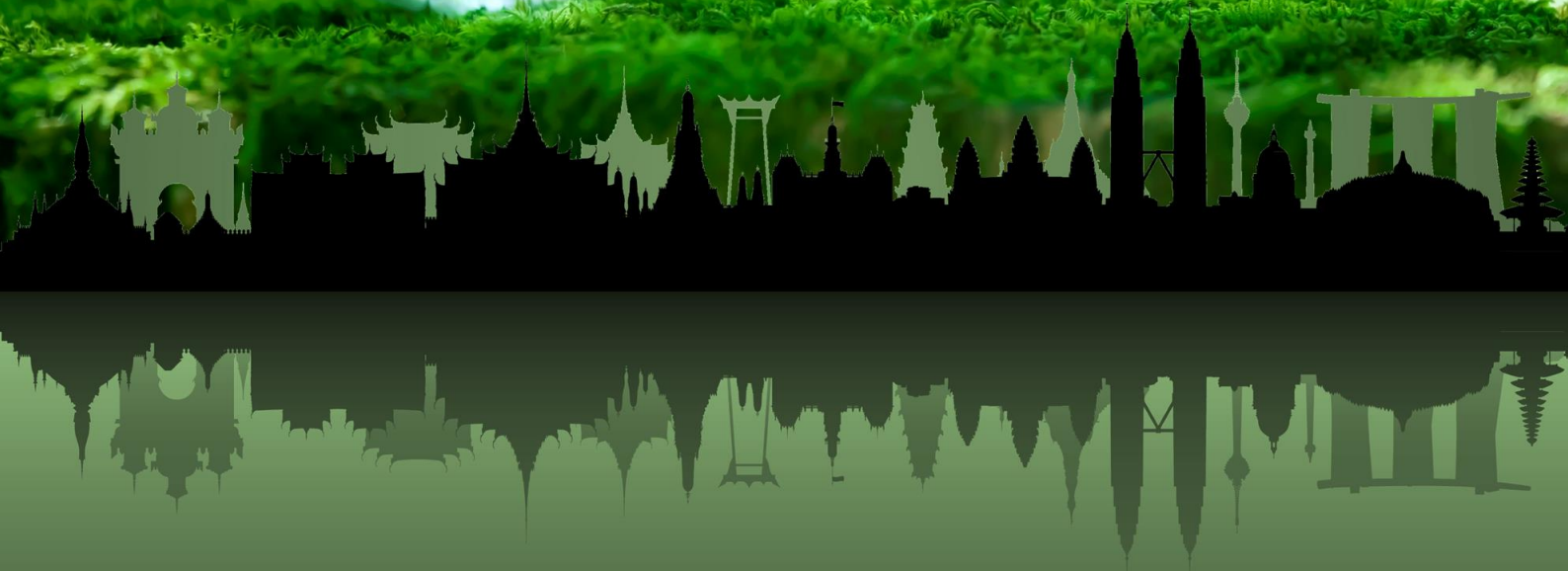


SOUTHEAST ASIA PATENT LANDSCAPE

DRIVING SUSTAINABLE DEVELOPMENT GOALS
THROUGH TECHNOLOGY INNOVATION



Foreword

Patent analytics draws on large sets of data to provide actionable intelligence for the innovation and business communities. With the surge in patent filings worldwide, patent analytics has become a valuable tool for understanding the technological landscape, including which areas of innovation are moving fastest, and where in the world patent applicants are based.

As the world's fifth largest economy—and on track to become the fourth largest by 2030—Southeast Asia is a region on the move. This growing and strategically placed engine of ideas, technology, and trade has seen gross R&D expenditure surge five-fold in the past two decades, crossing over USD 50 billion. This attests to the region's appetite and attractiveness as a hub for innovation and technological development.

As well as supporting growth nationally and regionally, these developments can and must serve the world. Back in 2015, the international community came together to agree to the United Nations Sustainable Development Goals (SDGs), in recognition that global partnership and a common blueprint are required to pursue peace and prosperity for people and the planet.

The challenges ahead are no doubt multifaceted and complex, but opportunities abound to tap into our ingenuity and intellectual property (IP) to build our common, better future. That's why this year's World IP Day is themed ***IP and the SDGs: Building our common future with innovation and creativity***. At a time when the world urgently needs ideas and inspiration to overcome common challenges, IP incentivises the improvement of existing solutions and the creation of new ones. This makes IP a critical and indispensable lever for the advancement of all 17 SDGs.

To underscore the significance of this year's campaign, this report, ***Southeast Asia Patent Landscape***, unravels insights, specifically on the region's contributions towards the SDGs. The analysis covers patenting trends across technological fields—such as digital and medical technology—while highlighting both homegrown and cross-border collaborations. Notably, the report also showcases region-specific examples, such as the development of biofuels, as Southeast Asia transitions into adopting green energy. As a regional analysis, it also complements the recent WIPO patent analytics report ***Mapping Innovations: Patents and the SDGs***.

This report is produced by IPOS International under the ambit of the Memorandum of Understanding (MoU) between WIPO and the Government of Singapore. Since its inception in 2005, the MoU has delivered a myriad of activities to promote IP awareness and strengthen the IP capabilities of

countries in the Southeast Asia region and beyond. The WIPO-Singapore partnership continues to forge collaborations on innovative topics that will enable the region to maximise the value of its IP and intangible assets (IA) for economic growth and societal benefits.

Last but not least, let us take the opportunity to wish you a very happy and meaningful World IP Day!

Mr Daren Tang
Director General
World Intellectual Property
Organization (WIPO)

Mrs Rena Lee
Chief Executive
Intellectual Property Office of
Singapore (IPOS)

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Executive Summary

In recent years, Southeast Asia (SE Asia) has shown a significant increase in its ability to develop new ideas, evidenced by the growing number of patent families originating from the region. These new patent families are a sign of technological development. The region's innovation spans multiple sectors, impacting the region's progress toward the United Nations Sustainable Development Goals (SDGs).

This report uses patent data as its primary source of information to take a close look at the innovations in SE Asia. Its goal is to provide stakeholders with a clear picture of how these technological advancements work in SE Asia and their implications for the SDGs.

1. Southeast Asia: A growing market for patent protection

Southeast Asia is increasingly recognised as a critical market for patent protection, drawing considerable interest from global innovators. Over the past decade, the region has received approximately 471,000 patent applications, with a notable increase of 15,000 applications in 2022 alone, compared to ten years earlier. This surge is predominantly driven by international applicants from the United States, Japan, Europe, China, and South Korea, underscoring SE Asia's strategic global importance. Noteworthy is the significant rise in filings from Chinese applicants, which more than doubled in the recent period, reflecting China's growing interest in the region. Despite the dominance of foreign filings, local innovators remain significant, contributing about one-seventh of the total applications.

2. Innovation synergy: SE Asia's fusion of local and foreign ingenuity

Over the past decade, SE Asia has experienced a surge in inventions, with Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam leading

the charge. Together, these countries account for 99.8% of all inventions originating from the region.

In SE Asia, innovation is driven by a dynamic blend of local research institutes and foreign entities. These local institutes play a key role in innovation and provide a rich local talent pool that attracts foreign entities to establish regional research and business operations. Homegrown companies are also active innovators, demonstrating the region's ability to create innovations that compete globally.

3. Digital technology: powering diverse SDGs in SE Asia

The region has witnessed a notable increase in digital technology inventions, spanning Computer Technology, Digital Communication, and Telecommunications. These technological breakthroughs are essential in advancing SDGs, particularly in promoting SDG 3 (Good Health and Well-Being), SDG 9 (Industry, Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).

Digital technologies have been pivotal in growing SE Asia's digital economy, leading to the rise of digital unicorns. Evolving from startups to significant contributors in the digital landscape, these companies show how digital innovation can break through traditional market barriers to create a more inclusive and sustainable industrial environment.

4. Medical technology innovation in SE Asia: catalysing progress towards SDG 3

From 2018 to 2022, SE Asia witnessed a surge in medical technology development compared to the preceding five years. This progress in medical technology was the result of the collaborative efforts of various stakeholders, including research institutes, universities, healthcare providers, and medical technology firms.

These breakthroughs introduced innovative healthcare solutions tailored to meet regional needs. They play a crucial role in advancing SDG 3, which aims for healthier lives and promotes well-being at all ages. They have helped expand healthcare access, enhance delivery efficiency, empower individuals to take control of their health, and drive innovation in healthcare delivery models.

5. Pharmaceutical innovation in SE Asia: strengthening SDG 3 through global-local collaboration

Compared to global trends, SE Asia shows a stronger focus on pharmaceutical innovation, highlighting the region's ability to achieve technological breakthroughs and the collaborative efforts between local and international research institutes.

Collaboration between local research organisations and international pharmaceutical giants promotes the exchange of knowledge and fuels the development of pharmaceutical innovations designed to address the region's unique health challenges. These innovations are crucial for advancing treatments for various health conditions and contribute significantly to SDG 3, which aims to fight various diseases and improve health outcomes.

6. Biofuel innovation: SE Asia's stronghold to achieve SDG 13

By harnessing SE Asia's agricultural expertise, biofuels have become a key area of innovation. Nations rich in agriculture, such as Indonesia, Malaysia, and Thailand, use their capabilities to meet domestic energy needs and fulfil global demands. In Singapore, the city-state capitalises on its strategic position as an energy trading hub to focus on renewable fuels, like biofuels, to enhance energy security and stimulate economic growth. This shift towards biofuel usage is in line with goals set out in SDG 13, which addresses climate change by reducing greenhouse gas emissions and promoting sustainable economic growth through the adoption of renewable energy sources.

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Introduction

Southeast Asia (SE Asia), recognised as the third-largest economy in Asia and the fifth globally, is a dynamic and diverse region. It consists of countries at various stages of development—Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam—each contributing to the region’s potential for technological growth. This region, united under the Association of Southeast Asian Nations (ASEAN), is committed to leveraging technology for sustainable development.

In 2015, all United Nations member states, including those in SE Asia, adopted the Sustainable Development Goals (SDGs)¹ to tackle global challenges such as poverty and climate change, to improve quality of life and ensure sustainability by 2030. Countries in SE Asia have been actively integrating these goals into their initiatives, emphasising the role of technological innovation as a key driver.

Patent filings originating from SE Asia offer a tangible measure of its progress in technological innovation and reflect the region’s focus across various sectors like healthcare, renewable energy, and environmental sustainability. These filings underscore efforts to create novel solutions that address regional challenges and contribute to achieving the global SDGs.

This report provides an overview of SE Asia’s innovation landscape over the past decade, focusing on SE Asia’s contributions to the SDGs. It explores how these technological advancements are pivotal to the region’s future and how they align with the broader goals of environmental sustainability, economic growth, and social development.

¹ United Nations, The 17 Goals. <https://sdgs.un.org/goals>

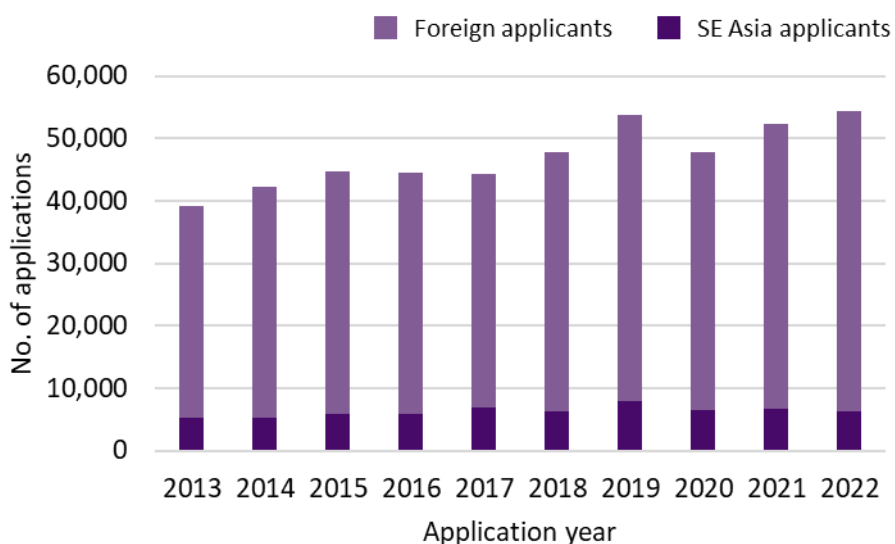
Overview

Patent Applications in SE Asia

Southeast Asia is a region of significant importance in the global market, ranking as the third-largest market in Asia and fifth globally, with a combined population exceeding 660 million.² Strategically positioned at the nexus of major trade routes, the region is integral to global trade and commerce and a consistent attraction as a market for global innovation efforts.

Over the past decade, SE Asia has received about 471,000 patent applications. Notably, there has been a significant increase in patent applications, with an additional 15,000 inventions seeking protection in 2022 compared to 10 years ago. This surge is primarily driven by international applicants, illustrating the region's global allure (**Exhibit 1**). Despite the dominance of foreign patent filings, local innovators within SE Asia are crucial and contribute about one in every seven patent applications in the region.

Exhibit 1: Patent application trend in SE Asia, 2013–2022



² ASEAN Main Portal: Investing in ASEAN 2023. <https://asean.org/book/investing-in-asean-2023/>.

With its strong economy and favourable environment for research, development, and robust intellectual property protection, Singapore stands at the forefront with over 121,000 patent applications from 2013 to 2022, representing a substantial 26% of the applications in SE Asia (**Exhibit 2**). Patent applications in Singapore grew at a compound annual growth rate (CAGR) of 5.5% from 2018 to 2022. Indonesia and Thailand are close contenders, with approximately 92,000 and 80,000 applications, respectively. Malaysia follows with 73,000 patent applications, and Viet Nam and the Philippines rank fifth and sixth, with around 63,000 and 40,000 patent applications received, respectively. Viet Nam, however, exhibits the highest CAGR of 9.4% from 2018 to 2022, a growth rate unrivalled by its regional counterparts.

Exhibit 2: Patent applications in SE Asia by country, 2013–2022

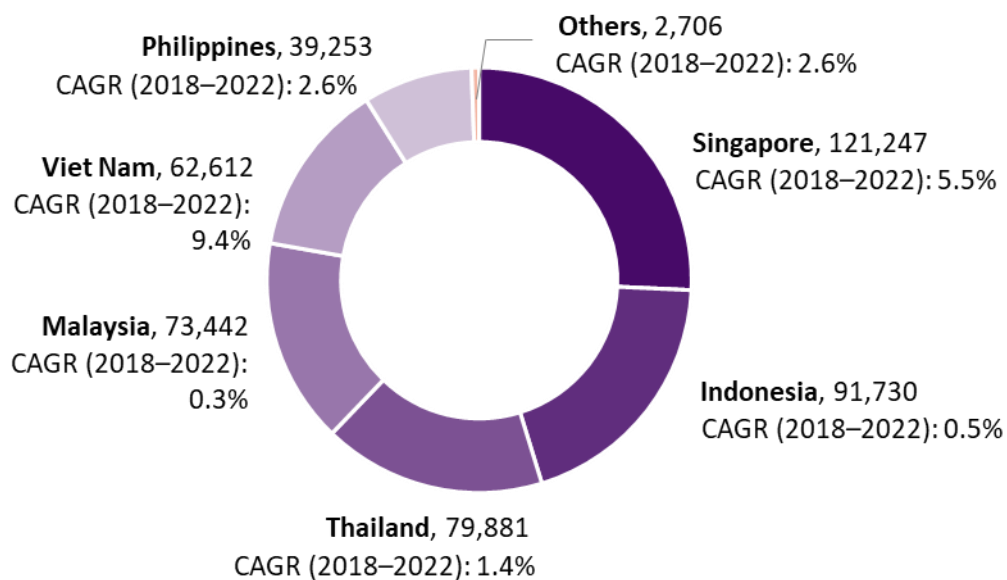
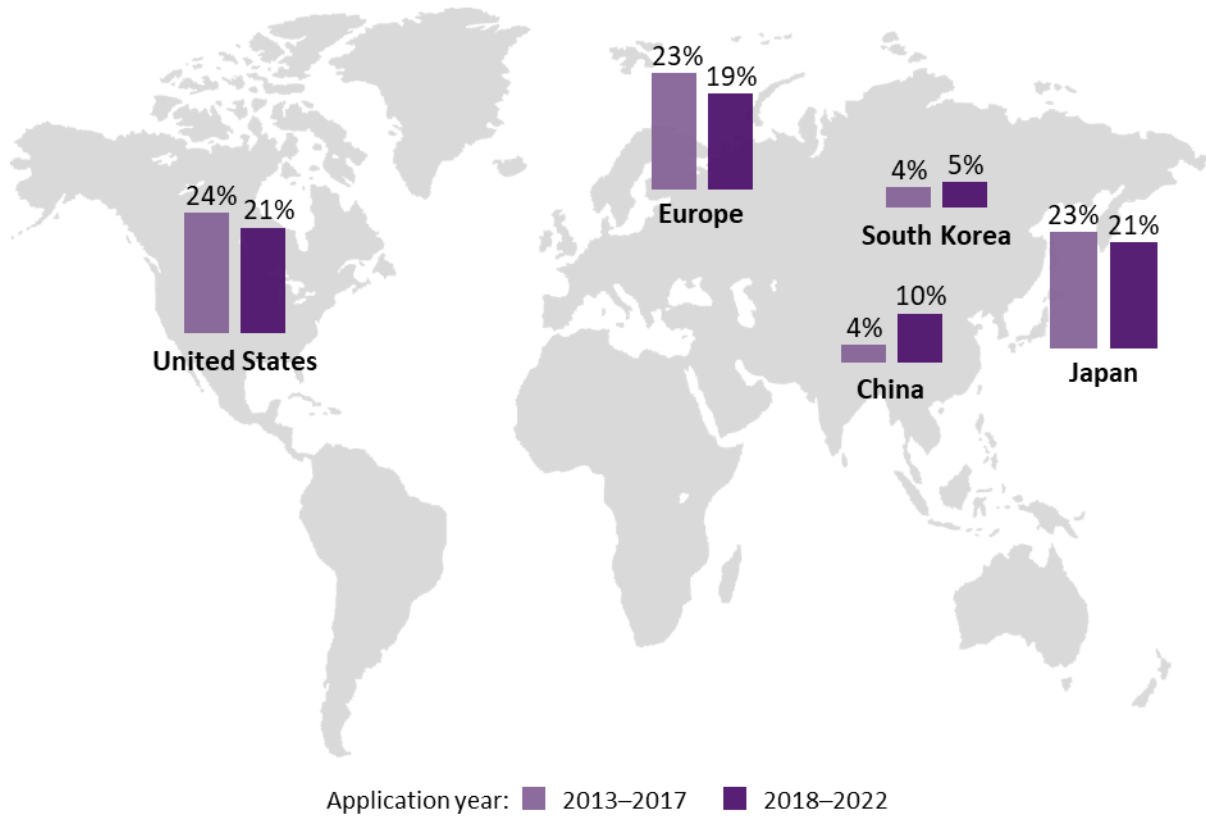
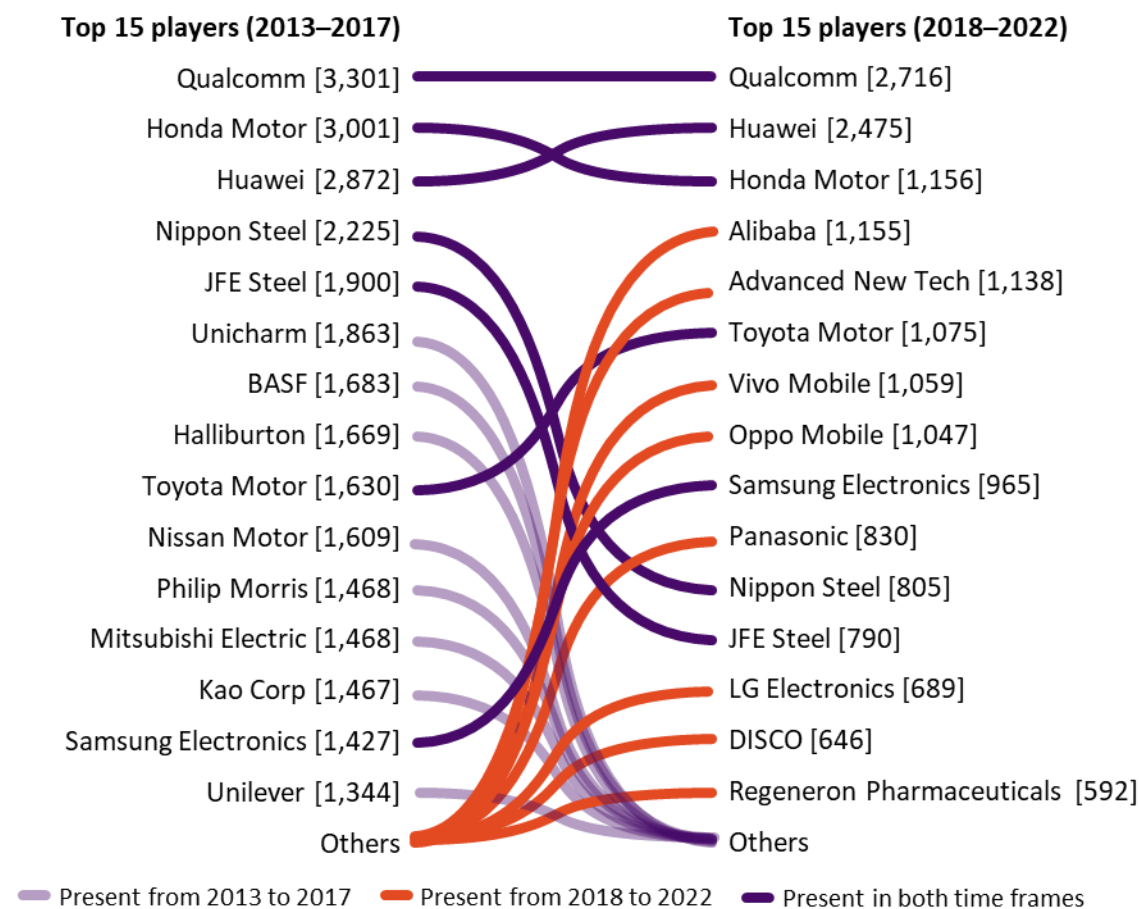


Exhibit 3: Top 5 countries/regions of origin seeking patent protection in SE Asia, 2013–2017 vs. 2018–2022



The United States (US), Japan, and European countries are the major contributors to patent filings in SE Asia (**Exhibit 3**). Specifically, the US accounted for 21% of applications in 2018–2022, dipping slightly from 24% in 2013–2017. Japan and European countries mirrored this trend, with their share also decreasing to 19% and 21%, respectively. A noteworthy trend is the rise in filings from China, which has seen its share more than double from 4% in 2013–2017 to 10% in 2018–2022. South Korea, maintaining its fifth position, has also seen modest growth, from 4% to 5% in its share of patent applications in the region.

Exhibit 4: Comparison of top applicants seeking patent protection in SE Asia: 2013–2017 vs. 2018–2022



Note: The numbers in brackets denote the volume of patent applications filed in SE Asia. These numbers may be understated owing to potential data incompleteness in recent years.

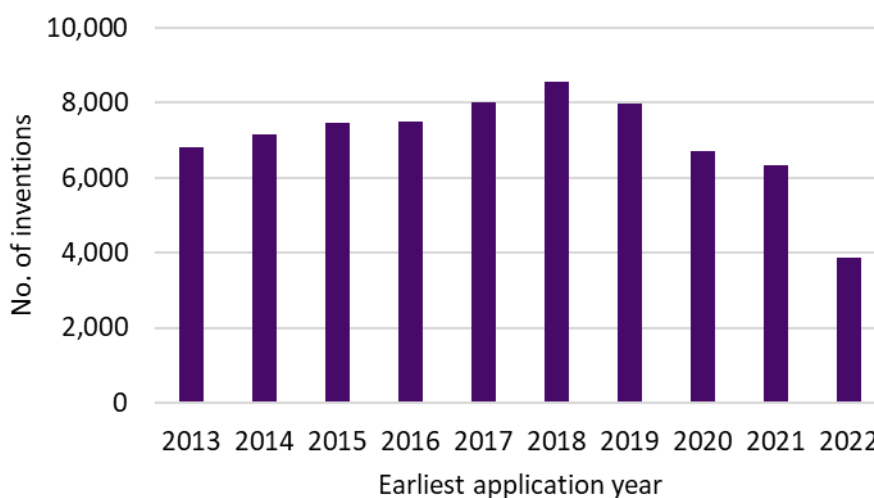
The SE Asia market, with its compelling prospects, continues to captivate multinational corporations (MNCs) across various sectors from prominent economies such as the US, China, Japan, South Korea, and Europe (**Exhibit 4**). From 2013 to 2017, SE Asia saw a significant increase in patent applications from consumer goods companies, such as Unicharm, Kao, and Unilever, alongside firms in the chemicals sector, such as BASF, as well as contributions from energy sector companies like Halliburton. Recently, there has been a rise in patent filings from entities in digital technologies, electronics, and their cognate fields. Leading companies such as Qualcomm, Huawei, and Samsung are growing their patent protection portfolios, joined by companies like Alibaba, Advanced New Tech, Vivo, Oppo, Panasonic, LG, and DISCO Corporation, which are increasing their filings in the region. The automotive sector remains strong, with mainstays like Honda Motor and Toyota Motor, and the steel industry has stalwarts like Nippon Steel and JFE Steel.

Innovations Originating from SE Asia

The SE Asia region, led by the Association of Southeast Asian Nations (ASEAN), has increasingly placed science, technology, and innovation at the heart of its collective mission. The formation of the ASEAN Permanent Committee on Science & Technology (PCOST)³ reflects collaborative efforts to create an environment conducive to innovation and technological growth. This shows a region working together towards common goals, with solidarity and purpose.

Based on global patent applications originating from SE Asia applicants, SE Asia nations have collectively produced about 70,000 inventions in the past decade (**Exhibit 5**), as measured by unique patent families.⁴ Notably, from 2013 to 2019, a period for which the data is complete, there is a clear increase in the volume of patent family filings, indicative of a growing innovation ecosystem in the region.

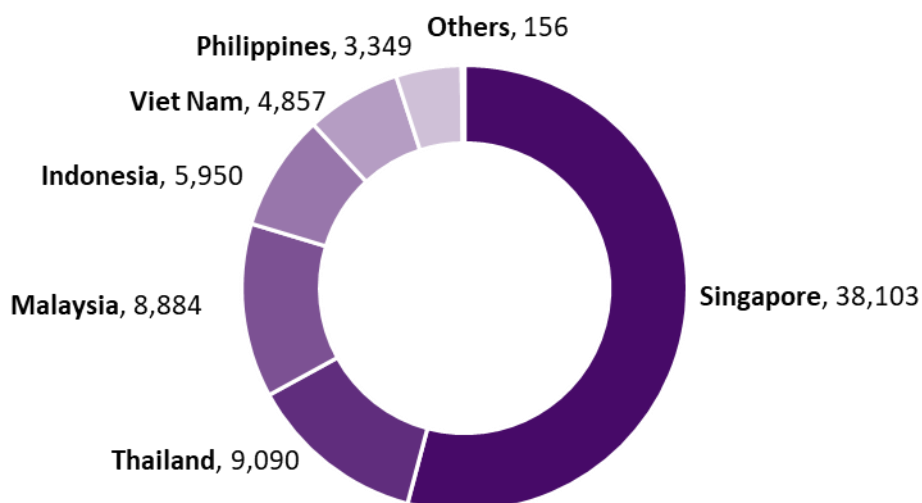
Exhibit 5: Patenting trend by SE Asia applicants, 2013–2022



Note: Data from 2020 onwards are incomplete due to the unavailability of patent data of SE Asia nations and the average 18-month delay between patent filing and publication.

³ ASEAN Main Portal: ASEAN Permanent Committee on Science & Technology. <https://asean.org/our-communities/economic-community/asean-science-technology-and-innovation/>.

⁴ The number of inventions is measured by counts of patent families. A patent family is a group of patents related to the same invention. Analyses based on unique patent families reflect the innovation output more accurately, considering individual patent applications will inevitably involve double counting as a patent family may contain several patent publications if the applicant seeks patent protection for the same invention in multiple jurisdictions.

Exhibit 6: Number of Inventions by SE Asian countries, 2013–2022

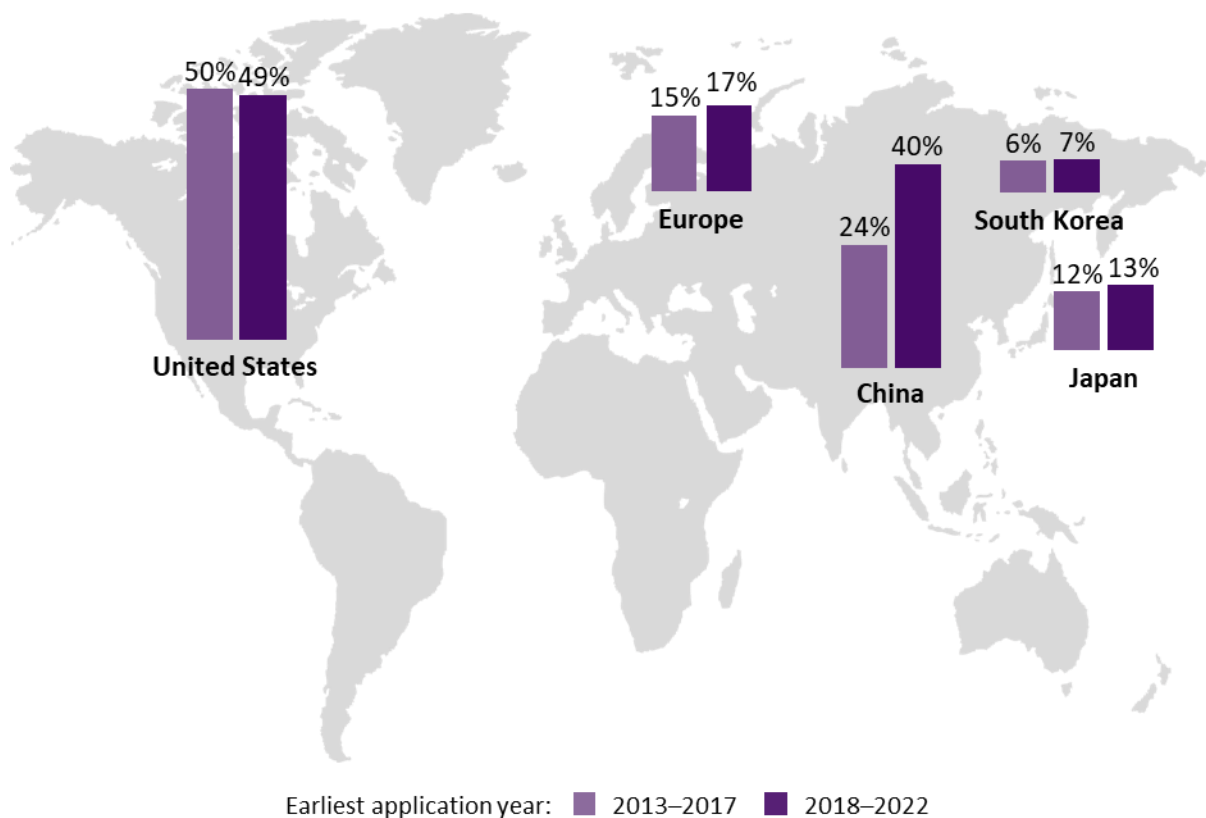
Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam have emerged as SE Asia’s leading innovation centres. Collectively, these six nations constitute an innovation powerhouse, contributing an impressive 99.8% of all inventions originating from the region (**Exhibit 6**). This strength in innovation is supported by national initiatives and substantial investments in science and technology. For instance, Singapore, the frontrunner with 38,103 inventions, has instituted the Research, Innovation, and Enterprise 2025 budget plan (RIE2025), earmarking \$25 billion Singapore dollars from 2021 to 2025—a significant increment from the preceding five-year RIE plan.⁵ Similarly, Malaysia has introduced its National Policy on Science, Technology, and Innovation (NPSTI) 2021–2030 to guide its STI endeavours. The NPSTI includes ten Science, Technology, Innovation, and Economy acceleration programs, aiming to reach a Gross Expenditure on R&D (GERD) target of 3.5% by 2030.⁶

⁵ The National Research Foundation. *RIE Ecosystem*. <https://www.nrf.gov.sg/rie-ecosystem/ecosystem/>.

⁶ Ministry of Science, Technology and Innovation, *National Policy on Science, Technology, and Innovation (NPSTI) 2021–2030*

The US has consistently been the leading market of interest, with nearly half of the inventions originating from SE Asia seeking patent protection within its borders (**Exhibit 7**). This highlights the enduring allure of the US as a hub for commercialising and protecting innovative ideas. However, China's emergence as an attractive market is noteworthy, with a substantial surge from 24% of SE Asia's patent interests in 2013–2017 to 40% in the following five years (2018–2022). This rise underscores China's growing influence and the pivot of SE Asia innovators towards this new epicentre of technology and manufacturing. The European and Japanese markets also command significant attention from SE Asia patent seekers, attracting 17% and 13%, respectively, of SE Asia inventions in 2018–2022. In addition, South Korea stands out as an important market of interest, attracting 7% of SE Asia's inventive output filed in 2018–2022.

Exhibit 7: Top five jurisdictions of SE Asia originated inventions



Note: The cumulative percentage of patent protections may exceed 100%, as patent protection for one invention may be sought in multiple jurisdictions.

Exhibit 8: Top innovators of the top six SE Asian countries, 2013–2022

Singapore	Malaysia
Lenovo Singapore [4,120]	Intel Malaysia [666]
AAC Tech [3,206]	MIMOS [551]
Avago Tech (Singapore) [1,727]	Uni Malaya [369]
Agency Sci Tech Research [1,693]	Motorola [306]
National Uni Singapore [1,395]	Uni Teknologi Malaysia [199]
MediaTek Singapore [1,210]	Uni Putra Malaysia [198]
Nanyang Tech Uni [1,030]	Petroliam Nasional Berhad [197]
Alibaba Singapore [926]	Uni Kebangsaan Malaysia [163]
Marvell Asia [824]	PixArt Imaging [153]
GlobalFoundries Singapore [751]	Uni Teknologi PETRONAS [127]
Thailand	Indonesia
National Sci Tech Dev Agency [1,112]	Lembaga Ilmu Pengetahuan Indonesia [532]
Hoya (Thailand) [339]	Uni Gadjah Mada [312]
Siam Cement Group [295]	Uni Brawijaya [309]
Chulalongkorn Uni [269]	Uni Indonesia [289]
Honda Motor (Thailand) [204]	Uni Negeri Surabaya [225]
PTT Public [189]	Inst Teknologi Bandung [217]
Thailand Inst Sci Tech Res [171]	Inst Pertanian Bogor [176]
Thailand Research Fund [166]	Inst Teknologi Sepuluh Nopember [140]
Mahidol Uni [156]	Uni Airlangga [103]
King Mongkut's Uni Tech [143]	Uni Andalas [101]
Viet Nam	Philippines
Viettel [244]	STMicroelectronics Philippines [58]
Viet Nam Academy Sci Tech [210]	NCR Corp Philippines [57]
FPT Group [70]	Astec International Philippines [56]
Hanoi Uni Sci Tech [66]	Lexmark International Philippine [44]
Viet Nam National Uni, Hanoi [52]	Samar State Uni [41]
Samsung Electronics Viet Nam [51]	De La Salle Uni [28]
Ho Chi Minh City Uni Tech [43]	International Rice Research Inst [26]
BUSADCO [34]	Uni Philippines Los Baños [26]
Viet Nam National Uni, Ho Chi Minh City [31]	Surigao del Sur State Uni [21]
Ton Duc Thang Uni [28]	Batangas State Uni [20]

The innovation landscape in SE Asia is characterised by a dynamic blend of prominent local institutes of higher learning and international corporations (**Exhibit 8**). National research institutes also play an instrumental role in SE Asia's research and development (R&D), serving as central pillars in advancing national science and technology. In Singapore, the Agency for Science, Technology and Research accumulated a total of 1,693 inventions from 2013–2022. The National Science and Technology Development Agency of Thailand is another innovation powerhouse, with 1,112 inventions. Other significant contributors include Malaysia's MIMOS Berhad, the Indonesian Institute of Sciences, and the Viet Nam Academy of Science and Technology.

MNCs are drawn to establish research and business operations in this thriving innovation ecosystem. Rich talent pools from leading local research institutes attract foreign companies to set up regional R&D facilities, contributing to the inventions from the region.

Global players like Alibaba, Intel, and Honda Motor have established strategic outposts in SE Asia to leverage the region's abundant talent and conducive business environment. Other companies, such as AAC Tech, a provider of sensory experience solutions based in Shenzhen, China, with over 18 R&D centres worldwide, are also drawn to the region for its favourable business conditions.

Southeast Asia is also a fertile ground for nurturing homegrown enterprises that have gained international acclaim across various sectors. A prime example is Thailand's Siam Cement Group, with 295 inventions. Its innovative endeavours stretch across construction, chemicals, and packaging, underlining its diversified industrial capabilities. Another luminary is Viet Nam's Viettel, with a portfolio of 244 inventions. Viettel has earned the title of the most valuable telecommunications brand in SE Asia and is currently ranked 17th globally.⁷ Malaysia's Petrolia Nasional Berhad (PETRONAS) has demonstrated its innovative edge with 197 inventions. Approaching its half-century mark, PETRONAS has cemented its status as a leading global energy group, consistently ranking within the upper echelons of the Fortune Global 500.⁸ In the energy sector, Thailand's PTT Public Company Limited has 189 inventions. This multinational conglomerate operates across an extensive range of energy-related businesses, including power generation, renewable energy, and alternative fuels. Meanwhile, Viet Nam's FPT Group has built a name for itself as an innovator in technology and IT services, with 70 inventions. It excels in delivering cutting-edge IT solutions and services on a global scale.

⁷ Vietnamplus, *Viettel named most valuable telecoms brand in Southeast Asia*, 2023

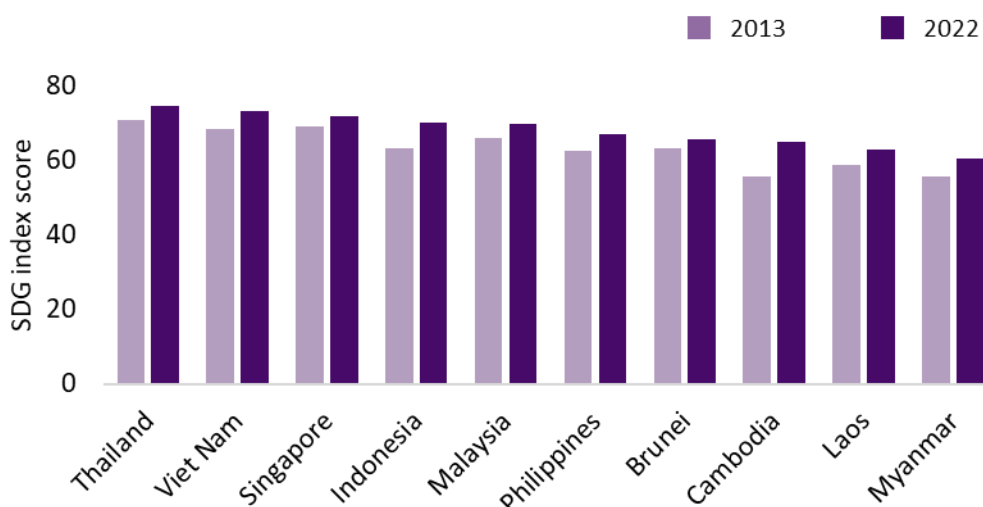
⁸ Fortune, *Global 500*

Technological Innovation and Sustainability

The nations in SE Asia have placed increasing emphasis on aligning their efforts with the SDGs, recognising the urgency of addressing global challenges such as poverty, climate change, and sustainable economic growth. This commitment is evident across the SE Asian countries despite being in different stages of economic development.

Leveraging technological advancements is pivotal in advancing the SDGs within the SE Asia region, with each nation showing improvements in its SDG index score from 2013 to 2022 (**Exhibit 9**). Notably, the top-scoring SE Asian countries are also leading innovators in the region, indicating a strong correlation between innovation and sustainable development. These countries harness technological advancements and innovative solutions to tackle pressing challenges in infrastructure, healthcare, medical technology, and climate change. By prioritising innovation coupled with sustainable practices, they not only bolster their socio-economic standings but also make substantial contributions to the region's collective advancement.

Exhibit 9: SE Asia country sustainable development goal (SDG) index score⁹



⁹ Sachs, J.D., Lafortune, G., Fuller, G., Drumm, E., *Sustainable Development Report 2023: Implementing the SDG Stimulus*.

Technology Categorisation

This report examines the innovation trajectory of SE Asia through its inventions from the past decade (2013–2022) into five technology sectors and 35 fields.¹⁰ It also gauges the “relative recency”¹¹ of these technologies—a metric of development timeline—to reveal SE Asia’s innovation focal points (**Exhibit 10**).

The report outlines three prominent technology clusters within SE Asia’s innovation landscape, assessing their pace of innovation in relation to global trends and their impact on advancing SDGs.

The first cluster includes digital technologies—such as Computer Technology, Digital Communication, Telecommunications, and IT Management Methods—where SE Asia’s innovation activity is well-aligned with global movements.

The second cluster highlights Medical Technology, a technology field in which SE Asia’s relative innovation efforts are particularly pronounced.

Finally, the third cluster identifies the fields of Pharmaceuticals, Chemical Engineering, and Basic Materials. In these fields, SE Asia not only places a higher relative emphasis on innovation but also demonstrates notable recency.

¹⁰ The categorisation of inventions to technology sectors and domains was performed using the IPC and Technology Concordance developed by the World Intellectual Property Organization.

¹¹ The “Relative Recency” is a proprietary metric developed by IPOS International. See Annex A: Methodology

Exhibit 10: Comparison of SE Asia and global inventions, 2013–2022.



Note: The size of each bubble represents the number of inventions in the particular technology field. Different scales were used for SE Asia and the world due to the much larger volume of world data; each group’s bubble sizes are only relative to themselves.

Digital Technologies

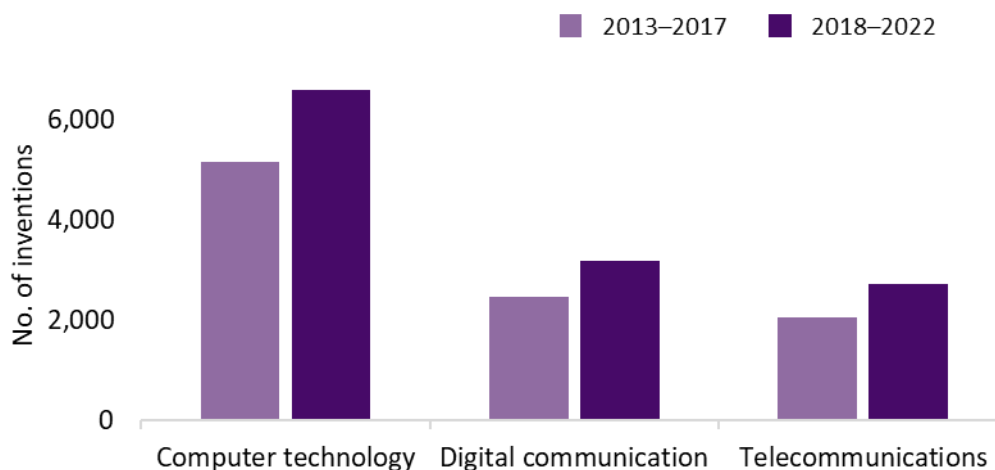
Overall Innovation Trend

Digital technology inventions stand out both in terms of volume and recency within SE Asia, which is in line with global trends. These include inventions in Computer Technology, Digital Communication, and Telecommunications (**Exhibit 10**). There has been a marked increase in the number of inventions filed within these technology fields compared to the volume of inventions from the most recent five years to those from the five years prior (**Exhibit 11**).

Computer Technology has the most substantial growth, with the number of inventions increasing from 5,179 in 2013–2017 to 6,598 in 2018–2022. Digital Communication has also shown progress, increasing to 3,192 inventions in 2018–2022. Telecommunications, while smaller in volume compared to the other two fields, has shown an uptick, reaching 2,725 inventions. These increases across the board highlight a vibrant and growing digital innovation environment, which forms the foundation of SE Asia’s burgeoning digital economy, projected to reach \$2 trillion by 2030.¹²

Acknowledging the pivotal role of digitalisation, SE Asian nations have been proactive in developing key policies and frameworks to enhance digital collaboration among themselves. Notable initiatives include the ASEAN Digital Masterplan 2025, the Master Plan on ASEAN Connectivity 2025, and the Digital Economy Framework Agreement (DEFA).

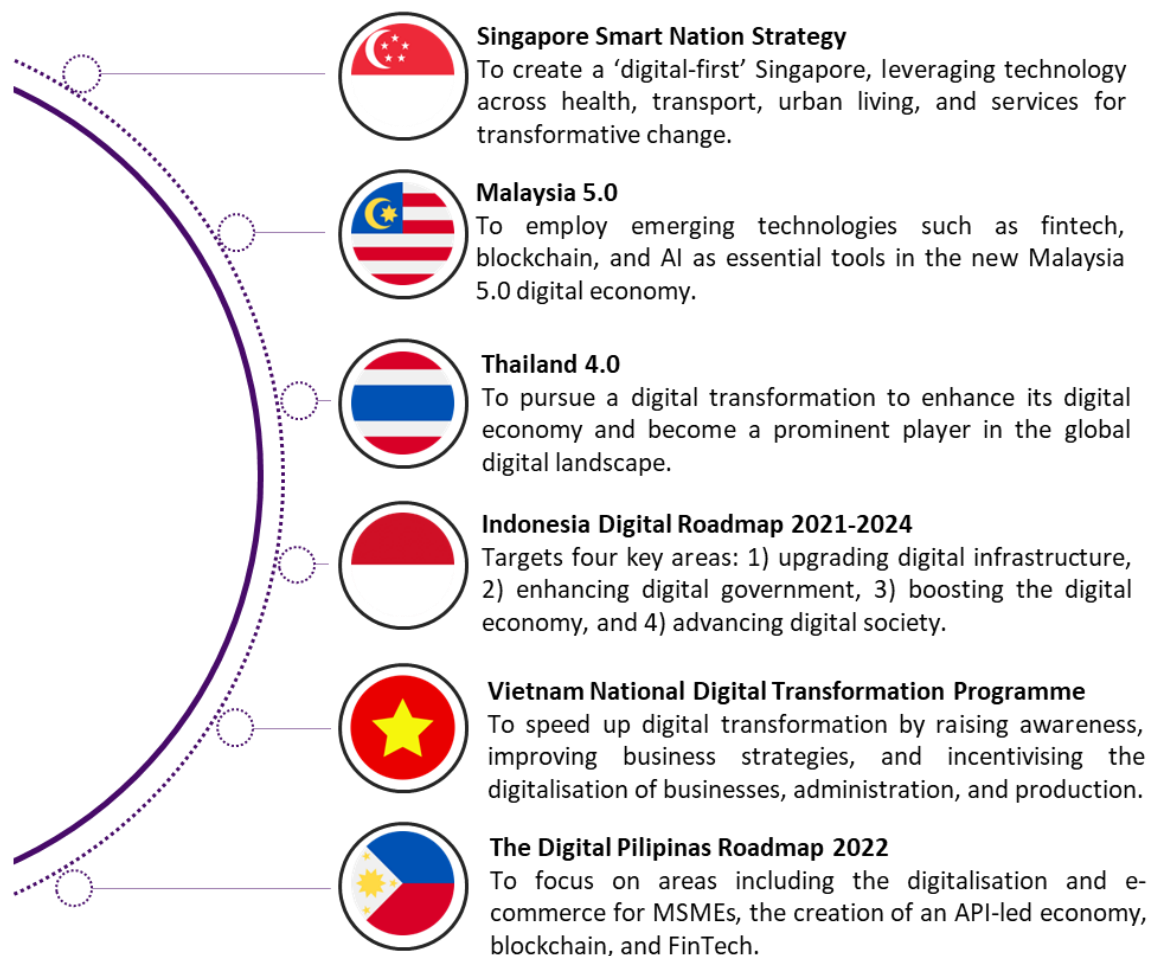
Exhibit 11: Comparison of SE Asia’s digital technology inventions, 2013–2017 vs. 2018–2022



¹² The Business Times, ‘Game changer’ agreement to unlock Asean’s potential US\$2 trillion digital economy, 6 Sep 2023.

Beyond regional collaboration, SE Asia nations are individually advancing digital innovation and adoption (**Exhibit 12**). Singapore’s Smart Nation Strategy encourages a digital-first mindset across sectors such as health and transport. Malaysia 5.0 leverages FinTech, blockchain, and AI to promote a sustainable economy essential for digital transformation. Whereas Thailand 4.0 aims for industrial transformation to spur economic growth and environmental sustainability. Indonesia’s Digital Roadmap 2021–2024 accelerates digital infrastructure and services development, which supports its startup ecosystem with initiatives like NextICorn. Viet Nam’s National Digital Transformation Programme focuses on digitalising business, governance, and production, encouraging shifts in awareness and strategy. The Philippines’s Digital Pilipinas Roadmap 2022 is aimed at addressing significant challenges through technology, focusing on several priority areas, including the digitalisation and e-commerce for micro, small, and medium enterprises (MSMEs), the creation of an application programming interface (API) economy, micro education, and certification on the blockchain, as well as developments in FinTech.

Exhibit 12: Examples of national-level digitalisation plans in SE Asia

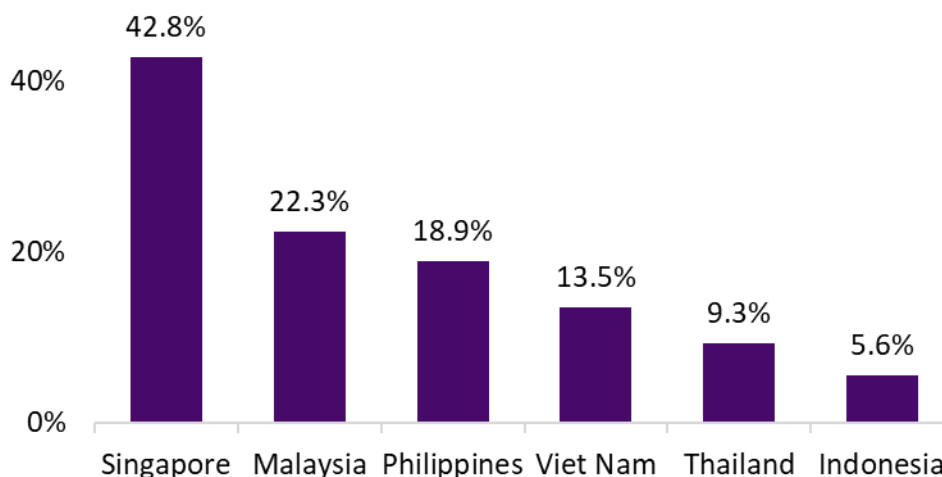


Innovation Trend by Country

Singapore leads in digital technology innovation, with about 40% of its inventions being related to digital technology when compared to other countries in the region (**Exhibit 13**). Malaysia and the Philippines follow closely in second and third place, respectively, with Viet Nam also making notable strides. Thailand and Indonesia each have a relatively modest share of digital technology-related inventions in their total innovation portfolios.

The regulatory climate is the most important factor for these differences, as leading nations like Singapore and Malaysia actively advance digital integration through innovation, intellectual property rights, digital skills and talent acquisition, cybersecurity, digital payment systems, and logistics infrastructure. This creates an environment ripe for digital progress.¹³ Additionally, the urban-rural digital divide accentuates these disparities. Aside from Singapore, Malaysia, and Brunei, rural dwellers constitute over 40% of the populace in other SE Asia nations. Even with extensive internet availability and mobile device access, digital savviness beyond basic social media interaction is often limited in rural areas, impeding wider digital engagement and transformation endeavours.¹⁴

Exhibit 13: Proportion of digital technology inventions relative to the total number of inventions by country, 2013–2022



¹³ United States Agency for International Development, *ASEAN digital integration index: Measuring digital integration to inform economic policies*, Aug 2021.

¹⁴ CNBC, *Southeast Asia's digital economy may be set to hit \$1 trillion, but roadblocks remain*, 31 May 2023.

Applications

Digital technology is an umbrella term for a wide range of tools, systems, and processes that use digital information and communication technologies. This includes hardware, software, network infrastructure, and data processing techniques. Key digital technologies feature AI, cloud computing, the Internet of Things (IoT), blockchain, and data analytics.

Digital technology applications are the practical deployments of these technologies to meet specific challenges or fulfil particular goals. They transform digital technologies into real-world solutions, products, or services, adding value for individuals, enterprises, or society. Examples of such applications include E-commerce websites, mobile payment services, smart city frameworks, digital medical solutions, and virtual education platforms.

The rise of digital technology applications marks a pivotal change in the digital economy, led by progress in digital connectivity and capabilities. Although SE Asia has seen substantial innovation in digital technologies, with 18,500 inventions, the applications of these technologies are less explored, accounting for a modest 3,000 inventions. The ongoing advancement of digital infrastructure and skills is essential and lays the foundation for the broad uptake of digital solutions across diverse industries.

These application-related inventions were significantly driven by commercial interests, with substantial involvement from both MNCs and indigenous firms. These entities have each amassed extensive portfolios of inventions (**Exhibit 14**); major international players like Mastercard Asia Pacific, Alibaba, Lenovo, NCR Corp, Motorola, and Intel have significantly contributed to the region's digital application landscape. Their wealth of experience and expertise in digital technology have been crucial in spurring innovation within SE Asia. Similarly, local enterprises have been instrumental in regional innovation by developing customised solutions based on their native understanding of SE Asian markets.

Exhibit 14: Top SE Asia innovators in digital technology applications, 2013–2022

Singapore	Rest of SE Asia
Mastercard Asia Pacific [169]	MIMOS (Malaysia) [40]
Alipay Labs Singapore [116]	NCR Corp (Philippines) [28]
Alibaba Singapore [95]	Motorola (Malaysia) [27]
Lenovo [110]	National Sci Tech Dev Agency (Thailand) [18]
Grab [67]	Intel (Malaysia) [11]

Digital Technologies and SDGs

Digital technologies are at the heart of achieving the SDGs, particularly SDG 9 (Industry, Innovation, and Infrastructure). The World Intellectual Property Organization underscores this connection, revealing that over 20% of Digital Communication inventions directly contribute to SDG 9.¹⁵ Computer Technology and Telecommunications intersect strongly with SDG 9, albeit with a slightly smaller percentage of related inventions. This connection between digital innovation and sustainable development emphasises the indispensable role of technology in creating resilient infrastructure, promoting inclusive industrialisation, and driving innovation across SE Asia.

Digital innovations play a crucial role in enhancing infrastructure resilience. Increased connectivity, coupled with the deployment of IoT devices, sensors, and data analytics, transforms infrastructure management by enabling real-time monitoring, predictive maintenance, and timely interventions.¹⁶ This integration strengthens the resilience of critical systems and democratises access to information, resources, and markets, paving the way for a more inclusive and sustainable industrial landscape.

Among the notable players in SE Asia digital technology innovation are Viettel and Telekom Malaysia, with 130 and 44 inventions, respectively. Viet Nam's Viettel has made substantial strides in expanding the nation's digital connectivity, with ownership of Viet Nam's largest 4G network, covering 97% of the population across 42,000 broadcast stations. Transitioning into the 5G era, Viettel became the nation's pioneering 5G carrier in 2020, initiating 5G testing across approximately 500 stations spanning 63 provinces and cities. Similarly, Telekom Malaysia stands as a beacon in Malaysia's digital transformation journey. Initiatives like Jalanan Digital Negara JENDELA and agreements for fibre leasing services with Digital Nasional Berhad highlight its crucial role in enhancing broadband access and the use of the government-owned 5G network.¹⁷

¹⁵ World Intellectual Property Organization, *Mapping Innovation: Patents and the Sustainable Development Goals*, 2024.

¹⁶ AIB, *Investing in Technologies for Climate-Resilient Infrastructure in Asia*, August 2023.

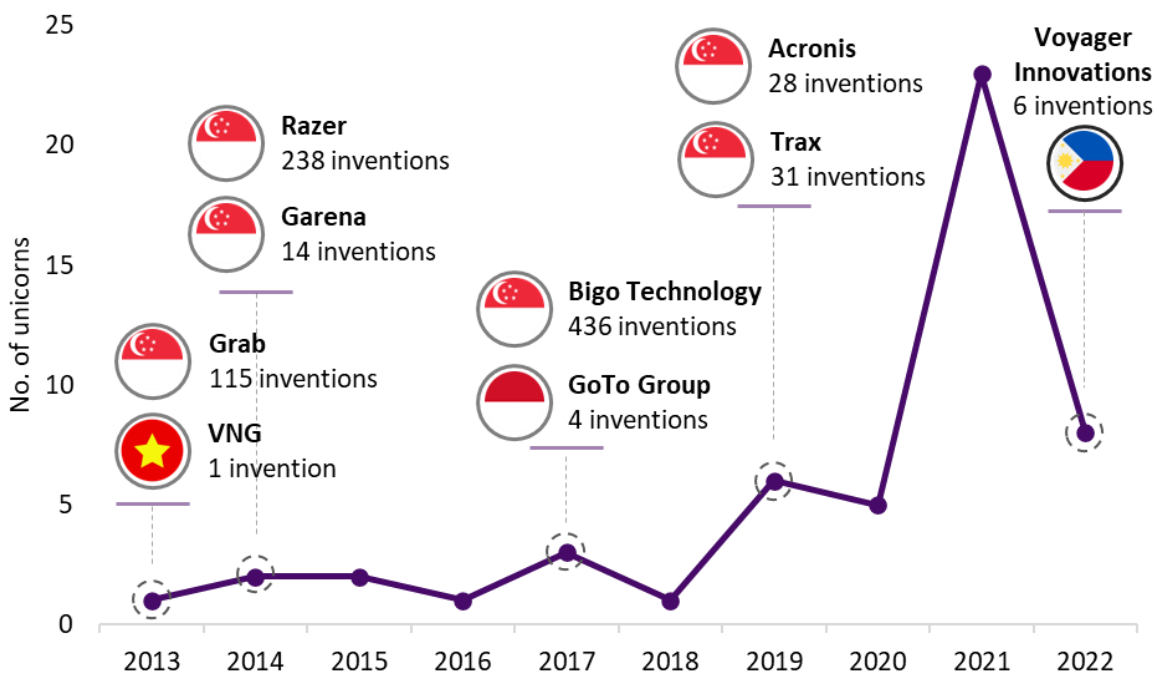
¹⁷ Telekom Malaysia, *The 3 Key Components to Building Malaysia's Future-Ready Network*.



Digital technologies also significantly promote inclusive and sustainable industrialisation, exemplified by the rise of SE Asia’s unicorns (**Exhibit 15**). These companies, evolving from startups to major players in the digital economy, underscore the potential of digital technologies to break through traditional market barriers and create an inclusive and sustainable industrial landscape. Their contributions, ranging from e-commerce to digital finance, support economic growth and provide scalable solutions to societal challenges.

Singapore has harnessed digital technologies to an outstanding extent, hosting unicorns such as Grab, Razer, Garena, Bigo Technology, Acronis, and Trax. Grab, for instance, has expanded its focus from ride-hailing to include food delivery and digital finance, amassing 115 inventions from 2013 to 2022. Indonesia’s GoTo Group, formed from the merger of Gojek and Tokopedia, demonstrates the power of digital innovation in creating equitable opportunities and strengthening the region’s economy. Supported by global investors, GoTo Group drives economic and technological progress, with Gojek notably improving transportation options, supporting one million driver partners, and benefiting SMEs. Viet Nam’s VNG, a frontrunner in digital content and online services, is the country’s first unicorn, underscoring the immense potential of digital innovation in the region. Voyager Innovations, a leading digital payment platform in the Philippines, also highlights the impact of digital technology in providing a comprehensive FinTech ecosystem that allows users to access financial services such as payments, remittances, banking, and insurance.

Exhibit 15: Unicorns minted in SE Asia by year, selected examples and their digital technology invention portfolios, 2013–2022



Source: DealStreetAsia

Digital technologies are also instrumental in advancing SDG 11 (Sustainable Cities and Communities), which aims to make cities and human settlements inclusive, safe, resilient, and sustainable. They have a transformative impact on urban development and management.¹⁸ Through the implementation of smart systems, urban operations can be optimised, resulting in smoother traffic flows and more efficient utility management. This underscores the vital role digital technologies play in urban development in SE Asia, where smart transportation systems can contribute to sustainable mobility by reducing congestion and emissions.¹⁹ An illustrative case of such innovation is Singapore's Eutech Cybernetic, renowned for its commitment to sustainable urban development. Through its iViva platform, Eutech merges information technology, operational technology, and IoT. This integration has been crucial in projects like One Bangkok, which not only achieved a Green Mark Platinum rating but also improved the operational efficiency of Medina City through digitalisation. Through intelligent infrastructure solutions, including advanced energy grids and waste management systems, cities enhance their resilience to environmental challenges and climate change, paving the way for more sustainable and liveable urban environments.²⁰

In addressing climate change and supporting SDG 13 (Climate Action), digital innovations enable data-driven strategies, environmental monitoring, and the promotion of sustainable practices across SE Asia. Technologies such as remote sensing, satellite imagery, and GIS provide essential data on climate patterns and environmental changes, which are crucial for climate action and policy. Data analytics and predictive modelling aid in climate risk assessment and preparedness, while IoT and smart grids optimise resource use and bolster infrastructure against climate-related threats. These innovations are crucial for global efforts to combat climate change and build resilient communities and ecosystems.

Finally, digital technologies play a significant role in promoting SDG 3 (Good Health and Well-being), transforming healthcare delivery across SE Asia. Telemedicine platforms, mobile health apps, and wearable devices enable remote healthcare services and increase access to medical advice and treatments, especially in remote or underserved communities.²¹ This digital transformation aligns with SE Asia's commitment to universal healthcare, fostering collaboration to enhance health equity and enable data-driven healthcare solutions. By improving healthcare accessibility, efficiency, and quality, digital innovations contribute to achieving SDG 3's goals, including reducing mortality rates, combating infectious diseases, and promoting universal health coverage.

¹⁸ Diplo, *Digital technology for the sustainable development goals*, June 2023.

¹⁹ McKinsey, *Infrastructure technologies: Challenges and solutions for smart mobility in urban areas*, March 2023.

²⁰ McKinsey, *Smarter cities are resilient cities*, January 2019.

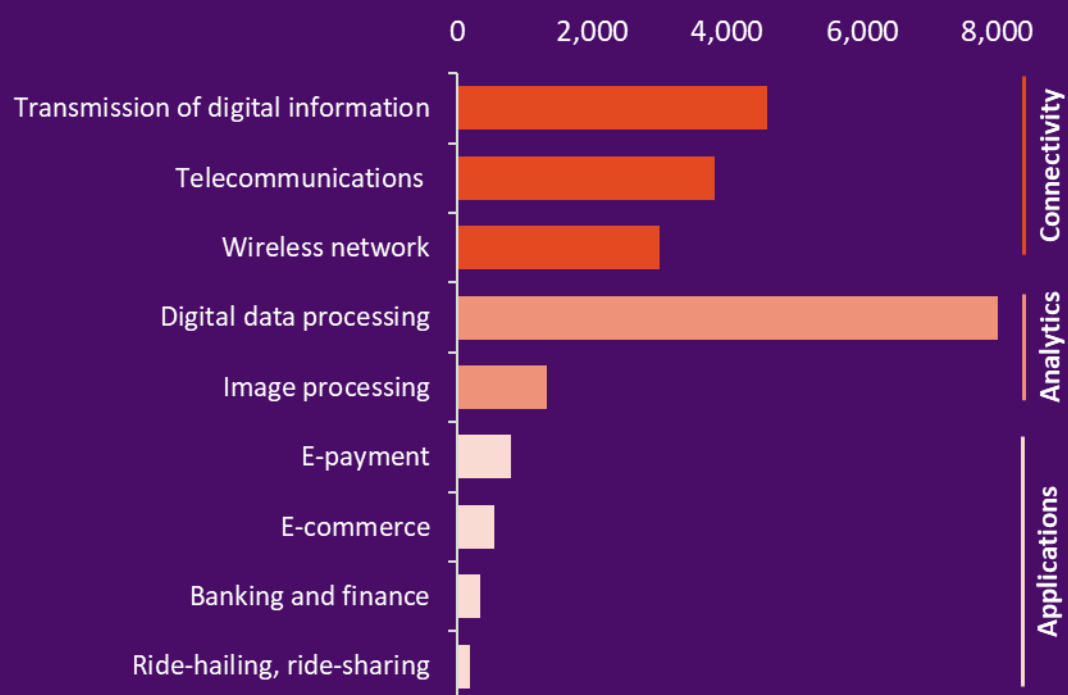
²¹ ASEAN Business Partners, *The Rise of Telemedicine And E-Pharmacy in Southeast Asia*, 2022.

Spotlight: Singapore's Digital Prowess: Innovating for a Smart Future

Singapore leads the way in digital competitiveness, consistently demonstrating excellence in various knowledge and technology aspects, such as proficiency in technology skills and access to high-speed internet and comprehensive wireless broadband services. With its extensive digital infrastructure, Singapore is a global powerhouse in digital innovation, with the potential to catalyse economic growth through digitalisation across multiple sectors.

The city-state's exceptional connectivity and analytical capabilities are at the heart of its digital innovation achievements. Over the past decade, there has been a significant increase in digital and image processing innovations, evidenced by approximately 9,000 inventions filed (**Exhibit 16**). Singapore's prowess in artificial intelligence (AI) research and development, ranking third globally, is supported by local research institutions recognised among the top 20 for their highly cited AI research papers. This emphasis on analytics and AI not only cements Singapore's status as a digital innovation leader but also lays the groundwork for future growth in the digital era.

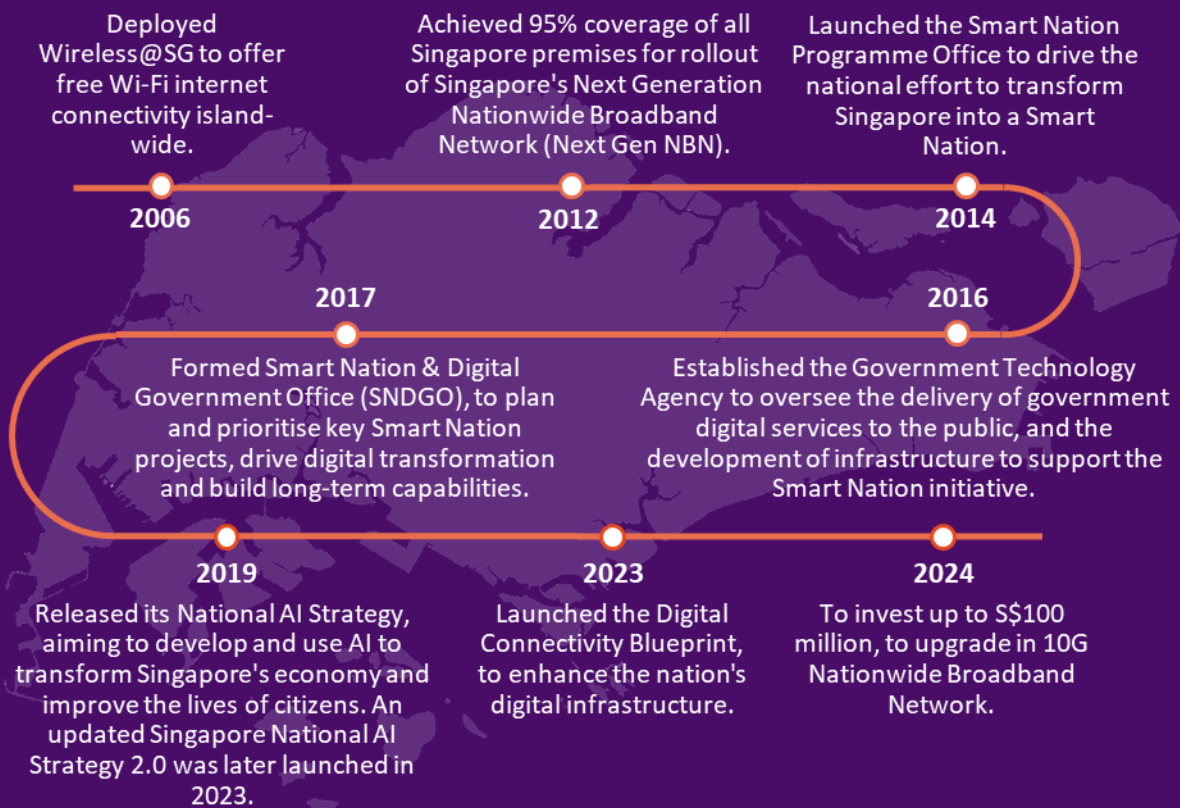
Exhibit 16: Singapore innovation focus on digital technologies



Singapore's commitment to connectivity is evident through approximately 7,500 inventions in digital information transmission, telecommunications, and wireless networks. By advancing its Smart Nation initiative (**Exhibit 17**), the city-state leverages technology to transform daily life and business practices. Its leading-edge digital connectivity infrastructure includes being the central hub in Asia for ICT, connecting through 25 active submarine cables,²² with the world's fastest fixed broadband speed,²³ and achieving an impressive mobile penetration rate of 164%.²⁴ Singapore's digital infrastructure supports the fastest download and upload speeds in SE Asia and houses 60% of Asia Pacific's data centres,²⁵ reinforcing its position as a global digital hub.

Singapore's progress in digital technologies spans a diverse range of application areas, with 2,000 inventions dedicated to digital technology applications in fields such as e-payments, e-commerce, banking, finance, and ride-hailing services. This broad spectrum of digital innovations not only reinforces Singapore's role in leading global technology development but also aligns with the SDGs by promoting economic growth, creating sustainable cities, and fostering innovation across sectors.

Exhibit 17: Key milestones of Singapore's Smart Nation Programme



²² TeleGeography, *Submarine Cable Map: Singapore*.

²³ Speedtest, *Speedtest Global Index*, Dec 2022

²⁴ Infocomm Media Development Authority, *Statistics on Telecom Services for 2022 Jul-Nov*

²⁵ International Trade Administration, *Singapore New Data Centers*, Nov 2022

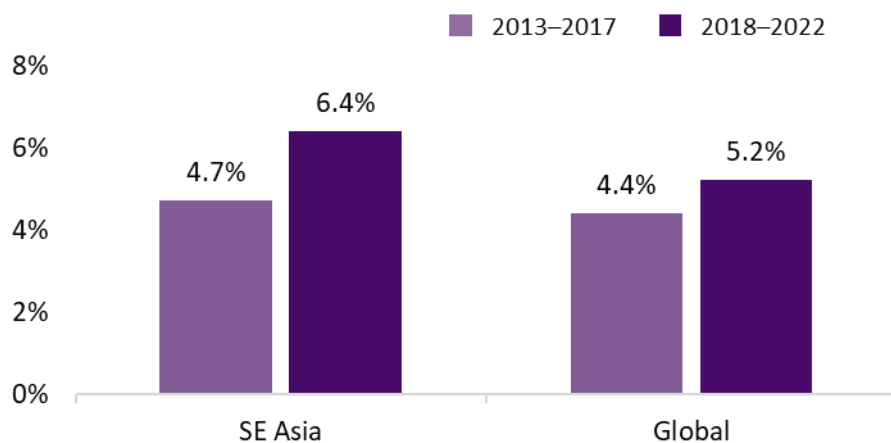
Medical Technology

Overall Innovation Trend

Medical technology is gaining significant attention, particularly in SE Asia, where there is a stronger focus compared to the global trend (**Exhibit 10**). Among the different technology fields under the Instruments sector, medical technology stands out with the highest innovation volume and relative recency in SE Asia, reflecting the region's concerted effort to address healthcare challenges and improve patient outcomes.

From 2018 to 2022, SE Asia witnessed a remarkable upswing in the development of medical technology when compared with 2013–2017. The proportion of inventions in this field rose to 6.4% of the total number within the region (**Exhibit 18**). This boost is more pronounced than the global trend, which increased from 4.4% to 5.2% over the same periods.

Exhibit 18: Comparison of the percentage share of portfolio relating to medical technology between SE Asia and the world, 2013–2017 vs. 2018–2022



Notably, SE Asia's increasing urbanisation rate²⁶ has led to concentrated healthcare challenges in densely populated urban areas that require innovative solutions related to healthcare access, diagnostics, and treatment.²⁷ The region is also experiencing a rapid expansion of its middle class, resulting in increased health awareness and a surge in demand for quality healthcare services and cutting-edge medical technologies.²⁸ To complement these societal shifts, SE Asia countries are investing significantly in healthcare infrastructure, including hospitals, clinics, and research centres, which creates an environment conducive to the development and adoption of medical technology.²⁹

Economic considerations underscore the importance of the medical technology industry as a vital economic booster for SE Asia countries. For instance, Singapore's MedTech sector contributed S\$13.3 billion to its economy in 2018, demonstrating its substantial economic impact.³⁰ Similarly, Malaysia views pharmaceuticals and medical device manufacturing as robust industrial bases with substantial growth potential.³¹

Despite being a major importer of medical devices,³² SE Asia recognises the importance of strengthening domestic development and production capabilities to avoid shortages. The global mask shortage during the COVID-19 pandemic serves as an example of the region's vulnerability to disruptions in the global supply chain. Factories in China, the primary supplier of the world's surgical mask supply, faced disruptions, prompting a critical need to reduce dependency and enhance domestic manufacturing capabilities within the region. This imperative emphasises SE Asia's commitment to fostering a resilient and self-reliant medical technology ecosystem to better address the evolving healthcare needs of its population.

²⁶ ASEAN, *ASEAN Statistical Highlights*, 2022

²⁷ Mihajlo Jakovljevic, et al., *Asian innovation in pharmaceutical and medical device industry – beyond tomorrow*, *Journal of Medical Economics*, 24:sup1, 42-50, 5, 2021

²⁸ Allurentis, *Investing in ASEAN*, 2015

²⁹ Healthcare Asia Magazine, *Southeast Asian hospitals prioritise investment over staff safety–study*, Feb 2024

³⁰ The Business Times, *Greater support for medtech firms in Singapore to thrive*, 11 Nov 2019

³¹ CodeBlue, *Malaysia's New Industrial Master Plan Targets High-Value Pharmaceuticals, Medical Devices*, 1 Sep 2023

³² Medical Manufacturing Asia, *A MedTech Boom in Southeast Asia*, 2024

Countries in SE Asia have made notable progress in advancing medical technology, particularly in ensuring healthier lives and promoting well-being for all ages. Leading this charge is Singapore, which has made significant strides in medical technology development within the region. With a total of 2,161 inventions and accounting for 61% of the total innovations in SE Asia (**Exhibit 19**), Singapore has played a crucial role in driving advancements in healthcare technology. Meanwhile, the rest of SE Asia has contributed 1,363 inventions, demonstrating collective progress towards improving healthcare outcomes.

Singapore's achievements in medical technology are remarkable and reflect the nation's commitment to improving public health and well-being. Singapore has garnered recognition for its efforts, ranking first in health-related UN goals among 188 countries worldwide.³³ Additionally, the city-state has been acknowledged as the 6th Blue Zone globally, where residents are known for leading long and healthy lives.³⁴ These accolades accentuate the positive impact of Singapore's use of medical technology to improve health outcomes.

Exhibit 19: Top SE Asia innovators in Medical Technology, 2013–2022

Singapore	Rest of SEA
2161 inventions (61%)	1363 inventions (39%)
Singapore	Rest of SEA
Smith & Nephew [254]	National Sci Tech Dev Agency [72]
National Uni Singapore [233]	B. Braun (Malaysia) [61]
Agency Sci Tech Research [154]	Unicharm (Thailand) [39]
Nanyang Tech Uni [117]	Uni Malaya [36]
Singapore Health Services [93]	Chulalongkorn Uni (Thailand) [26]
Leica Instruments (Singapore) [80]	Mahidol Uni (Thailand) [24]
Becton Dickinson (Singapore) [70]	Hoya Lens (Thailand) [23]
ResMed Asia [54]	Top Glove (Malaysia) [20]
Hill-Rom Asia Pacific [46]	Uni Kebangsaan Malaysia [18]
Sivantos (Singapore) [36]	Thammasat Uni (Thailand) [18]

³³ The Straits Times, *Singapore comes up tops on progress in health-related UN goals*, 13 Sep 2017

³⁴ Fortune, *The longevity secrets of Singapore, the 6th blue zone city where people are living the longest, happiest lives*, 29 Aug 2023

The advancement of medical technology in SE Asia is the result of collaborative efforts by various stakeholders. Research institutes, universities, healthcare providers, and medical technology firms, including Smith & Nephew, B. Braun, and Becton Dickinson, have all played crucial roles in driving innovation and encouraging the adoption of medical technologies (**Exhibit 19**).

Homegrown companies like Top Glove have also made valuable contributions to the ecosystem by developing innovative healthcare solutions tailored to local needs. Founded in 1991 and based in Malaysia, Top Glove Corporation Bhd is the world's largest manufacturer of gloves, commanding a substantial 26% share of the global rubber glove market.³⁵ Over its three-decade history, Top Glove has been steadfast in its response to various disease outbreaks, including H1N1 influenza, SARS, Ebola, and the HIV/AIDS epidemic.

Amidst the COVID-19 pandemic, Top Glove intensified its efforts to meet the growing demand for medical gloves worldwide. With operations spanning 44 factories across the globe, the company maintained round-the-clock production, operating 24 hours a day, seven days a week. This ensured the timely provision of medical gloves to 195 countries. Additionally, Top Glove allocated 185 million ringgits to support the Malaysian government's initiatives to procure COVID-19 vaccines and essential healthcare equipment.³⁶ The company also donated 2.5 million medical gloves to bolster the global fight against the pandemic.³⁷

While actively combating COVID-19, Top Glove is also advancing sustainability in its glove manufacturing processes by engaging in R&D aimed at creating gloves that are not only effective but also environmentally friendly. Notable innovations include the development of an environmentally friendly glove (patent number CN109749299) and the exploration of plant-based glove alternatives (patent number MY196699A). Through these initiatives, Top Glove is able to maintain its position as a global leader in glove production while minimising its environmental footprint.

Together, these stakeholders form a robust ecosystem that promotes the development and adoption of medical technology innovations, benefiting healthcare outcomes across SE Asia.

³⁵ Financial Times, *How the world's largest maker of rubber gloves is coping with COVID*, June 2020.

³⁶ Reuters, *Malaysia's major medical glove companies commit \$97 million to help fight COVID-19*, November 2020.

³⁷ Top Glove, *Top Glove Lends Helping Hand to Support War on Covid-19*, March 2020.

Medical Technology and SDG 3

By advancing medical technology, SE Asia countries are helping to achieve SDG 3, which aims to ensure healthy lives and promote well-being for all ages. Medical technology plays a pivotal role in these efforts, which go beyond conventional treatment and care. Its multifaceted contributions encompass various aspects of healthcare delivery, preventive measures, and patient empowerment.

Both Singapore and the rest of SE Asia have placed strong emphasis on various aspects of medical technology, with some differences in focus (**Exhibit 20**). The principal area of innovation for both Singapore and the rest of SE Asia is ‘Measuring for Diagnostic Purpose.’ This shared priority reinforces the regional commitment to improving healthcare delivery and efficiency using advanced diagnostic tools and treatment modalities.

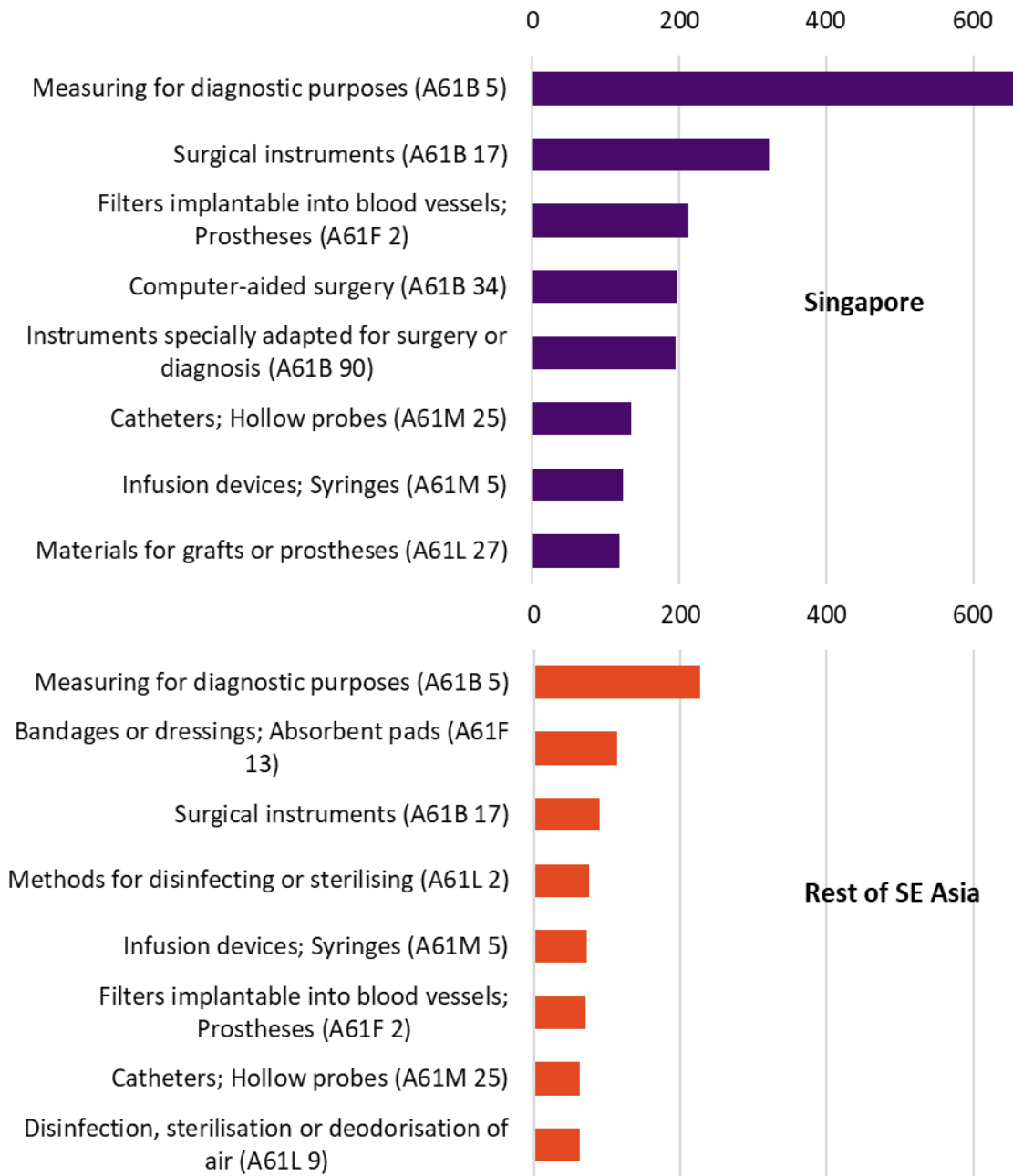
Innovative diagnostics solutions from the region show a concerted effort to improve healthcare practices and outcomes. One example is the collaboration between Malaysia’s Genting Berhad and Singapore’s TauRx Pharmaceuticals through Genting TauRx Diagnostic. They focus on dementia by pioneering the use of tau aggregation inhibitors (TAIs) to impede the progression of cognitive decline linked to tau tangles, as detailed in their patents (patent numbers WO2017/118733 and WO2023/165955).

In Singapore, a collaboration between Singapore Health Services and the National University of Singapore has produced SELENA+, an AI-driven software that swiftly analyses retinal images for signs of diabetic retinopathy (patent numbers WO2016/099402 and WO2019/022663). Following its remarkable success, the innovators behind SELENA+ have moved ahead to commercialise the innovation through EyRIS, a startup aimed at bringing this innovative solution to the global market. This remarkable journey from development to market readiness has also been featured as a case study by prestigious educational platforms – Harvard Business Publishing and The Case Centre, showcasing its impact and potential in transforming healthcare through AI.³⁸

The pandemic spurred regional innovation, with Malaysia’s Biogenes Technologies creating a rapid biosensor for detecting SARS-CoV-2 (patent number WO2022/225388). The University of the Philippines Manila also contributed by developing specialised antibodies targeting specific parts of the virus, thereby improving detection and insight into its behaviour (patent number WO2023/022613). In Singapore, Biobot Surgical and Singapore Health Services developed the SwabBot (patent number WO2021/221566), a robotic device for self-administered nasal swabbing for COVID-19 diagnosis, enhancing the safety and efficiency of testing procedures. These developments highlight the region’s proactive engagement in addressing urgent and complex medical challenges.

³⁸ SingHealth DukeNUS, *Development journey of Singapore eye screening AI system published as teaching case for business students and corporates worldwide*, 2023.

Exhibit 20: Top innovation areas in medical technology by SE Asia innovators, 2013–2022



Advancements in medical technology are making healthcare more accessible, especially in underserved and remote communities. Telemedicine platforms and mobile health apps, such as Singapore's MyDoc, the Philippines' Medgate, Thailand's Doctor Raksa, Malaysia's DoctorOnCall, and Indonesia's Halodoc and Tele Sehat, are bridging the gap between healthcare providers and patients in rural or isolated regions. These innovations are vital where traditional healthcare infrastructure falls short, as seen during the COVID-19 crisis.

Indonesia's Tele Sehat, for instance, has leveraged IoT technology through their ATM Sehat (patent number IDP000079756) to enable routine health assessments and tele-consultations in over 30 villages since its launch in 2021. Such initiatives show a commitment to enhancing healthcare accessibility and convenience.

Sanitation, a key component of SDG 3, has seen SE Asia initiatives like those from Thailand's Siam Cement Group and the Asian Institute of Technology. They have patented an integrated waste treatment system (patent numbers SG10201807200Q and SG10201807199W), crucial for safe waste disposal and resource recovery. This innovation, applied to the Khlong Phlabphla Community, Rama IX, demonstrates the benefits of industry-academia partnerships in advancing public health.

In summary, advancements and investments in medical technology catalyse SDG 3 by improving healthcare access, delivery efficiency, and empowering individuals to take control of their health, while driving innovation in healthcare delivery models. Through continued investment in medical research, technological innovation, and healthcare infrastructure, countries can leverage the potential of medical technology to promote healthier lives and well-being for all individuals, regardless of age, geography, or socio-economic status.



Chemistry

Chemistry-related technologies have emerged as a significant stronghold in SE Asia, constituting the second-largest sector following electrical engineering (**Exhibit 10**). This sector encompasses a diverse range of technology fields, including specific fields such as pharmaceuticals, basic materials chemistry, and chemical engineering. These disciplines serve as critical drivers of innovation and advancement across various industries. The region's strategic prioritisation of pharmaceuticals, chemical engineering, and basic materials chemistry is reflected in the substantial proportion of inventions accumulated over the last decade in these disciplines (**Exhibit 21**), indicating the extensive resources and investments dedicated to advancing these technology fields.

Exhibit 21: SE Asia's top technology fields in the Chemistry sector by country, 2013–2022

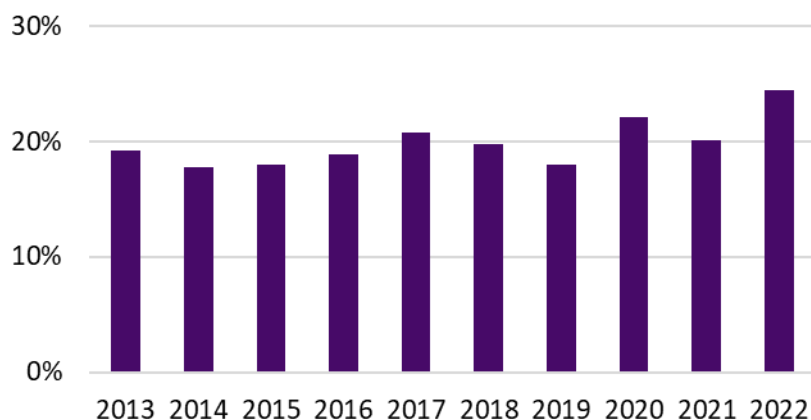
Singapore	Malaysia	Thailand
Pharmaceuticals [1,468]	Basic materials chemistry [509]	Macromolecular chemistry, polymers [560]
Chemical engineering [1,414]	Chemical engineering [361]	Biotechnology [527]
Biotechnology [1,147]	Pharmaceuticals [325]	Basic materials chemistry [502]
Basic materials chemistry [930]	Macromolecular chemistry, polymers [282]	Chemical engineering [482]
Surface technology, coating [791]	Food chemistry [276]	Pharmaceuticals [466]
Indonesia	Viet Nam	Philippines
Food chemistry [820]	Chemical engineering [295]	Food chemistry [200]
Pharmaceuticals [746]	Basic materials chemistry [276]	Chemical engineering [158]
Basic materials chemistry [597]	Environmental technology [275]	Pharmaceuticals [122]
Biotechnology [411]	Pharmaceuticals [268]	Biotechnology [83]
Chemical engineering [333]	Materials, metallurgy [225]	Organic fine chemistry [64]

Pharmaceuticals and SDG 3

Compared with the global trend, SE Asia shows a stronger focus on pharmaceuticals (**Exhibit 10**), reflecting significant regional innovative capacity. This emphasis also highlights the region's commitment to tackling healthcare challenges and promoting public health, with the pharmaceutical industry serving as one of the pillars supporting economic growth and development.

Over the past decade, pharmaceuticals have consistently been a focal point in the SE Asia region (**Exhibit 22**), reflecting the region's commitment to achieving SDG 3. Representing about 20% of all chemistry-related inventions in the region, pharmaceuticals stand out as the largest application area. The pharmaceutical industry plays a crucial role in the region's economy, significantly contributing to its growth and development. In 2022, the revenue generated by the pharmaceuticals market in SE Asia reached US\$16 billion, nearly double the figure recorded in 2016, which stood at US\$8.8 billion.³⁹

Exhibit 22: Percentage share of pharmaceutical inventions contributing to the overall chemistry inventions of SE Asia, 2013–2022



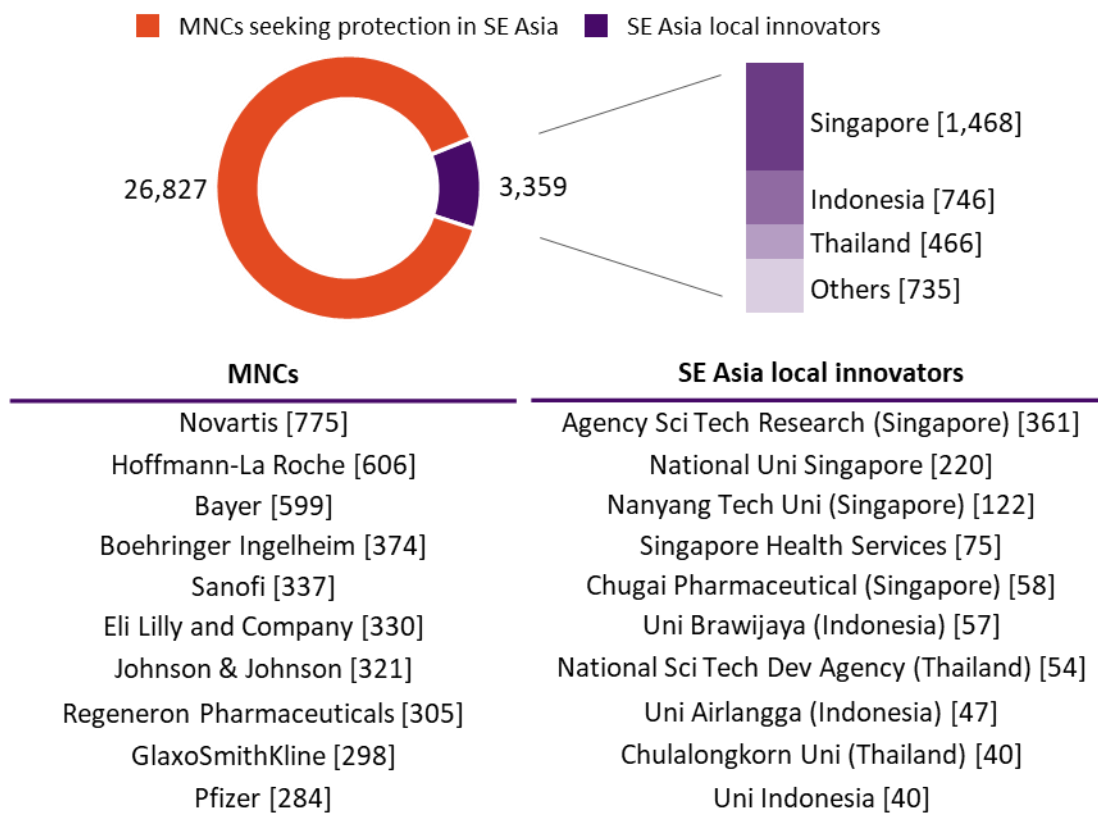
³⁹ Statista, *Pharmaceuticals - Southeast Asia*.

This innovation vigour in SE Asia is driven by the collaborative efforts between international and local entities, as evidenced by the substantial number of inventions filed by both foreign companies active in SE Asia and local innovators from universities and research institutes (**Exhibit 23**). The region's strong research capabilities and skilled talent pool have attracted top pharmaceutical firms to establish R&D and manufacturing hubs here. For example, Singapore is home to facilities for eight of the world's top 10 pharmaceutical companies, such as Novartis, GlaxoSmithKline, and Pfizer, highlighting its position as a key pharmaceutical hub and growing prominence on the global stage.

The collaboration between local research bodies and global pharmaceutical leaders facilitates knowledge exchange and drives the development of innovations catered to the region's specific health needs. These innovations, including drugs, vaccines, and therapies, are vital for advancing treatment across various health issues and achieving SDG 3's objectives to combat diseases and improve health conditions. Additionally, pharmaceutical R&D in the region has led to significant medical breakthroughs, thanks to partnerships between industry leaders and academic entities. These ventures deepen scientific understanding and lead to new healthcare technologies. The commitment to R&D in SE Asia fosters an ecosystem ripe for innovation and supports the region's efforts to address healthcare challenges and fulfil the aims of SDG 3.



Exhibit 23: Top SE Asia Pharmaceuticals-related inventions, 2013–2022



The synergy between local expertise and international collaboration in SE Asia is a catalyst for innovation. For example, Thailand’s National Center for Genetic Engineering and Biotechnology (BIOTEC), a key national research centre under Thailand’s National Science and Technology Development Agency, has partnered with Novartis in drug discovery research for over a decade. Since 2005, BIOTEC has leveraged its capabilities in microbiology and Novartis’ strengths in global compound development. Together, they focus on exploring therapeutic applications for microorganisms and natural compounds, underlining a strategic push for novel medical solutions.

Another example is BioNet-Asia, a leading biotech company in Thailand focusing on vaccine development, manufacturing, and distribution. Founded by executives with extensive experience in major pharmaceutical firms like Sanofi, Novartis, and GlaxoSmithKline, BioNet-Asia prioritises research and innovation. The company has forged strong partnerships with renowned universities and government research bodies, notably collaborating with Mahidol University to develop the recombinant monovalent pertussis vaccine (Pertagen®), effectively combating whooping cough.

In Singapore, the collaboration between local research bodies and international companies is exemplified by Chugai Pharmaceutical's research institute, Chugai Pharmabody Research. Since 2012, it has tapped into Singapore's rich talent and robust intellectual property regime. The institute's collaboration with Singapore's Agency for Science, Technology and Research (A*STAR) has yielded significant projects, such as developing antibody drugs for dengue and therapies for COVID-19 (patent number SG10201607778X and WO2022/139680), strengthening its position as a pivotal player for drug discovery in the region.

Indigenous firms like Indonesia's PT Kalbe Farma Tbk also play a central role. Founded in 1966 and now a leading pharmaceutical company in Southeast Asia, Kalbe engages in diverse research areas, from anaemia treatments to synthetic bone grafting. Their partnership with Roche to introduce genomic profiling for cancer therapy in Indonesia exemplifies local firms' capability to bring cutting-edge services to the SE Asia market.

Unique in its approach, the Philippines prioritises local collaborations to advance healthcare innovation. The University of the Philippines Manila (UPM) has partnered with Pascual Laboratories, a distinguished local pharmaceutical company with a legacy exceeding 70 years, focusing on research and development for anti-diabetic drugs (patent example PH22020050513). UPM has also partnered with Herbanext Laboratories, a company specialising in medicinal plant extracts, to pioneer treatments for hypertension (patent example PH22020050509).

These initiatives reflect SE Asia's forward-looking approach to pharmaceutical research, supporting SDG 3. By combining local insights with global partnerships and a commitment to R&D, SE Asia nations are enhancing healthcare access, improving treatment outcomes, and bolstering health and well-being across the community, mirroring the goals set forth in SDG 3.

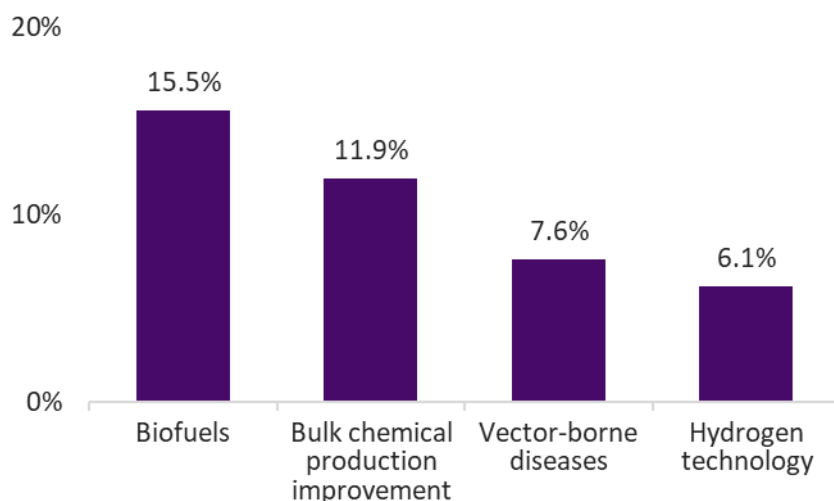
Chemical Engineering and Basic Materials Chemistry

Chemical engineering and basic materials chemistry are two technology fields where countries in SE Asia have made substantial breakthroughs (**Exhibit 10**), amassing about 5,500 inventions from the period 2013–2022. Notably, one in every 10 of these inventions focuses on combating climate change, encompassing major areas like biofuels, bulk chemical production improvement, vector-borne diseases, and hydrogen technologies (**Exhibit 24**).

Biofuels, occupying 15.5% of SE Asia’s inventions in climate change technologies, are derived from renewable biomass sources. They serve as a sustainable alternative to fossil fuels, reducing greenhouse gas emissions and mitigating climate change. Following closely at 11.9%, advancements in bulk chemical production methods aim to enhance efficiency and reduce environmental impact, contributing to sustainable manufacturing practices. Vector-borne disease control strategies, comprising 7.6% of the dataset, are crucial for addressing health challenges associated with climate change. Hydrogen technology development and application, which comprises 6.1% of the dataset, is essential for transitioning towards clean energy sources and reducing carbon emissions. Hydrogen fuel cells offer a clean and efficient energy alternative for various sectors, including transportation and power generation.

These innovative solutions, which draw on the strengths of chemical engineering and basic materials chemistry to combat climate change and its impact, contribute to the objective of SDG 13. In doing so, they play a pivotal role in promoting sustainable development and confronting the formidable global challenge of climate change.

Exhibit 24: Breakdown of climate-change inventions from SE Asia, 2013–2022



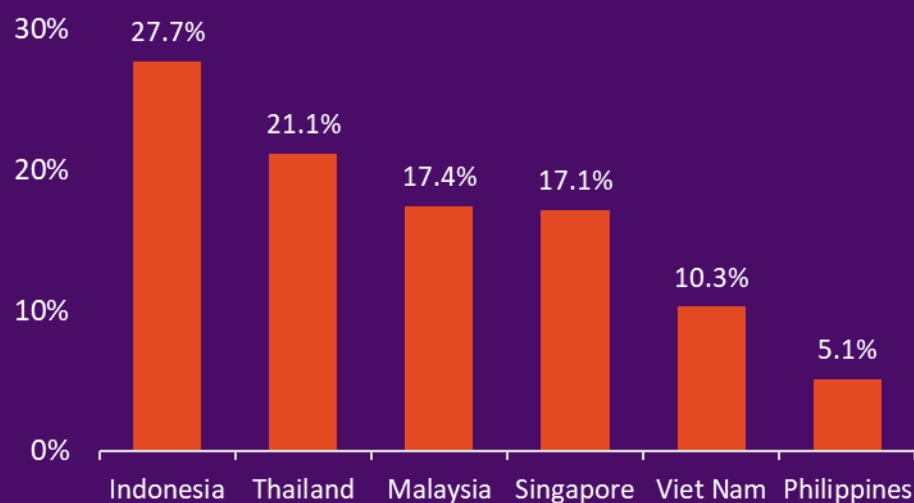
Spotlight: Pioneering Biofuel Innovations - Indonesia, Malaysia, and Thailand's Journey to Green Energy

Biofuels, as the leading area of focus in SE Asia's climate-change innovations, are of special relevance due to the region's abundant agricultural resources. Led by Indonesia, Thailand, Malaysia, and Singapore, these countries form over 80% of SE Asia's contributions to biofuel innovations (**Exhibit 25**).

Indonesia, Thailand, and Malaysia, known for their palm oil and agricultural exports, rank among the world's leading biofuels and biodiesel producers.⁴⁰⁻⁴¹ They harness their agricultural prowess to fulfil both local energy requirements and the demands of the global market. Meanwhile, Singapore is carving a niche as a crucial trading hub for renewable fuels, specifically biofuels. This diversifies energy sources, strengthens energy security, and capitalises on economic opportunities arising from the evolving energy paradigm.

The push for biofuel development in the region is in tandem with SDG 13, which prioritises urgent action to combat climate change and its impact. The shift toward biofuels is essential, as it helps to curb greenhouse gas emissions and reduces the reliance on fossil fuels. Promoting biofuels drives sustainable economic progress by using renewable energy and opening avenues in the burgeoning green energy market. This approach showcases SE Asia's commitment to environmental and economic sustainability and reaffirms its integral part in the international effort to address climate change.

Exhibit 25: Percentage share of SE Asia's biofuel inventions by country, 2013–2022



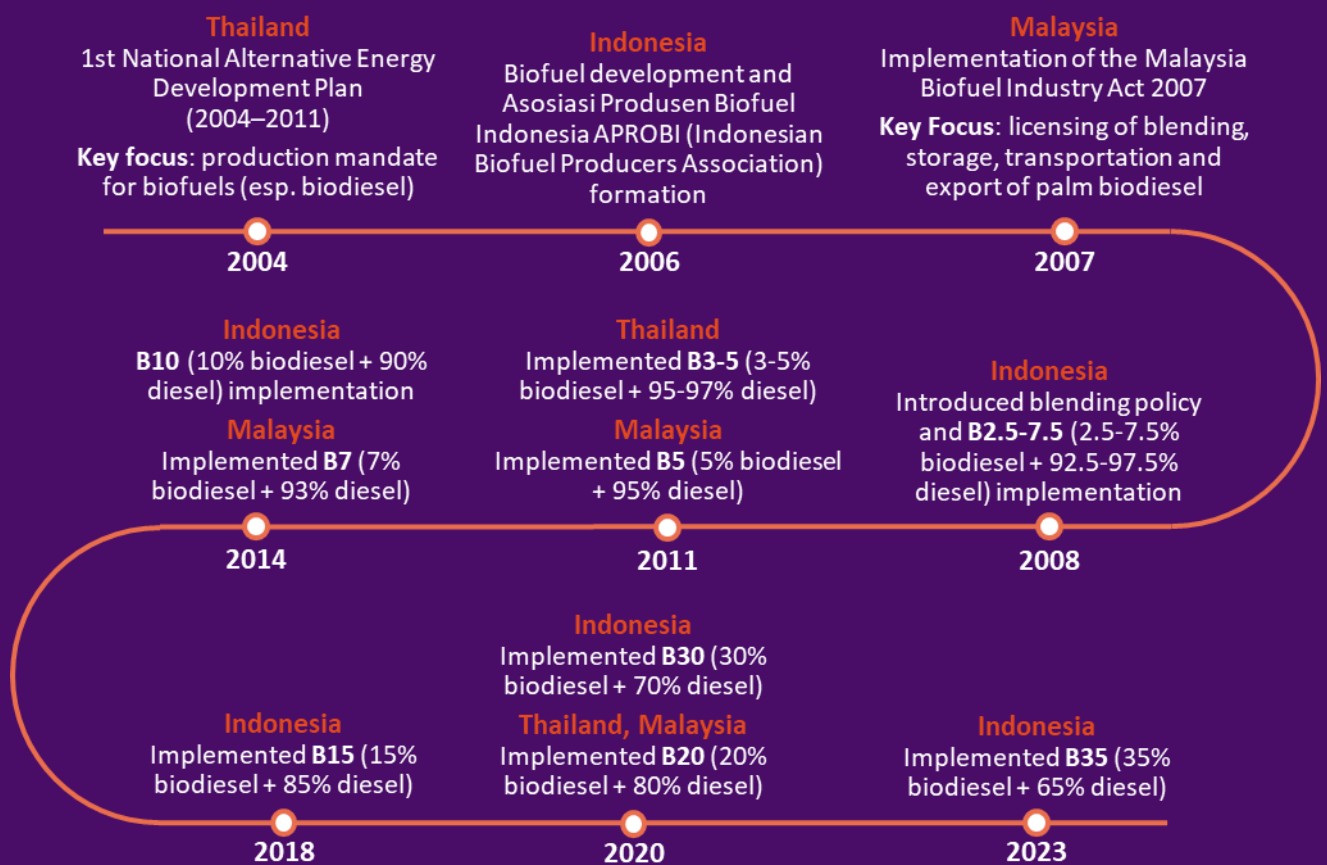
⁴⁰ Statista, *Leading countries based on biofuel production worldwide in 2022*.

⁴¹ OECD-FAO Agricultural Outlook 2020-2029.

Indonesia, Thailand and Malaysia have also made strides in implementing blending mandates and advancing biofuel technologies (**Exhibit 26**). For instance, Thailand’s 1st National Alternative Energy Development Plan (2004–2011) prioritised the production of biofuels, particularly biodiesel. Similarly, Indonesia introduced blending policies and established the Indonesian Biofuel Producers Association (APROBI) in 2006, while Malaysia enacted the Malaysia Biofuel Industry Act in 2007, which focused on regulating blending activities.

Over time, these nations have incrementally increased their biofuel blending ratios, with Indonesia implementing B30 (30% biodiesel) in 2020 and Thailand and Malaysia reaching B20 (20% biodiesel) implementation in the same year. These collective efforts highlight the region’s commitment to advancing biofuel technologies and creating sustainable solutions to address climate change.

Exhibit 26: Country highlights: Indonesia, Thailand, Malaysia



While biofuels offer environmental benefits, recent concerns have been raised regarding first-generation biofuels made from crops like palm oil, which can strain global food supplies and lead to widespread deforestation.⁴² To address these issues, efforts are underway to transition to next-generation biofuels sourced from non-food materials. For instance, the European Union has mandated phasing out non-renewable palm oil-based fuels by 2030.⁴³ This global shift reflects a commitment to develop sustainable alternatives that minimise environmental impact and ensure food security.

One notable player leading the charge in next-generation biofuels is Thailand's PTT. From 2008 to 2012, PTT invested nearly 100 million baht into micro-algae biofuel research through its "Think Algae" project. This initiative has brought together key partners such as the Thailand Institute of Scientific and Technological Research, the National Science and Technology Development Agency, and prominent universities, including Mahidol and Chulalongkorn, along with Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO).

PTT's commitment to creating next-generation biofuels is evident in its patent examples, including US1068980 and US11236375. These patents reflect PTT's innovative R&D efforts to create sustainable biofuel solutions that mitigate environmental impact and fight climate change.

Given the rich agricultural resources in SE Asia, biofuels are integral to member countries' net-zero plans. Closer regional collaboration can accelerate progress in a sustainable and cost-effective manner. The ASEAN Biofuel Research and Development (R&D) Roadmap, part of the ASEAN Plan of Action for Energy Cooperation (APAEC) Phase II: 2021–2025, targets existing barriers across upstream, midstream, and downstream elements through coordinated efforts among member countries. The successful implementation holds promise for a greener, more sustainable future in the years ahead.

⁴² Forbes, *EU Labels Biofuel from Palm Oil as Unsustainable, Bans Subsidies*, March 14.

⁴³ Reuters, *EU to phase out palm oil from transport fuel by 2030*, June 2018.

Conclusion

The innovation landscape in SE Asia has been remarkably dynamic and impactful. Through collaboration between local and international entities, the region has made considerable progress across various sectors, including digital technologies, medical technology, pharmaceuticals, chemical engineering, and biofuels. These innovations are technological milestones and are crucial contributions towards the SDGs related to health, climate action, and economic prosperity.

The integration of digital technologies has been particularly transformative, opening new avenues for innovation and sustainable development. This has been instrumental in advancing SDGs such as SDG 3 (Good Health and Well-Being), SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).

Medical technology advancements have revolutionised healthcare delivery, disease management, and preventive measures, directly aligning with the goals of SDG 3. These developments exemplify the region's commitment to using technology for better healthcare outcomes. Pharmaceutical innovation, fuelled by local ingenuity and international partnerships, has been pivotal in addressing healthcare challenges and improving access to quality medical care, as outlined in SDG 3.

The progress in biofuel development, particularly in overcoming feedstock limitations and moving towards advanced biofuels, reflects SE Asia's commitment to SDG 13 and sustainable energy solutions. Supported by initiatives like the ASEAN Biofuel R&D Roadmap, these efforts demonstrate the region's approach to tackling challenges through collaborative innovation.

Looking to the future, the innovation landscape in SE Asia holds vast potential to drive further progress towards the SDGs. By nurturing collaboration, increasing investment in R&D, and focusing on sustainability and digitalisation, SE Asia can amplify its strengths to address global challenges. This path forward promises to lead to a brighter and more prosperous future for the region and beyond.



Annex A: Methodology

Dataset

The final dataset was retrieved on 26 January 2024 from various databases, including WIPO IP Statistics Data Center, WIPO Patentscope, Questel Orbit, and Patsnap.

Grouping by patent family

The innovation intensity, i.e. the number of inventions in this study, is measured by counts of patent families. A patent family is a group of patents related to the same invention. Analyses based on unique patent families reflect the innovation output more accurately, considering individual patent applications will inevitably involve double counting as a patent family may contain several patent publications if the applicant seeks patent protection for the same invention in multiple jurisdictions.

Data cleaning

Systematic data cleaning and manual review were carried out to

- 1) remove non-patent specifications, e.g. utility model, and
- 2) ensure the relevance of the dataset prior to carrying out the analyses.

Refinement of the applicant field

IPOS International's proprietary patent data cleaning platform and automated algorithms from commercial tools were used to refine applicants' information, e.g. by removing various spelling and punctuation mark discrepancies. The refined results were manually checked for accuracy.

Grouping of technology domain and sub-domains

Grouping of patent families of the retrieved dataset into the respective technology domains and sub-domains was carried out based on patent classification codes, text-mining and semantic analysis of the patent specifications, in particular, the titles, abstracts, and patent claims, as well as a manual review of the individual patent applications.

Recency

Recency used in this study measures quantitatively how recently the technologies were developed. It is calculated by a weighted average of the inventions whereby a higher weightage is given to inventions published in more recent years.

Formula

$$\bar{R} = \frac{\sum_{i=1}^n (w_i \times i)}{n \times \sum_{i=1}^n w_i}$$

where

$i = 1$ for the first year of the survey period, and i increases by 1 for every subsequent year in chronological order.

n = total number of years of the survey period, and

w_i is the number of inventions published in the year.

Relative recency

Relative recency in this study refers to normalised recency by taking the recency of the entire dataset to be 1.

Annex B: United Nations Sustainable Development Goals

	SDG 1: No Poverty	End poverty in all its forms everywhere
	SDG 2: Zero Hunger	End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
	SDG 3: Good Health and Well-Being	Ensure healthy lives and promote well-being for all at all ages.
	SDG 4: Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
	SDG 5: Gender Equality	Achieve gender equality and empower all women and girls.
	SDG 6: Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all.
	SDG 7: Affordable and Clean Energy	Ensure access to affordable, reliable, sustainable and modern energy for all.
	SDG 8: Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
	SDG 9: Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation.
	SDG 10: Reduced Inequalities	Reduce inequality within and among countries.

	SDG 11: Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient and sustainable.
	SDG 12: Responsible Consumption and Production	End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
	SDG 13: Climate Action	Take urgent action to combat climate change and its impacts.
	SDG 14: Life Below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
	SDG 15: Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
	SDG 16: Peace, Justice and Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
	SDG 17: Partnerships for the Goals	Strengthen the means of implementation and revitalise the global partnership for sustainable development.

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