SUNRISE
INDUSTRIES

A snapshot of seven emerging industries in the formative stages of growth within ASEAN and neighbouring nations

CONTENTS

EXECUTIVE
SUMMARY

Countries in the Association of Southeast Asian Nations (ASEAN) and their neighbours will undergo significant social, economic and industrial change over the coming decades. Consumer incomes will rise, advanced technologies will be cheaper and more accessible, and economies will shift from industrial production to the provision of services. These factors, among others, will drive future population and economic growth across the region. In the face of these changes, some industries will decline, while new 'sunrise industries' will emerge, generating new sources of long-term economic development. This report identifies and profiles the following set of potential sunrise industries:

- **Artificial intelligence and autonomous systems.** Made up of large and small companies which design, construct, implement and operate automated systems, this industry emerges as a result of the increasing capabilities of automation and artificial intelligence to deliver benefits at lower costs.

- **Financial and regulatory services technology.** Enabled by technology and growing demand for innovative financial services, the FinTech and RegTech sector is made up of companies that provide digitally enabled financial and regulatory products and services.

- **High value nutrition.** Growing incomes, rates of chronic diseases and concerns about food safety and provenance have drive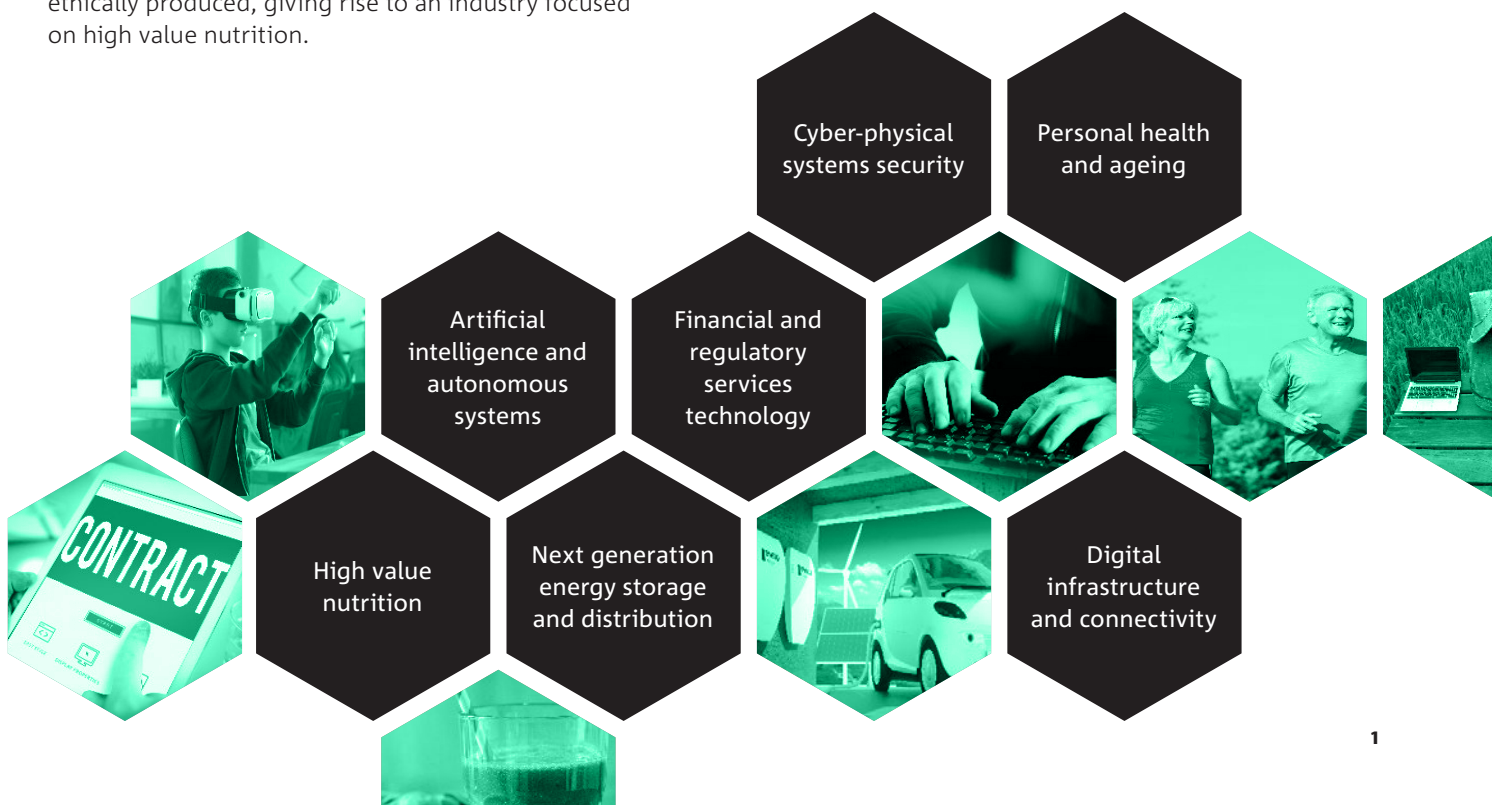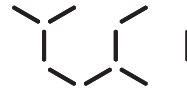n demand for healthy, traceable and trustworthy food products that are sustainably and ethically produced, giving rise to an industry focused on high value nutrition.

- **Next generation energy storage and distribution.** Improvements in the affordability and capability of batteries, other technological innovations, and consumer demand for clean energy solutions are fuelling demand for companies (both big and small) in the energy storage and distribution market.

- **Cyber-physical systems security.** While cyber-physical systems (i.e. systems which have intertwined software and physical components) are becoming increasingly widespread, they can be vulnerable to hacking, creating new opportunities for the cyber-physical systems security industry.

- **Personal health and ageing.** Rapidly aging populations are creating demand for products and services related to personal health and ageing (e.g. apps, wearable devices and mobile/telehealth services) along with personalised health and aged care.

- **Digital infrastructure and connectivity.** While the wider Asia Pacific region has some of the world's most digitally advanced nations, digital infrastructure is still lacking for many ASEAN members, creating opportunities for the digital infrastructure industry to respond to the growing connectivity demand.

Cyber-physical systems security

Personal health and ageing

Artificial intelligence and autonomous systems

Financial and regulatory services technology

High value nutrition

Next generation energy storage and distribution

Digital infrastructure and connectivity

1

1 INTRODUCTION

The global economy is moving eastwards. By 2050, the world's economic 'centre of gravity' – the average location of economic activity across geographies on Earth – is predicted to fall between China and India.[1] China's gross domestic product (GDP) in 2060 is projected to reach almost $70 trillion and India's almost $51 trillion, while the projected 2060 GDP of the United States is just over $48 trillion.[2] Indonesia, with an expected national output of about 30 percent of the United States, will be the world's fourth largest economy.[3] Other emerging economies, like Vietnam and the Philippines, are also expected to make significant advancements. While not all economic growth in the region is predicted to occur within the Association of Southeast Asian Nations (ASEAN), developments in neighbouring countries will likely have broader regional effects and contribute to shaping the future of ASEAN.

At the same time as their economies advance, many Asian nations are transitioning from industrial production to service-based economies. This transition is aided by increasingly cheaper and more capable technologies, including advances in artificial intelligence (AI), robotics, quantum computing, 3D printing, nanotechnology, biotechnology, materials science and chemical engineering. Economic development, industrial transition, and technological advancement within and around the ASEAN region are creating an environment where there is much scope for first-mover advantage and for small and large companies alike to establish a foothold in new territory.

This report assesses this environment and identifies a set of potential emerging industries ('sunrise industries') for ASEAN members and neighbouring nations. Sunrise industries are defined as new industries arising due to technological, regulatory, economic, or social change. They may be existing industries which are reappearing after a period of dormancy due to changing conditions within the industry or the environment. Or they may be entirely new industries born from new market drivers and trends, or from the intersection of two or more existing industries. In both instances, sunrise industries are associated with high potential for growth in the near future.

Seven emerging industries in the formative stages of growth within ASEAN countries and neighbouring nations are identified in this report (discussed in detail in Chapter 4). These sunrise industries are:

- AI and autonomous systems
- Financial and regulatory services technology
- High value nutrition
- Next generation energy storage and distribution
- Cyber-physical systems security
- Personalised health and ageing
- Digital infrastructure and connectivity.

This report describes the nature of each of these industries in terms of likely function, size and composition over the coming decades, and the evidence supporting their future growth. It aims to inform government, industry and other stakeholders around potential future areas of growth, and to assist decision makers in making strategic choices around the best ways to capitalise on the opportunities presented. We do not intend for the list of sunrise industries identified here to be exhaustive; rather, the report is designed to provide an indication of some significant opportunities for future regional growth and job creation. In a time of significant economic, industrial, technological, and social change, these industries could foster economic development and prosperity across ASEAN countries in decades to come.

2 ASEAN AND ITS NEIGHBOURING NATIONS

This report focuses on the ten member states of ASEAN – Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. The populations and economies of these nations are expected to grow considerably over the coming decades (Table 1). ASEAN had the world's third largest population in 2016, and is set to become the equivalent of the world's fourth largest economy by 2030, with economic growth rates that outpace the global average.[4] It is strategically well-positioned to capture trade opportunities with other economic powerhouses, including China, India, and the US.

While this report explores the emergence of sunrise industries within ASEAN, we note that ASEAN-specific data are not available for all the trends and drivers impacting the emergence of these industries. As such,

we have treated data from neighbouring economies as weak signals for what could plausibly occur in the ASEAN region, now and in the future. In other words, we assume that developments within non-ASEAN nations will likely have flow-on effects for ASEAN in terms of economic development, technological advancement and costs, and industry emergence.

Significant economic growth is already occurring in the broader Asia Pacific region. China and India are now the world's two fastest-growing large economies,[10] and Asia's share of the global economy continues to rise, increasing from 12.7 percent in 1960 to 31 percent in 2015.[11] The IMF's World Economic Outlook projects year-over-year growth rates of more than 6 percent in the emerging and developing Asia region, compared to roughly 2 percent in advanced economies and around 3 percent globally.[12]

Table 1. Current and long-range forecasts for ASEAN

	POPULATION		GDP (IN BILLIONS)		GDP PER CAPITA	
	2018	2028	2018	2028	2018	2028
Brunei	434,000	482,000	16.3	26.3	37,465	54,639
Cambodia	16,246,000	18,412,000	36.5	213.7	2,244	11,606
Indonesia	264,075,713	289,052,453	1,367.9	2,514.9	5,180	8,701
Lao, P.D.R.	6,961,000	7,887,000	24.3	55.4	3,487	7,022
Malaysia	32,042,000	36,102,000	437.6	867.4	13,657	24,027
Myanmar	53,856,000	58,192,000	103.4	306.2	1,920	5,262
Philippines	106,512,000	122,331,000	442.8	789.3	4,157	6,453
Singapore	5,762,000	6,202,000	429.4	736.8	74,523	118,801
Thailand	69,183,000	69,690,000	589.6	1,159.2	8,522	16,634
Vietnam	94,579,000	102,160,000	304.7	647.8	3,222	6,341

Data sources: Australian Bureau of Statistics,[5,6] OECD,[2] World Bank,[7] IMF[8]
Note: GDP estimates are given in AUD. Currency conversions were made using a yearly average of the USD/AUD exchange rate, from the Reserve Bank of Australia.[9] See the Appendix for more information on the forecasting methodology.

However, after decades of rapid growth via industrialisation, many Asia Pacific nations are now transitioning to consumer and services-driven economies. The previous decade saw China go from 12.7 percent GDP growth in 2006, with a peak of 14.2 percent in 2007, before falling to 6.7 percent in 2016.[13] Within ASEAN, the services sector has now overtaken industry and agriculture in terms of its contribution to the economy, accounting for 50 percent of average value added to ASEAN economies in 2016 (see Figure 1) and growing as a proportion of every ASEAN economy since 2010 (see Figure 2).

The Asian middle-class population also continues to grow. Real per capita incomes in developing economies of the region have doubled on average since the early 1990s,[16] and the number of people living in poverty has more than halved between 1990 and 2009.[17] In 2009, the Asian middle class represented 28 percent of the global middle-class population and 23 percent of middle-class consumption, but by 2030, this is projected to rise to 66 and 59 percent, respectively.[18] The middle-class population in ASEAN alone is expected to grow from 190 million people in 2012 to 400 million people in 2020.[19] With rising incomes comes rising demand for higher-value products and services in areas such as food, education and tourism.
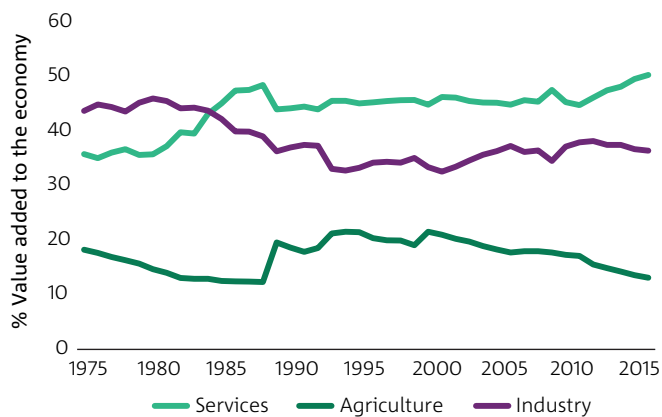

Figure 1. Average value added to ASEAN economies by services, agriculture and industry

Data source: World Bank Indicators[14]
Note: Complete time series data were not available for the following countries: Indonesia, Cambodia, Laos, Myanmar, and Vietnam.
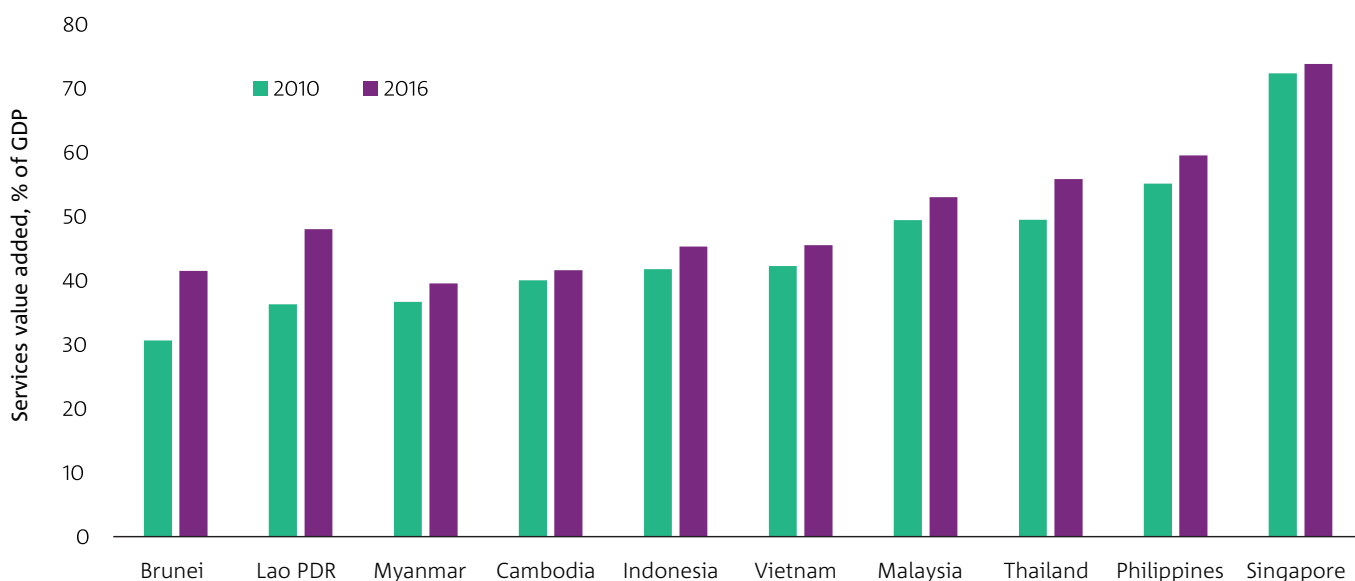

Figure 2. Service industry growth in the ASEAN region, 2010 compared to 2016
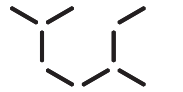
Data source: World Bank Indicators[15]

3 INDUSTRY FORMATION AND GROWTH

Changing economic, social, and demographic conditions give rise to new industries. The 'lifecycle model' can be used to describe different phases of industry formation.[20-23] While there are numerous lifecycle models with varying degrees of complexity, put simply, the four main phases in the industry lifecycle are introduction, growth, maturity and decline (see Figure 3). We use this framework here in characterising new and emerging sunrise industries.
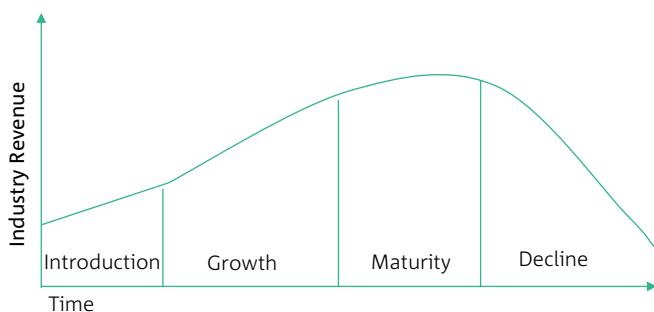

Figure 3. Key stages of the industry lifecycle
Data source: Porter[24]

Sunrise industries are active during the introduction phase, which is associated with identifying and defining a market need and developing a product or service (or series of products/services) to meet these new market needs. Generally speaking, a sunrise industry undergoes three main stages within the introductory lifecycle phase:[20,25,26]

A *pre-founding stage*, where the existing industrial order, market and technology is challenged by a forthcoming (but yet to be significantly developed) set of innovations. These new industries can be triggered by technological development,[20] a shift in cultural value,[27] a regulatory change,[27] or a demand shock.[28]

A *co-evolutionary stage*, which marks the convergence of the variety of products that have emerged from an initial stage to a dominant one. This stage is also marked by increased collaboration across stakeholders in the new industry and an increasing number of firms entering the market.

An *early growth stage*, where the new industry settles following the co-evolutionary stage, and sales begin to take off. There is also an improvement in product quality and an increase in competition, mainly among incumbent firms of the new industry.

There are benefits to acting during the introductory phase (see Table 2). Among these benefits, market pioneers can have the first-mover advantage, providing long-lasting benefits and/or competitive advantages that lead to a higher market share. For instance, *eBay* was the first online peer-to-peer marketplace, allowing it to gain a dominant market share. Later entrants to the online marketplace industry have had to specialise, offering distinct services or benefits that are not currently offered through *eBay*.[29] However, this was not the case in all markets. In New Zealand, for instance, other companies such as *TradeMe* established early dominance and effectively shut *eBay* out of the market.[30]

In addition to low levels of market competition during the introductory lifecycle phase, early entrants in the pre-founding stage can also reduce overall costs through accumulated experience. This is known as the 'experience curve' — a concept developed in the mid-1960s, when consultants from the Boston Consulting Group noticed that a company's unit cost of manufacturing dropped by around 25 percent for each doubling of the volume that it produced.[31] Being active in the introductory phase can also allow pioneers to establish control over required resources, which may become limited for later entrants. First-movers also have a tendency to shape consumer tastes and preferences, wherein the costs of switching to another buyer can deter the customer from exploring new entrants to the market.[32]

Table 2. Challenges and benefits of each stage within the introduction phase for industry formation

	PRE-FOUNDING STAGE	CO-EVOLUTIONARY STAGE	EARLY GROWTH STAGE
Challenges	• Lack of resources, practices and complementary assets • Uncertainty surrounding technology, markets and regulation • Free rider problems	• Strong competition among entrants in structuring the industry • Lack of broadly-accepted standards for the sector • Uncertainty and information asymmetries	• Difficulty securing resources to scale up production • Flattening entrepreneurship opportunities • Increased firm competition, both incumbents and entrants
Benefits	• Entrepreneurship opportunities • Ability to achieve technology leadership • Opportunity to pre-empt key resources	• Potential high growth of firms • Increasing entrepreneurship opportunities	• Sustainable growth of the industry due to the increase in production size

However, simply being a market pioneer does not guarantee success. For instance, *Sony* enjoyed massive success as the first entrant into the portable music device industry with the invention of the 'Walkman' in 1979. When music mp3 files first became available in the late 1990s, South Korean firm *Saehan* created the first digital audio player, the 'MPMan'; but the lack of widespread broadband accessibility needed to download mp3s meant that the appeal of a digital music device was limited.[33] The iPod was launched three years later – when both mp3s and broadband were widely available – and quickly became the new 'Walkman' of the 21st century.[33] Early market entry needs to be combined with a surrounding ecosystem that supports the growth of the industry.

4 SUNRISE INDUSTRIES
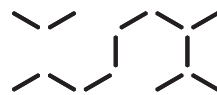
This chapter outlines a set of sunrise industries that present significant opportunities for future regional growth and job creation within ASEAN and across the broader Asia Pacific region. Leveraging the first-mover advantage, these industries reflect a change in market conditions, impacting future supply and/or demand in the market. A change in supply presents new opportunities to establish firms and products, reduce production costs, and make value chains more efficient, whereas a change in demand presents opportunities to provide products and services to new markets. This report identifies seven key sunrise industries for ASEAN countries, and their neighbours, that could promote economic development and prosperity over the coming decades.

AI and automated systems

The AI and automated systems industry will be comprised of large and small companies that convert manual processes into automated processes. They will do so using robotics, sensory systems, machine learning, predictive analytics and AI. Companies in this industry will supply services to practically all other industries, as automation becomes increasingly pervasive across ASEAN economies and other economies around the world. These services will include the design, construction, implementation and operation of autonomous systems, as well as consulting and advisory services for businesses looking to transform their existing systems into autonomous systems. Many companies in this industry will be spinoffs and startups from larger technology companies and research organisations, where most AI capability currently resides.

ASEAN industries are already adopting AI to improve customer experience. For instance, *Hong Leong Bank* of Malaysia uses IBM's Watson to detect customer emotions over the telephone, and Singapore's *DBS* has opened Digibank, which uses a virtual assistant to deal with customer enquiries.[34] These cases are likely to become more common as automated systems become more widely available. ASEAN startups using AI include Myanmar's *Bindez* (an online search and discovery platform)", Indonesia's *Kata.ai* (developing natural language processing for Bahasa), Vietnam's *FPT* (helping app developers enable automated interaction with end-users), Indonesia's *Ruangguru* (using machine learning to develop personalised education services), Vietnam's *Sero* (providing farmers with crop information via AI analytics of imagery and in-field data),[34] and Singapore's *Foodpanda* (using a complex algorithm to optimise food delivery logistics).[35]

Automation has the potential to impact a wide range of industries and improve productivity across entire economies. Robotic automation has been identified as the major technology impacting the key ASEAN manufacturing industries of automotive and auto parts, and textile, clothing and footwear.[36] Thai food and beverage company *ThaiBev* and Malaysian car manufacturer *Proton*, for instance, are aiming to introduce automation technologies in their plants.[34]

There is also considerable business opportunity in using AI in the ASEAN financial services and telecom sectors.[34] In the financial services sector, ASEAN firms will need to integrate AI functions such as credit scoring, dynamic pricing, and digital marketing, which have demonstrated value in other contexts but have yet to be scaled up in ASEAN. In the telecom sector, local companies can use their access to data to develop increasingly sophisticated analytic tools.[34] Demand for AI is also likely to be high within the healthcare industry and the public sector.[35] CSIRO's AI and machine learning capability may prove useful to firms entering or expanding within the AI and automated systems industry.[37]

Figure 4. Estimated annual shipments of industrial robots, Asia/Australia

Data source: International Federation of Robotics[38]

The following trends support future growth of this emerging industry in ASEAN and neighbouring economies:

SUPPLY

- AI research in the region is accelerating – China, India, Japan, Australia, Taiwan, and South Korea were among the 20 most productive countries for AI research from 1990 to 2014.[39] In Singapore, the National Research Foundation will invest up to $195 million in AI research and deliver 100 projects which solve end-user problems over the coming five years.[40]

- Robot prices are one-fifth of their 1990 level, due to improvements in robotic quality,[43] and the cost of robots is projected to fall by 22 percent by the year 2025.[44]

DEMAND

- Robots are becoming more popular – industrial robot sales in Asia/Australia increased from 70,000 in 2010 to 134,000 in 2013, to 191,000 in 2016 (see Figure 4). The Asia Pacific region is the fastest growing robotics market globally – led by China, Korea and Japan – and is expected to reach 70 percent of worldwide robotic spending by 2020.[42]

- China has emerged as the global leader in automation, increasing its operational stock of industrial robots from 17,000 units in 2006 to 340,000 in 2016.[45] China plans to create a $77.2 billion AI industry by 2025, creating almost $1 trillion of value via efficiency gains in other industries.[46] Complementing this, the Chinese government plans to establish an initial set of laws, regulations, ethical norms and policy systems for AI use by 2025.[46]

- The Asia Pacific region is an automation hub, with three out of the four most automated countries in the world – as measured by robot density – being South Korea, Singapore, and Japan.[38] When it comes to the workforce, it is estimated that 56 percent of employees in Cambodia, Indonesia, the Philippines, Thailand and Vietnam have a high probability of being automated in the future,[47] which is higher than that predicted for the Australian workforce (40 percent).[48]

- External investment in AI is growing at a faster rate in Asia than in Europe and North America,[41] with robotics expenditure in the Asia Pacific expected to more than double from $78 billion in 2016 to $172.9 billion in 2020.[42]

Financial and regulatory services technology

The 'FinTech' and 'RegTech' industries use technological innovations to deliver cheaper and more efficient financial and regulatory services. Some examples of FinTech applications include: the use of distributed ledger technologies and smart contracts* to automatically execute contracts between buyers and sellers when conditions are met; robo-advisors utilising algorithms to provide more accessible and affordable investment advice; and cryptocurrencies operating on the blockchain. RegTech uses technology to automate regulatory compliance and checking. An example service is Data61's Regorous technology, which assesses a new business proposal against legislative requirements, identifies the necessary permits and licenses, and prompts the user for the relevant information.[50]

Many companies within this sector will likely begin as small tech startups, some of which will scale up rapidly. Singapore is dominant within the ASEAN FinTech sector: it is one of two countries with the greatest concentrations of FinTech accelerators in the world,[51] and ten of the fifteen best-funded FinTech startups in Southeast Asia are from Singapore. Other well-funded startups include Malaysia's *Money.my* (personal finance), the Philippines' *Ayannah* (online payments), Thailand's *Omise* (online payments), and Vietnam's *Payoo* (e-wallet).[52] FinTech firms may also emerge as spinoffs of existing large digital businesses – for example, *Ant Financial*, a successful spinoff of the Chinese company *Alibaba*, now has over 450 million users.[53]

Although banks will find many FinTech and RegTech services useful for improving efficiency, this sector will also disrupt the banking industry, offering consumers convenient and low-cost alternatives to traditional banking services (e.g. peer-to-peer lending, investment tools and international money transfer platforms). In ASEAN, online payments and mobile wallets present a major business opportunity, accounting for 43 percent of the ASEAN FinTech sector.[54] Growth in this sector is driven partially by the high number of migrant workers sending remittances home – the World Bank estimates that remittances to developing countries in the East Asia and Pacific region rose by 4.8 percent in 2013, to reach $145 billion,[55] and the US-to-Vietnam remittance market is worth $18.2 billion alone.[54] Increasing mobile internet penetration within the ASEAN and the broader Asia Pacific region[56] supports the further development of firms in this space –Singapore is ranked as the most mobile payment ready nation in the world, with the Philippines and Malaysia in thirteenth and fourteenth places respectively.[57] More comprehensive consumer protection laws and regional collaboration on mobile payment systems will be important in developing this business opportunity.[54]
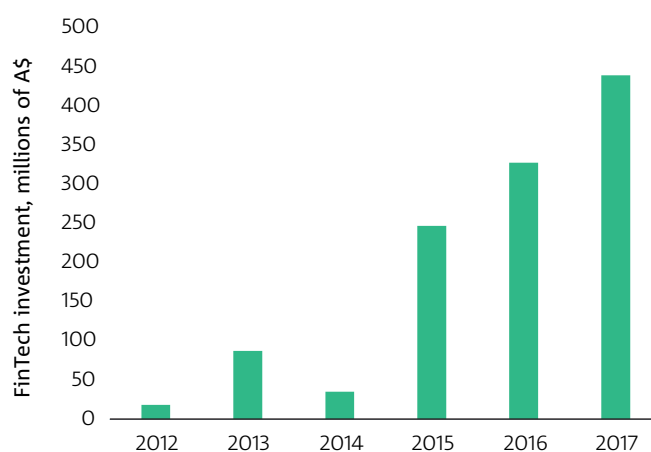
Figure 5. Fintech investment in ASEAN

Data source: United Overseas Bank[58]

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*A distributed ledger (e.g. a blockchain) is a consensus of replicated, shared and synchronised data geographically spread across multiple parties, with no central administrator or centralised data storage. A smart contract is computer code stored on the blockchain ledger and able to be executed as part of a transaction's validation on the blockchain.[49]

The following trends support future growth of this emerging industry in ASEAN and neighbouring economies:

SUPPLY

- The advancement of cutting-edge technologies such as blockchain and cryptocurrencies, augmented reality, artificial intelligence, big data and advanced analytics are aiding the development of increasingly capable FinTech tools and services.

DEMAND

- The Asia Pacific region accounted for nearly three-quarters of the world's payment transactions in 2012, making it a hub for financial activity.[59]

- The number of Chinese mobile payment users exceeded 520 million in 2017. Chinese banks dealt with 8.6 billion payments by mobile services in 2017 – up 40.5 percent from the prior year.[60] Mobile device payments in China – facilitated by firms such as *Ant Financial* and *Tenpay* – are forecast to reach $8.19 trillion by 2020.[61]

- The FinTech sector could prove useful for the large numbers of citizens without a bank account in the Asia Pacific. As of 2014, Indonesia had 5.6 percent of the world's unbanked population, Vietnam had 2.4 percent, the Philippines had 2.2 percent, and Myanmar had 1.5 percent.[62]

- The FinTech and RegTech sector could help to reduce unnecessary business costs in the banking industry. In 2016, it was estimated that governance, risk and compliance costs account for 15 to 20 percent of the total operating costs for most banks globally.[63] Worldwide demand for regulatory, compliance and governance software is projected to reach $154.4 billion by 2020, with 55 percent of this directed toward consulting and business services.[64]

- The development and widespread use of digital finance could boost the annual GDP of all emerging economies by $4.8 trillion by 2025 – a 6 percent increase over a business-as-usual scenario.[65] Of the 1.6 billion individuals who would be newly included in the financial system, 14 percent would be from Southeast Asia.

- Digital financial solutions could promote financial inclusion, addressing around 40 percent of the unmet demand for payment services and 20 percent of unmet credit needs in the poorest socio-economic segment and micro, small, and medium enterprises of Indonesia, the Philippines, Cambodia, and Myanmar.[66]

- FinTech investment in Asia has grown substantially and rapidly, from $200 million in 2012 to $8.6 billion in 2016 (see Figure 5).[67] By 2020, the FinTech industry in the Asia Pacific region is expected to generate more than $91 billion in revenue, with a compound annual growth rate of 72.5 percent.[68]

- RegTech startups raised around $2.3 billion (across 317 deals) worldwide between 2012 and 2016, demonstrating the high potential and continuing growth of the global RegTech industry.[69]

High value nutrition

The high value nutrition industry produces and distributes food products that provide health benefits beyond basic nutrition. These include 'nutraceutical' products (e.g. dietary supplements), 'functional foods' (e.g. energy boosting, weight loss, or diabetes management food products), and 'high-value' agriculture food products (e.g. those that are organic or fair-trade). These products are relatively expensive, often sold in specialised stores and rely heavily on consumer perception of quality.

Firms in the high value nutrition sector are likely to be highly innovative startups that are involved in the commercialisation of scientific research. For instance, the University of Auckland's High Value Nutrition program aims to produce and export food and beverage products that have scientifically proven health benefits.[70] The perceived value, safety and nutritional content of these food and beverage products add to their competitive advantage in the market. Existing agribusinesses (including small-scale organic producers) may attempt to move up the value chain and expand into the high value nutrition market.

The greatest demand for high value nutrition products is likely to come from markets with rapidly-expanding middle classes. Indonesia's middle class is projected to become the world's eighth-largest by 2020 and the fourth-largest by 2030.[71] The Philippines, Vietnam, and Thailand are also expected to have grown their middle classes considerably by 2030.[72] While the production of high-value nutrition products within ASEAN is still in a nascent stage despite high demand, there are a few potential hubs. Thailand is a regional leader in organic agriculture, with sales of organic food growing seven percent annually between 2010 and 2014.[73] Regarding high-tech 'functional foods', Singapore's Clinical Nutrition Research Centre, established in 2014, could make Singapore a hub for nutrition research and commercialisation within the region. Finally, given the region's high demand, there is scope for ASEAN firms in the high-value nutrition sector to partner with established research expertise – for instance, CSIRO's food innovation centre helps manufacturers create value-added food products.[74]

The following trends support future growth of this emerging industry in ASEAN and neighbouring economies:

SUPPLY

- Several ASEAN governments, including Thailand and the Philippines, have introduced organic labels or developed organic farming policies.[76,77] An ASEAN-wide organic standard, the ASEAN Standard for Organic Agriculture, has also recently been developed.[78] These policies, particularly when harmonised at the regional level, may help to facilitate the emergence of the ASEAN organic agriculture sector.

- Scientific knowledge regarding nutrition is expanding considerably. In 2014, Singapore established the Clinical Nutrition Research Centre, which specialises in basic and translational human nutrition research and is in an excellent position to develop high-value nutrition knowledge within the ASEAN region.
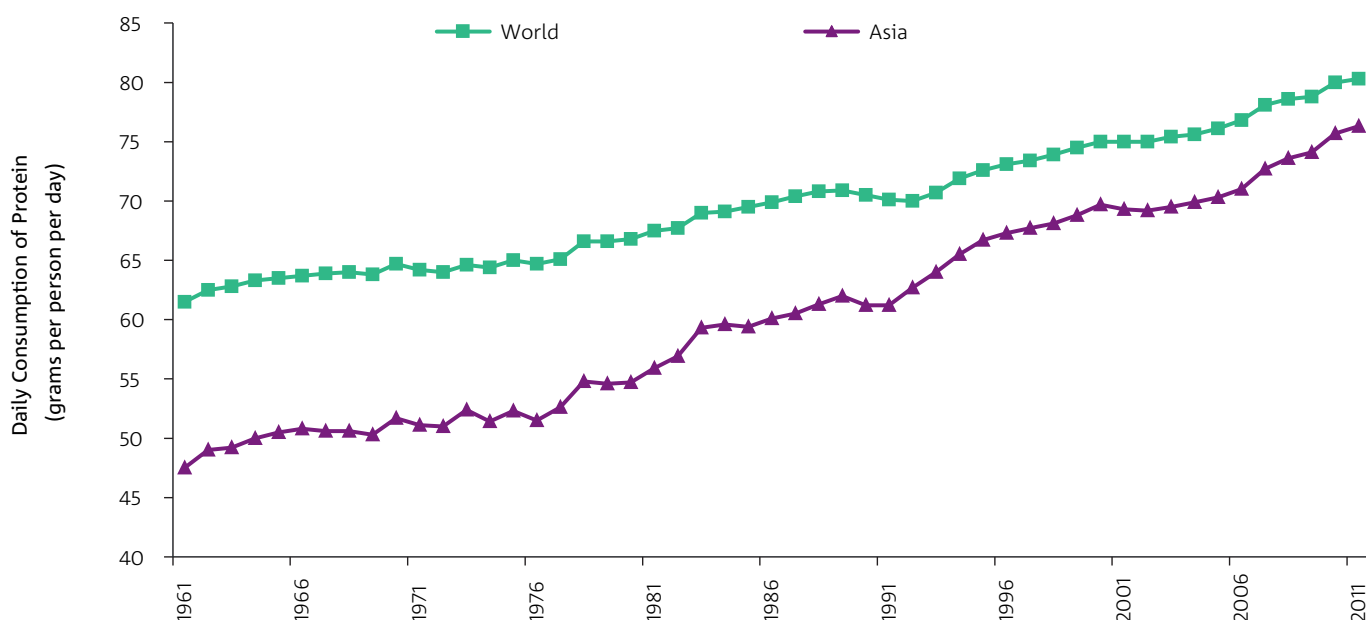

Figure 6. Daily protein consumption in Asia and worldwide

Data source: United Nations Food and Agriculture Organization[75]

DEMAND

- Demand for food is increasing, with the United Nations Food and Agriculture Organisation estimating that global food production will need to increase by 70 percent to meet demand in 2050.[3] Population growth and urbanisation will be concentrated in Africa and South Asia,[79] as will the associated food demand.

- Asian diets are evolving: the average daily consumption of protein in Asia has grown rapidly over the past few decades (see Figure 6).[75] Similarly, annual per capita consumption of milk in Asia rose from 32 kg in 1990, to 41 kg in 2000, to 60 kg in 2013.[80] A 2011 study found that 28.5 percent of total energy intake among Chinese consumers comes from processed foods, and retail sales of processed food in China have quadrupled from 1999 to 2013.[81]

- Changes in Asian diets have also led to a greater incidence of chronic diseases. China now has the largest overweight population in the world,[82] and almost half of the people with diabetes live either in China or India.[83] Around 80 percent of all deaths in China are attributable to chronic illness, while the figure in Thailand is around 50 percent.[84] Type 2 diabetes in South Asia is forecast to rise by more than 150 percent between 2000 and 2035.[83] About half of the world's cardiovascular burden is predicted to occur in the Asia Pacific region.[85]

- Consumers are becoming increasingly health-conscious in response to the growing burden of chronic disease: 93 percent of Asia Pacific consumers are willing to pay more for foods with health attributes.[86]

- Food safety scandals and concerns in the broader Asia Pacific region remain a pressing concern. In China alone, there were 500,000 food safety violations in the first nine months of 2016.[87] Food provenance is a particularly salient feature for Asian consumers, with a third of consumers rating the origin of a product more important than other factors, compared to 28 percent of consumers worldwide.[88]

- Consumers in the Asia Pacific are willing to pay for assurance around food safety. Research has found that Chinese milk products with quality management certification sold at a price premium of around 5 percent, relative to regular milk products.[89]

- The Asia Pacific region has the world's highest percentage of consumers who want more organic products (51 percent compared to 44 percent of consumers worldwide).[90] A survey of consumers from Thailand found more than a third reported buying organic fruit or vegetables, and over half stated that they were concerned about pesticide residues on produce.[91] Consumers from the Asia Pacific region are also more likely to rate sustainably sourced/fair trade ingredients (43 percent of respondents)[86] and social responsibility (64 percent)[92] as important to their purchase decision.

- Across the Asia Pacific, the region's share of global health and wellness sales from 2002–2018 is projected to increase from 20 to 31 percent.[93] The Asia Pacific nutraceuticals market, specifically, is forecast to grow at a compound annual growth rate of 7 percent from 2014 to 2019.[94]

Next generation energy storage and distribution

The next generation energy storage and distribution industry produces and distributes batteries and distribution technologies such as smart grids or micro-grids (for supplying power to remote areas). This industry will grow as battery storage becomes more affordable and as the systems that rely on battery storage (e.g. solar photovoltaic panels and electric vehicles) increase in popularity. The next generation energy storage and distribution sector will consist of a mixture of startups developing cutting-edge new battery technologies, and large industrial companies with resources for large-scale battery production and distribution. An energy startup may also develop smart technologies to reduce energy consumption, improve energy efficiency, and/or improve stability and efficiency of the grid.[95]

There is significant opportunity to develop this industry across the entire ASEAN region, with the potential to draw on existing research expertise in battery technologies – e.g. CSIRO's energy storage and battery technologies research unit, which has developed the advanced UltraBattery solar system.[96] With Indonesia's recent commitment to the ASEAN Transboundary Haze Agreement, there is likely to be growing demand from all ASEAN members for renewable energy solutions, including solar power systems and electric vehicles. Industry and government programs to test and promote electric vehicles are present in Singapore, the Philippines, Thailand, Malaysia, and Indonesia. Malaysia has publically stated its aim of having 100,000 electric vehicles, 2,000 electric buses, and 125,000 charging stations by 2030.[97] In solar energy, Thailand, the Philippines, Indonesia, Malaysia, and Vietnam are the five main markets driving solar photovoltaic development within ASEAN.[98]

The region has been identified as having much lower market-entry barriers compared to China and Japan, with *"an almost equal balance between competent new local players and international renewable energy companies who are establishing a strong, even leading, market position."*[98]

Several Singaporean-based energy startups have already emerged: *Intraix* (which develops low-cost energy management systems and devices, e.g. smart thermostats), *DLRE Holdings* (which has deployed micro-grids in the Maldives, Vietnam, and Singapore),[95] and *SolarHome* (which provides solar energy for rural off-grid houses and has operations in the Philippines, Cambodia, Indonesia, and Myanmar).[99]
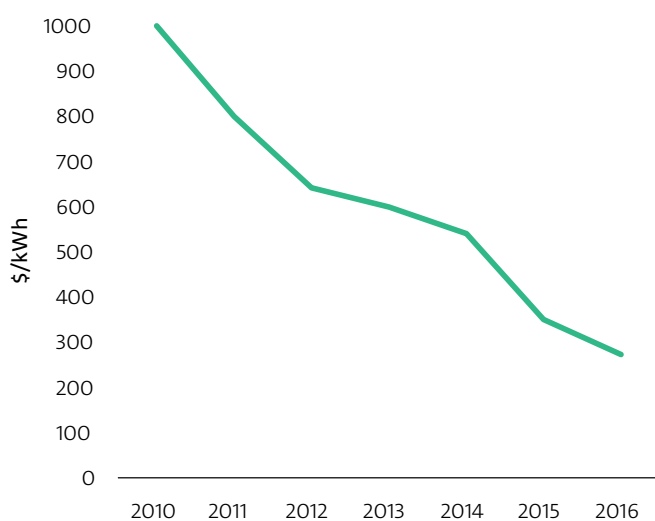

Figure 7. Lithium-ion battery prices, worldwide
Data source: Bloomberg New Energy Finance[100]

The following trends support future growth of this emerging industry in ASEAN and neighbouring economies:

SUPPLY

- Energy storage technologies are declining dramatically in cost. Lithium-ion battery prices have declined 75 percent over the last six years (see Figure 7),[100] and installation costs are expected to fall 50 to 66 percent by 2030.[101] Production costs for solar photovoltaic panels have declined dramatically worldwide, falling 58 percent in five years.[102] Total installed photovoltaic system costs similarly fell by around 56 percent between 2010 and 2015, and are projected to fall by a further 43 to 65 percent between 2015 and 2025.[103]

- Price declines coincide with predicted increases in battery storage capacity.[101] For instance, fuel cells have been shown to be more durable than lithium-ion batteries, and gold nanowire batteries show no signs of degradation after more than 200,000 charges.[104,105]

- Globally, 70 GW of new solar power capacity was added during 2016, breaking the 50 GW record set in 2015.[102] China led the way with 34 GW of solar photovoltaic capacity added. In 2017, India unveiled the world's largest solar farm, and quadrupled its capacity over the last three years to produce 12 GW of solar power.[106] Increases in solar power capacity will continue to drive demand for battery technologies.

- Southeast Asian firms are now entering the battery market, which has typically been dominated by firms from China, South Korea and Japan. Thai company *Energy Absolute* announced in May 2017 that it will spend up to $3.8 billion on a project that could produce 50 GWh of lithium-ion batteries annually.[107] In 2011, Asian developers submitted 2,100 patent applications relating to battery storage, compared to 530 and 410 made by Europe and the United States, respectively.[108]

DEMAND

- There is increased pressure for governments in the Asia Pacific to adopt renewable energy solutions. Of the 6.5 million deaths that occur annually due to exposure to poor air quality, 70 percent occur in the Asia Pacific.[109] China's Action Plan on Prevention and Control of Air Pollution pledges to lower coal consumption to 65 percent of energy usage by 2017 and reduce $PM_{2.5}$ levels (a measure of air quality) by 15 to 25 percent by 2020.[110] China aims to produce at least 15 percent of its overall energy output from renewable energy sources by 2020, and 20 percent by 2030.[111]

- Solar energy, combined with battery storage technologies, is already being used to supply power to up to 300 million off-grid people in Asia[101] – a number which is likely to increase as solar systems become more efficient, affordable and sophisticated.

- The growth of the electric vehicle industry is fuelling demand for batteries. Assuming that battery prices reach parity with the $7,800 cost of an internal combustion engine, the electric vehicle battery industry will be worth roughly $312 billion within the next 20 years.[112]

- In 2015, electric vehicle sales increased by 70 percent from the previous year, totalling around 540,000 units.[113] By the end of 2016, the global electric vehicle fleet reached two million vehicles.[101] If these trends continue, it is predicted that electric vehicles will account for 33 percent of the light-duty vehicles on the road by 2040, displacing 8 million barrels of transport fuel per day and adding about 5 percent to global electricity consumption. This will translate to skyrocketing demand for battery production.

- Furthermore, high demand for electric vehicles has positioned the Asia Pacific region as the largest revenue-generating market for electric vehicles in 2016.[113] China is currently responsible for around half the global sales of electric vehicles,[114] and the International Energy Agency predicts that it will capture more than 40 percent of the world electric vehicle market by 2040.[115] There are now more than 140 electric vehicle battery manufacturers in China, with the top lithium-ion manufacturers for electric vehicles – *Panasonic*, *BYD* and *LG Chem* – based in Japan, China and South Korea.[116]

- Demand for energy storage within ASEAN is also growing. In 2016, the number of commissioned storage installations (i.e. batteries, largely lithium-ion) in the ASEAN region almost doubled, driven by small-scale and island systems.[117] Total annual revenue earned from energy storage deployments in East Asia and the Pacific is projected to be around $2.6 billion in 2018, and is expected to rise almost seven-fold by 2025.[118] South Asia is also projected to experience a rise in revenue earned from energy storage, from almost $0.5 billion in 2018 to more than $3.5 billion in 2025.[118]

Cyber-physical systems security

This industry provides cybersecurity for cyber-physical systems, which consist of both software and physical components (e.g. smart grids, autonomous cars and drone fleets). The bulk of the companies driving growth in the cyber-physical systems security sector will be startups. In 2017, cybersecurity startups generated $9.9 billion worldwide in venture capital funding, doubling the amount raised in 2016.[119] Products and services provided by the industry include, but are not limited to:

- setting up protection barriers such as firewalls, sandboxes or intrusion prevention systems

- monitoring and maintaining the security of the networks and systems

- enhancing the underlying structures for cyber-risk awareness and regulations for compliance, governance and risk management in cybersecurity

- cyber insurance

Business opportunities for the cyber-physical systems security industry vary throughout the region. In late 2017, Singapore formed a research programme to improve trust, security, and robustness of critical cyber infrastructure.[120] Malaysia also has cyber components to its CNII (Critical National Information Infrastructure), and has been boosting its security capability in recent years.[121] Singapore, Malaysia, and Indonesia are expected to drive growth in the ASEAN cybersecurity industry, accounting for 75 percent of the market by 2025. Indonesia, the Philippines, Vietnam, and Malaysia are expected to see the highest growth in their cybersecurity industries, as they address infrastructure gaps over the coming years.[122]

The following trends support future growth of this emerging industry in ASEAN and neighbouring economies:

SUPPLY

- Cybersecurity technologies are improving. For instance, distributed ledger technology allows for the provision and management of trust and data integrity at a large scale; remote browsers delivered via the cloud keep malware off end-user systems; and user and entity behavioural analytics (UEBA) makes threat detection more effective. The rapid advancement of these and other technologies is enabling the continual development of cybersecurity products.[123]

DEMAND

- Cyber-physical security is becoming increasingly important as acts of geopolitical aggression are executed through attacks on cyber-physical systems.[124,125] Under-developed data protection laws, weak adoption of cybersecurity best practices and widespread use of illegal software has made many other Asia Pacific nations vulnerable to attacks in the past.[126]

- In the Asia Pacific region, the number of networked devices rose from 7.2 to 7.9 billion between 2015 and 2016 – an increase from 1.8 to 1.9 per capita.[127] Projected estimates for the number of networked devices range anywhere from 8.6 billion devices by 2020[128] to 12.2 billion networked devices by 2021.[127] Ensuring the security of internet-connected devices and systems will be key as these devices become more common and more relied upon by businesses, governments, and consumers. Cybersecurity spending in the ASEAN region is predicted to grow steadily out to 2025 (see Figure 8).

Figure 8. Projected ASEAN Cybersecurity spending
Data source: AT Kearney[122]

- Automated vehicles, airplanes and drones are vulnerable to external hacking.[129] Security researchers of *Tesla* and *Jeep* automotive systems have demonstrated vulnerabilities by suddenly activating vehicle brakes, and by disabling engines while at speed.[129] There will likely be an increasing demand for sophisticated and capable cybersecurity systems to combat these attacks.

- The use of drones is increasing globally, with worldwide revenue from drone production for commercial and personal use growing by 35.5 percent in 2016; similar growth rates are predicted for 2017.[130] In the Asia Pacific region, spending on robotics (including drones) and related services is estimated to rise from $85 billion in 2017 to $210 billion by 2021 – over 70 percent of the global robotics market.[131] The remote piloting of drones is susceptible to outsider interference and attack; as such, as drone use increases, there is growing global interest in drone-related security.

- The Asia Pacific region has experienced a 40 percent year-on-year increase in the number of daily cyber-attacks.[132] In 2016 alone, 90 percent of Asia Pacific businesses experienced some kind of cyber-attack.[133] Between 2013 and 2014, supervisory control and data acquisition attacks doubled worldwide, indicating the increasing vulnerability of cyber-physical infrastructure systems.

- Asian companies are at a high risk of future cyber-attacks.[134] In ASEAN, it takes an average of 184 days to identify a data breach and 65 days to contain it, signalling the need for better detection and response systems. The top 1,000 ASEAN companies are at risk of losing an estimated $975 billion in market capitalisation as a result of cybercrime.[122]

Personal health and ageing

The personal health and ageing industry provides older people and their families with a variety of services, allowing them to access appropriate levels of care as they age. These include, but are not limited to:

- face-to-face residential or at-home caring services

- emergency detection and response (e.g. home sensors or activity and location trackers)

- care management and navigation tools

- online health services and tools

- personal care products

The personal health and ageing sector is expected to grow as the ASEAN population continues to age rapidly (see Figure 9) and as the region's chronic disease burden grows. While care services are likely to continue to be delivered by larger, established companies with extensive experience and resources, there is significant opportunity for technology startups to develop supplementary services within this sector (e.g. apps and devices). For instance, Vietnamese startup *CLAS Healthcare* offers a range of services for both patients and medical providers, including electronic medical record management, image diagnostics management and storage, and an app allowing patients to easily book appointments with nearby available doctors.[135] Medical devices also represent a business opportunity – with the exception of Singapore, local ASEAN markets for medical devices are underdeveloped, and Vietnam, Indonesia, and Thailand all import more than 85 percent of their medical devices.[136] The ASEAN Medical Device Directive – an agreement to harmonise regional standards for medical device registration – also makes it easier for medical device manufacturers to expand from a national to a regional level.[136]
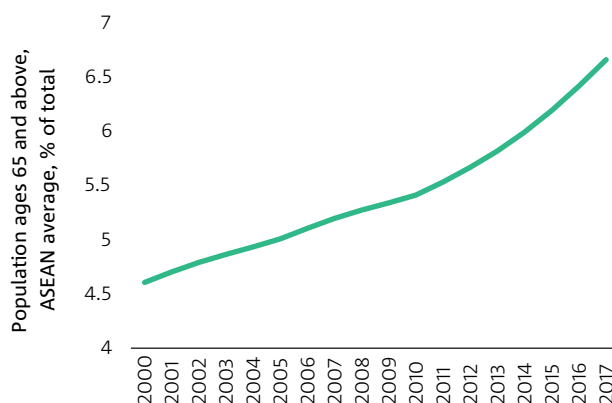

Figure 9. Average percentage of ASEAN population aged 65 and over

Data source: World Bank[138]

The following trends support future growth of this emerging industry in ASEAN and neighbouring economies:

SUPPLY

- The growing capability of technology to intersect with the body (e.g. tracking a wearer's heart rate or counting steps) provides a major opportunity for the development of individualised healthcare technologies. Digital technologies are also enabling new tools for the healthcare industry (e.g. electronic health records).

DEMAND

- Many ASEAN economies are transitioning from the developing to the developed world. This change has coincided with a shift in their disease burden from communicable to non-communicable diseases, driven by ageing populations and unhealthy lifestyle choices.[138]

- Between 1990 and 2010, coronary artery disease rates in Asia Pacific increased by 76 percent, lung cancer by 86 percent, and diabetes by 76 percent.[139] In 2010, overweight and obesity accounted for 3.4 million deaths, 3.9 percent of years of life lost, and 3.8 percent of disability-adjusted life-years worldwide.[140]

- The percentage of the ASEAN population aged 65 and above has been rising steeply (see Figure 9). In 2017, 6.6 percent of the ASEAN population was over 65, and by 2020 this is projected to rise to 7.8 percent.[141] In 2015, the average life expectancy in ASEAN was 72.8 years, up from 63.5 years in 2007.[*,142] Continually rising life expectancies will increase demand for products catering to older people.

- Population ageing is particularly prevalent in rural regions. Young people are increasingly migrating from rural to urban areas without their parents, which means that rural populations are ageing rapidly and there is decreased support for them as they age. This trend has been witnessed in China,[143] the Philippines,[144] and Vietnam.[145]

- Driven by its ageing population, increased prevalence of chronic disease, and rising costs of drug development, healthcare expenditure in ASEAN increased by 250 percent between 1998 and 2010.[141] Similar trends are seen globally, with worldwide healthcare spending forecast to increase by an average of 4.3 percent from 2015 to 2019.[14]

- Despite the demand for healthcare, hospital infrastructure in the region remains lacking, with hospitals in Asia and Australasia having just over two beds per 1000 people – the lowest rate in the world.[146] As the cost of care rises and infrastructure struggles to keep pace with demand, the healthcare industry is likely to shift toward preventive and value-based care.[147]

- The Asia Pacific consumer wearables market has grown 9 percent year-on-year, with 3.3 million units sold across developed markets in the region in 2017,[148] signifying increasing consumer demand for personalised health devices. On the healthcare industry side, the Asia Pacific electronic health records market is forecast to grow at a compound annual growth rate of 7 percent from 2017 to 2025, and globally, this industry is expected to reach $43.4 billion by 2025.[149] The Asia Pacific telehealth market (including telemedicine, remote patient monitoring, and mobile health) is similarly expected to grow, reaching $2.3 billion by 2020.[150]

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*Data were not available for Thailand.

Digital infrastructure and connectivity

Many of the industries discussed thus far will rely upon reliable and high-quality digital infrastructure to develop and expand. Digital infrastructure refers to the technologies and structures needed to ensure widespread internet connectivity across a particular region. These include, but are not limited to:

- fibre-optic backbone networks
- copper wire networks
- wireless microwave links
- satellite services
- submarine cables
- data centres
- mobile towers
- Internet of Things components e.g. sensors and actuators

Companies in this industry are responsible for designing, manufacturing, installing, and maintaining this infrastructure. Companies working in the digital infrastructure and connectivity industry are likely to be larger firms with significant material resources and experience.

Connectivity in ASEAN is relatively good – the Akamai State of the Internet report in 2017 found that Singapore, Thailand, Vietnam, Malaysia, Indonesia, and the Philippines* all had average connection speeds above 5 Mbps, and a combined average speed of 11.23 Mbps, compared to a global average connection speed of 7.2 Mbps.[151] Despite this, it was estimated in 2016 that 58 percent of the broader Asia Pacific region was still unconnected to the internet.[152] Given this, there is significant opportunity to provide backbone infrastructure to unconnected areas. In 2016, Laos had the lowest rate of individuals using the internet (21.87 percent), followed by Myanmar, Indonesia, and Cambodia at roughly 25 percent each.[153] Other ASEAN nations have better backbone infrastructure but may be in the market for improved or more advanced digital infrastructure, such as Internet of Things installations.
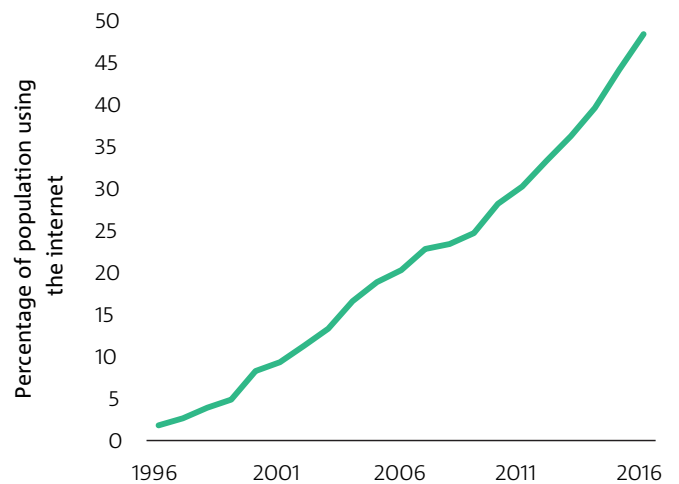

Figure 10. Percentage of population in ASEAN countries using the internet

Data source: World Bank Indicators[154]
Note: Complete time series data were not available for the following countries: Cambodia, Laos, and Myanmar

The following trends support future growth of this emerging industry in ASEAN and neighbouring economies:

SUPPLY

- ASEAN cross-governmental support for digital infrastructure is growing. 2015 saw the launch of the ASEAN ICT Master Plan 2020, which outlines a wide range of initiatives for improving connectivity within the region, including action points on ICT Infrastructure Development.[155] Regional harmonisation and governmental support is likely to aid the emergence of the digital infrastructure industry.

- Many digital infrastructure components are dropping in cost. The cost of generic computing power has decreased from $288 (for one million transistors) in 1992 to $0.08 in 2012. Over the same time period, the cost of data storage decreased from $739 per gigabyte to $0.04.[156] Internet of Things technologies are similarly dropping in cost, with sensor costs predicted to decrease from $1.69 in 2004 to $0.49 by 2020.[157]

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*Data were not available for the other ASEAN members.

DEMAND

- Demand for connectivity is growing. In the last twelve months, the Asia Pacific has seen six new users of the internet every second,[158] and has accounted for 70 percent of the 10 percent growth in internet users worldwide.[159] Steady growth in internet use is also seen across ASEAN countries (see Figure 10). The average broadband penetration in the Asia Pacific is expected to rise from 33 percent in 2015 to 38 percent in 2020, with smartphone penetration growing from 43 percent to 66 percent over the same period.[160]

- Mobile devices are preferred within the Asia Pacific. Over a third of the Asia Pacific population now uses mobile broadband.[161] In 2016, 43 percent of Asia Pacific internet traffic came from non-PC devices (e.g. TVs, smartphones, tablets) and machine-to-machine (M2M) modules.[127] These technologies have been adopted very quickly – for instance, the 2014 arrival of international mobile network operators in Myanmar saw the world's fastest rollout of mobile phones, with approximately 30 million SIM cards in use by mid-2015.[4]

- Between 2016 and 2021, the Asia Pacific's mobile traffic is expected to increase seven-fold, at which point the region will account for 47 percent of global mobile traffic – the largest share of traffic expected for any region.[162]

- As the number of internet users grow, so too does the demand for data. The region is forecasted to experience massive growth in smart device connectivity,[127] which uses higher volumes of data than non-smart devices.[162] As a result, data consumption in the Asia Pacific is forecast to grow by 30 to 60 percent per year between 2015 and 2020.[160]

- Growing data usage is fuelling a growing data services market. In 2016, the data services market within the Asia Pacific was valued at $15.6 billion, and this is forecast to grow by 27 percent per year, outpacing the European market by 2021.[160]

- Growth in digital technologies is also impacting the business landscape – a 2017 survey of Asia Pacific business leaders found that 80 percent believe they need to transform to a digital business for future growth.[163] Government and business spending on technological goods and services in the Asia Pacific region is predicted to grow by 3.3 percent in 2017 and 5.7 percent in 2018.[164]

- However, low-quality connectivity limits the adoption of more advanced digital technologies. For instance, in 2012, only 19 percent of retailers across key markets in the Asia Pacific region were evaluating the adoption of some form of cloud computing service.[165]

- There is significant price disparity across ASEAN – countries with good submarine cable connectivity, such as Singapore, pay less than $13 per Mbps per month, while countries with poorer infrastructure, such as Cambodia, Laos and Myanmar, pay up to $130 per Mbps per month.[166] The higher cost correlates with lower fixed broadband adoption rates.[167] Furthermore, backbone network connectivity and internet traffic exchange and management systems within ASEAN are notably inefficient.[168]

- There are also considerable regional disparities in broadband penetration. For example, Singapore has 26.5 fixed broadband subscriptions per 100 residents, but Vietnam has 8.1, Indonesia has 1.1, and Myanmar has just 0.3.[167] This 'digital divide' is likely to limit future expansion of the digital economy within ASEAN, but there is also opportunity for the digital infrastructure industry to bridge this divide.

5 CONCLUSION
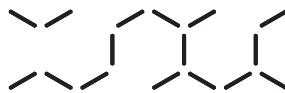
The ASEAN region is entering a period of significant change. As economies transition from industrial production to supply of services, middle-income populations grow, new technologies become available, and consumer preferences change, the industry makeup within ASEAN countries is likely to shift. This report points to some emerging industries that have the potential to reshape ASEAN economies in the decades to come. These sunrise industries reflect a change in supply and/or demand in the market, opening up opportunities for regional development and job creation.

Governments and other stakeholders must decide how best to capitalise on the benefits of the changing industry landscape. However, the importance of intra-regional collaboration in any strategy must be emphasised. Cooperation between economies to secure a regional comparative advantage has been shown to have positive impacts for economic development, allowing companies to improve efficiency, foster innovation through knowledge spill-over, and encourage business formation.[6] This cooperation can come in the form of coordinated and joint macroeconomic, infrastructure and industrial policies.[169]

Digital infrastructure is one area where regional collaboration is particularly important. Ensuring quality regional broadband access will be crucial to ensuring that the industries identified in this report are able to develop across the entire region. A notable future project is the Asia-Pacific Information Superhighway, which aims to create *"a seamless regional network of fibre optic cables to provide both intra-regional and intercontinental connectivity, in order to drive international bandwidth prices down and improve affordability; increase resilience by offering redundancy; decrease latency across the region; and enhance digital inclusion."*[170] To further support the emergence of digitally-enabled industries, other areas of potential regional collaboration and harmonisation include policies and laws on privacy, cybersecurity, and data protection; digital business regulation (especially digital payment systems); and educational efforts to address ASEAN's shortage of technically-skilled workers.[36,54] As ASEAN grows more interconnected, establishing a regional framework for cybersecurity will be particularly important. The development of an ASEAN Rapid Action Cybersecurity Framework has been recommended elsewhere.[122]

Regional collaboration may also include the deliberate creation of regional industry 'hubs'. While this report lacks scope to discuss these opportunities in comprehensive detail, we note that some ASEAN members already house thriving or high-potential sunrise industries (e.g. Singapore's FinTech industry or Thailand's organic agriculture industry), and that these existing strengths could be leveraged in further developing these industries at a regional level.

At the national level, there are two broad directions to take in facilitating the growth of new industries:

1. **Build architecture and remove barriers.** This approach involves creating a business-friendly environment by standardising regulations, addressing regulatory barriers, streamlining the business-founding process and investing in digital and physical infrastructure. This reflects a lower risk, lower reward approach. Benefits to the economy are broad, and industries that succeed are likely to be self-sufficient and require little governmental support in the long-term. The potential payoff associated with this approach is smaller, however, and the process of industry emergence is likely to be lengthier and less transformative.

2. **Strategically invest in a particular industry.** Another approach entails 'picking a winner' – choosing an emerging industry that is strategically suited to a given context and investing heavily in its development. The aim of this strategy is to utilise first-mover advantage to become a regional or global leader in a particular field. This approach is higher risk – investments may fail, optimal market conditions may cease, or a competitor may move faster and establish a dominant industry. However, with the right industry and policy levers, the potential payoff is significant.

Either of these strategies has the potential to deliver positive outcomes for economies and citizens within ASEAN. This report aims to contribute to the conversation by highlighting a set of emerging industries and providing the framework for strategic investment decisions that ensure future prosperity. It aims to inform government, industry and other stakeholders around potential future areas of growth, and assist decision makers in making strategic choices around the best ways to capitalise on the opportunities presented.

STRATEGIC INVESTMENT CASE STUDY: FINTECH IN SINGAPORE

As Singapore's economy became more digitised through the 2000s, high-tech start-ups emerged in collaboration with the country's advanced financial sector. In 2014 the Singaporean Government launched the Smart Nation strategy, aimed at introducing digital and advanced ICT technologies to policy processes as well as exploring potential industries that may emerge from such technologies.[171,172] One of these industries is FinTech, which has grown significantly in recent years.

Singapore's central bank, the Monetary Authority of Singapore, has a dedicated department called the 'FinTech and Innovation Group', whose directive is to facilitate the use of technology in the financial sector. Singapore also has a clear regulatory environment and legislative support for financial innovation. There is a strong culture of public-private cooperation in Singapore – the government Institute for Infocomm Research connects financial companies with scientists looking to commercialise their research, and in 2015 the Monetary Authority of Singapore announced plans to spend $225 million over five years to support the creation of innovation centres and digital technology projects within the banking sector.[173] The government is also taking steps to grow domestic FinTech talent, with the launch of two new coding schools, the review of polytechnic curricula to include FinTech skills, and a national SkillsFuture program including training vouchers, enhanced internships, career guidance, and matching programmes.[174] Since 2016, Singapore has hosted an annual FinTech Festival, which brings together startups, investors, financial institutions, and government agencies.

Although Singapore is itself a financial centre, its focus on FinTech demonstrates its commitment to innovations around its core industry, and positions it as a global leader able to meet the demands of the broader Asian financial sector.

6 APPENDIX
METHODOLOGY

Foresight methodology

This report incorporates insights gained via methods of strategic foresight. Strategic foresight is a cross-disciplinary field of study which aims to explore plausible futures that help people to make wiser choices. Over the past eight years the Data61 Insight Team, housed within one of CSIRO's business units, has developed a generic strategic foresight process pioneered through multiple megatrends, scenario planning and strategy projects delivered in diverse industry sectors.

The generic process draws upon numerous theories developed by researchers worldwide and on CSIRO's own practical experience in delivering many strategic foresight projects to private and public clients. The process of identifying megatrends has here been adapted to help identify the emerging markets discussed. Identifying emerging markets involves three key stages of the strategic foresight method.

In the first stage the process commenced with a background study and scope definition. The background study documented the current conditions, size, structure, opportunities and challenges within the ASEAN region. The scope defined the stakeholder groups, timeframe and issues to be considered throughout the remainder of the project.

In the second stage, trends were identified by a horizon scanning process. This cast a wide net over all patterns of change which are potentially relevant to stakeholders and decision makers, and grouped them as geopolitical, social, economic, environmental and technological. The horizon scan errs on the side of being overly inclusive rather than exclusive.

Processes of validation and screening were used at a secondary stage to remove any "by-catch" (i.e. trends which were unsubstantiated or irrelevant). The screening and validation process checked to ensure trends passed two tests: (1) evidence that the pattern of change is actually occurring and likely to continue occurring into the future, and (2) evidence that it matters to the decision maker. The process of validation often involved checking the proposed trend against datasets, expert opinions and research findings in journals to ensure accuracy.

In the third stage the trends were collated and synthesised to identify more salient patterns of change and possible future events which hold significant implications for decision makers. In this report, the synthesis yielded our list of seven emerging industries. These 'sunrise industries' and many of their composite trends were presented for discussion and validation at two stakeholder consultation workshops, which were held in Singapore and Ho Chi Minh City at the end of 2017.

GDP forecasting method

The method of estimation for 2018 and 2028 GDP forecast figures (in Table 1) is as follows.

1. GDP-level data for the relevant countries was derived from the IMF DataMapper, which provided measures in 2017 current prices and in billions of United States dollars (USD).

2. Actual figures of the time series data were available for the period between 1980 and 2016 (inclusive). Please note that for the following three countries, data were only available for the time periods defined: Brunei Darussalam (1985–2016), Cambodia (1986–2016) and Myanmar (1998–2016).

3. Out-of-sample forecasts were made for the GDP level of each country listed using an autoregressive model which predicts future behaviour based on past behaviour of time series data. This involved transforming available time series data (i.e. GDP level) into stationary data (i.e. GDP growth), and then regressing the transformed data on their own past values. The estimated model was then used to compute out-of-sample forecasts for GDP growth and GDP level.

4. All estimates were converted into Australian dollars (AUD) using a 2017 yearly average exchange rate, calculated from the Reserve Bank of Australia's data on the monthly average exchange rate between AUD/USD.

5. GDP per capita values were derived by dividing the forecast AUD figure of the relevant year by the forecasted population levels of that year. The value was then multiplied by 1,000,000,000 in order to yield values in ordinary terms (i.e. thousands, or hundreds of thousands of AUD per forecast year, per capita).

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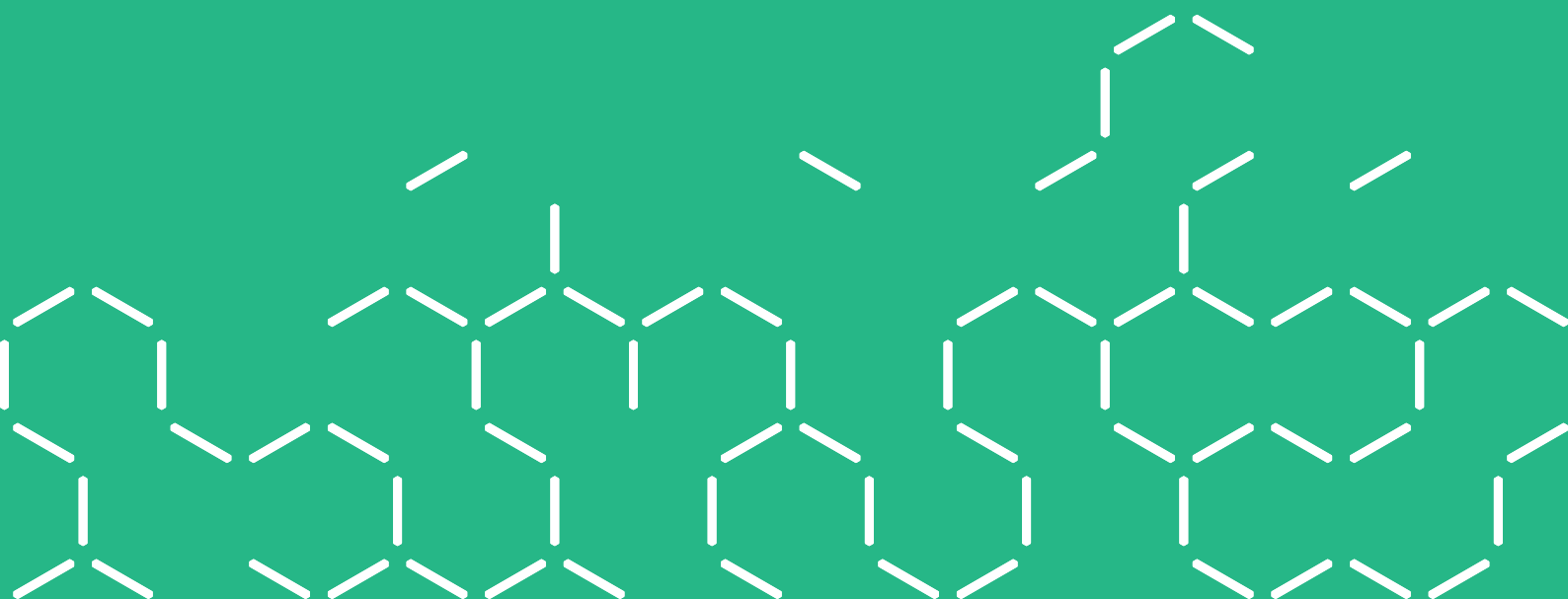
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