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Transforming and Deepening the ASEAN Community

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**ASEAN Vision 2040:
Towards a Bolder and Stronger
ASEAN Community**

Volume III

Transforming and Deepening the ASEAN Community

ASEAN Vision 2040: Towards a Bolder and Stronger ASEAN Community
Volume 3

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ERIA hopes that the recommendations in the report will help ASEAN Member States to step boldly forward and to strengthen ASEAN centrality and community, as the region will face ever greater challenges over the next 2 decades. As always, ERIA is ready to support ASEAN Member States to address the challenges and to realise the ASEAN Vision 2040.

Jakarta, March 2019

Hidetoshi Nishimura
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The Digital and Fourth Industrial Revolution and ASEAN Economic Transformation

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The vision for the Association of Southeast Asian Nations (ASEAN) economy in 2040 is one of a competitive, integrated, and digitally interconnected ASEAN characterised by (1) widespread adoption of modern technologies, including by micro, small, and medium-sized enterprises; (2) cross-border collaborative production networks supplying goods and services globally; (3) productive, innovative, and modernised agriculture, manufacturing, and services sectors; (4) a highly skilled and adaptable workforce; and (5) a flexible labour market, all of which is enabled by advanced infrastructure and smart regulations.

I.   Implications of Modern Technology

Technology is rapidly transforming the economic landscape around the world and in ASEAN. As always, we should welcome new technologies as a blessing rather than a curse and utilise them effectively for our economic development. In developed countries, the 'disruptive' nature of technologies tends to be emphasised. People worry about a situation in which machines would substitute humans in various economic activities. With slow economic growth, industrial adjustments and labour

replacements may well be costly in developed countries. But ASEAN is different. The economies of the ASEAN Member States (AMS) are steadily growing. Most of the AMS still have a young population who are growing up in a technological age. People do not have to stick to their current jobs and are willing to switch to better jobs. We can think of growth rather than adjustments. Our strength resides in our adaptability.

We cannot predict exactly what would happen by the year of 2040: there is much uncertainty about the advancement of new technologies and its consequences. And we must realise that most of the AMS are not at the very frontier of technological innovation. Thus, the question for us is how to utilise new technologies for our economic development and accelerate our catching-up.

Broadly, AMS will need to enhance their existing comparative advantage by encouraging purposeful adoption of technology, which will generate high-value employment. For AMS with high wages, this means aggressively switching to labour-saving technology, retraining their workforce, and moving up the value chain. Others need to continue infrastructure development, domestic reforms, and trade liberalisation to attract labour-intensive production processes, while gradually modernising the production processes by adopting Industry 4.0. At the same time, they can also exploit the potential of third unbundling to create dynamic modern sectors.

Concurrently with technological changes, the ASEAN economy itself continues to grow. With higher incomes, consumers demand greater variety and higher quality goods and services. Modern technology, coupled with greater physical connectivity, will enable them to source these goods from anywhere in the world. The challenge will be to ensure that ASEAN producers are positioned to meet these demands cost-effectively by producing innovative products and adding greater value. Micro, small, and medium-sized enterprises, the mainstay of the ASEAN economy, will need to adopt new technology to improve their productivity and remain competitive. This will require concerted efforts

to counteract the increased competition from early adopters of modern technology.

These new technologies will impact all aspects of the ASEAN vision that has been articulated in the AEC Blueprint 2025. The AEC Blueprint 2025 envisions a 'highly integrated and cohesive economy' characterised by a 'seamless movement of goods, services, investment, capital, and skilled labour', with the goal to 'enhance ASEAN's trade and production networks' and 'establish a more unified market for its firms and consumers'. As technology will make geographic proximity less relevant in many areas of trade and production networks, institutional coordination and collaboration across AMS will be crucial to maintain a cohesive ASEAN economy. ASEAN will need to move strategically to harness the opportunities afforded by new technology while also meeting the challenges posed.

Furthermore, technology will directly challenge one of the key pillars of ASEAN community: leaving no-one behind. While the fear of widespread job losses may be exaggerated, it is clear that the future ASEAN economy will inevitably require greater human capital. The relative demand for skilled workers will naturally increase wages for skilled workers, incentivising greater efforts towards acquiring skills. But the region needs concrete steps to increase access to skills training for everyone within ASEAN by developing modern educational infrastructure. There may still be some part of the low-skilled population unable to respond to the slower growth in low-skilled jobs, which will require designing social protection policies.

II. Two Faces of New Technologies

Information technology (IT) and communication technology (CT) comprise two facets of technology. Although both come from the same technological resources, their implications for the international division of labour may differ widely. Aghion, Bloom, and Van Reenen (2014) originally proposed the concept of IT and CT to understand the internal organisation of firms. Baldwin (2016) adapted the concept so it could

be applied to the coming transformation of the international division of labour. We further apply Baldwin's idea to the situation in the AMS.

Information technology includes artificial intelligence (AI), robotics, data processing, and machine learning that can be applied in the production of goods and services. IT permeates through all aspects of production, from marketing, research, and design to industrial processing, to inventory management. These basically speed up data processing, economise the process of production and distribution, reduce the number of tasks, and thus may generate a concentration of forces in economic activities. For example, in the future, a large proportion of manufacturing activities may go back to a few specific developed countries such as Germany.

IT applied to the production process of existing industries can improve productivity by reducing the number of tasks and substituting human labour in conducting many routine non-cognitive tasks more efficiently. On the one hand, lower cost of production will make firms more competitive, and make goods available at lower prices for consumers. On the other hand, some jobs may become obsolete: There has been much discussion about the 'future of work' in light of current technological changes.[1] The McKinsey Global Institute (2017) estimated that as much as 50% of jobs are technically feasible for automation, but only 15% of jobs may actually be replaced due to economic feasibility. IT also enables creation of new products and services in data-driven analytics and management.

Communication technology such as Internet and smartphone connect people and overcome distance. Internet, smartphones, and soon coming 5G represent CT. CT lowers the cost of communication and reduces distance. Face-to-face interaction, usually requiring physical movement of people, can now be done virtually due to expanding broadband connectivity and availability of low-cost smartphones, allowing ideas to be shared over longer distances in real time.

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[1]   Asian Development Bank (2018) and World Bank (2018) are two examples.

From a production perspective, the ability to coordinate tasks from afar allows production processes to be further subdivided and distributed across space, creating opportunities for finer degrees of specialisation. CT tends to encourage the division of labour, both domestically and internationally, and generate dispersion forces in economic activities. Matching costs in business to consumer (B-to-C) and consumer to consumer (C-to-C) transactions or communications are now drastically reduced, which generates various new businesses in both developed and developing countries. Domestic and global value chains of production and consumption could be further expanded and deepened with CT. Services would be detached from a firm and be outsourced with CT, which may eventually lead to the third unbundling (Baldwin, 2016) or cross-border service outsourcing. Differences in economic conditions such as wage levels and specialised skills may be further exploited in the international division of labour.

These technologies will continue to become cheaper for both producers and consumers, leading to greater proliferation. Concentration forces and dispersion forces – which would be dominant in the future? We cannot be sure right now, but what the AMS have to do is obvious: think of various applications of IT while aggressively utilising CT to generate new businesses. As with any new technology, IT and CT create opportunities for innovation that lead to creation of new goods and services, new markets, new methods of production, new combinations of factors of production, and new markets. These imply that new industries and jobs will be created. At the same time, existing industries will be transformed and made more productive.

III. Economic Landscape

A. Information technology and the Fourth Industrial Revolution

A good framework to understand what lies ahead is to remind ourselves about where technology fits in the overall organisation of production and consumption. Numerous books have been written on the topic of technological revolutions. In a recent book on Artificial Intelligence, the authors note that new technologies will continue to emerge, but the economic fundamentals will not change much. Reminiscing about the

hype surrounding the expansion of the Internet in mid-1990s, Agarwal et al. (2018) wrote that

> '[Economists] did not see a new economy or a new economics. To economists, this looked like the regular old economy. To be sure, some important changes had occurred. Goods and services could be distributed digitally. Communication was easy. And you could find information with the click of a search button. But you could do all of these things before. What had changed was that you could now do them cheaply.'

In the context of economic transformation, perhaps the most pertinent question to ask of new technology is: what sort of costs are reduced by new technology? This in turn determines how businesses of the future are going to employ new technology. Current thinking on this topic is varied, but there are some fundamental principles at play (Agarwal, 2018). The adoption of any given technology by firms depends on how it changes the cost, assuming that demand conditions do not change. First, processes that are directly relevant to the technology are affected. Second, other processes are modified to make greater use of cost-saving technology. Third, use of complementary processes is expanded, and substitute processes are discarded.

In other words, the biggest economic consequence of modern technology is its widespread use where it is economically feasible. Production processes themselves will undergo massive changes in the next few decades. As much as new types of products and sectors are created, traditional sectors can also benefit from application of modern technology. Farmers can obtain precise information about markets, soil quality, and weather through their smartphone, use sensors to monitor their crops, and sell directly to consumers over the Internet. Better inventory management will lower the cost of producing and delivering perishable agricultural products by decreasing waste. Farmers can also use self-driving tractors to harvest quickly and efficiently.

Factories will become a lot more automated, with robots performing almost all the routine tasks and production taking place through 3D printing. Entrepreneurs will be looking for better ways to organise production in light of modern technology. These may include increasing the share of tasks performed by machines. In developed countries, the substitution of machines and human beings has already started and its possible implications have been a cause of great concern. The applicability of machines occurs at the micro level, and thus accurate predictions are difficult to make. Even though new technology emerges rapidly, its adoption in ASEAN will depend on trends in wages and availability of human resources.

Basically, manual and/or routine jobs are first replaced by machines, and the middle range of human capital, rather than the high or low range, seems to experience some negative effects. A report by the Asian Development Bank (2018) cites examples of the apparel and footwear industry – a mainstay in ASEAN manufacturing – that is already experimenting with automated production. However, at the same time, net loss of jobs does not seem to be large, at least so far. Rather, many new jobs are created, and there may in fact be net gains generated in the numbers of jobs (Autor, 2014). In newly developed and developing countries, the replacement of labour by machines seems to come at a slower pace than in developed countries because relatively low wage levels reduce the substitutability (Hallward-Driemeier and Nayyar, 2018; ADB, 2018). As routine low-skilled tasks get substituted away, demand for cognitive and non-cognitive skills will rise.

It may not be easy for the AMS to compete at the very frontier of IT development in the short run. The development of IT is costly and highly human capital-intensive, requiring the accumulation of research and development (R&D). International competition is harsh. Therefore, from the viewpoint of newly developed economies, rather than infusing our precious resources for R&D into such competition, we may want to follow the advancement of IT closely and concentrate on its applications. A wide range of applications of piecemeal technologies must be possible. It should be noted that technology-intensive production processes may need to be organised differently than traditional production processes, requiring process innovation.

B.   Communications Technology and the Third Unbundling

Baldwin (2016) provides a useful way of thinking about impact of technological changes on economic globalisation, which determines the geographic structure of production and consumption. The author views historical trends in globalisation as progressive reductions in the costs of moving goods, ideas, and people. The first phase of globalisation, 'the first unbundling', was a consequence of declining transport cost, which made moving goods across countries profitable. Still, production was concentrated within the same country (or regions within a country) due to coordination cost.

Since the 1990s, improvement in information and communication technology reduced the cost of moving ideas, so that production processes could be linked, and therefore dispersed, across longer distances. One distinguishing feature of globalisation during the second unbundling is the mixing and matching of national competitive advantages led by multinational firms looking for the most cost-effective way to combine various production-related tasks. Firms in developed countries off-shored the labour-intensive parts of the production process to low-wage countries. Baldwin (2016) deemed this the 'second unbundling'. Many countries in ASEAN were direct beneficiaries of such production fragmentation. However, coordination still required movement of people during this phase, which limited the extent to which production would be fragmented. Geographic proximity still mattered, limiting offshoring largely to nearby countries.

The current frontier of technology is the reduction in cost of moving people (virtually). With modern technology making face-to-face interaction cheaper across longer distances, physical movement of people may no longer be necessary. As such, the production process can be further decomposed and combined across countries. The result will be a 'third unbundling', where tasks that comprise a smaller part of production may be performed in different locations. One important consequence of the third unbundling is that a country's comparative advantage may lie in a small part of the production process, which can be combined with advantages of other countries in complex ways.

Although the development of technologies is mostly done in developed countries, the penetration of CT-related businesses is worldwide, including newly developed and developing countries. Thanks to the lenient regulatory framework, the introduction of new businesses is sometimes quicker in the latter than in the former. Various business models are already in the AMS and are rapidly growing. CT affects the way producers and consumers interact to buy and sell goods. E-commerce, already representing a growing mode of acquiring goods and services, will proliferate as more producers sell their goods over the Internet directly to customers. This has the potential to expand the reach of small retailers to not only other locations within the country, but also to foreign consumers.

Platformers, which provide platform websites for search engines, social media, provider-consumer matching, e-commerce, e-payments, and others, include both international giants and domestic players. On platforms, various applications are developed by a lot of foreign and domestic start-ups. New participants in matching services and e-commerce, both providers of goods and services and buyers of them, have come into markets. Gaps between urban and rural are much smaller than in traditional communications and transactions though it is probably biased towards the young population rather than the established old generation. CT provides a new scope of equitable development.

Most of the new businesses are categorised as services. However, the manufacturing sector and even more traditional industries such as agriculture and fishery have started using piecemeal communication technologies and have tried to transform their businesses. For example, CT helps improve B-to-B coordination in domestic and global value chains in machinery industries. Even agriculture and fishery have a lot of potential to upgrade their activities with smartphones. Furthermore, the nature and ingredients of the manufacturing sector and others become more service-intensive, which is sometimes called 'servicification'. Both IT and CT accelerate such transformation of industries.

In applying CT, there is no fundamental difference between domestic and cross-border transactions. Indeed, communications and transactions

already go beyond national borders, with some friction and regulatory restrictions. Baldwin (2016) predicted that the reduction in face-to-face costs would soon develop a new form of international division of labour, i.e. the third unbundling or cross-border service outsourcing. In the second unbundling, we had the task-wise international division of labour. Now in the third unbundling, one task may be fragmented to individuals located in different countries. The level of human capability may not differ much even if a person lives in either a developed or developing country. On the other hand, wage gaps between developed and developing countries may remain in the near future. Once matching costs in service outsourcing are further reduced due to efficient platform services, translation software, and e-payments, the international division of labour at the individual level may develop as one of the major forms of international transactions.

AMS should take advantage of CT much more aggressively. Although the usage of CT has so far advanced mainly with private activities, the government of AMS must play a supplementary role in further exploiting opportunities provided by CT for economic development. Key policies are threefold.

The first is the infrastructure provision for digital connectivity. Many people worry about the digital divide between urban and rural areas and between rich and poor people. Such concern must be addressed. However, as for the digital connectivity, we observe that disparity can be much smaller than what other types of physical connectivity would generate. Even people in rural areas would like to have a smartphone, and many of them already have one. CT may be a powerful tool for promoting inclusiveness. And, actually, the deployment of digital connectivity can be mostly done by private investment rather than by huge public expenditure. The role of the government may be limited to providing trunk lines and activating private Internet providers properly. Now most of the AMS are in the process of expanding 4G to the whole country. The next challenge is to upgrade the digital connection to 5G. It is an already established technology, and the AMS must prepare for it urgently. It is important to catch up with or even lead the worldwide shift to 5G.

The second is policies on jobs and human capital. To aggressively utilise CT, we certainly need computer programmers, computer engineers, and entrepreneurs for new businesses, and thus it is obvious for the government to expand the high education programme to meet such demand for a new set of human capital. On the other hand, platform users may not be college graduates, which may make another possible channel for inclusiveness open. Impacts of CT on the demand for human capital may be much more unpredictable and complicated. This suggests that the upgrading of general education is continuously important for taking advantage of CT.

Third, most importantly, the government must provide a proper regulatory framework for the private dynamism of the CT usage. To further activate new businesses, the government may want to help start-ups, at least not bother them.

And the policy environment for 'almost' free flow of data with 'minimal' restriction must be achieved. Free flow of data, both domestic and cross-border, is crucial for invigorating CT-related businesses. However, the flow of data cannot be completely free. We have to take care of a series of people's concerns. With proper back-up policies, we can take advantage of the advancement of CT.

C.   Structural Change

As the ASEAN economy grows, it will continue to undergo structural transformation away from agriculture towards the services sector. The role of the services sector will expand – both as consumption goods and as inputs to agriculture and industry – where many of the workers will be employed. This is generally the case at higher levels of economic development, but due to the consequences of technological change, this process is likely to be different from earlier periods. Early industrialisers in ASEAN like Malaysia and Thailand were able to create low-skilled manufacturing jobs that allowed workers to transition directly from agriculture, enabling low- skilled workers to earn higher wages outside agriculture. Such transition is going to be more difficult as new technology shrinks the availability of low-skilled jobs. Workers will need

to develop higher levels of skills beforehand to succeed in the new labour market.

As its employment share increases, the services sector will also feature greater use of modern technology. For example, self-driving cars that are currently under development will revamp the transportation industry. Greater utilisation of modern technology will increase productivity and allow service providers to reach customers easily. Human capital development will again be an important policy priority area to manage the structural change in an era dominated by technology.

D.   Gig economy

Improvements in CT has also enabled proliferation of new forms of employment, broadly called the 'gig economy'. Ride-hailing services such as Uber, Go-Jek, and Grab are popular examples. These services provide a platform for customers and service-providers to interact over the Internet and perform specific tasks. The workers are essentially 'freelance' workers and paid according to tasks performed. These types of task-based hiring are appealing due to its flexibility and ease of use. Thus, this form of labour relation is likely to expand in the future.

This allows for more flexibility, but also brings with it more challenges. It is harder to enforce labour laws as these workers are classified as contractors rather than employees. The security and pensions that comes with traditional forms of employment are no longer available. Governments need creative solutions to ensure that vulnerable employees are adequately protected, and their future secured, without stifling innovation.

IV. ASEAN During the First and Second Unbundling

Since technological change has been occurring at different speeds throughout history, it is instructive to analyse how ASEAN fared during earlier periods of globalisation. ASEAN was conceived during an era of

globalisation when import-substitution and domestic industrialisation were the popular domestic strategies to foster economic growth.[2] At its conception, ASEAN was predominantly a platform for political cooperation and fostering peace in the region. During this time, tariffs were high and the political attitude was protectionist, so production mostly took place for home consumption with exports as an added bonus. The size of the home market was a crucial determinant of production. The emergence of the second unbundling coincided with the success of export-led economic growth strategy in East Asia, market-oriented reforms in many countries of the region, and expansion of ASEAN from five to 10 members by 1999.

Economic development strategy in the region during the second unbundling period was designed to attract foreign direct investment in the labour-intensive manufacturing sector. Many ASEAN Member States transformed themselves into a manufacturing base. Thailand, Viet Nam, Malaysia, and to a lesser extent, Indonesia, took advantage of low-cost labour to attract foreign, mostly Japanese, businesses to establish labour-intensive manufacturing processes in their countries. Since distance mattered a lot during the second unbundling due to the cost of moving people, ASEAN countries had the advantage of proximity over Japan and the Republic of Korea, which allowed them to be a primary destination for FDI from these early industrialisers in Asia (Baldwin, 2016). This was enabled by trade and investment liberalisation, domestic policy reforms, and special incentives to attract foreign businesses in strategic sectors. The rapid growth and economic transformation of the region since the 1980s is a manifestation of the second unbundling. ASEAN economies are participating in international production networks to varying degrees.

Reductions in tariffs were pushed to expand foreign markets for domestically produced goods. Liberalisation of international trade complemented the fragmentation of production process enabled by technology. The ASEAN Free Trade Area (AFTA) was signed in 1992. This was also a time when ASEAN looked to expand integration with rest of Asia, forming ASEAN Plus Three with China, Japan, and the Republic of

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[2]   Baldwin (2016) dated the periods of the first unbundling from the start of industrial revolution in Europe during the 1800s to the 1980s.

Korea in 1997, then expanding it as ASEAN Plus Six to include Australia, India, and New Zealand. Much effort has been made to foster closer economic ties in the region, with the ASEAN Economic Community (AEC) established in 2015 and the launching of free trade area negotiations amongst the ASEAN Plus Six members, called the Regional Comprehensive Economic Partnership (RCEP).

The pace of growth in AMS during this period was uneven. As a result, some AMS are currently in a better position to adopt digital technology due to their deeper engagement in the current technology frontier, partly arising from their different levels of engagement with global value chains. Agriculture remains an important sector in Lao PDR and Myanmar, employing over 50% of the workforce in 2017. These countries need to focus on using new technology to upgrade these primary sectors, while looking for ways to manage their transition into modern sectors. Countries like Thailand and Singapore have already initiated forward-looking responses to new technology in the form of 'Thailand 4.0' and 'Singapore Mobility 2030'. Others are still focused on adopting the opportunities afforded by the first and second unbundling. Such differences across economies are likely to persist.

V. Challenges for ASEAN

A. Growth Strategies of First and Second Unbundling Are No Longer Sufficient

Since the mid-1980s, the AMS have aggressively taken advantage of the second unbundling or the task-wise international division of labour, particularly in the machinery industries, in their development strategies. From now on, to maintain international competitiveness and climb up the value chain ladders, the partial application of new technologies such as robotics, 3D printing, and the Internet of Things (IoT) cannot be avoided, even though replacement of the entire production by machines may not occur any time soon. Various IT technologies must be applied in the service industries.

The new industrial revolution requires taking a fresh look at what policies are effective. As Baldwin (2016) pointed out, high tariffs on imports made logical sense in an environment characterised by the first unbundling, where entire production process took place within the same country. But the second unbundling rendered this counterproductive as high tariffs would make imported parts and components more expensive for domestic producers. Policymakers now embrace trade liberalisation as a way to enhance the competitiveness of their own economies. Today, policymakers are still reluctant to liberalise the services sector or reduce barriers to movement of skills. This could prove to be anachronistic in tomorrow's world defined by widespread access to technology and deep people-to-people connectivity. Therefore, reconsidering the role of services liberalisation and skills mobility in the future growth of the ASEAN economy will be important.

It will be more difficult to identify winners and losers from globalisation, and therefore even harder to adopt protective economic policies that purport to protect specific groups. As the international production networks become more complex, policies that made sense during the second unbundling, such as Special Economic Zones, would be far from sufficient. The third unbundling reduces governments' ability to target specific sectors or groups with their industrial policy, for example by providing tariff reductions for certain 'priority' goods and services. Rather, a whole-of-economy approach to make the country business-friendly will be necessary. Competitiveness will be determined by cross-cutting economic and policy environment fundamentals rather than incentives provided in certain sectors. As businesses look to lower cost by allocating tasks across countries, people-to-people, greater connectivity (physical, institutional and people-to-people), and cooperation and coordination across countries will be necessary.

Related policies are twofold. First, the introduction of new technologies and capital investment must be mildly promoted. The most serious market failure is incomplete information in which proper technologies may not be known amongst entrepreneurs and thus chances for their timely introduction tend to be lost. The government and public research institutes should play an active role in disseminating proper information on new technologies. In addition, some AMS have already started

applying a subsidy or tax reduction for promoting the introduction of robots. It may make sense to countervail market failure in the form of dynamic economies of scale or incomplete information. However, too strong government intervention would become distortive for a good balance between labour and machines. It is in any case necessary to promote capital investment in general.

Second, related to human capital, it is clear that computer programmers, computer engineers, and entrepreneurs will be in high demand. Upgrading higher education, both in quantity and quality, is essential. Beyond that, what sort of human capital would be complementary with machines? Although it is difficult to predict how the substitution of labour by machines will proceed, manual and routine jobs seem likely to disappear sooner, whereas cognitive, non-routine, flexible, multi-task jobs would survive. Formal education, on-the-job training, and adult education may need to be redirected to smooth out labour supply adjustments and fill the demand for new businesses.

While it is important for all AMS to recognise the importance of digital technology, some will have to focus on closing the gap with current frontier technology. This means adopting a gradual development strategy: further developing traditional industries with comparative advantage, removing domestic barriers to sectoral connectivity, creating linkages with existing production networks, and applying institutional reforms. Nonetheless, exploring ways to inject the latest technology into these areas will help the process along. At the same time, there is no reason to believe that some AMS cannot 'leapfrog' by directly adopting the most cutting-edge production methods and technologies, or by gradual step-by-step upgrading (Kimura, 2017).

B.   Technology Adoption

Innovation will be a key feature of the new industrial revolution. Businesses will need to compete with one another by lowering cost and improving efficiency in the use of technology. Some examples include using big data to research consumer demand and computers to manage inventory. Businesses will have to constantly experiment and adapt,

requiring good entrepreneurial skills. AMS must strive for an economic environment where businesses and individuals are applying their creativity to solve problems and discover new ideas. While improvement has been steady, technology adoption is vastly different across ASEAN. For example, 80% of individuals in Singapore used the Internet in 2015, compared to 20% in Lao PDR.[3] At the same time, Asia is at the forefront of technology usage. For example, 65% of industrial robots are in Asia.[4] The region is also at the forefront of technology production, with Japan and the Republic of Korea leading in robotics.

Adoption of new technology is not merely a matter of substituting some human-performed tasks with computers. It also requires the entrepreneur to rethink the business strategy. Currently, only large firms are adopting modern technology such as digital technology[5] and artificial intelligence[6] in ASEAN.

During the second unbundling, ICT innovation allowed the production tasks to be dispersed geographically. This required a different type of production process – one that allowed various parts to be seamlessly assembled. For such innovation to be possible, it is necessary to have an adequate supply of human capital comfortable working with technology. As such, it will be important for an economy to provide opportunities and incentives to improve people's skills. The essential elements include education infrastructure, on-the-job training, and entrepreneurship.

A good policy environment becomes indispensable for a modern economy characterised by the third unbundling and industry 4.0. Because everything is moving faster, policy bottlenecks can be detrimental to innovation. Therefore, AMS governments should aim to reduce transactions cost associated with rules and regulations, and make the

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[3] http://asean.org/storage/2017/09/Ch.2_The-Future-of-Technology-Opportunities-for-ASEAN-in-Digital-Economy.pdf

[4] https://www.weforum.org/agenda/2018/09/chart-of-the-week-invest-in-robots-and-people-in-asia

[5] https://www.businesstimes.com.sg/top-stories/smes-can-lift-asean-gdp-by-us11t-with-tech-adoption-bain

[6] https://www.computerweekly.com/news/252444634/Indonesia-leads-ASEAN-region-in-AI-adoption

government nimble, ready to adapt to changing circumstances. This has to be balanced with the importance of policy innovations in the areas of consumer protection and data privacy.

C.   Ensuring Dynamism of Small and Medium-sized Enterprises

Small and medium-sized enterprises (SMEs) are the backbone of ASEAN economies, employing a large fraction of its workforce. At the same time, they are usually lagging in technology adoption and innovation, which has mostly come from large multinational enterprises. SMEs face additional opportunities as lower cost makes technology more accessible to all, including small enterprises. Additionally, CT also makes engaging in international value chains easier by connecting small businesses across space. At the same time, changing patterns of demand from consumers and increased competition in an integrated global economy will make technology adoption indispensable for small firms to thrive.
ASEAN countries must ensure that its SMEs are utilising the latest technology to upgrade their production process and expand their market. Singapore is already experimenting with grants to encourage SMEs to adopt new technology – albeit to address the issue of labour shortage. AMS can expand such efforts to achieve a wider set of economic objectives such as making SMEs a dynamic growth centre of the ASEAN economy.

D.   The Future of Work

With technology adoption and economic growth, the structure of labour demand will change. The changes include creation of new jobs and the obsolescence of some existing jobs, and relatively greater demand for skilled workers. One major concern about new technology is the increasing automation of tasks performed by labour. The increased competition with automation will lead to absolute or relative decline in wages of workers. To prepare for the upcoming changes to the labour market, it is important for policymakers to understand how technology will affect labour markets. Replacement of human labour by technology does not necessary lead to unemployment, as predicted during earlier waves of technological changes (Acemoglu and Restropo, 2018).

Nonetheless, it is clear that new jobs will require use of higher-order cognitive capacities rather than manual labour, and this set of skills is largely acquired rather than naturally endowed. This brings the focus squarely on the education system that is preparing workers for the technological changes. The implication is that some segments of the population may be left out, which calls for a strong social protection.

Another change is in the relation between employers and employees. With the rise of the 'gig economy', traditional employment relations will no longer be the norm in the labour market. This requires some changes in labour market policies as well. Workers need a flexible work arrangement coupled with opportunities for upskilling. AMS should aim for labour regulation that strikes a balance between protection and flexibility.

The Human Capital Index (HCI), newly launched by the World Bank, attempts to gauge the amount of human capital children born today can expect to achieve when they are 18 years old, relative to the ideal scenario of full education and health. The index comprises of indicators of mortality, education quality, and health. For Southeast Asia, the index ranges from 0.45 for Lao PDR to 0.88 for Singapore and correlates with the level of economic development. This is interpreted to mean that given the current provision of health and education, the productivity of a child born today in Lao PDR is expected to be 45% of the ideal condition. This indicates that much needs to be done by ASEAN countries to ensure that workers of the future are prepared for the new economic conditions that they will face.

VI. Way Forward

With the help of modern technology, ASEAN has the potential to become a dynamic growth region supplying goods and services globally and generating fulfilling jobs for its workforce. ASEAN in 2040 should aim for a wide adoption of the new technologies to upgrade their economies. It is also possible to modernise traditional industry by use of technology. Any development strategy will require connectivity through improvements in soft and hard infrastructure. Some mild industrial policies may be

necessary to put ASEAN on the correct path, particularly to help SMEs adopt new technologies.

For this vision to be realised, AMS need to improve the skill base to suit the needs of new industry so that everyone can participate in the new economic structure. Success in the technological era requires entrepreneurial spirit and cross-border flow of ideas and information, workers with cognitive and non-cognitive ('soft') skills, a workforce comfortable with using modern technology, and connectivity within and between AMS enabled by a fully developed IT infrastructure.

The costs of technology have come down very rapidly, following breakthroughs that allowed for more powerful technology in low-cost consumer devices. The share of the population using the Internet was below 40% in Singapore in 2000; now it is above that in six of the 10 ASEAN countries. Widespread adoption enables innovation to come from any corner and synergies to be formed between any two entities. To take advantage of these, growth strategies have to be adjusted. Liberalisation of services has moved slowly, and skills mobility remains weak. Both of these will be crucial during the third unbundling.

ASEAN's movement towards a technology-dominated economy has to be supported by a regulatory environment that provides a conducive legal and institutional environment that encourages innovation but protects consumers and producers. So far, back-up policies for CT-related businesses are highly fragmented across countries. It is even difficult to find best practices in the world. However, the stocktaking of back-up policies should certainly be useful for the policymaking of AMS. The logic of regulation must be clarified to avoid inefficient and excessive regulation. Otherwise, the introduction of CT would be delayed by redundant regulations.

Moreover, a policy environment for an 'almost' free flow of data with 'minimal' restrictions must be achieved. Free flow of data, both domestic and cross-border, is crucial for invigorating CT-related businesses. Yet, the flow of data cannot be completely free as a number of people's

concerns have to be taken into account. Back-up policies include consumer protection; privacy protection; the 'general exceptions' such as culture preservation, public morals, and public health; intellectual property protection; non-discrimination and tariffs; and cyber-security. In a wider scope, competition policy, taxation, and statistics may also need to be adjusted for the CT-related activities. To take advantage of CT, the proper level of regulation, rather than too lenient or unnecessarily excessive, is crucial.

So far, back-up policies for CT-related businesses are highly fragmented across countries. Even worldwide, it is difficult to find best practices. However, the stocktaking of back-up policies should certainly be useful for the AMS in their policymaking. The logic of regulation must be clarified to avoid inefficient and excessive regulation. Otherwise, the introduction of CT would be delayed by redundant regulations.

The fragmented regulatory regime is costly particularly for countries small in size. International cooperation and rule-making are very important. International organisations and various economic gatherings such as the World Trade Organization (WTO), United Nations (UN), Asia-Pacific Economic Cooperation (APEC), and others have recently been seeking a common denominator for a desirable regulatory framework in the era of the digital economy. But such efforts will take considerable time and effort to bear fruit. Even the United States and the European Union cannot easily reach agreement on a number of important issues, let alone some of the big newly developed economies such as China and India. Thus, ASEAN can be an important forum to take stock of the current fragmented policies and come up with best practices to boost the digital economy for AMS.

ASEAN should harmonise regulations, accelerate service liberalisation, and foster greater regulatory cooperation to leverage economic diversity into competitiveness through closer integration. Exchange of information through the ASEAN Single Window and a liberal services trade and investment regime will be key ingredient for success.

ASEAN Member States will achieve middle- and high-income status in the next 2 decades. In addition, the region enjoys proximity to the rapidly growing economies of China and India, which can serve as a large consumer base for Southeast Asian products and services. Therefore, a closer economic integration will generate opportunities for producers in ASEAN. ASEAN will have to accelerate coordinated reforms to develop itself as a single production base in the era of the third unbundling through technological connectivity across member states. This will be crucial for maintaining ASEAN centrality.

Going forward, existing differences across ASEAN Member States need to be taken into account, as these differences have implications for countries' economic policy. Diversity in ASEAN could be a source of competitive strength. Lagging countries could focus on the labour-intensive part of the production process and gradually improve their technology. In some areas, they can cooperate with technological leaders to move ahead faster. Finally, AMS should work together to manage anti-globalisation sentiments by ensuring that the benefits of new technology can be felt by the entire population.

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Innovation for ASEAN 2040

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Discussion Points

- How will the Association of Southeast Asian Nations (ASEAN) and ASEAN Member States (AMS) be able to have economic prosperity up to 2040 through a drive towards an innovative ASEAN?
- Given that most AMS fall far below Northeast Asian countries and even India, how can they markedly strengthen their innovation capability and innovation ecosystems?
- What is the nexus of policies, institutions, firms and clusters, linkages and collaborations, multinational companies, foreign direct investment and trade, finance, incentives, human capital, entrepreneurship, intellectual property rights, etc. in furthering innovation in ASEAN for the global and regional markets?
- How would the drive for an innovative AMS and ASEAN benefit everybody in the region (i.e. be inclusive)?

1. Background

In considering the development of the Association of Southeast Asian Nations (ASEAN) towards 2040, concern is growing that ASEAN Member States (AMS), particularly Malaysia and Thailand, will fall into the so-called 'middle-income trap', where their growth in gross domestic product (GDP) per capita stagnates at the upper middle-income level[1] for a prolonged period after achieving a certain level of economic development (Griffith, 2011). Figure 1 shows the comparison of the highest average real GDP growth rates achieved over a 20-year period before 2005 versus the 10-year average growth rate during 2005–2014. Several AMS – Brunei Darussalam (hereafter, Brunei), Malaysia, Singapore, and Thailand – finished their high-speed growth periods more than a decade ago, while Cambodia, Indonesia, the Lao People's Democratic Republic (Lao PDR), Myanmar, the Philippines, and Viet Nam still enjoy rapid take-off growth.

Figure 1: Comparison of Real GDP Growth Rates (%)
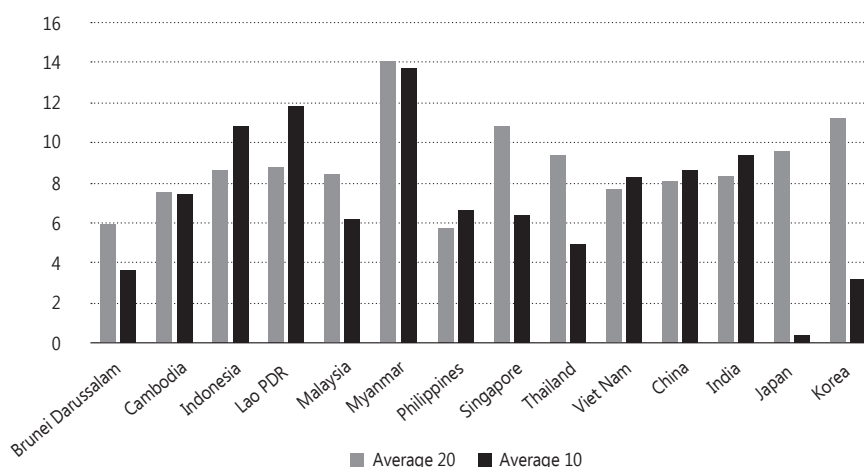
GDP = gross domestic product, Korea = Republic of Korea, Lao PDR = Lao People's Democratic Republic.

Note: The table compares the average growth rate between the 'highest growth rate for 20 years' (Average 20) and 'recent 10-year growth rate between 2005 and 2014' (Average 10). The 20-year period is as follows for each country: Brunei Darussalam, 1989–2008; Cambodia, 1994–2013; Indonesia, 1972–1991; Lao PDR, 1995–2014; Malaysia, 1965–1984; Myanmar, 1965–1985; the Philippines, 1952–1971; Singapore, 1965–1985; Thailand, 1959–1978; Viet Nam, 1995–2014; China, 1992–2011; India, 1992–2012; Japan, 1951–1970; Republic of Korea, 1969–1988.

Source: University of Groningen, Groningen Growth and Development Centre, The Database, Penn World Table version 9.0. https://www.rug.nl/ggdc/productivity/pwt/ (accessed 30 November 2018).

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[1]   Cabinet Office of Japan (2013) argues that less developed economies (LDEs) in Asia and Central and South America have tended to stagnate at $10,000 of GDP per capita since 1960.

The decline in the growth rates of Singapore and Brunei occurred after they had already achieved high-income status. For Malaysia and Thailand, however, it seems to have occurred while they are still at the upper middle-income stage and could be partly because of insufficient diversification and upgrading of their traditional industrial and export structures (Felipe, 2012). Indeed, although these two countries have achieved some degree of diversification and upgrading from primary to manufacturing products (e.g. automobiles and automotive parts in Thailand; electrics and electronics in Malaysia) during industrialisation, their productivity levels as represented by their total factor productivity (TFP) have never been sterling relative to Japan, the Republic of Korea (hereafter, Korea), and Singapore (Figure 2). They have also experienced lower TFP growth rates than China, and even India, in most periods of the 21st century (Figure 3). This should provide a compelling reason for Malaysia and Thailand to climb much higher on the 'technology ladder' to improve industrial productivity through enhancing their innovative capability.

Figure 2: TFP Level at Current PPPs (United States = 1, 2014)
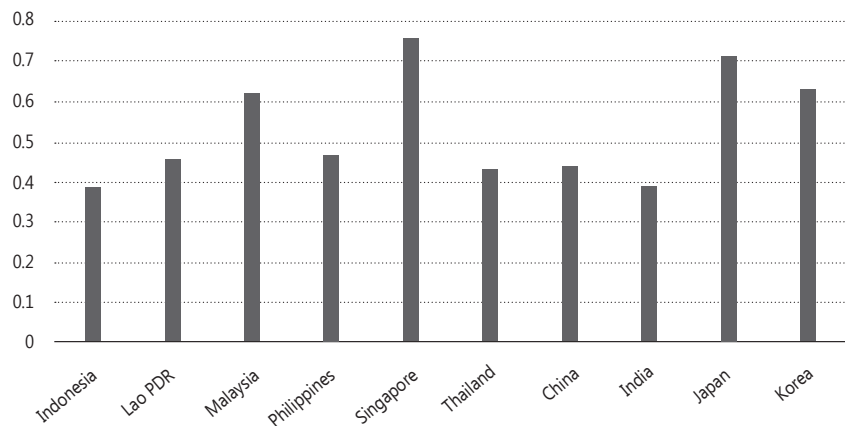
Korea = Republic of Korea, Lao PDR = Lao People's Democratic Republic, PPP = power purchasing parity, TFP = total factor productivity.

Note: Cambodia, Myanmar, and Viet Nam are omitted because of unavailability of data.

Source: University of Groningen, Groningen Growth and Development Centre, The Database, Penn World Table version 9.0. https://www.rug.nl/ggdc/productivity/pwt/ (accessed 30 November 2018).

Figure 3: Growth Rates of TFP at Constant National Prices (2011 = 1, %)
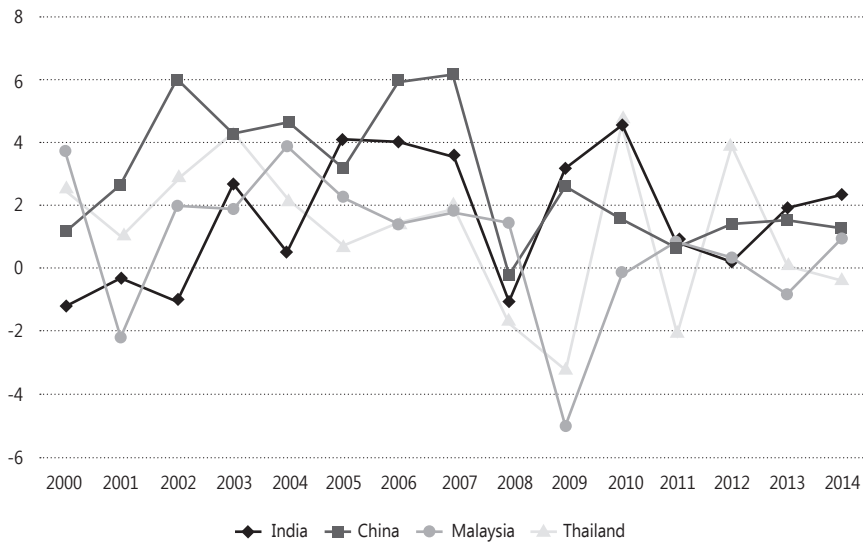
TFP = total factor productivity.

Source: University of Groningen, Groningen Growth and Development Centre, The Database, Penn World Table version 9.0. https://www.rug.nl/ggdc/productivity/pwt/ (accessed 30 November 2018).

Among the other AMS, Brunei and Indonesia continue to rely on primary products. For example, Indonesia's exports still include a significant share of crude materials and fuels (28%), such as coal (10%), gas (5%), petroleum (4%), and other crude materials (9%) in comparison with manufacturing (43%) as of 2016. In addition, Cambodia, the Lao PDR, Myanmar, and Viet Nam (the CLMV countries) utilise abundant low-wage labour forces in initial industrialisation and have just launched their basic manufacturing industries, such as garments and other labour-intensive products, taking advantage of production networks in East Asia (ASEAN–Japan Centre, 2017).

In terms of innovation, the overall progress of the AMS does not appear satisfactory.[2] Data on research and development (R&D) intensity as a percentage of GDP reveal that all AMS except Singapore have maintained substantially lower investments in R&D than Japan and Korea, which have an R&D intensity in excess of 3%. While Malaysia's R&D expenditure

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[2]   We later argue that these kinds of data do not necessarily represent real innovative activities in LDEs.

has been rising rapidly and reached 1.3% in 2016, Thailand's has been low even during the 2000s and was 0.6% in 2016 (Table 1). Worse still, the CLMV countries have made minuscule investments in R&D. Patent applications show the same pattern. Although the number of direct patent applications per million population has increased in all AMS, it is still considerably lower than in Asia's developed economies (Table 2). Further, although Malaysia (2,030 per million population) had the highest number of researchers among the AMS except Singapore (6,730) in 2014, the number is small relative to that of Japan (5,329) and Korea (6,856) (Table 3).

Table 1: Gross Domestic Expenditure on R&D per GDP (%)

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Brunei Darussalam												
Cambodia											0.12	
Indonesia					0.08				0.08			
Lao PDR												
Malaysia		0.61		0.70	1.01	1.04	1.03	1.09		1.26	1.30	
Myanmar												
Philippines	0.11		0.11		0.11		0.12		0.14			
Singapore	2.16	2.13	2.34	2.62	2.16	2.01	2.15	2.00	2.00	2.18		
Thailand	0.22	0.23	0.20	0.20	0.23		0.46		0.44	0.48	0.62	
Viet Nam							0.19		0.37		0.44	
Asia (Southeast)	0.64	0.66	0.68	0.73	0.74	0.75	0.78	0.78	0.80	0.83	0.85	
China	1.31	1.37	1.37	1.44	1.66	1.71	1.78	1.91	1.99	2.02	2.06	2.11
India	0.84	0.82	0.82	0.87	0.84	0.82	0.83			0.62		
Japan	3.18	3.28	3.34	3.34	3.23	3.14	3.24	3.21	3.31	3.40	3.29	3.15
Korea	2.63	2.83	3.00	3.12	3.29	3.47	3.74	4.03	4.15	4.29	4.22	4.24

GDP = gross domestic product, Korea = Republic of Korea, Lao PDR = Lao People's Democratic Republic, R&D = research and development.

Source: UNESCO Institute for Statistics, Data for the Sustainable Development Goals. http://uis.unesco.org/ (accessed 30 November 2018)

Table 2: Total Patent Applications per Million Population

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Brunei Darussalam	712	110.7	170.7	197.8	109.4			77.5	86.3	284.2		
Cambodia	19.0		1.0	2.8	2.0	1.8	3.0	3.6	5.0	4.4	4.2	
Indonesia		20.1	22.0	21.7	18.9	23.2	23.7		29.6	31.4	35.5	36.9
Lao PDR												
Malaysia	245.0	183.6	89.1	195.6	207.8	227.1	225.3	237.9	242.5	252.1	251.5	232.0
Myanmar												
Philippines	34.4	37.1	38.9	36.5	32.5	36.2	33.5	30.9	33.4	35.9	36.7	33.1
Singapore	2,017.2	2,0819	2,168.6	2,00.7	1,751.6	1,925.1	1,889.4	1,823.1	1,800.6	1,885.3	1,953.7	1,958.2
Thailand	96.9	95.1	103.0	101.3	87.6	28.8	58.1	99.4	108.7	115.9	119.0	113.6
Viet Nam	23.1	25.5	33.3	36.9	33.0	40.5	39.8	42.1	43.7	48.1	53.8	55.3
China	132.9	160.6	186.0	218.8	236.3	292.4	391.6	483.3	607.9	680.3	803.6	970.9
India	21.3	24.9	29.9	30.7	28.2	32.3	33.9	34.8	33.7	33.1	34.9	34.0
Japan	3,342.5	3,196.4	3,096.0	3,053.2	2,722.4	2,690.7	2,680.1	2,685.9	2,77.1	2,5613	2,506.8	2,507.0
Korea	3,339,7	3,430.9	3,542.6	3,478.4	3,316.4	3,432.6	,583.0	3,763.3	4,144.0	4,144.0	4,188.9	4,075.1

Korea = Republic of Korea, Lao PDR = Lao People's Democratic Republic.

Note: Direct and Patent Cooperation Treaty national phase entries.

Sources: World Intellectual Property Organization, Intellectual Property Statistics. https://www.wipo.int/ipstats/en/ (accessed day month year); World Bank, World Development Indicators. http://datatopics.worldbank.org/world-development-indicators/ (accessed 30 November 2018).

Table 3: Researchers per Million Inhabitants

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Brunei Darussalam												
Cambodia											30.4	
Indonesia					89.2							
Lao PDR												
Malaysia		370.8		602.9	1,072.6	1,467.4	1,649.8	1,784.4		2,029.6	2,274.0	
Myanmar												
Philippines	79.9		77.9		81.4		84.4		187.7			
Singapore	5,297.1	5,428.0	5,739.1	5,739.1	6,148.5	6,312.4	6,514.4	6,477.2	6,720.1	,729.7		
Thailand	313.4		323.2		328.9		538.4		790.9	964.2	865.4	
Viet Nam									673.9		672.1	
Asia (Southeastern)	328.9	344.3	373.2	395.7	441.6	491.3	527.5	573.0	613.2	637,8	642.6	
China	846.5	920.7	1,064.8	1,184.5	852.3	890.5	963.9	1,021.0	1,073.2	1,096.5	1,158.9	1,205.7
India	135.3					156.6					216.2	
Japan	5,303.5	5,332.6	5,325.2	5,108.3	5,098.8	5,103.2	5,109.9	5,032.8	5,147.5	5,328.6	5,173.4	5,210.0
Korea	3,691.6	4,090.1	4,523.4	4,942.9	4,942.9	5,330.0	5,807.7	6,317.8	6,415.1	6,856.4	7,045.3	7,113.2

Korea = Republic of Korea, Lao PDR = Lao People's Democratic Republic.

Note: Full-time employment.

Source: UNESCO Institute for Statistics, Data for the Sustainable Development Goals. http://uis.unesco.org/ (accessed 30 November 2018).

The experience of the Northeast Asian economies thus strongly suggests that ASEAN needs to significantly increase its investment in innovation if it wants to achieve strong economic development towards 2040.[3] The point we should notice is that AMS has achieved different development levels in terms of innovations (Tables 4 and 5 exhibit the Global Innovation Index and Competitiveness Index, respectively).[4] Investment

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[3] ASEAN Secretariat (2017) declares that ASEAN recognises 'the importance of Science, Technology, and innovation (STI) to foster sustainable economic growth, job creation, and enhanced well-being and science and innovation systems, to spur creativity and innovation that will serve as a foundation in driving the growth and competitiveness of industries in the region'

[4] The large discrepancy in the levels of innovative activities among AMS means that innovation policies for individual AMS may also vary in detail. In drawing up innovation policies for each AMS, a typology of technology and innovation is useful to guide individual AMS. Considering AMS at very different stages of innovation, Ambashi (2017) and Intal et al. (2014) roughly categorise AMS into (1) frontier (Singapore); (2) catch-up (Malaysia and Thailand), (3) learning (Indonesia, the Philippines, and Viet Nam); and (4) initial condition (Cambodia, the Lao PDR, and Myanmar). This categorisation suggests that it is important to understand which innovation stages AMS have reached and to move up the technology ladder accordingly based on effective strategic and systemic economic policies.

in innovation will be critical for Malaysia and Thailand to escape the 'middle-income trap' and attain the status of developed economies, while for the CLMV countries, their ability to adopt technologies will be critical to help them adapt to the newly changing global environment driven by rapid technological advancement. Nevertheless, the presumption that innovation would only help advanced developed economies like Singapore is no longer valid. The potential of innovation should be brought into all AMS at various levels of development on the technology ladder. From this perspective, we argue how ASEAN and AMS will only be able to realise economic prosperity in 2040 through strong involvement with innovation.

Table 4: Ranking of Global Innovation Index

Country	2013	2014	2015	2016	2017	2018
Brunei Darussalam	74	88			71	67
Cambodia	110	106	91	95	101	98
Indonesia	85	87	97	88	87	85
Lao PDR						
Malaysia	32	33	32	35	37	35
Myanmar		140	138			
Philippines	90	100	83	74	73	73
Singapore	8	7	7	6	7	5
Thailand	57	48	55	52	51	44
Viet Nam	76	71	52	59	47	45
China	35	29	29	25	22	17
India	66	76	81	66	60	57
Japan	22	21	19	16	14	13
Korea	18	16	14	11	11	12

Korea = Republic of Korea, Lao PDR = Lao People's Democratic Republic.

Sources: Cornell University, INSEAD, and the World Intellectual Property Organization. https://www.globalinnovationindex.org/Home (accessed 30 November 2018).

Table 5: Ranking of Global Competitiveness Index

Country	2010	2011	2012	2013	2014	2015	2016	2017
Brunei Darussalam	28	28	28	26			58	46
Cambodia	109	97	85	88	95	90	89	94
Indonesia	44	46	50	38	34	37	41	36
Lao PDR				81	93	83	93	98
Malaysia	26	21	25	24	20	18	25	23
Myanmar				139	134	131		
Philippines	85	75	65	59	52	47	57	56
Singapore	3	2	2	2	2	2	2	3
Thailand	38	39	38	37	31	32	34	32
Viet Nam	59	65	75	70	68	56	60	55
China	27	26	29	29	28	28	28	27
India	51	56	59	60	71	55	39	40
Japan	6	9	10	9	6	6	8	9
Korea	22	24	19	25	26	26	26	26

Korea = Republic of Korea, Lao PDR = Lao People's Democratic Republic.

Source: World Economic Forum, The Global Competitiveness Report 2017–2018. http://reports.weforum.org/global-competitiveness-index-2017-2018/ (accessed 30 November 2018).

The rest of this paper is organised as follows. Section 2 presents conventional policy options for an innovative ASEAN from the viewpoint of 'national innovation systems' (NIS). Section 3 makes a detailed explanation of the new trends of innovation, that is, globalisation in innovation and the shift in conceptual framing of innovation. It also presents plausible directions that AMS should pursue. Section 4 briefly touches on the challenges of 'no one left behind by innovation', i.e. 'inclusive innovation'. Section 5 concludes with policy goals and priorities.

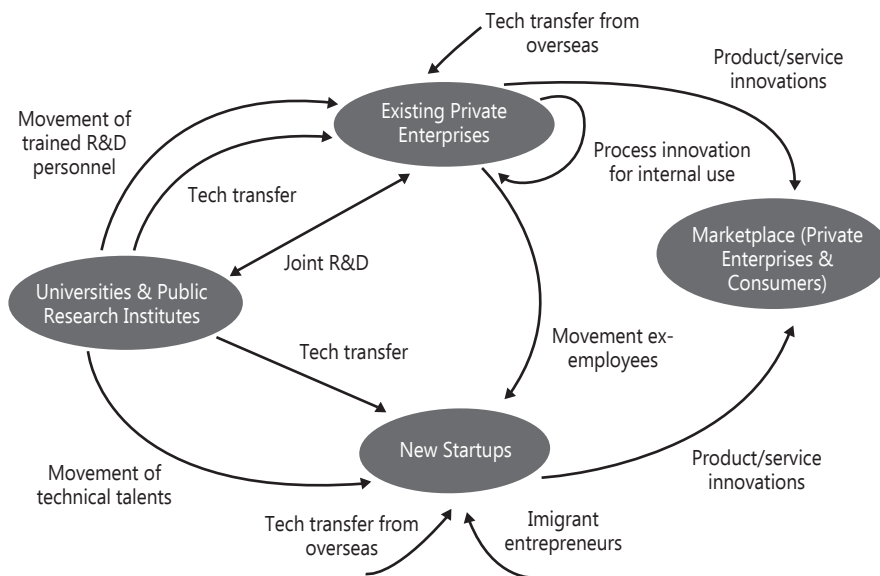## 2. Conventional Policy Options for an Innovative ASEAN

2.1. What is a National Innovation System?

How can AMS and ASEAN build the foundation for innovation (i.e. innovation capability)? In response to this question, one reference is that many developed economies, including leading Asian countries such

as Japan, Korea, and Singapore, have successfully formulated effective and functional NIS, and their governments function as active agents in coordinating systematic innovation policies to make them work well. More generally, NIS can be defined as a continuous process of systemic change facilitated by government policies (at central and local levels), where institutions, learning processes, and networks play a central role in generating technological advancement and innovation via the intentional, systemic interactions between various components such as universities, institutions, the private sector, and investors (Soete, et al., 2010).

Figure 4 illustrates that the systematic innovation framework involving all actors is likely to transform individual small steps into great achievements, which is a strategy of implementing NIS for AMS that seeks to create innovation dynamics. In short, given that AMS must embrace and generate new innovations, the role of governments, universities, public research institutes, and the private sector (particularly new start-ups) and consumers in the marketplace, is becoming much more important.

Figure 4: Stylised Flow of National Innovation System

R&D = research and development.

Source: Wong (forthcoming).

2.2. Conventional Policy Options

This section discusses in more depth the conventional innovation policy options for ASEAN to achieve its development goals.

The fundamental strategy of innovation policy for individual AMS has been to continuously attract foreign direct investment (FDI) from multinational companies so as to receive the benefits of knowledge spillovers from them. AMS have attracted FDI by encouraging multinational companies headquartered in developed economies to locate their factories in industrial zones – usually special economic zones – in the hope of receiving significant technology transfers from them. This FDI strategy is still valid for AMS to enhance 'process innovation'. However, as discussed previously, some AMS need to significantly upgrade their industrial structures and competitiveness in the marketplace through their own 'product innovation' achievements. Hence, they need to implement forward-looking innovation policies and create product innovation based on well-crafted NIS development policies.

From this viewpoint, Ambashi (2018) presents three conventional policy options that individual AMS are encouraged to consider.

(1) Establish their own NIS: drive and implement harmonised innovation policies; set priorities over measures, plans, and programmes; and monitor and evaluate them.
The biggest problem most AMS face is the absence or functional failure of government organisation in promoting innovation policies. In principle, they need to control and coordinate innovation policies that are formulated and implemented across various government departments. It is also important to give responsibility for the establishment and/ or reinforcement of a member state's NIS framework in a government organisation.

(2) Encourage the private sector, including both domestic and foreign firms, to invest more in R&D and innovation-related activities.

AMS should orient their innovation policies more towards encouraging the innovative activities of the private sector. In NIS, governments are responsible for proactively addressing market failure that hinders innovation creation. One conspicuous area of market failure is the way innovation achievements are commercialised. To promote the commercialisation of innovation, governments need to consider creating specialised public research institutes whose primary mission is to conduct R&D and technical support related to commercialising various types of innovation achievements (e.g. the Industrial Technology Research Institute (ITRI) in Taiwan, Fraunhofer-Gesellschaft in Germany).

(3) Further develop a conducive 'innovation ecosystem' in their NIS involving universities, public research institutes, and the private sector.

University–industry collaboration (UIC) is an integral part of innovation ecosystems which are conducive to technology diffusion and knowledge spillovers. Therefore, AMS need to formulate policies and measures to expedite UIC like the Basic Law for Science and Technology, 1995 and the Technology Licensing Organization Law, 1998 in Japan and the Bayh–Dole Act, 1980 in the United States. AMS could also aim to create local public technology centres, which function as innovation intermediaries and foster the development of local manufacturing industries, particularly small and medium-sized enterprises.

3.   New Trends Surrounding Innovation

This section sheds light on new trends surrounding innovation: (1) globalisation in innovation and (2) a shift in the conceptual framing of innovation. These new trends stem from the rapid advancement in information and communication technology (ICT), which alters the dynamics of innovation diffusion.

3.1. Globalisation in Innovation

Paradigmatic shifts have occurred in innovation policy because of the rapid development of ICT in recent decades. The situation that ASEAN and AMS face now is totally different from what Japan and Korea experienced decades ago. The successful experiences of Japan and Korea were based on strategic innovation policies to catch up with Western developed countries. That is, their strategy emphasised using domestic industrial resources for innovation (e.g. importing technologies via licensing agreements and alliances with Western companies, inventing through reverse engineering, and restrictive industrial and trade policies to promote home-grown innovation), which was efficient because the globalisation of trade and investment was limited at that time compared with what it is today. The World Trade Organization agreement regarding trade and investment restrictions, subsidies, and intellectual property rights also makes it difficult for AMS to adopt the same industrial policies as the developed Asian countries did in the 1970s–1980s.

To understand most recent globalisation, the concept of the '3rd unbundling' advocated by Baldwin (2016) is helpful for us to shape the development strategies of AMS based on innovation. His unbundling framework is illustrated in Figure 5. Notably, in the 3rd unbundling, advanced ICT (especially communication technology) reduces face-to-face costs and accelerates the international division of labour in terms of human tasks. Kimura (2018) points out that the 3rd unbundling will encourage a sharing economy as a result of easier matching between individuals on internet platforms, make complex tasks managed by persons in different locations possible, increase the international data flow that is available for businesses, and connect individuals with each other more tightly all over the world. Such an impact is anticipated to generate three unique aspects of globalisation in innovation.

Figure 5: Overcoming Distance and the Evolution of 'Unbundlings'

Major characteristics	Pre-globalised world (0)	The 1st unundling (1)	The 2nd unundling (2)	The 3rd unundling (3)
Trade costs communication costs face-to-face costs	High High High	Lower High High	Lower Lower High	Lower Lower Lower
What starts moving? What overcomes distance ?	None	Goods	Ideas	People
International division of labour	Autarky	Industry-wise (Production and consuption are fragmented)	Task-wise (An inustry is fragmented)	Person-wise (A task is fragmented, B-to-B and C-to-C matching easier)
Years of dominance	-1820	1820-1990	1990-2015	2015-

B to B = business to business, C to C = consumer to customer.
Source: Kimura (2018).

First, the reduction in face-to-face costs and globalisation presently operates to benefit front-runner internet firms, particularly large firms ('unicorns') in Silicon Valley, in generating dominant innovations as internet platforms, (e.g. Apple, Google, Facebook, and Amazon).[5] There is concern that frontier innovation based on advanced ICT seems to be increasingly dominated and monopolised by the existing big platform firms, which can afford to continue to invest in huge amounts of R&D and take over innovative start-ups in related spaces (Taplin, 2017). This may widen the gap in innovation capabilities between developed economies and LDEs.

Second, many innovative activities still require human inputs, especially in the form of services trade (e.g. not only engineers, programmers, and scientists, but also professional managers, accountants, lawyers, and university professors). This is why developed economies aim to import significant amounts of skilled human capital as immigrants from LDEs

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[5]   Chinese platform firms such as Alipay, Alibaba, and Tencent have emerged and established market positions in China.

to promote domestic innovation. Baldwin (2016) indicates that with a reduction in face-to-face communication costs because of progress in communication technology, a new phase of globalisation is beginning in which the international division of labour in units will be realised in the 3rd unbundling. According to his vision, a 'virtual immigration' will be achieved, leading to 'telepresence', which will enable the above-mentioned 'brainworkers' to provide their services across borders from LDEs to developed economies. Thus, future workers may find job opportunities while residing in LDEs if individual innovative activities are globally fragmented despite the concentration of large firms.[6]

Finally, local applications of technology and business model innovation in each LDE demand physical interactions between engineers/scientists and entrepreneurs across the world. In particular, new technologies provided by firms of developed economies are indispensable for business model innovations in LDEs. It is notable that ASEAN home-grown internet platform providers like GO–JEK, Grab, and Lazada supply new relevant services (e.g. e-payment systems) to their core business models in combination with the technological professionals of ICT, finance, and others, offered initially by foreign professionals (e.g. technology alliance) or those who have received a science and engineering education in developed economies. This case not only demonstrates a good example of the interaction between the technologies of developed economies and business model innovations of LDEs, but also suggests the importance of arranging effective innovation ecosystems with a particular emphasis on human capital that has updated knowledge about technology.

Innovation in the 3rd unbundling would be a big challenge for the AMS. The NIS that AMS have established were tailored basically for manufacturing sectors in the 2nd unbundling; consequently, they may not automatically provide the innovation bases, especially human capital, for the 3rd one. Hence, the way to connect their existing advantages with the 3rd unbundling is a critical issue. Although it may be difficult for them to establish strong innovation bases in the short run, specific

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[6]   Baldwin (2016) also predicts the emergence of 'telerobotics', which will enable workers in LDEs to provide physical labour services in developed economies by, for example, controlling cleaning robots.

policies to maximise the exploitation of opportunities created by ICT and globalisation should be prioritised.

In particular, we may need to adopt more forward-looking, "futuristic" innovation policies in addition to, or somewhat away from, those derived from the traditional NIS frameworks that focus only on challenges to be addressed in the short term. To achieve innovation in the globalised period, the NIS of AMS must put more emphasis on (1) inviting innovation service outsourcing in connection with developed economies; (2) implementing local applications of technologies for innovative business models; and (3) attracting both indigenous and foreign human capital. The last point (3) is the most important in addressing the challenges of (1) and (2). Therefore, AMS may need to start competing for attracting well-educated people, and prepare comfortable urban amenities for them, which can be improved relatively easily if good infrastructure in the 2nd unbundling has already been established.[7]

## 3.2.   Shift in the Conceptual Framing of Innovation

We have also experienced a shift in the conceptual framing of innovation to a greater extent than in the past. In particular, two conspicuous shifts must be highlighted.

First and foremost, 'imitative innovation' is increasing in importance for LDEs (Wong, 2018). Despite the seemingly strong evidence of less innovative AMS shown in Tables 1–3, we may need to go beyond R&D and patenting outputs in measuring their actual innovative activities. Many innovation efforts made by latecomer economies frequently takes the form of what we call 'creative imitation' (Figure 6), whereby latecomers seek to part-imitate and part-adapt new products and services from overseas to meet local market needs or produce lower cost versions to compete in more price-sensitive lower-end markets. This creative

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[7]   Glaeser, Kolko, and Saiz (2001) list the elements of urban amenities as (1) the presence of a rich variety of services and consumer goods, (2) aesthetics and physical setting, (3) good public services, and (4) speed.

imitation is what China (and Korea earlier) did in much of their catch-up phase, although observers from developed economies have sometimes called these indigenous products copycats or intellectual property (IP) piracy. However, they are not always complete copies, and some degree of innovation is included.[8] These part-imitative, part-creative activities involve little R&D or patent granting. In a nutshell, we can argue that the innovative part compared with the imitative part would increase as LDEs move up the technology ladder. Figure 7 depicts the comparison between path-following and path-breaking learning. AMS should reinforce path-breaking learning since it has broader potential for innovation.

Figure 6: Continuum Between Imitation and Innovation
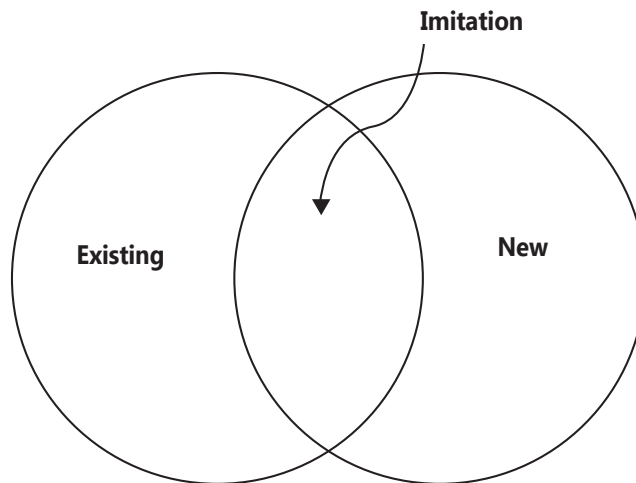
Source: Wong (2018).

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8   Baidu in China did not just copy Google by providing better search engines in the Chinese language; it adapted them to search Chinese chat sites instead of just web pages. GO-JEK in Indonesia is not a mere copy of Uber for since GO-JEK introduced ride-hailing motorcycles with women drivers for women passengers (important in Islamic culture) and delivery services 2 years before Uber.

Figure 7: Pass-Following and Pass-Breaking Learning

Learning type	Pass following	Pass breaking
Learning to innvate	Incremental Continuous Sustaining Explorative	Radical Discontinuous Disruptive Explorative
Learning to replicate	Duplicative imitation	Creative imitation6
Learning to use	Imitative use	Creative Use
		A broader definition of innovation

Source: Wong (2018).

The second shift is found in the growing role of technology entrepreneurship in the NIS of LDEs. Table 6 shows that a growing number of people have engaged in entrepreneurship and start-up businesses in many AMS. According to recent entrepreneurship and innovation literature (Sahut and Peris-Ortiz, 2014), the importance of young technology start-ups, not large established firms, has been the main driver for spurring innovations, especially those associated with digital technologies and business model innovations which are enabled by digitalisation and mobile internet (e.g. e-commerce mobile apps, Fintech, internet of things). Such entrepreneurial exploitation of the latest technologies is not confined to developed economies but can often allow LDEs to leapfrog existing technology ladders.[9] As such, public policies that affect the development of the entrepreneurship ecosystem may be just as significant as traditional policies in encouraging technology transfer from public research institutes. In addition, recent research has shown that injecting entrepreneurship education into university curricula can increase the supply of entrepreneurs in AMS (Low, Ho, and Wong, 2014; Wong, forthcoming). In conclusion, many AMS, such as Indonesia, the Philippines, and Viet Nam, which are still reaping the demographic bonus of relatively young populations, have the potential to supply a large amount of young IT talent and entrepreneurs,[10] provided that the education systems in these countries can scale up quickly in both quality and quantity.

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[9] Mobile payment penetration in China is now the highest in the world, and it has been quite high even in many ASEAN developed economies partly because traditional banking services do not exist in many rural areas.

[10] In the case of the National University of Singapore (NUS), where one of the authors oversees the university's tech start-up support system, digital technology start-ups established by alumni and students do not draw on patent inventions granted from the NUS lab.

Table 6: Entrepreneurship in ASEAN economies

Country	Total early-stage entrepreneurial activity	New business density
Cambodia		0.217
Indonesia	7.5% (2017) 14.1% (2016)	0.333
Lao PDR		0.100
Malaysia	21.6% (2017) 4.7% (2016)	2.262
Philippines	17.2% (2015)	0.331
Singapore	11.0% (2014)	8.623
Thailand	21.6% (2017) 3.5% (2016)	0.991
Viet Nam	23.3% (2017) 13.7% (2016)	

Lao PDR = Lao People's Democratic Republic.

Note: Total early-stage entrepreneurial activity represents the percentage of the population aged 15–64 who are either nascent entrepreneurs or owner-managers of new businesses less than 42 months old. New business density includes new registrations per 1,000 people aged 15–64.

Source: Global Entrepreneurship Monitor. https://www.gemconsortium.org/ (accessed day month year); World Bank Entrepreneurship Surveys. http://www.enterprisesurveys.org/ (accessed 30 November 2018).

The above-mentioned innovation ecosystem seems to be reinforced by advantages of ASEAN, i.e. emerging global middle classes which demand common product categories but differentiated local ones, and more opportunities to meet indigenous social needs and fit local cultural contexts – implying more inclusiveness in its impact. Not only does ASEAN have a rising number of upper classes which are connected globally, but also a diversity of cultural, physical, and social contexts simply because the region is more diverse than a single country. In short, the ecosystem associated with these advantages can serve as a good foundation for innovation in AMS that involves creative imitation. The successful experience of creative imitation and facilitating innovation policies in Asia's newly industrialised economies and China should be more broadly recognised among policymakers of AMS.

4. Leave No One Behind from Innovation

So far, we have discussed the need for human capital that can adapt to globalisation, creative imitation, and technology entrepreneurship. In this sense, education systems are critically important in the long run to fill knowledge and technology gaps between latecomers and the front-runners, and a sufficient number of people who receive higher education is necessary. With respect to formal school education, elementary education should be reformed to be consistent with the knowledge economy. For example, since quality online courses (EdTech) are widely available via the internet, AMS can implement labour policies that improve workers' abilities even at the initial stage of education and learning. On-the-job training, the other pillar of the education system, should also be enhanced in AMS to facilitate flexible labour movement from declining to growing industries.

Conceptual framing of innovation has also shifted in recent years to highlight the importance of inclusive innovation in supporting growth with political stability. We should note that the outcomes of innovations do not always increase social benefits for all people. Since innovation has frequently shifted towards labour-saving or extremely skill-biased technologies, the impact of such innovation is generally quite adverse for the low-skilled labour force. Likewise, Stiglitz and Greenwald (2014) argue that financial innovations that are driven purely for short-term financial returns are likely to benefit the rich at the expense of the poor. In this way, unfettered capitalist market forces may lead to significantly increased inequality, which may result in social and political instability.

Technological innovations that widen income inequality and regional disparities could contribute to a backlash against globalisation, leading to growing industrial and trade protectionism in recent years. Stiglitz and Greenwald (2014) also argue that societies with a large domestic income or wealth inequality gap tend to perpetuate the use of innovation to maintain or even widen the gap, which suggests the importance of social protection. By contrast, creating new jobs by leveraging technologies and innovations could resolve the problem of unemployment caused by them, which has been demonstrated by history since the past Industrial Revolution (Acemoglu and Restrepo, 2018). For AMS that still depend

on labour-intensive industries, innovations should be used to enhance existing industrial structures at least in a shorter time span. Accordingly, a public policy role is needed in promoting social innovation (e.g. innovation in public transport, urban environment, healthcare, and educational services) as well as inclusive innovation that can create jobs for the lower population pyramid, including frugal innovation that raises the productivity of rural farmers and urban small and medium-sized enterprises.

5. Concluding Remarks

New technologies and innovations are critical for the future development of ASEAN. Innovation activities could be enhanced in all countries regardless of their level of development, but the diversified mix of innovation policies needs to be adapted to AMS at different levels of technological development. It should be therefore noted that details of innovation policies could be varied in individual countries.

Having said that, ASEAN innovation policies should reflect the new trends surrounding innovation. First, in a globalised world accelerated by the 3rd unbundling, advanced ICT that reduces face-to-face costs generates various business innovation opportunities. However, the exploitation of such opportunities still not only requires human capital especially in terms of professional services, but also demands interactions between engineers/scientists and entrepreneurs at the global level to develop apt innovative business models in domestic LDEs. From this perspective, we need to put more emphasis on inviting innovation service outsourcing in connection with developed economies, implementing local applications of technologies for local business models, and attracting both indigenous and foreign human capital to AMS.

In addition, we have experienced a shift in the conceptual framing of innovation. Imitative innovation will remain important for LDEs, as many of the innovation efforts made by latecomer economies take the form of creative imitation. On the other hand, the role of technology entrepreneurship is growing in the NIS of LDEs. As such, public policies may be significant to affect the development of the technology

entrepreneurship ecosystem. The most important thing is that, with rapidly growing middle classes and social/cultural diversity, ASEAN will benefit particularly from innovation of the creative imitation type, driven by indigenous technology entrepreneurs who can best understand and decode the market opportunities of their own societies and cultures.

Based on these discussions, we should focus on expediting ASEAN market integration from the viewpoint of spurring pan-ASEAN regional innovation. The innovation induced by advanced ICT can be facilitated by a large market, which means that current innovation and its outcomes tend to be subject to economies of scale and positive network externalities. ASEAN therefore needs to recognise the importance of pan-ASEAN market integration to promote the rapid diffusion of innovation from individual ASEAN economies to the whole of ASEAN to reap economies of scale and scope.

Accordingly, we highlight the following policy goals and priorities to drive innovation towards ASEAN 2040.

First, AMS need to introduce policies responding positively to globalisation and to facilitate both services outsourcing and free movement of natural persons, especially of highly skilled human capital. More service provision and freer movement of human capital are usually desirable because innovation is still often spurred through person-to-person contacts physically and virtually, especially by professionals like engineers, scientists, and entrepreneurs who can contribute to R&D and innovative activities. The free movement of engineering service providers, assured in mutual recognition agreements, is particularly important given that the engineering workforce is a foundation for science, technology, and innovation. Further improvements in domestic laws and regulations on engineering services are needed to make it easier for certified engineers to work overseas.

Second, governments' aggressive support for the innovation ecosystem, especially technology entrepreneurship, is also critically important. It is necessary to provide policy incentives for young entrepreneurs to

establish technology start-ups that are keen to create imitative innovation leading to economic viability through, for example, R&D investment tax credits, the formation of industrial clusters promoting knowledge spillovers, and facilitated institutions such as incubators and technology license offices, for university start-ups and spin-offs. AMS also need to focus governments' efforts on entrepreneurship education not only for aspiring young entrepreneurs but also students even at the basic education level. Granting a prestigious entrepreneurship award to conspicuous entrepreneurs may encourage young people to follow them. Finally, ASEAN could consider the establishment of an ASEAN-wide innovation performance benchmarking and innovation policy best practice sharing platform. ASEAN seems to need an innovation performance benchmarking system, similar in spirit to what the European Union (EU) has established among its member states – EU Innobarometer or Innovation Scorecard – but adapted to ASEAN (e.g. including indicators for the creative-imitation type of innovation, pace of adoption of the Fourth Industrial Revolution technologies, and measures of inclusiveness of innovation). Such a benchmarking system is likely to motivate each AMS to accelerate the development of their respective NIS and promote the diffusion of best innovation policy practice across ASEAN.

Table 7: Goals and Policy Recommendations

Goals	Policy recommendations
• Exploit opportunities of globalisation through the effective use of human capital in professional service at the global level. • Promote 'imitative innovation' or 'creative innovation' through pass-breaking learning to meet local markets and to produce lower cost versions of products and services. • Develop the technology entrepreneurship ecosystem and nurture young technology start-ups as a main driver for innovations. • Reinforce the innovation ecosystem of ASEAN by taking advantages of emerging global middle classes and diversified local needs	• Introduce policies facilitating services outsourcing and free movement of natural persons, especially of highly skilled human capitals, e.g. MRAs for professional workers, improvement in domestic laws and regulations on engineering services. • Provide policy incentives for young entrepreneurs to establish technology start-ups, e.g. R&D investment tax credits, promotion of incubators and technology license offices of universities. • Inject entrepreneurship education into university curricula, e.g. granting a prestigious entrepreneurship award. • Establish an ASEAN-wide innovation performance benchmark and innovation policy best practice sharing platform like EU Innovarometer and Innovation Scorecard to promote the diffusion of best innovation policy practices across ASEAN

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Harnessing New Technologies for Social and Economic Progress Towards ASEAN 2040[1]

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Discussion Points

- What is the prospect for new technologies in a changing world?
- How can ASEAN fill the gap and catch up with countries in the vanguard of new technologies and achieve relevant industrial development?
- How can ASEAN maximise the opportunity of new technologies?

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1. Introduction

The idea of creating innovation by taking advantage of new technologies, thereby improving productivity and promoting economic growth, has been widely accepted by academia, policymakers, and the private sector. It was argued that innovation and new technologies were not necessary for developing countries because of difficulties in fully using and managing them (Fagerberg et al., 2010). However, such a growth opportunity has been opened not only to developed countries but also to emerging countries, including ASEAN Member States (AMS), through enabled simpler application of them to businesses and industries. This is evidenced by ASEAN's stress on productivity-driven growth, innovation, research and development, and technology commercialisation (B.4) in the ASEAN Economic Community Blueprint 2025 (ASEAN Secretariat, 2015). The important point is to recognise that it may possible for AMS to achieve drastic, discontinuous, and leapfrogging development (cf. step-by-step development) if they can cleverly utilise new technologies and the outcomes of innovation.

It seems that information technology (IT) and communication technology (CT) have different implications for industrial society. Put simply, whereas IT reduces the number of tasks and performs routine non-cognitive tasks at a low cost through the use of computers, CT lowers the face-to-face communication cost and overcomes physical distance through mobile devices linked with high-speed Internet. This information and communication technology (ICT) have made serious changes in existing industrial structures. The most important consequence of ICT is deemed to be the 'third unbundling', a new type of globalisation, where person-wise division of labour and resultant service outsourcing from developed to developing countries.

Accordingly, since the beginning of the 21st century, disruptive new technologies have been emerging in tandem with the progress of ICT as well as extensive computer and Internet capacities. As a series of new technologies have expanded to the field of ICT, the speed of modern industrialisation has accelerated. These digital technologies include the internet of things (IoT), big data, and artificial intelligence (AI), which are expected to play a substantial role in innovating and reforming existing

industries in the next 20 years. The effect of ICT has penetrated beyond the internet space to 'traditional' industries such as finance, agriculture, medical and health care services, and conventional manufacturing. Given this rapid digital technological development, we may witness critical changes in both industries and societies in 2040 that are beyond our imagination.

This new type of industrialisation in the 21st century is frequently called the Fourth Industrial Revolution and it could be totally different from the past three industrial revolutions (Schwab, 2017). Some authors insist that the Fourth Industrial Revolution is a buzz word and that its impact is exaggerated. However, we believe that it has great potential not only to facilitate the economic transformation of ASEAN based on new technologies, but also to markedly increase society's ability to address social problems and promote social progress in a more efficient and effective manner. This social progression will be encouraged through customisation of products and services provided for individuals by integrating analogue hardware with digital software technologies. Concretely, potential innovations can be found in future-oriented robotics, drones, bioindustry, automated driving systems, educational technology (EdTech, an educational method based on ICT), and blockchains (decentralised, distributed, and public digital ledger), as discussed later.

This paper provides a brief overview of new technologies and examines the challenges and opportunities for ASEAN in providing favourable environments that encourage the adoption and adaptation of new technologies and innovations. We emphasise that ASEAN and its member states need to establish their own innovation ecosystems (i.e. innovation hubs), linked to the rest of the world, so that the private sector in ASEAN can make full use of new technologies in collaboration with the innovation enterprises of the United States, Japan, China, and other countries. Developing a way to address inherent social problems, such as ageing, traffic, and environmental pollution, in ASEAN is also an important issue. In short, we argue that ASEAN and its member states need to improve, catch up, and adopt and adapt new technologies to the varying conditions of the diverse region, while setting up distinguishing innovation ecosystems that leverage their advantages. Towards this end,

AMS may need to consider regulatory sandboxes[2] and encourage joint projects with technology leaders.

This paper is organised as follows. Section 2 presents the current situation surrounding technological development, focusing on four promising key new technologies. Section 3 highlights applications of new technologies to industry and illustrates the state of industrialisation. Section 4 discusses the direction that ASEAN and its member states need to follow regarding new technologies, with a view to consolidating their unique innovation ecosystems. Section 5 makes concluding remarks.

2. What Happens Now in the World?

The advance of the Fourth Industrial Revolution revolves around four technological fields–(1) IOT, (2) big data, (3) AI, and (4) robotics–which have achieved remarkable technological and industrial evolution. Among other things, it is becoming possible to obtain a great deal of big data about products, plants, and daily business operation levels on site; conduct statistical analyses of such data; and take effective actions based on the analyses, thanks to rapid technological development of ICT (Ministry of Economy, Trade and Industry of Japan (METI), 2017).

(1) **IOT**: The popular definition of IoT is the network of physical devices and other items embedded with digital devices (e.g. electronics, software, sensors, and actuators) and the ability of these devices to connect each other and exchange data with distributed intelligence (Atzori, et. al, 2010; Santucci, 2010; Gubbi et al., 2013). Information obtained from manufacturing production and operation can be accumulated as useful data throughout the IOT system. Such data helps us control the system of IOT and conduct remotely-connected and diversified manufacturing production and operation through the linkage of internet networks, which is expected to realise highly digitalised economies, industries, and societies.

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2   The regulatory sandbox is a kind of deregulation that temporarily halts the application of regulations stipulated by current legislation for limited stakeholders with an aim to create innovative new businesses through pilot projects. This system was first introduced in the UK for Fin Tech services and has now expanded to regions such as the US, Singapore, and Australia.

(2) **Big data**: This includes a variety of non-structured and non-stylised data being generated and recorded on a real-time and time-series basis. Vast information associated with big data exceeds the ability of commonly used software tools, existing data analysis approaches, and typical manage and storage data systems within a tolerable elapsed time (Snijders, Matzat, and Reips, 2012). More importantly, big data alone does not create any value added unless it is employed in a beneficial manner to facilitate real business or social planning. So, if we intend to make use of big data for real activities, we need to create new value added by developing customised marketing plans while conducting a simultaneous data analysis (Varian, 2014; McAfee and Brynjolfsson, 2012).[3]

(3) **AI**: This is also sometimes called machine intelligence, displayed by computers and machines, in contrast to natural intelligence demonstrated by human beings and other animals. The term AI is typically used when a machine simulates cognitive functions such as learning and problem solving (Nilsson, 1998; Russell and Norvig, 2009). The idea of developing AI as a national policy project has a long history that dates back to the 1980s.[4] Computers equipped with AI can engage in a variety of very advanced tasks (e.g. interpretation of speech, driving, drug discovery, and optical character recognition) and can expedite an instant decision making that is difficult and generally beyond the ability of human beings by using deep learning through which computers learn by themselves for better decision making.[5]

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[3] Varian (2014) indicates that taking full advantage of big data requires increased sophisticated knowledge about what to do with the massive amounts of data which are now available. McAfee and Brynjolfsson (2012) emphasise a change in decision-making culture to radically improve enterprises' performance.

[4] In 1980s Japan, supercomputers equipped with AI based on natural language (fifth generation computers) was promoted in collaboration with government research institutes and the private sector.

[5] Deep learning is a kind of machine learning based on learning data representations. It solves problems by introducing and extracting representations that are expressed in terms of other, simpler, and more meaningful representations from data (Goodfellow, Bengio, and Courville, 2016).

(4) **Robotics**: This is formed by an intersection of various technologies including mechanical engineering, electronic engineering, and computer science. The design, fabrication, and operation of robots are studied based on these technologies. The aim of robotics is to create machine robots that can replace human beings or their tasks with physical suffering in dangerous construction sites, manufacturing processes, and even education systems (Nocks, 2008). Robots are expected to perform complex, diversified, and hazardous tasks done by human beings previously.

These new technologies, which constitute the core of the Fourth Industrial Revolution, are the common technological foundation for next-generation industries to emerge and prosper. To fill the gap between using new technologies and producing innovative products and services, a tight association with a variety of 'existing' technologies based on the common foundation (IOT, big data, AI, and robotics), and unique business models is indispensable (Figure 1).

Thanks to technological development ushered in by ICT that facilitates lively interactions between suppliers and consumers, we can more easily identify social structural problems that have not explicitly appeared as obvious demand from people. Suppliers can perceive such problems as true social needs of consumers and can transform them to real businesses. For example, many newly emerging IT platform firms in ASEAN, such as Lazada (e-commerce and online shopping), GO-JEK (ride-hailing transport services, food delivery, payment solutions, etc.), and Grab (similar on the GO-JEK), have become profitable by discovering social needs and providing possible service solutions. In other words, these platform firms employ ICT to establish markets which connect supply with demand, and confront socioeconomic challenges such as financial transactions and transportation.

The way in which global and local firms respond to the Fourth Industrial Revolution is highly likely to affect their productivity and competitiveness in the global marketplace. Manufacturing and service provision, which generates high value added, and newly emerged markets would promote further value addition and productivity improvements. In the

'smile-curve' relationship between the value chain (horizontal axis) and value added (vertical axis), there is the possibility of realising high value addition across all three value chains of (1) material, (2) production and fabrication, and (3) services. Even in the production and fabrication stage, which tends to be low value added in common understanding, making unique manufacturing products with high value added would be feasible through an innovative combination of existing and digital production technologies. More importantly, platform firms have entered into various markets across sectoral borders within value chains by providing business platforms (application software, contents, and others) in which suppliers are efficiently matched with customers. As a consequence, we will witness an inevitable change in industrial structures and business models along every value chain.

Figure 1: Comparison of Real GDP Growth Rates (%)
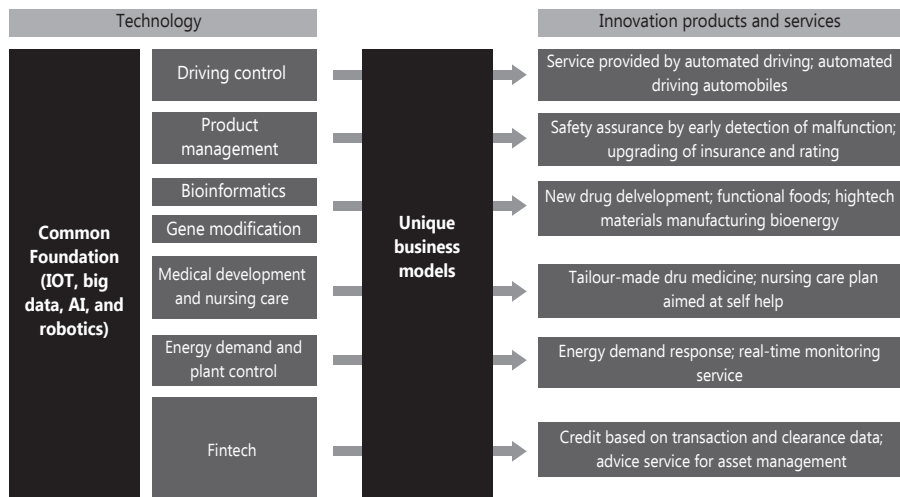
AI = artificial intelligence, IOT = Internet of Things.

Source: Author's compilation in reference to METI (2017b).

Further, where technological development and industrial structures change and accelerate rapidly, 'flexible' firms, especially ventures like start-ups which can continuously reform their business models, resources, and projects, lead radical innovation by overcoming the so-called 'innovator's dilemma'.[6] In contrast, large, mostly old, firms (e.g. department stores and taxi service firms) encounter difficulties in adapting to new environments where ICT radically destroys the existing business order.

3. Application of New Technologies and Industrialisation

In the industrial society of the future, it is anticipated that business facilities, plants, and factories will be connected with each other in terms of skills, technologies, and consumer preferences (which have not been necessarily connected), and that such close connection will dramatically increase technological development, productivity improvement, and skills transfer among workers. For example, the following impacts of 'Connected Industries' are generally assumed in the Fourth Industrial Revolution, as illustrated in Figure 2 (METI, 2017a; pp. 4):

- 'Firm data' stocked among diversified plants, facilities, and sections will be connected with each other.
- 'Consumer data' on provided products and services will be connected with suppliers and is expected to contribute to firms' productivity improvements.
- Data analysed by AI will be utilised for further technological development, productivity improvement, and competitiveness enhancement.
- AI and robotics introduced into on-site jobs will work harmoniously with human workers.
- Digitalised skills will be easily and efficiently transferred to next-generation workers.

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[6]   Christensen (1997) argues that small entrepreneur firms put themselves in more favourable positions than large incumbent firms in terms of seizing the next wave of innovation in their respective industries because the former firms can avoid cannibalisation, which destroys the outcomes of existing innovations.

Figure 2: Concept of 'Connected Industries'
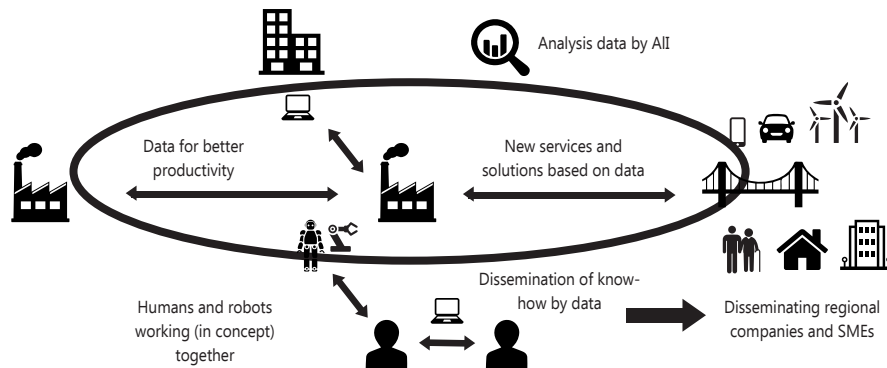
AI = artificial intelligence, SMEs = small and medium-sized enterprises.
Source: METI (2017a).

As described in the abovementioned case of connected industries, it is likely that AMS will also be able to develop and upgrade their industrial and export structures equipped with new technologies associated with IOT, big data, AI, and robotics. Since industries of AMS are firmly incorporated into global/regional value chains and production networks, they have significant potential to enhance their industries in tandem with surrounding economic partners. In this regard, more emphasis should be put on accepting cooperation provided by industrially advanced countries such as the United States (Silicon Valley), Japan (Connected Industries), Germany (Industry 4.0), and China (Made in China 2025).

Potential new technologies and their applications include the following:

- **Future-oriented robots**: These robots are defined as 'intelligent machinery systems' which possess three elemental technologies: intelligence, control systems, and drive systems (METI, 2006). They are also roughly categorised into industrial robots (e.g. welding, equipping electronic parts) and service robots (e.g. business and livelihood support, nursing care). When it comes to using robots, there is huge potential not only to drastically raise productivity and cut the costs of manufacturing plant lines but also to promote service industries generally suffering from low productivity. Additionally, using robots in infrastructure development and maintenance and disaster

recovery would be useful for ASEAN, one of whose policy challenges is to enhance 'resilience' and 'responsiveness' to social requirements. For instance, checkout and repair works using robot power will be practical, without depending on human engineering workers, at dangerous disaster sites.

- **Uninhabited airborne vehicle (i.e. drone)**: Drones, controlled in indirect operation without attended human pilots, are devised for various objectives, i.e. policing, land surveillance, product delivery, aerial photography, scientific research, and agriculture in addition to the military affairs. For example, home delivery of daily essentials such as food, clothes, and medicines by drones will vitalise distribution logistics. For ASEAN, which has many remote islands and mountainous villages, it is hoped that drones will play a role in enhancing connectivity between urban and rural areas.[7] Moreover, drones specialised in agriculture can be used for soil and field analysis, planting, crop spraying, crop monitoring, irrigation, health assessment, and so on.

- **Biotechnology**: Biological innovation has been generated in agriculture, food production, and medicine. In recent years, because of technological advancement, biotechnology has expanded to applications such as gene modification and editing, recombinant gene techniques, cellular fusion, immunology, and development of pharmaceutical therapies and diagnostic tests. Since AMS have diversified affluent biological resources in the (sub)tropical region, there seems to be much leeway for them to develop natural drugs through the use of such resources.[8] In industrial sectors, the application of biotechnology will help innovate in production processes; productivity improvement; pollution reduction; and recycling of wastes for a circular economy through making industrially useful products such as foods, chemicals, and textiles. 'Bioinformatics' is also expected to address problems in the pharmaceutical sector by combining biotechnology with ICT.

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[7]   Strickland (2018) reported that vaccines would be delivered to local people by drones in isolated island villages of Vanuatu.
[8]   The Bogor Agricultural University conducts research on developing new drugs made from indigenous plants in Indonesia that prevent epidemic of living stocks (The Nikkei, 2018).

- **Automated driving system**: This system attempts to control automotive travel, based on enhanced cognitive and judgement abilities which can imitate human drivers' perception, decision making, and operation of the automobile. The automated driving system requires advanced information processing, real driving, big driving data, and awareness of surroundings under the complex systems of AI. The ultimate objective of this technology is to achieve a safe, untroubled, and environmentally friendly 'mobility society'. The main benefit is its potential contribution to mitigating traffic problems, which have troubled many AMS. In recent years, the alignment driving system of tracks, control technology of inter-vehicular distance, and automated driving architecture based on AI have been under study in countries such as the US (e.g. Amazon, Google, and Uber), China, and Japan for practical use in the near future.

The infrastructure of ASEAN to use these new technologies fully–such as physical and soft infrastructure including institutions, laws, and regulations; potential industries and firms in domestic marketplaces; and skilled human resources–is far behind that of advanced countries (which have not necessarily fully achieved the infrastructure). With a view to enhancing infrastructure, it is essential that the governments of AMS arrange: institutions, laws, and regulations and rules regarding the use of big data and AI as well as applications of new technologies like drones; incentive mechanisms to promote applications (e.g. subsidies and tax incentives for R&D, and grants for targeted innovation); nurturing existing micro, small, and medium-sized enterprises (MSMEs) to form domestic supporting industries; and capacity building programs for workers who can lead new technologies.

Among other things, human resources should be developed to create innovations using new technologies. In the new era of AI and big data, governments of AMS need to produce talented workers who can not only figure out how to use AI and big data on the basis of mathematical abilities, but also can create unique values by setting appropriate frameworks, enhancing general abilities to identify and solve problems, and using universal abilities that are not easily replaced by machines. Mechanisation has heavily impacted low-skilled workers so far, but AI and robotics may replace the jobs and tasks of medium-skilled workers such

as middle managers in the near future.[9] For no one to be left behind from new technologies, it is necessary to provide people, including general workers, with enough educational opportunities to receive 'recurrent education', while reforming existing elementary and higher education systems is also an urgent issue.

EdTech is an educational method based on ICT that has been attracting attention. It aims to bring about innovation in education based on new technologies, represented by advanced ICT, to achieve effective education. EdTech targets areas such as infant intellectual stimulation, curriculum support for school children, and English conversation and computer programming classes for business persons. Concrete examples include the delivery of online lectures by leading global universities, adaptive learning systems that offer study content customised for individual students in primary and secondary education, and management platforms for instructors that control the learning progress of students. By using such educational innovation, governments of AMS will be able to promote human resources development efficiently in response to the emergence of new technologies and applications, and thereby narrow educational gaps between urban and rural regions.

The following box illustrates policy applications for new financial technology–blockchains–to enhance the nexus of cross e-residency system in ASEAN (i.e., provision of multi-citizenship and administrative services among AMS based on the blockchain technology).

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[9]   Brynjolfsson and McAfee (2011) and Frey and Osborne (2017) argue that AI may replace the task of information analysis or judgement conducted by so-called white-collar workers.

ASEAN People's Vision, ASEAN Community, and ASEAN Identity: the Nexus of Cross E-Residency System Based on Blockchain to Enhance 'ASEANity'

(1)   The New ASEAN Identity (ASEANity)

One of the most important tasks to be tackled in the post-ASEAN Economic Community era since 2015 is to foster the new ASEAN identity, attached to an integrated entity of ASEAN, in addition to each national identity. The new ASEAN identity may be called 'ASEANity' and citizens in ASEAN member states (AMS) would be 'ASEANians'. The integrated entity of ASEAN would be of ASEANians, by ASEANians, and for ASEANians.

In the past, fostering a new identity took a long time and involved spending huge amounts of capital. For example, before the Meiji Revolution in Japan in 1868, people living on the Japanese islands held provincial identities. After the revolution, however, Japan established a strong centralised government backed by a strong 'Japanese' identity. The Japanese identity was the invention of the central government of Japan, which spent a huge amount of budget fostering it for decades.

In the 21st century, we can apply the latest disruptive information and communication technology (ICT) to this issue. Our recommendation is to adopt blockchain technology. By employing a blockchain, we would be able to develop a new ASEAN identity in a short time with relatively small amounts of capital. We propose establishing the 'nexus of cross e-residency' system based on a blockchain to foster a new ASEAN identity, i.e. ASEANity.

(2)   The 'Nexus of Cross E-Residency' System

In fostering the new ASEAN identity, one of the most important requirements would be 'understanding' other AMS, including their respective culture, history, formal and non-formal social institutions, and way of thinking. The best way to enhance understanding would be to become a citizen of those AMS. In other words, people living in ASEAN would hold multi-citizenship of several AMS in addition to their original

citizenship. A citizen of one AMS (AMS-a) would hold citizenship of other AMS (AMS-b, AMS-c, etc.) and enjoy the administrative services of AMS-b, AMS-c, etc., in addition to the administrative services of the original AMS-a. This multi-citizenship may be called 'hyper people-to-people connectivity'.

Holding such multi-citizenship and enjoying administrative services from various AMS is important for people who act cross-nationally, e.g. business people or academics. We believe that this system would help all people living in ASEAN understand other AMS. Such cross-national understanding would lead people to 'create' or be 'aware' of ASEANity.

Establishing this system would invite a kind of 'popularity competition' among AMS. A popular AMS would be able to attract many people in ASEAN to obtain citizenship. An AMS which attracts only a small number of people would be forced to undertake reform policies, especially in the area of administrative services for residents. As a result, many people in ASEAN would hold multi-citizenship in ASEAN. Large numbers of people would hold 'complete' citizenship (i.e. of all 10 AMS). Through obtaining citizenship of other AMS, people would understand the cultural, historical, and social background of other AMS to become and act as 'good citizens' there. This mutual understanding would be the basis for ASEANity.

This mechanism shows the bottom–up, decentralised strategy of fostering identity. Considering the character of the concept of identity, we argue that this strategy has a significant advantage over the centralised strategy.

(3)   Technical Background

(i) Blockchain technology
Blockchain is a distributed ledger technology on a peer-to-peer network, based on technology including consensus algorism, smart contract, or encryption. The structure of a blockchain is decentralised, without big databases, and provides a high level of visibility and reliability on the

internet platform. A blockchain enables people to share a huge amount of information at a low cost, with confidentiality guaranteed.

In establishing the nexus of cross e-residency system, we recommend introducing a total e-government system covering not only each AMS but also the integrated entity of ASEAN based on a blockchain.

(ii) Structure of the three-layered system
We propose establishing a three-layered system: the first layer is the e-government system of each AMS, the second is the harmonised system of each e-government system, and the third is the integrated system of ASEAN.

The first layer is a blockchain-based e-government system in each AMS. On this layer, the main task is to establish an e-government system in each economy based on a blockchain.

Estonia is famous for its e-government system based on blockchain. We can obtain many lessons from the Estonian e-government case, despite the difference between Estonia (a single economy with a population of 1.3 million) and ASEAN (10 economies with a population of more than 600 million). We can follow the Estonian e-government case while modifying it or adding some functions. The strategy on this layer will be called 'the Expanded Estonian Model'. At this stage, each AMS will develop its original e-government system, partially based on blockchain, using a standardised e-government system, i.e. the ASEAN Standard Model of e-government.

The second layer is the harmonisation of each AMS e-government system by introducing the bridge system. This layer will be called the 'ASEAN Information Sharing System'. Each AMS government is requested to categorise the personal information of their people in three categories: highly confidential, open to domestic people, and open to all people in AMSs. The ASEAN Information Sharing System will provide the third category of personal information to all people in AMS.

Finally, the third layer is the integrated operation layer, where the headquarters of the ASEAN integrated entity will operate. This headquarters will oversee the operation of various region-wide administrative services based on the first and the second layers. Typical services could include the following:

- An ASEAN cryptocurrency. After the Asian financial crisis in 1997, many ideas have been developed for a common currency in East Asia, including a kind of basket currency or Asian currency unit. Researchers raised the issue of information sharing regarding a common currency, but a blockchain could substantially solve this problem since it is distributed ledger technology. A new cryptocurrency could be used in intergovernmental settlements among AMS at the first stage, intergovernmental agencies settlements at the second stage, and between large private enterprises settlements at the third stage. Settlements among SMEs and the public would follow later.
- Integration of operating people's health records.
- Common education systems or curricula would be operated in a variety of educational institutions in AMS.
- Joint operation of manufacturing factories by IOT. This is also known as the cyber physical system where all systems are controlled by computers to improve the efficiency of the society and create new inudstries. ASEAN will be able to operate this system at the regional (transnational) level, which might be called 'Industry 4.0 Plus (4.0+)'.

4. Way Forward for ASEAN and its Member States with New Technologies

Towards 2040, Silicon Valley, which still dominates other countries and cities in the development of AI and big data, may continue to play a leadership role in digitalising all sorts of industries and may monopolise radical innovation outcomes led by new technologies. It is also highly likely that fierce global competition will take place for 'innovation ecosystems' among countries and cities with respect to practical applications of new technologies to innovations in real businesses and socioeconomic progress.

Practical applications of modern ICT have been occurring all over the world based on high-speed internet, cloud computing, and smartphones. In line with the above-mentioned four fundamental new technologies (i.e. IOT, big data, AI, and robotics) and financial technology such as blockchain, diversified innovation ecosystems are being formed in countries and cities to escalate into more elaborate industrial sectors and markets as an experimental application of these technologies (e.g. agriculture, health care, fintech, and manufacturing). AMS should catch up, customise, and disseminate new technologies to local firms and MSMEs, especially 'technology entrepreneurs', to innovate distinguishing business models that better leverage their advantages, such as thick consumer markets supported by increasing middle and upper groups, the sheer diversity of the region, and young talent that is familiar with ICT.

The critical element of the Fourth Industrial Revolution builds mainly on the software developed around ICT, which allows for customisation to a greater extent on the hardware. For example, the design of a drone used for a tropical multi-crop system frequently observed in ASEAN might be different from that for a monoculture agricultural system in other regions. This room for customisation would call for strenuous efforts to produce innovations geared to the characteristics of a country, subregion, or even a large city in ASEAN. Therefore, AMS should have enough capacity to innovate with effective customisation adapted to the region, and then to render their products, services, and business models transferable and saleable to the rest of the world with similar characteristics beyond the region. This innovation ecosystem is what ASEAN should seek to

leverage its competitive advantage and establish its position as a global 'innovation hub' in 2040.

Lastly, in the Fourth Industrial Revolution centring on new technologies, AMS need to develop new frontiers of potential market to be targeted by innovative business models and thereby realise an affluent society for all people. Meanwhile, it might be essential for AMS to rebuild the whole socioeconomic system including institutions, laws, regulations, and rules, particularly from the viewpoint of strengthening capacity building of human resources and facilitating the movement of young talent, to adapt to the era of new technologies. Thus, for ASEAN and AMS to obtain the full benefits, a holistic approach is needed to formulate unique innovation ecosystems. In this regard, we do not have much time left to achieve that goal before 2040.

5. Concluding Remarks

From the discussions so far, the key messages of this paper are concluded as follows:

In the first place, the new technologies–IoT, big data, AI, and robotics–will constitute the technological foundation for next-generation innovation in association with innovative business models. Through these technologies, AMS can identify social and structural problems that have not appeared as obvious and create new markets that satisfy real demand. To this end, AMS need to arrange: institutions, laws, and regulations and rules for the use of AI and big data; incentive mechanisms to promote practical applications of new technologies; nurturing existing MSMEs to form domestic supporting industries; and capacity building programs for workers who can lead new technologies. It is also worthwhile to receive industrial cooperation from the United States, Japan, China, and others.

The opportunity to employ new technologies and innovations are equally opened to countries and cities other than ASEAN. Towards 2040, it is likely that AMS will face fierce competition among them for innovation ecosystems that realise socioeconomic progress. AMS is

required to immediately start nurturing local firms, especially technology entrepreneurs, to innovate distinguishing ecosystems that better leverage their advantages, such as thick consumer markets and diversified societies. On the other hand, AMS also need to establish innovation hubs and produce their 'own innovations' geared to their characteristics through effective customisation of new technologies. By doing so, AMS are expected to render their products, services, and business models transferable and saleable to the rest of the world with similar characteristics beyond the region.

Goals and policy recommendations

Goals	Policy recommendations
• Survive global competition for "innovation ecosystems" among countries and cities with respect to practical applications of new technologies to innovations in businesses and socioeconomic progress. • Catch up, customize, and disseminate new technologies to local MSMEs, especially "technology entrepreneurs", to innovate distinguish business models that better leverage ASEAN's advantages. • Form "innovation hubs" that render products, services, and business models transferable and saleable to the rest of the world.	• Arrange (1) institutions, laws, and regulations and rules for the use of new technologies, particularly, big data and AI; (2) incentive mechanisms to promote applications (e.g. subsidies and tax incentives for R&D, grants for targeted innovation; (3) nurturing existing MSMEs to form domestic supporting industries; and (4) capacity building programs for workers who can lead new technologies. • Receive industrial cooperation from countries, such as Japan, Germany, and China. • Produce talented workers who can not only figure out how to use new technologies but also create innovations. • Provide people with enough educational opportunities from elementary school to 'recurrent education' with support of new educational methods such as 'EdTech'.

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Resilience and Environmental Sustainability

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Introduction

Almost all of the Association of Southeast Asian Nations (ASEAN) countries are vulnerable to natural disasters, having long experienced a disproportionate share of global floods with high fatalities and economic damages. Large segments of ASEAN people live in low-lying coastal areas, river deltas, or floodplains. These areas are particularly prone to frequent and severe floods. Future climate change will cause more intense typhoons, coastal floods, droughts, heatwaves, and landslides. By 2040, countries must find innovative ways to reduce their vulnerability and increase their resilience. Since the 1970s, ASEAN Member States have witnessed remarkable demographic and industrial changes, exacerbating serious risks to environmental sustainability. These include worsening air pollution, degradation of land and water resources, and rising greenhouse gas emissions. Today, many of those seemingly far-off concerns of vulnerability, resilience, and sustainability are becoming a reality. This has sobering implications for achieving the Sustainable Development Goals (SDGs), and challenges the ability of 600 million people to survive and thrive in the ASEAN single market. This chapter offers a visionary pathway towards a resilient and sustainable ASEAN

by 2040. These new ideas are disruptive, but far less disrupting than an ASEAN running low on drinking water, with unproductive land and polluted air, against a backdrop of climate change, extreme weather events, and rising natural resource scarcity.

The first section of this paper reviews the future of a resilient and sustainable ASEAN and provides a brief assessment of activities so far. It shows that ASEAN and its member states (AMS) are aware of the importance of resilience and sustainability, but that some indicators reflect weak implementation towards a resilient and sustainable ASEAN. The second section considers possible technological development that may contribute to improve resilience and reduce the environmental burden of economic growth. To maximise the benefit of economic integration of ASEAN in these fields, some product standards related to resilience and environmental sustainability should be harmonised. The need for such harmonisation is discussed in section 3. A vision for resilience and sustainability is proposed in section 4.

1. Existing Visions and Targets for Resilience and Sustainability in ASEAN

Resilience and environmental sustainability are not new concepts for ASEAN and its member states; rather, they are identified as imperatives in the ASEAN community building process. The ASEAN Vision 2020 stated that 'we envision a clean and green ASEAN with fully established mechanisms for sustainable development to ensure the protection of the region's environment, the sustainability of its natural resources, and the high quality of life of its peoples' (ASEAN, 1997).

The ASEAN Socio-Cultural Community Blueprint (ASEAN, 2009; hereafter, Blueprint 2015) and ASEAN 2025: Forging Ahead Together (ASEAN 2015a; hereafter Blueprint 2025) highlighted both resilience and environmental sustainability. Various actions have been implemented. AMS have also participated in international initiatives to improve resilience and environmental sustainability, such as United Nations activity toward the SDGs, the Paris Agreement under the United Nations Framework Convention on Climate Change, and the Sendai Framework for Disaster

Risk Reduction. This section reviews the existing vision and related actions in the future.
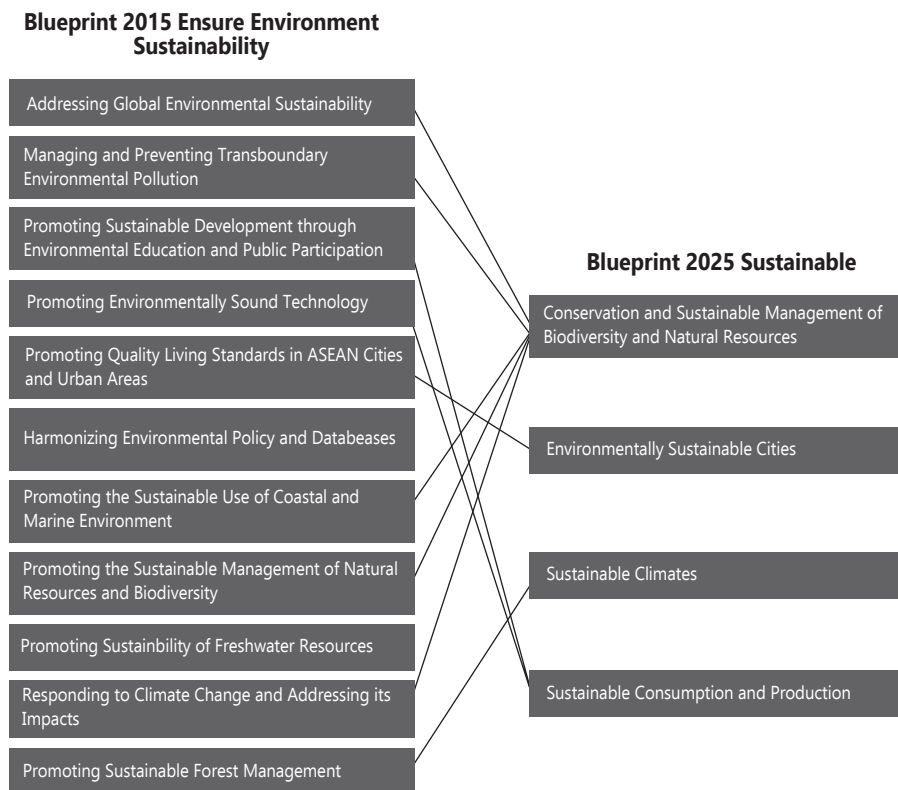
1-1. ASEAN Blueprints

In the Blueprint 2015, resilience was dealt with as a subsection for social welfare protection. In the B.7 section (Building disaster-resilient nations and safer communities), the stated strategic objective is to 'Strengthen effective mechanisms and capabilities to prevent and reduce disaster losses in lives, and in social, economic, and environmental assets of ASEAN Member States and to jointly respond to disaster emergencies through concerted national efforts and intensified regional and international cooperation' (ASEAN, 2009: 11). Various actions were also specified, such as the full implementation of the ASEAN Agreement on Disaster Management and Emergency Response by 2015, support for the establishment and operationalisation of the ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre), and functioning of the ASEAN Disaster Information Sharing and Communication Network.

Resilience has a higher profile in the Blueprint 2025, becoming one of the sections under the ASEAN Socio-Cultural Community Blueprint 2025. Section D addresses disaster resilience (D.1), resilience to health-related hazards (D.2), adaptation to climate change (D.3), and other aspects (ASEAN, 2015a).

Environmental sustainability was also emphasised in the 2015 and 2025 blueprints. Four areas of activities were mentioned in the Blueprint 2025: (i) conservation and sustainable management of biodiversity and natural resources, (ii) environmentally sustainable cities, (iii) sustainable climate, and (iv) sustainable consumption and production. The Blueprint 2015 mentioned 11 areas of activities. Although the number of areas in the sustainability section of the Blueprint 2025 decreased, most of the areas in the Blueprint 2015 are covered in the Blueprint 2025 (Figure 1). For example, environmental education and environmental technology, which were included as sub-sections of 'Ensure Environmental Sustainability' in Blueprint 2015, are not included as sub-sections, but covered in the sub-

section of 'sustainable consumption and production' in Blueprint 2025. Similarly, in Blueprint 2015, natural resource management was separately mentioned in the sub-sections for marine and coastal resources, forests, natural resource and biodiversity, and global environmental sustainability. They were integrated into 'Conservation and Sustainable Management of Biodiversity and Natural Resources'.

Figure 1: Environmental Sustainability Topics in the 2015 and 2025 Blueprints under ASEAN Social and Cultural Community

Blueprint 2015 Ensure Environment Sustainability

- Addressing Global Environmental Sustainability
- Managing and Preventing Transboundary Environmental Pollution
- Promoting Sustainable Development through Environmental Education and Public Participation
- Promoting Environmentally Sound Technology
- Promoting Quality Living Standards in ASEAN Cities and Urban Areas
- Harmonizing Environmental Policy and Databeases
- Promoting the Sustainable Use of Coastal and Marine Environment
- Promoting the Sustainable Management of Natural Resources and Biodiversity
- Promoting Sustainbility of Freshwater Resources
- Responding to Climate Change and Addressing its Impacts
- Promoting Sustainable Forest Management

Blueprint 2025 Sustainable

- Conservation and Sustainable Management of Biodiversity and Natural Resources
- Environmentally Sustainable Cities
- Sustainable Climates
- Sustainable Consumption and Production

ASEAN = Association of Southeast Asian Nations.

Source: Authors, based on ASEAN (2009) and ASEAN (2015a).

Although strategic measures are listed for each sub-section in the Blueprint 2025, no clear targets are specified. Sustainability aspects are not only mentioned in the Blueprint for the ASEAN Socio-Cultural Community, but also in various sections of the ASEAN Economic Community in Blueprint 2025. Chapter B (A Competitive, Innovative and Dynamic ASEAN) of the AEC states that sustainable economic development is regarded as an integral part of the region's growth strategy. Various strategic measures are also mentioned, such as supporting renewable energy, promoting the use of biofuels for transportation, and promoting forest management involving the community living within and surrounding the forest.

Section C-1 (Transport) also stressed the importance of the sustainability of ASEAN transportation, with connectivity, efficiency, integration, and safety. The Kuala Lumpur Transport Strategic Plan, 2016–2025 (ASEAN, 2015b) also mentions actions for sustainable transport, such as fuel economy policies and standards, green and efficient freight, and logistics.

Section C-5 (Food, Agriculture and Forestry) mentioned the promotion of sustainable forestry and organic agriculture. Section C-6 on tourism emphasised the necessity of environmental protection to make tourism more sustainable, in addition to the necessity of adaptation to climate change. Section C-8 pointed out that the mining industry should become more environmentally and socially sustainable. The ASEAN Minerals Cooperation Action Plan, 2016–2025 (ASEAN, 2016) includes more concrete activities such as implementing the sustainability assessment framework and guidelines; and conducting training to strengthen the capacities of national authorities to ensure safe, responsible, and sustainable mineral development.

Efforts to ensure environmental sustainability are being conducted not only under the Socio-Cultural Community but also in the Economic Community.

1-2. Other Visions: SDGs and Paris Agreement

The SDGs were adopted in September 2015 at the United Nations Sustainable Development Summit. Table 1 shows the complementarities between the SDGs and the Blueprint 2025 which cut across the three pillars of the ASEAN community vision – the ASEAN Economic Community, the ASEAN Socio-Cultural Community, and the ASEAN Political-Security Community.

Table 1: Cross-Sector ASEAN Coordinating Bodies on SDGs

SDGs	Occurrence in the blueprints of the ASEAN Community			Corresponding mechanisms
	AEC	APSC	ASCC	
Goal 1 (poverty)	X		X	Ministerial meeting on rural development
Goal 2 (hunger)	X		X	Ministerial meeting on agriculture and forestry
Goal 3 (health)			X	Ministerial meeting on health development
Goal 4 (education)			X	Ministerial meeting on education
Goal 5 (gender)			X	ASEAN committee on women
Goal 6 (water)			X	Ministerial meeting on environment
Goal 7 (energy)	X			Ministerial meeting on energy
Goal 8 (work)	X		X	Ministerial meeting on labour
Goal 9 (innovation)	X		X	ASEAN committee on science and technology
Goal 10 (inequality)			X	Initiative for ASEAN Integration task force (narrowing development gaps)
Goal 11 (cities)	X		X	Ministerial meeting on development planning
Goal 12 (consumption)	X		X	Ministerial meeting on economy
Goal 13 (climate)	X		X	Ministerial meeting on environment
Goal 14 (ocean)		X		Ministerial meeting on maritime
Goal 15 (land)			X	Ministerial meeting on land and infrastructure
Goal 16 (peace)		X		Ministerial meeting on foreign affairs
Goal 17 (partnership)	X	X	X	All sectoral bodies

AEC = ASEAN Economic Community, APSC = ASEAN Political-Security Community, ASCC = ASEAN Socio-Cultural Community, ASEAN = Association of Southeast Asian Nations, SDG = Sustainable Development Goal.
Source: Authors.

For example, the High-Level Brainstorming Dialogue on Enhancing Complementarities between the ASEAN Community Vision 2025 and the 2030 Agenda for Sustainable Development was held in March 2017, wherein ASEAN sectoral bodies reaffirmed their commitment to building synergy and complementarities between the Blueprint 2025 and the SDGs.

The SDGs have various goals and targets, including resilience and sustainability, some of which are presented in Table 2.

Table 2: Selected Goal and Target Related Resilience and Sustainability in SDGs

Goals	Targets and indicators
Goal 6: Ensure availability and sustainable management of water and sanitation for all	By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
	By 2030, improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
	By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all	By 2030, increase substantially the share of renewable energy in the global energy mix
	By 2030, double the global rate of improvement in energy efficiency
Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable	By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations

Goals	Targets and indicators
Goal 12 : Ensure sustainable consumption and production patterns	By 2030, achieve the sustainable management and efficient use of natural resources
	By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimise their adverse impacts on human health and the environment
Goal 13: Take urgent action to combat climate change and its impacts	Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
	Integrate climate change measures into national policies, strategies and planning
Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development	By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
	By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans
Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally
	By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development

Source: Compiled from United Nations General Assembly (2015).

The AMS ratified the Paris Agreement in December 2015, committing to reduce annual emissions from 20% to 65% by 2030. The nationally determined contributions (NDCs) represent a new level of engagement towards green growth. Achieving the NDC targets will require accelerated investments in low-carbon infrastructure.[1]

As mitigation and adaptation have co-benefits, some of the AMS mention the forestry sector in mitigation measures. Brunei Darussalam declares that the total gazetted forest reserve will be increased to 55% of its total land area by 2030, compared with 2018 levels of 41%. Cambodia also revealed its intention to undertake voluntary and conditional actions to achieve the target of increasing forest cover to 60% of its land area by 2030. This would result in the net sequestration from land use, land-use change, and forestry (LULUCF) falling to 7,897 GgCO2 in 2030 compared with projected sequestration of 18,492 GgCO2 in 2010. For Indonesia, land use change and forestry, including peat fires, is the largest source of greenhouse gas (GHG) emissions, accounting for 47.8%, while the energy sector contributes 34.9%.

Most of the AMS' NDCs also mention adaptation. The NDCs of the Lao People's Democratic Republic (Lao PDR) focus on adaptation projects and programs in agriculture, water resources, and public health. Myanmar also stresses the importance of adaptation, and has initiated new plans in the agriculture, livestock, and water resources sub-sectors. The Philippines also identifies agriculture, water, and health as key sectors for adaptation.

1.3 Moving Towards Resilience and Sustainability: The Achievements

The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) reported on the progress of the SDGs for Asia and the Pacific, stating that 20 out of 53 targets are on track to be achieved (UNESCAP, 2018). Regarding environmental issues, Southeast Asia is on track to achieve the goals for 'affordable and clean energy' and

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[1] The chapter on energy deals with the vision on energy. This chapter discusses mitigation measures in other sectors such as deforestation, and adaptation measures.

'sustainable cities and communities'. However, progress is not observed in climate change and life below the water. UNESCAP (2018) also pointed out that the material footprint and material consumption such as water, raw materials, and forest products have increased. Such trends should be reversed to achieve the SDGs.

UNESCAP (2018) classified the indicators into three categories: (i) 'current rate of progress needs to be MAINTAINED to meet the target', (ii) 'need to ACCELERATE current rate of progress to meet the target', and (iii) 'current trend needs to be REVERSED to meet the target' (Table 3).

Table 3: Anticipated Progress on Resilience and Sustainability in 2030 by Southeast Asia

Progress Level	Strategy
Current rate of progress needs to be MAINTAINED to meet the target	Safely managed sanitation, reliance on clean energy, economic loss from disasters, CO_2 emissions per manufacturing value added
Need to ACCELERATE current rate of progress to meet the target	Renewable energy share, CO_2 emission intensity, Ocean Health Index, terrestrial and freshwater biodiversity
Current trend needs to be REVERSED to meet the target	Material footprint, domestic material consumption, forest area (% of land)

CO_2 = carbon dioxide.
Source: UNESCAP (2018).

Table 4 shows some indicators related to environmental sustainability and resilience. The forest area (% of land) indicator is categorised 'needs to be REVERSED' for Southeast Asia, but some AMS such as the Lao PDR, Malaysia, and the Philippines increased the forest area. Regarding the proportion of the population practising open defecation, most AMS show a significant improvement. All AMS increased their material footprint, although huge differences in the material footprint per capita can be observed among them. Singapore is the largest, reaching 73.04 tons, while Myanmar only produces 1.50 tons.

Table 4: Selected Indicators of Sustainability and Resilience

Country	Proportion of population practising open defecation (%)		Material footprint per capita (ton)		Forest area as a proportion of total land area (%)		Climate Risk Index score (rank)
	2000	2015	2000	2017	2000	2015	2016
Brunei Darussalam	2.5*	2.6	12.60	19.09	75.33	72.11	109.50 (120)
Cambodia	82.7	40.6	1.66	3.57	65.41	53.57	95.17 (111)
Indonesia	32.2	12.4	3.36	6.23	54.87	50.24	46.17 (37)
Lao PDR	62.0	22.1	1.26	7.37	71.60	81.29	109.50 (120)
Malaysia	1.6	0.3	19.19	22.61	65.72	67.55	65.50 (72)
Myanmar	11.2	4.7	0.53	1.50	53.39	44.47	57.17 (53)
Philippines	10.9	5.7	4.00	4.34	23.57	29.96	31.33 (16)
Singapore			51.14	73.04	23.06	23.06	109.50 (120)
Thailand	1.0	0.3	7.75	14.90	33.30	32.10	37.50 (20)
Viet Nam	17.7	3.9	3.42	10.01	37.82	47.64	15.33 (5)

Lao PDR = Lao People's Democratic Republic.*2007.

Source: United Nations, Global SDG Indicators Database, https://unstats.un.org/sdgs/indicators/database/ (accessed 5 August 2018).

The Climate Risk Index (CRI), shown in Table 4, quantifies the impacts of extreme weather events – both in terms of fatalities as well as economic losses – based on the Nat CatSERVICE database. The countries ranking highest were the ones most impacted in 2016.

The United Nations identified indicators for SDGs, but some indicators related to sustainability and resilience issues have not been measured in Southeast Asian countries, so data collection should be strengthened. Furthermore, some of these indicators did not capture the sustainability costs of economic growth.

Southeast Asian countries have a challenge to tackle environmental issues, with conflicting demand for accelerated economic growth and poverty reduction, among others. The management of resources to reduce the ecological footprint of the AMS needs to involve new approaches to planning for cities and rural areas that incorporate

resource efficiency in the production process; energy efficiency in building regulations, land use, and transport planning; and management of water, air, and solid waste to promote a circular economy – a closed loop material system wherein raw material needs are minimised and economic benefits are maximised. The region needs ambitious and achievable targets for sustainable development, reflecting multidimensional challenges. The programs and their implementation plans are still patchy, which is problematic for implementing and monitoring the SDGs.

Countries can reduce disaster, environmental, and climate risks by developing and periodically updating systematic risk management plans to minimise the economic impact of and vulnerability to climate-induced disasters. Disaster risk reduction and management programs should be accorded the highest priority in all national resilience programs. The sectors most vulnerable to disasters and climate change are agriculture, urban development, water supply and sanitation, transport, and health (Anbumozhi, 2018). Climate change will necessitate shifts in crop production and land management techniques in many AMS, as well as changes in water use (Anbumozhi et al, 2017). There is an urgent need to develop both country level and regional knowledge on the links between climate change, disasters, water availability, and dry land management. In many countries efforts need to be initiated to search for more climate-smart agriculture that involves new information and communication technology (ICT). From now until 2040, policymakers need to dramatically increase efforts to adapt their development strategies and programs to the impacts of disasters and climate change. With the accelerated absorption of ICT and above-ground sensors and satellites, by 2040 they should be in a position to take full advantage of early warning systems.

Improving the resilience of global and regional value chains is critical for the AMS. Reducing the severity of disruptions in the flow of goods and services across borders to customers very much depends on improving the capabilities of enterprises along the value chain, which could be catalysed by strengthening the disaster readiness of locations and functions at the nodes in the value chains. Establishing multiple channels between suppliers, company sites, and functions could be established under business continuity plans. Countries and companies can reduce

disaster and climate risk by developing systematic business continuity plans that incorporate innovative risk financing instruments and techniques. Experience in the region and in other small island countries has shown that disaster risk finance and crop insurance schemes can play a pivotal role in developing active risk management capacity along the value chains, and reduce the economic impact of and vulnerability to climate-related disasters. Financing instruments, when combined with other emerging technologies such as blockchain, can provide effective risk reduction capability for small and medium-sized enterprises (SMEs), emergency credit or liquidity, and access to external risk transfer markets including reinsurance.

2. Impact of Digital Economy and Industry 4.0 on Resilience and Sustainability

The progress of the digital economy and the Industry 4.0 (fourth industrial revolution technologies) may have a large impact not only on our consumption and production patterns, but also on resilience and sustainability. We need to utilise this new technology to improve resilience and sustainability.

2.1 Industry 4.0 and Opportunities for Resilience and Sustainability Leapfrogging

Technologies of Industry 4.0 create opportunities for some of the AMS to bypass traditional phases of industrial development. Online and mobile banking is reducing the need to build physical networks. While the infrastructure needs of ASEAN remain formidable, developments driven by Industry 4.0 suggest they could be lower, and certainly different and more circular, than they would be otherwise (Anbumozhi and Kimura, 2018). Localised and close-looped production networks with 3D printing technologies could reduce the need for raw materials and enable firms to manufacture products in small and required quantities, without much waste getting into the system. SMEs are the backbone of ASEAN economies, but their environmental impacts are significant, as they are limited in their access to technology, finance, and business information. The rise of the internet of things and artificial intelligence can empower SMEs to produce in a more eco-efficient way and connect them to the

giant ASEAN single market rather than just local customers. Technologies such as blockchain will revolutionise the procurement of eco-products and services, logistics, and payments – enabling small and micro firms to interact with new customers on a trust basis, never having met each other (Nielsen, 2014).

Equally, the Industry 4.0 technologies can provide new ways of preparing for disasters and climate risks. Some ASEAN nations are archipelagic, and physical connectivity has long been a concern for growth and resilience. Other AMS have large rural and agricultural populations. In general, the use of ICT in the context of resilience has the potential to achieve the resilience objectives of developing early warning and hazard risk information, developing mapping tools to map vulnerable areas, and transmitting adaptation choices and the availability of financial resources to support that. Artificial intelligence, drones, and remote sensing offer opportunities to monitor agriculture, forestry, and fishery activities much more effectively. Irrigation systems can be automated and blockchains can be used to manage water allocation among farmers.

2.2   Digital Economy and Environmental Sustainability

Diffusion for the digital economy increases resource consumption such as energy, water, and materials for data exchanges, calculation, and others. It is a direct impact of the digital economy on resource consumption. Blockchain technology may stimulate more energy consumption because data mining activities consume a significant amount of energy.

Studies on the energy consumption of data centres in the United States (US) show an improvement in energy efficiency, having stabilised since 2008 (Shehabi et al., 2016). The energy efficiency of hardware has been improved through software. Shehabi et al. (2016) predicts that total energy consumption from data centres will not grow rapidly. It is also forecasts that more energy efficiency hardware and blockchain technology will be introduced in the future.

The US, European Union (EU), and Japan have an index and guidelines for energy efficiency in data centres. For example, the US Department of Energy issued a best practice guide for energy-efficient date centre design (US Department of Energy, 2011). Since more data centres are likely to be established in Southeast Asia, it would be an economic and environmental burden to the region if their energy efficiency were low. Therefore, energy efficiency guidelines and regulations for data centres should be developed at the ASEAN level.

On the other hand, teleworking and teleconferencing could reduce the need for commuting and business trips – decreasing energy consumption and GHGs. Onley (2015) estimated that teleworkers at Dell, Aetna, and Xerox in the US saved 95,294 metric tons of GHGs in 2014.

Many ASEAN countries have a large agriculture sector, which could enjoy a positive impact from the digital economy. In the short term, the impact of connecting farmers to telecommunication facilities has brought improvements to farm labour productivity, profitability, and resilience. Smartphones give workers and farmers better access to work choices, climate information, and knowledge about inputs and outputs. When connected to GPS, smartphones may also enable the sharing economy to take hold, whereby users such as farmers who cannot afford to buy mechanical or transport equipment can rent it by the hour from other farmers via online sharing sites.

2.3. Self-Driving Automobiles and the Sharing Economy

Many automobile companies, information technology industries, and car sharing companies invest in self-driving cars, which are projected to be on the market from 2020. This will have an impact on the business model in the automobile sector, taxi and car sharing services, and the ownership rate of automobiles.

Berret et al. (2017) argue that many people would not buy a car again if fully autonomous robocabs – driverless taxis – could be used at a lower cost per trip than their own car. In Singapore, 51% of respondents

answered that they would not buy a car again. Car owners in India and China were more likely to buy a car again, but 33% in India and 27% in China said they would not buy a car if robocabs were cheaper than owning a car.

Although the survey did not cover ASEAN countries, except Singapore, the car ownership rate in other ASEAN countries is not expected to reach the same level as in developed countries. Reduced car ownership would cut the resource consumption of automobiles.

Consumers will also be able to choose types of cars according to their demand. Mini vehicles for one to two people will be used for short tips of a few kilometres (transport to/from the transit point of public transportation, e.g. bus stop or subway station). Such usage will also reduce materials and energy for transportation.

Digital market platforms, usually referred to as the sharing economy, should become an essential part of city planning. Connectivity between public transport and self-driving cars should be carefully designed in that digital-driven city economy. Otherwise, many people will use automobiles and public transport will be decreased, which would have a negative impact on sustainability. As the trends of increasing connectivity, low-cost hardware, and informal and social entrepreneurship continue to advance in ASEAN, it is not yet clear whether traditional regulations will stifle progress on normalising the environmental and safety risks.

Carbon pricing is being highlighted as a key policy instrument to support changes in consumer behaviour. It was found successful in promoting innovation, creating new businesses, and delivering meaningful emissions reduction – particularly in urban centres – by forcing commuters to shift to public transport systems (Tamilian, Cao, Ho, 2017).

On the other hand, relatively high population densities in ASEAN cities mean that rail mass transit will have a significant place in the future of ASEAN in 2040. However, rail mass transit is expensive and not the

only solution, especially for medium-sized to small cities. Curitiba, Brazil (through its TranMilino system), Jakarta (through its TransCity express bus), and Manila (with elevated city terminals) have become successful low-carbon transport systems by reducing private car use.

3. Regional Approaches and Single Market for Resilience and Sustainability

As ASEAN has intensified its efforts to create a single market for products and services, it is becoming easier for goods, services, and factors of production to be moved across countries as easily as within countries. To maximise the benefit of the single market in environmental goods, some standards should be harmonised in ASEAN countries.

3.1 Consumer and Product-Related Environmental Regulations

Consumers – either individuals or industries – considering buying an environmental good or service go through three stages. First, they become aware of the environmental threat and become keen to help mitigate it through consumption. Second, they acquire the necessary information about the good. Third, they buy the good. Labelling and certification are crucial for highlighting the environmental attributes of products. Economic integration in ASEAN increases the need for harmonisation of not only conventional goods but also product-related environmental standards, such as measurement methods of the energy efficiency of appliances and automobiles, labelling requirements related to energy efficiency and environmental issues, and evaluation methods of decentralised wastewater systems. Without harmonisation for evaluation methods, manufacturers would have to conduct multiple tests for each country.

Although international standards may be created for these aspects, some regional standards should be developed in ASEAN because certain conditions (e.g. climate and culture) differ by region. For example, the efficiency of decentralised wastewater treatment depends on temperature, which affects the speed of decomposing. As a result, the size of tanks in Southeast Asia can be smaller than in Europe, Japan, or

the US. Appropriate regional standards should be developed, based on scientific research and agreement, among stakeholders in the region.

Similarly, governments may directly affect the demand for environmental goods and services. The public sector – national, provincial, and local government – is the largest consumer of finished goods and transport services in many ASEAN countries. Given such volume, governments can drive the markets to scale up the purchase of products. This combined approach of market push and harmonised regulatory pull could bring radical changes in production standards and consumers.

3.2   Circular Economy

The circular economy can reduce the environmental burden in various ways. Promotion of the circular economy should be harmonised in the region. When ASEAN economies are fully integrated, international trade of recyclable waste, used goods, core for remanufactured goods, and remanufactured goods itself will increase, because of scale economies in recycling, repairing, and remanufacturing industries. The EU issued the Circular Economy Package in 2016, which has various actions to stimulate the circular economy in the region.

Marine plastics issues have highlighted insufficient waste management and recycling in Southeast Asian countries. Jambeck et al. (2015) estimated the volume of marine plastic generation from land around the world, based on the population within 50 kilometres of the coastline, waste generation per day, the rate of plastic waste in waste generation, and the rate of improper treatment of plastics. This method revealed China to be the top marine plastics generator, followed by Indonesia, the Philippines, and Viet Nam. Total marine plastics generation in ASEAN countries is estimated to exceed that of China. Although this estimate is based on very strong assumptions, the findings of the study suggest that ASEAN countries should put more effort into waste management and recycling.

Small-scale recycling industries in ASEAN countries have caused pollution. It is costly for small-scale recyclers to install wastewater treatment and air pollution control equipment. Some countries, such as Japan and China, conduct stricter enforcement of pollution control and promote recycling industrial parks, where small recyclers can move their factories and invest in pollution control.

Industrial standards for recycled products should also be established. For example, Japan has set various industrial standards for recycled goods, such as aluminium dross for iron and steel making (JIS2402) and eco-cement (JIS5214). Such standards should be harmonised in the ASEAN region because recycled products are traded in the region.

When combined with circularity principles, the sharing economy can also contribute to reducing environmental burdens. The EU regards sharing as part of the circular economy. Some surveys show that sharing is very popular in ASEAN countries, even compared with developed countries. Nielsen conducted a worldwide consumer survey on the sharing economy in 2013, which found that consumers in Southeast Asia are more likely to share than in other regions (Nielsen, 2014). Some 87% of Indonesian consumers said they were likely to share from others, which is second highest after China's 94%, while Slovenia (87%) ranked 3rd, the Philippines (85%) ranked 4th, and Thailand (84%) ranked 5th. Similar results are reflected in Rakuten-AIP (2017), which conducted a consumer survey in Japan, Singapore, the US, and Viet Nam, showing that 53% of Vietnamese people had used ride/car sharing, which is higher that Singapore (28%), the US (23%), and Japan (4%). Therefore, ASEAN countries may be able to improve resource efficiency through the sharing economy.

On the other hand, remanufacturing is not very popular in ASEAN countries. Rebuilt automobile parts are not well recognised by customers, and remanufactured goods and cores for remanufactured goods are often regarded as used goods and prohibited for import to the region (Kojima, 2017).

Ekins et al. (2017) pointed out that remanufacturing has the potential to improve resource efficiency. The Government of Singapore, with Nanyang Technological University, established the Advanced Remanufacturing and Technology Centre in 2012. Research and development for the sector should be strengthened. Regulatory barriers for the remanufacturing business, such as import restrictions on cores for remanufactured goods, should also be removed.

3.3   Building Standards

Across ASEAN, making housing and buildings safer is a concern as some areas have a higher risk of earthquakes, flood storms, landslides, etc. To reduce the risk of collapse of buildings from earthquakes, building standards for resilience to earthquakes should be developed. Such standards should be required for the construction of new buildings. Since many construction companies are expected to provide services in more than two ASEAN countries, it would be advisable to create an ASEAN building code to reduce the risk from earthquakes and associated risks. Local governments should become visibly more committed to safe housing and prohibit the occupancy of structures in high-risk areas. In the planning arena, governments, the private sector, and housing finance institutions should take a joint lead in the implementation of standards.

4. Vision 2040 for Resilience and Sustainability

4.1 Vision for Disaster Risk Reduction and Climate Change Adaptation

Disaster risk reduction and climate change adaptation are among the main goals of the SDGs. The Blueprint 2025 identified climate change and variability as a driver of disaster risk, along with uncontrolled urbanisation and poor land management. Tackling these by 2040 is expected to lead to a sizable reduction in disaster risk and resilience.

Risk assessments can further be improved through the results of new ICT and high-performance computing, a new generation of early warning systems and disaster loss models, and increased availability of high-resolution exposure datasets, as well as an improved stakeholder engagement and knowledge synthesis process. As shown in Figure 2, a comprehensive multi-hazard risk and vulnerability assessment framework can support evidence-based robust decision making.

Figure 2: Application of ICT in Disaster Resilience – A 2040 Roadmap

Resilience Options	Drought	Current and Short-term (Present - 2020)	Mid-term (2021 - 2030)	Mid-term (2026 - 2040)
Climate and siasters Risk / **Risk Assessment** / **Risk Management**	**Step I** Harmonized Data collection	• Meteorological data (i.e. hazard) • Socioeconomic data)i.e. exposure) • Climate change scenarios • Projections of socioeconomic conditions	• Updating meteorological data and improving data quality • Expanding data categories relevant to climate risk conditions • Updating socioeconomic and climate change scenarios	• Updating database and advancing quality control procedure • Real-time collection of meteorological data and R/S data
	Step II Risk Analysis	• Analysis of extreme occurrence and severity w/ meteorological data • Assessing spatial extent of hazards • Inventory resources and indetify groups at risk	• Updating climate and disaster risk properties (e.g spatial extent, occurrence) • Assessing further impacts of climate induced disaster on socieies • Assessing social resilience to expected impacts of droughts	• Establishing forecast based climate and disaster risk analysis framework
	Step III Understanding the risks	• Mapping hazard risks in term of hazard, exposure, and vulnerability • Assessing risk of climate change on weather events with scenarios • Assessing risk of changing socioeconomic conditions	• Developing mitigation plans for reducing climate risk under cahanging adaptive conditions • Finding and assessing adaption strategies	• Assessing drought hazard and vulnerability under forecastedclimatic conditions
	Step IV Developing System for disasters and climate risk management	• Developing hazard monitoring system • Archiving past drought events and their consequences	• Finding predictors for early warning • Improving social communication system (Mass media, Telecommunication)	• Developing real-time forecasting and early warning-system • Integrated multi-hazard detection system
	Step V Strengthening and enhancing risk manaement plan	• Review on existing strategies, policy, plans, laws and regulations • Developing climate risk education and training program • Policy for emergency response and relief • Establishing local climate adaption and resilience policy framework	• Improving governance and stakeholloders's cooperation • Regional resilience policy framework • Developing risk mitigation and control plan • Identifying and fill institutional gaps	• Developing and publicizing national resilience policy framework • Evaluating and revising adaption and resilience plans

ICT = information and communication technology.

Source: Adopted from Anbumozhi et al. (2012).

In some ASEAN countries, policies for disaster risk reduction and climate change adaptation are well integrated. New institutions have been established to develop joint actions towards resilience, benefitting both policy areas. Responding to extreme events is the prime responsibility of local governments, but provincial and central governments have a role in supporting local governments at different stages and periods of resilience building. This entails effective multilevel governance. Better coherence between disaster risk reduction and climate change adaptation can be fostered through the development of a high-level strategic vision and local level engagement of key actors, supported by adequate funding.

Community-based organisations have been playing an important role in co-managing natural resources and strengthening resilience. They are often best positioned to bridge the real need and the emerging technological possibilities. As new digital technologies (e.g. sensors, drones, and artificial intelligence) provide increasingly powerful traceability of resource depletion and co-management of common property resources such as water and forests, the services of community-based organisations are needed to establish the norms and institutional capacity of communities for harvesting the resources in a sustainable manner. Multi-stakeholder collaboration and co-management also have an important role in creating market demand. Over the past 20 years, sustainable forest councils and the sustainable seafood movement – involving diverse collaboration among non-governmental organisations, leading companies, farmers, fishers, and governments – have been a powerful market driver for better management of resources. Multi-stakeholder collaboration on the traceability of these public goods provides a clear signal for maximising the benefits of digital technologies.

The economic costs of climate risks can be reduced through well-designed ex ante financial management and protection instruments. Public–private partnerships can provide services with joint bearing of responsibilities and efficient risk sharing. A number of public–private partnerships under the ASEAN Single Market could be conceptualised and promoted, aiming at increasing insurance coverage and market penetration, and ensuring strong financial backing for low-probability high-impact risks. A well-functioning system of public and private user-driven ICT-based climate and disaster risk services could catalyse

economic and societal action and transformation which reduces risks and improves societal resilience.

The Economic Research Institute for ASEAN and East Asia (ERIA) has developed resilience roadmaps for the region, which are planned sectoral actions to be adopted over a period of time. They give a prioritised data service perspective on resilience – moving away from supplier- to user-driven – and are scientifically e-informed, underpinned by an approach to innovation based on co-design, co-development, and co-evaluation of resilience services. Improved alignment of demand-led climate change adaptation and disaster risk service products would require policymakers to have stronger linkages. Adding climate change and disaster resilience to the considerations used to motivate and design nature- or ecosystem-based solutions would add to the multipurpose nature of these solutions, help to leverage funding, and help to connect communities working on joint solutions.

The above measures require the establishment of national level indicators for monitoring actions towards improved resilience. Progress in implementing the Sendai Framework for Disaster Risk Reduction will be monitored through an agreed set of indicators, while the United Nations Framework Convention on Climate Change is considering how best to track resilience efforts at the national level. SDGs will also require countries to report on progress. There are opportunities to improve connectivity and coherence between these indicators and data requirements at the ASEAN level, improve the efficiency of data collection at the national level, and build a more complete picture of climate change adaptation and disaster risk progress and priorities at the national level.

A multi-stakeholder approach should be strengthened for information sharing and coordination within each country and among AMS. Resilience and environmental sustainability issues require the collaboration and cooperation of various sectors such as governments, industries, academics, and non-governmental organisations. Even in government, various ministries and agencies should cooperate with each other. Institutional arrangements within various stakeholders should be strengthened.

The ASEAN single market is bound to the rest of the economies through multiple systems that enable two-way flows of materials, financial resources, ideas, and innovations. The pace of technological change – particularly Industry 4.0 in the fields of information, communication, nanotechnology, and biotechnologies – is unprecedented. These innovations can help to reduce the waste and impact of industrial development. A circular economy could contribute to this. Unlike the traditional linear take–make–consume–dispose approach, a circular economy seeks to respect physical boundaries by increasing the share of renewables or recyclable resources while reducing the consumption of raw materials. Approaches such as eco-design and sharing, reusing, repairing, refurbishing, and recycling existing products and materials will play a significant role in maintaining the utility of products, components, and materials retaining their economic value. A circular economy at ASEAN level offers considerable benefits, reducing the ecological footprint. Circular economy strategies could also result in substantial cost savings, increasing the competitiveness of the ASEAN single market while delivering benefits in terms of job opportunities.

4.2   Vision for Environmental Sustainability

AMS have committed to improve sustainability by subscribing to the Blueprint 2025, adopting the SDGs, and ratifying the Paris Agreement. These commitments represent a new level of engagement towards green growth. Achieving these visions and goals will require accelerated investments in infrastructure for reducing risks caused by disaster risks, protecting natural resources, constructing low-carbon energy infrastructure, formulating a circular economy, and protecting natural resources.

Both the public and private sectors are playing a prominent role in meeting ASEAN's green investment needs. On the other hand, the current deployment of green technologies – in terms of installed capacity, patents registered, and new business development – is not yet in line with the level of ambition expressed in their national targets or the commitment to international society, which suggests there is a gap in investment flows, particularly from the private sector. Further, it seems that the regional aspirational targets for environment-friendly cities, living

environment, and 2030 sustainability agenda do not play a major role in the definition of NDC targets and the innovation capacity at the national level, which again retard private investment.

Huge potential exists for private sector investment in the region. From 2005 to 2015, private investments in ASEAN totalled $4,280 billion, of which foreign direct investment accounted for 33.7% (United Nations Conference on Trade and Development, 2017). A key question for policymakers in ASEAN is how to direct large cross-border private investments towards cleaner production systems to meet these targets. The private sector is bound by fiduciary duty to maximise the shareholder values of current assets. .Green financing carries high risks. Perceived risks in ASEAN countries are also high, where market-based mechanisms to finance green initiatives are in the early stage of development. Producer and consumer responsibilities are low, with subsidies remaining, and they do not reflect the full costs, including environment externalities. Regulatory regimes are also complicated, creating additional uncertainties. These conditions do not provide adequate incentives for private investment, resulting in different levels of readiness towards sustainability, such as a circular economy.

Table 5: Enablers and Readiness Rating of ASEAN for a Circular Economy

Country	Higher Education and Training	Good Market Efficiency	Labour Market Efficiency	Financial Market Development	Technological Readiness	Market Size	Overall Rating
Cambodia	2.8	4.2	4.5	3.9	3.0	3.0	3.6
Indonesia	4.5	4.4	3.7	4.2	3.5	5.7	4.3
Lao PDR	3.2	4.3	4.5	3.8	2.8	2.9	3.6
Malaysia	5.0	5.4	4.9	5.2	4.6	5.0	5.0
Myanmar	2.5	3.6	4.2	2.4	2.2	4.2	3.2
Philippines	4.5	4.2	4.1	4.2	3.9	4.9	4.3
Singapore	6.2	5.7	5.7	5.6	6.2	4.8	5.7
Thailand	4.6	4.7	4.2	4.4	4.2	5.2	4.6
Viet Nam	3.8	4.2	4.4	3.7	3.3	4.8	4.0

Lao PDR = Lao People's Democratic Republic.

Source: Viswanathan and Anbumozhi (2018).

Sufficient time is required to develop and mature market mechanisms and regulatory capacity in individual countries. In a long-standing regional cooperation arrangement like ASEAN, member countries can work together to support market development, innovation, and regulatory capacity. There are feasible opportunities for such regional efforts. Here, we highlight five regulatory factors that need to be addressed at the regional level to promote the green economy.

First, private financial institutions operate in an environment where prices for ecosystem-based natural resources management are very low and volatile. Where permits and approvals are required to implement the green economy, delays can be lengthy. Both banking and regulatory authorities grapple with assessing new investments based on old risk assessment methods (Hongo and Anbumozhi, 2015). This becomes more complicated when the users are state-owned enterprises. Individual mandates for meeting goals and targets are neither agreed nor generally consulted during the performance reviews. This results in shareholders or entrepreneurs not being ready to increase their investments.

Second, private investors in green economy systems operate a capital-intensive business model. Foundational capital stocks such as green bonds and innovation funds are still in the establishment stage in ASEAN countries. As a result, pioneering investors need to balance intense competing demand for capital within firms. At the corporate level, the competing demand for capital is subject to intense management scrutiny, in an effort to allocate scarce capital for low-carbon risky investment).

Third, low-carbon economy, circular economy, and sharing economy projects or other areas of environmental project developers are often called on to provide solutions for investors with long lived assets. Some of these potential investors may also operate under reduced competitive pressures because of fiscal and public finance subsidies to conventional polluting industries. These subsidies or incentives put green investors at a competitive disadvantage and subject them to unfair market conditions (Yao and Anbumozhi, 2015).

Fourth, product standards related to environmental goods should be harmonised in the region to reduce the cost of production and testing, as explained in 4.1. Such efforts would contribute to diffuse environmentally sound goods, which have better performance in GHG emissions, energy efficiency, or resource efficiency. In addition, transaction costs between consumers and producers on the environmental performance of goods can be reduced.

Fifth, AMS should use ICT to improve environmental sustainability. As shown in section 3, ICT may have an impact on commuting, urbanisation, the number of automobiles, and other factors. Existing regulations often hamper such new technologies. If they are beneficial to human well-being and sustainability, governments should revise such regulations to facilitate new technologies.

Decoupling economic growth from pollution and emissions in ASEAN also implies coordination problems across different ministries within ASEAN governments. The target year of the Paris Agreement is 2030. If voluntary commitment under the Paris Agreement is effective and if GHG emissions are reduced significantly by 2030, a similar approach will be used after 2030. Otherwise, the international community will seek stricter international commitments to reduce GHGs. However, meeting the Paris Agreement targets does not mean that ASEAN will be on a sustainable development path. The commitments are modest, especially when compared with the business-as-usual scenario of ASEAN growth, not the ASEAN single market.

The target year of the SDGs is also 2030. As shown in section 1, most of the indicators related to environmental sustainability show that the current rate of progress is not sufficient to achieve the SDGs in 2030.

Further, a one-size-fits-all approach is not viable across ASEAN. Instead, green economy priorities should be based on each country's economic circumstances. Countries with high and medium levels of resource consumption and pollution levels must invest more in eco-innovations and reorient policies to drastically increase resource efficiency and limit

or reduce emissions. For dynamic emerging economies, priorities are improving resource efficiency in new infrastructure and basic industries. Countries with low consumption levels will require support from other ASEAN countries to increase material affluence with green economic opportunities. These countries may particularly benefit from the transfer of green technologies from abroad, adapted to local conditions.

Conclusion

ASEAN has come a long way in building resilient and sustainable societies. ASEAN and its member countries have a clear vision and ambitious targets which are covered in the 2015 and 2025 blueprints, the SDGs, and the Paris Agreement. Actions towards the vision have also been identified in other documents, as shown in section 1. However, the success of current approaches faces many implementation challenges. Current agreements, commitments, declarations, and decrees often focus on specific environmental problems and cannot tackle the different issues of sustainability and resilience as a whole. Countries tend to free-ride on regional issues, as they are rarely in a position to coordinate action across the sectors. This results in differentiated progress in some indicators, such as sanitation, and reliance on clean energy. However, some of the indicators, such as domestic material consumption and forest area, show a negative trend which should be reversed in the future.

To implement planned actions for resilience and sustainability in ASEAN, various stakeholders should be involved. Governments should develop and enforce appropriate regulations, producers should have cleaner production processes, and people should have viable choices to ensure their resilience and environmental sustainability. No one should be left behind in resilience and environmental sustainability, and the effort to facilitate multi-stakeholder involvement should be strengthened.

Having said that, a sustainable and resilient ASEAN under the ASEAN single market, driven by the application of progressive technologies, should been seen as an economic imperative to improve people's lives by generating new business opportunities and incentivising social inclusion

while mitigating negative impacts on the environment. The coherence and consistency of this agenda are key for its success by 2040.

Second, it is critical to support the development of local capacity for a sustainable and resilient ASEAN. When indigenous innovations are connected with international models, they provide a different profile for low-carbon, circular, and sharing economies – which will serve as a tool to enhance competitiveness and attract talent.

Third, the key aspects of such a new paradigm should be addressed in a cross-sectoral manner to maximise the benefits. Issues such as taxation, social benefits, licences, ecosystem payments, and employment conditions should be addressed to reduce vulnerability and enhance competition among key stakeholders.

Towards that end, capacity development for various stakeholders should be enhanced, including government capacity in various ministries to enforce regulations, incentives, and rewards; and industrial capacity to use resources efficiently to make industry more competitive.

As shown in section 2, ICT can be used to reduce the environmental burden. AMS should carefully use such opportunities to realise the vision. Creating harmonised product standards in ASEAN, related to resilience and sustainability, is beneficial to reduce the cost of such products, as shown in section 3.

Within governments, various ministries and local governments should share information and cooperate to develop appropriate regulations and enhance enforcement capacity. Such a multi-stakeholder approach is crucial to achieving a resilient and sustainable ASEAN in 2040.

These aspects require an expanded mandate for specialised ASEAN institutes like the ASEAN Centre for Biodiversity, ASEAN Centre for Energy, ASEAN Centre for Green Growth, the AHA Centre, and ERIA –

particularly in generating solid knowledge and convening spaces to discuss issues openly and share good practices. Having those capacities available regionally would make the country actions faster, cheaper, and culturally more acceptable.

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Secure, Affordable, and Sustainable Energy for All

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1. Vision Statement

Energy is one of the most basic inputs for any kind of economic activity and, more broadly, human life. As the Association of Southeast Asian Nations (ASEAN) aims at further prosperity towards 2040 through the ASEAN Single Market (ASM), secure, affordable, and environmentally sustainable energy supply for all is crucial in each country and the region. However, the Economic Research Institute for ASEAN and East Asia (ERIA) Energy Outlook and Saving Potentials in East Asia Summit[1] (ERIA, 2018a) forecasts rapid growth in energy demand, higher oil import dependence, and a still dominant share of fossil fuels, notably coal and higher carbon dioxide (CO_2) emissions, towards 2040. This could threaten a stable supply of affordable energy and the national, regional, and global environment.

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[1] The East Asia Summit (EAS) is a meeting of 18 regional leaders for strategic dialogue and cooperation on the key political, security, and economic challenges facing the Indo-Pacific region. The EAS comprises the 10 member-states of ASEAN along with Australia, China, India, Japan, the Republic of Korea (henceforth, Korea), New Zealand, the Russian Federation, and the United States.

ASEAN member countries have a lot to do to change this pathway. They need to be well prepared for possible oil supply disruption; enhance energy efficiency; reduce oil demand, particularly in the transport sector; clean the use of fossil fuels; promote energy diversification to such sources as natural gas and renewable energy; alleviate local air pollution; and minimise the growth of CO_2 emissions. Most fundamentally, as a basic input for economic and human activities, energy needs to be accessible to all at affordable prices. These goals cannot be achieved simply through target setting (e.g. energy mix, CO_2 emissions), but require concrete actions. Given multiple uncertainties (e.g. the international and domestic political and economic situation, technology development, scientific knowledge), the plan–do–check–act (PDCA) cycle is recommended, with sufficient flexibility and multiple pathways.

Some of the above goals could be more efficiently and effectively pursued through regional collaboration (ASEAN-wide, plurilateral, or bilateral), including emergency response measures, cross-country energy interconnections, and harmonisation of energy-related standards and a regulatory environment for energy industries. They also require capacity building of policymakers and enhanced public awareness. Again, regional collaboration through learning from each other and sharing best practices, including via peer review, could make a significant difference. The concept of an 'ASEAN Energy Community' is a remote vision given different national circumstances (e.g. the energy endowment, economic development, and energy mix to be pursued) and sovereignty in energy policy making, but if ASEAN ultimately aims in that direction, it should start with areas where regional collaboration is feasible.

2. Energy Outlook in 2040

ERIA (2018a) projects ASEAN's total primary energy supply (TPES) to grow by 143% from 667 million tons of oil equivalent (Mtoe) in 2015 to 1,624 Mtoe in 2040 under the business-as-usual (BAU) scenario, reflecting each country's current goals, action plans, and policies. Even under the alternative policy scenario (APS), assuming (i) more efficient final energy consumption, (ii) more efficient thermal power generation, (iii) higher consumption of new and renewable energy and biofuels, and (iv) the introduction of higher utilisation of nuclear energy for countries which

have chosen to do so, the TPES is projected to grow by 102% to 1,346 Mtoe in 2040. During the same period, ASEAN's total power generation will achieve higher growth, at 184% under BAU and 139% under the APS. Figure 1 shows total primary energy supply in ASEAN of the base year of 2015 and the estimated year of 2040 for both BAU and APS.

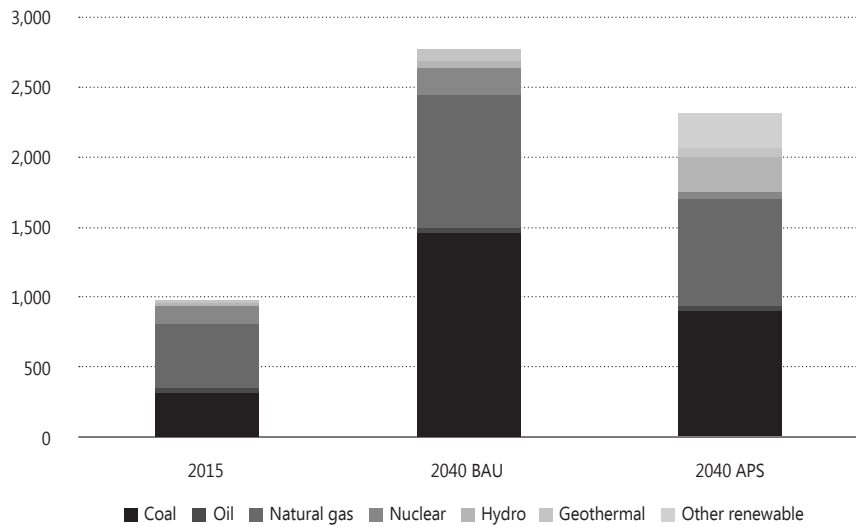**Figure 1:** Total Primary Energy Supply in ASEAN (Mtoe)
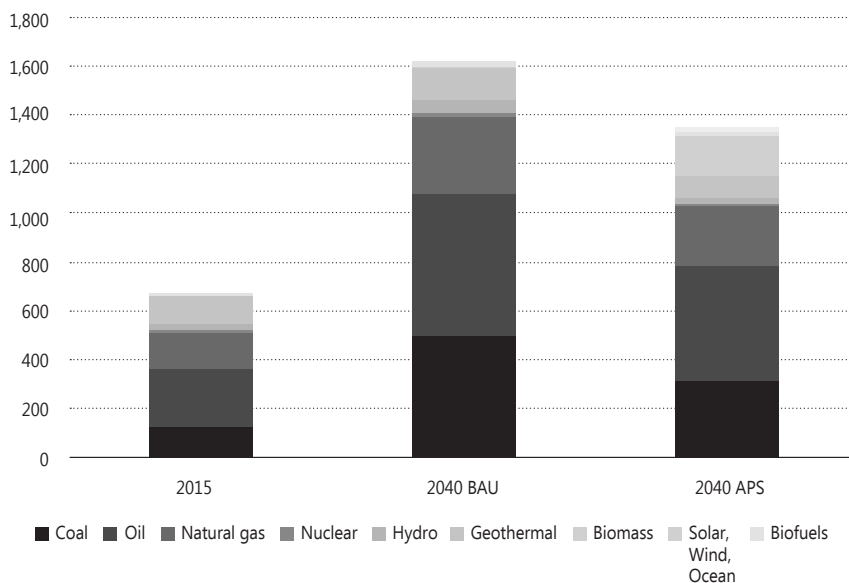
APS = alternative policy scenario, ASEAN = Association of Southeast Asian Nations, BAU = business as usual, Mtoe = million tons of oil equivalent.

Source: ERIA (2018a).

Regarding the energy mix, the share of fossil fuels will grow from 76% (coal 19%, oil 35%, gas 22%) to 86% (coal 31%, oil 36%, gas 19%) under BAU. While this trend is the same in the power generation mix as shown in the Figure 2, where the share of fossil fuels will grow from 83% (coal 33%, oil 3%, gas 47%) to 88% (coal 53%, oil 1%, gas 34%), the high growth of coal deserves attention. Under the APS, where a higher share of non-fossil fuels is envisaged, the share of fossil fuels out of the total primary energy supply is still dominant at 76% in 2040 (coal 23%, oil 36%, gas 18%). In power generation, where more rapid growth of renewable energy is envisaged in 2040 (25%), the share of fossil fuels in 2040 will decline to 73% (coal 39%, oil 1%, gas 33%), but still be dominant.

Figure 2: ASEAN Power Generation Mix (TWh)

APS = alternative policy scenario, ASEAN = Association of Southeast Asian Nations, BAU = business as usual, TWh = terawatt-hour.

Source: ERIA (2018a).

Consistent with robust economic growth, energy demand growth in the ASEAN region will be higher than in other regions as shown in Figure 3. The Institute of Energy Economics, Japan (IEEJ, 2018) projects annual growth of total primary energy consumption from 2015 to 2050 to be 2.6% in ASEAN and 3.2% in India, compared with 1.1% for the world total, 1.7% in non-Organisation for Economic Co-operation and Development (OECD) Asia, and 0.9% in China.

Figure 3: Energy Demand Growth in Asia by Country
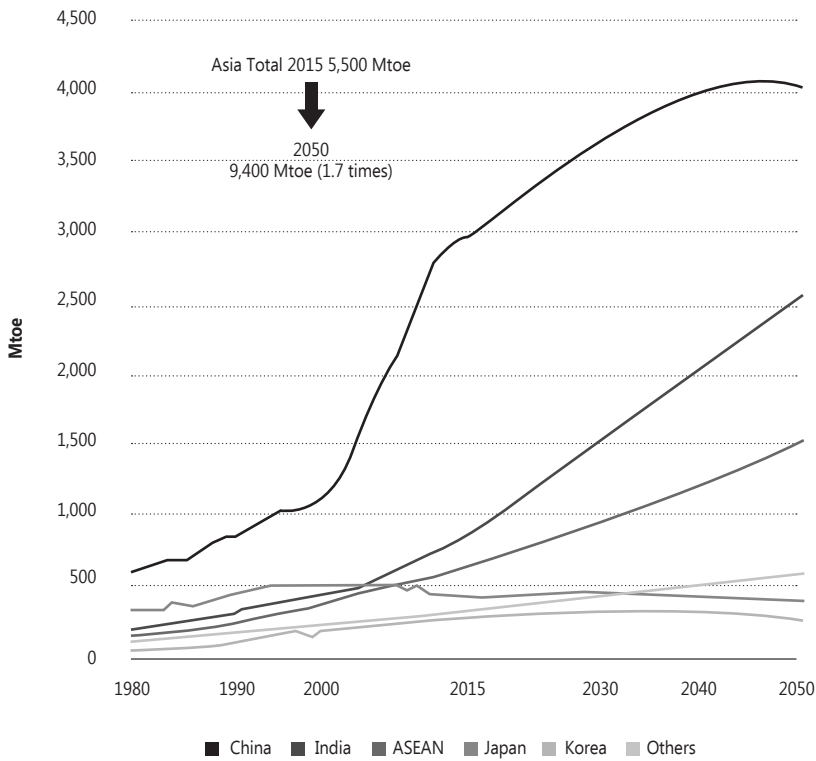
ASEAN = Association of Southeast Asian Nations, Mtoe = million tons of oil equivalent.

Source: IEEJ (2018).

Given the robust growth in energy demand and the continued dominance of fossil fuels in the energy mix, energy-related CO_2 emissions in ASEAN as shown in Figure 4 will grow by 169% from 587 million tons of carbon (Mt-C) in 2015 to 1,581 Mt-C in 2040 under BAU. Under the APS, assuming higher energy efficiency and a higher share of non-fossil fuels, CO_2 emissions will increase by 84% to 1,077 Mt-C in 2040. More than 70% of the CO_2 emissions reduction from BAU to the APS are attributed to improved energy efficiency in the end use sectors.

Figure 4: ASEAN Energy-Related CO2 Emissions
(Mt-C)
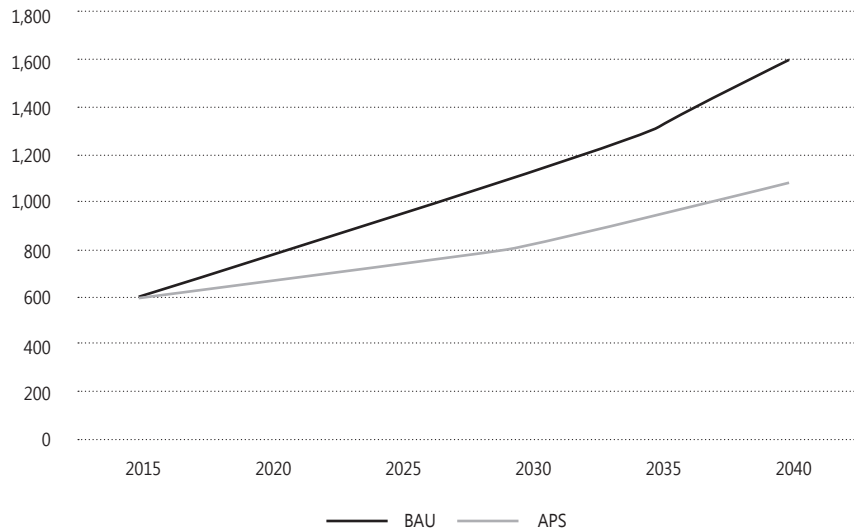
APS = alternative policy scenario, ASEAN = Association of Southeast Asian Nations, BAU = business as usual, CO_2 = carbon dioxide, Mt-C = million tons of carbon.

Source: ERIA Energy Outlook 2018a.

Like the energy demand trend, Figure 5 shows how ASEAN and India will show higher growth of energy-related CO_2 emissions than other regions. IEEJ (2018) projects the annual growth of CO_2 emissions from 2015 to 2050 to be 3.0% in ASEAN and 3.4% in India, against 0.8% for the world total, 1.4% in non-OECD Asia, and 0.3% in China.

Figure 5: CO_2 Emissions in Asia by Country ($Gt\text{-}CO_2$)
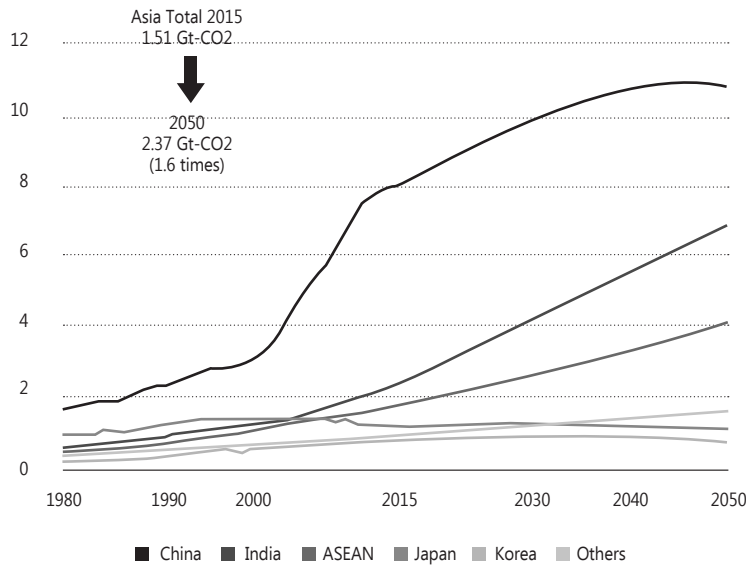
ASEAN = Association of Southeast Asian Nations, $Gt\text{-}CO_2$ = gigatons (1 billion tons) of carbon dioxide.

Source: IEEJ (2018a).

3. Secure and Affordable Energy System Towards 2040

Securing Affordable Energy Access

Access to a modern type of energy is one of the most basic human needs. In 2016, 65 million people did not have access to electricity and 252 million relied primarily on the traditional use of biomass in the ASEAN region. This situation could threaten the region's sustainable economic growth. Energy is strongly linked to economic opportunity, as electricity is used as an input to generate economic goods and services. Table 1 shows access to modern energy services in ASEAN. Of the ASEAN countries, Cambodia and Myanmar still have very low access to electricity in rural areas. In some remote areas of ASEAN countries, the root cause of energy poverty is not just the energy price and poverty, but the lack of access to modern energy because of inadequate energy infrastructure. Intermittent energy supply and/or electricity blockades is a challenge in urban centres. Electricity access at affordable prices is more challenging in small islands of archipelagic countries like Indonesia and the Philippines. Research suggests that energy poverty has important consequences if

not addressed, such as impacting health, entrenching poverty, adversely affecting the Human Development Index indicators, and making most of the Sustainable Development Goals (SDGs) less attainable. Therefore, achieving energy access for all in an equitable manner is a high priority for most ASEAN countries.

**Table 1:** Access to Modern Energy Services in ASEAN

Country	Population without access to electricity (2016)		Population primarily relying on traditional use of biomass (2015)	
	Million	Share (%)	Million	Share (%)
Brunei Darussalam				
Cambodia	6	40%	13	83%
Indonesia	23	9%	67	26%
Lao PDR	<1	9%	7	96%
Malaysia	<1	1%		
Myanmar	22	41%	51	94%
Philippines	11	10%	61	60%
Singapore				
Thailand			18	26%
Viet Nam	2	2%	36	39%
Total ASEAN	65	10%	252	40%

ASEAN = Association of Southeast Asian Nations, Lao PDR = Lao People's Democratic Republic.
Source: IEA (2017b).

As shown in the Figure 6, the International Energy Agency (IEA) projects that universal electricity access will be achieved by the early 2030s in all ASEAN countries. Globally, 67% of people who gained access to electricity from 2000 to 2015 did so via fossil fuels (coal, gas, and oil), while the share of renewable energy (hydropower, geothermal, solar, and wind) is increasing. Figure 7 shows how estimate from IEA (2017a) on the number of people gaining electricity access by fuel type in developing countries. As the cost of renewable energy technologies falls, universal electricity access in ASEAN will be achieved using a wide range of fuels and

technologies, as well as centralised and decentralised solutions (Figure 8). The IEA projects that mini-grid or off-grid technologies will fulfil more than half of additional electricity demand for ensuring universal access. Varying resource distribution, distance from existing demand centres, and population density mean that there is no one-size-fits-all approach.
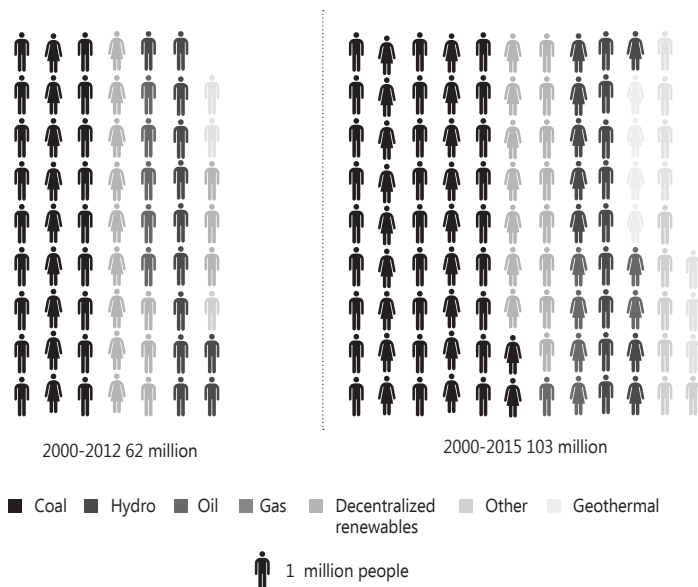
Figure 6: Electricity Access Rates of Southeast Asia (%)

Philippines ■ Thailand ■ Viet Nam ■ Indonesia ■ Lao PDR ■ Cambodia ■ Myanmar
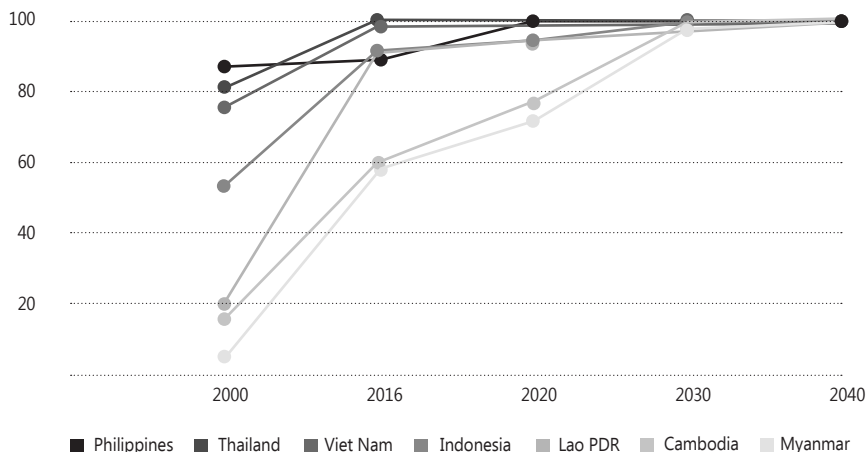
Lao PDR = Lao People's Democratic Republic.

Source: IEA (2017b).

Figure 7: Annual Number of People Gaining Electricity Access by Fuel Type in Developing Countries

2000-2012 62 million

2000-2015 103 million

■ Coal ■ Hydro ■ Oil ■ Gas ■ Decentralized renewables ■ Other ■ Geothermal

👤 1 million people

Solar PV: Solar photovoltaic

Source: IEA (2017a).

Figure 8: Additional Demand for Access and its Share of
Total Incremental Demand in 2030 in ASEAN (TWh)
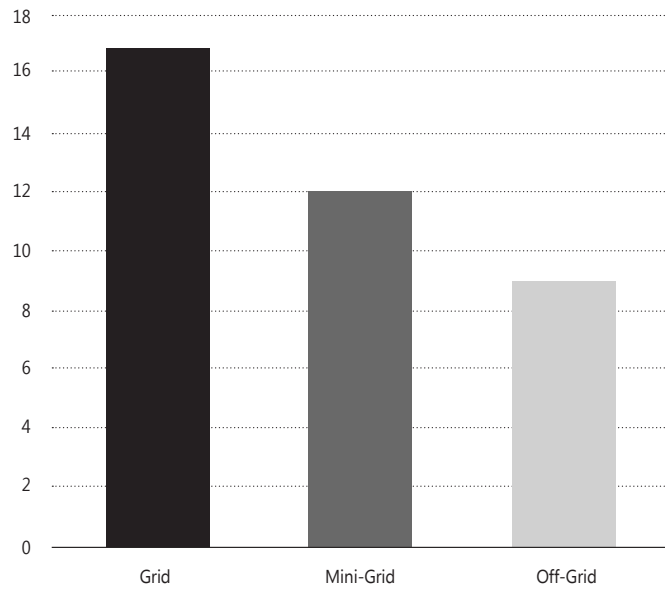
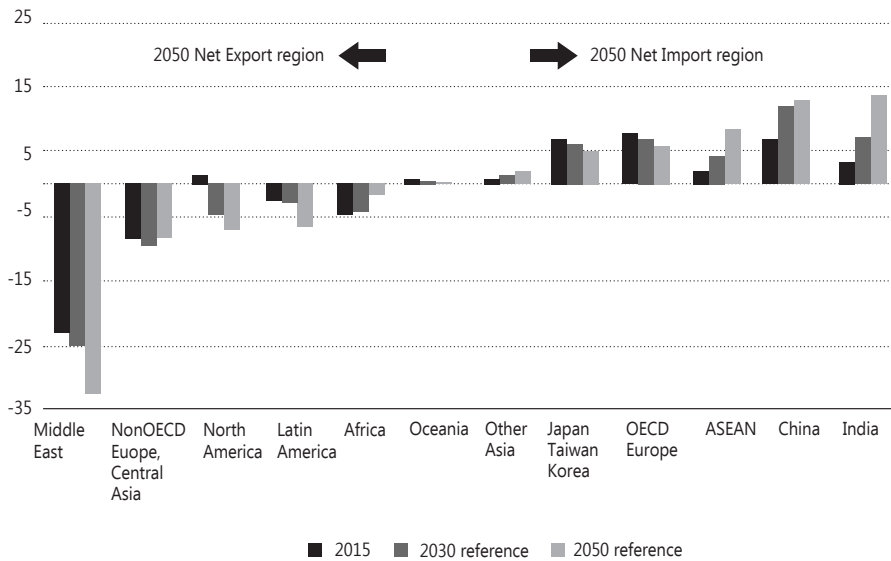ASEAN = Association of Southeast Asian Nations, TWh = terawatt-hour.
Source: IEA (2017b).

In ensuring energy access for all, affordability is crucial. Basic electrification is largely considered a public good to be provided by the government. It is not fair that the poor in rural or isolated areas have to pay higher energy costs than the rich in urban areas because of the high cost or difficulties of electrification. Economically, an orthodox approach is to provide direct income support to the low-income population instead of subsidising energy prices. However, some countries may find it difficult to bridge the electrification gap while ensuring affordable prices given limited fiscal space. For example, Myanmar is estimated to need more than $30 billion to achieve universal access while its annual tax revenue is less than $5 billion. To mobilise private funds into infrastructure for electrification, governments may consider a cross-subsidy approach to improve the affordability and reliability of energy infrastructure development. For example, differentiated electricity prices, such as step-wise electricity tariffs, can collect more revenue from rich social groups or well-developed areas to subsidise poor social groups or remote rural areas. ERIA (2018c) indicates that the private sector and international community have the potential to help rural electrification, but more technological and financial innovations and stronger support are needed to enhance synergies.

Enhancing Emergency Preparedness

Since regional oil demand will increase rapidly (2.5 times) from 2016 to 2040 and regional production will not be able to keep pace with it, the ASEAN region and India will see a rapid increase in net oil imports. Most incremental oil imports come from the Middle East through such choke points as the Strait of Hormuz and the Strait of Malacca, even taking into account the prospect of shale oil imports from the United States (US), so the ASEAN region will be particularly vulnerable to supply disruptions caused by events such as natural disasters, accidents, regional conflict, terrorist attacks, and piracy. Figure 9 shows net exports and imports of world's major regions.

Figure 9 : Net Exports and Imports of Major Regions
(million barrels per day)

ASEAN = Association of Southeast Asian Nations, OECD = Organisation for Economic Co-operation and Development.

Source: IEEJ (2018).

In safeguarding against supply disruptions, the ASEAN region needs to enhance its emergency preparedness through developing early warning systems, oil stockpiling, preparing measures for demand restraint and fuel switching in each country, and establishing regional cooperative arrangements for coping with emergencies.

Stockpiling is the typical countermeasure that addresses oil supply security and resilience. All countries recognise the need to develop stockpiling. Establishing stockpiling is a lengthy and costly business, but it is the basis of any supply security policy. Several stockpiling options are available. The traditional approach, which obliges industry to maintain stocks followed by institutionalised government stockpiling, will be the main path for stockpile development mainly because of national security concerns. However, low-cost options such as tickets and/or investments from third parties (tank companies and crude exporters) could expand tank capacity. Given domestic financial (budget) constraints, it is necessary to tap into the dynamics and capability of third parties by creating a favourable investment environment. It is critical for governments in the region to address oil stockpiling with a portfolio

of traditional and low-cost approaches to expand storage capacity and institutionalise oil stockpiling.

Infrastructure development is important. It should include not only oil-related infrastructure such as refineries and pipelines but also general social infrastructure like roads and ports, which are prerequisites for oil transportation. Given the multi-utility of roads, ports, and other social infrastructure, it is the government's responsibility to develop such infrastructure.

Planning, an institutional and legal framework, and education are very important for oil supply resilience, aside from hardware such as refineries, tanks, and pipelines. Developing this framework is a time-consuming process, and governments in ASEAN member countries are encouraged to start before the next disaster happens. In terms of the institutional and legal framework, industries can work on enhancing their resilience to natural disasters and other risk factors associated with oil supply. They could start by making a business continuity plan under the PDCA cycle.

It is important to utilise or revitalise existing institutional platforms for oil supply resilience. ASEAN member countries have been working on the ASEAN Petroleum Security Agreement (APSA) since 1986 and these countries generally value a regional oil-sharing scheme. However, its functionality during an emergency is questionable. In addition, the ASEAN Council on Petroleum (ASCOPE) recently revealed the uncertain future of APSA after it expires in 2023. While APSA remains important, the uncertainty reflects varied views on the scheme among ASEAN member countries. Therefore, it may be realistic to start with an oil-sharing scheme by selected countries that are willing to participate. In this sense, it is worth considering international cooperation on a stockpiling facility and crude oil terminal in Kalimantan, which Indonesia is planning to develop.

More broadly, the East Asia Summit (EAS) region as a whole is vulnerable to oil supply disruption. This means that EAS regional cooperation on emergency preparedness makes sense. Various initiatives related to emergency preparedness in Asia are ongoing, such as the Oil Stockpiling

Roadmap under ASEAN+3[2] and the Oil and Gas Security Initiative under the Asia-Pacific Economic Cooperation (APEC) Energy Working Group. However, the Oil Stockpiling Roadmap does not cover two big players: (i) India, whose oil demand growth will be much faster than the EAS average; and (ii) the US, which has growing export potential to Asia. Meanwhile, the Oil and Gas Security Initiative does not cover Cambodia, India, the Lao People's Democratic Republic (Lao PDR), and Myanmar. Taking into account the membership coverage of the EAS, its share of global oil demand, and the presence of both producers and consumers, it is the most appropriate forum for addressing emergency preparedness in the region. The EAS Energy Cooperation Task Force (ECTF) is focusing its efforts on three workstreams: (i) energy efficiency and conservation, (ii) biofuel for transport and other purposes, and (iii) renewable and alternative power generation. However, it does not address emergency preparedness. The Cebu Declaration (2007), on which the ECTF was established, clearly reaffirmed the 'collective commitment to ensuring energy security for our region' and its intention to explore 'possible modes of strategic fuel stockpiling such as individual programmes, multi-country and/or regional voluntary and commercial arrangements'. Given the increasing dependence on oil imports from the Middle East and growing vulnerability to supply disruptions, the ECTF should address oil emergency preparedness, including taking stock of progress in the ongoing APEC and ASEAN+3 initiatives and avoiding duplication of efforts.

Mobilising Huge Investment Needs

Investment is vital in both energy supply and demand to mitigate the security of supply concerns as well as transitions to a more sustainable energy system towards 2040.

ERIA (2018a) estimates that $430 billion–$440 billion is necessary in the power generation sector, $149 billion–$226 billion for refinery, and $0.16–$28 billion for liquefied natural gas (LNG) terminals. As shown in Table 2, IEA (2017b) estimates that $2.1 trillion is required for oil, gas,

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[2]   ASEAN + China, Japan, and Korea.

coal, and power supply. Power sector investment accounts for 60% of the total energy supply investment needs since robust economic growth and reaching universal electricity access require significant financial resources. Investment in transmission and distribution accounts for more than half of the total investment needs in the power sector. Figure 10 from IEA (2017) shows a breakdown of necessary energy supply investment in ASEAN between 2017 and 2040.

Table 2: Cumulative Investment in Energy Supply in ASEAN, 2017–2040
(2016 $ billion)

Energy source	2017–2025	2026–2040	2017–2040	2017–2040
Oil	146	206	352	15
Gas	120	303	423	18
Coal	14	25	39	2
Power	387	855	1,242	52
Fossil fuel	82	149	231	10
Nuclear	-	9	9	0
Hydropower	46	99	145	6
Bioenergy	11	21	32	1
Wind	9	34	44	2
Geothermal	7	10	17	1
Solar PV	26	62	88	4
T&D	207	470	677	28
Biofuels	7	18	25	1
Total	**674**	**1,407**	**2,081**	**87**

PV = photovoltaic, T&D = transmission and distribution.

Source: IEA (2017b).

Figure 10: Net Exports and Imports of Major Regions
(million barrels per day)

■ T&DI ■ Gas ■ Oil ■ Hydropower ■ Wind ■ Bioenergy ■ Solar PV
■ Geothermal ■ Coal ■ Biofuels ■ Nuclear
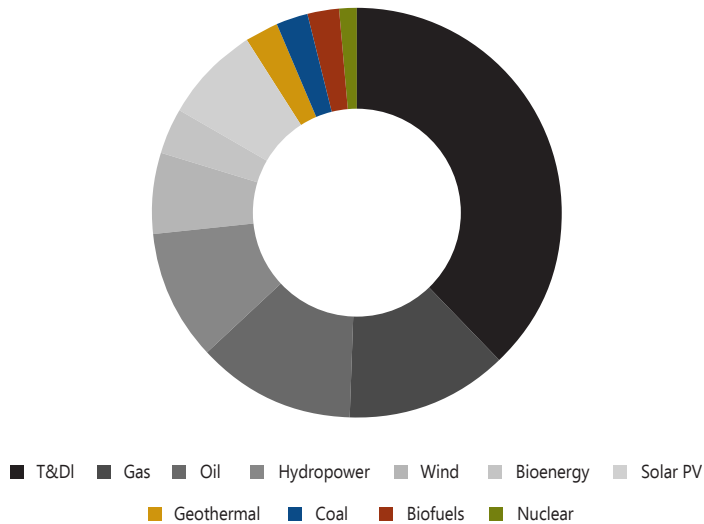
PV = photovoltaic, T&D = transmission and distribution.
Source: IEA (2017b).

The magnitude of investment needs poses a major challenge for the ASEAN region. For example, IEA (2017b) estimates that $1.2 trillion investment is necessary in the power sector towards 2040, which requires annual investment of $50 billion. Since this is equivalent to about 10% of the total ASEAN countries' government revenue, it represents a large burden for government budgets which are facing expenditure demands in multiple areas. Therefore, private sector participation is essential for mobilising the necessary investment resources. One way to mobilise private sector participation is through independent power producers, but their limited role in the power markets of many ASEAN countries could hinder this option. As the huge investment needs exceed what governments can afford, expanding the role of the private sector in power markets should be seriously considered. The feasibility of different innovative models of private financing should be considered for the region, such as a regional transition fund, best regulatory practices, and third-party warranty programs. These require various regulatory and institutional reforms, including electricity market deregulation, liberalisation of electricity pricing, phasing out of energy price subsidies, innovative models of private financing (e.g. regional transition fund, third-party warranty programs), and stronger capacity building of the private sector and financial institutions.

At the same time, policies promoting energy efficiency in the power sector have significant potential for reducing energy costs. Policies and measures to reduce the perceived risks (e.g. policy as well as technology uncertainty and public acceptance issues) of energy projects could also reduce energy costs since the costs of financing these projects could be cut. Such policies are also typically more feasible in achieving near-term policy targets. In such countries as Philippines, reforming the power sector and enable legacy power generation assets to compete in the market, thus get dispatched on real cost basis, has significant potential to reduce the cost of electricity This may help bring down the system cost further.

Improving Energy Efficiency

Improving energy efficiency is the most cost-effective way to achieve energy security, climate mitigation, and economic growth simultaneously, underpinned by industrial competitiveness. Therefore, it should be promoted with the highest priority as a 'no-regrets' policy.[3] Despite continuous efforts by ASEAN countries for improving energy intensity, the ASEAN region still has ample potential for improving energy efficiency. In Figure 11, IEEJ (2018) indicates that the energy intensity (primary energy consumption per gross domestic product at 2010 prices) of the ASEAN region was higher than the global and Asia averages in 2015 and will continue to be so in 2040. The ASEAN Plan of Action for Energy Cooperation (APAEC) sets an aspirational target of reducing energy intensity by 30% by 2025.

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[3] No regrets options are greenhouse gas (GHG) emissions reduction options that have negative net costs, because they generate direct or indirect benefits that are large enough to offset the costs of implementing the options.

Figure 11: Regional Comparison of Energy Intensity
(toe/million, 2010 US dollar prices)
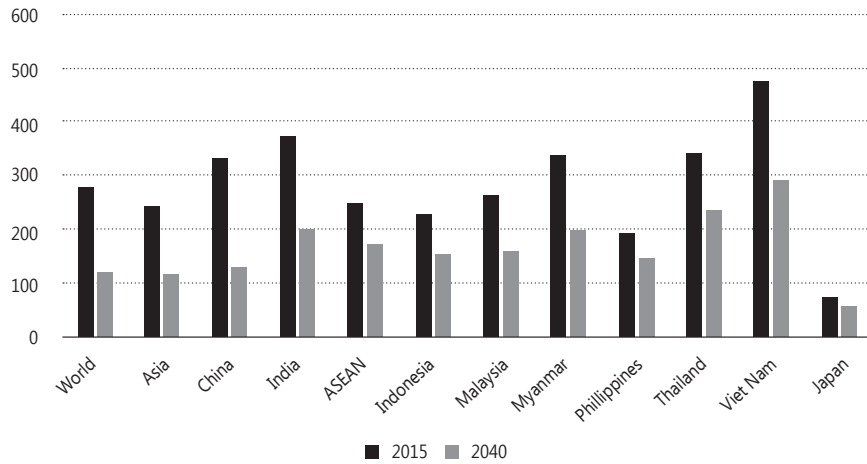
ASEAN = Association of Southeast Asian Nations, toe = ton of oil equivalent, US = United States.
Source: IEEJ (2018).

The industry sector is a major source of energy savings since it is the largest energy-consuming sector. Its share of total final energy consumption will grow from 30% in 2015 to 35% in 2040. Large factories and power plants consuming large amounts of energy should be required to measure and report their energy consumption levels as well as consider investment plans for improving their overall energy efficiency levels. Improving thermal efficiency in the power generation sector, by constructing or replacing existing facilities with new and more efficient generation technologies and introducing high-efficiency industrial motors, will be instrumental. Small and medium-sized enterprises require special attention because of their significant presence in the regional economy.

In accordance with population growth and urbanisation, energy efficiency in the building sector will play a crucial role. Since the demand for new buildings is likely to grow, governments should set up and enforce mandatory building codes as well as reward green buildings. They could also provide financial support for retrofitting technologies to improve energy efficiency in existing buildings and establish funds for supporting the utilisation of Energy Service Company (ESCO) services for accelerated diffusion of energy saving technologies, using levies on petroleum.

Minimum efficiency performance standards of appliance, machinery, and equipment are instrumental for improving efficiency in the residential, commercial, and industrial sectors. Since ASEAN is aiming at a common market, it could play a leading role in exploring the harmonisation of minimum efficiency performance standards in the region.

Across the sectors, information and communication technology (ICT), the internet of things (IoT), and artificial intelligence (AI) have great potential for improving energy efficiency without sacrificing final consumers' utility. For example, energy efficiency in houses, offices, and factories could be optimised through household, building, and factory energy management systems. ERIA's case studies in Indonesia, Malaysia, Singapore, Thailand, and Viet Nam identify energy-saving potential through household, building, and factory energy management systems as well as policy recommendations for incentivising their deployment (e.g. mandatory reporting and target setting on energy management, and capacity building of energy managers). Consumers' behaviour and consumption patterns could also be drastically changed by ICT, IoT, and AI, which will also affect energy consumption levels. For example, the penetration of car sharing, facilitated by ICT, could reduce the number of individual passenger vehicles and hence oil demand in the transport sector.

Cost-reflective energy pricing is a prerequisite for effectively incentivising energy efficiency. Electricity and oil are still subsidised in the region as shown in Figure 12. Energy price subsidies often encourage wasteful use of energy, discourage energy efficiency investment, and increase energy-related CO_2 emissions. While ASEAN countries are taking steps towards subsidy reforms, the recent reduction in fossil fuel subsidies is largely attributable to the drop in crude oil prices. Continuous subsidy reforms, with better targeting for vulnerable groups, are crucial. Credible information, including end user data and a harmonised/coordinated policy approach by the ASEAN countries, is essential.

Figure 12: Fossil Fuel Subsidy in Southeast Asia
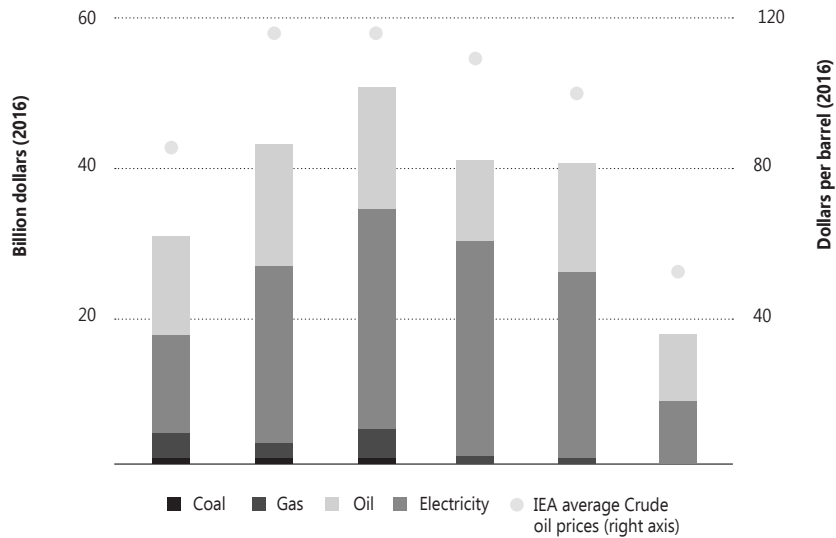
IEA = International Energy Agency.

Source: IEA (2017).

Reduction of Oil Demand in Transport Sector

Energy efficiency in the road transport sector is crucial. Since the bulk of incremental oil demand will come from this sector, improving energy efficiency would enhance resilience for oil supply security. Setting mandatory fuel efficiency standards and their periodic revision is indispensable for improving road transport efficiency. For example, ASEAN could take an initiative for developing a regional Top Runner Program[4] on the fuel efficiency of heavy vehicles and two-wheelers.

To reduce oil demand in passenger transport, a modal shift to public transport should also be promoted. A key element in promoting such a shift is accessibility and economic attractiveness, i.e. to extend/expand the public transport network and to make public transport cheaper or increase the cost of private car ownership. Kutani et al. (2015) indicates that a megacity like Jakarta requires mass rapid transit such as the metro, with dedicated lines to mitigate traffic congestion and oil consumption.
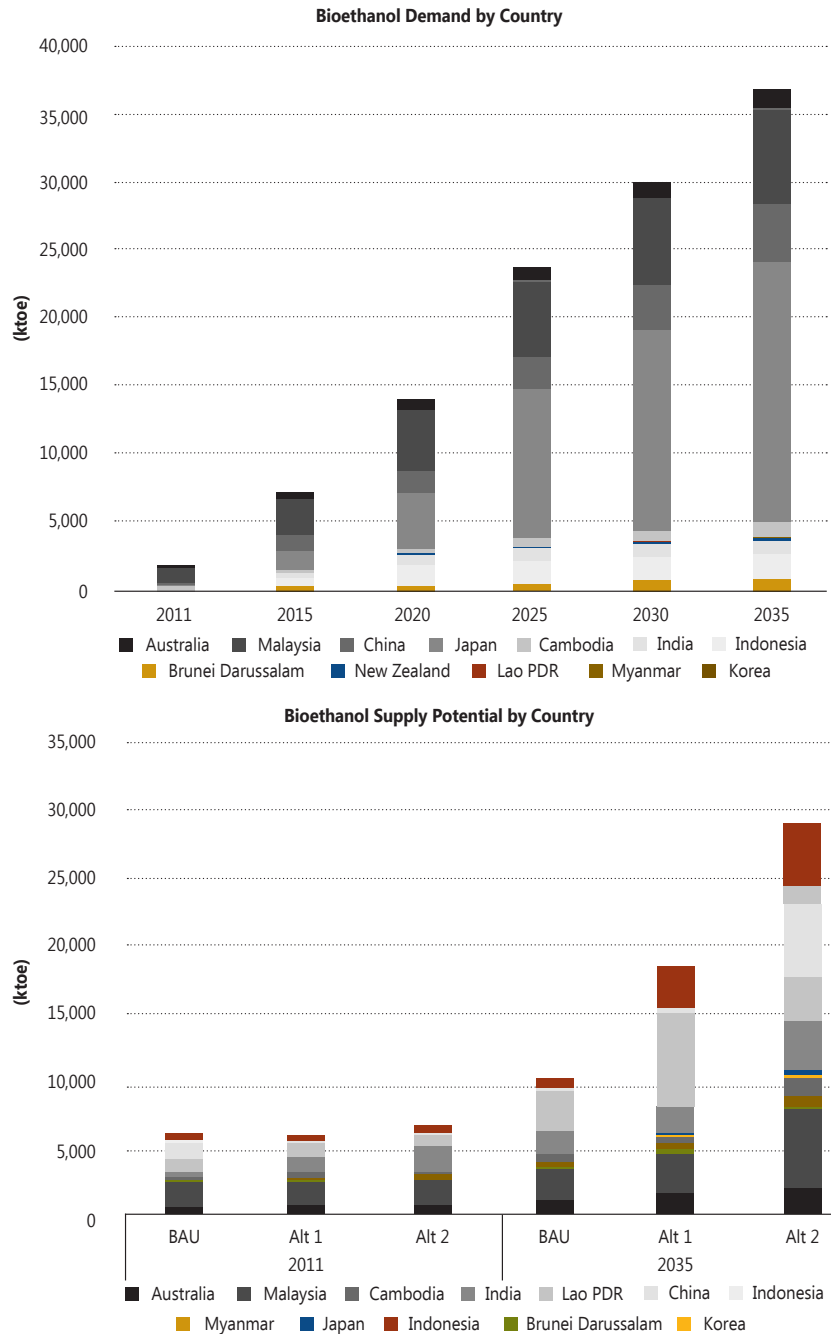
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[4]   The Top Runner Program is a set of mandatory energy efficiency standards in Japan for appliances and vehicles set on the basis of the most efficient model in the market (the Top Runner).

As it will take considerable time and funds to construct sufficient mass rapid transit capacity, expanding the bus rapid transit network or improving its convenience would be effective as a short- to mid-term measure.

In addition, governments could consider such measures as promoting eco-driving, telecommuting and flexible work schedules, and carpooling and driving restrictions (e.g., odd-even license plate driving bans) for managing energy demand in the road transport sector. IEA (2017b) projects that freight activity in Southeast Asia will more than double by 2040, boosted by growing economies and expanded road infrastructure, and that fuel consumption by trucks will account for about 40% of transport energy demand growth to 2040. Logistical improvement is one of the key strategies to reduce oil demand in freight transport. This might include inter-modality, i.e. improving transhipment in ports or terminals to promote long-haul trip shifting to rail and sea, creating and/or optimising urban area consolidation/distribution centres, and increasing the use of information technology to optimise goods transport (e.g. avoiding empty running vehicles and reducing truck overloading).

Biofuel is one possible option to address the oil security issue, since expanding the use of biofuels will not only result in reducing demand for oil but will also contribute to the diversification of import sources for liquid fuels. Biofuel production also provides an additional way to increase the income of farmers. According to the Yamaguchi (2013) study on regional bioethanol and biodiesel demand and supply potential, countries with large biofuel demand in the future do not necessarily have sufficient supply potential, and vice versa. For example, Indonesia is expected to have the largest bioethanol demand, accounting for 52% of the region's total aggregated bioethanol demand in 2035, while its supply potential of bioethanol is estimated to be only 5.8% of the region's total. On the other hand, while Malaysia is supposed to be the region's largest biodiesel supplier with 42% of the region's total supply in 2035, its domestic biodiesel demand is projected to account for only 2% of the region's total. This mismatch of demand and supply indicates that cross-country biofuel trade is necessary to optimise the region's biofuel utilisation. The following Figures 13 and 14 show demand and supply outlook respectively for bioethanol and biodiesels.

Figure 13: Regional Bioethanol Demand and Supply Outlook (ktoe)

Bioethanol Demand by Country

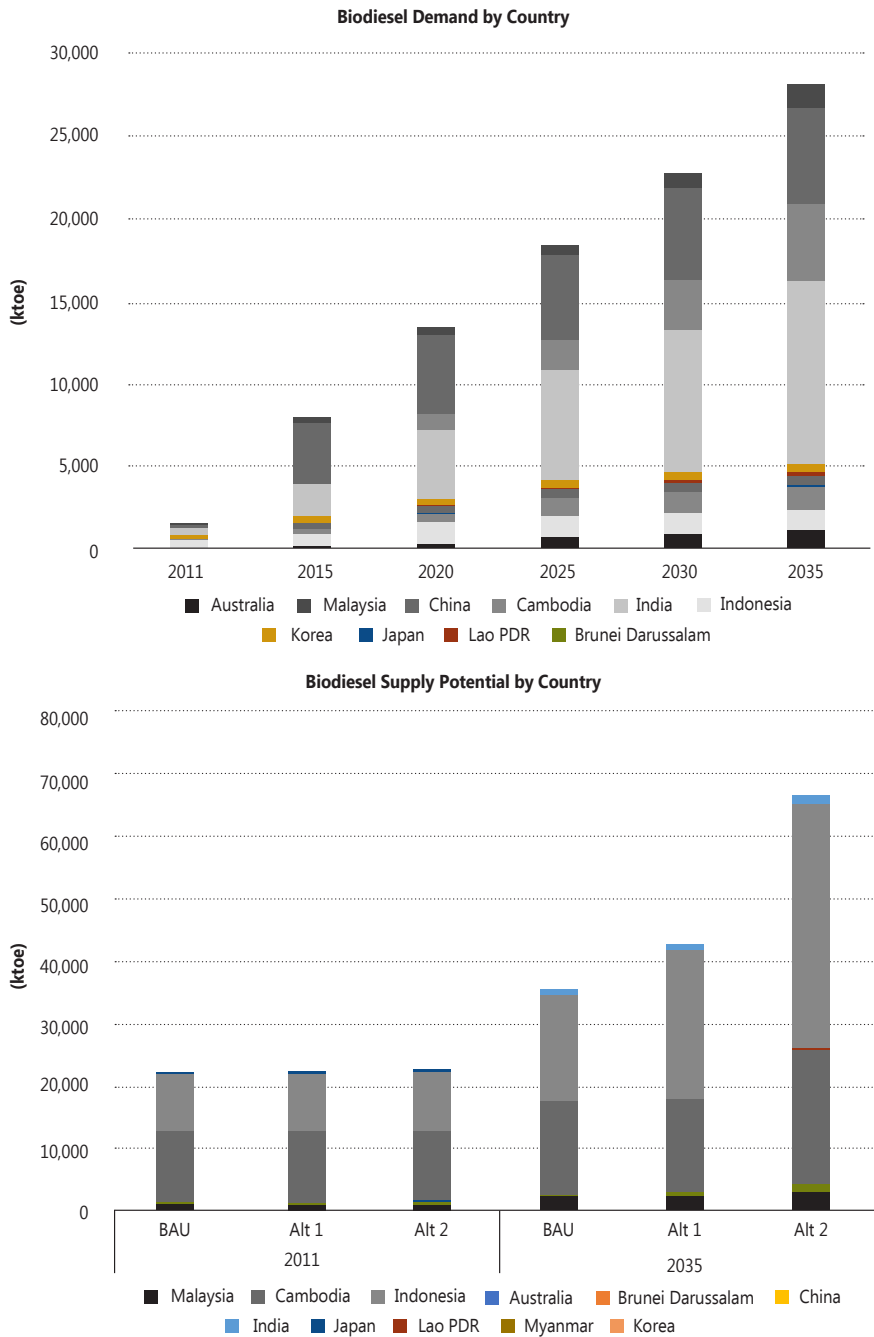Bioethanol Supply Potential by Country

ktoe = kiloton of oil equivalent, Alt. = alternative, BAU = business as usual, Lao PDR = Lao People's Democratic Republic.

Note: Alt. 1 is a case where the land use for each crop in this region is maximised by 2035 by increasing the cultivated area and maximising the use of arable land, following the definition of the Food and Agriculture Organization of the United Nations. Alt. 2 is a case where the land use and productivity per cultivated area for each crop in this region is maximised by 2035. The most advanced productivity of each crop in this region has been assumed as the baseline value, and technology and high productivity varieties are available to be shared and transferred in the region.

Source: Yamaguchi (2013).

**Figure 14:** Regional Biodiesel Demand and Supply Outlook (ktoe)

ktoe = kiloton of oil equivalent, Alt. = alternative, BAU = business as usual, Lao PDR = Lao People's Democratic Republic.

Note: Alt. 1 is a case where the land use for each crop in this region is maximised by 2035 by increasing the cultivated area and maximising the use of arable land, following the definition of the Food and Agriculture Organization of the United Nations. Alt. 2 is a case where the land use and productivity per cultivated area for each crop in this region is maximised by 2035. The most advanced productivity of each crop in this region has been assumed as the baseline value, and technology and high productivity varieties are available to be shared and transferred in the region.

Source: Yamaguchi (2013).

Various policies should be promoted for maximising the potential of biofuel utilisation. On the supply side, incentives should be provided for increasing productivity and utilising unused agricultural land as energy–agriculture joint policy initiatives as well as improving conversion efficiency from solid to liquid biomass. Agriculture and municipal waste-to-energy programs should be targeted, along with enforcing stringent sustainability criteria in the production of biofuels. On the demand side, best local practices of the sustainable consumption/utilisation of biofuels should be promoted as well as preparing enabling market conditions through the mandatory use of biofuel. Regional energy security should be promoted through regional biofuel trade while sharing biofuel standards. In addition, ASEAN countries should collaborate in developing next-generation biofuel technologies to achieve energy security, food security, and sustainability via academia–industry partnerships, incubation programs, and international innovation networks.

Zero emissions vehicles (ZEVs) have been gaining attention for curbing oil consumption as well as preventing air pollution. Figure 15 shows estimates from IEEJ (2018) on the global level share of ZEVs in Reference and Oil Demand Peak Scenarios. An increasing number of ASEAN member countries are developing policies for promoting the penetration of ZEVs. For example, Thailand is aiming at 1.2 million electric vehicles (EVs) in 2036 based on its EV Strategy, while France and the United Kingdom announced that sales of new gasoline and diesel vehicles will be prohibited in 2040. However, it remains to be seen whether these ambitious targets can be achieved. Banning internal combustion engines could be particularly challenging in the ASEAN region where the public has a strong aspiration for mobility. Market penetration of ZEVs could be promoted by providing incentives to both producers and users, particularly in the initial stage and through public–private partnerships, on establishing necessary supporting infrastructure. However, it is not fiscally sustainable to promote widespread penetration relying on heavy subsidies. This means that wide penetration of ZEVs will be possible only when they are price competitive with conventional vehicles. Government regulations (e.g. banning sales of internal combustion engines) without due regard for market conditions could result in unintended consequences such as a significant expansion of the used car market or slower retirement of less efficient vehicles. This would

be counterproductive in terms of energy security and environmental protection.

**Figure 15:** Share of ZEVs in Reference and Oil Demand Peak Scenarios
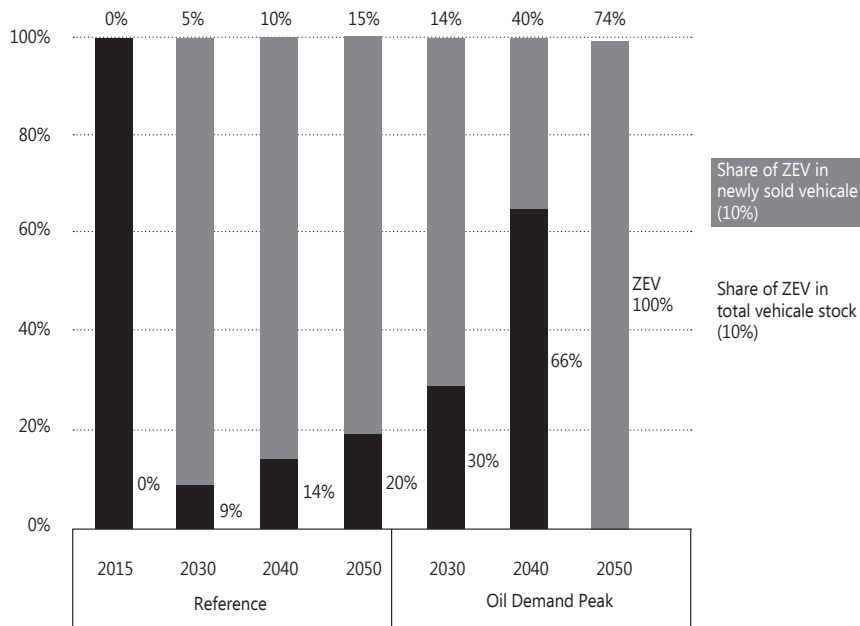
ZEV = zero emissions vehicle (electric vehicle, plug-in hybrid vehicle, fuel cell vehicle).

Source: IEEJ (2018).

IEEJ (2018) projects that global oil demand will stay at the current level, even under an extremely ambitious scenario in which all the global sales of new passenger vehicles are ZEVs in 2050 (Figure 16). This suggests that oil will continue to be the major energy source even in 2050, so governments should enhance emergency preparedness as well as enhancing the fuel efficiency standards of gasoline vehicles.

Figure 16: Global Oil Demand in Reference
and Oil Demand Peak Scenarios
(million barrel per day)

Reference Scenario ■ Oil Demand Peak Case ■ Advanced Technology Scenario
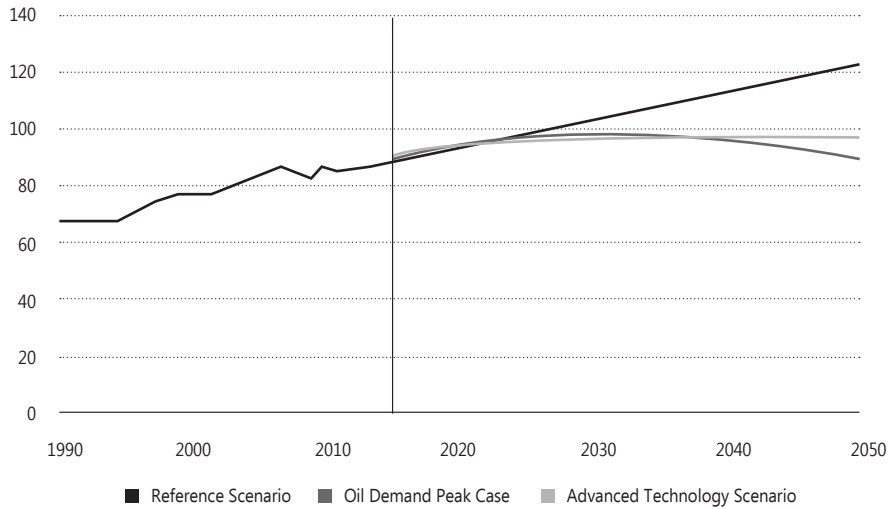
Source: IEEJ (2018).

Expanded Use of Natural Gas

As the world moves towards the aspirations of the Paris Agreement, natural gas is expected to play a more important role in the regional energy mix as the fossil fuel with the lowest carbon content.

While ERIA (2018b) projects that natural gas demand in the ASEAN region will expand by 1.2–1.5 times by 2030, while demand in the EAS region could expand by 2.7–2.9 times by 2030. With a view to maximising natural gas penetration in the energy mix, it is crucial to ensure the efficiency of the LNG market and improve the competitiveness of LNG prices in the region. Figures 17 and 18 show ASEAN natural gas demand potential consecutively by sector and by country.

**Figure 17:** ASEAN Natural Gas Demand Potential by Sector (Mtoe)
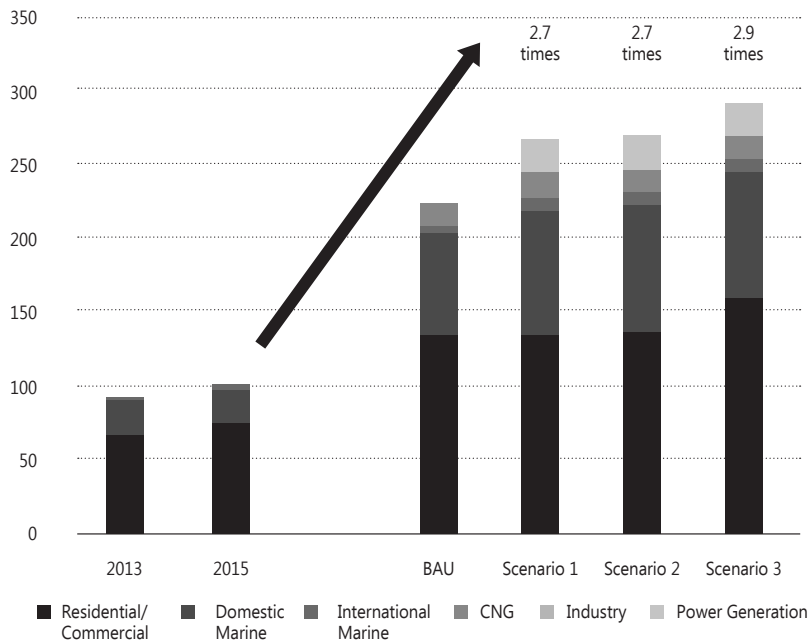
ASEAN = Association of Southeast Asian Nations, BAU = business as usual, CNG = compressed natural gas, Mtoe = million tons of oil equivalent.

Scenarios 1, 2, and 3 assume that 15%, 30%, and 60% of coal thermal power capacity addition from 2015 to 2030 is substituted with natural gas power.

Source: ERIA (2018b).

Figure 18: ASEAN Natural Gas Demand Potential by Country (Mtoe)
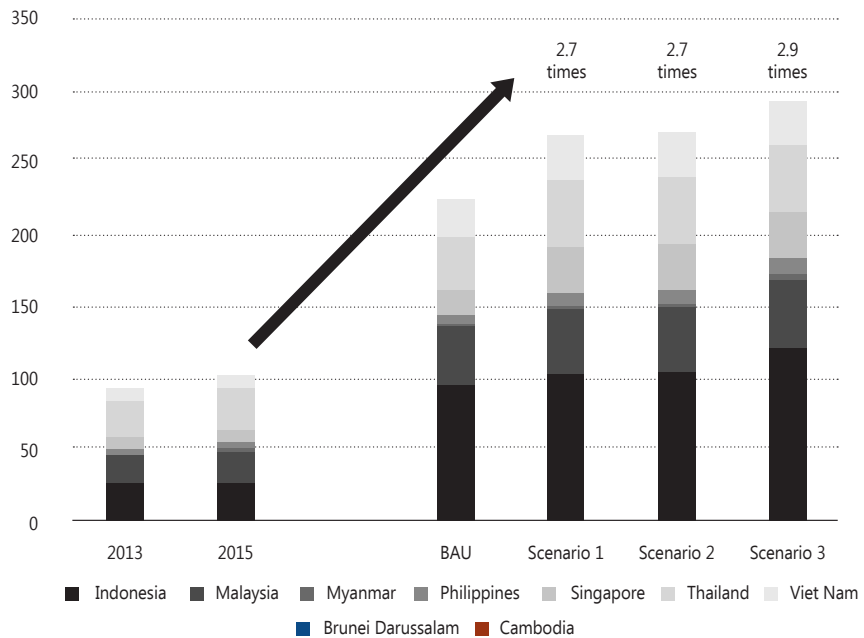
Mtoe = million tons of oil equivalent, ASEAN = Association of Southeast Asian Nations, BAU = business as usual.

Scenarios 1, 2, and 3 assume that 15%, 30%, and 60% of coal thermal power capacity addition from 2015 to 2030 is substituted with natural gas power.

Source: ERIA (2018b).

The liberalisation of natural gas markets, through shared third-party operated infrastructure, would encourage new players to enter the market. A rising number of gas-receiving terminals around the region would open opportunities for a more flexible LNG market. This would allow gas prices to be more market-driven and competitive and create more gas interconnectivity.

The establishment of gas hub(s) in Asia, as a focal point of active LNG spot trading, could help stabilise markets by enhancing supply flexibility, thus making gas more competitive in the region. An Asian LNG hub should have its own benchmark price representing the Asian LNG market, reflect the physical LNG market balance, and have various types of market participants. Experiences in the American and European hubs and lessons for creating an Asian hub should be carefully examined while noting similarities and differences with the EAS region and the lack of a simple cut-and-paste solution. The LNG market in the ASEAN region should be designed as a win–win situation for all players, assuring both the

producer and consumer ends of the chain. At the same time, innovative use of natural gas should be promoted to achieve the maximum demand potential.

In addition to its low-carbon content, natural gas could serve as a fuel to generate zero-carbon energy sources, such as the production of hydrogen gas for fuel cells.

Enhancing the Regional Energy Network

The interconnection of energy networks across the ASEAN region is essential for more resilient and secure energy systems as well as the efficiency of the ASM. In this regard, the ASEAN Power Grid (APG) and Trans-ASEAN Gas Pipeline (TAGP) play a vital role.

Development of the APG is tasked to the Heads of ASEAN Power Utilities/ Authorities (HAPUA), as a specialised energy body. The construction of the APG is initially motivated on cross-border bilateral terms. It is envisioned that the APG will expand to a subregional basis and then to an integrated ASEAN-wide regional system. Ongoing collaboration between the Lao PDR, Myanmar, and Thailand symbolises the initiation of multilateral trading of power in the region. However, several preconditions must be fulfilled to enable multilateral power trading in a level-playing field, including (i) the harmonisation of technical standards of grid operation; (ii) the harmonisation of relevant regulations and institutions, such as third-party access agreements; and (iii) the coordination of the estimation, allocation, and compensation of available interconnection capacity for trading purposes, ideally applying commonly accepted business/market models. HAPUA is leading initiatives to study such harmonisation and coordination among ASEAN countries. One of the ongoing efforts is the study on the ASEAN Power Grid Generation and Transmission System Planning Institution (AGTP) as well as the ASEAN Power Grid Transmission System Operators Institution (ATSO).

The development of a fully functioning TAGP requires harmonised and flexible third-party network or access code across the region. The latest

development of the TAGP, according to the APAEC 2016–2025, envisions an extension of the concept to cover the transportation infrastructure of LNG as virtual pipelines to interconnect ASEAN countries as well as other Asian gas consumers in a regional market.

Complementary to the progress of the TAGP, new technological solutions such as floating storage and regasification units and small-scale LNG are receiving attention to enhance ASEAN's downstream natural gas infrastructure capacity.

4.   Climate Change Challenge

In considering the ASEAN 2040 Energy Vision, the most daunting challenge is how to achieve secure and affordable energy supply and CO_2 emissions reductions simultaneously.

As discussed above, robust energy demand growth and still dominant fossil fuel, notably coal in power generation, will significantly expand regional energy-related CO_2 emissions by 169%. The APS includes the following assumptions: (i) more efficient final energy consumption (APS1), (ii) more efficient thermal power generation (APS2), (iii) higher consumption of new and renewable energy and biofuels (APS3), and (iv) the introduction or higher utilisation of nuclear energy (APS4). Under all scenarios, incremental CO2 emissions are lower, mostly because of cost-effective energy efficiency improvement. Nevertheless, CO_2 emissions will grow by 84% from 2015 to 2040.

The United Nations Framework Convention on Climate Change (UNFCCC, 2016) projects that the Parties' nationally determined contributions (NDCs) are not sufficiently ambitious to bring the global greenhouse gas (GHG) mitigation path on track for achieving the target of 1.5–2.0 degrees Celsius (°C). On the other hand, ASEAN countries' projected CO2 emissions under the APS are, in some cases, higher than their respective NDCs. This indicates a huge gap between climate aspirations and energy reality.

IEA (2017b) presents the New Policies Scenario (NPS), factoring in NDCs and the Sustainable Development Scenario (SDS) consistent with the target of well below 2°C under the Paris Agreement as shown in the Figure 19. While the NPS projects an 80% increase in CO_2 emissions from 2016 to 2040, the SDS will mark a significant reduction from 2016 levels.

Figure 19: ASEAN Energy-Related CO_2 Emissions under NPS and SDS (Mt-CO_2)
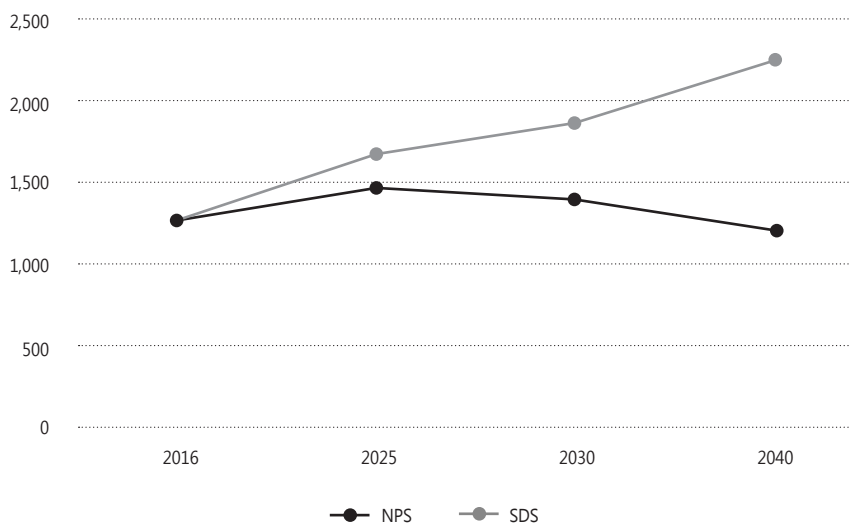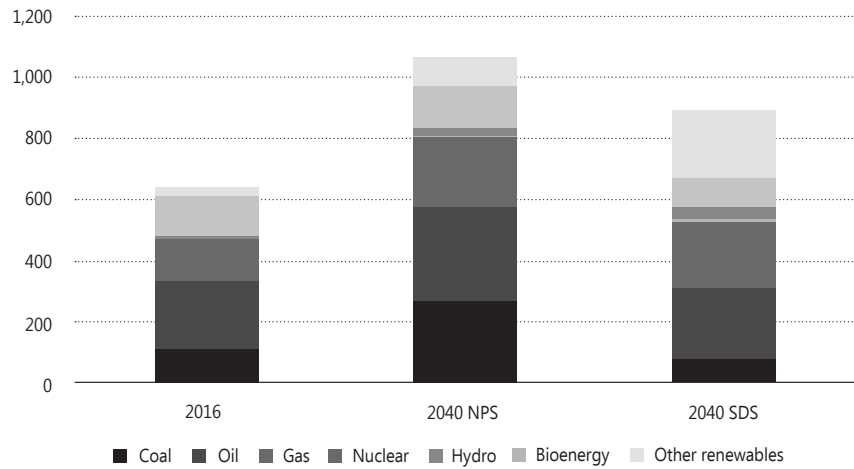

ASEAN = Association of Southeast Asian Nations, Mt-CO_2 = million tons of carbon dioxide, NPS = New Policies Scenario, SDS = Sustainable Development Scenario.

Source: IEA (2017b).

However, a tremendous gap exists between the NPS and SDS in terms of the share of coal and renewable energy. It should be noted that the demand projection under the IEA scenarios is lower than the ERIA (2018a) because of a lower assumption of economic growth. This means that the distance towards the 2°C pathway is even greater. ERIA's Outlook and IEA's NPS have been developed on a bottom–up basis, considering each country's energy reality, while the SDS has been developed as a top–down scenario for achieving the below 2°C target. The feasibility of the SDS is subject to various conditions, notably how much people are willing to pay for combating climate change. Figures 20 and 21 show respectively ASEAN energy and power generation mix under both NPS and SDS.
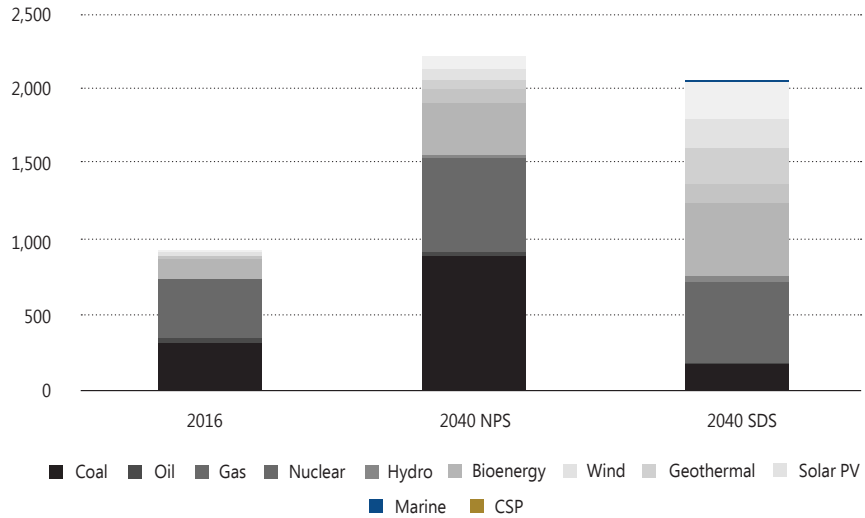
Figure 20: ASEAN Energy Mix under NPS and SDS (Mtoe)

ASEAN = Association of Southeast Asian Nations, Mtoe = million tons of oil equivalent, NPS = New Policies Scenario, SDS = Sustainable Development Scenario.

Source: IEA (2017b).

Figure 21: ASEAN Power Generation Mix under NPS and SDS (TWh)

ASEAN = Association of Southeast Asia Nations, CSP = concentrated solar power, NPS = New Policies Scenario, PV = photovoltaic, SDS = Sustainable Development Scenario, TWh = terawatt-hour.

Source: IEA (2017b).

In general, capacity and willingness to pay for combatting climate change in developing economies tends to be low since they are predominantly occupied with energy access at affordable prices. Given that energy prices are subsidised in many ASEAN countries and their phasing out is posing political challenges, raising energy prices by adding carbon costs could be even more difficult. While climate change is one of the 17 SDGs, it is not the supreme objective taking precedence over other policy objectives such as economic growth, higher living standards, and energy access at affordable prices. In fact, many SDGs are achievable only when robust economic growth is achieved underpinned by cheap and reliable energy.

As presented in section I, ASEAN's energy mix will continue to rely on fossil fuels. Radical energy transition, as envisaged in the SDS, could occur only when non-fossil fuels become economically viable and reliable.

Renewable Energy: Promising, but Subsidy Cost Needs Attention

A climate-driven energy vision requires far more aggressive penetration of renewable energy (e.g. solar, wind, and biomass) in power generation. It is encouraging that the cost of renewable energy technologies is rapidly declining. Distributed power generation using renewable technologies could present a more economically viable option in rural electrification than grid extension for remote areas. Enhancing regional interconnections could expand further penetration of renewable energy such as large hydro.

On the other hand, a large portion of incremental power demand in the region would come from industrialisation and urbanisation, which rely on grid-based power supply. A significant expansion of intermittent renewable energy in the power system, as envisaged in the SDS, would need direct and/or indirect subsidies (e.g. feed-in tariffs and renewable portfolio standards) as well as system integration costs (e.g. back-up power, batteries, and expansion of the transmission and distribution network). These costs need to be borne by final consumers or governments. If governments bear such costs to avoid an additional cost burden for final consumers, the fiscal burden will grow in accordance with the higher penetration of renewable energy. This could be challenging for

governments facing multiple budget expenses, even taking into account some role of international financial institutions.

Renewable energy will play a more important role in the regional energy mix in the coming decades. The cost of supporting renewable energy could be regarded as a domestic investment for the future. At the same time, promoting renewable energy is one of the means for achieving energy policy objectives, not the ultimate objective in itself. Formulating renewable energy policies beyond the power sector to focus on the final energy consumption become imperative, particularly in the manufacturing and residential sectors. In designing and implementing support schemes for renewable energy, governments should regularly examine their cost-effectiveness taking into account the most recent trends of their production and integration costs. Deployment policies seeking an overly quick transition from the pace of development of cost-effective technologies will result in inefficient and expensive pathways, which is not politically or economically sustainable.

Coal: Stigmatised, but Cannot Be Simply Dismissed

ERIA (2018) indicates that coal will continue to be the dominant energy source in the region because of its abundance and reliable supply. With fast-growing electricity demand, ASEAN countries are inclined to build coal-fired power plants (CPPs) with less capital cost since the emissions standards of sulphur dioxides (SOx) and nitrogen oxides (NOx) are far more lenient than in OECD countries. These low-efficiency CPPs will harm the environment because of air pollution and greenhouse gas emissions. Stringent environmental regulations need to be introduced and enforced effectively so that investors select better technologies. Ultra-supercritical technology for CPPs, considered clean coal technology, uses coal more efficiently and cleanly than traditional coal power plants, such as sub-critical technology. Raising the level of public acceptance is a precondition to the future use of CPPs in ASEAN countries. To this end, the emission of air pollutants from CPPs must be minimised. ASEAN should raise the current emissions standards of air pollutants from CPPs to the level of OECD countries. In this case, clean coal technology would be selected automatically, enabling ASEAN to advance towards the common environmental standard for coal-fired power generation.

While the air pollution problem could be largely resolved by introducing clean coal technologies, environmental groups are advocating the phasing out of coal because of its high carbon content. Scenarios driven by the Paris Agreement (e.g. SDS) envisage a drastic reduction in coal use in the coming decades. As discussed above, the feasibility of such a large reduction depends highly on people's readiness to bear higher energy costs as well as the cost trends of competitors such as natural gas and renewable energy. Coal cannot be simply dismissed because its abundance, low cost, and widespread global distribution could contribute to better energy access at affordable costs. As long as coal stays in the energy mix, what matters is to explore how to use it in an environmentally sustainable manner as a bridge to a carbon-free energy future, rather than simply ruling out coal altogether. The deployment of high-efficiency low-emissions technologies and the development of carbon capture and storage are essential.

Research, Development, Demonstration, and Deployment: Key for Ultimate Energy Transition

Most of the technologies to push a transformation until 2040 already exist and some are emerging. These include advances in science, hardware and software, and technical system configurations. The research, development, demonstration, and deployment of more cost-effective low and zero emission technologies hold the key to ultimate energy transition and decarbonisation.

To date, governments have tended to establish targets and timetables (e.g. X% GHG reduction by 20XX) and to pick particular technology winners through prescriptive intervention. Such an approach could well result in high costs and fail to garner public support, in particular in developing countries where the bulk of incremental energy demand and GHG emissions would occur.

Given multiple uncertainties, it is more sensible and pragmatic to invest in a wide range of technologies including cleaner use of fossil fuels; carbon capture, utilisation, and storage (CCUS); renewable energy; storage battery; new generation of biofuels; hydrogen; energy efficiency; smart

grids; and next-generation nuclear, taking into account each country's competence. More broadly, innovation in energy and environment technologies increasingly emerges from a combination of a wide range of technologies not limited to the energy and environment arena. While ICT, IoT, and AI could have a tremendous impact on energy production and consumption patterns, they have not been developed by prescriptive government policies. Rapid innovation is needed at the ASEAN level to create the business practice. Governments should provide an ecosystem which will encourage basic expenditure on scientific and technological research and development by private industries. Policy frameworks both at the systemic level (market design, regulatory instruments, and new business models) and the operation level (consumer engagement, supply-side management, and demand-side responses) need to be established.

Climate change is a global agenda, so greater international collaboration should be promoted in developing, sharing, and applying best available technologies which are suitable for specific national circumstances. There is little certainty on how this will transpire in policy practices. Important questions remain regarding the optimal functionality and integration strategies. New financial challenges in meeting the NDC are expected to emerge. Multilateral development banks and finance institutions should be encouraged to facilitate private investment through guarantees and risk sharing mechanisms and technology transfer at sector level or economy wide.

Long-Term Strategy: Flexibility in Responding to Many Uncertainties

The inherently uncertain and complex nature of climate change indicates the need for a flexible and adaptable policy approach. Such an approach will need to respond to a deeper understanding of climate science; the cost trends of various energy options; the development of new technologies; and domestic, regional, and/or international political and economic situations. As encouraged by the Paris Agreement, ASEAN countries are considering their respective long-term low-carbon development strategies towards 2050. Such strategies should be pragmatic, flexible, adaptable, and affordable in striking a balance between economic growth and climate goals. In tackling long-term

decarbonisation, several alternative pathways (e.g., target, timetable, and energy mix) should also be considered.

Markets need to innovate to meet specific needs in scale and time. New regulatory approaches and cooperation policies are needed to facilitate the creation of new energy markets as well as the improvement of existing markets. At the same time, flexibility is needed in policy design, as the end points, pathways, technology options, and palatable costs will differ across countries as well as subnational levels.

5. Capacity Building, Public Awareness, and Public Acceptance

The pursuit towards the ASEM (Asia-Europe Meeting) must be underpinned by the rapidly growing ASEAN energy system. Lack of human resources and expertise in utilising advanced and sophisticated energy technologies, such as clean coal technology, new and renewable energies, nuclear energy, and LNG, has been one of the biggest hurdles in planning and deploying new energy infrastructure as well as financing them. The evolving nexus between IT, AI, and IoT will be a defining feature of the energy transformation, enabling ASEAN to take a new systematic approach to manage regional supply and demand systems. Lack of experience and expertise not only exists with the energy industries in ASEAN, but also with regulation and policy design. The following actions are recommended:

Providing Training to Government and Industrial Officials in Asia

Capacity building programs, including training programs and technical assistance, should be conducted by relevant international agencies in a coordinated manner. Topics could include policy, regulations, technologies, technical standards, operational safety guidelines, environmental regulation, and financing, among others. In developing such programs, countries could be grouped with peers that have similar characteristics and stages of development.

Regulatory Development

Relevant international agencies should help Asian governments to develop a regulatory system in adopting and utilising advanced energy technologies. Environmental regulation is one of the key areas in this regard. A clear and consistent environmental regulatory system would clarify the role and the task of project investors and facilitate investment through lowered regulatory risk. Another important regulatory area concerns safety regulations. Training programs on safety issues would help Asian governments to develop a well-organised safety regulation to monitor operational safety to avoid unexpected accidents.

Public Awareness and Acceptance

Public awareness and public acceptance are equally important. The public should be educated with knowledge and information about available new technologies as well as the benefits of adopting such technologies. Understanding should also be built regarding the factors that drive public acceptance of new energy technologies in each country, given the respective social and political backgrounds. Public awareness and acceptance are particularly crucial for strengthening people's willingness to pay for the energy and environment agenda.

Taking good care of the above-mentioned factors would significantly improve the perception of project risk by financial institutions, thus promoting the financing of new energy projects.

6. Conclusion

As a high economic growth region, ASEAN has an important role to play in the global energy and climate agenda. Secure, affordable, and sustainable energy is a prerequisite for ASEAN's prosperity. The regional energy outlook towards 2040 indicates multiple challenges in terms of the security of energy supply and climate change mitigation. These are fundamental dynamics in national development and ASEAN's integration in the global energy market. Many actions need to be taken on both the demand and supply sides and in the domestic, regional, and international

arena. As ASEAN is making a giant stride towards the ASM, it is logical to envisage enhanced ASEAN-wide collaborative initiatives in the energy field while acknowledging member countries' unique situations in terms of economic development and resource endowment. Enhancing emergency preparedness, promoting regional interconnection, regulatory harmonisation, technology collaboration, and sharing long-term visions are the most promising areas for such collaboration. In addition, learning from each other and sharing best practices is instrumental for building the capacity of policymakers and effective regional policy collaboration. ASEAN could consider a peer review process with the help of relevant international organisations (e.g. ERIA and the Asia Pacific Energy Research Centre) in key energy policy agenda such as energy efficiency, renewable energy promotion, electricity and gas market reform, and so forth. If ASEAN is ultimately aiming at the ASEAN Energy Community, enhanced regional collaboration as indicated above is a necessary first step.

In the coming decades, the ASEAN region will need to bear an additional cost for internalising environmental externalities. This is only possible when the public becomes more willing to pay in accordance with better living standards backed by robust economic growth. When policies focused on economic growth confront policies focused on emissions reductions, the former will almost always win. Energy transition in ASEAN must be based on pragmatism, not advocacy.

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Leave No One Behind

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1. Background

'Leave no one behind'[1] implies inclusiveness of all people in the development of the state and its economy to the degree that all people have sufficient access to the resources needed to generate an income, make contributions to society, and live with dignity. Leaders of the Association of Southeast Asian Nations (ASEAN) took the decision at the 23rd ASEAN Summit in November 2013 to develop a Post-2015 Vision to realise a politically cohesive, economically integrated, socially responsible, and truly people-oriented, people-centred ASEAN (ASEAN, 2013). ASEAN Member States (AMS) adopted the ASEAN Community Vision 2025 in November 2015 to build an ASEAN Community that is inclusive, sustainable, resilient, and dynamic (ASEAN, 2015).

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[1]   This phrase is a pledge by United Nations (UN) member states that adopt the 2030 Agenda for Sustainable Development. People get left behind when they lack the choices and opportunities required to participate in and benefit from development progress (UN Development Programme (UNDP), 2018).

AMS have adopted the Complementarities Initiative, a collective effort to promote an ASEAN Community that is inclusive, people-centred, and leaves no one behind, while assisting AMS to achieve their international commitments to attaining the Sustainable Development Goals (SDGs). During 2017–2018, the priority has been to develop catalysts that would help the region attain multiple SDGs simultaneously, through concrete projects (ASEAN–Thailand, 2018).

ASEAN is a highly heterogeneous area with varying levels of development. There is a wide gap between member states in terms of socio-economic indicators. This influences the policy measures affecting performance indicators in SDGs. For instance, not all member states have implemented universal healthcare or an advanced social security system. Fiscal capacity also differs across AMS, resulting in various levels of capability to provide public services essential for human development. Within-region migration, while bringing positive impacts for the economy, also creates challenges in social protection.

The new wave of industrialisation, known as Industry 4.0 or the 4th Industrial Revolution (4IR), is coming to the region and affecting almost all aspects of society and the economy. Divergent demographic trends also affect the region, with both ageing and young societies. These technological and demographic trends require policymakers to respond appropriately to ensure that no one is left behind.

As a region, Southeast Asia has both a positive economic history and outlook. Much has been achieved in Southeast Asia since the early 2000s, with the poverty rate having fallen significantly in all the AMS, the Human Development Index indicators having largely improved, and income levels having increased. This brings optimism that ASEAN will become a prosperous and inclusive community, as stated in the vision.

By 2035, the percentage of the population aged over 60 years is projected to nearly double in all the AMS except for Cambodia, the Lao People's Democratic Republic (Lao PDR), and the Philippines. Moreover, Indonesia, the Philippines, and Viet Nam will together account for

around 72% of ASEAN's total population by that time. Another risk is that some economies may have an ageing population before becoming rich, increasing the burden of the working age cohort. Consequently, it is crucial to anticipate the pace of ageing in these countries to balance the whole region's expected productivity and its people's well-being. In this context, social protection policy becomes a central issue for ASEAN as it can partially address the challenges of ageing populations, a shrinking labour force, a large number of people not covered by the social protection system, and the need to match skills with future demand (Zen, 2017). It is also important to have a healthy old-age population, since it can reduce the cost of healthcare and improve their contribution to society.

2. Existing and Emerging Challenges

With many AMS having large and growing populations, a major challenge facing the region is providing all citizens with good jobs as well as equal access to basic services such as education and healthcare. People living in remote areas usually have limited or no support from the government because of connectivity challenges. This marginal group includes other less protected groups such as undocumented people; vulnerable groups (children, youth, persons with disabilities, people living with HIV/AIDS, older persons, indigenous peoples, refugees, internally displaced persons, and migrants); and uninsured people.

Covering and protecting these vulnerable groups involves four types of challenges: (i) regulatory limitations, when a country has incomplete legal references to handle such challenges; (ii) capacity, when the authority does not have sufficient resources (material or non-material); (iii) lack of incentives for people to participate in formal procedures; and (iv) lack of bilateral agreements, in the case of cross-border migrants. Each challenge shall be addressed appropriately, specific to the country context. The externalities arising from cross-border undocumented migration can trigger more than one type of challenge, since the host country may lack capacity as well as domestic and bilateral supportive regulatory systems; and the undocumented migrants may find it difficult to follow administrative and legal procedures.

Countries with large remote areas or many islands – such as Myanmar, Indonesia, and the Philippines – also face problems of unreached economies of scale, poor and costly connectivity, and uneven distribution of skilled labour in both the private and public domains. These create unreached groups whose welfare and security are usually behind those of their counterparts in more densely areas closer to economic centres. Referring to the pledge of all United Nations (UN) member states to 'endeavour to reach the furthest behind first' (UN, 2015: item 4), AMS have to make more effort to prioritise provision to these groups. This could mean a reverse mechanism – starting from the unreached – while it is typically easier to provide services to the most reachable groups. This will not be an easy undertaking, since the existing socio-economic status of more privileged groups, such as urban people, should not be sacrificed.

In AMS with younger populations, the key challenge is providing the right skills to match the requirements of manufacturing and industry, and providing good remunerative jobs for working-age people. Meanwhile, countries with ageing populations and labour shortages have a twofold challenge to provide sufficient support for elderly groups and keep them in healthy activities, and to fill the labour supply gap to maintain economic growth.

Another challenge is the coming waves of technology leaps, known as 4IR – a set of highly disruptive technologies likely to transform all aspects of our lives, including social, economic, and political systems, often in unpredictable ways. The definition and coverage of 4IR keeps changing, but includes things like artificial intelligence, robotics, the Internet of Things, blockchain, and 3D printing. Almost every aspect of our lives will be touched, including jobs, business models, industrial structures, social interactions, systems of governance, and the like. Its greatest impact could arguably be on all forms of inequality. There could be both positive and negative effects on inclusion, the poor, and vulnerable groups in society.

On the whole, however, 4IR is likely to add to inequality, both between and within countries. Economic convergence between ASEAN's developed

and developing economies has shown promising trends since early 2000. Singapore's gross domestic product was 57 times that of the Lao PDR in 1997, but was reduced to less than 19 times in 2016. However, this promising trend has been accompanied by growing inequality within countries (Menon and Fink, 2018). The impact of 4IR has the potential to accelerate returns to talent and knowledge. This could slow down – or even reverse – convergence between countries and would widen inequality within countries. Non-inclusive growth has the potential to increase social and political instability within countries and undermine popular support – and indeed trust – in greater regional integration.

In the context of 4IR and providing good jobs for the labour force, the major challenges are to equip people with suitable skills and provide people who do not fit into the formal job market with other means of survival. This could involve access to financial resources for those with entrepreneurship talent; reduced transaction costs for accessing public services, including new types of public services emerging from adapting 4IR; or providing and facilitating learning centres to equip active-age people with the skills to complement or support high-tech jobs.

The identification of current and anticipated challenges shall be done first by individual countries and then escalated to regional level. Some of the issues require better coordination amongst AMS, and in many cases synergies can be achieved only when there is regional or subregional cooperation. Given the vision of the community pillars – economic, social, and political – the inclusiveness vision is the catalyst to bring those pillars into solid and strong community building.

3. 2040 Vision of Inclusiveness

'AMS aim to live in a strong community with the shared values of welfare, dignity, and leaving no one behind.'

This means that AMS will embrace the spirit of inclusiveness in their strategies, programmes, and actions in an effort to become a prosperous, strong, and globally connected region. Both individual nations and

the region will make sincere efforts to reduce inequalities within and between countries. Amongst the approaches are formulating the national strategies, exploring potential areas of cooperation with other members, and enhancing existing cooperation. It is also indispensable to put values of humanity above all, especially if there is a dispute or conflicting action.

Economic development policies should be directed to reach the unreached and improve the whole community's welfare. Everyone must have the opportunity to participate in the development process, contribute to economic growth and social capital, and enjoy the benefits of the process. Social security is one of the instruments to redistribute uneven wealth and support a level playing field, making it possible for anyone to compete and cooperate fairly for synergies.

4. Tackling the Challenges and Tapping the Opportunities

Dealing with limited resources and time-dependent actions which will determine the results, the AMS need to work on prioritised programmes. Since the impact of 4IR is fast approaching, it requires early anticipation policy. In the context of current and future challenges, human capital is vital. To prepare for and face the waves of 4IR, the region needs to take action on the following issues:

a. Programmes for saving children from malnutrition and preparing them as main players in the future economy. The current cohort of children, especially those aged 0–15 years, will be the key cohort of the Southeast Asian region in 2040. They will reach 22–37 years old by 2040, becoming the community socio-economic drivers. However, they cannot reap the benefits of the digital age if they are not prepared with adequate nutrition and education. The table shows that malnutrition in AMS is still alarming.

Table 1: Percentage of Under-Fives Stunted Children (%)

Country	Year reported	Percentage
Brunei Darussalam	2009	19.7
Cambodia	2014	32.4
Indonesia	2013	36.4
Lao People's Democratic Republic	2011	44.2
Malaysia	2016	20.7
Myanmar	2016	29.4
Philippines	2015	33.4
Singapore	2000	4.4
Thailand	2016	10.5
Viet Nam	2015	24.6

Source: UNICEF (2018).

The youth demographic economies are facing malnutrition problems, particularly Cambodia, the Lao PDR, Indonesia, and the Philippines. Almost three quarters – 12 million of the 17 million – of the stunted children live in Indonesia and the Philippines. Can AMS cut the number in half in the next 5 years and to one quarter in another 5 years?

The most critical period for handling malnutrition is the first 2 years of a baby's life. The condition of the newborn is determined by the maternal health condition, so maternal care should be included in this programme. The region also needs to enhance cooperation amongst the members, together with existing international communities working on this issue, to provide support for national programmes. Building a reliable and regularly updated database is important to provide good monitoring and evaluation as a basis to take further action.

b. Vocational training for 18–35 year olds, particularly in skills related to 4IR. Partnership with the private sector is important for at least two reasons: (i) industry, the main recipient for this cohort, knows what it needs; and (ii) it will free up some fiscal space that can be used for other types of obligatory public services (e.g. increasing the school participation rate, reducing malnutrition, and improving maternal health care for the poor).

c. Facilitating business with the agility to respond to the fast-changing environment in the digital era. The spirit of the government is to support innovation and facilitate the growth of a fast-changing business environment. Regulatory functions should be imposed to create a clear, adaptive, and transparent business environment and to avoid conflicts amongst the players. Regulatory excellence is the key in this issue.

d. Opening the market to several types of jobs and services that it is inefficient for the domestic market or public sector to supply alone. In regions comprising households with both high and low purchasing power, the government can delegate service provision to private and foreign providers to partially fulfil demand from consumers with the ability to pay, so more public resources can be dedicated to provide services for low-income and unreached households.

Apart from the above-mentioned programmes, at national level, AMS must aim to reach universal healthcare (UHC) to ensure that every citizen, regardless of status and preference, is sufficiently protected. The cost to provide UHC can be made affordable by designing appropriate gradual steps and improving efficiency in relevant policy (Asher, Zen, and Dita, 2018). Since education influences health status,[2] policy can utilise both social programmes to reach multipurpose welfare objectives. Other relevant programmes include infrastructure development to lower the costs to access the healthcare services, improve the quality of services, and promote prevention programmes; and social programmes such as food stamps for children, food supplements in elementary schools, support for women entrepreneurship, and slump area improvement.

AMS can also use information and communication technology (ICT) to widen the coverage and improve the quality of services in remote areas. Telemedicine applications have been applied in some countries to help frontline health providers to diagnose and give treatment instruction to patients in remote areas. Other types of applications

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[2]   There are many studies on this issue, including Lochner (2011) and Contoyannis and Jones (2004).

are online services for the banking system, long-distance education, civil administration, disaster information, cash transfer, market access, insurance, and helping to connect isolated areas. Utilisation of ICT can also strengthen public services by improving transparency and reliability, reducing administration costs and time, and improving database systems. More importantly, it can provide AMS with the possibility of leapfrogging into the digital age. Africa has been very active in using ICT in public services provision, and there are ample reports on the benefits of these programmes (Yonazi et al., 2012; Mimbi and Bankole, 2016; Sharma and Sturges, 2007). AMS can learn a lot from other regions' experiences because embracing suitable technology in this era could address several challenges simultaneously. Some IT-based companies in Asia create simple yet powerful applications to help farmers; fishermen; small merchants; and micro, small, and medium-sized enterprises (MSMEs) in their business. The applications running on cell phones provide marketplaces, information on market prices, weather forecasts, transaction platforms, financial access, logistics transactions, and suggestions for business action. These companies are mainly start-ups, founded by the younger generations – many of whom are scientists and engineers – supported by global venture capital and established rapidly around the world, especially in emerging markets. This is an important feature of the future global economy.

At the action level, AMS first need to identify the number, location, and status of vulnerable groups; and determine the issues they face. This process must involve civil society and organisations that have been working with such vulnerable groups. Such a stocktaking will provide governments with a comprehensive map of the situation, and provide an analytical basis for policy formulation and decision making. The ways to tackle these issues may differ from one country to another, but the inclusiveness principles are similar.

Further, since MSMEs employ a large part of the working population, it is crucial to have adequate policies supporting MSMEs, e.g. by providing access to affordable credit, training, targeted subsidies, and simplifying procedures to reduce transaction costs. Women are particularly important in this type of business. An estimated 33–66% of small and medium-sized enterprises (SMEs) are owned by women in Cambodia, Indonesia, the

Philippines, and Viet Nam; and only a small fraction (3–21%) is adequately served by financial services (Women's World Banking, 2015). Closing the credit gap in the 15 BRIC + N-11 countries[3] by 2020 (including Indonesia, the Philippines, and Viet Nam) could mean a 12% increase in per capita incomes by 2030. This gain could be as large as 25%–28% for Brazil and Viet Nam, where the credit gaps in the formal SME sectors are currently widest (Goldman Sachs, 2014). This effort should be synergised with the use of ICT to empower low- and middle-income groups, including those which use e-commerce as their trade platform. Harmonising laws and regulations will also help homegrown ASEAN companies to compete with larger rivals from outside the region.

To anticipate the demographic changes, AMS facing rapid ageing could explore cooperation with countries with younger populations. This could help address the challenges associated with labour shortfalls in the former countries as well as the challenges in providing productive employment for the growing labour force in the latter ones. Freer movement of labour could benefit countries with shrinking and burgeoning labour forces.

The portability of social security systems for migrant workers could reduce the burden for receiving countries, which would otherwise have to provide those services. Harmonisation and streamlining of employment visas has been an important initiative of the ASEAN Economic Community in reducing barriers to labour mobility. Existing mutual recognition agreements for professional qualifications also need to be expanded to cover new occupations. Commitments on harmonising and streamlining employment visas will be critical, and programmes that help workers overcome language and cultural barriers to movement could be considered. Further consideration could be given to reducing the extent of informal or unrecorded labour movement within the region, particularly for vulnerable workers, through greater cooperation and coordination. Other relevant policies are extending the retirement age,

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[3]   The BRIC countries are Brazil, Russia, India, and China. The N-11 (emerging economies that Goldman Sachs has identified as having high growth potential over the coming decades) are Bangladesh, Egypt, Indonesia, Iran, the Republic of Korea, Mexico, Nigeria, Pakistan, the Philippines, Turkey, and Viet Nam.

providing senior citizens with the opportunity to contribute actively to society, and promoting a healthy society (not only focusing on curative programmes).

It is clear that 4IR will be disruptive to labour markets. Artificial intelligence and robotics are rapidly increasing the jobs that machines can perform better and faster than people. While this may reduce costs and raise productivity, it will also threaten jobs, at least in the short term as workers are reskilled. Workers in low-skilled repetitive jobs such as assembly line workers are most at risk, but it will increasingly affect middle-skilled jobs (i.e. back office, data processing). The International Labour Organization estimates that 56% of jobs in five ASEAN countries (Cambodia, Indonesia, the Philippines, Thailand, and Viet Nam) are at high risk of automation in the next few decades (Chang and Huynh, 2016).

AMS governments and the region's private sector should be aware of the opportunities and threats that come from the 4IR waves. Private sector awareness is just as important as public sector awareness because the private sector is the main actor and user of 4IR. The recent survey by Deloitte (Renjen, 2018) of 1,500 C-level executives across 19 countries provides some interesting insights: only 14% are confident of their organisation's readiness to embrace 4IR, and 75% of respondents believe that businesses have more influence than the government in shaping this future, yet less than a quarter of respondents believe that their organisations have much influence in critical factors such as education, sustainability, and social mobility. Here, the awareness, willingness, and capacity of both the public and private sectors are critical to shape 4IR to become a new equilibrium of inclusive socio-economic order.

Businesses in Southeast Asia are run by both regionally owned and global companies, which may have different approaches and capacity levels to embrace 4IR. While the approaches and strategies may be unique for each type of businesses, public leadership is crucial to create a supportive and facilitative environment. Several possibilities are worth exploring, such as mapping the distribution of workers in terms of skill types, location, and sector, to be linked with potential transformation in the 4IR

era; assessing the need for transformation; and providing appropriate incentives and supports for the private sector to participate in the transformation. The mushroomed technology-based start-ups, driven by young scientists and engineers, have brought new ways of combining business and social entrepreneurship. They show the importance of this new pattern of business and its linkage with 4IR. AMS need more creative scientists and engineers, business and finance literate young people, and enabling policy and regulation.

AMS also can learn from Germany's experience in transforming its industry to digital manufacturing by increasing digitisation and the interconnection of products, value chains, and business models; as well as supporting research, the networking of industry partners, and standardisation. The policy initiative, known as 'Industrie 4.0' or I40, is led by the Ministry of Education and Research and the Ministry for Economic Affairs and Energy. The approach combines top–down and stakeholder collaboration, funded by both the public and private sectors, with a forward-looking horizon of 10–15 years. One of the important outputs is the dynamic I40 platform as a reference for policymakers on I40 implementation to support the creation of knowledge, standards, and examples; mobilise businesses and SMEs; disseminate understanding; promote global networking; and ensure the practical operation of I40 (Klitou et al., 2017).

To have an effective regional policymaking process, AMS have to agree and commit to shared goals – particularly in the case of sensitive issues, e.g. migration policy, handling refugees, and minorities issues. Aligning the process with SDG adoption will create synergy and reduce potential disputes because of the common goals of the Agenda for Sustainable Development. It is also important to synchronise the roles of national policy actions and regional cooperation.

As a region, ASEAN needs to speed up the harmonisation of rules and regulations, especially in focus areas, including the implementation of mutual recognition agreements, flexible labour exchange, knowledge exchange, social protection, and disaster risk management. For some AMS, bilateral or subregional agreements on certain issues may work to

allow greater labour mobility and provide continuous social protection. The region also needs to establish protocols to handle cross-border communicable diseases, refugees, and forced migrants.

In parallel with international regulatory cohesion, domestically, each AMS must put in place regulatory review mechanisms, based on dialogue between the private sector and regulators, to prevent companies from being burdened with implementing regulations that serve no clear purpose while still allowing regulators to provide the oversight and due diligence needed to protect the public. This will allow the private sector to use resources effectively and reduce transaction costs, thereby supporting competitiveness and encouraging investment. This would support MSMEs as well as large firms, growing both wages as well as tax generation.

There are several examples of massive regulatory reform to reduce the regulatory burden. In East Asia, Thailand ran a regulatory guillotine programme in 2017 for regulatory consolidation by cutting unnecessary regulations, updating obsolete ones, and creating required ones. It improved its Ease of Doing Business (World Bank) rank from 46th in 2017 to 26th in 2018 and made Thailand join the 10 top improvers for the first time. Australia, Indonesia, Malaysia, New Zealand, the Republic of Korea, and Viet Nam had previously undertaken regulatory reform strategies – improving the quality of regulations and business climate and reducing the regulatory burden. With the new dynamics of 4IR, it is imperative to develop strategies to enhance the regulatory framework in order to support the desired outcomes. Whether the changes are procedural, in line with good regulatory practice, or require developing laws and regulations in emerging fields where no existing canon exists, governments need to support one another in understanding these complex issues and draft appropriate frameworks that will allow the business sector to flourish. Finally, the public sector needs to be supportive of the private sector while addressing emerging social and welfare issues to meet the aims of a society in which no one is left behind.

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'ASEAN Vision as ASEAN Peoples' Vision: ASEAN Community and ASEAN Identity'

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Background: Southeast Asia's long history

Before the establishment of the Association of Southeast Asian Nations in 1967, Southeast Asia had two distinct and disconnected entities – one covering the broad mainland Southeast Asia and the other the maritime countries. On the continent, there were three zones divided amongst its colonial masters. The first one, under the British Empire, comprised Malaysia, Singapore, and Burma, also now known as Myanmar. The French colonies of Indochina – Cambodia, Lao PDR, and Viet Nam – made up the bulk of mainland Southeast Asia. Only Thailand has not been colonised by any foreign power. Meanwhile, in maritime Southeast Asia, the Netherlands took over Indonesia, while Spain and America ruled over the Philippines.

For centuries, the combined experiences of Southeast Asian countries and their foreign governors made this diverse region even more distinctive, adding to their already colourful languages, religions, cultures, and traditions. Local resistance to foreign domination was the hallmark of the freedom fighters of these countries. Their struggle for independence took different paths depending on local conditions.

On the mainland, the fight for independence was fiercest in Viet Nam due to France's strong determination to continue its dominance. Other colonial masters such as the Dutch, the Spanish, and the Americans were more docile, wanting to extricate themselves from local uprisings, knowing full well that their rule must come to an end sooner rather than later.

After the countries in Southeast Asia gained independence in the 1950s, they had to learn how to coexist with other newly independent countries in the most unusual and indigenous ways. They for the first time have to come to grips with their own non-protective selves – struggling to move quickly with nation-state building and new narratives untarnished by their colonial past. Their colonial experiences implanted in their home cultural, traditions, and norms created regional dynamism as never before seen, yielding a myriad of unintended consequences and repercussions. The regional environment, not to mention the wider international circumstances, was equally fresh but tense as ideological struggles between the great powers began in earnest at the same time.

Development options were limited as Southeast Asian nations tried to proceed with nation-building after decolonisation. Post-independence leaders must mobilise local human and natural resources in all areas for economic and social development to revive and strengthen nationhood, identities, and pride. As they were left on their own without any supervision, they quickly learned that rather than venturing ahead on their own it was more expedient to work together with neighbours to achieve shared goals.

Such a realisation did not come naturally, and early efforts to collaborate and forge collective entities failed due to a lack of mutual trust and confidence. The experience of Maphilindo[1] was typical. The subsequent construction of Association of Southeast Asia (ASA)[2] yielded similar failures. In post-independent Southeast Asia, the political and social environment was left fragmented and battered by heavily enforced foreign dominance and ideas that would necessitate/require strong and sustained leadership to overcome centuries of Western dominance. Roughly a decade following independence, Southeast Asian leaders from the Philippines, Singapore, Indonesia, Thailand, and Malaysia attempted to form a new collective entity to protect themselves from intra-fighting and most importantly so they could fight jointly against external threats. After long debates and deliberations, these leaders overcame their mutual suspicions and forged new commitments in Bangkok, Thailand, in the first week of August 1967 when they agreed unanimously to establish ASEAN.

Unity in Diversity

Southeast Asia has been the crossroads of the world. It is one of the world's richest regions in terms of cultural, religious, linguistic, and ethnic diversity. In a relatively small geographical space, there are 240 million Muslims, 130 million Christians, 140 million Buddhists, and 7 million Hindus (Mahbubani and Sng, 2017).[3] This remarkable diversity has often been seen as a challenge for the people-to-people relationships in ASEAN. However, this diversity is increasingly viewed as an asset that forms the basis of 'unity in diversity'.

In October 2017, an online poll was conducted by Blackbox in Singapore where 3,040 adult ASEAN citizens were surveyed across the 10 ASEAN nations.[4] The study revealed that nearly three in five (58%) of Southeast

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[1] Maphilindo, which stands for Malaysia, the Philippines, and Indonesia, was formed in July 1963 with the initiative of the Philippines to form the Greater Malayan Confederation. It was dissolved a month later with the start of konfrontasi by Indonesia with Malaysia.
[2] The Association of Southeast Asia (ASA) was formed in July 1961 by the Philippines, Thailand, and the Federation of Malaya (now part of Malaysia). It lasted until the establishment of ASEAN in August 1967 which effectively replaced ASA.
[3] Mahbubani, K. and J. Sng (2017), The ASEAN Miracle: A Catalyst for Peace. Singapore: NUS Press, p. 5.
[4] Blackbox (2017), ASEAN Turns 50: A Study of Southeast Asian Perceptions., p.1.

Asians believe that people born and raised in Southeast Asia have a lot in common while 31% think they have at least a little in common. Also in 2017, ERIA conducted an ASEAN-wide survey of over 2,322 people with a series of questions regarding the concerns, aspirations, and expectations of ASEAN people for ASEAN. More than three-fourths of all respondents felt 'moderately' to 'very much' like ASEAN citizens. Combined with those who indicated feeling somewhat as ASEAN citizens, a sense of ASEAN belonging was shared by virtually all the respondents. Much of this sense of ASEAN belonging is shaped by geography. A full sense of ASEAN citizenship may call for ASEAN to be more deeply engaged and more aligned with the concerns and interests of the non-elites. Only 3% of the respondents said they did not feel like they were ASEAN citizens.

However, in the Blackbox poll, less than half of the respondents (43%) said they define themselves as Southeast Asian first ahead of being Asian (51%). Despite the lower self-identification with being Southeast Asian, nearly three in four (74%) rate the current state of relationships between ASEAN member states to be positive.[5]

In contrast, government officials and ASEAN Leaders possess stronger mutual trust and confidence amongst each other. It is the ASEAN Leaders who feel the responsibility of maintaining and strengthening the sense of ASEAN identity. There is deep camaraderie and community that has developed amongst the ASEAN officials over the course of ASEAN meetings. This is the ASEAN institutional identity that ERIA's 2015 report highlighted which covers 'ASEAN institutions, programmes, initiatives and processes. The prominent ASEAN institutions and processes are the ASEAN Summits and ASEAN Secretariat. They also include the numerous ASEAN Committees and Working Groups as well as the hundreds of meetings being held every year'.[6]

Ownership of ASEAN has always been with the governments in the region. By 2040, the ownership of ASEAN has to be more inclusive and

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[5] Ibid., p.9 and p.10.
[6] Intal, P. et al. (2015), Framing the ASEAN Socio-Cultural Community Post-2015. Jakarta: ERIA, p.211.

to include the people. It is building the communal identity, the 'we feeling', the 'ours feeling' and the 'we are in together' that have to be cultivated. Mahbubani observed that 'the relative enthusiasm of the member countries for ASEAN changes when governments change' and 'to protect ASEAN from the vicissitudes of changes in government, the people of ASEAN need to feel a greater sense of ownership.'[7] The sense of ownership comes from understanding ASEAN's history, the interconnectedness and shared destiny.

Embedding ASEAN into the curricula of national education system has always been recommended to strengthen ASEAN awareness and ASEAN identity. There is evidence that elements of ASEAN are incorporated in the national educational system of ASEAN Member States. FGDs conducted in 2017 through the ERIA survey revealed 'a number of participants said they had learned about ASEAN first in their primary school, high school, or university classes, while there were also a number who had learned about ASEAN only in 2015 from news and media as the ASEAN Member States prepared for the realisation of the ASEAN Economic Community (AEC).

Comparisons with earlier studies conducted by the Institute of Southeast Asian Studies (ISEAS) and the ASEAN Foundation in 2007 and 2014 indicate that awareness of ASEAN increased significantly after 2014 – perhaps as a result of all the news about the establishment of the AEC in 2015. In the ISEAS's 2014 survey of students, only 56% were aware of ASEAN – this jumped to 87% in ERIA's survey in 2016. However, comments during the FGDs made it clear that much of the participants' awareness was related to ASEAN's economic pillar. Indeed, several respondents stated that they believed the AEC and ASEAN were the same. Many respondents could not identify the other two pillars of ASEAN.[8]

7   Mahbubani, K. and J. Sng (2017), *The ASEAN Miracle: A Catalyst for Peace*. Singapore: NUS Press, p. 222.
8   Intal, P. and L. Ruddy (eds.) (2017), Voices of ASEAN: What Does ASEAN Mean to ASEAN People?

Moving ahead to 2040, we anticipate a steady increase amongst ASEAN citizens with regards to awareness of ASEAN and stronger articulation of ASEAN identity by understanding its shared history, geographical proximity, and shared interests. The following sections will outline how to create more ownership of the communal identity amongst ASEAN people.

Nationalism and Regionalism

There is a strong tendency to juxtapose nationalism versus regionalism when discussing ASEAN community and identity. Viewed within this framework, a sense of national community and identity invariably trumps the regional. Given that ASEAN is at core an intergovernmental entity and, unlike Europe, does not have a historical experience of devastating wars amongst AMS, there is less motivation for developing a stronger regionalism if presented as two contrasting possibilities. The more fruitful area of inquiry may be 'how can the pursuit of regionalism enhance nationalism?' In other words, how can regional measures contribute to the national agenda and how can regionalism temper nationalism for the benefit of all?' For example, regional measures that constrain national policy agendas may actually lead to better human welfare for everyone at both national and regional levels. Similarly, environmental issues, climate change, and disaster management are all policy areas where action at the regional level is far more likely to improve the situation at national levels, than disparate and uncoordinated policies at the national levels.

Since ASEAN identity is largely a matter of feeling, impression, and expression of one's self, awareness and ultimately the incorporation of 'ASEANness' (e.g. welfare or understanding of other ASEAN peoples or of the region) as part of a person's 'utility function' or sense of overall welfare are what we would like to aim for in engendering an ASEAN identity and an ASEAN Community.

Role of Youth

The youth, both as active agents of change as well as representative of the future of ASEAN, play a key role in building ASEAN identity. ASEAN's current population is 645 million people of which 153 million people are

between 15 to 29 years of age.[9] Overall, ASEAN is viewed as a young region except for countries like Singapore, Thailand, and Viet Nam. To strengthen the communal identity amongst the youth, opportunities for student mobility whether for studies and for work have to be increased. The mobility of students, especially those involving region-wide internship, are constrained as long-term internship visas are not available. The ASEAN Council of Teachers (ACT), an entity affiliated with ASEAN raised this constraint at the recent 2nd Forum of Entities Associated with ASEAN in Jakarta on 15 October 2018. By 2040, such barriers should be removed and replaced with a visa-free internship scheme that allows for greater mobility of students. The most effective way to inculcate the communal identity is to create opportunities for youth to interact. Greater interaction amongst the different nationalities of youth in the region certainly builds strong connections and through the sharing of knowledge can spark a robust exchange of ideas that can lead to greater collaboration to grow their countries and ASEAN as a region.

Role of ICT

A young ASEAN is defined as a 'digital natives', tech savvy, digitally nimble, and multitasking individuals who are fluent in digital devices and the Internet. A young ASEAN multitasks. Eight to 24-year olds in Asia fit 38 hours' worth of activities in a 24 hour-period. They spend 10 hours on media whether the Internet, watching TV, or DVD/VCD/videos, reading newspapers, or magazines and listening to the radio. Of the youth who were interviewed in the region, 37% said they could not live without the Internet and 29% would be unable to function without their mobile phones.[10]

By 2040, digital platforms are the norm to build and strengthen relationships with citizens in the ASEAN Community. Hence, existing official social media platforms like Facebook, Instagram, LinkedIn, Youtube, Twitter, of the ASEAN Secretariat and other ASEAN bodies,

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9   ASEAN Secretariat 2018
10   Emmanuel C. Lallana, PhD, Chief Executive, Ideacorp in his presentation on ASEAN and ICT: A Tale of Two Cities

need to constantly engage users by exploiting digital features on these platforms to actively respond to queries. Furthermore, content on these social media platforms have to reflect the eclectic blend of ASEAN news items, quizzes, news stories from the region (sometimes trivial, sometimes serious), material showcasing individual countries and various kinds of discussion-starters.[11] Such content is the interactivity and openness of the format, combined with the immediacy of the response potential allows for people who can access social media platforms, an excellent way of experiencing something of the 'real' Southeast Asia, motivating users, perhaps, to support ASEAN's regional linking endeavours.[12]

By 2040, prominent influencers identified from the interconnectedness of youth in ASEAN Community through strong networks of students from their mobility, will be a permanent feature to increase the salience of ASEAN related issues. These influencers become role models for promoting ASEAN values from an alternative angle.

Role of Private Sector

The private sector can play a key role in developing a stronger sense of ASEAN community and identity. In particular, the private sector can contribute to the development of ASEAN community and identity by addressing some of the concerns and aspirations that ASEAN peoples have expressed for ASEAN.

In ERIA's 2017 'Voices of ASEAN' Survey the top priority concerns across the region, for all types of respondents including the private sector were (1) corruption and (2) climate change and natural disasters. The fifth most pressing concern was agriculture and food security. The private sector is already heavily engaged in each of these issues, but mostly at national levels. But the survey results clearly mandate that the people of ASEAN see these as ASEAN issues.

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[11] Linda Quayle (2013), 'Promoting "Diplomatic" or "Cosmopolitan" Culture? Interrogating ASEAN Focused Communication Initiatives', *Contemporary Southeast Asia*, 35(1), pp.104–28.
[12] Idem.

In the same survey, ASEAN peoples shared their aspirations for ASEAN and again sectors that involve the private sector topped the list: (1) ease of communication through information and communications technology, (2) easy access to goods and services for other ASEAN countries, (3) good physical connectivity via land, air, and water. As aspirations, these sectors are less politically charged than the concerns expressed above and thus there is more potential for action through ASEAN-level platforms that involve the private sector. Again, ABAC can play a key role, but individual companies are also able to advocate policies and capacity building that could help them deliver their products and services to the ASEAN market. Chambers of commerce could also actively engage on these issues.

Note that two out of three of the top aspirations have to do with connectivity. The importance of connectivity and people-to-people contact cannot be over-estimated as a mechanism to help individuals and groups to become aware that citizens of other ASEAN Member States share many of the same values and perspectives. The industries of travel and tourism can support package tours of Southeast Asia for Southeast Asians – this is a largely untapped market that is in the process of 'coming of age' as southeast Asians have begun to show increasing interest in exploring their own unique heritages instead of travelling to the more traditional destinations in Europe and the United States.

On this topic it is also important to consider the work being done on smart cities and digital connectivity. Singapore has already started creating networks of smart cities throughout ASEAN members under its chairmanship in 2018. These networks will play a pivotal role in connecting peoples in all member states living in urban areas (39 cities selected). Digital technology and seamless connectivity will enhance exchanges and pool common resources amongst people and communities in all areas including transportations, energy, healthcare, education, local government administration and security. As digital connectivity becomes more and more widespread, diverse forums for sharing common interests are flourishing. Some examples of forums that have already been created include:

- ASEAN Affairs: A division of Time International Management Enterprises Company Limited (T.I.M.E.), ASEANAFFAIRS provides a broad range of information and services to the growing audience of governments, businesses, academia, and individuals interested in ASEAN;
- ASEANER: a youth-oriented ASEAN magazine;
- ASEAN Forum: a business magazine devoted to Southeast Asia;
- c-ASEAN Centre with a mission to build a regional knowledge hub on business start-ups and promote public knowledge, awareness, and understanding on regional integration
- CIMB Young Leaders ASEAN Summit where 50 or so outstanding university students and fresh graduates in ASEAN debate on issues related to ASEAN economic integration.

More attention needs to be paid to how to better integrate the private sector into the ASEAN process. According to the Rules of Procedures for Private Sector Engagement under the ASEAN Economic Community. 'The private sector organisations/councils to be engaged with ASEAN Economic Ministers (AEM)/ASEAN sectoral bodies or ASEAN Leaders should be associated with ASEAN and listed in Annex 2 of the ASEAN Charter as Business Councils, Business Organizations, Industry Associations, and Other Stakeholders in ASEAN; or as suggested by ASEAN sectoral bodies.' According to these procedures, ASEAN bodies can create working committees composed of private sector representatives that report to the body. For example, the ASEAN Women Entrepreneurs Network, which worked directly with the Senior Economic Officials Meeting to prepare the Manila Statement on Women's Economic Empowerment in 2017.

Role of the Media

It is important to note the vital role of the media. Although the ASEAN Social and Cultural Community mentions the role of media in promoting an ASEAN sense of belonging and identity, ASEAN leaders have never paid much attention to the ASEAN-based community. ASEAN media still report about the grouping's activities in an ad-hoc manner, most of the time focusing on controversies or bilateral matters. Very few media outfits or journalists write about ASEAN as an entity with vision and aspiration.

They tend to follow narratives from outside rather than of their own making. The ASEAN Secretariat and Secretary General must adopt an open-house policy so that media can access materials related to ASEAN easily. World Bank, IMF, and ADB have adopted open-house policy for quite a while. It is interesting to note that given the importance of ASEAN, as it enters its 51st year, there are no journalists or media outlets assigned specifically to cover ASEAN as an institution, which convenes more than 1,000 meetings annually. In contrast, nearly one hundred journalists are registered to cover the EU in Brussels.

Role of People–Private–Public Partnership

Developing the communal identity of ASEAN can be enhanced when the people of ASEAN see their national issues as ASEAN issues, as highlighted in the previous section. This people's mandate offers a clear opportunity to at least partially reframe national issues so that they become part of the ASEAN discussion. People–Private–Public Partnership can support the development outcomes of ASEAN or ASEAN priorities by encouraging different stakeholders to participate and be involved in ASEAN priorities. By 2040, we would like to see sustained people–private–public partnership platforms. Below are examples of existing and potential platforms that we should certainly strengthen as a way forward.

An example is the ASEAN Heritage Parks system that fosters cooperation, awareness, and appreciation for the need to conserve and manage the 40 heritage parks in ASEAN. The ASEAN Mayor's Forum, while not an official ASEAN sectoral body, can support the communal identity of ASEAN. It is a platform that promotes networking amongst local governments in ASEAN to build a stronger ASEAN by improving awareness of local stakeholders for the regional agenda of ASEAN.

More sister cities in ASEAN can be developed to promote cultural and commercial ties through the ASEAN Smart City Network as well.

Strengthening Coordination and Collaboration amongst ASEAN Bodies

All sectoral bodies from the three pillars of the ASEAN Community are expected to promote ASEAN awareness, identity, and ASEAN Community. Particularly in the ASCC pillar, several sectoral bodies like SOMY, SOMCA, SOMRI, and SOMED's have specific objectives in their 5-year work plan to work on ASEAN awareness.

Currently, the Community Relations Division (CRD) of the ASEAN Secretariat is actively doing outreach activities with different stakeholders. CRD has initiated the organisation of the Forum on Entities Associated with ASEAN since 2017 to update the entities on development in ASEAN. It also encourages ASEAN bodies in Jakarta to share information and explore collaboration with one another as well as with entities affiliated with ASEAN. With more interactions amongst the ASEAN bodies, these increase possible collaboration to work together. By 2040, we would expect to see better resources from the member states, the private sector, and the public to support ASEAN in its community building process using a people-private-public approach.

In summary, ASEAN has a lot of measures to promote ASEAN awareness to ensure ownership of ASEAN by the ASEAN peoples. It is time that ASEAN implements these measures and funds these programmes particularly student academic mobility using people–private–public partnerships. We need to explore sustainable business models to sustain these measures and programmes. We also need to leverage more on the Digital Economy and Fourth Industrial Revolution particularly the new technologies – digital platforms, big-data analytics, and cloud-based services to sustain the ASEAN Community.

References

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