limited but is gradually expanding

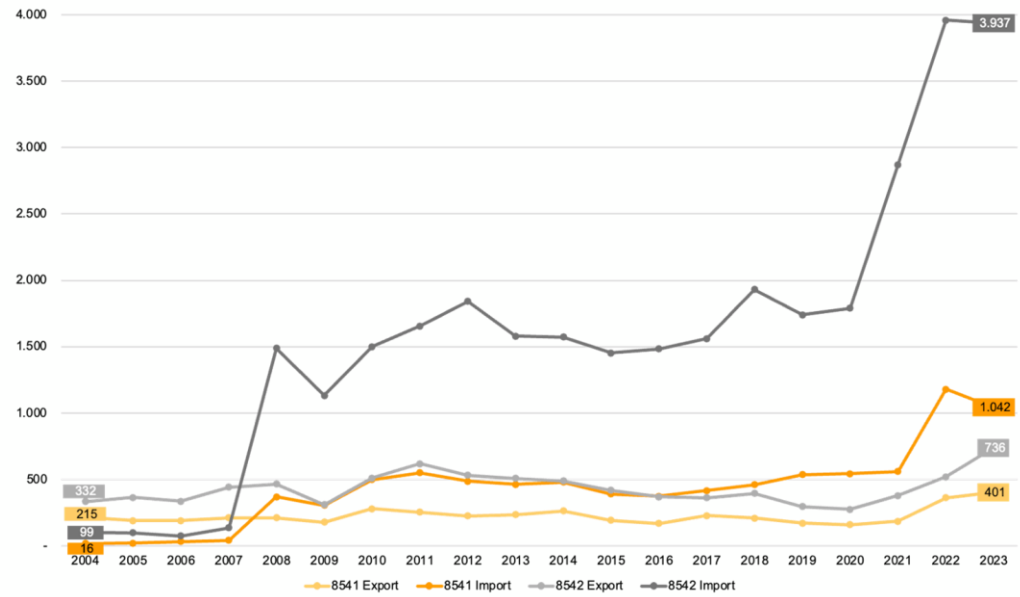
Indonesia holds a small but growing share in the global semiconductor value chain, contributing 0.24% of global revenue despite steady growth.



Indonesia's Semiconductor Revenue 2016 - 2024 (in Billion USD)

Source: Statista (2024)

This figure represents an increase, considering that in 2016, Indonesia's semiconductor market revenue was only USD0.90 billion, with the highest growth recorded in 2021 because of the pandemic and the surge in national digital technology usage



Indonesia's Export and Import on Semiconductor Devices (HS 8541) and Electronic Integrated Circuits (HS 8542) (Nominal Value in Million USD)

Source: CEIC (2024)

Indonesia exported USD 401 million worth of semiconductor devices and USD736 million of ICs. However, imports for both categories are significantly higher, amounting to 1,042 million USD for semiconductor devices and 3,937 million USD for ICs in 2024

Key Demand and Supply Factors Shaping Indonesia's Semiconductor Industry

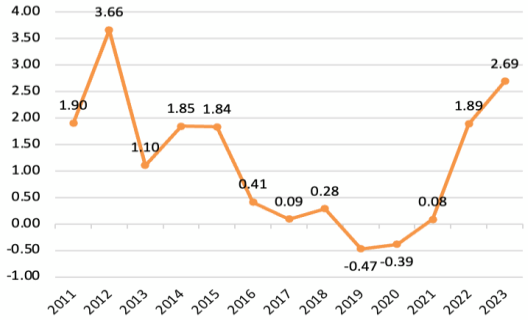
The Industry is driven by demand from electronics and automotive sectors, …

Indonesia's semiconductor ecosystem is primarily driven by electronic and automotive sectors while other sectors, including finance, public services, medical devices, and agriculture, also contribute to its growth.

Electronic Sector

Electronic Goods	2025 (million USD)	2029 (million USD)	CAGR 2025-2029
Telephony	11,790	12,640	1.76%
Computing	3,724	4,249	3.35%
TV, Radio & Multimedia	3,085	3,326	1.90%
Gaming Equipment	226.8	254.5	2.92%
TV Peripheral Devices	138.5	202.2	9.92%
Drones	7.6	9.6	6.01%
Total	**18,980**	**20,690**	**2.18%**

Indonesia Consumer Electronics Demand Projection
Source: Statistics Indonesia



Growth of Metal Product, Computer, Electronic, Optic, and Electricity Equipment (% y.o.y), 2011-2023
Source: Statistics Indonesia

- The growing electronics sector continues to drive semiconductor demand, with communications devices (such as smartphones), computers, and consumer electronics accounting for 68% of global semiconductor sales in 2023.
- Indonesia's electronics sector has demonstrated continuous growth, reinforcing its role as a key driver of semiconductor demand, with post-pandemic growth (10.19% in 2022–2023) outpaced pre-pandemic levels (5.16% in 2011–2019).

Automotive Industry

- Conventional vehicles encompass about USD 330 value of semiconductors, whereas Hybrid Electric Vehicles (HEV) comprise around USD 1,000 to USD 3,000; or three to ten times higher than conventional vehicles (Data Security Council of India & TechSagar, 2024); (Lawrence, Amanda, VerWey, & John, 2019).
- Total numbers of vehicles, either conventional, electric, or hybrid, in Indonesia is projected to continue expanding.
- The government also has a fundamental role in endorsing the EV industry and is attempting to transition the utilisation of conventional vehicles to a more environmentally friendly alternative through the Indonesian Electric Vehicle Industry Development Roadmap.

Other Sectors

1. **Financial Transaction Cards**
   Bank Indonesia's 2014 non-cash payment initiative has driven an 11.57% annual growth in card-based and digital payments (2019–2023).
2. **Medical Devices**
   Indonesia's local production of medical devices has encountered a progressive increase. Indonesia produced 2,126 medical devices locally in 2020, which grew to an estimation of 2,808 in 2023 (International Trade Administration of US, 2024).
3. **Agricultural Devices**
   Indonesia's Ministry of Agriculture underlined the need to transform traditional agriculture to modern system (Riswan, 2024) and is developing various agricultural devices such as AI-based Smart Farming 4.0 (Ministry of Agriculture, 2024).
4. **Public Sector**
   Since 2011, Indonesia has implemented e-KTP with Semiconductors supplying the chips, reaching 99.37% coverage by 2022.

Key Demand and Supply Factors Shaping Indonesia's Semiconductor Industry

… while on the supply side, it relies on raw materials, strategic geographic location, design houses, facilities, ATP experience, human capital, and R&D.

Indonesia has key supply drivers for semiconductor development, including abundant raw materials and strategic geographical location, design houses, specialized facilities, a growing electronics industry, ATP experience, human capital, and R&D, all contributing to its value chain

Abundance of Raw Materials

- Indonesia possesses abundant natural resources, including quartz sand, bauxite, zinc, coal, and nickel, and is strategically positioned to export semiconductor materials.
- However, it lacks the advanced processing technology needed to refine these minerals into the ultra-high-purity components essential for semiconductor manufacturing.

Strategic Geographical Location

- Indonesia's strategic geographical location (between two continents and two oceans) allows it to become a wide-open exporter of semiconductor materials.
- As the sixth largest silica sand exporting country, Indonesia could become China's trading partner in silica commodities because of its strategic location on the Malacca Strait and the South China Sea.

Growing Presence of Design Houses

- Existing design houses, science and technology parks, and higher educational institutions have driven development of semiconductor design houses in Indonesia.
- PT Xirka Silicon Technology, PT TSM Technologies, and Versatile are known for the development of Indonesia's semiconductor ecosystem in design.
- Indonesia has also signed a memorandum of understanding (MoU) regarding the establishment of a design house, such as an MoU between Polytron and IMEC.

Established Specialised Infrastructure

- The Special Economic Zone (KEK), specifically the one on Batam , is equipped with specialised infrastructure required for semiconductors foundry, with an uncontaminated abundant water supply and robust power system
- According to a government representative,BRIN is currently constructing the microelectronics laboratory as the centre of excellence for micro and nano electronics.

Existing Companies

- One of the supply drivers supporting the growth of Indonesia's semiconductor ecosystem include the existing ATP companies operating in Indonesia and the existing industries that manufacture other electronic components, e.g. PT Infineon Technologies.

Human Capital and R&D

- Indonesia has been engaging to strengthen its human capital to support the industry. Several initiatives have been carried out for this matter, wherein collaborations between various entities holds a crucial role.
- Indonesia focus to develop R&D through the establishment of specialised infrastructure and facilities through technopark and collaboration with researchers, companies, international associates, and educational institution.

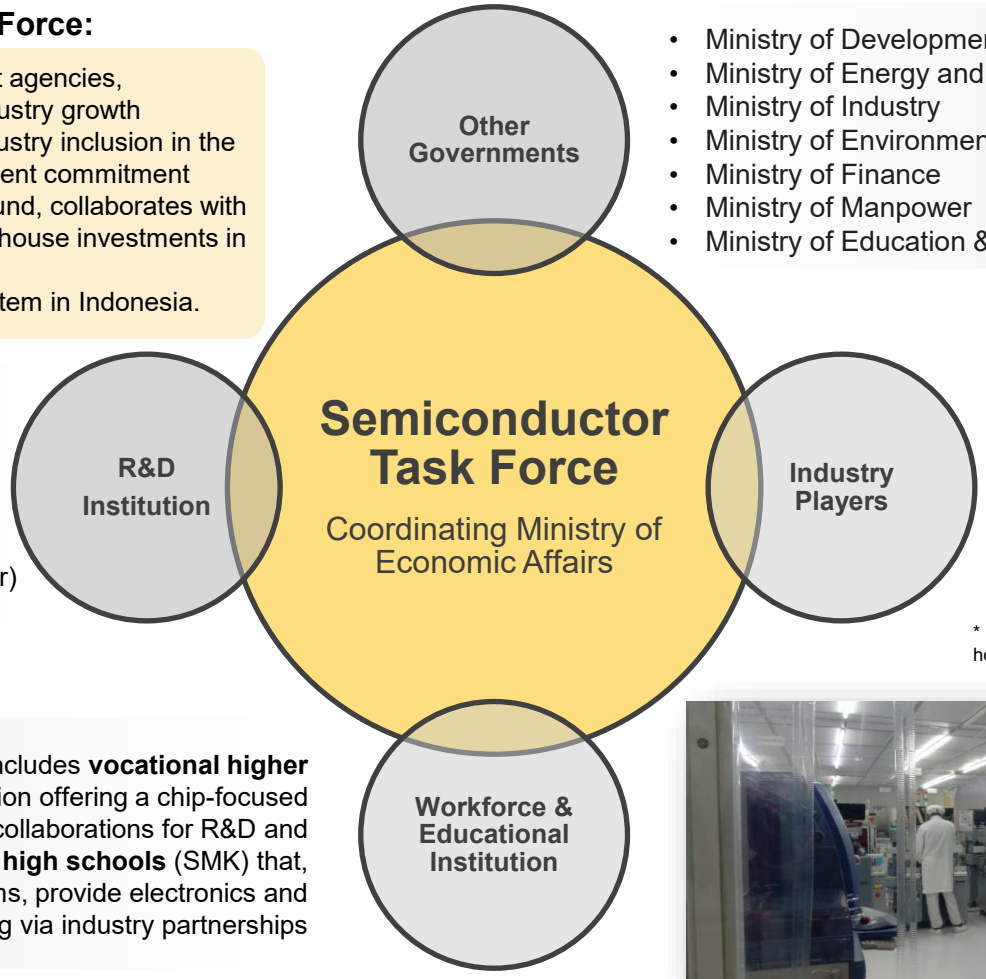
Key Stakeholder in Indonesia's Semiconductor Ecosystem

Domestically, stakeholders are coordinated by the semiconductor task force, …

Indonesia's semiconductor ecosystem consists of domestic and global stakeholders: Domestic players include industry, workforce & educational institution, government, and research institutions, coordinated by the Semiconductor Task Force to drive integration into global supply chains

Role of Indonesia's Semiconductor Task Force:

- **Established Coordination** – Unifies government agencies, professionals, NGOs, and embassies to drive industry growth
- **Policy Integration** – Secured semiconductor industry inclusion in the 2025–2029 RPJMN, ensuring long-term government commitment
- **Global Engagement** – Participates in the ITSI Fund, collaborates with OECD and U.S. initiatives, and advances design house investments in Indonesia
- **FDI Enhancement** for the semiconductor ecosystem in Indonesia.



- Ministry of Development Planning
- Ministry of Energy and Mineral Resources
- Ministry of Industry
- Ministry of Environment and Forestry
- Ministry of Finance
- Ministry of Manpower
- Ministry of Education & Higher Education

Various ministries support Indonesia's semiconductor industry through integrated planning, mineral regulation, industrial policy, environmental oversight, fiscal incentives, workforce training, and education alignment

Indonesia's semiconductor R&D ecosystem is driven by BRIN at Samaun Samadikun STP in Bandung, and by ICDeC, a Polytron-led collaboration with 13 universities

- BRIN (National Research and Innovation Agency)
- ICDeC (Indonesia Chip Design Collaborative Center)

- **Material Extraction:** Currently, no companies operate in material processing* that meets the required silicon purification standards.
- **Design:** Versatile Systems and Technologies, PT Xirka Silicon Technology, and PT TSM Technologies
- **ATP:** PT Infineon Technologies Batam

* Indonesia has 328 silica mining companies, with 98 holding production IUPs and 82 holding exploration IUPs, but there are not yet any facilities for silica processing.

Indonesia's semiconductor talent pipeline includes **vocational higher education** through Polibatam—the only institution offering a chip-focused program in partnership with Infineon—**university** collaborations for R&D and design workforce development, and **vocational high schools** (SMK) that, while lacking dedicated semiconductor programs, provide electronics and automation training via industry partnerships

Manufacture of Electronics Program, Polibatam

Source: https://www.polibatam.ac.id/jurusan-pembuatan-chip-dibuka-di-politeknik-negeri-batam-cuma-ada-di-indonesia/

Key Stakeholders in Indonesia's Semiconductor Ecosystem

… while global players contribute through collaboration, knowledge sharing, and technology transfer.

Global players facilitate collaborations between Indonesia and other countries, including partnerships on Intellectual Property (IP) licensing, knowledge sharing, and technology transfer. Collectively, these stakeholders create a robust framework from material extraction, design, fabrication, and ATP process, to advance Indonesia's position in the global semiconductor landscape.

Intellectual Property (IP) Licensing

1. IP licensing is granted to companies or countries that fund the research and development of the chip.
2. If Indonesia utilises chip design IP from other countries, Indonesia will be required to pay licensing fees for the use of such designs.
3. US became one among countries with IP chip holders in semiconductor. In 1984, US introduced the Semiconductor Chip Protection Act (SCPA) to enable intellectual property protection for the layout designs of semiconductor integrated circuits.

Global Value Chain in Manufacturing

1. Many global semiconductor companies focus exclusively on one of many semiconductor chains. For example, NVIDIA and Qualcomm specialise in chip design, while X-FAB and TSMC are primarily involved in wafer foundry operations.
2. In GVC, Indonesia currently has only one company capable of performing ATP, the Infineon Batam. Consequently, Infineon Indonesia relies on imports from other countries to obtain semiconductor components for the ATP operations.

Collaborations and Partnerships

1. Collaborations and partnerships are held both at governmental level between Indonesia and other countries and within industry and academic sectors. For example: MOU between ICDeC and Interuniversity Microelectronics Centre (IMEC) and MOU between Indonesian government and Arizona State University (ASU) and Purdue University.
2. Indonesia attended Electronica 2024, European largest semiconductor exhibition that are expected to give access to further collaboration in the semiconductor human development, training, research, and technology transfer.

Global Association

1. World Semiconductor Council (WSC), representing the largest market share holders in the global semiconductor industry.
2. Global Semiconductor Alliance (GSA), assisting semiconductor companies worldwide through networking, advocacy, and knowledge-sharing initiatives.
3. SEMI Southeast Asia, uniting the electronics manufacturing and design supply chain.
4. However, Indonesia has limited role in global and regional semiconductor associations.

Policies and Regulations Governing Indonesia's Semiconductor Industry

Despite the absence of specific regulations, Indonesia offers fiscal incentives, …

To strengthen the semiconductor industry, the Indonesian government provides various incentives and policy support, including Fiscal incentives: Tax allowances, tax holidays, R&D benefits, and royalty incentives to attract investment

Tax Allowance & Incentives

Based on **Government Regulation No. 78/2019** and **Minister of Industry Regulation No. 47/2019**, corporate taxpayers in the semiconductor sector can receive a 30% net income reduction over six years. This tax incentive applies to businesses meeting criteria such as high investment value, high local content (TKDN), or significant job creation. Additionally, accelerated depreciation and amortization are provided to reduce the fiscal burden for investors.

Tax Exemptions

Under **Law No. 25/2007 on Investment and Ministry of Finance Regulation No. 130/2020**, semiconductor companies can receive up to 100% corporate income tax (PPh Badan) exemption for 5–20 years, depending on investment size.

- Investments of IDR 500 billion to IDR 1 trillion → 5-year tax holiday
- Investments exceeding IDR 1 trillion → Up to 20-year exemption
- Medium-sized investments (IDR 100 billion to IDR 500 billion) → 50% corporate income tax reduction for 5 years

R&D Incentives and IP Protection Measures

The **Ministry of Finance Regulation No. 153/2020** provides a gross income deduction of up to 300% for eligible semiconductor R&D activities. This incentive covers chip design, wafer fabrication, and production efficiency research, aiming to strengthen Indonesia's innovation ecosystem. Additionally, **Ministry of Finance Regulation No. 136/PMK.02/2021** grants financial incentives to researchers and innovators licensing their intellectual property rights (IPR). This allows universities and research centers involved in semiconductor R&D to receive royalties from patents and technology developed, encouraging stronger industry-academia collaboration.

Policies and Regulations Governing Indonesia's Semiconductor Industry

… and non-fiscal incentives applicable to the semiconductor industry, …

The Indonesian government also offers various non-fiscal incentives focusing on infrastructure, streamlined regulations, workforce development, and product standardization to enhance competitiveness and attract investment.

Industrial Facilities and Infrastructure
Under **Government Regulation No. 20 of 2024 on Industrial Zoning**, the Indonesian government ensures the **availability of land** in designated industrial estates with integrated transportation, utilities, and telecommunication infrastructure to support the development of high-tech industries, including semiconductors.

Workforce Development
The government offers training programs and professional certifications to enhance workforce skills in high-tech industries, including semiconductors. This initiative aims to align labour capabilities with industry demands and improve Indonesia's competitiveness as a semiconductor manufacturing hub.

Simplified Business Licensing
The Online Single Submission (OSS) system, regulated under **Law No. 11 of 2020 on Job Creation**, streamlines business registration and licensing processes, reducing administrative burdens for semiconductor companies seeking to establish or expand operations in Indonesia.

Product Certification & Compliance Support
The government provides assistance in product certification, compliance with technical standards, and regulatory approvals to ensure that semiconductor products meet both domestic and international market requirements. This support enhances the credibility and global competitiveness of Indonesia's semiconductor industry

Spatial Planning
Spatial planning adjustments and regulatory support are provided to accelerate industrial development. By easing logistical and administrative constraints, these measures facilitate the growth of the semiconductor industry.

Policies and Regulations Governing Indonesia's Semiconductor Industry

… as well as policies supporting industrial development.

Additionally, policy and regulatory support aim to strengthen raw material security, local content requirements, workforce development, and intellectual property protection to enhance competitiveness

Silica Sand and Raw Materials Downstreaming	1. Silica sand export ban by 2027 to secure domestic raw material supply. 2. Silica Downstreaming Roadmap 2025–2035 aims to develop silicon wafer production for the semiconductor industry. 3. Challenges: Investment in processing infrastructure and advanced manufacturing technology for electronic-grade silicon (EGS).
Local Content Requirements (LCRs)	1. Government Regulation No. 29/2018 mandates minimum local component thresholds for electronics. 2. Semiconductors are crucial for compliance with LCRs in sectors like smartphones and telecommunications. 3. To maximize LCR benefits, investment incentives and ecosystem readiness are essential.
Labour Policy and Regulations	1. SKKNI No. 130/2024 sets competency standards for semiconductor jobs (IC design, fabrication, chip assembly). 2. Government Regulation No. 34/2021 & Permenaker No. 8/2021 govern foreign workers and technology transfer obligations. 3. Workforce challenge: Limited local training institutions for high-tech industries.
Intellectual Property Rights (IPR)	1. Law No. 13/2016 on Patents & Law No. 31/2000 on Industrial Design protect semiconductor innovations, including chip designs and fabrication processes. 2. Government Regulation No. 36/2018 on IC Layout Design ensures legal protection for integrated circuit (IC) layout designs, preventing unauthorized use. 3. Patent holders have exclusive rights for 20 years, with penalties for infringement, ensuring stronger IP enforcement and commercialization opportunities.

Indonesia's Semiconductor Ecosystem Compared to Global Leaders

Indonesia trails in R&D and talent, but holds strong growth and manufacturing potential...

The global semiconductor industry is dominated by a few major economies, with the US, China, Taiwan, Japan, South Korea, the UK, and Germany leading the way.

1. Indonesia currently plays a minimal role in the global semiconductor value chain, with **low export rankings—27th in semiconductor devices and 26th in integrated circuits**.
2. Within Southeast Asia, **Indonesia lags behind Malaysia and Singapore**, which lead in both semiconductor and integrated circuit exports.
3. Despite its small base, **Indonesia is projected to record the highest annual growth rate (CAGR 2025–2029)** in the global semiconductor industry.
4. With manufacturing contributing 18.67% to GDP in 2023, Indonesia has a solid base to support semiconductor.

Indonesia remains in the **early stages** with limited **R&D capacity** and **human resources** compared to other countries.

China
Under the "Made in China 2025" and National EDA Innovation Centre initiatives, China's reliance on foreign EDA tools poses a challenge, leading to a strategic push to increase domestic EDA market share and expand R&D collaborations.

Taiwan
As a global hub with over 285 companies and national semiconductor colleges, Taiwan's rising demand for skilled workers drives the National Key Fields Industry-University Act and expansion of chip education.

Vietnam
Aiming to train 50,000 semiconductor engineers by 2030, Vietnam's labour shortage in chip design and manufacturing is tackled through public-private R&D partnerships.

Germany
With "Silicon Saxony" and "Skills4Chips" at the core of its semiconductor drive, Germany faces an ageing workforce and microelectronics skill gaps, prompting national education (Mikrotec Academy) and industry partnership measures.

United Kingdom
Renowned for semiconductor design, IP, and compound semiconductors, the UK tackles its STEM shortage with a Skills Dashboard, alongside investments in STEM education and industry-based R&D.

United States
The USD 11 billion CHIPS R&D programme (NSTC, NAPMP, SMART USA, Metrology) combats high R&D costs and foreign manufacturing reliance by boosting advanced manufacturing and workforce training.

Indonesia: Although it has STPs, ITB labs, and BRIN research centres, Indonesia's shortage of skilled HR, IP limitations, and brain drain necessitate greater investment in human capital, STP expansion, and specialised research centres.

Note: *The full report have mapped key initiative, challenge, and strategic action on R&D and workforce in several countries, including United Kingdom, United States, Germany, China, Taiwan, Japan, South Korea, Vietnam, Malaysia, Singapore, and Thailand.*

Indonesia's Semiconductor Ecosystem Compared to Global Leaders

… and can catch up by adopting global best practices in incentives, regulation, and collaboration

Indonesia can boost its semiconductor sector by adopting global and UK strategies on incentives, regulation, and collaboration.

China

1. Made in China 2025 (2015)
   a. Semiconductor as one of priority industries.
   b. Targeting mass production of 16/14nm processes and set the domestic production ratio of ICs).
2. State Council Policy for Promoting High-Quality Development of the IC and Software Industry in the New Period (August 2020)
   a. 10-year full corporate tax exemption for semiconductor manufacturers .
   b. Tax incentives.
   c. Emphasises the importance of building a "national system" to develop core semiconductor technologies.
3. 14th Five-Year Plan (November 2020): Focus on semiconductor autonomy for technological independence.
4. More than 12.1 billion yuan (USD 1.75 billion) in subsidies for 190 domestic semiconductor companies (2022)

Taiwan

1. Providing access to essential resources such as water, electricity, and land and by offering tax incentives.
2. Established of industrial parks to create adequate infrastructure.
3. Increasing tax breaks from 15% to 25% for local companies' R&D investment.
4. Offering an additional 5% tax credit for investments of up to NT$10 billion (USD0.3 billion) for the purchase of new equipment supporting advanced process technology.
5. Increase the minimum corporate income tax from 12% (2023) to 15% (2025).

Vietnam

1. Comprehensive legal structure to attract and regulate semiconductor investment
2. Key governing laws:
   a. Law on Investment (2020): basis for foreign direct investment (FDI);
   b. High Technology Law: incentives and requirements for high-tech firms;
   c. Enterprise Law: rules for establishing and operating businesses;
   d. Specific Semiconductor Industry.

United Kingdom

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2. Key governing laws:
   a. Law on Investment (2020): basis for foreign direct investment (FDI);
   b. High Technology Law: incentives and requirements for high-tech firms;
   c. Enterprise Law: rules for establishing and operating businesses;
   d. Specific Semiconductor Industry.

United States

1. Creating Helpful Incentives to Produce Semiconductors Act - CHIPS Act (2020)
   - Aims to strengthen domestic semiconductor manufacturing, design, and research to enhance economic resilience, national security, and ensure the stability of the chip supply chain
2. CHIPS & Science Act (2022)
   - Provides grants, research investments, and tax credits for semiconductor production

Note: The full report have mapped policy and incentives in several countries, including United Kingdom, United States, China, Taiwan, Japan, South Korea, Vietnam, Malaysia, SIngapore, and Thailand.

Identifying Trends and Overcoming Challenges

Indonesia's Semiconductor Industry: Towards Realising The Potential for Growth

Trends and Opportunities for Growth in Indonesia's Semiconductor Ecosystem

PESTEL analysis highlights key enablers to Indonesia's semiconductor ecosystem growth…

The semiconductor ecosystem in Indonesia is shaped by the government's political commitment, social factors including workforce availability and education alignment, technological advancements, economic stability, and heightened awareness of the strategic importance of sustainable industrial development.

P – POLITICAL

1. The government's sustained commitment to developing the Semiconductor Industry by prioritising it as a key sector to support economic growth targets.
2. Harmonisation of policies and regulations across government agencies to prevent conflicts of interest in the direction of semiconductor development.
3. Provision of government support as a form of intervention (e.g. subsidies, domestic component level (TKDN), import duty policies, R&D incentives, and other incentives).
4. Government policy direction related to international relations in the semiconductor ecosystem within ASEAN and BRICS frameworks.
5. Access to international grants and aid.

E – ECONOMIC

1. Economic stability, particularly exchange rates and interest rates of Indonesia.
2. Market availability.
3. Ease of doing investment in strategic sectors of the semiconductor ecosystem, including R&D, advanced manufacturing, and material processing.

S – SOCIAL

1. Demographic bonus supporting the availability of a productive workforce.
2. Alignment of education levels with industry needs.
3. Lifestyle changes due to digitalisation and technological advancements.

T – TECHNOLOGICAL

1. Level of domestic R&D that supports the advancement of semiconductor development.
2. Technology transfer regarding further advanced semiconductor technology.
3. Techno-Park development.

E – ENVIRONMENTAL

1. Implementation of a circular economy in semiconductor waste and waste management.
2. Implementation of Occupational Health and Safety (OHS) in the semiconductor sector.

L – LEGAL

1. Intellectual property protection and provision of relevant legal assistance.
2. Data and cyber security protection.
3. Consistency in law enforcement.

Trends and Opportunities for Growth in Indonesia's Semiconductor Ecosystem

… and understanding market trends helps identify where Indonesia can compete and catch up

Government growing initiatives support and digital adoption drive semiconductor ecosystem development, yet regulatory and infrastructure challenges persist. While growing demand for digital technology supports economic expansion, weak local supply chains limit competitiveness.

	Domestic	Global
GROWTH	1. EV's demand growth. 2. Growth in demand for electronic household appliances (although not applicable to all devices). 3. The growing trend of digital lifestyle. 4. Increase in the number of applications for data center construction permits from the government.	1. EV's demand growth. 2. Growth in demand for electronic household appliances (although not applicable to all devices). 3. The growing trend of digital lifestyle. 4. The massive development of advanced technology (such as AI, robotics, big data, etc).
COMPETITION	1. There is no competition between companies because the market is still limited. 2. There is a potential increase in the number of foreign investments due to geopolitical condition.	The semiconductor competition among major player countries persists, although the key players remain largely unchanged.
INNOVATION	Innovation is showing growth, yet it is still constrained by several factors (investment, technology, regulatory challenges).	There has been a significant increase in innovation, where companies are even competing to create innovations.
COMPARATIVE ADVANTAGES	1. There are natural resource reserves for semiconductor raw materials; however, this potential has not yet become a comparative advantage due to its suboptimal utilisation. 2. Demographic bonus and low wages allow for cost efficiency compared to other countries. 3. Large population, providing a wide market potential.	Advanced technology and capital availability.
ROUTES TO MARKET	Indonesia's semiconductor ecosystem remains export-oriented, as the value-chain ecosystem has not yet developed due to the absence of strong domestic demand.	A complete supply chain ecosystem has been established.

Indonesia's Critical Challenges in Semiconductor Development

Despite the promising potentials, Indonesia faces several challenges that could hinder its growth and competitiveness …

The absence of a comprehensive national strategy, investor uncertainty due to unclear incentives and regulations, human capital shortages and weak industry-academia collaboration, infrastructure gaps, and a lack of structured research collaboration: altogether constraining innovation, technology adoption, and the development of Indonesia's semiconductor sector.

Policy and Regulation

- Absence of a clear national strategy and coordinated leadership structure
- Investment uncertainty and barriers to growth
- Weak investment incentives
- Ambiguous investment screening policies
- Import and export regulations
- Lack of a structured knowledge transfer mechanism

Human Capital

- Shortage of skilled semiconductor professionals
- Weak alignment between university curricula and industry needs
- Challenges in semiconductor-focused education and training
- Talent retention and brain drain

Infrastructure

- Limited domestic processing of raw materials
- Challenges in aligning industrial zones with semiconductor industry needs
- Inadequate industrial support systems for semiconductor manufacturing
- Absence of a centralised semiconductor research and development hub
- The development of environmentally sustainable semiconductor manufacturing infrastructure also remains a challenge

R&D and Commercialisation

- Dependence on foreign licensing
- Limited financial support for R&D
- Lack of structured research collaboration framework
- Weak semiconductor innovation ecosystem
- Barriers to commercialising locally designed semiconductors

Sources: various literature, in-depth interviews, and a consultative workshop.

SWOT Analysis of Indonesia's Semiconductor Ecosystem

… and SWOT analysis revealed that while the industry faces considerable weaknesses, it also has significant opportunities.

Indonesia's semiconductor industry has potential due to a large workforce, government support, and abundant resources, but is hindered by limited production capacity, fragmented R&D, and inadequate infrastructure. Opportunities exist through its strategic location, digital transformation, and FDI appeal, though challenges like geopolitical uncertainties, global competition, and rapid technological advancements remain.

S
STRENGTHS

1. Growing government support
2. Demographic dividend
3. Abundant natural resources

W
WEAKNESSES

1. Deficiency on the availability and quality of infrastructure
2. Limitations in curriculum support
3. Lack of business leadership
4. Inconsistencies in government regulations
5. Lack of customs officers' information of good and product classification
6. Fragmented semiconductor ecosystem

O
OPPORTUNITIES

1. The growth of digital lifestyle
2. Technological disruptions
3. Indonesia's neutral position for investment
4. New investment policy alternative
5. Chip-war

T
THREATS

1. Lack of industry cluster to attract investment
2. Minimal local workforce involvement
3. Intensifying global technological competition
4. Policy uncertainty and political commitment

Recommendations for Indonesia's Semiconductor Ecosystem

Indonesia's Semiconductor Industry: Towards Realising The Potential for Growth

Design and ATP are Indonesia's best entry points into the global semiconductor industry

"Becoming a key player in the global semiconductor ecosystem by leveraging Indonesia's resource advantages"

This vision ensures that the country's semiconductor development remains rooted in the effective utilisation of both its natural and human resources, aligning its industrial strategy with long-term economic and technological growth objectives.

Short-term (2–3 years)
- Focus on materials investment (e.g. silicon wafers), build design capabilities with incentives and talent development, and start feasibility studies for fabrication.
- Expand ATP capacity through partnerships and workforce development.

Medium-term (4–5 years)
- Advance value-added materials production and R&D.
- Grow chip design activities and pilot wafer production, while boosting ATP capacity and domestic demand.

Long-term (6–10 years)
- Position Indonesia as a global supplier of semiconductor materials and a regional hub for chip design.
- Develop commercial-scale fabrication and build a resilient ATP ecosystem with high-quality standards.

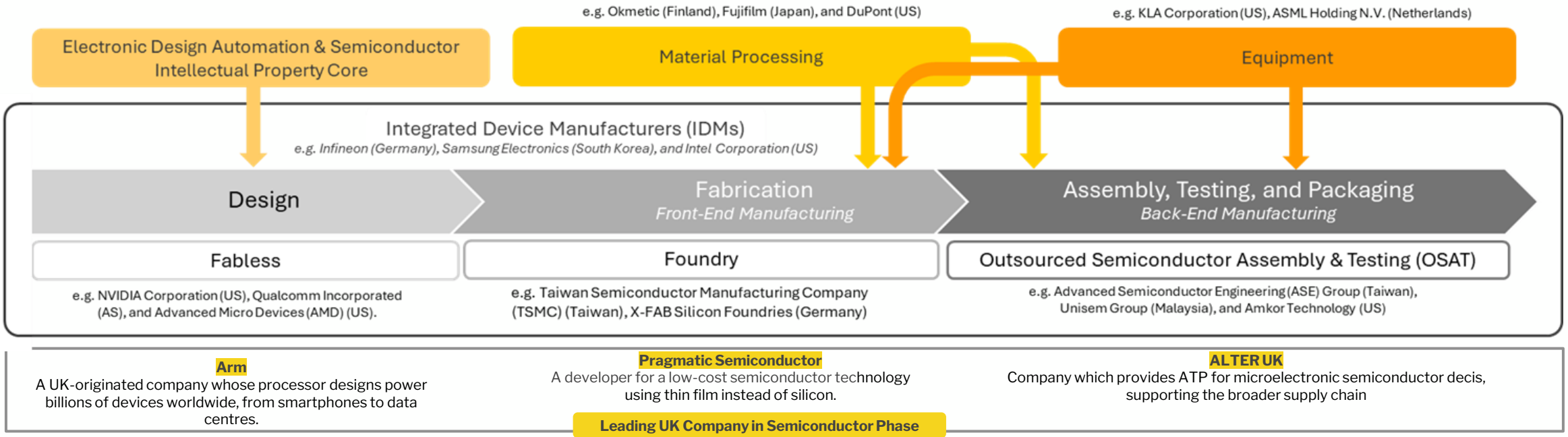
Aiming to become a global semiconductor player, Indonesia should leverage its resources and focus on design and ATP as the most viable entry points. Fabrication and materials remain long-term goals, but strengthening design and ATP is key to building expertise, attracting investment, and driving innovation

Time Frame	Materials	Design	Fabrication	ATP
Short-term	• Domestic and foreign investment in photovoltaic (solar grade) and electronic grade silicon wafer production	• Incentives to strengthen existing design houses • Human resources development • Collaboration with international universities • Provision of collaborative design tools	• Developing detailed engineering design and conduct feasibility study • Finding global partners (technology, equipment, investment)	• Encouraging new investment in ATP or expansion • Local partnership policies in high-tech industry • Human resources development
Medium-term	• Downstreaming process of semiconductor raw materials through foreign investment • Technology transfer through collaboration with local partners • R&D in material processing	• Human resources development • Collaboration of IC design with leading semiconductors company • Licensed IC chip development • Establishment of competency standards for IC design	• Technological transfer • Pilot-scale production of domestic wafer fabrication	• Strengthening new investment in ATP or expansion • Stimulating market expansion to absorb locally produced semiconductors
Long-term	• Downstreaming process of semiconductor raw materials through foreign and domestic investment • Advancing R&D in material processing	• Becoming a semiconductor talent centre • Having capability to produce licensed IC chips	• Small-scale factory commercialisation of wafer fabrication for domestic industry • Production and transfer technology	• Semiconductor industry ATP independence

Key Stakeholders in Indonesia's Semiconductor Ecosystem

The UK has a significant role as a global player in semiconductor, especially in fabless and ATP of microelectronic semiconductor devices, …

In the global semiconductor industry, some companies operate across all production stages as Integrated Device Manufacturers (IDMs), while others specialise in just one stage. The UK has capabilities in both fabless design and ATP (Assembly, Testing, Packaging) for microelectronic semiconductors, but its industry mainly focuses on fabless activities like chip design.



The UK is a leader in fabless semiconductor design
as companies focusing on chip architecture while outsourcing manufacturing to foundries.

Indonesia's Semiconductor Ecosystem Compared to Global Leaders

… backed by robust semiconductor policies and strategic initiatives

The UK has long been involved in the global semiconductor industries. In 2023, The UK has institutionalised a long-term and comprehensive roadmap for its semiconductor ecosystem development (i.e., National Semiconductor Strategy 2023).

Historical Perspectives on Semiconductor Strategies in the UK

Before and During 1960s

1. Discovery of the first transistor
2. The establishment of UK-based electronics firms (i.e. Plessey and Ferranti)
3. The UK government initiative to fund several high-technology companies (e.g. Marconi-Elliot Microelectronics)
4. The UK government allocate US$8m for UK semiconductors R&D

> 1960s - 1970s

1. More direct interventionist measures
2. The establishment of National Enterprise Board (NEB) to support UK industrial policy, including the provision of funding to Inmos (US-UK joined semiconductor firm)
3. The launching of Microelectronics Industry Support Scheme (MISP) and Microprocessor Applications Project (MAP)

> 1970s - 1990s

1. Change in industrial strategy: more privatisation and foreign ownership
2. The launching of Alvey (a 5-year research initiative on semiconductors)
3. The establishment of Arm (UK-based chip design firm)

2000s - now

1. In 2022, the revenue of UK semiconductors companies account for 2% of global semiconductor revenue (85% from chip design)
2. The legislation of National Security and Investment (NSI) Act to regulate foreign investment in semiconductors
3. The launching of National Semiconductor Strategy 2023

Lesson Learned from the UK

- Building on lessons from diverse policy experiences such as those in the UK during the 1970s–1990s, Indonesia can **combine both interventionist** (e.g. fiscal allocation for industrial policies, sound regulatory framework) **and non-interventionist measures** (e.g. foreign ownership)
- Indonesia need to establish a **long-term, well-coordinated, and consistent roadmap for semiconductors development,** which has specifically prioritised focus area (e.g. chip design, IP), similar to the National Semiconductor Strategy 2023
- More **targeted collaboration** between UK and Indonesia **specific on the development of semiconductors ecosystem**

Recommendations for Indonesia's Semiconductor Ecosystem

… unlocking mutual benefits through strategic partnerships.

There are several specific areas of strategic collaboration between Indonesia and the UK in developing Indonesia's semiconductor ecosystem, including policy alignment, talent development, research and innovation, infrastructure support, and digital governance

No.	Collaboration	Benefit
1.	**Policy and Regulatory Alignment:** Joint development of policy and regulatory frameworks, including sharing best practices in regulatory clarity and investment frameworks, shaping long-term roadmap, streamlining investment procedures, enhancing FDI screening mechanism, and improving trade facilitation processes.	**Indonesia:** Accelerates semiconductor ecosystem development; fosters cohesive and competitive national strategy. **UK:** Strengthens global leadership in semiconductor governance; promotes UK-aligned regulatory models.
2.	**Talent Development and Workforce Training:** Curriculum development, academic exchange programmes between Indonesian universities (e.g. ICDeC members) and UK universities (e.g. Cardiff, Bristol, and Swansea), scholarships, and on-the-job training at UK-based semiconductor companies (e.g. Arm, Pragmatic Semiconductor, and Dialog Semiconductor).	**Indonesia:** Builds domestic chip design and technical workforce; closes talent gap; enhances higher education quality. **UK:** Expands the global reach of UK universities and companies; attracts potential international students and trainees; foster long-term institutional partnerships.
3.	**Research and Innovation Collaboration:** Co-funded grants, prototype development and IP commercialisation initiatives, and access to design tools.	**Indonesia:** Strengthens Indonesia's R&D ecosystem particularly in chip design and compound semiconductors; accelerates local innovation and tech transfer. **UK:** Strengthens UK leadership in chip design and compound semiconductors; broadens access to emerging markets; enhances international relevance and impact of UK research.
4.	**Infrastructure Support:** UK could support the development of IC design and ATP capabilities, while also promoting the establishment of wafer fabrication facilities in Indonesia. This may include contributing to the design of industrial zones—particularly within Indonesia's Special Economic Zones (SEZs)—as well as facilitating strategic partnerships and providing investments.	**Indonesia:** Develops global-standard infrastructure; boosts fabrication development and ATP capacity. **UK:** Advances UK ambition to enhance its global role in chip manufacturing.
5.	**Digital Governance and Cybersecurity:** Joint initiatives on IP protection, data governance, and infrastructure security.	**Indonesia:** Strengthens innovation resilience; improves investor confidence and facilitate smoother global integration; enhances legal and data security environment. **UK:** Promotes UK digital standards; co-develops trusted digital infrastructure; reinforces UK's global role in secure technology governance.

Seizing the Opportunity: Charting Indonesia's Path in the Global Semiconductor Industry

Indonesia's Semiconductor Industry: Towards Realising The Potential for Growth

Executive Summary

The future of Indonesia's semiconductors: opportunities, challenges, and strategic recommendations for Indonesia

In the growing demand of global semiconductor-related products, which production chains are still concentrated among limited key players, Indonesia with its strategic advantages need to address several domestic challenges to advance its position in the global semiconductor's ecosystem.

Indonesia's Strategic Advantages

1. **Abundant natural resources for upstream development:** Indonesia is rich in key semiconductor raw materials (e.g., silica sand, tin, bauxite, nickel, etc.)
2. **Strategic geographic position in the Indo-Pacific:** Indonesia's strategic location between the Indian and Pacific Oceans and have geographical proximity to semiconductor hubs (i.e., China and Taiwan)
3. **Expanding domestic demand, broad sectoral applications, and global diversification momentum:** Optimizing a significant rise in the global semiconductors demand (electronics, automotive, etc) and the need for diversification from traditional hubs (i.e., China and Taiwan)
4. **Government initiatives and international partnerships**: Making Indonesia 4.0, the formation of Semiconductor Ecosystem Task Force,
5. **Potential to become an electric vehicle (EV) manufacturing hub**

Key Challenges

1. **Policy and regulatory challenges:** Indonesia lacks a cohesive, long-term national strategy for the semiconductor sector, resulting in fragmented progress across investment, talent development, research, and infrastructure
2. **Human capital challenges**: A critical barrier to Indonesia's semiconductor development is the shortage of skilled professionals across the value chain
3. **Infrastructure challenges**: Indonesia's infrastructure presents several challenges for semiconductor development, particularly the lack of advanced technology and the limited reliability of its industrial zones
4. **Research & development and commercialisation challenges**: Indonesia's underdeveloped innovation ecosystem, characterised by limited IP capacity, high R&D costs, weak academia-industry links, and lack of commercialisation support, undermines local semiconductor development

Recommendations

1. **Policy and regulatory frameworks:** Develop and implement a national semiconductor strategy with clear investment and regulatory reforms
2. **Human capital and talent development**: Strengthen semiconductor workforce through industry-aligned education and practical training
3. **Infrastructure development**: Upgrade industrial zones and upstream processing to support semiconductor manufacturing
4. **Research & development and commercialisation**: Establish integrated R&D hubs and reduce barriers to semiconductor innovation
5. **Innovation ecosystem and international collaboration:** Strengthen global partnerships to support strategy design, skills development, and technology transfer

Executive Summary

Charting Indonesia's path in the global semiconductor ecosystem through collaboration with the UK

With sustained political commitment, targeted investment, and strong international cooperation, Indonesia can begin to move up the value chain, from assembly and packaging towards design and, eventually, fabrication. By leveraging its strengths, closing critical gaps, and fostering collaboration with international partners (including the UK), Indonesia can chart a future as a key regional player in the global semiconductor landscape.

Semiconductor Roadmap for Indonesia

Time Frame/Phase	Strategies
Short-term (2 - 3 years)	Building chip design capabilities, investing in material research, undertaking feasibility assessments
Medium-term (4 - 5 years)	Scaling production, enabling effective technology transfer, and reforming institutional structures
Long-term (6 - 10 years)	Establishing innovation-led capacity across the full value chain, including materials, design, fabrication, and ATP

Collaboration Opportunities of Indonesia and the UK

1. **Policy and regulatory frameworks:** The United Kingdom and Indonesia could strengthen its bilateral cooperation to shape Indonesia's semiconductor policy and regulatory frameworks
2. **Human capital and talent development**: In human capital development, joint efforts may encompass support in curriculum design, academic exchange programmes between Indonesian universities (e.g. ICDeC members) and UK universities (e.g. Cardiff, Bristol, and Swansea), scholarships, and placements within UK-based semiconductor firms (e.g. Arm, Pragmatic Semiconductor, and Dialog Semiconductor)
3. **Research & development and commercialisation**: Joint efforts in research and innovation can focus on strengthening Indonesia's chip design ecosystem, by leveraging existing frameworks (e.g., the Newton Fund, the Global Challenges Research Fund, and Innovate UK), partnered with several domestic institutions which have been focused on chip design (e.g. ICDeC members) and UK's leading institution (e.g., University of Oxford, University of Cambridge).
4. **Industry and infrastructure development**: Industrial and infrastructure collaboration may focus on advancing labour-intensive semiconductor segments in Indonesia, such as wafer fabrication and assembly, testing, and packaging (ATP)
5. **Innovation ecosystem and cybersecurity:** Further engagement in cybersecurity, IP regulation, and open data standards can support Indonesia's alignment with international norms and enhance the overall resilience of its semiconductor ecosystem

Through these joint initiatives, both countries stand to benefit Indonesia can accelerate its industrial development and enhance self-reliance, while the UK reinforces its strategic presence in Southeast Asia and cultivates new economic and academic linkages in a high-growth market.

British Embassy Jakarta

UK International Development
Partnership | Progress | Prosperity

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Thank you

Indonesia's Semiconductor Industry: Towards Realising The Potential for Growth

Institute for Economic and Social Research
Faculty Economics and Business – Universitas Indonesia

Jakarta, July 23rd, 2025

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