The Comprehensive Asia Development Plan 2.0 (CADP 2.0)

Infrastructure for Connectivity and Innovation

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Economic Research Institute for ASEAN and East Asia

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Acknowledgements

The original version of the Comprehensive Asia Development Plan (CADP) presents a grand spatial design of economic infrastructure and industrial placement in ASEAN and East Asia. Since the submission of such first version of the CADP to the East Asia Summit in 2010, ASEAN and East Asia have made significant achievements in developing hard infrastructure, enhancing connectivity, and participating in international production networks.

However, continuous efforts for infrastructure development and narrowing development gaps are still needed not only for Tier 2 regions to participate in international production networks and for Tier 3 regions to be connected with distant urban centres, but also for Tier 1 regions to upgrade production networks and stimulate innovation by taking advantage of industrial agglomeration and urbanisation.

These economic environments and policy challenges motivated the Economic Research Institute for ASEAN and East Asia (ERIA) to upgrade the original version of the CADP to the second version, titled 'The Comprehensive Asia Development Plan 2.0 (CADP 2.0): Infrastructure for Connectivity and Innovation'. The revision of the CADP was also noted in the Chairman's statement of the 9th East Asia Summit on 13 November 2014 held in Nay Pyi Taw, Myanmar.

CADP 2.0 was drafted by Fukunari Kimura, Chief Economist, and Yasushi Ueki, Economist, with substantial contributions by ERIA's CADP research team members (Takashi Aoki, Toru Ishihara, Norihiro Kawasaki, Nobuyuki Mori, Takashi Okada, and Tadashi Takatsuka) and energy economists (Venkatachalam Anbumozhi, Shigeru Kimura, Yanfei Li, and Han Phoumin); intellectual inputs from Ponciano S. Intal, Jr.; insightful suggestions from Anita Prakash; and editorial support from Maria Priscila del Rosario, Fadriani Trianingsih, and Chrestella Budyanto.

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The methodology of the CADP 2.0 leaves much to be improved. But we hope that CADP 2.0 will be a useful reference for international donor agencies and funding institutions to take coordinated and effective actions for developing quality infrastructure for connectivity and innovation.

Prof Hidetoshi Nishimura

President, Economic Research Institute for ASEAN and East Asia

November 2015

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Executive Summary

Development Strategies and CADP 2.0

The original version of the Comprehensive Asia Development Plan (CADP) was submitted to the East Asia Summit in 2010 (ERIA, 2010). It presented a grand spatial design of economic infrastructure and industrial placement in ASEAN and East Asia and claimed to pursue both deepening economic integration and narrowing development gaps. Five years have passed since the first version of the CADP was publicised, and now is the time to draft CADP 2.0.

By taking advantage of a new type of international division of labour called production networks or the second unbundling, ASEAN and developing East Asia are moving up three unique steps that other parts of the world have not experienced yet. Coming into global value chains, which can be achieved with Tier 3 policy, is now fashionable everywhere in the world. What our region has achieved is to participate in production networks or the second unbundling. This is the step to go up with Tier 2 policy. Then the region is coming into uncharted waters and starts formulating industrial agglomeration, which should be supported by Tier 1a policy. And now forerunners in this region are facing a difficult issue of how to move up to fully developed economies. Here we need to create an innovation hub, supported by Tier 1b policy.

It is important to continuously develop middle-distance physical/institutional connectivity, i.e. Tier 2, to participate in production networks while Tier 3 needs to set appropriate technical grades of infrastructure. In addition, CADP 2.0 emphasises the importance of Tier 1a infrastructure to help an industrial agglomeration grow by securing connectivity with neighbouring industrial agglomerations. Infrastructure is also essential to innovation. Industrial agglomeration and urban amenities are the keys to stimulating and upgrading innovation, particularly after reaching the middle-income level. Infrastructure development for industrial agglomeration and urban amenities in Tiers 1a and 1b policy is expensive though essential to nurturing an innovative society.

The Conceptual Framework

The original CADP (ERIA, 2010) placed the fragmentation theory and new economic geography at the centre of the analytical approach. CADP 2.0 follows the same path and at the same time further extends it to reflect recent changes in the development stages of ASEAN and East Asia as well as the advancement of economic research at ERIA. CADP 2.0 proposes the direction of infrastructure development not only for connectivity but also for innovation.

Based on our conceptual framework, infrastructure development can be tabulated in a 2x3 matrix. The first row refers to infrastructure for connectivity while the second denotes infrastructure for innovation. Each of them is further classified by the degree of involvement in production networks, i.e. Tier 1, Tier 2, and Tier 3. Since infrastructure for Tiers 1a and 1b is often inseparable, the following will work with Tier 1 in total.

The Quality of Infrastructure and Infrastructure Projects

'The quality of infrastructure' and 'the quality of infrastructure projects' are multidimensional. CADP 2.0 discusses the quality issue from the viewpoint of project design, project implementation, macro discipline for development partners, and micro discipline on the partnership between the public and the private sectors.

The Assessment of Industrialisation and Urbanisation

CADP 2.0 assesses the recent development of production networks, industrial agglomeration, and innovation hubs by applying various novel analytical tools. ASEAN and East Asia have advanced a unique development path that has aggressively taken advantage of production networks or the second unbundling. Although the development performance has been widely diversified among countries and regions, it has overall achieved reasonably fast and sustained industrialisation and economic growth in the region. While continuous effort should be paid for Tier 3 and Tier 2, new issues for Tiers 1a and 1b must have heavier weights in the coming years.

Assessment of Soft and Hard Infrastructure Development

CADP 2.0 assesses the progress of projects for logistics and economic infrastructure development listed in the first version of CADP and finds substantial, though somewhat uneven, achievements in the past five years. The progress of soft infrastructure is also evaluated and lists homework to be taken care of.

Three Tiers of Soft and Hard Infrastructure Development

CADP 2.0 connects the conceptual framework with actual infrastructure projects. We list 120 projects by tier, sector, and target outcome (i.e. connectivity or innovation), which are selected from the 761 projects in the list of representative prospective projects. Tiers 1, 2, and 3 have 38, 68, and 14 projects, respectively. By sector, the projects are classified into the following nine categories: road/bridge (41), railway (21), energy/power (18), port/maritime (17), industrial estate/special economic zone (SEZ) (8), airport (6), urban development (5), telecommunications (3), and waterway (1). In the list, 87 and 33 projects are hard infrastructure projects for connectivity and innovation, respectively. The provision of proper quality of infrastructure with good project implementation is emphasised.

Quantitative Assessment on Hard/Soft Infrastructure Development

CADP 2.0 makes the quantitative assessment of further infrastructure development in the horizon of 2030 with the IDE/ERIA–GSM (Geographical Simulation Model) and tabulates our proposed infrastructure-related projects for connectivity and innovation. We conducted simulation for a baseline scenario and other alternative development scenarios in the form of 10-year (2021–2030) cumulative impacts. The development scenarios include eight economic corridor development and subregional development scenarios and four sectoral development scenarios—all infrastructure development (All Infra.); non-tariff barrier reduction (NTB); SEZ development in Cambodia, Lao PDR, Myanmar, and Viet Nam (SEZ); and combination of those three sectoral development scenarios (All-All). The simulation exercise reveals the economic impact of each development scenario in terms of the increment of income level in each province and income distribution among provinces.

Chapter 1

Development Strategies and CADP 2.0

1-1. The Original Version of the CADP

The original version of the Comprehensive Asia Development Plan (CADP) was submitted to the East Asia Summit in 2010 (ERIA, 2010). It presented a grand spatial design of economic infrastructure and industrial placement in ASEAN and East Asia and claimed to pursue both deepening economic integration and narrowing development gaps.

A unique feature of the CADP was to conceptually integrate infrastructure development with industrialisation. While infrastructure plans certainly need strong engineering support, engineers sometimes do not necessarily pay enough attention to the economic consequences. For example, engineers construct a beautiful road, but they may not really know who would use such road, what kind of cargo would move, and how the road would contribute to industrialisation in the region. Infrastructure does not go alone; it must serve economic activities by both producers and consumers. To think of the quality of infrastructure, we must specify how the infrastructure would be used and what the appropriate technical grade and specification would be.

Since the mid-1980s, we have come into an era with a new type of international division of labour called 'production networks' (Ando and Kimura, 2005) or 'the second unbundling' (Baldwin, 2011). ASEAN and developing East Asia comprise the region where production networks, particularly in machinery industries, have most advanced in the world. The new international division of labour requires a series of infrastructure in a technical grade different from the old type of infrastructure. Production networks call for a cost reduction of service links that connect remotely placed production blocks. The cost is not simply a monetary transport cost; in addition, the time cost and the reliability of logistics links become important. The coordinated development of soft and hard infrastructure also turns out to be essential. The new international division of labour calls for a novel approach in infrastructure development.

The CADP adopted a conceptual approach in infrastructure development with exploiting the recent development of economic theories, namely, the fragmentation

theory and new economic geography. It classified infrastructure projects into three tiers. Tier 1 includes projects that serve countries/regions that are already in production networks and have started forming industrial agglomerations. Tier 2 consists of projects supporting countries/regions that are about to participate in production networks. Tier 3 is comprised of projects in remote areas where the participation in production networks is difficult in the short run but better and more reliable connectivity can generate new business models in agriculture, mining, tourism, and other industries. Based on the conceptual framework that integrates infrastructure development and industrialisation, the CADP proposed 695 infrastructure-related projects with three levels of priorities.

Although the CADP was an indicative plan that was primarily drafted by the Economic Research Institute for ASEAN and East Asia (ERIA) in collaboration with the Asian Development Bank (ADB) and United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP), the proposed concept of connectivity has been well received and has been placed at the centre of infrastructure development in ASEAN and East Asia. It also provided a conceptual framework for the Master Plan on ASEAN Connectivity (MPAC) (ASEAN, 2010) that was drafted in parallel by the ASEAN Secretariat and ERIA. We believe that the CADP has contributed to infrastructure development and economic integration by placing infrastructure development as an essential input for the industrialisation and economic development of ASEAN and East Asia.[1]

1-2. CADP 2.0 for the Extended Development Strategies

Five years have passed since the first version of the CADP was publicised, and now is the time to draft CADP 2.0.

Table 1.1 presents GDP per capita in ASEAN Member States in 2009–2014. Loosely following the income-level classification by the World Bank, figures are highlighted in different colours for low income (less than US$1,000), lower middle income (US$1,000–4,000), upper middle income (US$4,000–12,000), and high income (above US$12,000). Now all ASEAN latecomers have stepped up to the lower middle–income level, the Philippines and Indonesia have moved up close to the upper middle–income level, Thailand

[1] The CADP was expanded in the context of ASEAN–India Connectivity in the following year (Kimura and Umezaki, 2011). The conceptual framework has been adopted in a series of policy research by ERIA, which includes the Myanmar Comprehensive Development Vision (MCDV).

and Malaysia have been in the upper middle–income level, and Brunei Darussalam and Singapore have been at the high income level. We, of course, have to be careful that substantial development gaps exist within a country. Resource endowments also influence GDP per capita. Thus, 'country-average' income levels do not tell the whole story. Nevertheless, the nature of development challenges evolves along the development paths from the most advanced regions of the country.

Table 1.1. GDP per capita in ASEAN Member States (in US dollar, nominal prices)

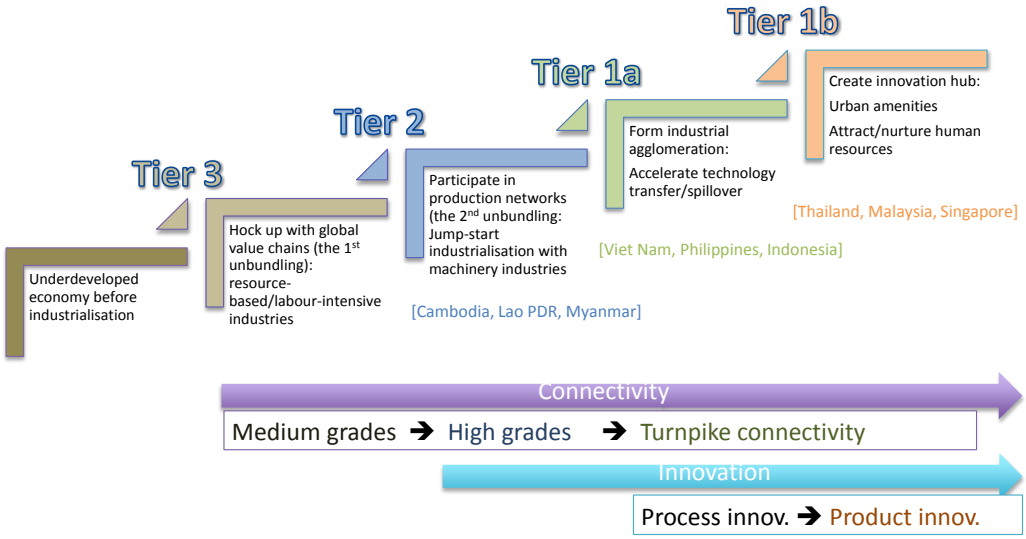
	2009	2010	2011	2012	2013	2014
Singapore	38,577	46,570	53,117	54,578	55,980	56,287
Brunei Darussalam	28,454	32,063	42,431	42,445	44,560	41,424
Malaysia	7,216	8,515	9,962	10,346	10,420	10,784
Thailand	3,947	4,743	5,116	5,391	5,679	5,436
Indonesia	2,359	2,988	3,498	3,564	3,461	3,901
Philippines	1,829	2,127	2,339	2,568	2,707	2,816
Viet Nam	1,232	1,338	1,543	1,755	1,909	2,055
Lao PDR	913	1,079	1,262	1,443	1,613	1,730
Cambodia	735	785	882	952	1,018	1,105
Myamnar	456	686	1,127	1,190	1,209	1,278

Source: ASEAN Secretariat webpage. Available at:
http://www.asean.org/component/zoo/item/macroeconomic-indicators

Figure 1.1 illustrates the unique path of economic development in ASEAN and developing East Asia. By taking advantage of a new type of international division of labour called production networks or the second unbundling, ASEAN and developing East Asia are moving up three unique steps that the other parts of the world have not experienced yet. Coming into global value chains, which can be achieved with Tier 3 policy, is now fashionable everywhere in the world. What our region has achieved is to participate in production networks or the second unbundling. This is the step to go up with Tier 2 policy. Then the region is going into uncharted waters and starts formulating industrial agglomeration, which should be supported by Tier 1a policy. And now forerunners in this

region are facing a difficult issue of how to move up to fully developed economies. Here we need to create an innovation hub, supported by Tier 1b policy.

Figure 1.1. New Development Strategies for ASEAN and East Asia and Quality of Infrastructure



Source: ERIA CADP research team.

Although infrastructure projects in Tiers 2 and 3 policies are still important for some countries and regions, more attention should be given to those in Tier 1 now. It is important to continuously develop middle-distance physical/institutional connectivity, i.e. Tier 2, to participate in production networks while Tier 3 needs to set appropriate technical grades of infrastructure. In addition, CADP 2.0 emphasises the importance of Tier 1a infrastructure to help an industrial agglomeration grow by securing connectivity with neighbouring industrial agglomerations.

Infrastructure is also essential to innovation. Industrial agglomeration and urban amenities are the keys to stimulating and upgrading innovation, particularly after reaching the middle-income level. Infrastructure development for industrial agglomeration and urban amenities in Tiers 1a and 1b policy is expensive though essential to nurturing an innovative society. For industrial agglomerations, suburban or metropolitan development with proper geographical designs is required for local firms or small and medium enterprises (SMEs) to have more opportunities to participate in production networks, enjoy technology transfer/spillover, and achieve innovation, particularly process

innovation. Furthermore, at higher stages of development in which the construction of an innovation hub is essential, urban amenities enhance their importance in attracting and nurturing human resources, and realising a creative society with active product innovation. Therefore, the subtitle of CADP 2.0 is 'infrastructure development for connectivity and innovation.'

CADP 2.0 also emphasises the quality of infrastructure and infrastructure projects. For what is infrastructure developed? The answer should be to serve economic development. How should we design infrastructure? It should be suited for the stages of industrialisation and economic development. Positive and negative indirect effects as well as externalities must be properly assessed. How should we implement infrastructure projects? The implementation must be efficient and non-distortive. How should actors, particularly foreign players, be coordinated? The disclosure of information and transparency among bilateral/regional/multilateral donors and financial organisations are essential. How should we design public–private cooperation to enhance efficiency without corruption of or distortion to the market? To answer this question, we have to go back to the basic argument on the role of government and Pareto-improving policies. All of these are the foundation for the quality of infrastructure and infrastructure projects. CADP 2.0 explicitly discusses these issues and provides guidelines.

At the end, CADP 2.0 presents 120 representative hard infrastructure projects selected from 761 listed projects for connectivity and innovation in Tiers 1, 2, and 3 as well as recommendations on soft infrastructure. The geographical simulation model verifies the effectiveness of these projects along with the development strategies in a spatial setting and stresses the importance of coordination between soft and hard infrastructure.

Chapter 2
Infrastructure for Connectivity and Innovation: The Conceptual Framework

This chapter discusses the theoretical background and the conceptual framework for CADP 2.0. The original CADP (ERIA, 2010) placed the fragmentation theory and new economic geography at the centre of the analytical approach. CADP 2.0 follows the same path and at the same time further extends it to reflect recent changes in the development stages of ASEAN and East Asia as well as the advancement of economic research at ERIA. CADP 2.0 proposes the direction of infrastructure development not only for connectivity but also for innovation.

The chapter plan is as follows: the first and second sections review and expand the framework of the fragmentation theory and new economic geography. The third section discusses innovation in industrial agglomeration as the microeconomic source of productivity growth. The fourth section argues the implication of our development strategy for the narrowing of geographical and industrial development gaps. The fifth section links the conceptual framework to infrastructure development for connectivity and innovation.

2-1. The Fragmentation Theory

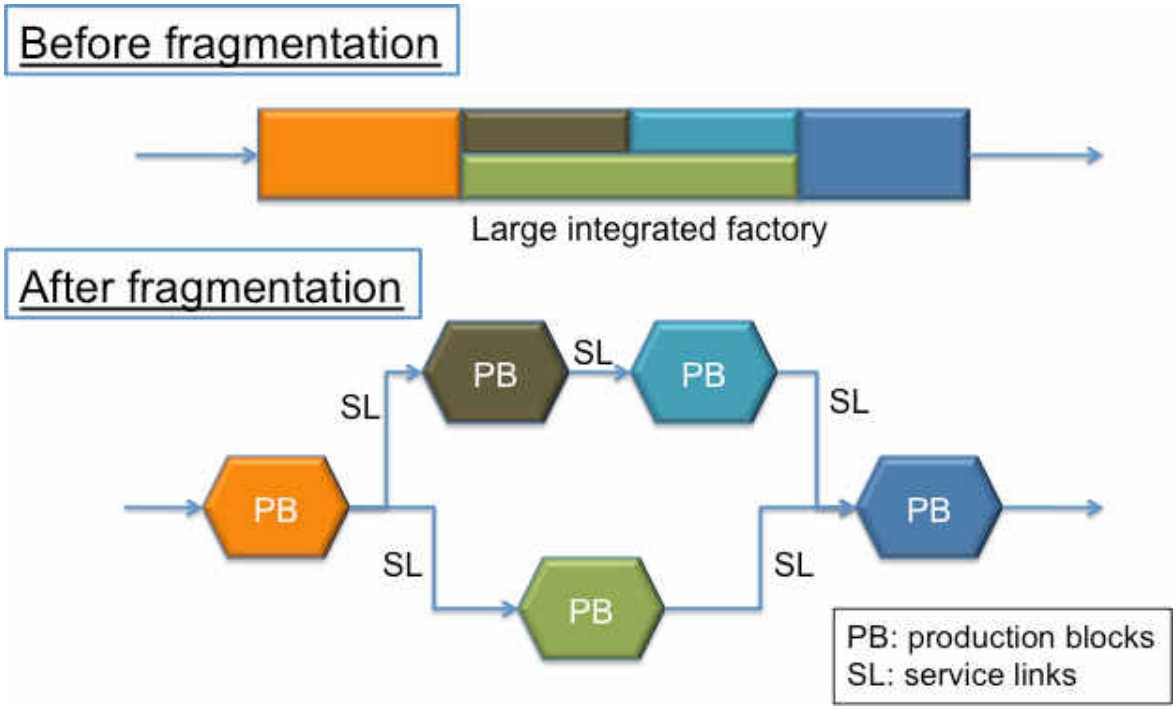
2-1-1. Fragmentation and the second unbundling

Since the mid-1980s, the world economy has started using a new type of international division of labour in production processes or tasks, instead of depending on the traditional industry-by-industry division of labour. The fragmentation theory (Jones and Kierzkowski, 1990) and the second unbundling (Baldwin, 2011) provide a conceptual framework to understand the mechanics.

Figure 2.1 illustrates the fragmentation theory. Suppose that before the fragmentation of production, a large factory took care of all production activities from upstream to downstream. It was a factory, for example, in the electronics industry, which was capital-intensive or human-capital-intensive so that it was located in a developed country, following the traditional comparative advantage theory. If we carefully looked at

the factory, however, it included diversified production processes that used different inputs and different technologies. Therefore, if we can separate some of the production processes into production blocks and place them in appropriate locations, we may save on total production cost. This is so-called fragmentation of production.

Figure 2.1. The Fragmentation Theory



Source: ERIA CADP research team.

Whether such fragmentation of production works depends on two conditions. First, the savings in production costs in a fragmented production block should be large enough. Second, costs of the service link that connects remotely located production blocks must not be too high. Fragmentation is a powerful tool to exploit differences in location advantages, particularly between countries/regions at different development stages. It can be much more flexible and articulate than the traditional industry-wise division of labour in taking advantage of gaps in factor prices, resource availability, logistics arrangements, policy environments, and others. On the other hand, it must at least partially overcome geographical distance by reducing service link costs, which include transport costs in terms of monetary and time dimension, telecommunication costs, and various coordination costs between production blocks.

The concept of the second unbundling further examines differences between fragmented production and traditional industry-by-industry division of labour. The first unbundling is the separation of production and consumption across national borders. It started at the end of the 19th century with the introduction of the mass transport system, such as steam ships and railways, and became a landmark for the formation of the world economy dominated by the industry-by-industry international division of labour based on comparative advantage. On the other hand, the second unbundling refers to the international division of labour in terms of production processes and tasks. It was initiated in the 1980s when the information and communications technology revolution drastically reduced coordination costs in distance. Fundamental differences between the first and the second unbundling reside in the way of dividing jobs/tasks with tight coordination rather than differences across industries or between finished products and parts and components. In the second unbundling, we have two-way flows of goods, ideas, technology, capital, and technicians between remotely placed production blocks. This requires a 'trade–investment–services nexus' supported by physical and institutional connectivity. For the second unbundling, connectivity by logistics infrastructure must be at a higher technical grade than for the first unbundling, which should take care of not only monetary transport costs but also time costs and the reliability of logistic links.

As we will review in detail in Chapter 4, ASEAN and East Asia have been forerunners in aggressively utilising the new international division of labour in their development strategies. In particular, machinery industries are major players in extending production networks. Machines consist of a large number of parts and components that are produced by using diversified materials and technologies. The industry thus has a sophisticated division of labour by nature and can be a natural forerunner of taking advantage of production networks. We, of course, observe the development of production networks or the second unbundling in other industries such as garment, food processing, cut flowers, software, and others. However, most of these industries are still in the traditional industry-by-industry international division of labour or the first unbundling. The concept of global value chains has recently been popular (Elms and Low, 2013) but we have to be careful that the concept includes both the first and the second unbundling. Production networks and the second unbundling are characterised by fast, high-frequency, and synchronised transactions rather than slow, low-frequency, and less

coordinated transactions in a simplistic international input–output structure. The development of production networks in machinery industries is actually a good indicator for assessing the degree of participation in production networks by each country; that is, because once the economic and policy environment allows machinery industries to extend production networks, other industries can also do so.

2-1-2. Policies to reduce three kinds of costs

For a developing country to participate in production networks, it needs to find a bottleneck. To join production networks, three kinds of costs need to be reduced: (i) network set-up costs, (ii) service link costs, and (iii) production costs per se in production blocks. If a country or a region has difficulty in joining production networks, some of these costs are likely to be too high. That is the bottleneck. Then policymakers would like to resolve the bottleneck by implementing necessary policies.

The government can reduce network set-up costs by policies to reduce investment costs, such as the enhancement of stability, transparency, and predictability of investment-related policies as well as the improvement of investment facilitation/promotion services provided by foreign direct investment–hosted agencies and industrial estates. Reduced service link costs may be achieved by a series of hard and soft connectivity policies to overcome geographical distance and border effects, which include the construction/operation of logistics infrastructure and trade liberalisation/facilitation. Reduced production costs per se are realised by policies that strengthen location advantages, which include, among others, enhancing and stabilising supplies of economic infrastructure services for electricity and other utility supplies, as well as industrial estate services.

2-1-3. Fragmentation and agglomeration

As a country or a region successfully participates in production networks and accumulates a number of production blocks, industrial agglomerations will start to form. Production networks in the world other than those in ASEAN and East Asia have barely reached the stage of forming industrial agglomerations, and thus the parallel development of fragmentation and agglomeration is not yet well recognised in the

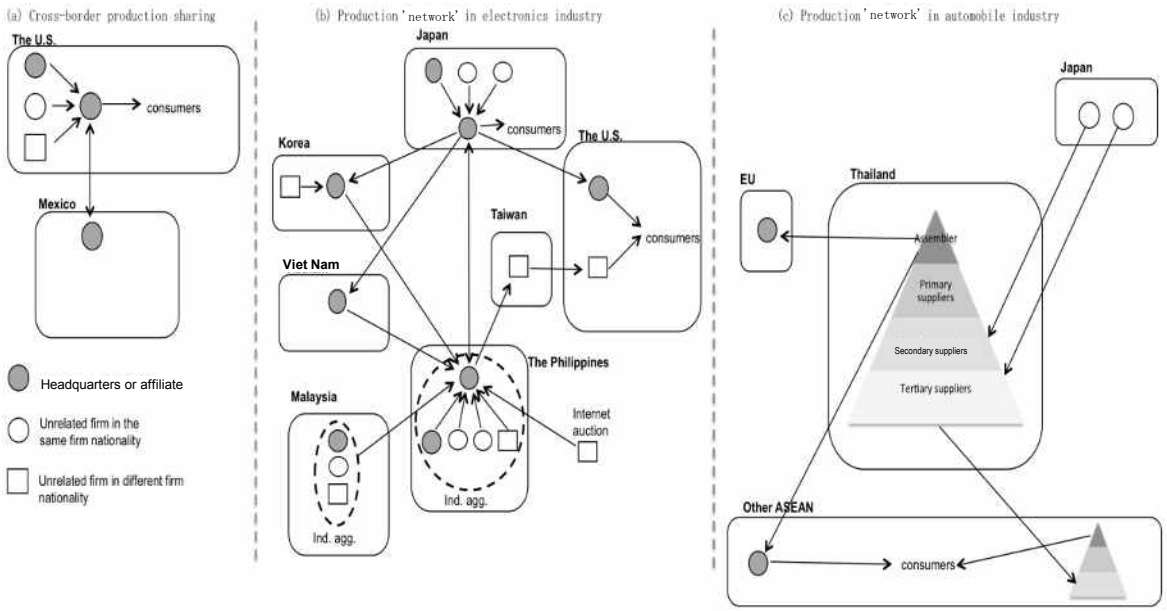
academic literature. However, this is important, and the seemingly paradoxical phenomenon can lucidly be explained by the extension of the fragmentation theory.

Kimura and Ando (2005) expand the fragmentation theory to two dimensions: fragmentation in the geographical distance and fragmentation in the disintegration. The new dimension, disintegration, means that fragmentation of production may occur in the context of intra-firm or arm's-length (inter-firm) division of labour. Arm's-length division of labour takes various forms of vertical linkages and outsourcing between unrelated firms. Compared with intra-firm fragmentation, arm's-length fragmentation is sensitive to geographical distance. In particular, one side of a transaction is a local firm or a small or medium enterprise in developing countries; the transaction is almost always in geographical proximity to save on distance-sensitive transaction costs.

This is a dominant economic logic in forming agglomerations in ASEAN and East Asia, which is quite different from typical cases in developed countries where industries with high transport costs are attracted to the most immobile element, people.

Figure 2.2 illustrates the evolution of production networks. Production networks typically start with a simplistic prototype as illustrated in Figure 2.2(a). This is just the intra-firm fragmentation of production across national borders with back-and-forth transactions between the United States (US) and Mexico, which is called cross-border production sharing. Similar forms of production networks were observed in many places at the beginning of the second unbundling era; examples are the semiconductor assembly in Penang, Malaysia and garment operations between Hong Kong and Guangdong. As production networks are extended and become sophisticated, fragmentation and agglomeration start evolving at the same time. Figure 2.2(b) is the case of hard disk drive production where geographical fragmentation dominates while industrial agglomeration with arm's-length transactions is initiated. Figure 2.2(c), on the other hand, is the case of the automobile industry where the logic of industrial agglomeration dominates though the formation is supported by parts and components supplies from abroad through production networks.

Figure 2.2. The Evolution of Production Networks: Illustrations



Source: Ando and Kimura (2010), modified.

A firm in production networks actually combines four layers of transactions (Table 2.1). Layer 1 is a transaction within an industrial agglomeration where a just-in-time system is literally operated. Layer 2 is a transaction within a subregion such as ASEAN that is connected with middle-distance transportation, still sensitive to time costs. Layers 3 and 4 are transactions on a regional basis, such as in East Asia, and on a global basis, which cannot be very time-sensitive anymore in most cases. The choice of four layers typically depends on the elements presented in Table 2.2. Weights of four layers depend on the economic and policy environment as well as industrial characteristics and corporate strategies. In the case of the electronics industry, more weights are placed in long-distance transactions because service link costs are low and arm's-length transactions go with relatively high credibility, balanced power, and are modular. On the other hand, the automobile industry typically prefers short-distance transactions, particularly under a corporate strategy like Toyota's, because service link costs are typically high and arm's-length transactions go with relatively low credibility, unbalanced power, and total integration.[2]

[2] This view seems to be particularly applicable in the case of Toyota. On the other hand, some other automobile assemblers such as Volkswagen and Hyundai may apply more module interface as well as communised parts and components worldwide so that a system close to complete knockdown may apply. This issue has been investigated in the series of automobile industry studies by ERIA and Research Institute Auto Parts Industries, Waseda University (2014).

Table 2.1. Four Layers of Transactions in Production Networks

	Layer 1 (Within ind. agg.)	Layer 2 (Within sub-region)	Layer 3 (Within region)	Layer 4 (Global)
Lead time	Within 2.5 hours	1 to 7 days	1 to 2 weeks	2 weeks to 2 months
Typical transaction frequency	More than once in a day	More than once a week	One a week	Less than once a week
Major transport mode	Track	Track/ship/airplane	Ship/airplane	Ship/airplane
Trip length	Within 100km	100-1,500km	1,500-6,000km	More than 6,000km

Source: Originally in Kimura (2009), modified.

Table 2.2. Determinants of the Transaction Layer Choice

	Layer 1	Layer 2	Layer 3	Layer 4
<Fragmentation (geographical)>				
Network set-up costs (e.g., cost to invite upstream firms)	small ⟷ large			
Service link costs (e.g., transport costs)	large ⟷ small			
Location advantages (e.g., wages, economics of scale)	small ⟷ large			
<Fragmentation (disintegration)>				
Intra-firm vs. arm's length (inter-firm)	Arm's length (inter-firm) ⟷ Intra-firm			
In cases of intra-firm transactions:				
Trust	weak ⟷ strong			
Power balance	unbalanced ⟷ balanced			
Architecture of firm-to-firm interface				
Modular vs. total integration	integration ⟷ modular			

Source: Originally in Kimura (2009), modified.

The formation of industrial agglomerations calls for a new set of hard and soft infrastructure—hard infrastructure for industrial agglomeration, and soft infrastructure for reducing transaction costs in arm's-length transactions.

2-2. New Economic Geography

2-2-1. Agglomeration and dispersion forces

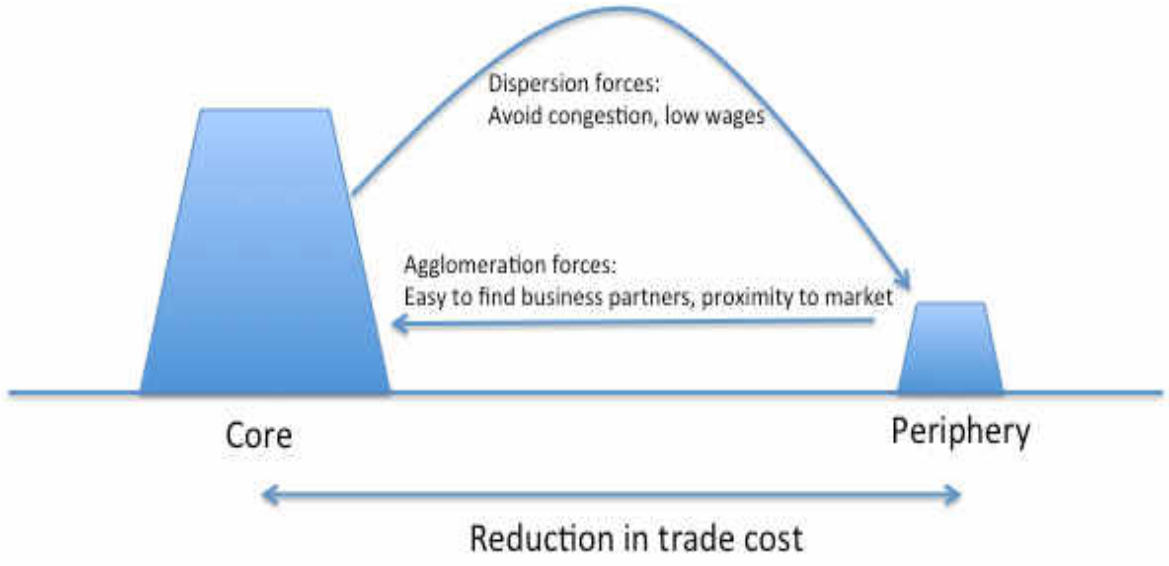
New economic geography (Fujita, Krugman, and Venables, 1999; Baldwin, Forslid, Martin, Ottaviano, and Robert-Nicoud, 2003) is another pillar of our conceptual framework. It complements the fragmentation theory, particularly in considering ways of participating in production networks. While the fragmentation theory inclines toward individual firms' decision-making, new economic geography looks at agglomeration forces and dispersion forces generated by production–consumption interactions in both internal

and external economies. In addition, new economic geography can think of a situation where not only economic activities but also people (or labour) can move.

Figure 2.3 depicts the essence of new economic geography. Suppose we have a core and a periphery in geographical distance. If trade costs between the core and the periphery go down, both agglomeration forces and dispersion forces are generated. Agglomeration forces mean that economic activities, people, and others are attracted to the core where positive agglomeration effects are found in the form of the easiness of finding business partners, the proximity to the market, and others. Positive agglomeration effects are often formalised as a sort of economies of scale external to individual firms that work within a certain geographical boundary. However, economies of scale internal to individual firms may also work as a benefit from moving to the core. On the other hand, dispersion forces generate movements of economic activities, people, and others from the core to the periphery. One source of dispersion forces is negative agglomeration effects or 'congestion' in the core, which includes wage increases, land price hikes, traffic congestion, environmental pollution, and others. Some economic activities or people do not like such congestion and may move from the core to the periphery. Another source of dispersion forces is a difference in location advantages such as differences in wages and others though this could also be interpreted as an element generated by 'congestion'. In contrast to a typical setting in Western Europe or the US where factor prices and other location advantages do not differ much, the core and the periphery in ASEAN and East Asia tend to have a large gap in development stages, factor prices, and others. We can thus expect dispersion forces of considerable magnitude in our region in contrast to situations in developed economies where agglomeration forces are almost always dominant.

The fragmentation theory may naively recommend a reduction in service link costs in order to participate in production networks. On the other hand, new economic geography poses a caveat that a reduction in trade costs may generate both agglomeration forces and dispersion forces; thus, we should properly control the two forces to achieve a balanced growth between the core and the periphery.

Figure 2.3. New Economic Geography: Agglomeration Forces and Dispersion Forces



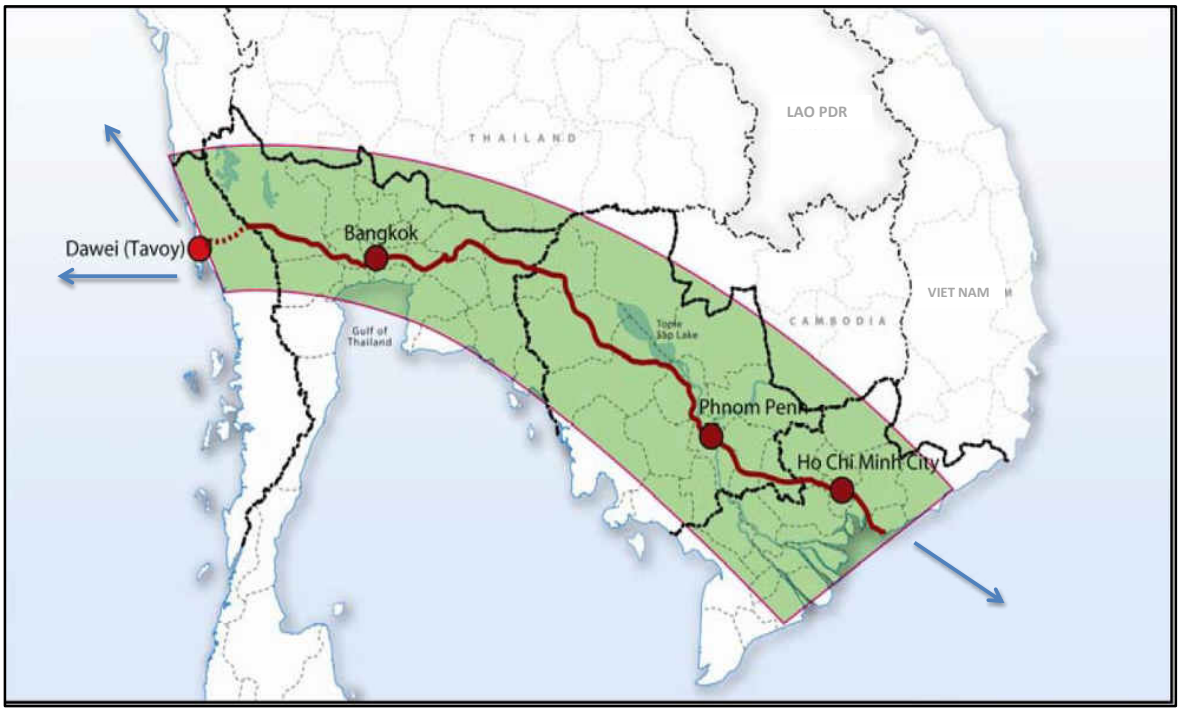
Source: ERIA CADP research team.

2-2-2. Supplementary policy package to control the two forces

How can we control the magnitude of agglomeration forces and dispersion forces? In particular, when latecomers would like to join production networks, a certain magnitude of dispersion forces must be generated, together with a reduction in trade costs. The answer is to properly plan and implement supplementary policy package together.

While the fragmentation theory also claims the necessity of enhancing location advantages, the strength of new economic geography is its ability to consider both agglomeration forces and dispersion forces as well as possible mobility of multiple elements. Let us use the Mekong–India Economic Corridor (MIEC) for thought experiments (Figure 2.4). MIEC is an economic corridor that connects Ho Chi Minh City, Phnom Penh, Bangkok Metropolitan Area, and Dawei. It has great potential for being a major manufacturing corridor in the near future. Think of the case of industrial development in Phnom Penh and in Dawei.

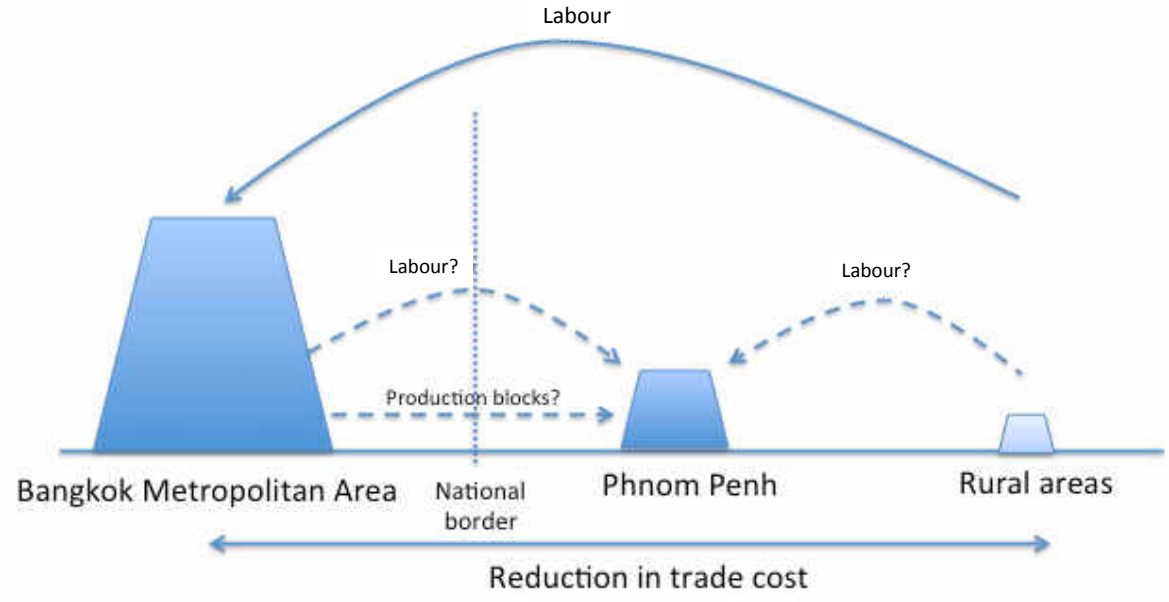
Figure 2.4. Mekong–India Economic Corridor



Source: ERIA CADP research team.

The recent development of the so-called 'Thailand+1' investment is a good sign of expanding production networks from the Bangkok Metropolitan Area to the neighbouring countries, together with reducing service link costs or trade costs. However, things may be a bit more complicated. As Figure 2.5 illustrates, the Bangkok Metropolitan Area has recently attracted a substantial number of labour from neighbouring countries. In the case of Cambodia, about 1 million out of 15 million Cambodians are now in Thailand working in unskilled labour–intensive sectors and the informal sector rather than in Phnom Penh. How can Phnom Penh attract labour from the rural areas and, at the same time, invite production blocks from Thailand? This is the case where reduced trade costs make both economic activities and people easier to move within Cambodia and across the national border.

Figure 2.5. Scenario for the Development of Phnom Penh



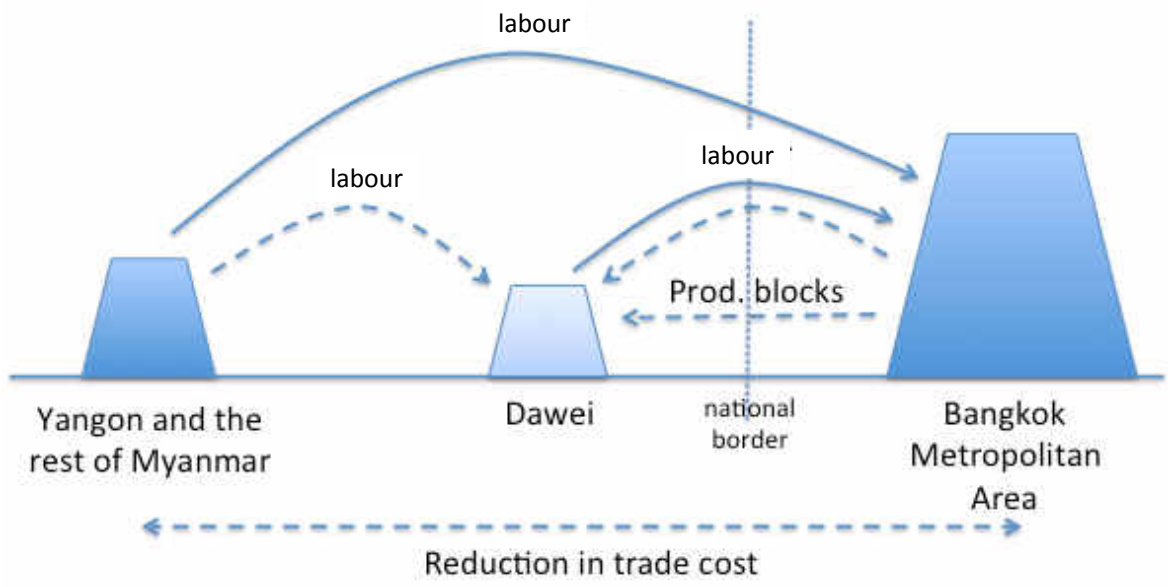
Source: ERIA CADP research team.

Although we need to conduct a serious micro study on the profile of migrant labour and its impact, a simplistic thought experiment is also useful. If the wage gap between Bangkok and Phnom Penh is too large, people do not come to Phnom Penh though production blocks may be motivated to come. On the other hand, if the wage gap is too small, production blocks do not come though people may flow into Phnom Penh. How can Phnom Penh attract both production blocks and people? The answer is the improvement of location advantages and liveability in Phnom Penh. The supplementary policy package may include the better provision of economic infrastructure services in Phnom Penh including better special economic zones (SEZs), more stable supply of electricity, and others. At the same time, people's movement costs from the rural areas to Phnom Penh may be reduced. People coming to Phnom Penh should be willing to stay in Phnom Penh, even if the salary is a bit lower than in Thailand, and enjoy comfortable living.

Another case of thought experiment is the Dawei development. Dawei also intends to attract both production blocks and people, thus requiring more drastic measures to meet its ambition than in the case of Phnom Penh. Currently, there is nothing in Dawei but a vast industrial site. One of the challenges is how to attract labour. To support this big industrial estate, we need at least half a million people. If some activities

are labour-intensive, wages should still be lower than in the Bangkok Metropolitan Area. This means that urban development just next to the industrial site is essential.

Figure 2.6. Scenario for the Development of Dawei

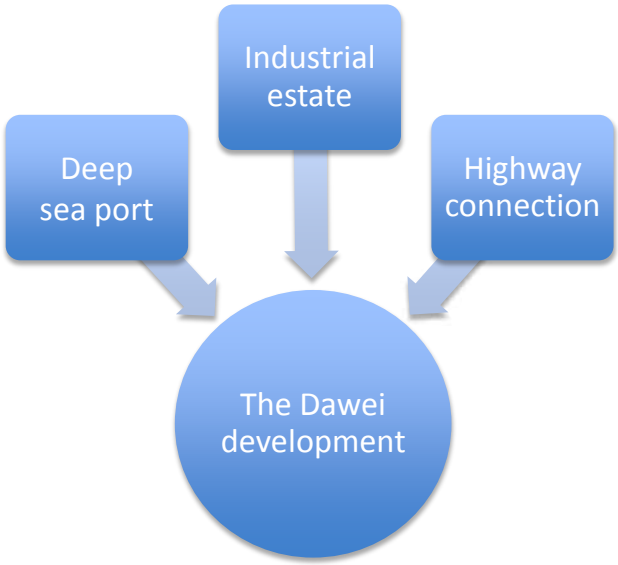


Source: ERIA CADP research team.

In addition, at least three projects—the industrial estate, highway connection to Thailand, and a deep sea port—must be implemented at the same time (Figure 2.7). This follows an old, yet important, idea of coordinated 'big push' (Rosenstein-Rodan, 1943; Murphy, Shleifer, and Vishny, 1989). If we miss one of them, the feasibility of the whole project would collapse.

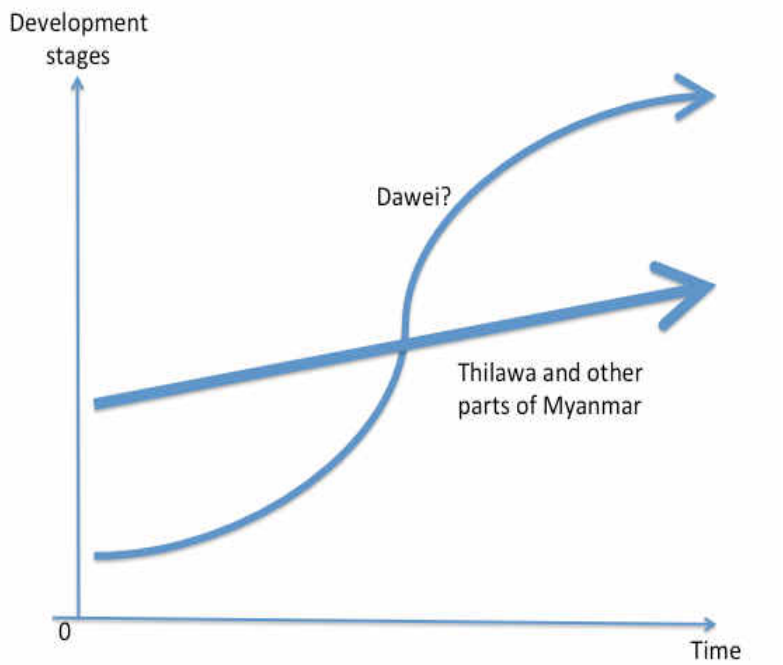
On the other hand, as shown in Figure 2.8, Dawei may 'leapfrog' (Bresiz, Krugman, and Tsiddon, 1993). Dawei is located far from the centre as a big vacuum. Land reclamation and other project preparations may be easier than in mainland Myanmar. It is closer to a massive industrial agglomeration in the Bangkok Metropolitan Area. It can jump to modern industrial technology and just-in-time logistics links, rather than step-by-step industrialisation. In this sense, speed will matter for Dawei. The construction of a deep sea port would take at least 10 years though Thilawa and others might take more time to have full industrialisation and a deep sea port. If so, Dawei could become a hub of industrial activities and logistics, which would also play a leading role for the industrialisation of mainland Myanmar.

Figure 2.7. Economics of Coordinated Investments



Source: ERIA CADP research team.

Figure 2.8. The Theory of Leapfrogging



Source: ERIA CADP research team.

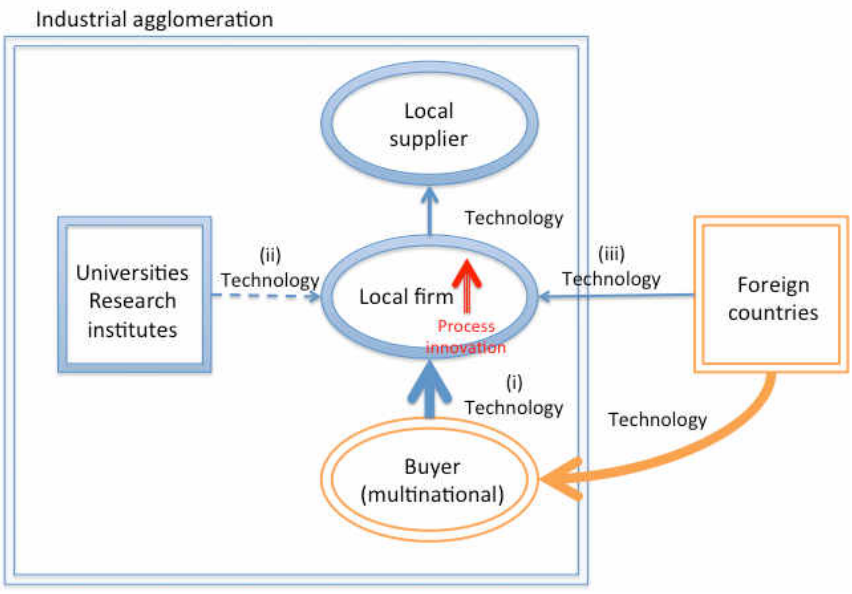
2-3. Industrial Agglomeration and Innovation

2-3-1. Catching-up and sources of technological information

In the globalisation era, local firms in developing countries inevitably face more exposure to competition and, at the same time, may enjoy better access to advanced technology. Up to some stages of development, the backwardness can potentially be an advantage for developing countries to learn from advanced countries at relatively low costs. Once we enter the era of the second unbundling, developing countries face globalisation in a deeper way.

ERIA has continuously conducted micro-level studies with structured questionnaires to scrutinise flows of technological information: what sort of technological information is flowing from where to where. A local firm may have three channels to access technology (Figure 2.9). The first is via affiliates of foreign firms in the same industrial agglomeration that are often in the downstream of production networks. The second is from universities or research institutes in the country. The third is direct learning from abroad by exchanges of technicians or through exports and imports. According to our questionnaire surveys, the first channel, via foreign affiliates in industrial agglomeration, is dominant in ASEAN. Furthermore, a local firm that receives technical training is likely to provide technical training to upstream firms (Kimura, Machikita, and Ueki, 2015).

Figure 2.9. Three Channels to Get Access to Technology



Source: ERIA CADP research team.

This is quite different from old models of technology acquisition. In the cases of Japan, South Korea, and Taiwan from the 1950s to 1970s, universities and research institutes played substantive roles in technology transfers and spillovers. Learning for export as well as imports of machines that embodied technology was also significant. In the case of ASEAN, these channels are relatively weak, and links with foreign affiliates are important. This indicates the weakness of indigenous capability of acquiring technology and the possible benefits of fragmented production.

Of course, not all local firms are automatically eligible to participate in production networks run by multinationals. To meet the strict quality standard of goods and services requested by other firms in the higher tiers of a production network, local firms must clear internal constraints—such as the lack of financial and managerial capability, weak competitiveness, and difficulty in having wider information/networks—in addition to external constraints, such as poor access to finance and unfavourable business and investment climate (Vo, Narjoko, and Oum, 2010).

The development of small and medium enterprises (SMEs) is certainly important, but we have to be careful as there exist different kinds of SMEs. In particular, SMEs in cottage industries and those in supporting industries are quite different. The confusion of these two may end up with inconsistent policies mixing social policy and economic policy. Both types of SMEs should be promoted but for different purposes and with different policy packages.

In connection with infrastructure development, it is crucial to form a critical mass of industrial agglomeration to enhance opportunities for local firms to link with foreign affiliates. Urban and suburban development is expensive and politically challenging but is an essential part of economic development.

2-3-2. Process and product innovation

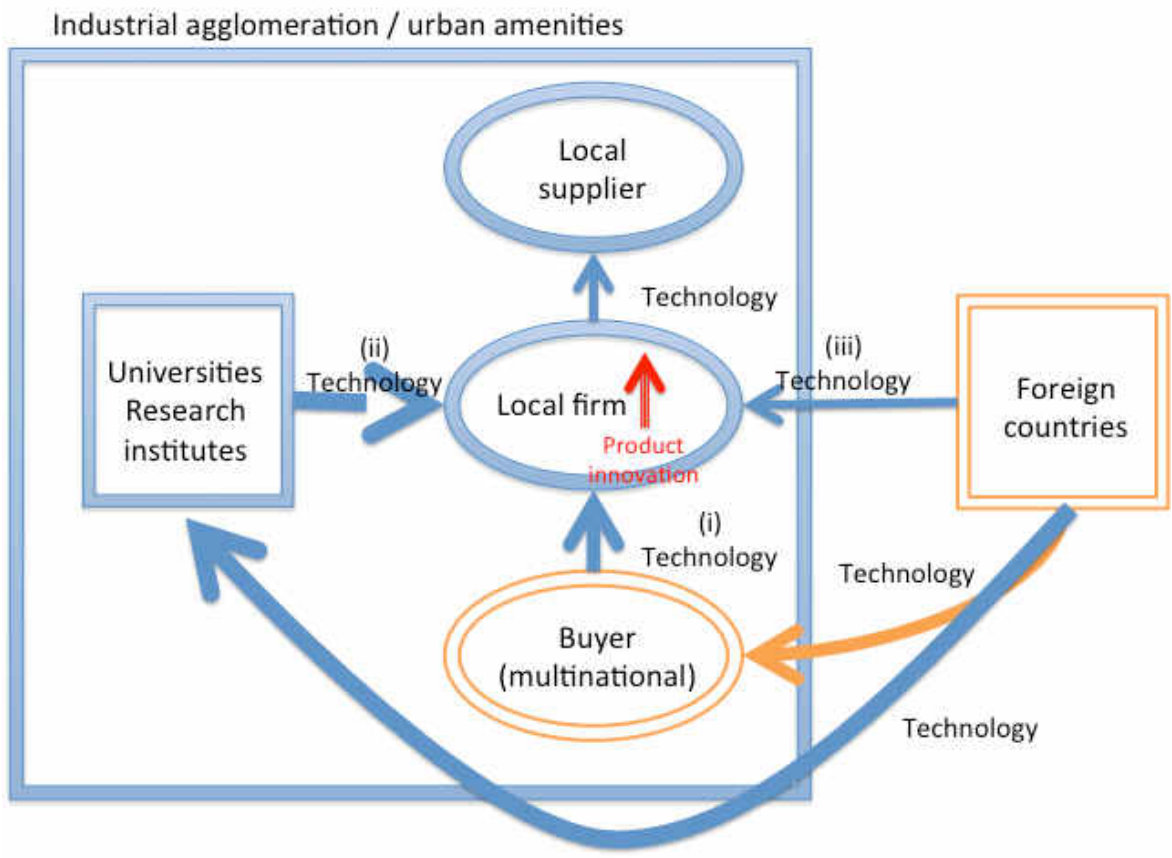
Productivity growth is derived from innovation at the micro level. In particular, after reaching the middle-income level, the innovation capability of local firms becomes the key for sustainable economic growth.

There is a ladder in innovation. The one at the lower end is process innovation. It includes minor changes in production processes through kaizen and QC circles, the improvement of production lines, and the restructuring of the whole operation. A firm

can improve efficiency while producing basically the same products or services. The higher end of the ladder is product innovation. A firm here introduces a new product or service; it could be new to the world, new to the country, new to the industry, or just new to the firm.

The higher a firm moves up the innovation ladder, the greater internal capability is required of it. The external interface of a firm also changes. The first channel of technology acquisition, which is via affiliates of foreign firms, can work well for process innovation and some product innovation for new to the firm. However, eventually, the second and third channels are going to be important, particularly after reaching the upper middle–income stage for product innovation. Then the supply of human resources will become crucial (Figure 2.10).

Figure 2.10. Technology Acquisition and Product Innovation



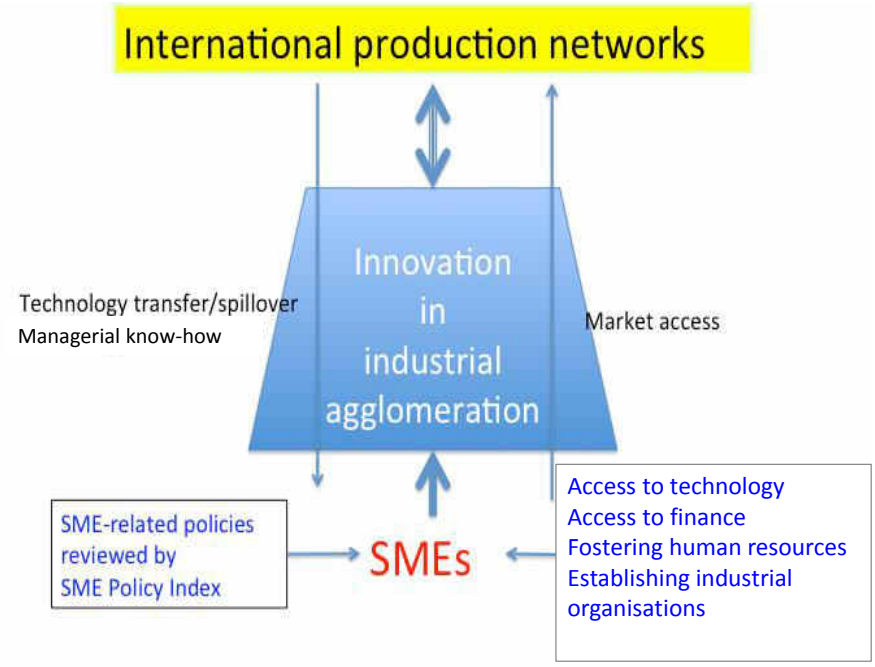
Source: ERIA CADP research team.

2-3-3. Industrial agglomeration and urban amenities

Infrastructure development is crucial in upgrading innovation in ASEAN and East Asia. The reason is twofold.

First, to accelerate process innovation and initiate some product innovation, the formation of industrial agglomeration beyond a critical mass is essential. In the era of the second unbundling, technology can come with fragmented production blocks, and local firms should take advantage of the proximity. Once industrial agglomeration grows up to a certain size, local firms have good chances to participate in production networks and get access to technology (Figure 2.11).

Figure 2.11. SMEs and Industrial Agglomeration



SMEs = small and medium enterprises.
Source: ERIA CADP research team.

In our experience in ASEAN and East Asia, a well-functioning industrial agglomeration seems to be as large as a circle of 100-kilometre (km) diameter in the case of a full-sized one and 50 km diameter in the case of a middle-sized one. The Bangkok Metropolitan Area is one good example of a full-sized industrial agglomeration. The role of government in the formation of an industrial agglomeration of the proper size is critical. An industrial agglomeration must be supported by urban/suburban infrastructure, which

includes logistics connection with neighbouring industrial agglomerations through a large port and an airport, urban and suburban highway system and urban transport, mass supplies of economic infrastructure services such industrial estates, supplies of electricity, water, and others.

By developing infrastructure, we must enhance positive agglomeration effects, which allow firms to set up a just-in-time system within 2.5 hours and increase chances for local firms to have a business relationship with multinationals. At the same time, negative agglomeration effects should be reduced by slowing down wage hikes, keeping living cost low, mitigating land speculation, avoiding traffic congestion, and staying away from pollution problems.

Because huge positive and negative externalities result from agglomeration effects, infrastructure projects for industrial agglomerations are often not financially viable if they are implemented purely by the private sector. However, we still need to implement some of them, with the involvement of the central/local governments that provide partial subsidies or insurance.

Second, at the stage of active product innovation, we must nurture and attract high-quality human resources and set up an innovation hub. It has not been much discussed in ASEAN yet, but eventually we need to think of how to provide good urban amenities or quality of life to attract intellectuals.

There are four critical urban amenities by Glaeser, Kolko, and Saiz (2001): (i) the presence of a rich variety of services and consumer goods, (ii) aesthetics and physical setting, (iii) good public services, and (iv) speed. The first urban amenity (i) must cover something that even advanced Internet shopping cannot provide, (ii) includes intellectual stimulus and comfortable living, (iii) contains opportunities for higher education and safety, and (iv) means easiness to get around and acceptable length of commuting.

In most ASEAN Member States and other East Asian developing countries, research and development (R&D) activities are still minimal. After the stage of upper-middle income, it is important to strengthen universities and government research institutes to accumulate R&D stock (Sunami and Intarakumnerd, 2011). Urban amenities are essential to attracting intellectual people, and infrastructure development must be headed in this direction.

2-4. The Narrowing of Development Gaps

Since Piketty's *Capital in the Twenty-first Century* (2013) became a bestseller, the issue of income distribution has been extensively discussed worldwide. Piketty claims that the income share of the highest one percent population substantially increased in the past few decades. Actually, such a pattern is observed in some countries. We at least cannot immediately conclude that globalisation aggravates income disparity.

If we simply look at the Gini coefficients of income size distribution, China and India have clearly experienced an upward trend since the 1990s whereas those of the ASEAN Member States have recently increased or decreased, depending on the country. Compared with that of other parts of the world such as Latin America, income disparity in ASEAN is not very serious, with relatively high Gini coefficients in Malaysia and the Philippines. In addition, the population below the poverty line has steadily reduced in ASEAN.

How to deal with super-rich people will become an important political agenda in ASEAN and East Asian countries at some point. In this aspect, Piketty's claim of the necessity of income redistribution policy would be applicable in the future. What ASEAN should immediately confront, however, is income disparity due to development gaps that are not pointed out by Piketty.

Development gaps are of two kinds: geographical and industrial.[3] Geographical development gaps are differences in income levels and development stages among countries or among regions within a country. Industrial development gaps refer to differences in productivity and development stages between multinationals and local firms, between large firms and SMEs, or between manufacturing and non-manufacturing.

Our development strategy, if it works effectively, can narrow these two development gaps. Geographical development gaps can be reduced in two ways. The first is through fragmentation of production. This is particularly applicable when production blocks move from a higher income country to a lower income country. If a less developed country/region can attract production blocks and participate in production networks, geographical development gaps are narrowed down. The second unbundling can exploit

[3] ERIA (2012b) proposes the concept of geographical inclusiveness, industrial inclusiveness, and societal inclusiveness. The first two are closely related to development issues and correspond to the narrowing of geographical and industrial development gaps.

differences in location advantages in a subtler and more articulate way than the first unbundling.

The second is through the movement of labour at the time an industrial agglomeration is forming. This particularly works when labour moves domestically from a rural area to an urban area. Less-developed countries typically have a huge agricultural/rural/informal sector where massive redundant labour resides. Smooth labour movements from the agricultural/rural/informal sector to the non-agricultural/urban/formal sector are often effective in reducing population below the poverty line and at the same time providing inexpensive labour to the manufacturing and modern services sectors.

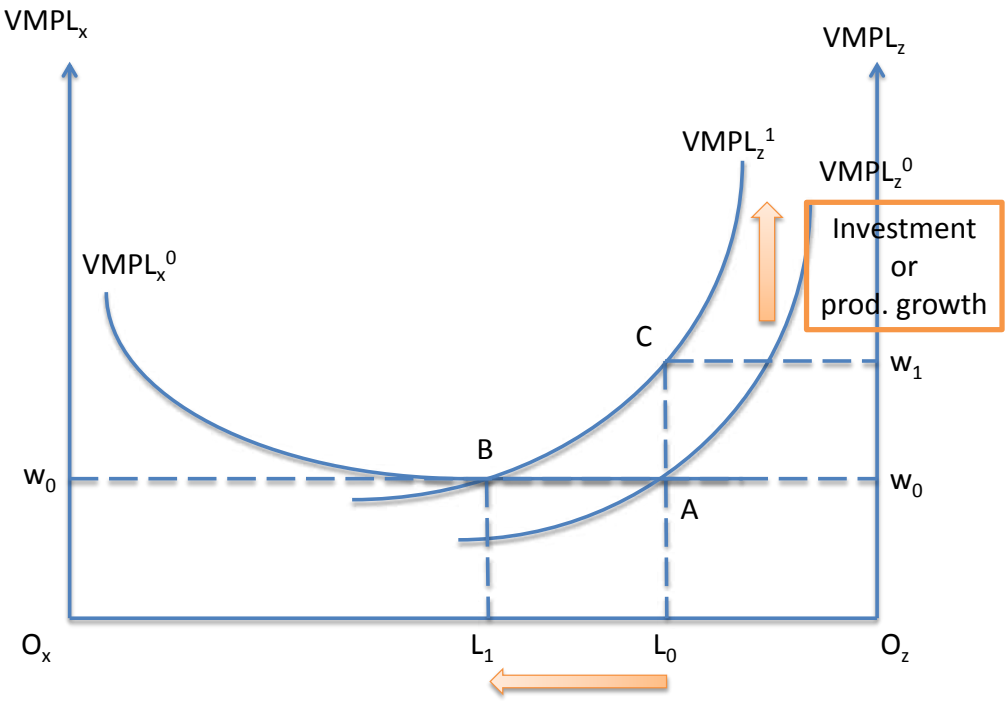
Figure 2.12 illustrates the situation by using a simple diagram a la Lewis (1954). O_xO_z stands for the total labour supply of this country, and $VMPL_x^0$ and $VMPL_z^0$ are curves that represent the original values of marginal product of labour (VMPL) in the rural sector (x) and the urban sector (z).[4] In the initial situation, O_xL_0 and O_zL_0 are the amount of labour employed by sector x and sector z with equalised wages at w_0. The area below the VMPL curve corresponds to the total value of production in each sector. BA is a flat or nearly flat portion of $VMPL_x^0$ curve that indicates redundant labour in the rural area[5]. Suppose that new investment or productivity growth occurs in sector z and the $VMPL_z$ curve shifts up to $VAPL_z^1$. If labour can move without friction, the BA portion of labour moves from rural to urban. By this labour movement, the capitalist in sector z gains area BCA while shifted labour earns area BAL_1L_0 in sector z. Here, the wage level still stays around w_0. However, if sector z has further investment or productivity growth, labour will shift more and the upward-sloping portion of $VMPL_x^0$ will allow the wages in both sectors to increase. This is a typical trickle-down effect from urban to rural.

The key setting here is that labour can move in a frictionless manner. In cases where labour can move only with substantial friction, the living cost in the urban area is substantially higher than in the rural area, education gaps are too large between rural and urban, or the minimum wage applied in the urban area is too high, the labour movement from rural to urban becomes smaller than BA. In the extreme, if labour cannot move at

[4] The interpretation of sector x and sector z could be 'agriculture and manufacturing' or 'informal and formal sectors'.
[5] What redundant labour is doing or how high the marginal product of labour was a point of big debate in the literature of the 1960s, but we do not step into such an argument here.

all, the equilibrium for sectors x and z is A and C where capitalist in sector z loses BCA, and even further upward shifts in $VMPL_z$ do not provide wage increases in sector x.

Figure 2.12. Labour Movements from the Informal to the Formal Sector



Source: ERIA CADP research team.

As shown in Chapter 4, ASEAN and East Asia have achieved relatively smooth labour movements from rural to urban, from agriculture to manufacturing/services, and from informal to formal sectors, which allow workers' wages to stay relatively low compared to GDP per capita. This is because economic growth has mostly been led by the manufacturing sector and related services and educational gaps between rural and urban have been relatively small. This has rapidly reduced the population living below the poverty line.

Let us turn to industrial development gaps. In industrial agglomeration, plants or establishments held by multinationals and local firms are located side by side. This means that local firms are sitting just next to higher technology and managerial ability. This form of globalisation certainly enhances competition, which may hurt local firms. At the same time, it may generate opportunities for local firms to acquire new technology and

managerial ability. If it works as intended in our development strategy, we can narrow industrial development gaps.

2-5. Infrastructure for Connectivity and Innovation

2-5-1. The 2x3 matrix for infrastructure development

Based on our conceptual framework, infrastructure development can be tabulated as Table 2.3. The first row refers to infrastructure for connectivity while the second denotes infrastructure for innovation. Each of them is further classified by the degree of involvement in production networks, i.e., Tier 1, Tier 2, and Tier 3. Since infrastructure for Tiers 1a and 1b is often inseparable, the following will work with Tier 1 in total.

Table 2.3. Infrastructure for Connectivity and Innovation

	Tier 1: Forming industrial agglomeration	Tier 2: Coming into production networks	Tier 3: Rural development for creating business
Infrastructure for connectivity	Turnpike connectivity with other industrial agglomerations - Full-scale port with container yard/airport for regular carriers and LCC - Multi-modal (cargo, passenger) - Institutional connectivity for reducing transaction costs	High-grade connectivity to participate in production networks - Dual-modal (cargo, passenger) - Capital city, border area, connectivity grid - Mitigate border effects - Institutional connectivity / soft infrastructure for trade facilitation	Medium-grade connectivity for various economic activities - Agriculture/food processing, mining, labor-intensive industries, tourism, and others
Infrastructure for innovation	Metropolitan development for full-scale industrial agglomeration and urban amenities - Highway system, urban transport (LRT, subway, airport access) - Mass economic infrastructure services (industrial estates, electricity, energy, water, and others) - Urban amenities to nurture/attract intellectual people	Urban/suburban development for medium-scale industrial agglomeration - Urban/suburban development plan for a critical mass of industrial agglomeration - Economic infrastructure services (special economic zones, electricity, water, and others)	Discovery and development of historical/cultural/ natural heritage - Premium tourism - Cultural studies

Note: LCC = Low-cost carrier, LRT = Light rail transit.
Source: ERIA CADP research team.

2-5-2. Infrastructure for connectivity

2-5-2-1. Tier 1

A full-sized industrial agglomeration requires ‘turnpike’ connectivity with other industrial agglomerations by overcoming time and space. Expensive but essential infrastructure includes a full-scale port with an ample container yard for main shipping routes and a large airport for both regular carriers and low-cost carriers. Turnpike connectivity must be multi-modal, ‘fast and slow’, and ‘high-priced and low-priced’, for both cargoes and passengers as far as the physical geography allows.

Institutional connectivity should be achieved at a high level in order to support efficient industrial agglomerations and affluent urban amenities. Institutional harmonisation or convergence must be pursued to reduce transaction costs.

2-5-2-2. Tier 2

Countries/regions that are coming into production networks must establish ‘high-grade’ connectivity. Dual-modal connectivity, i.e. fast and slow, must be provided for both cargoes and passengers with road, port, and air transportation. Plans for middle-distance high-speed railways should be reviewed from a viewpoint of economic viability; due to competition with air transportation, 800–1,000 km seem to be a threshold.

The balance between the capital city and border areas must be carefully maintained. Connectivity grids may be a key to extend connectivity to Tier 3 regions.

Connectivity with information and communications technology (ICT) would work as both supplement and substitute for other types of connectivity. The use of ICT should be aggressively explored.

In Tier 2, border effects are still likely to be barriers to production networks, which should immediately be mitigated. In particular, soft infrastructure for trade facilitation is important.

2-5-2-3. Tier 3

‘Medium-grade’ connectivity is needed for various economic activities such as agriculture/food processing, mining, labour-intensive industries, tourism, and others. A bit slow but reliable logistics links help various industries to be activated.

2-5-3. Infrastructure for innovation

2-5-3-1. Tier 1

Metropolitan development must include the construction of full-scale industrial agglomeration in the size of 100 km diameter and urban amenities. At a higher development stage, urban amenities are going to increase their importance. We need to control positive and negative agglomeration effects by taking care of externalities.

The efficient highway system and urban transport, such as light rail transit, subways, and airport access, are needed. These projects may be justified even if the financial returns to the projects are expected to be small because they may generate huge positive externalities and mitigate negative externalities such as traffic congestion.

Mass economic infrastructure services should also be provided; these include industrial estates, electricity, energy, water, and others.

After reaching the upper middle–income level, urban amenities must be emphasised in infrastructure development. Urban amenities include (i) the presence of a rich variety of services and consumer goods, (ii) aesthetics and physical setting, (iii) good public services, and (iv) speed (Glaeser, Kolko, and Saiz, 2001). Infrastructure is certainly needed to achieve these.

2-5-3-2. Tier 2

Although the scale would be medium-size, i.e. 50 km diameter or so, the formation of industrial agglomerations should be initiated. Urban/suburban development plans for infrastructure development must be prepared in order to reach a critical mass of economic activities. Bottlenecks in economic infrastructure services, such as SEZs, electricity, water, and others, have to be removed.

2-5-3-3. Tier 3

In some specific places, there is potential for discovering and developing historical, cultural, or natural heritage. In such a place, we can think of premium tourism and the establishment of a cultural study centre.

Chapter 3
The Quality of Infrastructure and Infrastructure Projects

'The quality of infrastructure' and 'the quality of infrastructure projects' are multidimensional.[6] This chapter discusses the quality issue from the viewpoint of project design, project implementation, and strengthening partnership among stakeholders, particularly among development partners and between the public and the private sectors.

3-1. Project Design

3-1-1. The appropriate grade of infrastructure

The key message of the whole CADP 2.0 is to establish a tight link between infrastructure development and industrialisation. Different stages of industrialisation require diversified infrastructure needs, and we have to provide infrastructure with proper technical grades and specifications for specific needs. That is why we divide infrastructure into two categories: infrastructure for connectivity and infrastructure for innovation. For each category, projects are further classified into Tier 1, Tier 2, and Tier 3.

In planning to build infrastructure, the cost consideration is certainly important to construct and operate infrastructure efficiently, but the cost should not be the single criterion for adopting a project plan. In a sense, it is natural for governments under budgetary pressure to tend to choose cheap but low-quality infrastructure projects. However, we still want to emphasise that infrastructure should be suited to the stage of industrialisation and economic development. The required resiliency of infrastructure against various risks such as natural and human-made disasters, including cybersecurity threats, is also one important element in setting the appropriate quality of infrastructure. We will discuss this issue of appropriate technical grades and specifications again in Chapter 6.

[6] The Asia-Pacific Economic Cooperation (APEC), Committee on Trade and Investment (2014), is a useful document to get an overview of the whole cycle of infrastructure projects from the viewpoint of the quality of infrastructure.

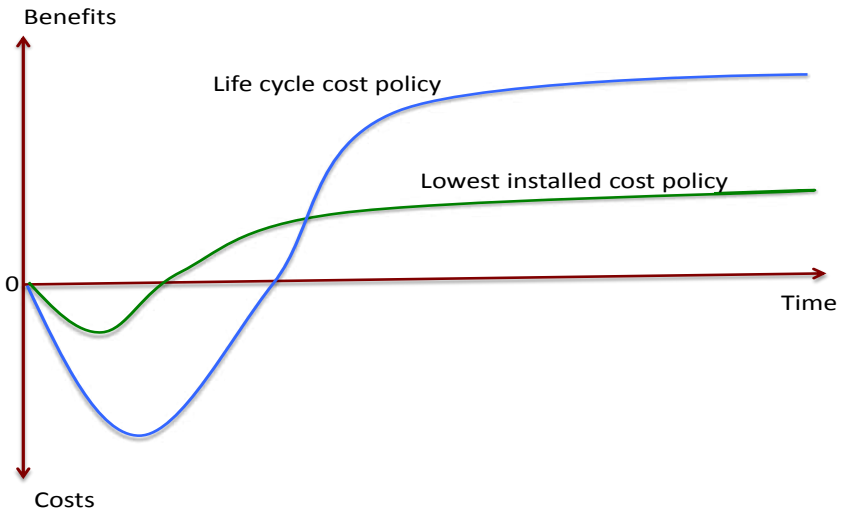
3-1-2. Project design in the time horizon

The construction of infrastructure takes time, and its financial/economic returns come over a very long period. We must thus properly design projects in the time horizon.

The project design should include the whole period of the feasibility study, procurement, construction, operation/maintenance, and ex post evaluation. Proper planning of the whole project is important not only for the sake of the project itself but also for the interface with the private sector's decision-making. This is because infrastructure is by nature tightly connected with the rest of the economy.

Another angle of the issue is the life cycle cost structure. Figure 3.1 illustrates a case. To implement a project, one may choose the lowest installed cost policy where the cost of construction will be low, the period of construction will be short, and the benefit of the project will start to come early. The other possibility is to choose a life cycle cost policy where the construction may be more expensive and lengthy but the future returns will be large. Which is better? To decide which, we must calculate the discounted sum of costs and benefits over time and compare the cost–benefit balance between the two schemes. The message here is that the cheapest, easiest way is not always the best. The life cycle cost policy in the figure, for example, may be optimal. In this example, we had better choose the scheme of large-scale and durable infrastructure.

Figure 3.1. The Life Cycle Cost Structure



Source: ERIA CADP research team.

Furthermore, the sequence of projects over time matters. Is it better to build a four-lane highway immediately? Or should we start from a narrow road and expand it later? Or, alternatively, we may start from a narrow road and construct a separate motorway later. How to set up a proper sequence of projects is one of the important decisions for policymakers.

In actual planning, the key is how to deal with uncertainty. Although it is not easy to grasp uncertainty that is external to the project, we should at least try to reduce internal uncertainty of the project as much as possible. It is also important to continuously reduce uncertainty during planning and implementation. In this regard, the way of thinking in 'real option' may be applicable to some cases. Even in the case of a project with a lot of uncertainty, we may set proper phasing in the timing of investment by progressively reducing uncertainty.

3-1-3. Taking care of possible negative effects and negative externalities

An infrastructure project may possibly cause negative effects to a certain group of people or generate negative externalities such as air pollution, noise, and others that are not fully internalised in the market mechanism. Project planning should build in the structure to deal with such possibly negative impacts from the beginning.

A typical concern about infrastructure projects is their possibly negative impact on the environment and society, disaster prevention, and others. Specific studies on environmental and social impact, for example, must be incorporated in project planning and implementation. Such studies should be open to the public as much as possible; public hearings and other exchanges should likewise be held to solve incomplete information and minimise social conflict. Communication with various stakeholders, including the private sector, local governments, and local residence, is essential.

3-1-4. Taking advantage of possible positive effects and positive externalities

Infrastructure projects may also generate indirect positive effects as well as positive externalities. For example, projects may accelerate technology transfer and human resource development for engineers, managers, and operators. It is worth planning a built-in mechanism to enhance such positive impact in the project design.

3-2. Project Implementation

3-2-1. Bidding

The bidding process is important in order to identify the most capable company/consultant who will implement projects efficiently.

In addition to its fairness and transparency, the quality of bidding depends on its openness. As a part of its procurement, the government may want to limit bidders only to domestic companies in order to protect infant industries. However, particularly in large-scale and technically difficult projects, the bidding had better be open to foreign bidders on non-discrimination basis because more competition may result in infrastructure of better quality and possibly accelerate technology transfer and spillover.

Another important element for quality is the criteria for selection. Figure 3.2 illustrates a case. Suppose private players that participate in bidding have two types of strengths: price competitiveness and non-price competitiveness. The pool of such private players is drawn as a convex set bounded by a frontier convex to the origin. On the other hand, levels of national welfare are depicted as community indifference curves. Now what would be the choice if we followed one of the standard two-step bidding procedures? In the first step, we impose the minimal technical standard and kick out low-quality bidders. In the second step, we choose the cheapest bidder. Then, we would choose B, which is obviously inferior to the optimal point A. The message here is that the bidding must follow multidimensional criteria rather than seemingly innocuous methods like the minimal technical checking and the lowest price.

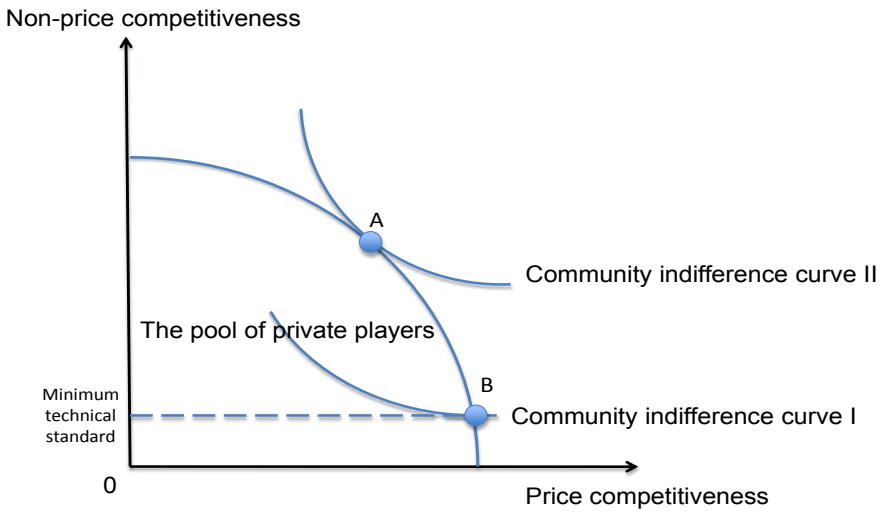
3-2-2. Construction

Timely construction is very important. A delay may seriously affect the profitability of projects. This must be emphasised because some government officials do not care much about interest rates.

A delay in construction occurs often due to difficulty in land acquisition and various legal procedures. Land acquisition is a difficult issue. Unfair displacement of residence is not acceptable, particularly in a democratic society. Yet, various forms of misuse of compensation schemes are observed in many countries. The establishment of a fair, transparent, and efficient procedure is necessary. On the other hand, legal procedures are

mostly what the government should take care of. Strong support of the government for the implementation is needed.

Figure 3.2. Competitive Bidding



Source: ERIA CADP research team.

3-2-3. Operation and maintenance

A project does not end until efficient operation and maintenance are stably provided. Maintenance is often completely neglected in the overall planning of infrastructure projects. For example, in road construction, maintenance costs are not typically included in the project budget; they must be covered by the annual government budget, which is often unstable over time. Although the maintenance cost is not huge, infrastructure does not work without it. One idea is to collect small amounts of toll fees from users. Thus, even if the whole construction cost may not be recovered, some money is at least secured for maintenance.

3-3. Macro Discipline for Development Partners

Infrastructure development has various stakeholders, and strengthening partnership among stakeholders is the key for successful projects. Stakeholders include central and local governments, public utility companies, consultants, constructors, private banks, other private companies, local residences, non-government organisations, foreign governments, foreign governmental financial institutions, international organisations,

foreign consultants and constructors, foreign private banks, other private companies, and others. Although perfectly reconciling all sorts of conflict over costs and benefits of various stakeholders is difficult, we should strengthen partnership among stakeholders as much as possible in a transparent way.

The launch of the Asian Infrastructure Investment Bank seems to work as a good stimulus for further activating our development efforts. It is good to see incumbent bilateral donors and international organisations start to review their lending practices and try to speed up and upgrade their activities. This is good competition. However, the problem is that communication among development partners looks thin.

It is important to strengthen partnership among development partners. To keep the fiscal sustainability of recipients, we need information on the amount and term conditions in detail for all sorts of foreign loans. We have to check whether the whole programme of development partners is consistent with each country's development strategy. We would like to watch whether the ownership of recipients on the programme is secured or not. Until now, some development partners do not fully disclose these types of information.

The establishment of the Asian Infrastructure Investment Bank and others is a good occasion for new partners to come into the international community. All kinds of bilateral donors and international organisations working as development partners in this region must disclose basic information on lending and other activities and conduct objective ex ante and ex post evaluations.

3-4. Micro Discipline on the Partnership between the Public and the Private Sectors

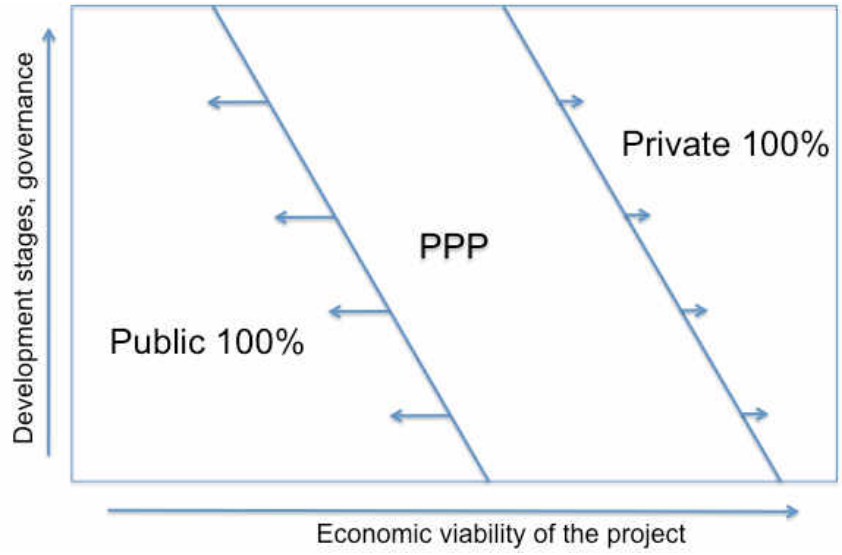
3-4-1. Public–private partnership

In the past several years, many ASEAN Member States made substantial progress in establishing institutional arrangements for public–private partnership (PPP) and in conducting the first bunch of PPP projects. PPP is not a panacea; it can, however, be a powerful tool to effectively and efficiently provide a certain type of infrastructure. ASEAN is now in a learning process to further utilise the mechanism. ERIA published in 2014 the

ASEAN Public–Private Partnership Guidelines (Zen and Regan, 2014) to promote this move.[7] An important breakthrough is establishing a perception that PPP is not just to save on government expenditure; rather, the government should initiate the creation of a market for the private sector.

There is potentially a huge room for PPP, and PPP is essential to some types of projects (Figure 3.3). Infrastructure was traditionally provided by 100 percent public projects. This type of arrangement is still needed for some economically unviable projects. On the other hand, some infrastructure can be provided by a 100 percent private scheme. When the projects are economically viable, we had better ask the private sector to take care of them with its creativity and efficiency. The difficult part lies in the middle. A lot of potential projects do not fall into either category: 100 percent public or 100 percent private. These projects may not be fully financially viable, though the economic and social return would be large because of positive externalities. Or some projects are too huge for the private sector to pool the risk effectively. In such cases, the public–private collaboration is essential. Thus, we should design the project scheme so that the public sector would take care of the financially unviable portion and a part of the risks including a policy risk while leaving the financially viable portion for the private sector with transparent and efficient competition. In this sense, governments must generate a market for the private sector.

Figure 3.3. Ample Room for Public–Private Partnership



Source: ERIA CADP research team.

[7] Farquharson, Torres de Mastle, and Yescombe (2011) and The World Bank and others (2014) are also useful references for PPP.

3-4-2. Possible policy discipline on public involvement in investment

Although the following is a complicated issue that cannot be solved immediately, we just want to point out the existence of potential problems. The issue is related to a possible asymmetry between investment liberalisation and involvement of the public sector.

Compared with international trade on which the World Trade Organization imposes a certain level of discipline, almost nothing is disciplined in the field of investment. In the past, there was at least a loose consensus that the government sector or governmental financial organisations should not jeopardise market competition among private companies in the arena of international investment, and activities such as export credit were placed under the loose discipline of the guidelines of the Organisation for Economic Co-operation and Development (OECD). The Official Development Assistance was under the umbrella of the Development Assistance Committee of the OECD so that a certain discipline, though not fully consistent with economics, was imposed. However, in the past one or two decades, globalisation was advanced and new players in the investment area came in; these included state-owned enterprises, sovereign wealth funds, and investors/aid donors from non-OECD countries such as China. In addition, the Global Financial Crisis loosened the discipline of public involvement in the market even in developed countries. Governments helped private companies such as General Motors and Japan Airlines get out of bad performance. Although such measures may be justifiable as temporary measures to avoid further macro shocks, it is certainly at the cost of partially giving up a discipline for the government to not intervene in private competition.

It is not at all easy to establish a new international rule on investment and government involvement. However, we at least have to realise that the current situation without any discipline on government involvement may not be ideal to maintain healthy and efficient market mechanisms in the future. In the case of international trade, the World Trade Organization bans export subsidy and allows countries to impose countervailing duties on domestically subsidised imports. While these may not be ideal, these at least try to remove distortions that government involvement may cause in the market. In the arena of foreign direct investment, state-owned enterprises in newly developed economies now extend active outward foreign direct investment. Foreign aid by some countries is

sometimes used to directly help private companies to invest. It is also a common practice that governmental financial institutions participate in a consortium with the private sector for a specific infrastructure project. While these do not always distort the market, at least these risk making the playing field uneven.

For a host country, the current situation may not necessarily be bad as far as it can freely select and control investors. However, once free trade agreements or other international treaties would impose the obligation of investment liberalisation and the non-discrimination principle, a host country may realise the necessity of some sort of discipline on possibly subsidised foreign investment.

One possible approach to constructing a new discipline is to go back to the basics of public economics where government policy may be justified only if it cancels out the original distortion due to market failure. Typical market failure occurs because of the existence of (i) scale economies, (ii) imperfect competition, (iii) positive or negative externalities, (iv) public goods, and (v) incomplete information and uncertainty. In economic development, the role of government is potentially large in cancelling out distortion due to the existence of scale economies, positive externalities, public goods, and incomplete information; these market failures are often salient in infrastructure development. However, when the market mechanism works, the government should not intervene.

This argument can apply to both domestic and foreign governments. Foreign aid and government-based financial institutions can also cancel out market distortions in some cases. When a project is economically meaningful but is not financially viable because of positive externalities or difficulty in private risk pooling, the involvement of these players is justified. However, if such a project directly benefited companies of the same nationality in market competition, it should not be allowed.

The issue is related to competition issues between state-owned enterprises and private companies. The status of state-owned enterprises, particularly in the interface with the market, is widely different across countries. However, in a general direction, we may want to strengthen discipline on state-owned enterprises to keep the market competitive and efficient. The negotiation over the Trans-Pacific Partnership seems to include competition issues with state-owned enterprises. We would like to see whether such an agreement could be a starting point to build up an international rule. In the case of foreign

direct investment by state-owned enterprises, as far as competition among private companies exists, in principle, we should impose some discipline to guarantee healthy competition. For example, the information disclosure of investing state-owned enterprises may be enforced to prove that the investment is not directly or indirectly subsidised.

If we have a chance to rewrite international policy discipline on government involvement in the market, we also had better review the justification of concessionality. Concessionality is the extent to which a soft loan reduces the return in terms of the amount or duration, compared with usual commercial loans. There was a loose discipline on concessionality by OECD's Development Assistance Committee (DAC) though new donors are not DAC members and thus do not follow it. Unless the aid is heading for basic human needs in very poor countries or under disastrous circumstances, concessionality should be limited to the extent of the commercially unviable portion of the project.

These are not easy issues to solve but would eventually be big agenda in our region. It is great to have various players coming into globalising economic activities. We may want to establish a fair and efficient market mechanism with disciplined involvement of governments in the future.

Chapter 4
The Assessment of Industrialisation and Urbanisation

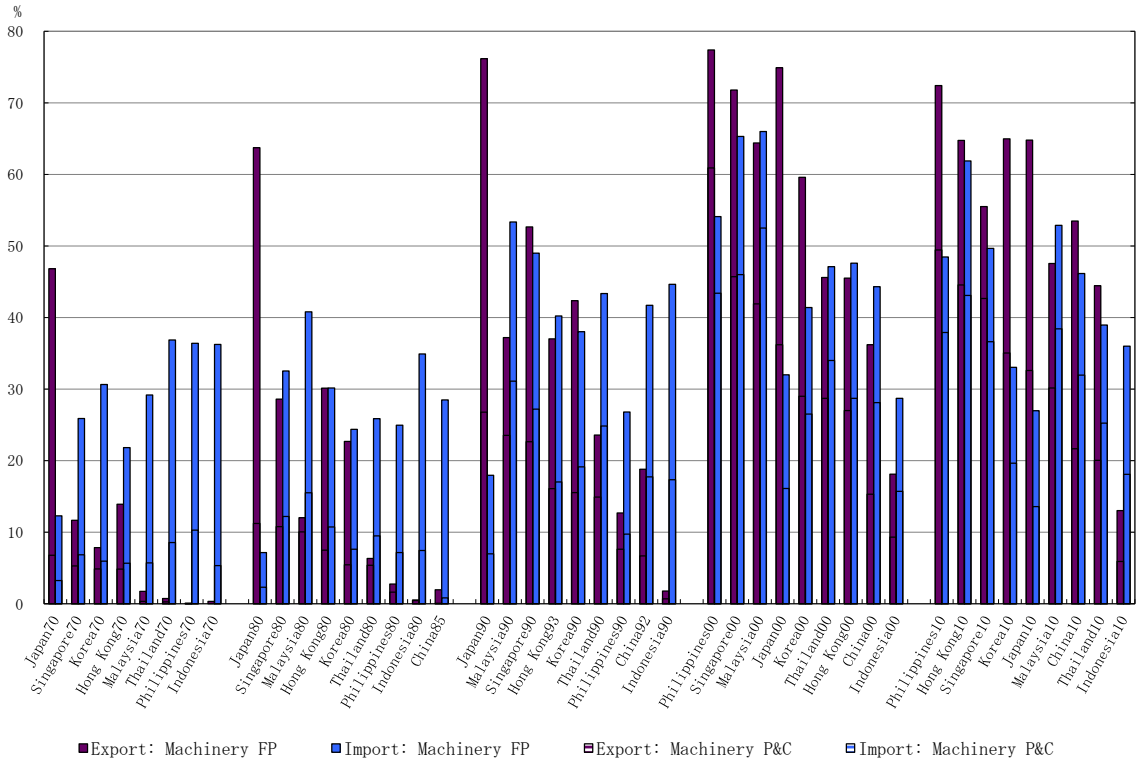
4-1. Positioning of ASEAN and East Asia in the Global Setting

ASEAN and East Asia have continuously led the development of international production networks, particularly in the machinery industries. Figure 4.1.1 presents shares of machinery trade, parts and components, as well as finished products, in total exports and imports in each country to show the evolution of machinery trade from 1970 to 2010. In 1970, most of machinery trade was for finished products, and Japan was the only net exporter in the region. In 1980, Singapore and Malaysia showed signs of export processing zone operations though export and import of machinery parts and components still had small shares. In 1990, we can see distinct changes from the first to the second unbundling. Malaysia and Singapore started both exporting and importing machinery parts and components in a massive manner. Hong Kong, Korea, and Thailand followed the similar transition. In 2000 and 2010, active production networks were developed with the Philippines and China added to the group of full-fledged second unbundling.

Figure 4.1.2 presents the total exports and imports of machinery parts and components and finished products in 1996 and 2011 by region. There are now three production centres of machinery industries in the world: East Asia that includes ASEAN+6, Europe, and North America. Among the three, East Asia is the largest. Indeed, particularly in electric machinery, East Asia exports parts and components to Europe and North America, indicating that production networks have extended to the whole world. On the other hand, the automobile industry tends to form agglomerations in each region or in a smaller area while international production networks support the formation of industrial agglomerations.[8]

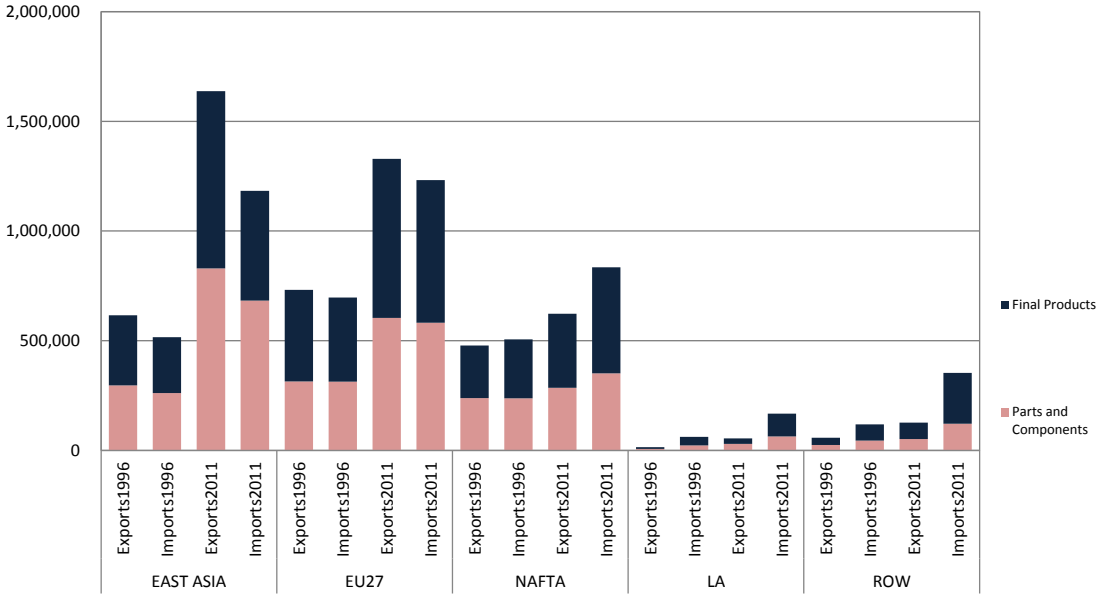
[8] Chang and Kimura (2015) provide the global picture of machinery production networks. Ando and Kimura (2013, 2014) conduct in-depth analyses on the relationship between Europe/North America and East Asia.

Figure 4.1.1. Shares of Machinery in the Total Exports/Imports to/from the World: 1970–2010



Note: The data for 1970 and 1980 and those after 1990 are based on SITC and HS commodity classification, respectively. Note that exports/imports of machinery parts and components based on SITC are understated by about one-fifth compared with those based on HS
Source: Kimura and Ando (forthcoming).

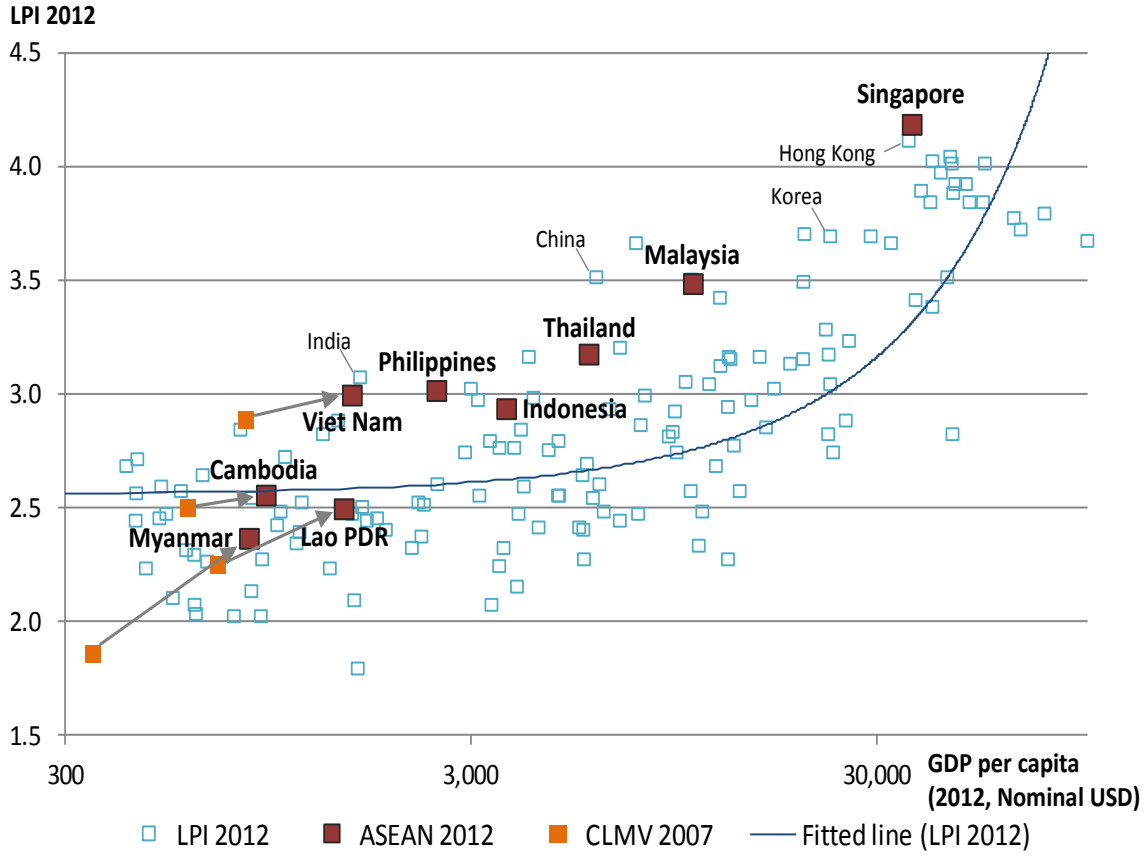
Figure 4.1.2. Machinery Exports and Imports by Region (US$ million)



Source: Chang and Kimura (2015).

East Asia's success in extending international production networks is at least partially due to the reduction in service link costs. The effort of economic integration as well as logistics infrastructure development obviously works well. Figure 4.1.3 plots the logistics performance index and GDP per capita for a number of countries in the world. Logistics performance in ASEAN and East Asian countries is relatively good compared with countries with similar per capita income though Cambodia, Lao PDR, and Myanmar are still at world average.

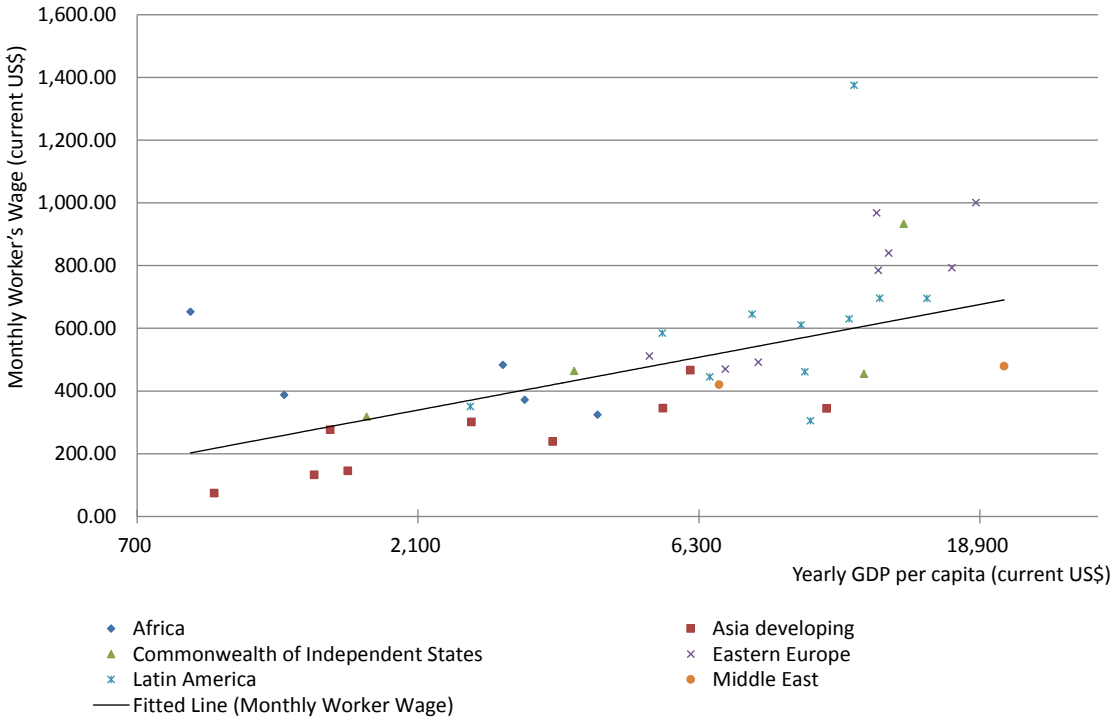
Figure 4.1.3. The Logistics Performance Index and GDP Per Capita



Note: LPI = logistics performance index, CLMV = Cambodia, Lao PDR, Myanmar, Viet Nam.
Source: ERIA (2010), updated. LPI is from the World Bank Website.

The competitiveness of the manufacturing sector is based on relatively smooth labour movements from the rural/agriculture/informal sector to the urban/manufacturing/formal sector. Figure 4.1.4 plots workers' wages in major cities and GDP per capita. Workers' wages are relatively low compared with countries in the rest of the world at similar income levels.

Figure 4.1.4. Monthly Worker's Wages and Yearly GDP Per Capita



Source: Chang and Kimura (2015). Data are from JETRO and the World Bank Database.

4-2. The Frontier of Production Networks

Let us assess in more detail the degree of participation of ASEAN Member States in international production networks in the recent period.

Figure 4.2.1 presents machinery shares in total exports/imports of manufactured goods to/from the world in 2007 and 2013 for East Asian countries and some other countries in Eastern Europe and Latin America. Different from Figure 4.1.1, we use manufactured goods exports and imports in the denominator in order to remove the influence of primary products trade. Countries are placed from the left in the order of the export shares of machinery parts and components.

Figure 4.2.1. Shares of Machinery in the Total Exports/Imports of Manufactured Goods to/from the World (2007)

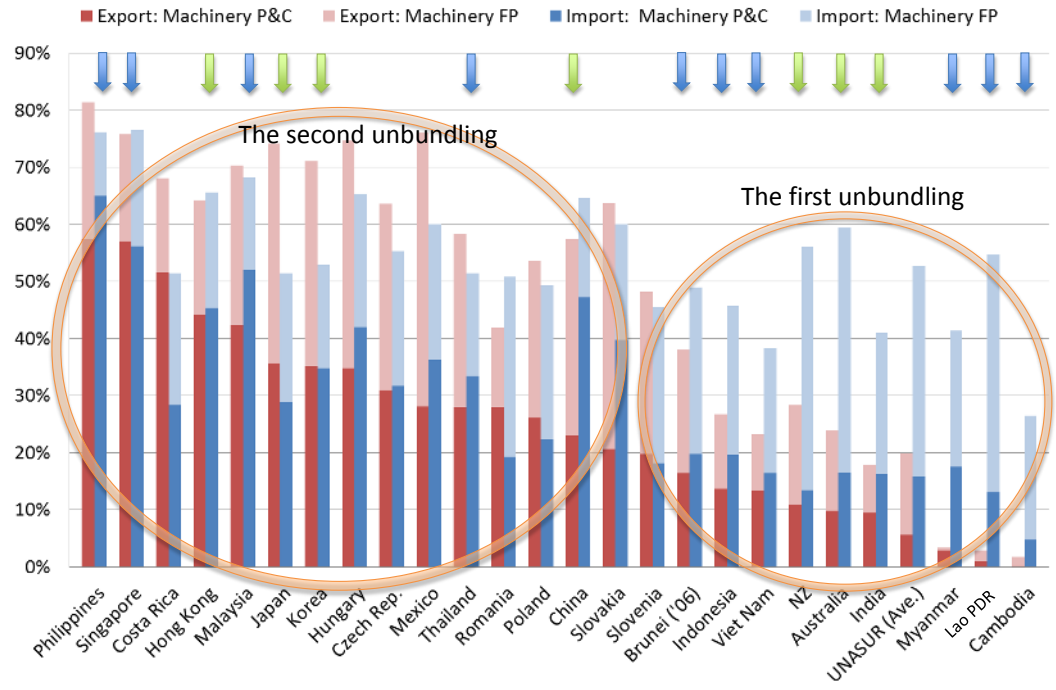
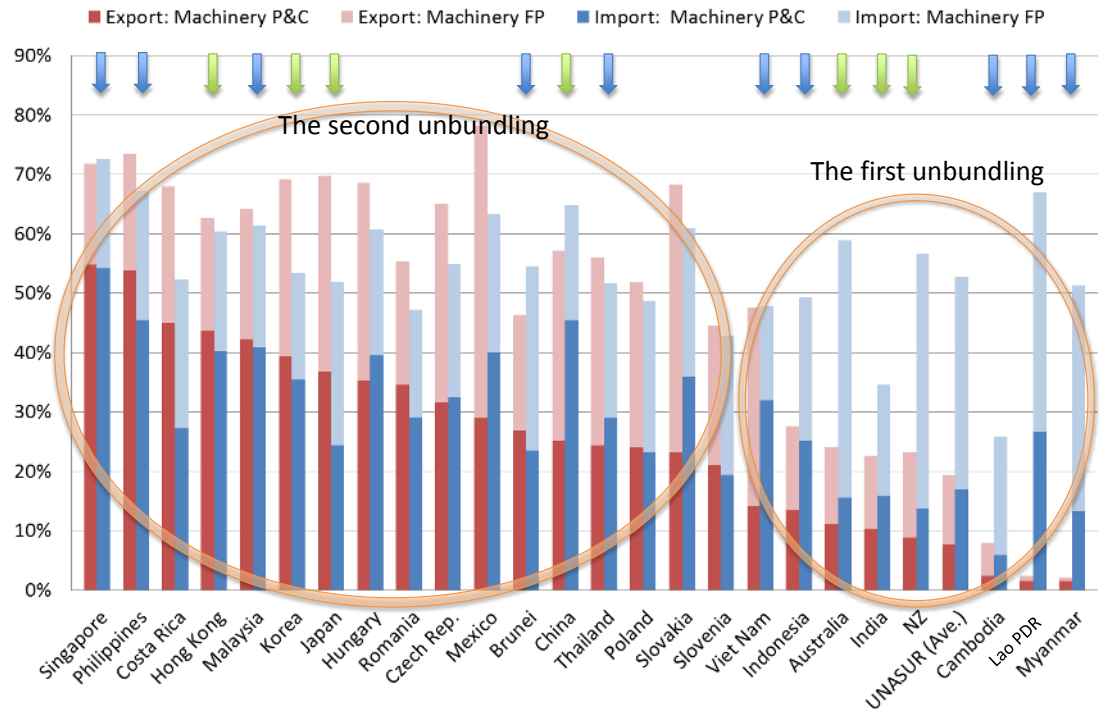


Figure 4.2.1. (*cont.*) Shares of Machinery in the Total Exports/Imports of Manufactured Goods to/from the World (2013)

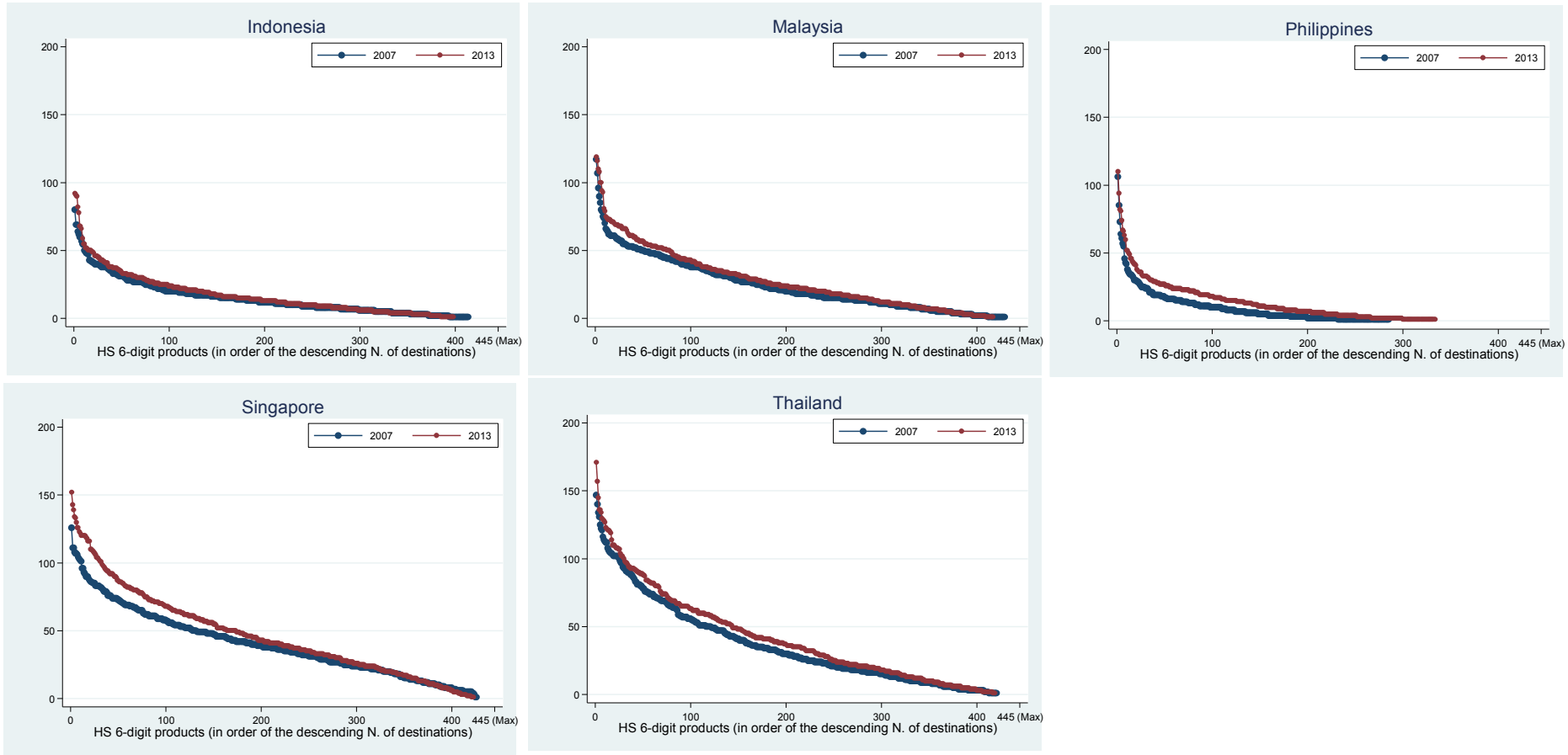


Source: Obashi and Kimura (2015).

The figure shows that Singapore, Malaysia, and the Philippines are continuously leading in fragmented production in ASEAN. Indonesia does not increase the parts and components share on the export side though its share on the import side goes up. Viet Nam has an increasing share of exports of machinery final products and an enhancing share of machinery parts and components imports. Cambodia seems to have started participating in production networks. Lao PDR expands parts and components imports. Overall, the latecomers seem to start coming into production networks though the degree of participation is still low in 2013.

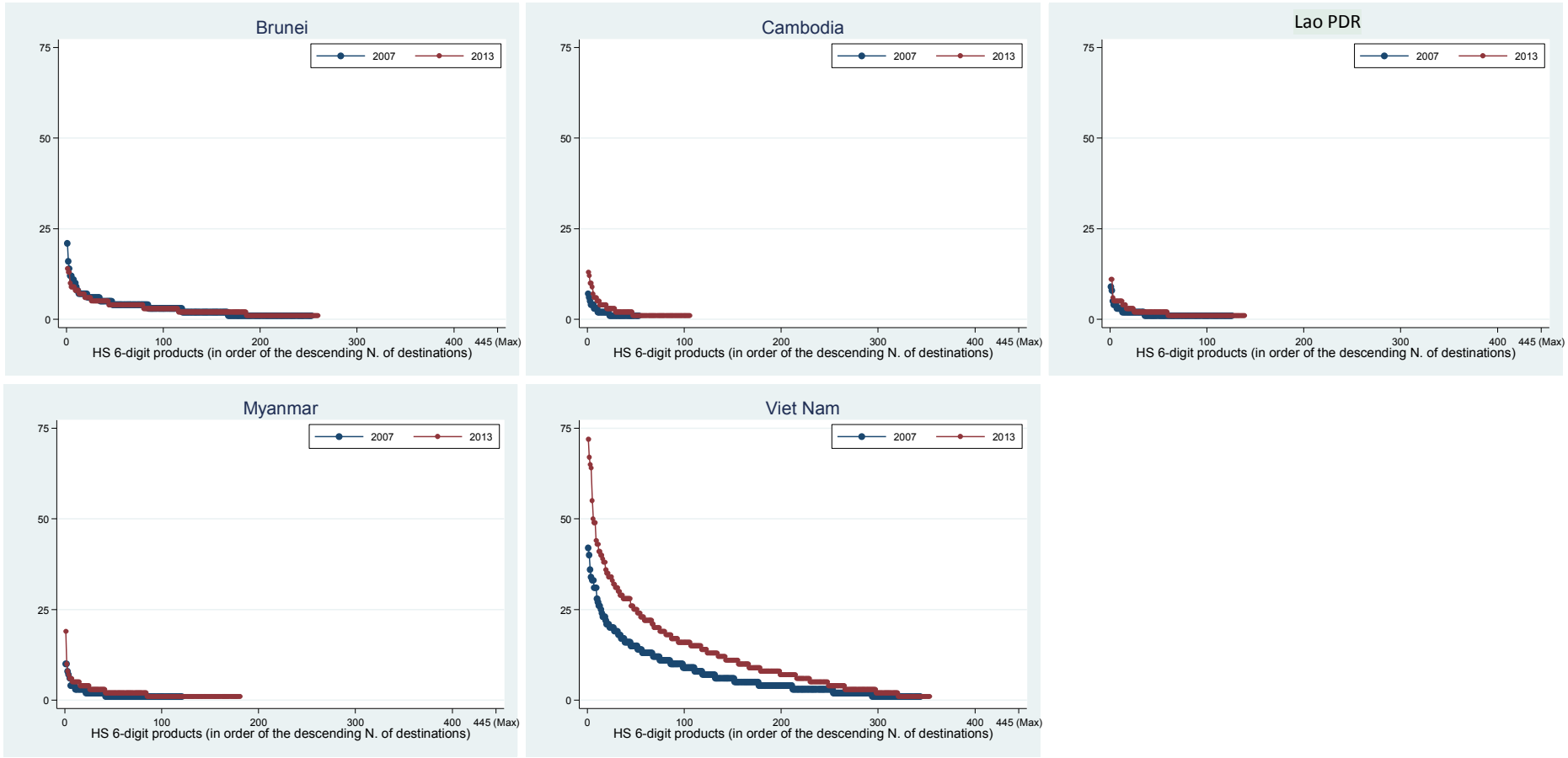
Figures 4.2.2 and 4.2.3 also assess the degree of participation in international production networks from a different angle. Here we check how many kinds of machinery parts and components are exported by each country, and to how many countries these are exported. The horizontal axis represents HS (Harmonized System) six-digit parts and components, the maximal number of which is 445. The vertical axis denotes the number of export destinations for each product. Products are in the order of the number of destinations. Figure 4.2.2 is for exports to countries all over the world while Figure 4.2.3 is for exports to East Asian countries, ASEAN+6 plus Hong Kong.

Figure 4.2.2. Number of Destination Countries in Export of Machinery Parts and Components to the World, by HS 6-digit product



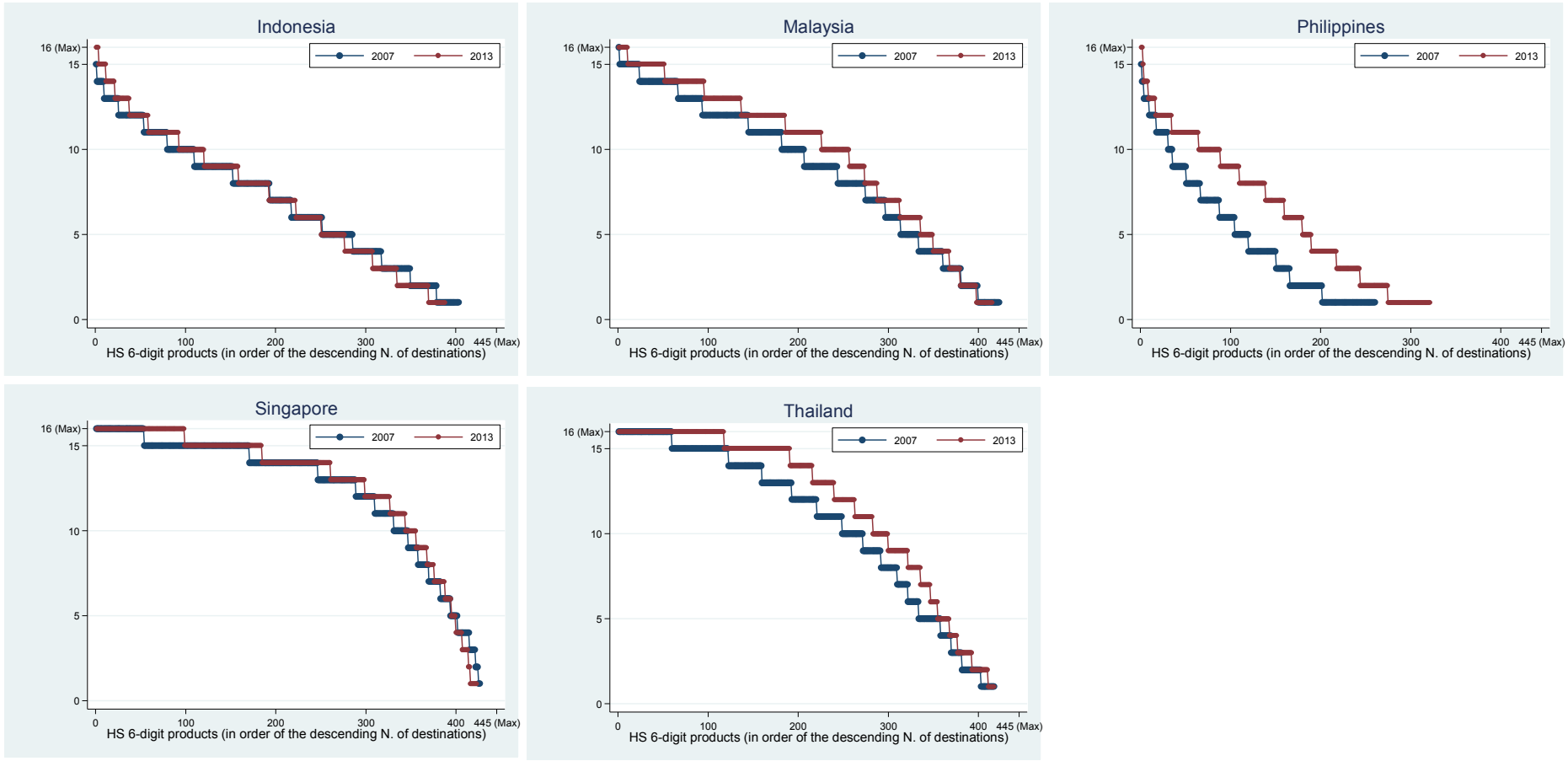
Source: Obashi and Kimura (2015).

Figure 4.2.2. (*cont*.) Number of Destination Countries in Export of Machinery Parts and Components to the World, by HS 6-digit product



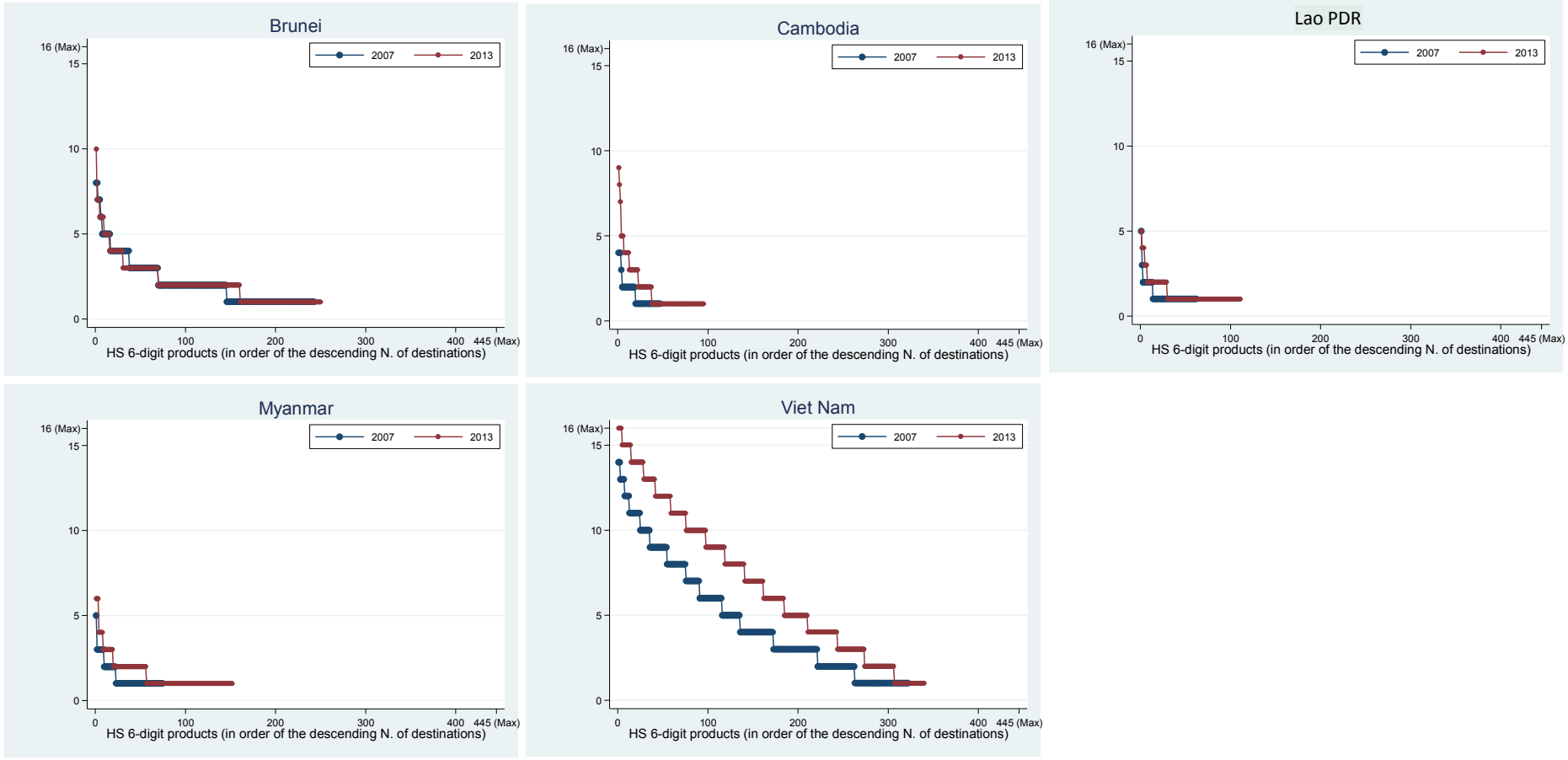
Source: Obashi and Kimura (2015).

Figure 4.2.3. Number of Destination Countries in Intra-East Asian Export of Machinery Parts and Components, by HS 6-digit product



Source: Obashi and Kimura (2015).

Figure 4.2.3. (*cont.*) Number of Destination Countries in Intra-East Asian Export of Machinery Parts and Components, by HS 6-digit product



Source: Obashi and Kimura (2015).

In Singapore, Malaysia, and Thailand, the number of exported products is almost saturated, close to the maximum. However, the number of export destinations still increased between 2007 and 2013, which means that production networks become more sophisticated. The Philippines is still notably behind but shows large expansion in both the number of exported products and the number of export destinations. Actually, the value of exports of these products by the Philippines disappointedly goes down while the involvement in production networks seems to be more sophisticated. Indonesia does not show much change.

Viet Nam quickly deepens its involvement in production networks in both the number of exported products and the number of export destinations, slightly surpassing the Philippines. Brunei Darussalam, Cambodia, Lao PDR, and Myanmar still have a long way to go, but the changes are drastic in percentage. They are quickly coming into production networks.

Overall, we can conclude that production networks in ASEAN steadily deepened and expanded in 2007–2013. In the coming years, the latecomers should make sure to expand their involvement in international production networks. For the forerunners, more sophistication in the way of participating in production networks will be the issue.

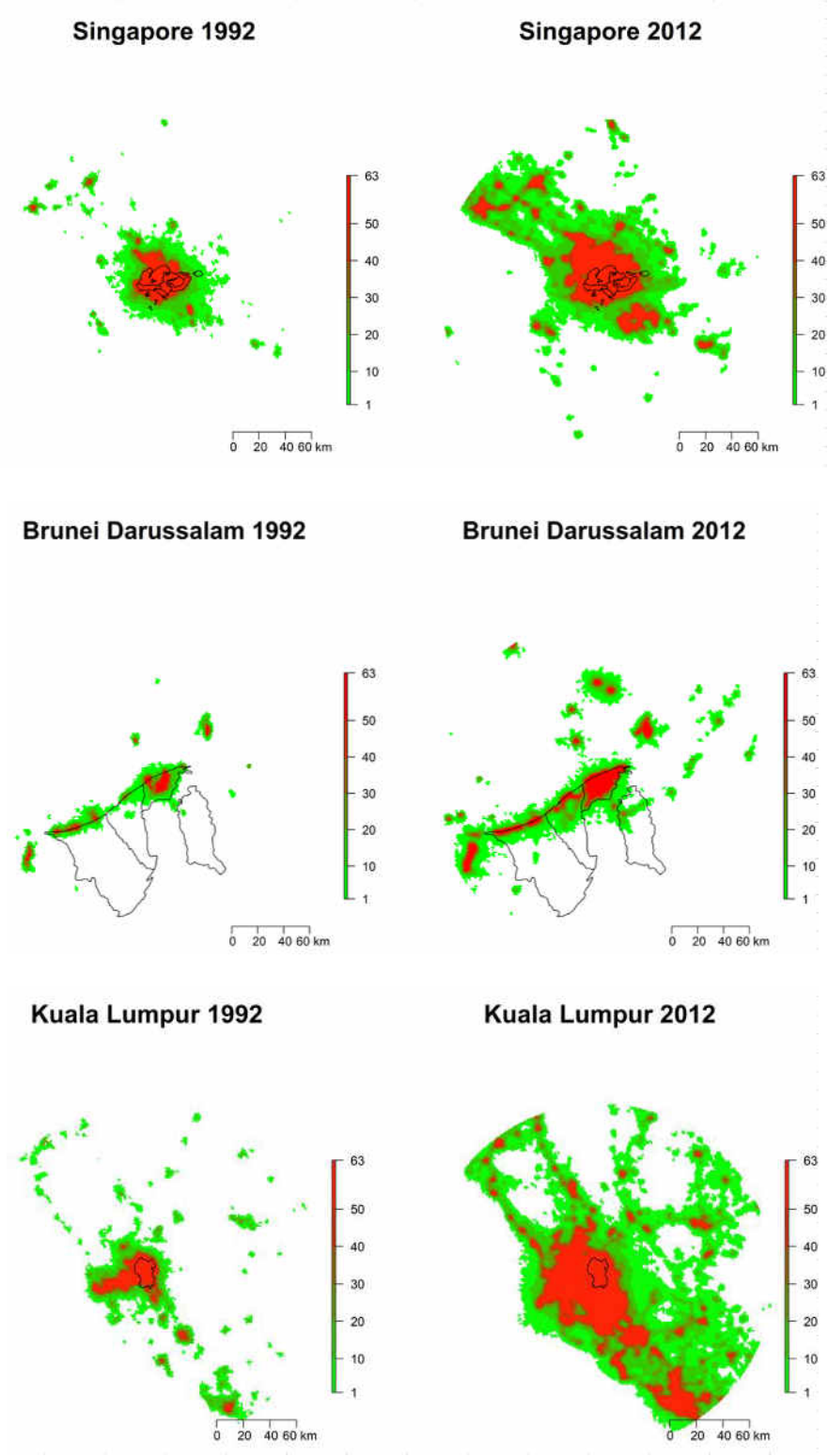
One update on policy research: ERIA and related researchers have extensively studied the durability and stability of production networks. A major conclusion is that despite any shock, economic crisis, or natural disaster, production networks consistently present robustness (Ando and Kimura, 2012; Okubo, Kimura, and Teshima, 2014). Production networks are less likely to be interrupted and more quickly to recover than other types of transactions. From the viewpoint of policymakers, the key is to contain a shock as temporary.

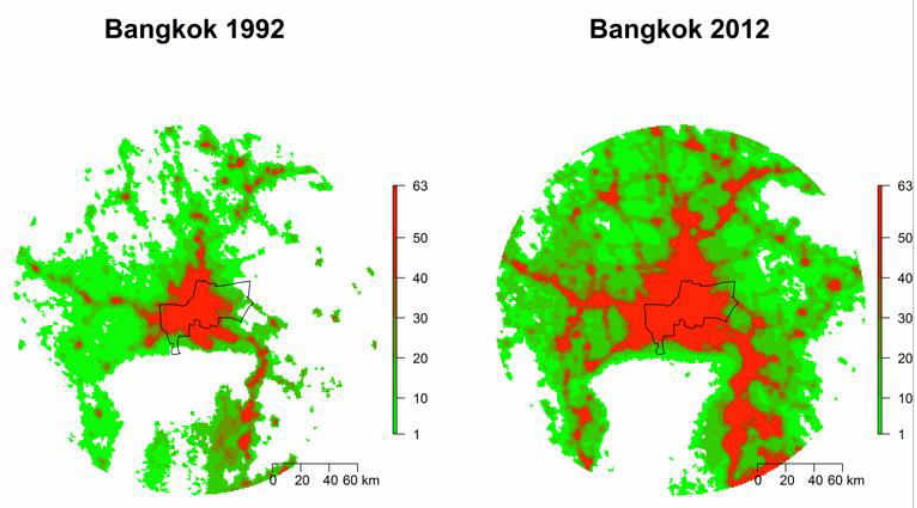
4-3. Size of Industrial Agglomerations

There is no established method to measure the size of industrial agglomerations. The following is still in an experimental stage, but we would like to share the possibility of a new empirical method that uses satellite pictures and maps night-time lights (Keola, Andersson, and Hall, 2015).

Figure 4.3.1 presents the strength of night-time lights in 12 cities in ASEAN10. Each map covers an area of 130 kilometres (km) diameter; the red and green areas stand for the strength of night-time lights in 63 grades. Black thin lines at the centre of each map show the city district except Singapore and Brunei Darussalam.

Figure 4.3.1. City Size with Night-time Light from Satellite




Bangkok 1992
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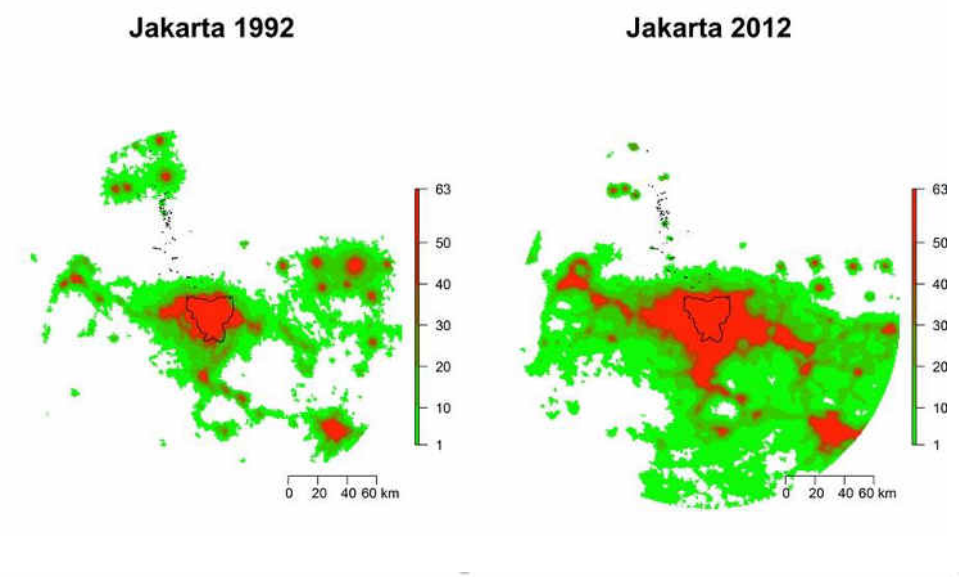
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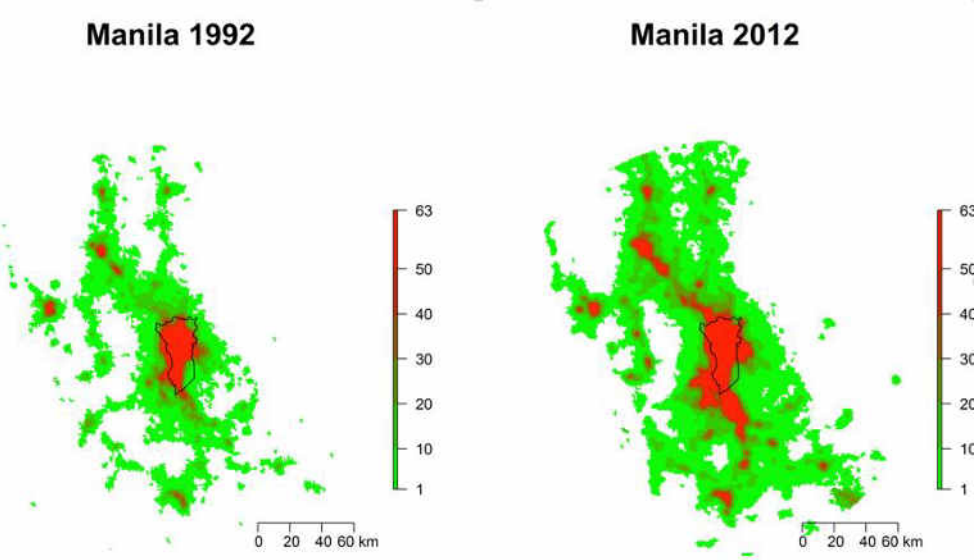
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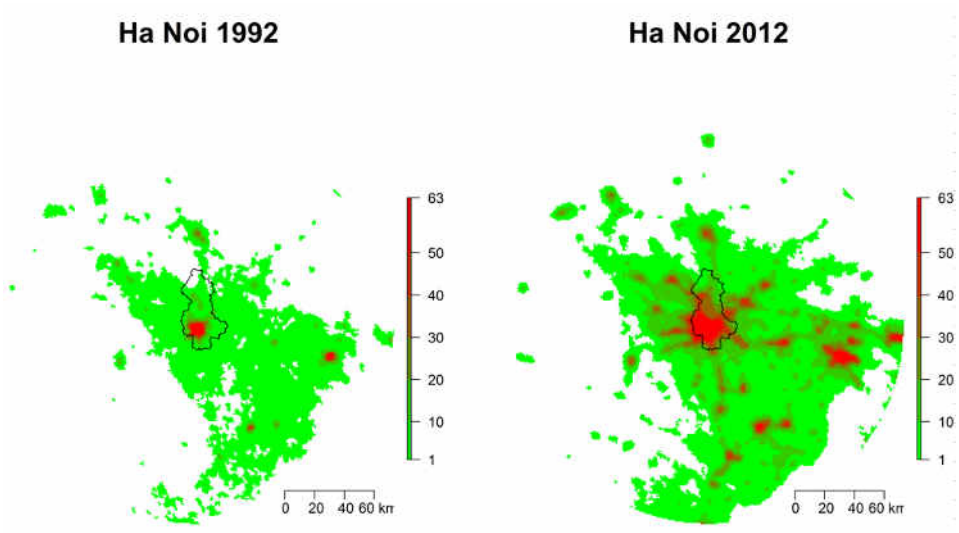
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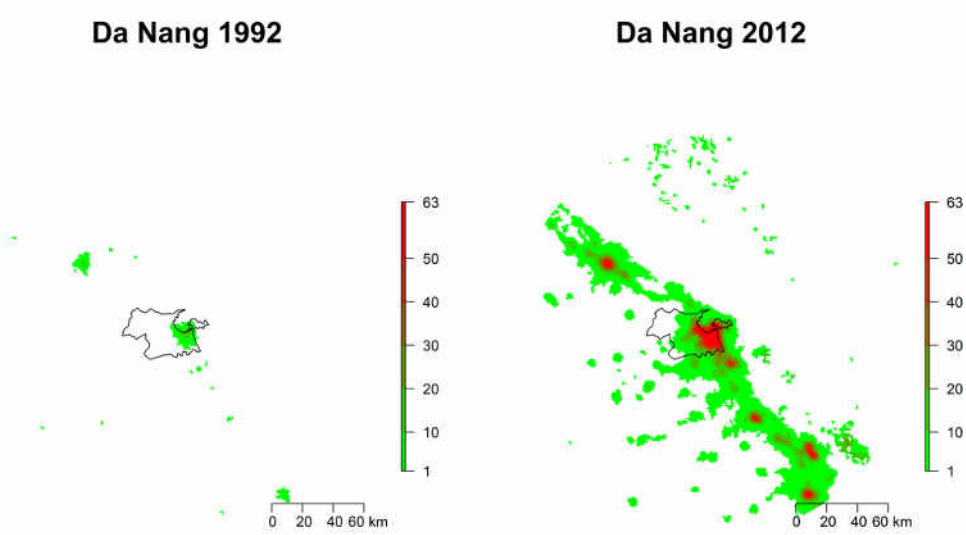
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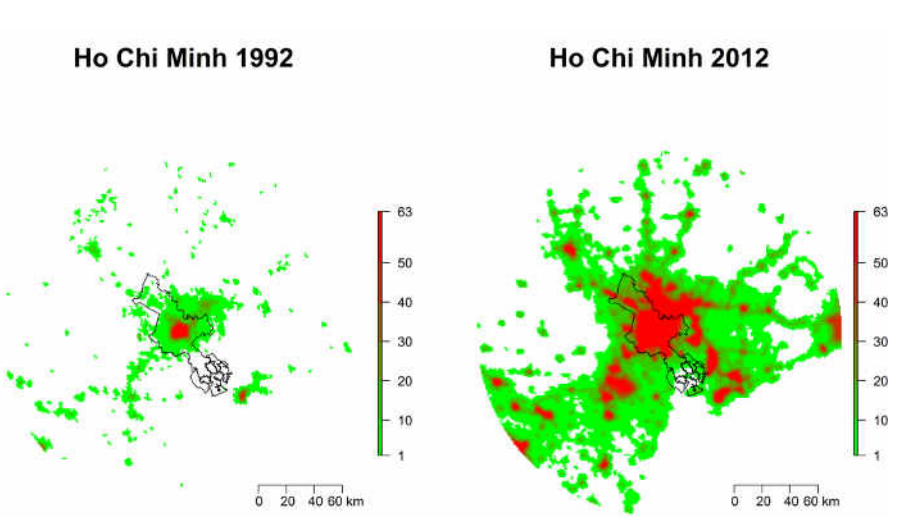
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Ho Chi Minh 2012
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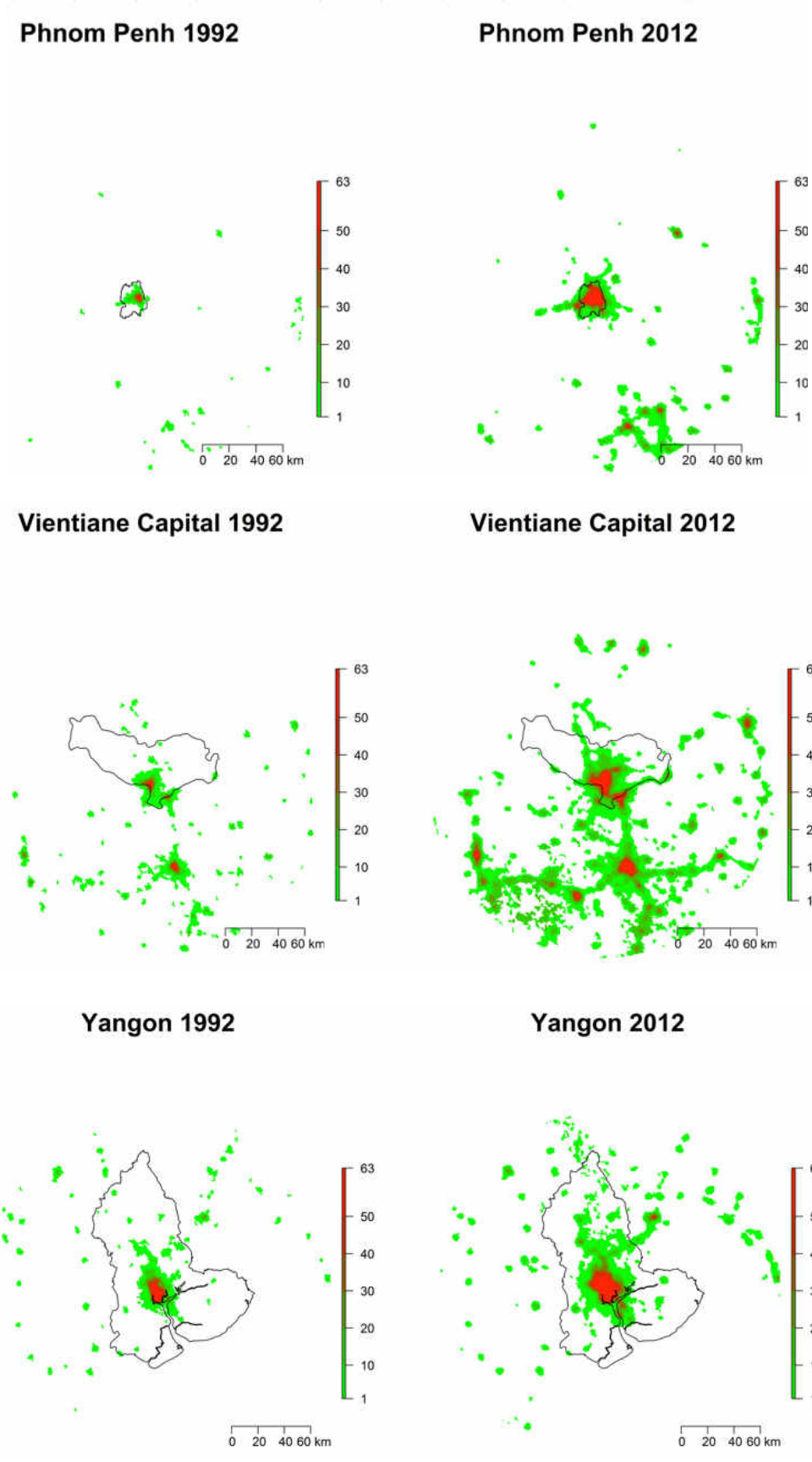


Source: ERIA-IDE Team.

The strength of night-time lights depends on many factors but loosely corresponds to the level of economic activities and population density. Although we obviously need to develop parameters to draw some meaningful economic indicators from these maps, we can at least grasp the size of urban/suburban area and industrial agglomeration.

Major findings from these maps are as follows: first, industrial agglomerations grew fast in all ASEAN cities in 1992–2012. Not only was the intensity of lights in the middle of the city enhanced, but the lights also spread widely. This suggests the importance of spatial planning way ahead of actual sprawl.

Second, full-size industrial agglomerations such as Bangkok, Jakarta, and Manila also grow fast though the spatial patterns are quite different. The economic activities in the Bangkok Metropolitan Area are widespread while those in Jakarta and Manila are condensed in narrow areas. To form efficient industrial agglomerations, the spatial planning for the whole metropolitan area is crucial in order to enlarge positive agglomeration effects and limit congestion such as wage increases, land price hike, traffic congestion, and pollution problems. Ho Chi Minh City, Ha Noi, and Yangon also seem to require proper spatial planning at an early timing.

4-4. Prospects for Full- and Medium-sized Industrial Agglomerations

Another way to identify industrial agglomerations in the future is to look at population size. Of course, population size will depend on the extent of agglomeration growth. However, it is still useful to watch the projection of population size to see what sort of role each urban agglomeration may play in the national and regional economies.

Table 4.4.1 lists urban agglomerations with 500,000 inhabitants or more in 2030. It sorts the urban agglomerations by each country in the descending order of inhabitants in 2015 (see also Figure 4.4.1). Although the definition of city or urban agglomeration may differ across countries, we can get a rough idea on the potential of each urban agglomeration.

Table 4.4.1. Forecasted Population Size of Urban Agglomeration in ASEAN (thousands)

Country	Urban Agglomeration	2015	2030
Cambodia	Phnom Penh	1,731	2,584
Indonesia	Jakarta	10,323	13,812
	Surabaya	2,853	3,760
	Bandung	2,544	3,433
	Medan	2,204	2,955
	Semarang	1,630	2,188
	Makassar	1,489	2,104
	Palembang	1,455	1,888
	Batam	1,391	2,486
	Pekan Baru	1,121	1,731
	Denpasar	1,107	1,870
	Bogor	1,076	1,541
	Bandar Lampung	965	1,350
	Padang	903	1,254
	Samarinda	865	1,291
	Malang	856	1,156
	Tasikmalaya	787	1,305
	Banjarmasin	682	955
	Balikpapan	655	973
	Jambi	604	874
	Pontianak	603	844
	Surakarta	504	668
	Mataram	457	662
	Manado	426	579
	Ambon	425	679
	Yogyakarta	385	503
Lao PDR	Vientiane	997	1,782
Malaysia	Kuala Lumpur	6,837	9,423
	Johor Bahru	912	1,249
	Ipoh	737	998
	Kuching	560	755
	Kota Kinabalu	478	673
	Kuantan	440	617
	Seremban	422	585

Country	Urban Agglomeration	2015	2030
Myanmar	Yangon	4,802	6,578
	Mandalay	1,167	1,654
	Nay Pyi Taw	1,030	1,398
	Bago	518	783
	Mawlamyine	487	698
	Monywa	478	748
Philippines	Manila	12,946	16,756
	Davao City	1,630	2,216
	Cebu City	951	1,278
	Zamboanga City	936	1,313
	Cagayan de Oro City	688	958
	General Santos City	616	859
	Bacolod	559	753
	Iloilo City	457	611
	Lapu-Lapu City	447	681
	Basilan City	424	570
	Mandaue City	374	521
	Cotabato	351	543
Singapore	Singapore	5,619	6,578
Thailand	Bangkok	9,270	11,528
	Samut Prakan	1,814	3,139
	Udon Thani	526	772
	Chon Buri	518	796
	Nonthaburi	409	526
	Lampang	382	576
	Nakhon Ratchasima	368	505
	Rayong	332	527
Viet Nam	Ho Chi Minh City	7,298	10,200
	Ha Noi	3,629	5,498
	Can Tho	1,175	1,902
	Hai Phong	1,075	1,569
	Da Nang	952	1,365
	Bien Hoa	834	1,225
	Vungtau	351	512

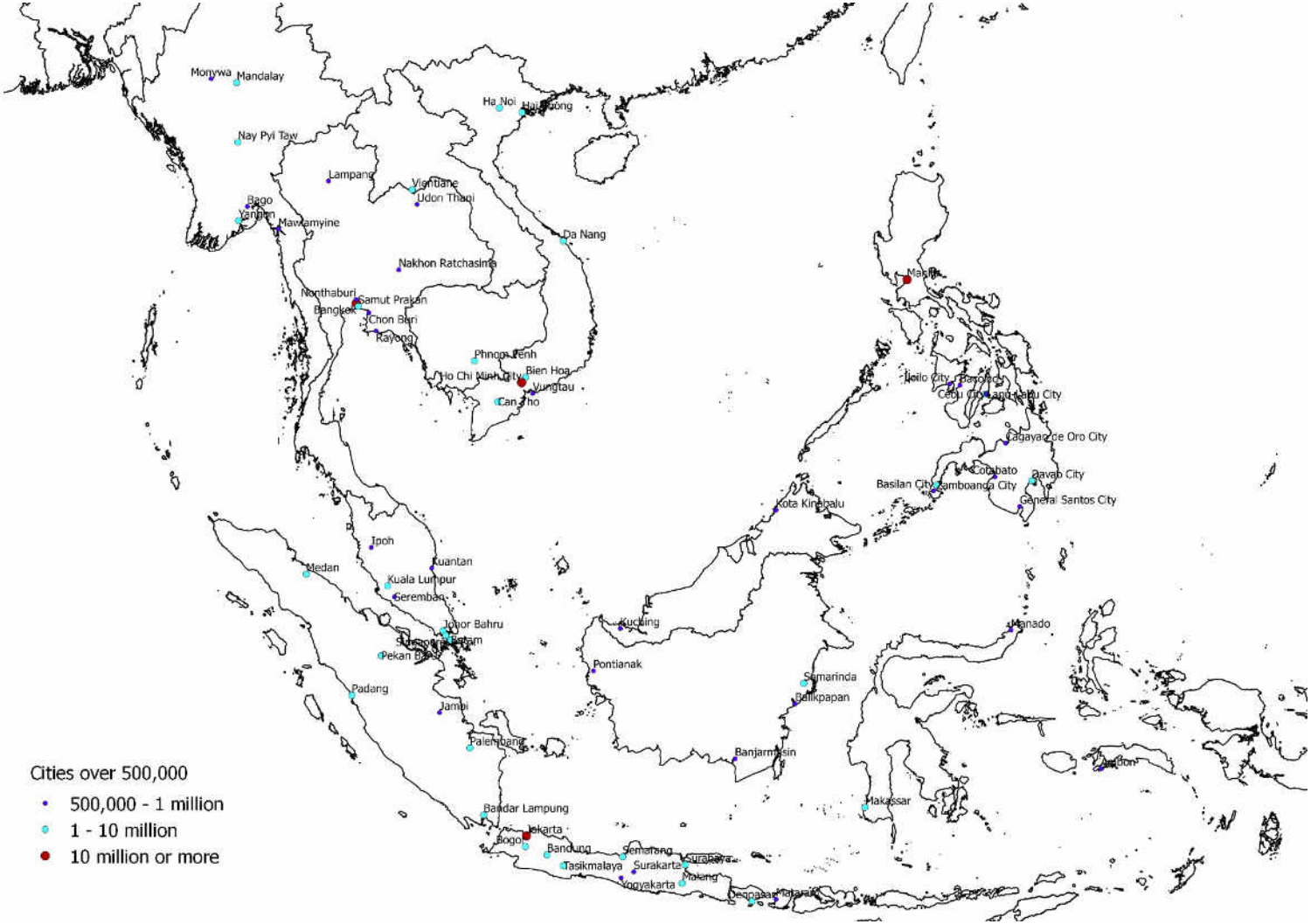
Source: United Nations (2015).

Urban agglomerations that will have more than 5 million people should be full-sized industrial agglomerations, classified as Tier 1. Such places will be, in the order of population size in 2030, Manila, Jakarta, Bangkok, Ho Chi Minh City, Kuala Lumpur, Singapore, Yangon, and Ha Noi.

The potential for middle-sized industrial agglomeration is found in cities with a population of 1 million or more in 2030. However, some of them seem to have peculiar characteristics. Let us look at these cities in more detail.

The table illustrates two types of the fast-growing urban agglomerations that will move up the ranking. The first agglomeration type is industrial districts near large urban areas such as Batam in Indonesia, Monywa in Myanmar, Chon Buri and Rayong in Thailand, and Vungtau in Viet Nam. These fast-growing urban agglomerations will attract industrial activities that need to avoid congestion in large urban areas. The second type is large cities in island countries with a steady population growth, such as Indonesia and the Philippines.

Figure 4.4.1. ASEAN Urban Agglomerations with 500,000 Inhabitants or More in 2030



Source: Data from World Urbanization Prospects, the 2014 revision, United Nations.
http://esa.un.org/unpd/wup/

Among the first type of fast-growing industrial districts is Batam in Indonesia, an island located about 20 km south of Singapore. Indonesia and Singapore have been developing Batam as a manufacturing base to host manufacturing activities relocating from Singapore. Similarly to Batam, Johor Bahru in Malaysia has a well-developed connectivity with Singapore through the Johor–Singapore causeway and will grow to have more than 1 million inhabitants in 2030. The present congestion in Singapore will stimulate the development of Singapore-centred subregional economic area in 2030.

Monywa in Myanmar is about 135 km away from Mandalay, the second largest city in Myanmar, and operates an industrial zone. Monywa is the capital of Sagaing Region and is situated on the Tamu–Mandalay (Indian Myanmar border) trade route. The urban agglomeration has potential to develop the border trade, domestic market for Sagaing and Chin State, and mining industry. Bago is another notable urban agglomeration that will expand as fast as Monywa. This urban agglomeration is located about 80 km away from Yangon, sitting on the highway road that connects Yangon, Nay Pyi Taw, and Mandalay. Bago is also a transport junction with the East–West Economic Corridor linking Yangon with Mawlamyine, Myawaddy in Myanmar, and other urban agglomerations in the Greater Mekong Subregion (GMS). Bago will expand its economic activities as an industrial zone due to its locational advantage and a new international airport project. As Kudo, Kumagai, and Umezaki (2013) discuss, two growth poles—Yangon and Mandalay––and their surrounding areas will lead Myanmar's economic growth.

Chon Buri and Rayong in Thailand are two main provinces in the Eastern Seaboard that agglomerate the automobile and petrochemical industries, respectively. The Eastern Seaboard has been developed with Japan's official development assistance for constructing infrastructure, including Laem Chabang Port in Chon Buri Province, to host Japanese and other foreign direct investment). Thai developers of industrial estates provide not only fundamental facilities for manufacturing—such as industrial land, utilities, and factories for rent—but also other facilities for accommodation, education, shopping, entertainment, recreation, and healthcare. Such improvement in urban amenities will attract more foreign direct investments and talents to these urban agglomerations outside Bangkok.

Vungtau in Ba Ria Vungtau Province of Viet Nam has been developing a new deep-water port, Cai Mep–Thi Vai Port, to relocate container transportation from the Saigon

port. The rapid urbanisation in Ho Chi Minh City generates dispersion forces, which promote industrial development in its surrounding areas including Bien Hoa in Dong Nai Province that is expected to have more than 1 million habitants in 2030. Bien Hoa is a transport junction that sits on National Route No. 1 connecting Ho Chi Minh City with Ha Noi and National Route No. 51 connecting Bien Hoa with Cai Mep–Thi Vai Port. Currently several industrial parks are operated in Bien Hoa, such as Bien Hoa Industrial Zone and Loteco Industrial Zone, and in Ba Ria Vungtau Province, such as My Xuan Industrial Park and Phu My Industrial Zone. The Japan International Cooperation Agency studies the construction of the new international airport, Long Thanh International Airport, in Dong Nai Province under a public–private partnership (PPP) programme and also plans to provide an official development assistance for an expressway between Bien Hoa and Vungtau.

The urbanisation prospects indicate the importance of urban planning and connectivity improvements for sustainable development in all tiers and narrowing development gaps, particularly between Tiers 1 and 2. The governments of ASEAN Member States need to mitigate congestion in major urban areas by developing public transportation services and ring roads on the one hand while constructing new roads to have better links between the urban areas and existing and potential industrial districts on the other.

4-5. Creating an Innovation Hub

Urban areas are large spaces that provide favourable environments to promote innovation. Large cities can accommodate a huge variety of skilled labour with specialised knowledge. The spatial concentration of diversified people and industries with specialised skills and knowledge and geographic proximities among them facilitate people-to-people and business-to-business knowledge flow. Interactions among such people and business in cities help them learn from others, obtain new ideas, and initiate innovations (Glaeser, Kallal, Scheinkman and Shleifer, 1992).

Innovation regularly occurs in cities. This is because talents, firms, and capitals attract each other, and consequently move to the areas where they are abundant. Therefore, developing countries, especially upper middle–income countries, need to

assess the strengths and weaknesses of their major cities and formulate appropriate plans to develop urban areas that can attract these scarce resources.

The Global Power City Index measures the comprehensive power of the world's major cities including those in ASEAN Member States such as Malaysia (Kuala Lumpur), Singapore, Thailand (Bangkok), and other East Asian countries such as Australia (Sydney), China (Beijing, Shanghai), India (Mumbai), Japan (Fukuoka, Osaka, Tokyo), and South Korea (Seoul). The index ranks 40 cities according to six main functions representing city strength (Economy, Research and Development [R&D], Cultural Interaction, Liveability, Environment, and Accessibility[8]) and based on the viewpoints of four global actors (Manager, Researcher, Artist, and Visitor) and one local actor (Resident) (MMF, 2014, p.1).

Table 4.5.1 shows Tokyo, Singapore, and Seoul rank in the top six, while two mega cities in China—Beijing and Shanghai—are ranked 14th and 15th, respectively, in 2014. On the other hand, two cities in upper middle–income ASEAN Member States, Bangkok and Kuala Lumpur, are ranked only 29th and 34th, and Mumbai ranked second to the last, 39th of 40 cities.

The ranking according to the functions demonstrates the strengths and weaknesses of each city. Tokyo ranks high in Economy (1st) and R&D (2nd) whereas its ranking based on Liveability (17th) is approximately median. Singapore has advantages in the functions of Cultural Interaction (4th) and Environment (5th) while its Liveability is ranked 37th, reflecting high living costs. It is worth mentioning that the ranking of Singapore's R&D function is the 8th highest among many of the large cities in East Asia and Southeast Asia, and is competitive with large cities in Europe.

Bangkok's strengths lie in Accessibility (12th) and Cultural Interaction (16th) whereas its weakness lies in R&D (34th). Kuala Lumpur has its strength in Liveability (22th) but is ranked low for all the other functions. Kuala Lumpur's weaknesses lie especially in R&D (35th) and Cultural Interaction (35th). Both Bangkok and Kuala Lumpur are far behind Beijing and Shanghai in R&D.

[8] The index measures the functions of (1) Economy with indicator groups of market size, market attractiveness, economic vitality, human capital, business environment, and regulations and risks; (2) R&D with indicator groups of academic resources, research background, and research achievement; (3) indicator groups of Cultural Interaction with trendsetting potential, cultural resources, facilities for visitors, attractiveness to visitors, and volume of interaction; (4) Liveability with indicator groups of working environment, cost of living, security and safety, living environment, and living facilities; (5) Environment with indicator groups of ecology, pollution, and natural environment; and (6) Accessibility with indicator groups of international transportation network, international transportation infrastructure, inner-city transportation services, and traffic convenience.

Table 4.5.1. Function-Specific City Ranking

City	Total Score	Economy	R&D	Cultural Interaction	Livability	Environment	Accessibility
London	1	4	3	1	21	7	1
New York	2	2	1	2	29	25	7
Paris	3	12	7	3	1	16	2
Tokyo	**4**	**1**	**2**	**6**	**17**	**9**	**10**
Singapore	**5**	**6**	**8**	**4**	**37**	**5**	**8**
Seoul	**6**	**11**	**6**	**12**	**23**	**11**	**5**
Amsterdam	7	18	23	15	8	13	3
Berlin	8	19	16	5	3	10	17
Hong Kong	9	5	12	26	34	19	6
Vienna	10	27	25	8	4	6	20
Frankfurt	11	20	28	31	16	4	4
Zurich	12	8	22	34	7	3	23
Sydney	**13**	**9**	**14**	**10**	**27**	**14**	**28**
Beijing	**14**	**3**	**21**	**7**	**24**	**40**	**27**
Shanghai	**15**	**7**	**15**	**19**	**19**	**37**	**11**
Stockholm	16	15	20	27	10	2	30
Toronto	17	10	17	24	14	26	22
Copenhagen	18	17	31	29	13	8	21
Madrid	19	35	32	17	11	12	14
Los Angeles	20	30	4	11	35	20	36
Istanbul	21	21	30	9	26	35	9
Vancouver	22	14	24	32	2	23	32
Brussels	23	28	29	13	20	32	15
Washington, DC	24	13	13	23	30	17	33
Milan	25	37	36	22	9	18	13
Osaka	**26**	**22**	**11**	**30**	**12**	**30**	**29**
Barcelona	27	38	33	14	5	31	16
Geneva	28	16	27	38	6	1	39
Bangkok	**29**	**32**	**34**	**16**	**28**	**21**	**12**
Boston	30	26	5	28	38	27	26
Chicago	31	29	9	21	33	33	24
San Francisco	32	24	10	25	36	24	31
Taiwan	33	23	18	39	18	28	19
Kuala Lumpur	**34**	**25**	**35**	**35**	**22**	**29**	**25**
Moscow	35	31	19	18	40	38	18
Fukuoka	**36**	**34**	**26**	**40**	**15**	**22**	**37**
Mexico City	37	36	38	20	31	36	35
Sao Paulo	38	33	37	33	32	15	40
Mumbai	**39**	**39**	**39**	**37**	**25**	**34**	**38**
Cairo	40	40	40	36	39	39	34

Source: Mori Memorial Foundation (2014), 'Global Power City Index 2014'.

The actor-specific city ranking also shows that Singapore, Kuala Lumpur, and cities in China have a higher Manager ranking but lower Resident ranking (Table 4.5.2). Among the cities of ASEAN Member States, Singapore (39th) is lower than Kuala Lumpur (33th) and Bangkok (24th) in the Artist ranking. On the other hand, Singapore is 9th in the Researcher ranking, whereas Bangkok and Kuala Lumpur are at 35th and 37th, respectively.

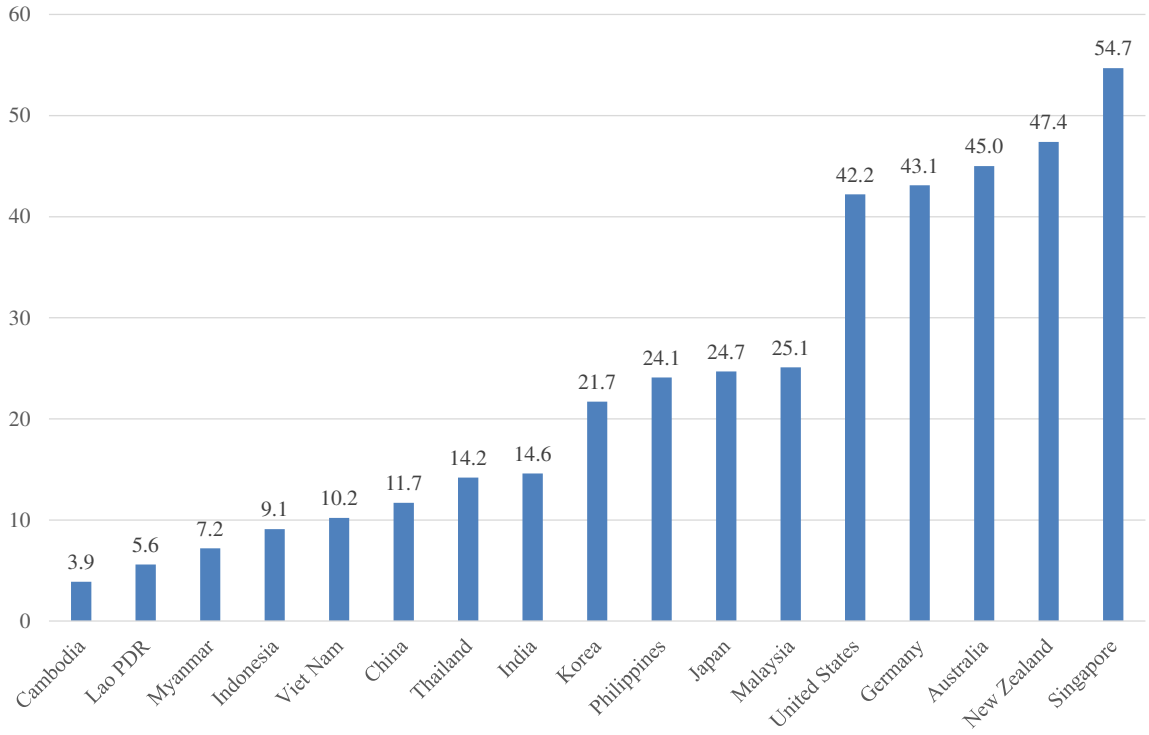
Table 4.5.2. Actor-Specific City Ranking 2014

City	Manager	Researcher	Artist	Visitor	Resident
London	1	3	2	1	2
New York	6	1	3	2	3
Paris	8	4	1	3	1
Tokyo	**9**	**2**	**8**	**6**	**5**
Singapore	**2**	**9**	**39**	**9**	**29**
Seoul	**11**	**7**	**35**	**15**	**18**
Amsterdam	14	23	6	13	11
Berlin	16	15	4	10	6
Hong Kong	3	16	40	16	20
Vienna	19	20	5	12	8
Frankfurt	23	26	19	20	7
Zurich	17	18	34	26	4
Sydney	**20**	**12**	**26**	**21**	**23**
Beijing	**4**	**14**	**10**	**7**	**25**
Shanghai	**5**	**29**	**17**	**5**	**27**
Stockholm	15	19	21	32	10
Toronto	10	22	18	17	21
Copenhagen	21	25	20	31	15
Madrid	29	31	11	14	16
Los Angeles	35	5	7	35	31
Istanbul	7	32	23	4	36
Vancouver	12	17	16	22	13
Brussels	26	33	22	18	26
Washington, DC	27	10	12	24	9
Milan	31	27	13	19	12
Osaka	**28**	**13**	**25**	**23**	**19**
Barcelona	30	36	9	8	24
Geneva	22	24	38	39	14
Bangkok	**25**	**35**	**24**	**11**	**35**
Boston	24	6	36	28	17
Chicago	32	11	15	27	32
San Francisco	34	8	30	30	22
Taiwan	18	30	37	29	30
Kuala Lumpur	**13**	**37**	**33**	**34**	**38**
Moscow	38	21	32	36	33
Fukuoka	**33**	**28**	**29**	**37**	**28**
Mexico City	39	34	14	25	34
Sao Paulo	37	38	27	40	37
Mumbai	**36**	**39**	**31**	**38**	**39**
Cairo	40	40	28	33	40

Source: Mori Memorial Foundation (2014), 'Global Power City Index 2014'.

Overall, the Global Power City Index indicates that Tier 1 capital regions in ASEAN Member States, Bangkok and Kuala Lumpur, lack R&D resources. Figure 4.5.1 shows that even large manufacturing bases such as Thailand (14.2 percent) and Indonesia (9.1 percent) have substantially lower proportions of skilled employment than the Philippines (24.1 percent) and Malaysia (25.1 percent) where electronics manufacturing is agglomerated.

Figure 4.5.1. Share of High-skilled Employment

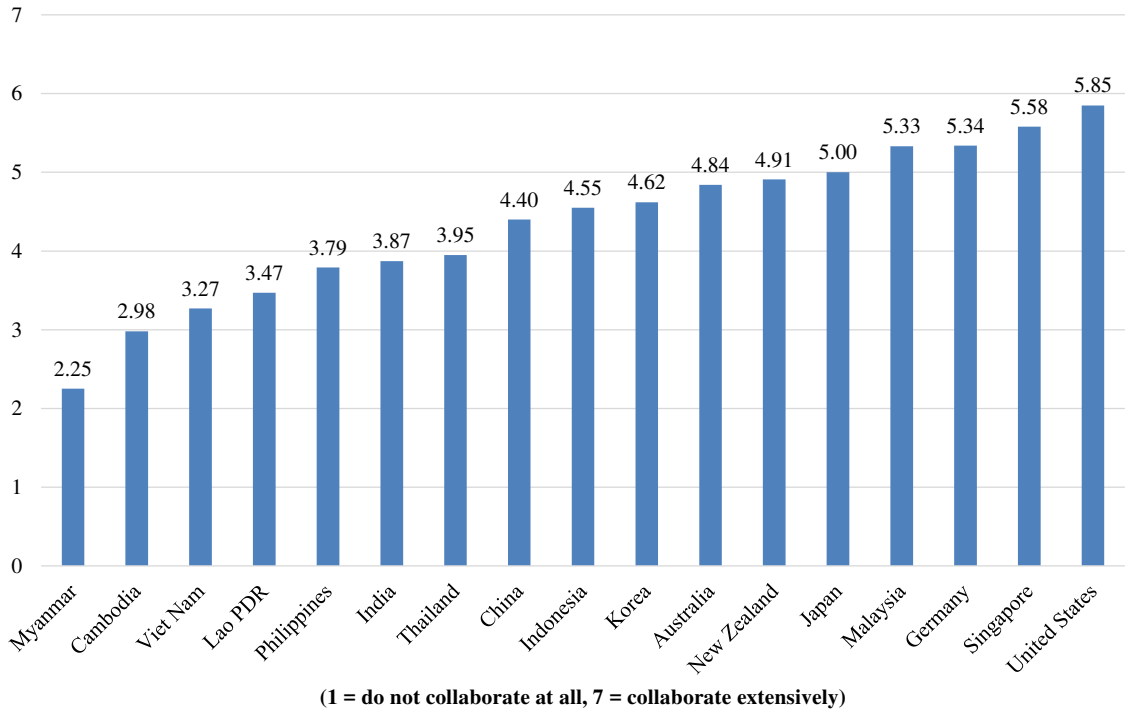


Source: World Economic Forum (2015). Originally ILOSTAT data from 2014 or latest available as of March 2015.

University–industry linkages do not play a main role in innovative activities in most middle-income countries in Southeast Asia. Figure 4.5.2 shows the perception of business leaders regarding university–business collaboration in R&D. Many business leaders do not recognise extensive collaboration in R&D between business and universities even in the Philippines and Thailand.

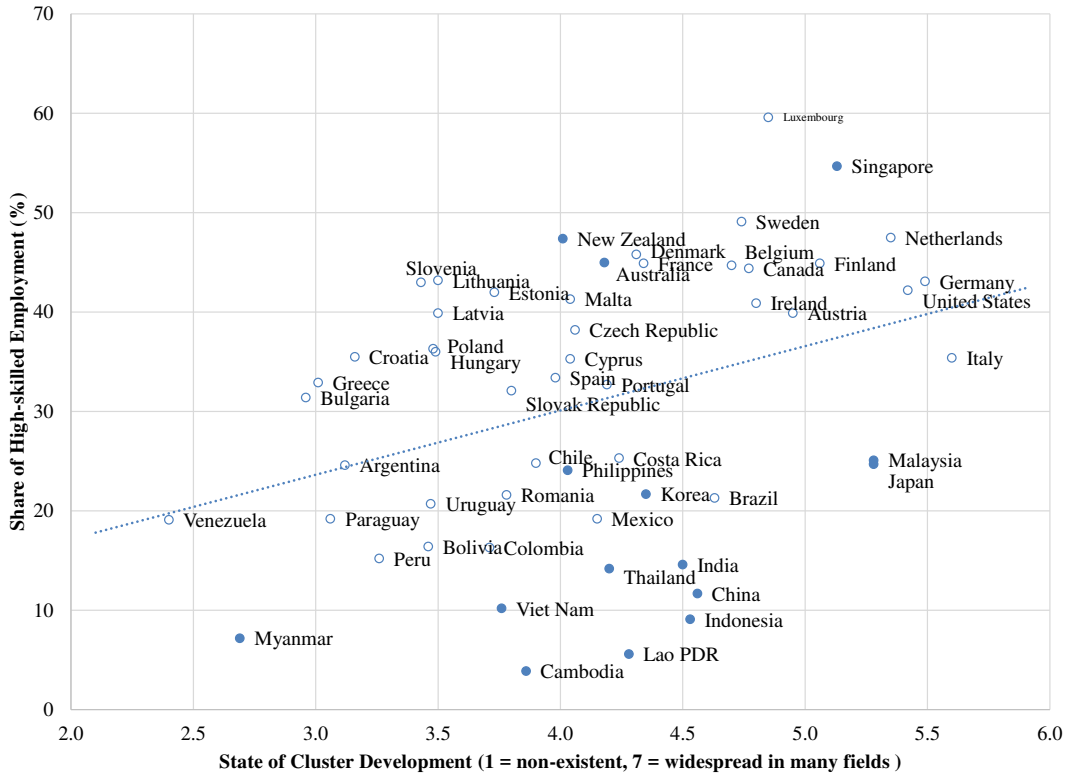
East Asian industrialisation has been taking advantage of agglomeration rather than depending on quality human resources. Figure 4.5.3 compares the relationship between cluster development and skilled employment share among countries in East and Southeast Asia, Europe, and North and South America. Most countries in Europe are positioned above the trend line, indicating these countries rely on skilled employment for their development. In contrast, all countries in Southeast Asia except Singapore are positioned below the trend line, indicating these countries rely on clustering for their development. Compared with Asian countries, Latin America has not developed clusters; rather it has more skilled employment as European countries.

Figure 4.5.2. University–Business R&D Collaboration



Note: R&D = research and development
Source: World Economic Forum (2015). Originally World Economic Forum, Executive Opinion Survey, 2014–2015.

Figure 4.5.3. Cluster Development and Skilled Employment



Source: Depicted from World Economic Forum (2015).

Presently, middle-income ASEAN Member States do not have sufficient skilled jobs and high-quality urban infrastructure. These countries need to foster human capital and upgrade urban infrastructure in Tier 1 regions and combine them with agglomeration forces to develop indigenous innovation capabilities.

Chapter 5

Assessment of Soft and Hard Infrastructure Development

5-1. Hard Infrastructure

5-1-1. Implementation of the CADP projects during 2012–2015

The first version of the CADP (ERIA, 2010) compiled a list of prospective projects for logistics and economic infrastructure development based on publicly available information. The CADP classified prospective infrastructure projects in terms of their priority, subregions (Mekong, BIMP-EAGA+, and IMT+) [10], and the three tiers of development in accordance with the conceptual framework of the CADP.

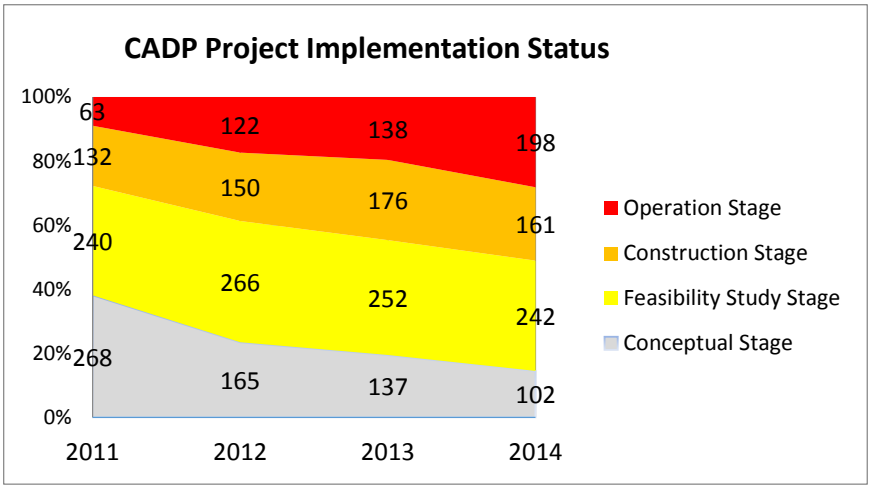
Following up the submission of CADP to the 5th East Asia Summit in 2010, ERIA updates the implementation status of the listed infrastructure projects every year. Figure 5.1.1 illustrates the considerable progress of CADP project implementation. The projects under the operation stage increased their shares from 9 percent in 2011 to 28 percent in 2014, while those under the construction stage expanded from 19 percent to 23 percent during the same period.

CADP infrastructure projects were categorised into top priority (that contains 178 projects), priority (166), and normal (359) projects. Among the top priority projects, projects under the operation stage increased from 10 percent in 2011 to 28 percent in 2014. As for the priority and normal projects, the percentage increased from 8 percent to 27 percent and from 9 percent to 29 percent during the 2011–2014 period.

CADP projects were also categorised by three subregions—the Extended Mekong, BIMP-EAGA+, and IMT+; the number of projects in each subregion is 452, 190, and 61, respectively. About 64 percent of CADP projects are planned or implemented in the Extended Mekong Subregion. Said subregion has made more progress than others in implementing projects. The projects under the operation stage account for 34 percent of all projects in the Extended Mekong Subregion in 2014, whereas such projects occupy only 19 percent and 15 percent in BIMP-EAGA+ and in IMT+, respectively.

[10] BIMP-EAGA+ refers to Brunei Darussalam-Indonesia-Malaysia-The Philippines East ASEAN Growth Area and surroundings regions; IMT+ refers to Indonesia-Malaysia-Thailand Growth Triangle and surroundings regions. The Extended Mekong, BIMP-EAGA+, and IMT+ are broad subregions that are designed to cover a wider geographical range than the existing framework in order to include Tiers 1, 2, and 3 as well as their inter-connectivity.

Figure 5.1.1. Status of CADP Project Implementation



Source: ERIA CADP research team.

The CADP classifies stages of development in terms of the degree of participation in production networks as follows (ERIA, 2010:12):

Tier 1: Countries/regions that are already in production networks and where industrial agglomerations have started to form.

Tier 2: Countries/regions that are not yet fully integrated into quick and high-frequency production networks.

Tier 3: Countries/regions that are not likely to come into quick and high-frequency production networks in the short run but would like to provide a new framework for industrial development with the development of logistics infrastructure as a trigger.

Tier 1 has 178 projects (25 percent of 703) whereas Tiers 2 and 3 consist of 321 (46 percent) and 204 (29 percent). Figure 5.1.2 shows the progress by three tiers.

The projects in Tier 1 under the conceptual or feasibility study stage decreased from 122 to 78 in 2011–2014. In other words, 33 projects or 36 percent of the projects (= 33/122) under the planning stage in 2011 moved into the construction or operation stage by 2014. The projects under the conceptual and feasibility study stages decreased from 45 to 12 and from 77 to 66, respectively. On the other hand, the projects under the construction and operation stages increased from 38 to 52 and from 18 to 48, respectively.

Consequently, the projects under the operation stage accounted for 27 percent of the projects in Tier 1 in 2014.

The projects in Tier 2 under the conceptual or feasibility study stage decreased from 249 to 157 in 2011–2014. A total of 92 projects or 37 percent of the projects (= 92/249) under these planning stages in 2011 were promoted to the more advanced construction or operation stage by 2014. The projects under the conceptual and feasibility study stages decreased from 138 to 50 and from 111 to 107, respectively. Instead, the projects under the construction and operation stages increased from 41 to 78 and from 31 to 86, respectively. Consequently, the projects under the operation stage reached 27 percent of the projects classified in Tier 2 in 2014.

The projects in Tier 3 under the conceptual or feasibility study stage decreased from 137 to 109 during the same period. A total of 28 projects or 20 percent of the projects (=28/137) under the planning stage in 2011 had advanced to the construction or operation stage by 2014. The projects under the conceptual stage decreased from 85 to 40, while those under the feasibility study stage increased from 52 to 69. The projects under the construction stage decreased from 53 to 31, though those under the operation stage increased from 14 to 64. Consequently, the projects under the operation stage reached 31 percent of the projects classified in Tier 3 in 2014. The projects in Tier 3 seem to need more time for feasibility studies compared to those in Tiers 1 and 2.

The observations commonly applied to all three tiers as follows:

1. The ratio of the infrastructure projects reaching the operation stage is relatively high in special economic zone (SEZ) projects.
2. About half of the road and power projects have moved into the construction or operation stage. Power projects have also achieved good progress because these have attracted investment successfully and are relatively easy to implement.
3. Many railway projects stopped at the feasibility study stage. The main reasons for this are the time-consuming process of acquiring land resulting from having to deal with numerous landowners, and the difficult financial arrangements due to large capital investment and the long project period. However, the fast realisation of urban railways under the strong initiative of municipal/regional governments is needed to mitigate severe traffic congestion in some metropolitan cities.

4. Some infrastructure projects encountered land acquisition problems. Some power projects were frozen because of the strong claim of residents of negative environmental impact on the surrounding areas.

Although East Asia has been making substantial progress in implementing CADP projects, public–private partnerships (PPPs) have not been well implemented in East Asia. Based on the observation that 25 percent of CADP projects can be implemented in the PPP framework, the utilisation of private funds should have a substantial impact on the total picture of infrastructure development. The development of a legal framework as well as knowledge and capacity enhancement of relevant parties is very much encouraged in East Asia.

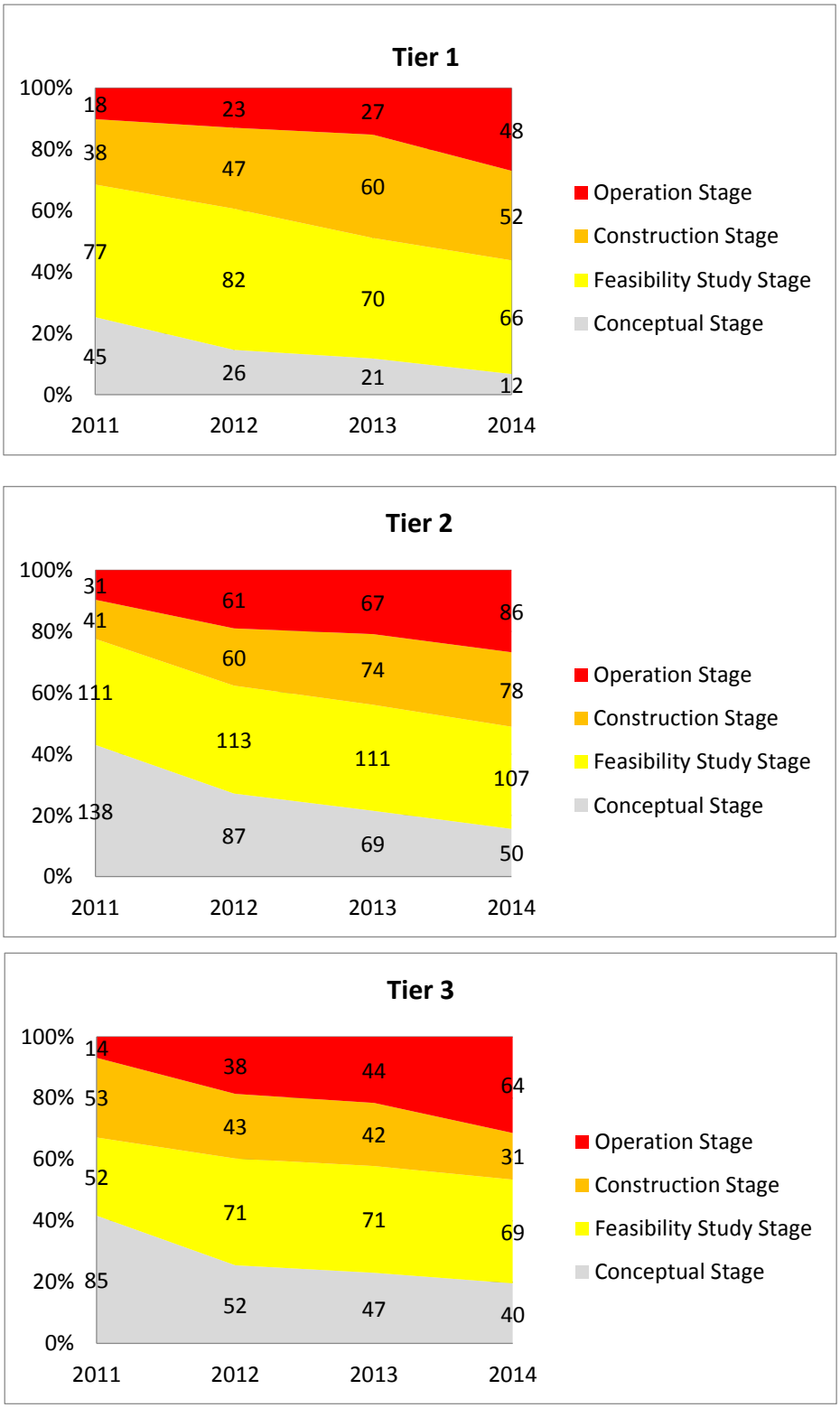
5-1-2. Representative projects in the operation stage

To exemplify the progress of infrastructure projects, representative operation-stage projects were selected from the CADP project list and mapped out in Figure 5.1.4. As Figure 5.1.3 shows, steady progress of infrastructure development occurs in the Extended Mekong Subregion than other regions. Also many of these representative operation-stage projects have been operationalised in the Extended Mekong Subregion, especially along the economic corridors.

The representative operation-stage projects in Tier 1 contain enhancement of urban transport and connectivity with suburban and provincial cities implemented in fast-growing capital areas such as Bangkok, Ha Noi, and Kuala Lumpur. Urbanisation requires developing and enhancing the urban transport system, including access roads to international airports and outer ring roads.

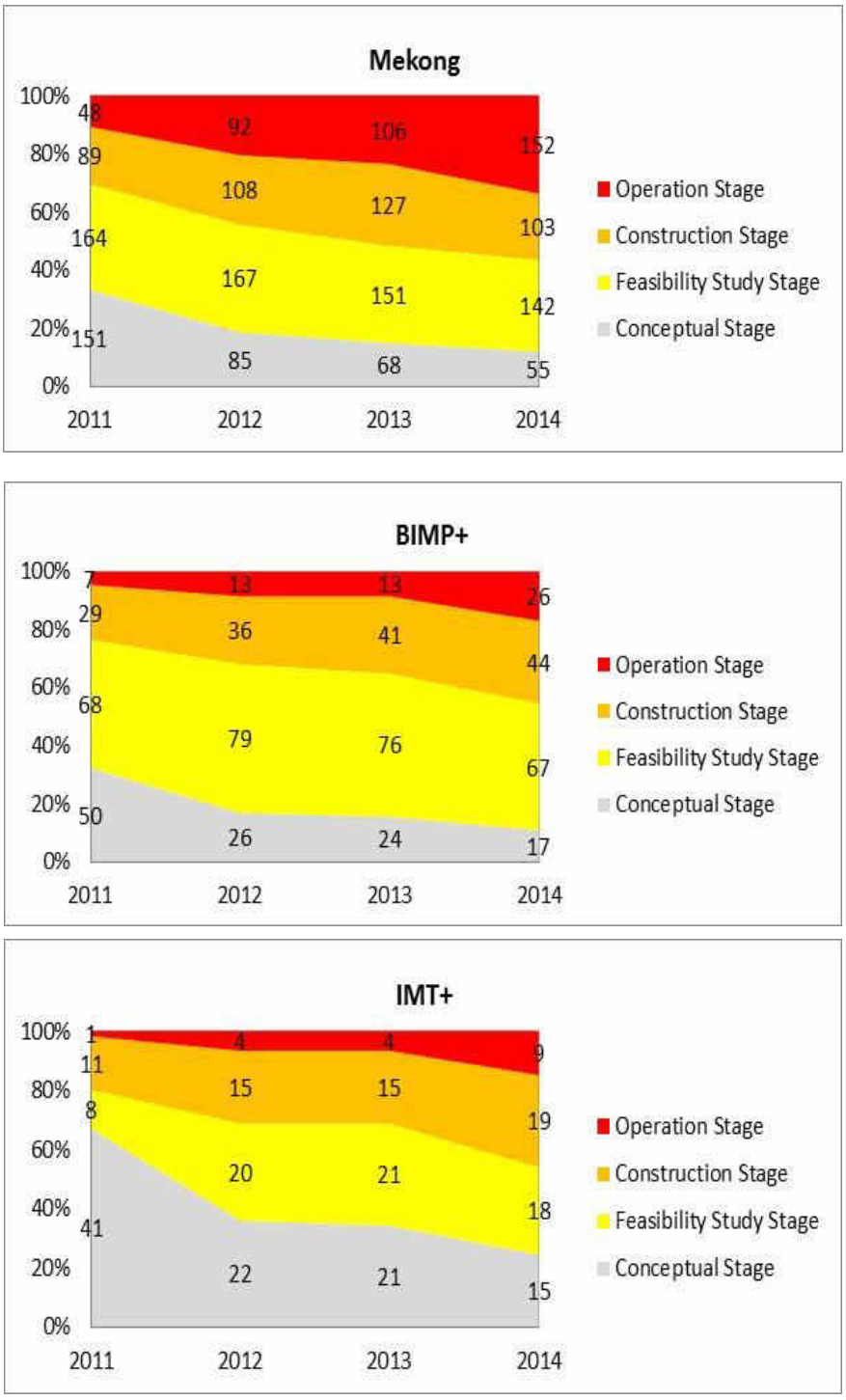
In Bangkok, the Bangkok MRT Green Line extension (WongwianYai−Bangwa) was completed in 2013 while construction of new lines and extension of existing lines are also being planned. Kuala Lumpur International Airport (KLIA) enhanced its capacity to meet the sharp increase of passengers of low-cost carriers. The construction of a new terminal (KLIA2) was completed for public use in May 2014.

Figure 5.1.2. Status of CADP Project Implementation, by tier



Source: ERIA CADP research team.

Figure 5.1.3. Status of CADP Project Implementation, by subregion



Source: ERIA CADP research team.

New city development is a radical step towards taking advantage of knowledge spillover and other positive agglomeration effects and mitigating congestion and other costs of urbanisation. A case in South India is the development of Sri City, an integrated business city spread over 100 square kilometres (km^2) located 55 km north of Chennai.

The city is well equipped with living, educational and recreational facilities to accommodate talents. The city also provides business facilities including a SEZ for export-oriented business, a domestic tariff zone for domestic demand–oriented businesses, and a better access to business and commercial services and facilities in Chennai.

The exemplified operation-stage projects in Ha Noi (Tier 1) are outlined as follows:

Nhat Tan Bridge in Ha Noi (Japan–Viet Nam Friendship Bridge). The bridge, with a total length of 3,755 metres (m), goes over Hong River, of which the cable-stayed bridge portion covers 1,500 m, marking the longest in Southeast Asia. It will be connected to National Road No. 3 to form part of the main artery from Ha Noi to the China border, passing by Noi Bai International Airport. With this bridge and the new route, driving time between the airport and central Ha Noi was shortened by 20–30 minutes, and driving condition improved.

Noi Bai International Airport Terminal 2 Construction in Ha Noi. The second passenger terminal building in the existing Noi Bai International Airport was constructed using Yen Credit. Construction started in February 2012 and was completed in December 2014, after 34 months. By constructing this terminal, the annual capacity of the international airport, combined with the existing terminal capacity, increased from 6 million passengers to a maximum of 16 million.

Vinh Thinh Bridge in Ha Noi. This 5,487-metre-long cross-river bridge that links Ha Noi to Vinh Phuc Province in the north opened in June 2014. The construction cost was mostly covered by official development assistance loans from South Korea. The four-lane bridge creates a transportation network linking the capital with the north-western provinces of Vinh Phuc, Phu Tho, Yen Bai, Tuyen Quang, and Lao Cai (and Yunnan province of China) as well as easing traffic congestion on some roads in the capital area.

The representative operation-stage projects in Tier 2 shown in Figure 5.1.4 will enhance transport connectivity with the main industrial districts and urban areas.

Neak Loeung Bridge in Cambodia. This bridge was built over the Mekong River along Asian Highway 1 (AH1), which is the major route of the Southern Economic Corridor linking Ho Chi Minh City and Bangkok. The bridge itself is 2,215 m long; the total length, including the attached access roads, is 5,460 m. Up until the completion of its construction in April 2015, the missing link in the Southern Economic Corridor used to force people to take a few hours, including waiting time, to cross the river by a ferry boat. A simulation

based on the ERIA/IDE geographical simulation model (GSM) estimated positive economic impacts of the bridge not only on Cambodia but also on other neighbouring countries (i.e. Cambodia: 1.104 percent increase in GDP compared with the baseline case, Viet Nam: 0.097 percent, Lao PDR: 0.063 percent, Thailand: 0.012 percent) (ERIA 2010:93).

Rehabilitation of Roads and Bridges. In Cambodia, many projects to improve and rehabilitate national roads have been undertaken with international and bilateral assistance such as from the World Bank, Asian Development Bank, Japan, China, Korea, Thailand, and other countries. In Lao PDR, a 58.1-kilometre-long section of the 240 km National Road No. 9 along the East–West Economic Corridor (EWEC) is rehabilitated with the financial support of a Japanese grant programme. The most damaged section (total length of 58.1 km) of National Road No. 9 (with 2 lane/9m width) was repaired by removing the lower and the surface layers based on the new pavement design. The project was completed in March 2015.

Fourth Friendship Bridge between Lao PDR and Thailand. The construction of the Fourth Friendship Bridge over Mekong River at the Lao–Thai border on the North–South Economic Corridor was completed in December 2013 with the grant programme from the governments of Thailand and China. This new bridge is expected to contribute to the enhancement of connectivity between Kunming, Yunnan Province of China, and Thailand through Lao PDR, and mitigate poverty in the border region.

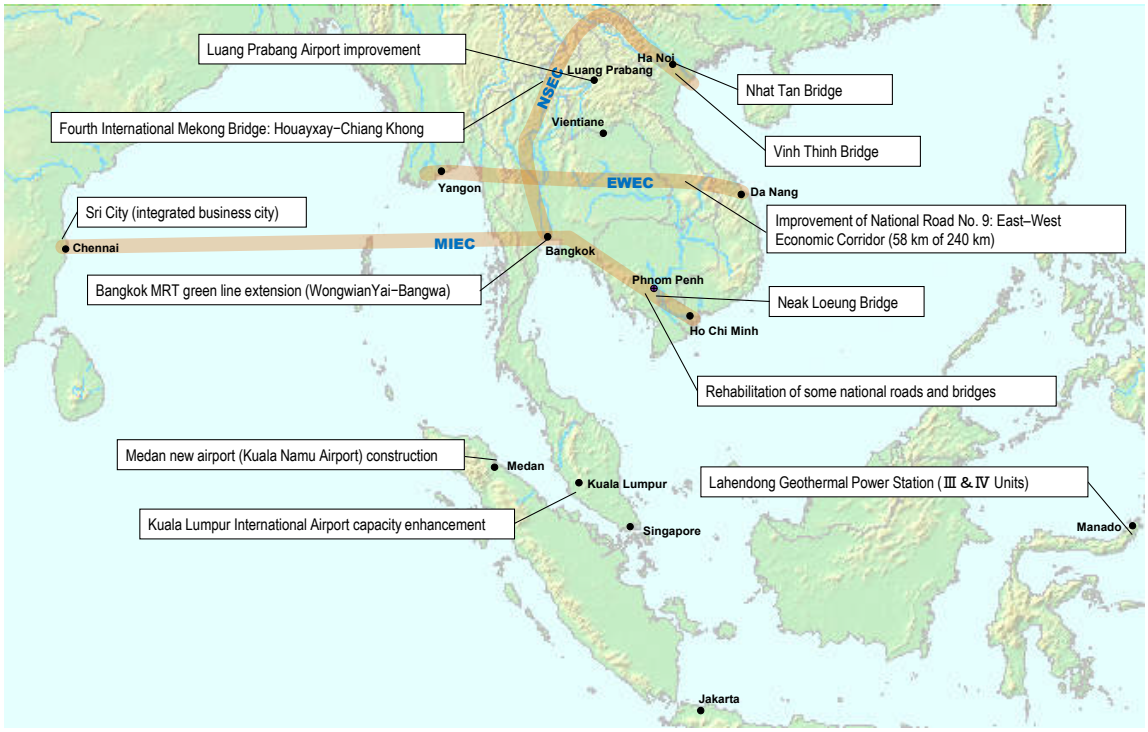
Medan New Airport (Kuala Namu Airport) Construction. The Kuala Namu International Airport is a newly constructed international airport, named after its location at Kuala Namu, Deli Serdang, North Sumatra, Indonesia, 39 km from Medan, replacing the Polonia International Airport. The airport is expected to become the new international transit centre in Sumatra and the western part of Indonesia, which is the second largest airport after Soekarno–Hatta International Airport but the first airport that has a direct rail link to Medan city, the capital of North Sumatra. It is part of the central government's programme under the 'Masterplan to Accelerate and Expand Economic Development in Indonesia' (MP3EI) and one of the strategies for the ASEAN Single Aviation Market (ASEAN-SAM), an open skies policy among member-countries in Southeast Asia starting 2015. The airport was opened to the public on 25 July 2013, handling all flights and services shifted from Polonia International Airport.

Two representative operation-stage projects in Tier 3 are shown in Figure 5.1.4, both of which make better use of locally available resources in less-industrialised provincial areas.

Luang Prabang Airport Improvement (Lao PDR). The construction of a 2,900 m length/45 m width runway and 9,800 m^2 new terminal building became necessary with the anticipation of a drastic increase of tourists due to the designation of Luang Prabang as a UNESCO World Heritage Site. This improvement project increased the annual passengers' capacity of the airport from 300,000 to 1 million, the second largest in Lao PDR. This project was implemented and completed in June 2014 through a soft loan from the Chinese government.

Lahendong Geothermal Power Station (Units III and IV) (Indonesia). The Lahendong geothermal power plant is situated in Tomohon, North Sulawesi, about 30 km south of the province's capital city Manado. Its Unit III has been operated since 2009 and Unit IV, since 2013. Each capacity is 20 MW.

Figure 5.1.4. Representative Operation Stage Projects of CADP



EWEC = East–West Economic Corridor, MIEC = Mekong–India Economic Corridor, NSEC = North–South Economic Corridor.
Source: ERIA CADP research team.

5-2. Soft Infrastructure

As discussed in Chapter 7 on the quantitative assessment on hard and soft infrastructure development using the Geographical Simulation Analysis of CADP2.0, in particular Table 7.2, the development of soft infrastructure has an economic impact equivalent to hard infrastructure development. Thus, it is important to review the recent progress of soft infrastructure development to consider policy issues to be discussed in CADP 2.0. As the first version of CADP emphasised mainly infrastructure for connectivity, the discussion in this subsection focuses on soft infrastructure related mainly to trade and transport facilitation.

5-2.1. Legal Instrument related to the ASEAN Economic Community and Master Plan on ASEAN Connectivity

Soft infrastructure is a key foundation that complements physical infrastructure to transform ASEAN into a single market and production base. The first version of the CADP demonstrates that the development of hard and soft infrastructure can remove bottlenecks for industrialisation in East Asia. The Master Plan on ASEAN Connectivity (MPAC), which the ASEAN Member States adopted on the occasion of the 17th ASEAN Summit in 2010, also emphasises the importance of upgrading soft infrastructure or enhancing 'institutional connectivity' in addition to physical connectivity and people-to-people connectivity for ASEAN community building.

The key elements of institutional connectivity in the MPAC list include trade liberalisation and facilitation, investment and services liberalisation and facilitation, mutual recognition agreements/arrangements, regional transport agreements, cross-border procedures, and capacity building programmes. These elements are closely linked to initiatives for building the ASEAN Economic Community (AEC).

To achieve these, MPAC encourages ASEAN Member States to taking such actions to:

- Operationalise the three framework agreements on transport facilitation: the ASEAN Framework Agreement on the Facilitation of Goods in Transit (AFAFGIT), ASEAN Framework Agreement on the Facilitation of Inter-State Transport (AFAFIST), and ASEAN Framework Agreement on Multimodal Transport (AFAMT).

- Facilitate inter-state passenger land transportation by implementing the existing bilateral and subregional initiatives like the Cross-Border Transport Agreement (CBTA) under the Greater Mekong Subregion (GMS) and developing a regional ASEAN arrangement.
- Ratify and implement the Multilateral Agreement on the Full Liberalisation of Air Freight Services (MAFLAFS), the Multilateral Agreement on Air Services (MAAS), and the ASEAN Multilateral Agreement on the Full Liberalisation of Passenger Air Services (MAFLPAS).
- Implement the National Single Window (NSW) and the ASEAN Single Window (ASW), together with the reform and modernisation of customs.

Since 2010 when ERIA submitted the original CADP to the 5th East Asia Summit and the ASEAN Member States adopted the MPAC, ASEAN has been making significant progress toward the AEC and the MPAC. As of the beginning of October 2015, ASEAN Member States have signed 173 legal instruments such as agreements, memoranda of understanding, and protocols that related only to AEC building. Of these, only 19 have not entered into force. In other words, ASEAN Member States have already ratified or accepted most of the framework agreements such as AFAFGIT (put into force in October 2000), AFAFIST (December 2011), AFAMT (October 2008), MAFLAFS (October 2009), MAAS (October 2009), and MAFLPAS (June 2011).

Among the 19 legal instruments not in force, three protocols are under the AFAFGIT: (i) Protocol 6 (Railways Border and Interchange Stations), (ii) Protocol 7 (Customs Transit System) signed by the ASEAN Member States on 24 February 2015, and (iii) Protocol 9 (Dangerous Goods). Other pending legal instruments include those related to services liberalisation and movement of people.

Table 5.2.1. Legal Instruments Not In Force

Name of Instrument	Signature
ASEAN Agreement on the Movement of Natural Persons	Phnom Penh 19-Nov-12
Protocol to Amend the ASEAN Comprehensive Investment Agreement	Nay Pyi Taw 26-Aug-14
Protocol on the Legal Framework to Implement the ASEAN Single Window (Agreement to Establish and Implement the ASEAN Single Window)	Ha Noi 4-Sep-15
E-ASEAN Framework Agreement	Singapore 24-Nov-00
ASEAN Mutual Recognition Arrangement on Tourism Professionals	Bangkok 9-Nov-12
Protocol 9 Dangerous Goods (ASEAN Framework Agreement on the Facilitation of Goods in Transit)	Jakarta 20-Sep-02
Protocol 6 Railways Border and Interchange Stations (ASEAN Framework Agreement on the Facilitation of Goods in Transit)	Phnom Penh 16-Dec-11
Protocol 7 Customs Transit System (ASEAN Framework Agreement on the Facilitation of Goods in Transit)	Bangkok 24-Feb-15
Protocol on Notification Procedures	Makati 7-Oct-98
ASEAN Framework Agreement on Intellectual Property Cooperation	Bangkok 15-Dec-95
Protocol to Implement the Second Package of Commitments on Financial Services under the ASEAN Framework Agreements on Services	Yangon 6-Apr-02
Protocol to Implement the Fourth Package of Commitments under the ASEAN Framework Agreement on Services	Jakarta 3-Sep-04
Protocol to Implement the Eighth Package of Commitments on Air Transport Services under the ASEAN Framework Agreement on Services	Pakse, Lao PDR 20-Dec-13
Protocol to Amend the Framework Agreement on Enhancing ASEAN Economic Cooperation	Bangkok 15-Dec-95
ASEAN Agreement on the Conservation of Nature and Natural Resources	Kuala Lumpur 9-Jul-85
Basic Agreement on the ASEAN Industrial Complementation	Manila 18-Jun-81
Protocol to Amend the Agreement on the ASEAN Food Security Reserve	Bangkok 22-Oct-82
Agreement for the Facilitation of Search for Ships in Distress and Rescue of Survivors of Ship Accidents	Kuala Lumpur 15-May-75
Agreement for the Facilitation of Search for Aircrafts in Distress and Rescue of Survivors of Aircraft Accidents	Singapore 14-Apr-72

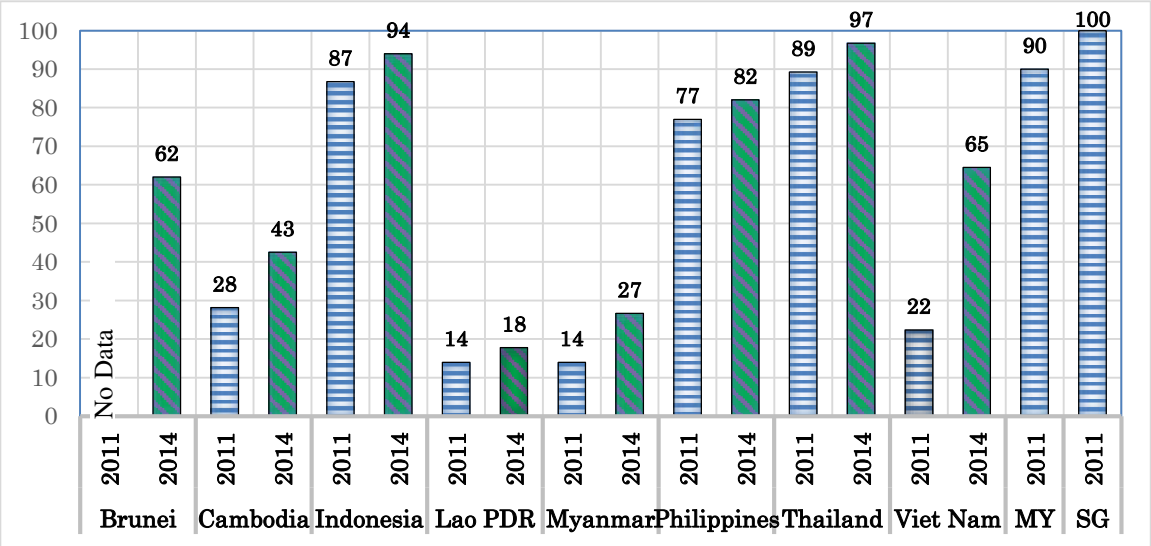
Source: Based on ASEAN Secretariat website database (accessed 6 October 2015).

5-2-2. ASEAN regional initiatives for trade and transport facilitation

Among various ASEAN initiatives for AEC building, trade and transport facilitation is one of the crucial initiatives to realise a single market and production base in ASEAN. To facilitate international trade, the agreement to establish and implement the ASW was signed and put into force in 2005. However, ratification of an agreement does not mean the attainment of the agreement's objectives. Establishment of the ASW necessitates implementation of the NSW that each ASEAN Member State develops. Establishment and implementation of the NSW involves institutional reforms, modernisation, and informatisation of customs administration.

Figure 5.2.1 illustrates the scoring on the implementation of the NSW. The figure shows a big gap in implementation among ASEAN Member States. Singapore, Malaysia, and Thailand had generally completed its implementation of the NSW. On the other hand, Cambodia, Lao PDR, and Myanmar are in the early stage of implementation, while Viet Nam had a significant progress during the period (Intal, 2015).

Figure 5.2.1. Implementation of National Single Window



MY = Myanmar, SG = Singapore.
Source: Intal (2015).

To realise the NSW and ASW, each member state needs to computerise customs and other procedures for cross-border trade and transportation. Countries advanced in the implementation of the NSW, such as Singapore and Malaysia, have a long history to automate customs and other procedures for trade so that they can develop the NSW based on their own information systems. On the other hand, CLMV countries are still developing or modernising their customs information system.

Cambodia and Lao PDR started using UNCTAD's Automated System for Customs Data (ASYCUDA) in 2008 and 2011 at the pilot site (Sihanoukville and Lao–Thai Friendship Bridge I, respectively), and then commenced the rollout of the system at other border crossing checkpoints gradually. Viet Nam developed its own NSW, Vietnamese Automated Cargo and port Consolidated System (VNACCS), based on Japan's Nippon Automated Cargo and port Consolidated System (NACCS) in 2014. Myanmar plans to leapfrog on the NACCS-based modern NSW, Myanmar Automated Cargo and port Consolidated System (MACCS), in 2016.

5-2.3. Subregional and bilateral/trilateral initiatives for trade and transport facilitation

In addition to the regional initiatives based on the above-mentioned ASEAN framework agreements, ASEAN Member States in the Mekong Subregion have been developing subregional initiatives for trade and transport facilitation based on the CBTA under ADB's GMS Economic Cooperation Program. Different from the ASEAN's framework agreements, the CBTA intends to facilitate trade and transport only within the six GMS countries including the five ASEAN Member States (Cambodia, Lao PDR, Myanmar, Thailand, and Viet Nam) and China.

The CBTA contains the main agreement, 16 annexes, and three protocols. Although the main agreement was already ratified by the six GMS countries and had come into force, the 19 annexes and protocols had been ratified by only four countries (i.e. China, Cambodia, Lao PDR, and Viet Nam) as of 2014. Thailand has ratified all annexes in 2015 (MFA, 2015). Myanmar has not yet ratified all annexes and protocols. Even so, substantial progress has been made based on bilateral and trilateral agreements or memoranda of understanding (MOUs) (ADB, 2013).

Bilateral agreements set the designated border crossing points and transport routes, technical requirements for vehicles, document requirements, quota for trucks,

and other details for implementation of the agreements. The bilateral MOUs had already been signed between the neighbouring ASEAN Member States in the GMS except Myanmar (i.e. Cambodia–Lao PDR, Cambodia–Thailand, Cambodia–Viet Nam, Lao PDR–Thailand, and Lao PDR–Viet Nam). In addition to the bilateral agreements in the GMS listed in the table, Thailand has an agreement with Malaysia on the transit of perishable goods by road from Thailand (Sadao crossing) through Malaysia (Bukit Kayu Hitam crossing) to Singapore (Sopadang et al., 2015).

Table 5.2.2. Bilateral Agreement between ASEAN Member States in the Greater Mekong Subregion

Bilateral Agreement	Notes
Cambodia–Lao PDR	The two countries signed the bilateral agreement on road transportation in 1999 and the subsidiary agreement in 2007. The quota for trucks is set at 40 trucks a year from each country. The sole border checkpoint for cross-border transport is Nong Nokkhien (Champasak Province, Lao PDR)–Trapaeng Kriel (Stung Treng, Cambodia).
Cambodia–Thailand	The two countries signed the bilateral MOU on the exchange of traffic rights for cross-border transport through the Aranyaprathet–Poipet border crossing points in 2008 and the addendum to the MOU in 2009.
Cambodia–Viet Nam	The two countries signed the agreement on road transportation in 1998 and the protocol in 2005. The initial quota of 40 vehicles stipulated in the 2005 protocol was increased to 150 in 2009, 300 in 2010, and 500 in 2012. The exchange of traffic rights is implemented at Bavet–Moc Bai and other border crossing points.
Lao PDR–Thailand	The two countries signed the agreement on road transport in 1999 and the subsidiary agreement in 2001. The agreements cover transport of passengers and goods between the territories of the two countries and through the territory of either country to a third country. They do not cover the transport of dangerous goods.
Lao PDR–Viet Nam	The two countries signed the agreement on cross-border transport facilitation in 2009 and the subsidiary agreement in 2010.

MOU = memorandum of understanding.
Source: Nguyen (2015), Nolintha (2015), Sisovanna (2015), Sopadang, Wichaisri, Teerasoponpong and Banomyong (2015).

The Lao PDR–Thailand–Viet Nam and Cambodia–Lao PDR–Viet Nam agreements were also signed in 2013 to facilitate cross-border transport of people and goods between and among the contracting parties. The Lao PDR–Thailand–Viet Nam MOU on the initial implementation of the CBTA (IICBTA) allows the properly licensed transport operators to provide international transport services along EWEC through Dan Savan–Lao Bao (Lao PDR–Viet Nam) and Savannakhet–Mukdahan (Lao PDR–Thailand) border crossing points. Currently, the cross-border transport among these three countries is governed by the MOU and its addendum signed in 2013 (Nolintha, 2015).

One recent symbolic achievement for realising the CBTA is the launch of the single window inspection and single stop inspection (SSI) in 2015 at the Dan Savan–Lao Bao border crossing point along the EWEC. The launch of SSI is expected not only to reduce time for exports, imports, and immigration but also to realise harmonised and coherent border controls by the two countries.

Chapter 6

Three Tiers of Soft and Hard Infrastructure Development

6-1. The Representative Projects for Developing Hard Infrastructure for Connectivity and Innovation

CADP 2.0 intends to link infrastructure development with industrialisation and emphasises the importance of setting proper technical grades and specifications suited to each development stage. Chapter 2 presents a conceptual framework for CADP 2.0, and Table 2.3 tabulates infrastructure development for connectivity and innovation with three tiers.

This chapter connects the conceptual framework with actual infrastructure projects. We list 120 projects by tier, sector, and target outcome (i.e. connectivity or innovation), which are selected from the 761 projects in the long list of representative prospective projects (Appendix 1). Tiers 1, 2, and 3 have 38, 68, and 14 projects, respectively. By sector, the projects are classified into the following nine categories: road/bridge (41), railway (21), energy/power (18), port/maritime (17), industrial estate/special economic zone (SEZ) (8), airport (6), urban development (5), telecommunications (3), and waterway (1) (Table 6.1.1).

As shown in Table 6.1.1, 87 and 33 projects are hard infrastructure projects for connectivity and innovation, respectively. Tier 2 includes a large number of projects for connectivity (57 projects) while Tier 1 is filled with projects for innovation (21 projects). Urban transport projects in Tier 1 are classified here as infrastructure projects for innovation whereas the mass transport system to link with neighbouring industrial agglomerations is categorised for connectivity.

Table 6.1.1. Summary of 120 Representative Hard Infrastructure Development Projects for Connectivity and Innovation

Tier	Sector	Category	Connectivity	Innovation	Total
Tier 1	Airport	Airport expansion to cater massive movements of passengers and freight	1		1
		Construction of new airport to support/substitute existing airport	2		2
	Energy/Power	Stable, ample, and clean electricity and energy supply for final users		3	3
	Port/Maritime	Development of sizeable port to cater to massive container transactions and specialised loading facilities	4		4
	Railway	Access railways to gateway ports/airports		1	1
		Railways for connecting metropolitan areas and other cities	5		5
		Urban public transport system (subway, LRT, MRT) and railways to connect urban and suburban areas		6	6
	Road/Bridge	Access roads/bridges to gateway ports/airports		1	1
		Highway system, bridges, and bypass roads in and around metropolitan areas	1	6	7
		Highway system, bridges, and roads for connecting metropolitan areas and other cities	4		4
	Urban Development	Comprehensive urban development		1	1
		Development for collaboration of research studies		1	1
		Science city development		1	1
		Transit-oriented development		1	1
			17	21	38
Tier 2	Airport	Construction of new airport	1		1
		Upgrading of major airports for both passengers and cargoes	2		2
	Energy/Power	Stable and ample electricity and energy supply for final users	10		10
	Industrial Estate/SEZ	SEZs development		7	7
	Port/Maritime	Dry port development	1		1
		Port development	5		5
		Upgrading major ports to enhance handling capacity	4		4
	Railway	Construction of new arterial railway	4		4
		Development and upgrading of regional arterial railway networks	4		4
		Modernisation and rehabilitation of railway in urban area	1		1
	Road/Bridge	Construction of bridge to connect regions	4		4
		Cross-border facilities	2		2
		Road for connecting industrial centres, logistics hubs, neighbouring industrial agglomerations; strengthening of network and the economic corridor	18		18
	Telecommunication	Development/upgrading of trunk telecommunications network		3	3
	Urban Development	Comprehensive regional development		1	1
	Waterway	Improvement of water transportation facilities	1		1
			57	11	68
Tier 3	Energy/Power	Development of power plants taking advantage of location advantages	5		5
	Industrial Estate/SEZ	Agriculture development		1	1
	Port/Maritime	Upgrading of local ports	3		3
	Road/Bridge	Construction of bridge to connect regions	1		1
		Road connection for various economic activities	2		2
		Upgrading rural road for various economic activities	2		2
			13	1	14
Total			87	33	120

Note: LRT = light rail transit, MRT = mass rapid transit, SEZ = special economic zone.
Source: ERIA CADP research team.

Table 6.1.2. Representative Prospective Projects for Tier-wise Development Strategies: Hard Infrastructure for Connectivity

Sector	Category	Project Name	Country
Tier 1			
Road/Bridge	Highway system, bridges, and roads for connecting metropolitan areas and other cities	Ha Noi–Hai Phong Highway	Viet Nam
		Moc Bai–Ho Chi Minh City	Viet Nam
		Motorway: Bang Yai–Ban Pong–Kanchanaburi	Thailand
		Phnom Penh–Ho Chi Minh City Expressway	Cambodia, Viet Nam
	Highway system, bridges, and bypass roads in and around metropolitan areas	East Jakarta industrial area (Cikarang) road network development	Indonesia
Railway	Railways for connecting metropolitan areas and other cities	High-speed rail link (Kuala Lumpur to Singapore)	Malaysia, Singapore
		Java high-speed railway construction	Indonesia
		Ha Noi–Vinh high speed	Viet Nam
		HCMC–Nha Trang high speed	Viet Nam
		High-speed train project: Bangkok–Chiang Mai	Thailand
Port/Maritime	Development of sizeable port to cater massive container transactions and specialised loading facilities	Cilamaya (its alternative) port development	Indonesia
		New container port at Diamond Harbor	India
		Lach Huyen Port Infrastructure Construction Project (Hai Phong)	Viet Nam
		Coastal Terminal Development Project of Laem Chabang Port	Thailand
Airport	Airport expansion to cater massive movements of passengers and freight	NAIA Development Project (New Manila International Airport Development)	Philippines
	Construction of new airport to support/substitute existing airport	Karawang new airport	Indonesia
		Long Thanh International Airport	Viet Nam
Tier 2			
Road/Bridge	Road for connecting industrial centres, logistics hubs, neighbouring industrial agglomerations, strengthen network and the economic corridor	Kaladan Multimodal Transit Transport Project	Myanmar
		Cavite Laguna (CALA) Expressway Project (The CALA East−West national road project)	Philippines
		Central Luzon Link Expressway (CLLEx), Phase I	Philippines
		Arterial Road Bypass Project, Phase II (Arterial highway bypass construction project (ii)	Philippines
		Upgrade of NR8 East–West Transport Route; AH15 (Ban Lao–Nan Phao) (215 km)	Lao PDR
		NLEX-SLEX Connector Road Project	Philippines
		Improvement of NR.9: East–West Economic Corridor (184 km)	Lao PDR
		Upgrade of NR12: Tang Beng–Na Phao border (91 km)	Lao PDR
		Upgrade of NR13N and 13S: Phase 1: [13N] Sikeut–Phonhong, [13S] Don Noun–Ban Hai Bridge; Phase 2: [13N] Phonghong–Vang Vieng, [13S] Ban Hai–Paksan	Lao PDR

		Jinghong–Daluo Expressway	China
		Trans-Sumatra Toll Road (Palembang–Bandar Lampung)	Indonesia
		Manado–Bitung toll road	Indonesia
		Trilateral Highway (Thailand–Myanmar–India)	Thailand, Myanmar, India
		4-laning of Siliguri–Guwahati, National Highway 31C	India
		4-laning of Kolkata–Siliguri, National Highway34	India
		Truong Luong–My Thuan Highway	Viet Nam
		My Thuan–Can Tho Highway	Viet Nam
		National Highway No. 5 Improvement Project	Cambodia
	Construction of bridge to connect regions	Korea–Myanmar Friendship Bridge	Myanmar
		New Thaketa Bridge Construction	Myanmar
		Bach Dang Bridge (part of Ha Long–Hai Phong Highway)	Viet Nam
		Construction of Temburong Bridge	Brunei Darussalam
	Cross border facilities	Thanaleng Border-Crossing Infrastructure Improvement	Lao PDR
		New border checkpoint in Poipet for cargo	Cambodia
Railway	Construction of new arterial railway	Boten (Chinese border)–Vientiane rail link	Lao PDR
		SKRL spur line (L): Vientiane–Thakek–Mu Gia	Lao PDR
		Yuxi–Mohan (Lao border) Railway	China
		Dali–Ruili Railway (Baoshan–Ruili section)	China
	Development and upgrading of regional arterial railway networks	Yangon Mandalay Rail Line Modernization Work	Myanmar
		Mandalay–Myitkyina Track and Signaling Upgrading Project	Myanmar
		North–South Railway Project (South Line)	Philippines
		Medan–Kualanamu (North Sumatra) elevated track	Indonesia
	Modernisation and rehabilitation of railway in urban area	Yangon Circular Railway Line Upgrading Project	Myanmar
Port/Maritime	Upgrading major ports to enhance handling capacity	Davao Sasa Port Modernization Project (Davao port: Development of quay crane and expansion of container terminal)	Philippines
		Sihanoukville Port Multi-Purpose Terminal	Cambodia
		Project for Strengthening Competitiveness of Sihanoukville Port (Package1)	Cambodia
		Muara container terminal extension	Brunei Darussalam
	Port development	Kaladan Multimodal Transit Transport Project	Myanmar
		Kuala Tanjung port development	Indonesia
		Bitung port development	Indonesia
		Pakbara deep sea port construction	Thailand
		Phnom Penh New Port Improvement Project	Cambodia
	Dry port development	Vientiane Logistics Park (VLP)	Lao PDR

Airport	Construction of new airport	Hanthawaday International Airport	Myanmar
	Upgrading major airports for both passengers and cargoes	Mactan-Cebu International Airport Passenger Terminal Building	Philippines
		Expansion of the Vientiane International Airport Terminal	Lao PDR
Energy/ Power	Stable and ample electricity and energy supply for final users	National Power Transmission Network Development Project	Myanmar
		M3-Block Gas Project	Myanmar
		Shweli 3 Hydropower Project	Myanmar
		Myingyan Power Generation Project (225 MW)	Myanmar
		Ninh Thuan 1&2 Nuclear Power Plant	Viet Nam
		Trans Borneo Power Grid Project (Sarawak–West Kalimantan) (Part of ASEAN Power Grid)	Indonesia, Malaysia
		Lao PDR–Viet Nam Power Transmission Interconnection (Hat Xan–Plei Ku)	Lao PDR, Viet Nam
		Xayaburi Hydropower (1285 MW) - exporting to Thailand	Lao PDR
		Jawa–Sumatra transmission connection	Indonesia
		Power Transmission Line from Lao Border–Stung Treng–Phnom Penh	Cambodia, Lao PDR
Waterway	Improvement of water transportation facilities	Further Maintenance and Improvement of the Upper Mekong River Navigation Channel from the PRC (at Landmark 243) and Myanmar to Luang Prabang in the Lao PDR	China
Tier 3			
Road/Bridge	Road connection for various economic activities	Pan Borneo Highway (Sabah–Sarawak)	Malaysia
		Balikpapan–Samarinda Toll Road, East Kalimantan	Indonesia
	Upgrading rural road for various economic activities	Upgrade of NR 13N: Oudomxay–Pakmong	Lao PDR
		Upgrade of NR 14A: Mounlapamok–Pakselamphao	Lao PDR
	Construction of bridge to connect regions	Xekong bridge	Lao PDR
Port/Maritime	Upgrading of local ports	Maloy port development in East Kalimantan	Indonesia
		Sorong port development (West Papua)	Indonesia
		Batam port development	Indonesia
Energy/ Power	Development of power plants taking advantage of location advantages	Wind Power plant development in Savannakhet, Attapeu, Salavan, and Xekong	Lao PDR
		Sarulla geothermal power plant	Indonesia
		Muaralabuh geothermal power plant	Indonesia
		Takalar steam coal power plant in South Sulawesi	Indonesia
		Andhra Pradesh state Coal fired power plant	India

Source: ERIA CADP research team.

Table 6.1.3. Representative Prospective Projects for Tier-wise Development Strategies: Hard Infrastructure for Innovation

Sector	Category	Project Name	Country
Tier 1			
Road/Bridge	Highway system, bridges and bypass roads in and around metropolitan areas	Metro Manila C6 Expressway Project	Philippines
		Metro Manila Skyway Stage 3	Philippines
		East Jakarta industrial area (Cikarang) road network development	Indonesia
		Hanoi Ring Road	Viet Nam
		Satellite ring road in Bangalore	India
		Peripheral ring road around Chennai	India
	Access roads/bridges to gateway ports/airports	NAIA Expressway Project (Phase II)	Philippines
Railway	Urban public transport system (subway, LRT, MRT) and railways to connect urban and suburban areas	Manila LRT line extension	Philippines
		Klang Valley MRT construction	Malaysia
		Jakarta MRT construction	Indonesia
		Ha Noi urban railway construction	Viet Nam
		Ho Chi Minh City urban railway construction	Viet Nam
		Bangkok MRT network development	Thailand
	Access railways to gateway ports/airports	Railway connecting Soekarno Hatta Airport and Halim Airport	Indonesia
Energy/ Power	Stable, ample and clean electricity and energy supply for final users	Batangas–Manila (BatMan) 1 Natural Gas Pipeline Project	Philippines
		Sumatra-Peninsular Malaysia HVDC Interconnection Project	Indonesia, Malaysia
		Sarawak-Peninsular Malaysia (SARPEN) HVDC Transmission Project	Malaysia
Urban Development	Comprehensive urban development	Iskandar Malaysia	Malaysia
	Transit-oriented development	MRT Lebak Bulus station square development	Indonesia
	Development for collaboration of research studies	Academic research cluster development	Indonesia
	Science city development	Amata Science City in Chon Buri's Nakorn district	Thailand
Tier 2			
Industrial Estate/SEZ	SEZs development	Thilawa SEZ Development Project	Myanmar
		Dawei SEZ Development Project (Dawei SEZ and Cross-Border Corridor Development)	Myanmar
		Kyaukpyu SEZ Development Project	Myanmar
		Myotha Industrial Park	Myanmar
		Industrial Estate Development in Pakse SME SEZ, Champasak Province	Lao PDR
		Joint PRC—Viet Nam Cross-Border Economic Zones (CBEZs)	China, Viet Nam
		Techno Park Poipet	Cambodia

Telecommunication	Development / upgrading of trunk telecommunication network	Communication Network Improvement Project	Myanmar
		Submarine Optical Fiber Cable connecting to AAG (Asia America Gateway)	Cambodia
		Submarine Optical Fiber Cable connecting to ASE (Asia Submarine Cable Express)	Cambodia
Urban Development	Comprehensive regional development	Sihanoukville Comprehensive development	Cambodia
Tier 3			
Industrial Estate/SEZ	Agriculture Development	Da Lat Agriculture High-tech Zone	Viet Nam

Note: HCMC = Ho Chi Minh City, NLEX-SLEX = North Luzon Expressway–South Luzon Expressway, LRT = light rail transit, MRT = mass rapid transit, SEZ = special economic zone.
Source: ERIA CADP research team.

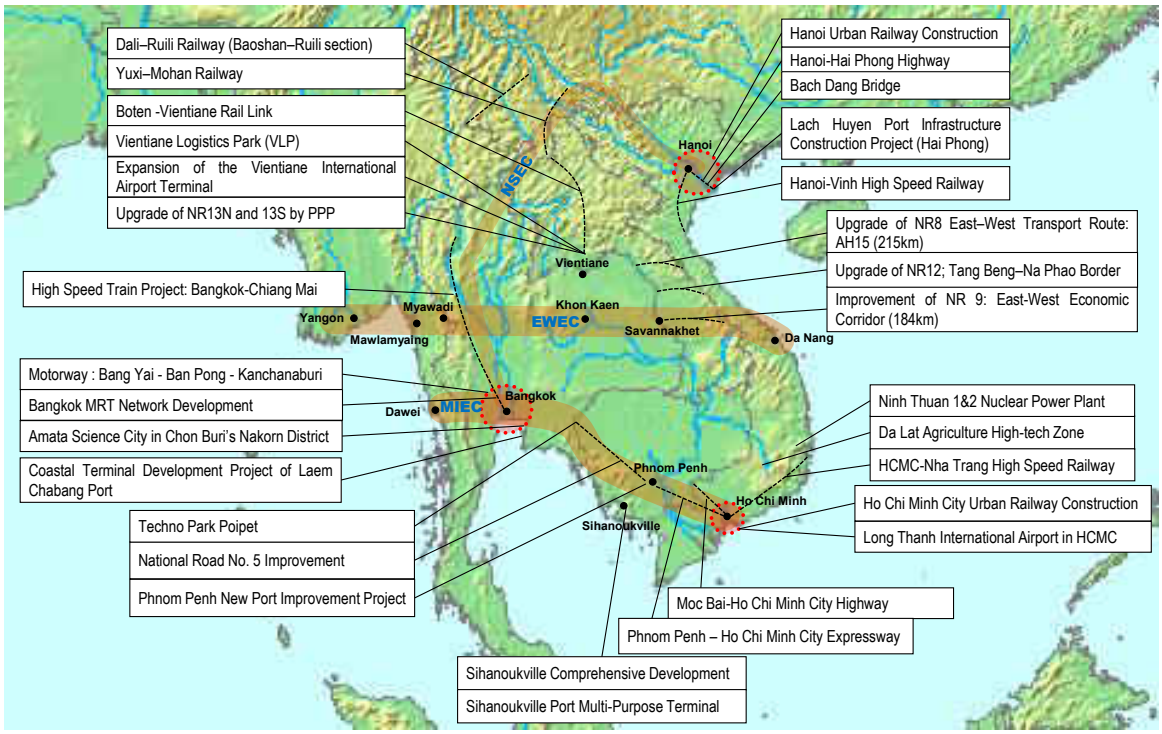
Table 6.1.4 classifies 761 projects in the list of representative prospective projects (Appendix 1) by country and subregion. About two-thirds of the projects (517 projects) are planned in the Mekong Subregion. Figures 6.1.1 to 6.1.4 map out the representative prospective projects selected from the long list.

Table 6.1.4. Summary of the Representative Prospective Projects Listed in Appendix 1, by subregion and by country

	Total	Mekong	BIMP+	IMT+	BIMP+ IMT+	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Thailand	Viet Nam	China	India	Brunei, Malaysia	Cambodia, Lao PDR	Cambodia, Viet Nam	Cambodia, Lao PDR, Myanmar, Thailand, Viet Nam	Indonesia, Malaysia	Lao PDR, Thailand	Lao PDR, Viet Nam	Lao PDR, Cambodia, Thailand	Lao PDR, China, Thailand	Malaysia, Singapore	Myanmar, Thailand	Thailand, Myanmar, India	China, Myanmar	China, Thailand	China, Viet Nam
Total	761	517	170	72	2	4	68	116	61	25	87	77	115	152	7	20	1	2	4	2	2	3	1	1	1	2	1	1	3	1	4
Tier 1	222	146	54	21	1		1	28		20		25	47	81		15				2	1					2					
Tier 2	432	319	75	37	1	4	65	44	29	1	84	46	64	65	6	4	1	1	4		1	1	1	1	1		1	1	2	1	4
Tier 3	107	52	41	14			2	44	32	4	3	6	4	6	1	1		1				2							1		
Road/Bridge	222	163	49	10		3	31	20	20	3	19	30	20	58	2	6		1	2			2						1	2		2
Railway	120	85	22	13			10	15	4	3	8	11	39	21	3	2			1							2			1		
Port/Maritime	73	33	26	14		1	5	28	3	2	9	6	13	5		1															
Other Transportation	7	5	2								4	2			1																
Airport	52	22	22	8				13	5	4	4	12	6	7		1															
Industrial Estate/SEZ	45	41	1	3			2		4		9	1	11	12	1	4															1
Energy/Power	169	113	33	21	2		15	30	20	10	24	10	15	28		5	1	1	1		2	1	1	1	1		1			1	1
Telecommunication	10	10					3				3		2	1						1											
Urban Development	9	6	2	1			1	2		1			2	3																	
Water Supply/Sanitation	36	22	12	2				7	1	2	5	5	5	10		1															
Others	18	17	1				1	1	4		2		2	7						1											

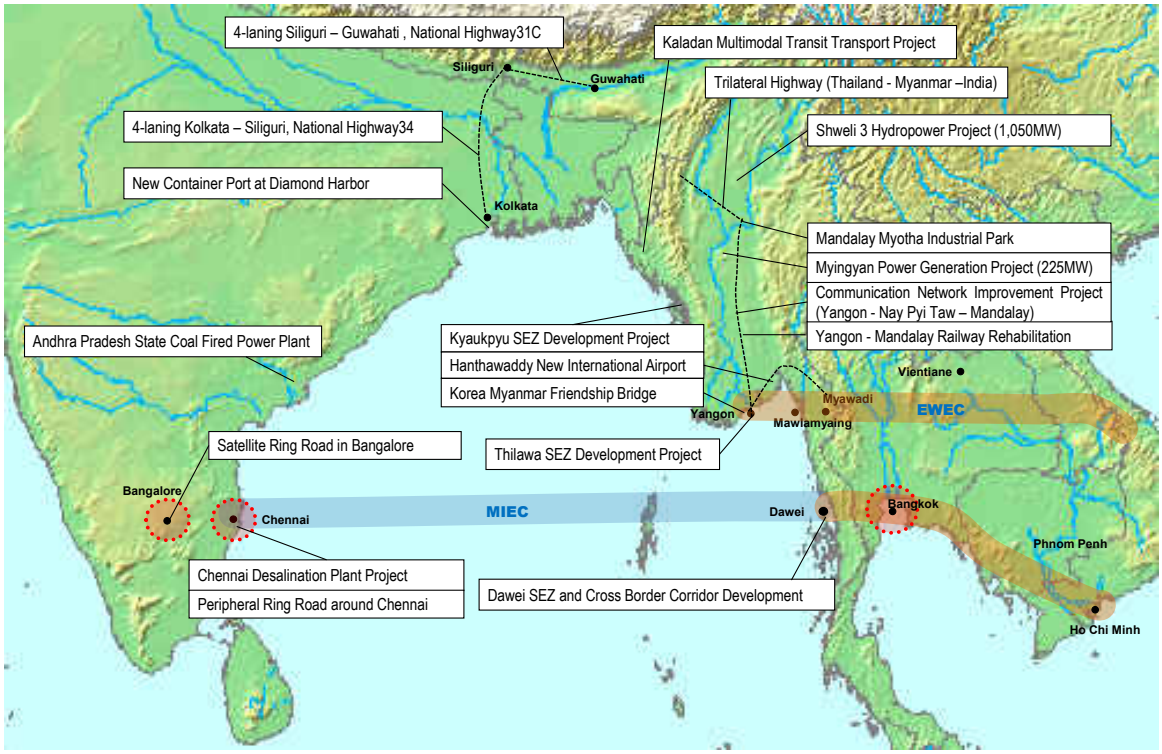
Source: ERIA CADP research team.

Figure 6.1.1. Selected Representative Infrastructure Projects in the Mekong Subregion



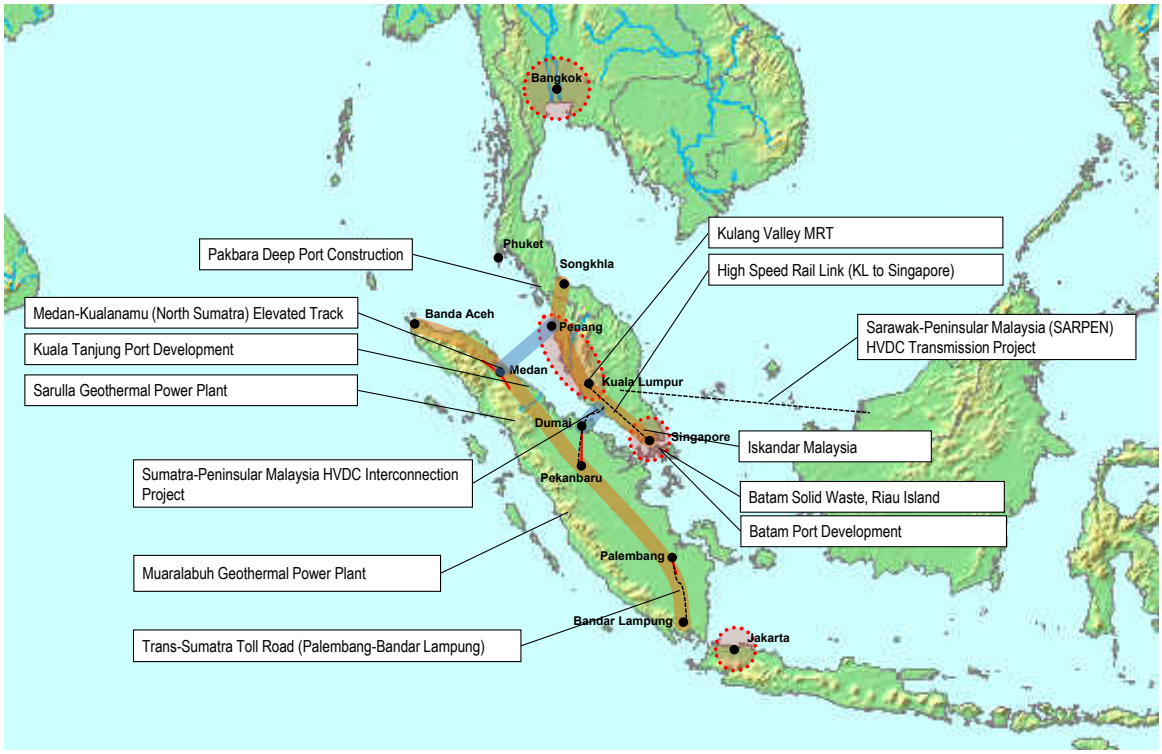
Note: HCMC = Ho Chi Minh City.
Source: ERIA CADP research team.

Figure 6.1.2. Selected Representative Infrastructure Projects in MIEC and East India



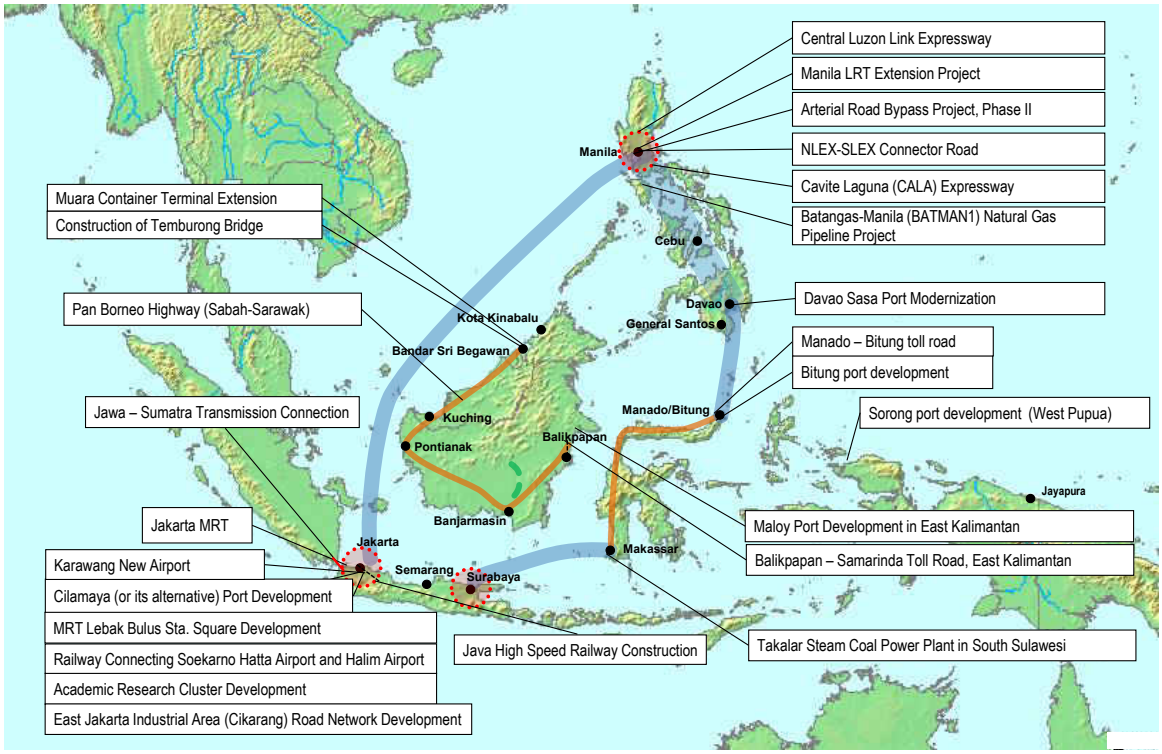
MIEC = Mekong–India Economic Corridor, SEZ = special economic zone.
Source: ERIA CADP research team.

Figure 6.1.3. Selected Representative Infrastructure Projects in the IMT+ Subregion



Note: HVDC = high voltage direct current, IMT+ = Indonesia-Malaysia-Thailand Growth Triangle and surrounding regions, MRT = mass rapid transit.
Source: ERIA CADP research team.

Figure 6.1.4. Selected Representative Infrastructure Projects in the BIMP-EAGA+ Subregion



Note: BIMP-EAGA+ = Brunei Darussalam-Indonesia-Malaysia-The Philippines East ASEAN Growth Area and surrounding regions, MRT = mass rapid transit, NLEX-SLEX = North Luzon Expressway–South Luzon Expressway
Source: ERIA CADP research team.

The following subsections describe outlines of the highlighted sectors for each tier and the two infrastructure categories.

6-1-1. Hard infrastructure for connectivity

6-1-1-1. Tier 1

◇ Railway

Railway projects in Tier 1 include those for connecting metropolitan areas with other cities, which include Singapore–Kuala Lumpur, Java (Jakarta–Bandung), Ha Noi–Vinh, Ho Chi Minh City–Nha Trang, and Bangkok–Chiang Mai high-speed railway projects. The following benefits are expected from these railway developments:

- reduction in transportation time between cities
- boosting of regional interactions
- mitigation of road congestions
- reduction in CO_2 emissions
- increase in tourists
- promotion of urban amenity
- promotion of human resource development and connectivity among industrial agglomeration areas.

Thus, while railway projects generate a lot of positive externalities, we still need to carefully assess economic and financial viability. First, projects should bring in large economic effects, including positive externalities. Second, if projects themselves are not financially viable due to positive externalities, we must design a proper demarcation between public and private involvement. Typically, construction requires some public involvement while operations and maintenance should stand alone with private businesses. In cases of middle- and long-distance railways, possible competition with highway connection and air transportation must be considered.

◇ Airport

Responding to a drastic demand growth of air passengers, expansion of the existing airports and construction of new airports are planned in capital cities and metropolitan areas. In case of expansions, the surplus land space of the original sites is

utilised in many cases. Before constructing new airports, quite a long time is needed to obtain consensus of residents, land, and environmental assessment.

In Ho Chi Minh City, Viet Nam, because the capacity of Tan Son Nhat International Airport is reaching its limit, Long Thanh International Airport is planned to be built 35 km east of Ho Chi Minh City in Dong Nai province, the first phase of which will be completed in 2025. As new airports tend to be constructed in distant locations, developing infrastructure for airport access is critical to the fast, punctual, and long-distance movement of people.

6-1-1-2. Tier 2

◇ Road/Bridge

Many projects in Tier 2 are selected from the perspective of connecting industrial centres, logistic hubs, and neighbouring industrial agglomerations as well as strengthening networks and economic corridors. In particular, Cambodia's National Highway No. 5 Improvement Project is important in view of the development of the Mekong–India Economic Corridor (MIEC). Improvement of National Road No. 9 in Lao PDR is also important in view of the development of the East–West Economic Corridor (EWEC). Truong Loung–My Thuan–Can Tho Highway strengthens network in the Mekong delta area. The Trans Sumatra toll road enforces rapid and fair economic growth in the island.

The construction of bridges, such as the Korea–Myanmar Friendship Bridge, Bach Dang Bridge (part of Ha Long–Hai Phong Highway), and Temburong Bridge in Brunei, coupled with approaching roads to connect regions along the corridor, is expected to drastically reduce transportation time and strengthen connectivity.

The enhancement of cross-border facilities, such as the Thanaleng Border-Crossing Infrastructure Improvement in Lao PDR and the new border checkpoint in Poipet for cargo, is important in the Mekong Subregion for economic integration.

◇ Port/Maritime

Port/Maritime is a critical infrastructure needed for a country to participate in domestic and international production networks. Mass transportation of natural resources and establishment of inter-island logistics are particularly important for local

development. Indonesia as a maritime country has 24 strategic port development plans, of which Kuara Tanjung and Bitung ports are expected to be new international hub-ports.

6-1-1-3. Tier 3

◇ Energy/Power

Tier 3 projects aim to develop infrastructure, enabling to make better use of locally available resources for local development. In the case of infrastructure development of the energy sector in Tier 3, a special focus is placed on the development of power plants utilising location advantages. The list of representative projects includes power projects under categories of hydro, geothermal, wind, and other renewable energies that would help energy conservation and environmental concerns such as the Sarulla and Muara Labuh geothermal power plants in Sumatra island; Shweli 3 Hydropower Project in Myanmar; and wind power plant development in Savannakhet, Attapeu, Salavan, and Xekong.

Power grid/transmission projects, such as inter-island and some cross-border power transmission interconnections, including some projects categorised under other tiers, are also an important foundation to formulate the efficient use of power for the whole region.

◇ Road/Bridge

In Tier 3, standard/semi-standard grade infrastructure for connectivity for various economic activities—such as agriculture/food processing, mining, labour-intensive industries, tourism, and others—are required. Since Tier 3 regions consist mainly of rural and island areas, which are far from metropolitan or large cities, Tier 3 projects include some parts of Lao PDR and Indonesia.

6-1-2. Hard infrastructure for innovation

6-1-2-1. Tier 1

◇ Urban Development

Various types of urban development projects are listed as hardware for innovation. As an example of large-scale multipurpose development, Iskandar Malaysia is set to

become Southern Peninsular Malaysia's most-developed region, where living, entertainment, and business will seamlessly converge within a bustling and vibrant metropolis.

The MRT Lebak Bulus station square project in Indonesia combines the development of a large land space in front of the station and of the city railway. The project aims to amplify the traffic networks and enhance urban amenities through development of bus terminals, park-and-ride parking, hotels, and commercial facilities.

Academic research cluster development should contribute to promoting collaborations between research institutes and private companies and facilitating innovation of various aspects. The Amata Science City is a multi-city development plan in Chon Buri, Thailand. It is planned to be a source of innovation that may push up the value added of Thai industry, strengthen the country's competitiveness against the surrounding nations, provide solutions for environmental concerns, and cause the emergence of new industries associated with technical innovations.

◇ Railway

Railway projects in Tier 1 include those for the urban public transport system (subway, LRT, MRT) and railways to connect urban and suburban areas. Representative projects are the Manila LRT line extension, Klang Valley MRT construction, Jakarta MRT construction, Ha Noi urban railway construction, Ho Chi Minh City urban railway construction, and Bangkok MRT network development. Those projects are needed mainly to ease road congestion in metropolitan and large cities caused by heavy traffic.

Airport access railway has an advantage over congested roads because of its punctuality. There is a plan to connect Soekarno Hatta Airport and Halim Airport by railway.

These construction projects would increase urban amenities and promote innovation.

6-1-2-2.Tier 2/3

◇ Industrial Estate/SEZ

A highlighted project is the Dawei SEZ development, which will accelerate the international division of labour along the MIEC and drastically improve the logistic environment leading to India, South Asia, and the Middle East. Another project on industrial estate/SEZ, the Da Lat Agriculture High-tech Zone project in Viet Nam, aims to enhance agricultural productivity based on the recognition of huge growth potential.

◇ Telecommunication

Under the current telecommunication society, innovation development and upgrading of trunk telecommunication network are important. An example is the Communication Network Improvement Project in Myanmar and Submarine Optical Fiber Cable connecting projects in Cambodia.

6-2. Proper Technical Grades of Transport Infrastructure

CADP 2.0 proposes a new approach of categorising infrastructure projects according to the targeted project outcomes (i.e. for connectivity and innovation). Tiers 1 and 2 projects are categorised into (i) infrastructure for connectivity and (ii) infrastructure for innovation.

To supplement the categorisation of the infrastructure projects described above, the following subsections provide technical features of transport infrastructure. Engineering-based knowledge is useful for considering transport infrastructure appropriate to the three tiers at different development stages and for achieving particular outcomes of connectivity enhancement and innovation.

6-2-1. Roads

Proper road grades for different development stages can be determined by considering various practical elements such as traffic of heavy vehicles, cost of land acquisition, construction and maintenance, and level of services provided. The matrix below provides a guideline of references.

Table 6.2.1. Proper Road Grades

	Multilevel/Ground	Number of Lanes/Width	Pavement
Tier 1	Multilevel (elevated or underground)	depends on planned traffic volume	high grade pavement
Tier 2	Ground (over/under pass for some intersections)	depends on planned traffic volume	high grade/standard pavement
Tier 3	Ground	depends on planned traffic volume	standard/semi-standard

Source: ERIA CADP research team.

Graphic 6.2.1. Image of Road Grades

Source: Ikumo Isono for medium and low grade, METI for high grade
ttp://www.kanto.meti.go.jp/webmag/series/token/images/1204token-1.jpg.

Tier 1 needs to develop and maintain high-quality transport infrastructure that ensures efficient, on-time, and safe movements of people and goods by automobiles without deteriorating urban amenities and the environment. Newly constructed roads at the centre of cities should often be elevated or built underground to mitigate congestion and effectively use land. Some advanced cities tend to build underground for better views regardless of the cost. Four or more lanes are recommended, but in reality two lanes are typical because of the difficulty in acquiring land. As for pavement, some new technologies to reduce noise and vibrations and to accelerate drainage should be adopted for environmental and safety concerns. Projects such as the Ha Noi–Hai Phong Highway in Viet Nam and the NLEX–SLEX (North Luzon Expressway–South Luzon Expressway) Connector Road in the Philippines are planned by high grade.

The road network development in Tier 2 shall assure physical connections of industrial agglomerations in a reasonably short time. Over- or underpass is necessary for some main road intersections. The width of roads where large vehicles usually pass should

be able to accommodate those vehicles. Higher-grade pavements with easy drainage and anti-abrasion are preferable for safe driving. Some national roads in Cambodia are planned to be improved to medium grade.

The priority in Tier 3 is establishing physical networks (connections) even with moderate specification roads for less construction costs. At the same time, certain provisions for future expansion and upgrade should be incorporated in the original plan.

6-2-2. Railways

Railways are an important transportation mode that can complement and alternate with road transportation. Compared with road transportation, railways have several advantages, such as punctuality, large transport capacity, and safety and low CO_2 emissions, as well as disadvantages, such as huge investment costs and the lack of door-to-door services. Considering these technical features of railways and the demand condition in each tier, proper technical grades of railways are summarised in Table 6.2.2.

Table 6.2.2. Proper Railways Grades

	Ground/Elevated/ Underground	**Single track/ Double track**	**Electrified/ Non-electrified**
Tier 1	Elevated/Underground	Double track	Electrified
Tier 2	Ground	Double track	Electrified (Non-electrified)
Tier 3	Ground	Single track	Non-electrified

Source: ERIA CADP research team.

Tier-1 metropolitan and large urban areas are where the railway transportation system is more likely to be economically viable and better suited for realising efficient, speedy, accurate, and safety transportation services. From the viewpoint of safety and road congestion mitigation, intersections of railways and roads shall be avoided as much as possible. Also, for effective use of land, elevated or underground railway is highly recommended. Double track with electrification is required to handle a large number of trains. Utilisation of devices for safety enhancement, such as platform doors, and for facilitation of passenger flows, such as escalator/automatic ticket gates coupled with

smart cards, is recommended for use in passenger stations. MRT extension/construction in Bangkok and Jakarta are planned with such specifications.

Graphic 6.2.2. Image of Railways Grades

Elevated, Double Track, Electrified | Ground, Double Track, Electrified | Ground, Single Track, Non-electrified

Source: ERIA CADP research team.

Tier 2 needs railways to have better inter-city transport systems. Ground railways are good enough for main line regional connection in consideration of construction cost. Double track may be suited to handle a number of trains. For example, in Thailand, there are some doubling track plan such as Nakhon Pathom–Hua Hin, and Lopburi–Paknampho.

Electrification is generally recommended, but diesel trains can minimise on-ground facilities and equipment at the early stage.

In Tier 3, middle-distance railways to carry natural resources and tourists can be ground, single track, and non-electrified to save costs.

6-2-3. Airports

Various factors may affect necessary facilities for airports. Movements of passengers and cargoes depend not only on the size and nature of hinterland economies but also on the movements for transit and tourism in the surrounding area. Air traffic is disproportionately high at hub airports such as Bangkok and Singapore compared to their economy and population sizes. The number of airport passengers is also relatively large at airports close to tourist destinations.

Although it is difficult to definitely grade airport facilities by the three tiers of development stage, the following values are widely used for airport development planning.

- Runway capacity: One runway has an annual capacity of 150,000 movements of aircrafts.
- Total floor space of passenger terminal: 10,000 m^2 floor space for 1 million airline passengers per year.
- Total floor space of air cargo terminal: 1 m^2 floor space per 10–20 tonnes of cargo volume.

Necessary runway length depends on the take-off and landing distance for each type of aircraft and other conditions, such as climate and operational hour. Basic take-off and landing distances for twin-prop regional aircrafts such as ATR 42 and ATR 72 are around 1,000–1,200 metres. A single-aisle narrow-body jet aircraft such as Airbus A320 and Boeing B737 needs a 2,500-metre runway. Large international airports, where double-aisle wide-body jet aircraft such as Airbus A330 and Boeing B777 can take off, tend to have 3,000–4,000-metre runways. In Cambodia, international airports in Phnom Penh and Siem Reap have 3,000- and 2,550-metre runways, respectively (Website of Cambodia Air Traffic Services, http://www.cats.com.kh/).

These figures indicate that if single-aisle jet aircrafts, which are numerous in small to midsized airports in Asia and have a capacity of approximately 180 seats, could fly 150,000 times annually with a load factor of 70 percent (126 passengers per flight) using a 2,500-metre runway at an airport, the airport would require capacity to handle 18.9 million passengers annually by having a 189,000 m^2 passenger terminal. A thorough planning of cargo handling facility will be required should the airport expect to handle double-aisle wide-body aircrafts.

Noi Bai Airport, Luang Prabang Airport, and Kuala Lumpur Airport were improved and extended for their growing demand. Local airports in Indonesia likewise have expansion plans.

6-2-4. Ports

Designing ports takes into account various components, including total land space, water depth, capacity of container yard and terminal, length and number of berths, number and capacity of cranes, and so on. In general, these elements are closely related to the following determinants of cargo throughput:

Graphic 6.2.3. Image of Airport Grades

Suvarnabhumi International Airport

Siem Reap International Airport

Source: ERIA CADP research team.

- Size of port hinterlands that affect the cargo volume of consumer commodities
- Size and type of surrounding industrial estates that affect the volume of export and import cargo
- Degree of trans-shipment hub-port role played, which depends on the location of port, and government policy and its operation and management capacity.

Vessel size is a key engineering factor that constrains the length and water depth of ports. Panamax is a standard, middle-sized container ship that fits in the lock chamber of the Panama Canal that is about 1,000 ft. (304.8 m) in length, 110 ft. (33.5 m) in width, and 42 ft. (12.8 m) in depth and allows the passage of vessels carrying up to 5,000 TEU (twenty-foot equivalent unit). The Panama Canal is expanding the lock chamber to 1,400 ft. (426.7 m in length) x 180 ft. (54.9 m in width) x 60 ft. (18.3 m in depth) that allows the Post-Panamax vessels carrying up to 13,000 TEUs to pass through the Panama Canal (see websites of Panama Canal, http: //www.pancanal.com/, and Panama Canal Museum, http://museodelcanal.com/). Technical requirements for port and related facilities will be upgraded according to innovations in the ship building industry and international vessel transport networks.

Data on these elements help central and local governments and port operators to forecast the size, type, and number of vessel calls and cargo throughput at the port and to draw up a strategic master plan to design capacity and facilities of the port and port terminals. However, the practical size and capacity of existing ports may be smaller than the ideal ones mainly due to the constraints of land space and water depth. As a

countermeasure to these constraints, new ports have been developed at the locations not so far from the original port cities, examples of which are Bangkok port/Laem Chabang port, Saigon port/Cai Mep Thi Vai port, and Chennai port/Ennore port. Malaysia applies the same strategic way of thinking for the development of the Malaysia–Singapore border area including the Port of Tanjung Pelepas that has increased its container throughput by accommodating vessels avoiding the congestions on the sea route to Singapore.

Table 6.2.3. Standard Values of Main Dimensions of Berths for Container Ship (in cases where design ship cannot be identified)

Self-weight Tonnage DWT (t)	Length of Berth (m)	Water Depth of Berth (m)	Container Capacity (TEU)
10,000	170	9.0	500 – 890
20,000	220	11.0	1,300 – 1,600
30,000	250	12.0	2,000 – 2,400
40,000	300	13.0	2,800 – 3,200
50,000	330	14.0	3,500 – 3,900
60,000	350	15.0	4,300 – 4,700
100,000	400	16.0	7,300 – 7,700

Source: MLIT and PARI (2009), p.687.

Graphic 6.2.4. Image of Port Grades

Laem Chabang Port

Da Nang Port

Note: Ishida (2011) tabulates indicators on scales of major port terminals in the Mekong Subregion.
Source: ERIA CADP research team.

6-3. Energy Infrastructure Investment

Energy infrastructure includes power plant, transmission line, refinery plant, liquefied natural gas (LNG) receiving terminal, gas pipeline, and all energy projects.

They are basically categorised as follows:

Tier 1 - Stable, ample, and clean electricity and energy supply for final users

Tier 2 - Stable and ample electricity and energy supply for final users

Tier 3 - Development of power plants taking location advantages for local supply of electricity

As there are many types of energy infrastructure, some detailed categorisation is mentioned in the following paragraph.

Because energy use also depends on economic development, energy infrastructure can also be categorized into three tiers. The low income group uses biomass, charcoal, and coal briquettes (Tier 3). The middle income group shifts to petroleum fuel including LPG (Tier 2), and the high income group uses electricity and piped gas (Tier 1) to maintain a better life and shift from agricultural activities to manufacturing and services activities. The second classification is based on conventional and unconventional types. Basically conventional energy is similar to Tier 2 or 3 whereas unconventional energy represents Tier 1. The third classification is based on the advanced level of energy technology. Energy infrastructure projects that apply highly advanced technology are classified under Tier 1 and traditional energy technology projects in Tier 3.

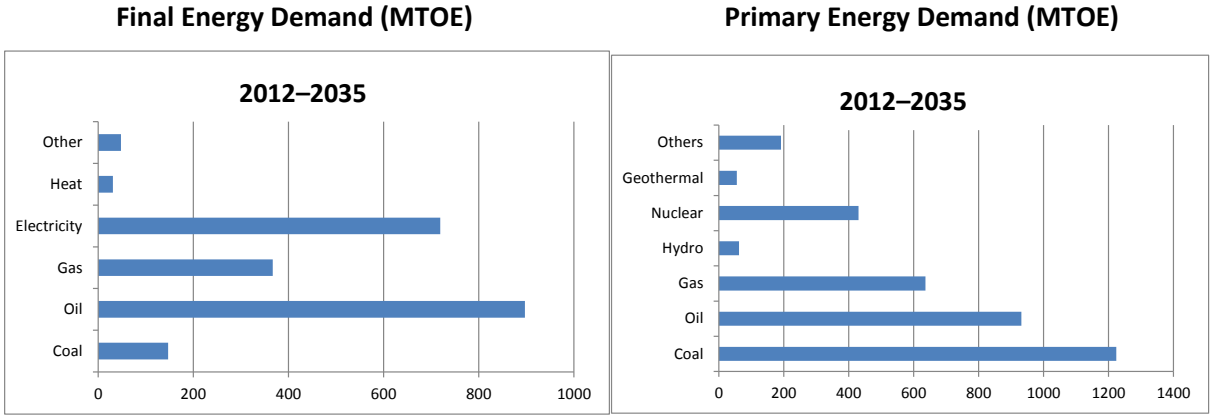
But choice of energy infrastructure sometimes does not necessarily follow economic development. For example, people living in rural areas who usually have low income may use photovoltaic (PV), wind, and mini-hydro system, which are classified as unconventional or renewable energy, if they want to have electricity to meet developmental needs.

Basically the energy development plan of East Asia Summit (EAS) countries consider four energy issues: locally available energy resources, energy efficiency, low carbon energy, and supply security. Usually high income countries emphasise energy efficiency, low carbon energy, and supply security. On the other hand, low income countries prioritise locally available energy and low-cost energy technology. In this regard, energy infrastructure investment is introduced along with the energy issues touching on the three categories in this section.

6-3-1. Basic principle

How is future energy infrastructure investment identified? There are two points of view: future energy demand and energy policies affected by energy and environment trends. How about future energy demand? According to *Energy Outlook and Analysis of Energy Saving Potential in East Asia*' published by ERIA in 2015 (Kimura and Han, 2015), fossil fuel is still dominant and plays an important role in this region (Figure 6.3.1).

Figure 6.3.1. Energy Demand Increment of Energies in the EAS Region (from 2012 to 2035)



Source: Kimura and Han (2015).

In terms of final energy demand level, oil and electricity will increase significantly from 2012 to 2035, followed by natural gas and coal. On the other hand, at primary energy demand level, coal will mark the highest increment, followed by oil, natural gas, and nuclear energy. Based on the energy demand project, electricity supply infrastructure, especially power generation, and oil and gas infrastructure are crucial.

On the other hand, what are the current key energy policies? They are as follows:

- Curtailing the increment of energy demand by promoting energy efficiency
- Responding to environmental challenges such as climate change related to CO_2 emissions from energy combustion
- Increasing energy supply security.

Energy efficiency needs aggressive use of high efficiency industrial equipment such as boiler and compressor and highly fuel-efficient vehicles, and application of green buildings.

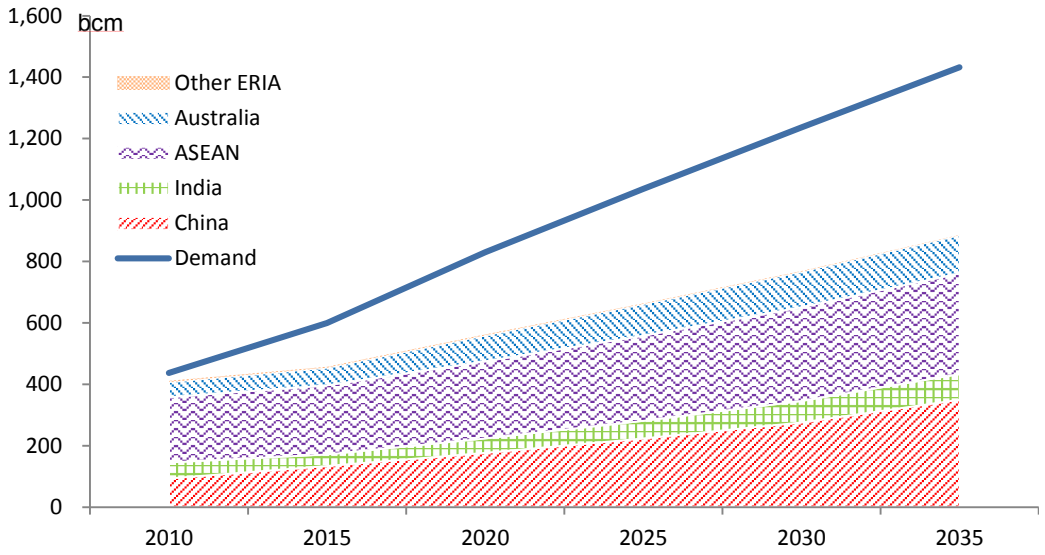
The usage of high efficiency type thermal power plants such as clean coal technology (CCT), especially Ultra Supercritical (USC), and high efficiency type natural gas power generation is included. Subcritical type coal power generation plants are also included as current power generation projects. Natural gas power generation is considered environmentally clean and has high thermal efficiency. In this regard, all Asian countries consider natural gas as a major power generation source. Several natural gas power generation projects applying combined cycle gas turbine (CCGT) technology are also included. These projects are in principle considered as Tier 2.

On environmental challenges, shifting to low carbon technologies and energies is recommended. Final energy demand sector could apply low carbon technologies directly, but the power sector has huge potential to apply low carbon technologies and energies as well. The low carbon energies consist of hydropower, nuclear power, geothermal power, PV/wind power, etc. Cambodia, Lao PDR, Myanmar, and Viet Nam or the CLMV countries have a large hydropower potential. Viet Nam started nuclear power generation projects with support from Russia and Japan. Some geothermal projects are also included, as Indonesia and the Philippines have large potential of geothermal energy. PV/wind/other RE (renewable energy) power generation are also included, such as power generation by incineration plants in Indonesia, Lao PDR, Myanmar, Thailand, and India. Natural gas power plants are also classified as low carbon emission plants vis-à-vis coal and oil power generation plants as earlier mentioned. According to ERIA's study on natural gas market (Kutani and Li, 2015), about 550 BCM will be imported as LNG (Figure 6.3.2). In this regard, a remarkable number of LNG-receiving terminals will be constructed besides upstream ports; this report includes some of the LNG-receiving terminals. These projects are in principle considered Tier 2 or Tier 1, depending on the use of the energy and the level of technological advancement. Specifically, if it is developed for the electrification of the local community and makes use of indigenous energy resources, it is considered Tier 2. If it is developed to supply cleaner energy to the grid for towns and cities, it is considered Tier 1.

Regarding energy security, oil stockpiling, power grid interconnection, and increase of fossil fuel supply are highlighted in the region. Due to the rapid and continuous increase in oil demand, an oil stockpiling system should be installed in this region in addition to that of EAS and OECD countries such as Australia and Japan. But stockpiling

projects are not included in Appendix 1 because of their uncertainty and the small investment.

Figure 6.3.2. Natural Gas Demand Supply Gap (BCM)



Source: Kutani and Li (2015).

Power grid connection is another method to secure electricity supply. After the great earthquake and tsunami in March 2011, the eastern part of Japan faced a serious lack of electricity supply due to the shutdown of nuclear power plants. Some experts say that if Japan's power grid were connected to neighbouring countries such as South Korea and Russia, its supply capacity could have been maintained. Currently, several ideas on power grid interconnections, such as the East Asia Super Corridor and EAS Super Corridor (China–ASEAN–India), have been put forward. There are also ongoing projects such as the GMS (Greater Mekong Subregion) Initiative and the ASEAN Power Grid Interconnection initiative. The basic concept of the ASEAN Power Grid is the interconnection of the national power grids of each ASEAN country. Consequently, the construction of national transmission lines and cross-border interconnections are and will be made by ASEAN countries, and this report includes these projects. Again, these projects are considered Tier 2 or Tier 1, depending on the use of the energy and the level of technological advancement. If the interconnection results mainly in the optimal use of energy

resources, especially clean energy, crosses the border, and supplies the main grid of the importing country, it is considered Tier 1.

ASEAN has another connectivity initiative, namely, the Trans ASEAN Gas Pipeline (TAGP). At the beginning, TAGP was planned to connect each ASEAN country by pipeline. However, the ASEAN Council on Petroleum (ASCOPE) changed the plan. TAGP now consists of two types of interconnection—through pipeline and through LNG. The infrastructure for LNG includes liquefaction and regasification facilities. LNG is thus referred to as virtual pipeline. TAGP also included a national gas pipeline settlement. This report includes several national pipeline projects in the Philippines, Thailand, and India which are considered Tier 2 or Tier 1, depending on the use of the energy and the level of technological advancement. If the interconnection results mainly in the optimal use of natural gas resources across-border and supplies high-efficiency natural gas power plants of the importing country, it is considered Tier 1.

Increase of regional fossil fuel supply is essential to maintaining the security of energy supply. But experts say that oil and natural gas production of producing countries in this region will decline in the future, except for Myanmar which could increase natural gas production due to its high reserves.

Oil will still be the dominant energy in this region, used in industry production activities, transportation, and power generation (mainly for backup power system in industry, commercial, and building sectors). Specifically, increase in crude oil demand means that the demand for petroleum products, such as gasoline and diesel oil, increases. Consequently, this region will need to increase the capacity of petroleum refinery plants. Whereas petroleum demand has already saturated in some developed countries in this region, such as Japan, that of emerging countries will increase rapidly and continuously. In this regard, petroleum companies of developed countries will invest and construct petroleum refineries in this emerging area. Some petroleum refinery projects in Viet Nam are included as Tier 2 projects.

6-3-2. Clean Coal Technology

Coal demand in EAS economies still has the largest share of primary demand, although its share will decline from 52 percent in 2012 to 44.9 percent in 2035 (Kimura and Han, 2015). The demand for coal is largely due to the increasing use of coal to

generate power to meet electricity demand. Demand for power generation is projected to grow at 3.3 percent per year on average from 2012 (8,717 TWh) to 2035 (18,530 TWh). The share of coal-fired generation is projected to continue to be the largest and will remain about 60 percent of the total until 2035. The share of natural gas is projected to be stable at around 12 percent from 2012 to 2035. The nuclear share (3.4 percent in 2012) is forecasted to increase to 10.5 percent in 2035.

Most of the coal demand in the region is expected to be addressed by Indonesia as it has abundant low-rank coal with low ash and low sulphur content that offers advantages in both price and environmental compliance (Otaka and Han, 2015). As emerging Asian economies will continue to rely on coal to steer economic growth, the proliferation of more sustainable energy development such as clean coal technologies (CCTs) will need to be deployed urgently to mitigate the negative effects on the region's environmental security, such as the potential of rising greenhouse gas (GHG) emissions from burning coal.

To date, the best available and mature technological developments on CCT to generate power from coal are combustion and gasification technologies.[11] CCTs for coal combustion generally deploy higher steam conditions, i.e. ultra-supercritical (USC), supercritical (SC), and subcritical technologies. USC and supercritical SC technologies, however, are more suitable for larger units. For units of less than 400-megawatt electrical output, the advantages of the higher steam conditions may not be realised. Integrated gasification combined cycle, though less mature than combustion technologies, can potentially offer high efficiencies from smaller capacity units.

Considering the level of development, least developed countries will likely use low-efficient coal-fired power plant such as sub-critical technology (Tier 3 of technological grade). Once a country moves up to the middle income level with better per capita income and distribution, people will demand for better social well-being, including environmental quality. Thus, middle income countries may select highly efficient coal-fired power plants with SC technology (Tier 2 of technological grade). Advanced countries with stringent

[11] The clean coal technologies (CCTs) in this paper refer to ultra-supercritical technologies for combustion and to integrated gasification combined cycle. Though there have been debates about whether CCTs also include carbon capture and storage (CCS) because CCS is not commercialised, it is not considered for the CCT deployment to emerging Asia.

environmental standards may consider highly efficient and low emission technologies, such as USC technology or integrated gas combined cycle technology (Tier 1 of technological grade).

The dissemination of CCT technologies for the clean and efficient use of coal in emerging Asia is of pressing importance. ERIA's 'Study on the Strategic Usage of Coal in the EAS Region: A Technical Potential Map and Update of the First-Year Study' (Otaka and Han, 2015) concludes that the application of inefficient technologies and ineffective environmental standards and regulations would lead to a waste of valuable coal resources. Thus, EAS economies may need to consider upgrading technological grades from Tier 3 to Tier 2 and to Tier 1.

The inclusion of mega projects for coal-fired power plants in the project list of CADP 2.0 illustrates the increasing use of USC in large economies in ASEAN region as countries move forward to limit CO_2 and GHG emissions, i.e. practically, most fleets of coal-fired plants in Central Java, Indonesia will be using the USC technology (Tiers 2 and 1). Likewise, Thailand is upgrading the existing subcritical coal-fired power plant with the first-ever USC coal-fired power plant in Mae Moh, located in Lampang which is expected to send electricity to grids by 2018 (moving from Tier 3 to Tier 1). In the project list, gas-fired power plants along hydropower development are included as part of the region's power generation mix. However, the speed of CCT deployment remains critical for emerging EAS economies.

To facilitate informed decision-making, ERIA's study on the strategic usage of coal in the EAS region (Otaka and Han, 2015) examined various technologies (USC, SC, and subcritical), comparing their generation cost by boiler types and coal price (Table 6.3.1). The study found that financing costs also account for a significant share of total generation costs. In this analysis, two IRR (internal rate of return) cases were included. Results show that USC loses cost-competitiveness in higher IRR case, implying higher financing cost. For example, at coal prices of USS50/tonne, USC is most cost-competitive (at US$6.77/kWh) when IRR is 9.5 percent. However, when IRR is increased to 15 percent, USC is less cost-competitive (at US$8.27/kWh) than SC and subcritical. Therefore, USC may be less viable in countries that do not have access to low-interest loans. This result also implies that the USC technology has a barrier of higher upfront cost than the SC technology and conventional plants. Thus, among other policies, an attractive financial scheme to bring

down upfront cost, such as long-term financial scheme with low interest rate, will be necessary to ensure the up-taking of USC technology in emerging EAS economies.

Table 6.3.1. Generation Cost by Boiler Type and Coal Price

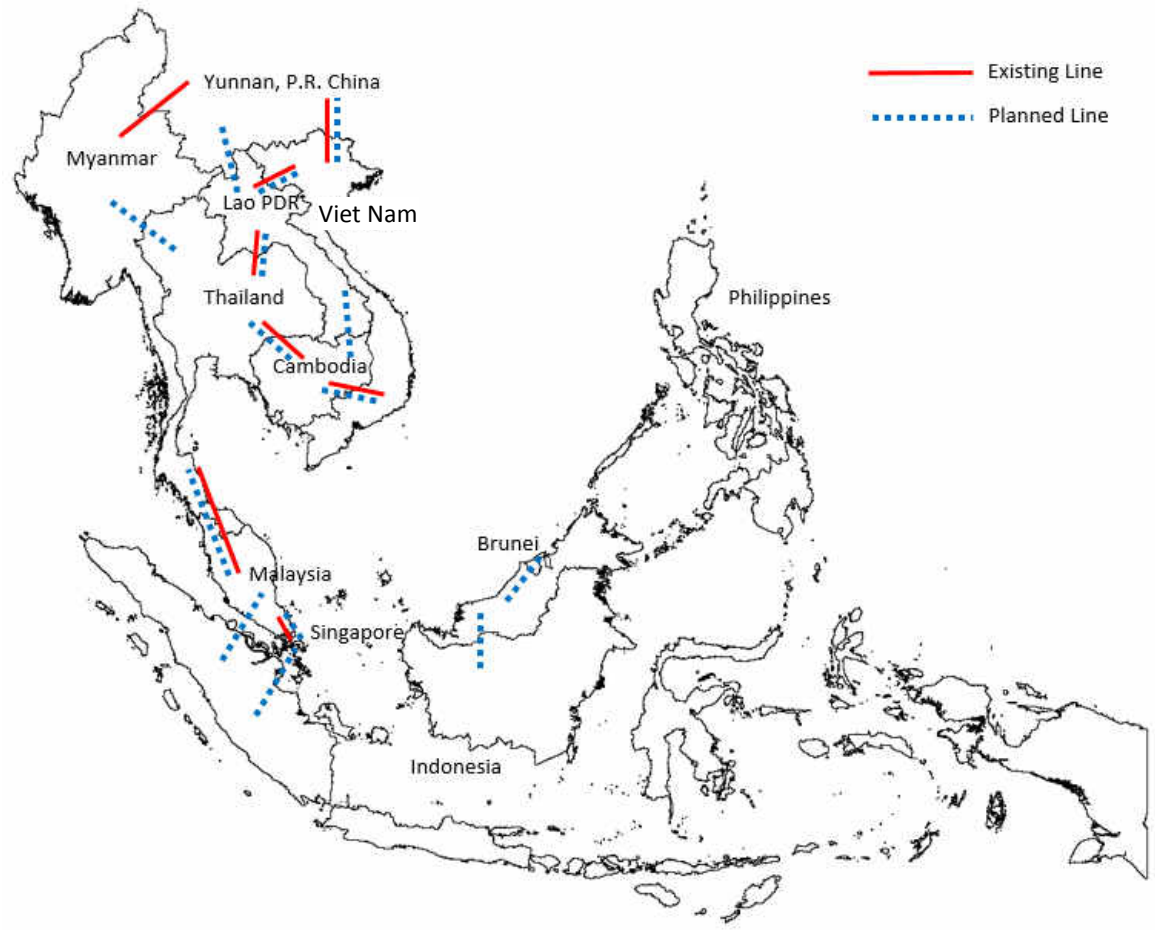
		Boiler Type		
		Ultra Super Critical (USC)	Super Critical (SC)	Sub-critical
Capacity		1,000 MW		
Coal CV / Price		4,000 Kcal/kg (GAR) / 50 USD/ton		
Thermal Efficiency (LHV)		42.1%	41.1%	38.2%
Initial Cost (million USD)		1,931	1,897	1,787
Coal Consumption (tons/year)		3,578,263	3,665,326	3,943,583
CO2 Emission (tons/year)		5,102,914	5,227,073	5,623,893
Generation Cost (USD cent/kWh) (@USD60/ton)	IRR= 9.5%	7.29	7.33	7.43
	IRR=15.0%	8.79	8.80	8.81
Generation Cost (USD cent/kWh) (@USD50/ton)	IRR=9.5%	6.77	6.79	6.85
	IRR=15.0%	8.27	8.26	8.24
Generation Cost (USD cent/kWh) (@USD40/ton)	IRR=9.5%	6.25	6.26	6.27
	IRR=15.0%	7.75	7.73	7.66

Source: ERIA CADP research team.

6-3-3. Power grid interconnection

The ASEAN Power Grid and the GMS Initiative are the two key initiatives to drive regional power grid interconnectivity among ASEAN countries (Figure 6.3.3). Both have been making steady progress in the form of bilateral interconnection projects with long-term power purchasing agreements. Such is perceived as the first stage towards the fully functioning regional grid for multilateral trading of power (Li and Chang, 2015).

Figure 6.3.3. ASEAN Power Grid Interconnectivity – Existing and Planned



Source: ERIA CADP research team.

A fully functioning regional grid bears many benefits to countries involved. Through such interconnection, cheaper renewable energy resources which are abundant in the region, especially hydropower in the GMS, could be further developed. In addition, the interconnected grids can take advantage of the varying peak and non-peak hours in different countries and thus save a large portion of the investment in expensive peak power generation capacities. ERIA (2013) estimated some US$11 billion net savings in the cost of electricity generation for all ASEAN countries plus two Southwest China provinces and Northeast India in 20 years, despite the high initial costs of investment in interconnecting transmission lines. The other independent estimation by Chang and Li (2012) presents a net savings of US$20.9 billion for ASEAN alone in 20 years.

Furthermore, the interconnection of grids in the region enhances the overall capacity of countries to adopt renewable sources of power generation, such as solar PV

and wind turbines. Chang and Li (2015) show that, with power grid interconnection among ASEAN countries and by implementing a feed-in-tariff (FiT) policy for renewable energy, renewable energy adoption could be increased by some 70 percent compared to the baseline scenario with no interconnection and no FiT, while the total cost of electricity generation increases by only 8 percent. With less aggressive FiT policy, an increase in the total cost by 1 percent can increase the adoption of renewable energy by some 30 percent.

However, the high upfront cost of new transmission lines for cross-border interconnection and the uncertainty of future demand for imports and exports of electricity through these transmission lines complicate the financial decisions to invest. The financial feasibility of each proposed cross-border transmission line needs to be carefully studied. A study by ERIA (2014) identified that a power grid interconnection among Lao PDR, Malaysia, Singapore, Thailand, and Viet Nam is financially feasible and should be prioritised (Table 6.3.2). This finding coincides with the initiative by the governments of Lao PDR, Thailand, Malaysia, and Singapore to develop interconnections and demonstrate a multilateral framework for cross-border trade of power.

Table 6.3.2. Possible Interconnection and Cumulative Costs and Benefits (2025–2035)

Case		Gross benefit (A)		Cost (B)		Net benefit (C)=(A)-(B)		Benefit/Cost ratio (D)=(C)/(B)
		[Million US$]	[US¢/kWh]	[Million US$]	[US¢/kWh]	[Million US$]	[US¢/kWh]	[-]
B	THA—LAO	21,387	3.77	1,506	0.26	19,881	3.51	13.2
E	VNM—LAO—THA	24,707	3.68	2,097	0.32	22,610	3.36	10.8
G	LAO—THA—MYS—SGP	27,490	3.88	2,000	0.28	25,490	3.60	12.7

Source: Fukasawa, Kutani, and Li (2015).

6-3-3-1. Challenges: Regulatory Connectivity

However, further institutional issues still stand as barriers to the realisation of a fully interconnected power grid in the region. Challenges in setting up the following remain: (i) a regional regulators' group/regional regulatory body to harmonise regulations and standards relevant to grid interconnection, (ii) a regional operators' group or regional system operator to synchronise actions in balancing the grid and the cross-border power

exchange systems, and (iii) a regional system planners' group to coordinate and optimise the future investment plan of power stations and the grid.

All these three points concern the soft infrastructure development in the region in order to match the hard infrastructure development of power grid interconnection and thus achieve the most benefits of it. Such soft infrastructure can also be referred to as regulatory connectivity.

In response to the challenges listed above, as components of the road map towards the materialisation of the ASEAN Power Grid, two research projects will jointly be carried out by ERIA and The Heads of ASEAN Power Utilities/Authorities (HAPUA).

The first is a Study on the Formation of the ASEAN Power Grid Transmission System Operators (ATSO) Institution. There are two layers of objectives: (i) to establish the roles, structures, operational guidelines, and processes of the ATSO institution; and (ii) to provide the detailed implementation plan for the creation and operation of the ATSO.

The second is a Study on the Formation of the ASEAN Power Grid Generation and Transmission System Planning (AGTP) Institution. The objective is to propose applicable procedures, structures, roles, and mechanisms to establish and maintain the AGTP.

The ATSO and the AGTP institutions, once achieved, will be symbolic of the regulatory connectivity in ASEAN.

6-3-4. Overall investment amount

ERIA's study estimated that US$13 trillion in cumulative investment will be required until 2035 to realise the energy saving potential through energy efficiency and conservation. This will need to be invested in highly efficient power sector, transportation, building, and other energy infrastructure.

ERIA's study on the strategic usage of coal (Otaka and Han, 2015, forthcoming) also quantifies the investment opportunities in the EAS region from the increase in coal-fired power generation. The results suggested that about US$1700 billion investment is needed to meet the rising 898 gigawatt (GW) generated from a coal-fired power plant in EAS economies by 2035. Further, about US$300 billion investment in coal field development is required to meet the demand of 1,943 metric tonnes (MT) coal per year by 2035.

The Southeast Asia Energy Outlook (IEA and ERIA, 2015) estimated that ASEAN alone will need US$2.5 trillion in cumulative investment in energy infrastructure to 2040 in order to secure the region's growing energy demand. More than half of the total is required for the power sector. ASEAN will also need about US$420 billion to improve energy efficiency over the period to 2040.

6-4. Policy Issues Regarding Soft Infrastructure Post 2015

The importance of soft infrastructure has been gaining more attention recently because of the remarkable progress of hard infrastructure development in ASEAN. Soft infrastructure can contain a wide range of soft aspects such as software, information systems, legal instruments, and regulations. Although various soft issues—including both technological and institutional barriers—should be overcome before making better use of hard infrastructure, institutional issues are practically more troublesome and require substantial time and efforts to solve. Not only creation but also harmonised implementation of quality regulations among ASEAN Member States affect domestic and cross-border business performance.

As assessed in Chapter 5, among infrastructure for connectivity and innovation, substantial progress has been made in the development of infrastructure for connectivity. ASEAN Member States have been ratifying legal instruments and subregional agreements related to the ASEAN Economic Community (AEC). Nevertheless, it will take more time and patience for the member states to conform related domestic laws and regulations to said international agreements. International cooperation is also needed to harmonise interpretation and implementation of such agreements and regulations.

Chapter 5 illustrated the difficulty in implementing international agreements with the example of the CBTA. Although the launch of single window and single stop customs inspections at the Lao PDR–Viet Nam border crossing point in 2015 marked a milestone in the history of trade and transport facilitation in the GMS, it should be noted that the CBTA was signed by GMS countries in 1999 and ratified in 2003. Such time-consuming task can be demanded to develop the ASEAN Single Window (ASW) that will involve difficult coordination among ministries within a country.

Development of infrastructure for innovation must be prioritised after 2015 especially in Tier 1 regions where manufacturing and service activities should be more

knowledge-based and innovative. Innovation can be realised by creating new knowledge from existing knowledge. Knowledge transfer and spillover are key mechanisms to generate innovation. As previous studies on innovation in Southeast Asia had investigated (e.g. Kimura, Machikita, Ueki, 2015), firms in the region tend to achieve innovation, using knowledge externally available for the firms. Infrastructure should be designed appropriately to create business environments that facilitate knowledge transfer and spillover, and foster human resources.

A better understanding on knowledge is needed to consider what infrastructure is essential for innovation. Knowledge can be categorised into two types: explicit/codified and tacit knowledge. 'Explicit knowledge can be expressed in formal and systematic language and shared in the form of data, scientific formulae, specifications, manuals, and such like. It can be processed, transmitted and stored relatively easily' (Nonaka, Toyama, Konno, 2000). Patent is a form of explicit knowledge. Licensing of intellectual property is a transmission channel of knowledge. In contrast to explicit knowledge, tacit knowledge is subjective insights, intuitions, and hunches that are highly personal and hard to formalise and often time and space specific. Knowledge is created through interaction between tacit and explicit knowledge and among individuals (Nonaka, Toyama, Konno, 2000).

Innovative activities need a freer flow of people and quality hard/soft infrastructure and services supporting the interactions and innovative activities. In addition to reliable transport infrastructure and services, transport facilitation and other soft infrastructure enable people to move timely and smoothly to transfer knowledge locally and internationally. Stable and clean power supply enables the use of precise high-tech equipment for research and development. Ubiquitous secure communication environments allow the conduct of innovative activities anytime and anywhere. Appropriate intellectual property law and cybersecurity help in exchanging knowledge and information in more secure environments. Quality living and business environments attract talents (e.g. inventors, researchers, entrepreneurs), which help develop quality business support services and educational institutions.

As the AEC envisions the free flow of services and skilled people, which will promote innovations, ASEAN Member States signed the ASEAN Framework Agreement on Services and have developed mutual recognition arrangements for eight professionals

(i.e., engineers, architects, nurses, doctors, dentists, accountants, surveyors, and tourism professionals). However, there are still institutional limitations on the free flow of people and services. Even though ASEAN Member States signed the ASEAN Agreement on the Movement of Natural Persons (MNP), the agreement has not entered into force. The MNP agreement covers business visitors, intra-corporate transferees, and contractual service suppliers. But the commitments vary widely across the countries. The agreement does not cover non-services sectors (Fukunaga and Ishido, 2015), indicating that manufacturing firms will not find it easier to send engineers between factories in ASEAN for technology transfer.

In order to promote innovation, adequate regulatory coherence within and among ASEAN Member States (i.e. regulatory connectivity) is fundamental. Excessive redundant documentation requirements and complicated burdensome procedures for trade, transport, and business trips result in a higher cost of doing business. Regulatory practice and regulatory management system should be improved continuously to address these implementation problems leading to enhanced business environments for connectivity and innovation.

Chapter 7

Quantitative Assessment on Hard/Soft Infrastructure Development: The Geographical Simulation Analysis for CADP 2.0

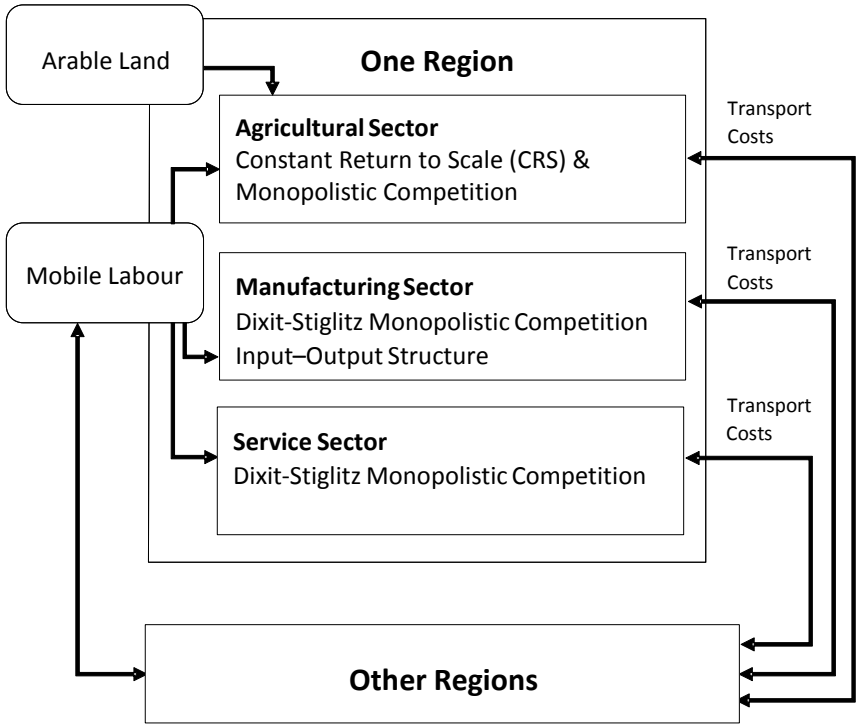
7.1. What is new in the IDE/ERIA–GSM 2015?

This chapter makes the quantitative assessment of further infrastructure development in the horizon of 2030 with the IDE/ERIA–GSM (Geographical Simulation Model) and tabulates our proposed infrastructure-related projects for connectivity and innovation. ERIA has been developing said model since 2007 in cooperation with the Institute of Developing Economies (IDE).

The IDE/ERIA–GSM illustrates the dynamics of the location of populations and industries in East Asia in the long term. Although many analyses forecast the macroeconomic indices in East Asia at the national level, an analysis using the macroeconomic models hardly forecast economic development in East Asia at the subnational level except for a scant amount of literature. The model also enables us to analyse the impact of specific infrastructure projects on regional economies at the subnational level. It further provides an objective evaluation tool to prioritise various infrastructure development projects.

The theoretical foundation of the IDE/ERIA–GSM follows New Economic Geography (NEG), in particular, Puga and Venables (1996), which captures the multi-sector and country general equilibrium. The IDE/ERIA–GSM features agriculture, five manufacturing sectors (automotive, electric and electronics, textile and garment, food processing, and other manufacturing), and the services sector. The model allows workers to move within countries and between sectors. A notable difference of the IDE/ERIA–GSM from that of Puga and Venables (1996) lies in the specification of the agricultural sector. The IDE/ERIA–GSM explicitly incorporates land size in its production and keeps its technology as constant returns to scale. For more details on the IDE/ERIA–GSM, see Chapter 4 of ERIA (2010), Kumagai and Isono (2011), and Kumagai et al. (2015).

Figure 7.1. Basic Structure of the Simulation Model in Simulation



Source: ERIA-IDE Team.

ERIA (2010) presented the simulation results based on the IDE/ERIA–GSM in terms of the cumulative gains in regional GDP for the 2011–2020 period from the set of CADP infrastructure projects. For CADP 2.0, we conduct an impact analysis of new sets of projects in terms of the cumulative gains in real GDP for the 2021–2030 period utilising the latest version of IDE/ERIA-GSM. The comparison of the 2010 CADP version and the current one is summarised in Table 7.1. In 2010, we covered ASEAN 10 countries, Bangladesh, and parts of China and India. Now the model includes whole regions of China and India, and other economies in East and South Asia such as Japan, Korea, Sri Lanka, Bhutan, and Nepal. The model also covers other areas of the world, referred as 'Rest of the World'. We use country data for those 65 other countries. In 2010, border costs, tariffs, and non-tariff barriers (NTBs) were treated as one parameter representing a border barrier in a broader sense, while they are estimated separately and incorporated into the model in the latest version.[12] The current version of the IDE/ERIA-GSM also incorporates changes in productivity parameters, which describes SEZ (special economic zone) development or disasters, and

[12] As for the construction of the data on non-tariff barriers (NTBs), see Appendix 2. Note that the definition of NTBs is a broad one, a part of which can be removed by policies while others may not.

congestion at borders, ports, and airports that is endogenously calculated in the model.

Table 7.1. Comparison of IDE/ERIA-GSM for CADP (2010) and CADP 2.0 (2015)

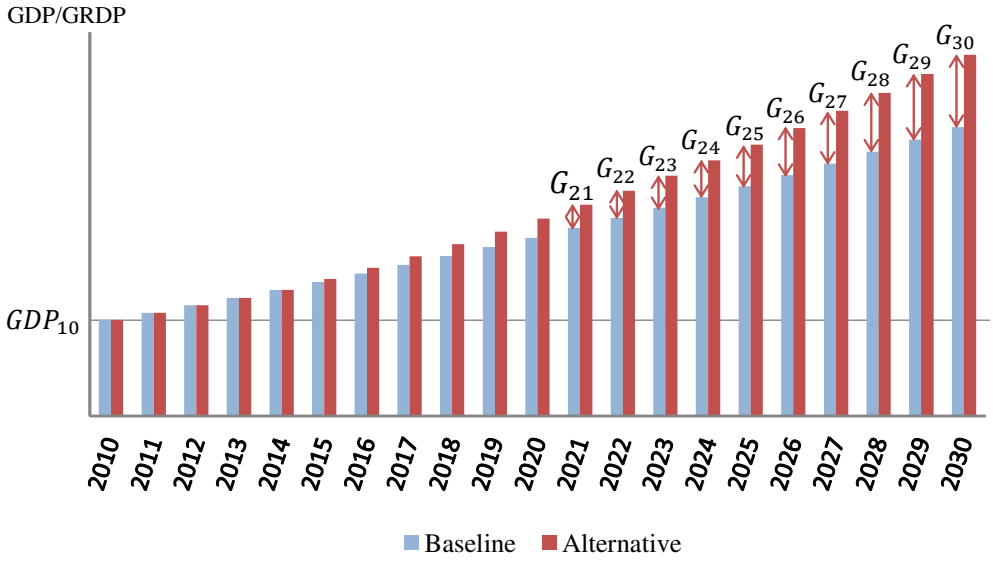
	For CADP (2010)	For CADP 2.0 (2015)
Version of IDE/ERIA-GSM	4.0	9.0
Number of economies in East and South Asia	15	21
Number of regions	956	1,818
Number of nodes	1,676	5,833
Number of routes	2,691	10,906
Number of transport modes	Road, Sea, and Air	Road, Sea, Air, and Rail
Number of industries	7	7
Intermediate goods	Yes	Yes
Non-tariff barriers	No	Yes
Rest of the World	No	65 economies
Tariff data	No	Yes
SEZ/disaster analysis	No	Yes
Congestion	No	Yes

SEZ = special economic zone.
Source: ERIA-IDE Team.

7.2. Scenarios and Results

We conducted a baseline scenario and other alternative development scenarios. A 10-year (2021–2030) cumulative impact would be shown as *Impact density,* that is, the impact in US dollars divided by area, and percentage which is derived as Figure 7.2.

Figure 7.2. Economic Impact, in percentage



$$\text{Economic Impact} = \frac{\sum_{y=21}^{30} G_y}{GDP_{10}}$$

Source: ERIA-IDE Team.

Baseline scenario

We have the following assumptions across all scenarios:

- The national population of each country is assumed to increase by the rate forecasted by the United Nations Population Division until year 2030.
- International migration is prohibited.
- Tariffs and non-tariff barriers are changing based on FTA/EPAs (free trade agreements/economic partnership agreements) that are currently effective.
- We have calibrated different exogenous 'technology progress' parameters for each country to replicate the average GDP growth rate between 2010 and 2020 projected in the World Economic Outlook Database by the International Monetary Fund.

In the baseline and other development scenarios, we assume that some specific infrastructure projects are completed in 2015 in the model. Those projects include the Third and Fourth Mekong Bridge; expressways provision and extension in Myanmar, Indonesia, and the Philippines; road construction and improvement in Myanmar; and the Tsubasa Bridge in Cambodia.

Table 7.2. Grand Table: Economic Impact in 10 Years Cumulation (2021–2030, %)

Economy	MIEC	EWEC	NSEC	IMT	IMT+	BIMP-EAGA	BIMP-EAGA+	BIMSTEC	All Infra.	NTB	SEZ	All-All
Australia	0.52	0.00	0.02	0.08	0.15	0.22	0.33	0.65	1.28	0.84	-0.04	2.10
Bangladesh	0.48	0.00	-0.01	-0.04	-0.05	-0.05	-0.07	11.45	11.51	8.48	0.02	20.56
Bhutan	5.84	0.00	-0.03	0.06	0.07	0.02	0.07	3.91	104.90	4.75	-0.01	109.81
Brunei Darussalam	1.95	0.01	-0.29	0.39	0.61	1.00	1.41	1.93	5.32	82.07	-0.12	88.33
Cambodia	144.45	0.00	-0.58	-0.02	-0.02	-0.03	-0.06	-0.26	24.86	8.44	125.39	160.30
China	0.15	0.00	0.00	0.00	-0.01	-0.01	-0.02	0.06	0.10	7.74	0.02	7.99
India	0.56	0.00	0.00	0.02	0.03	0.02	0.03	6.61	6.59	12.21	-0.01	19.28
Indonesia	0.07	0.00	0.00	2.20	35.01	27.30	57.88	0.07	91.87	25.86	0.03	118.50
Japan	0.52	0.00	0.02	0.10	0.12	0.18	0.22	0.57	1.39	1.29	-0.03	2.67
Korea	0.71	0.03	0.03	0.11	0.15	0.33	0.36	0.55	1.74	2.44	-0.03	4.17
Lao PDR	-1.58	25.55	2.69	-0.03	-0.04	-0.03	-0.04	-0.09	61.85	12.85	79.06	156.58
Malaysia	1.64	0.04	0.02	0.54	0.75	0.25	0.69	1.47	3.46	54.36	-0.01	58.55
Myanmar	9.80	44.27	5.54	-0.05	-0.06	-0.07	-0.09	76.70	89.19	25.35	70.54	193.82
Nepal	0.13	0.00	0.00	0.00	0.00	0.00	0.00	1.25	6.10	8.33	0.00	14.69
New Zealand	0.56	-0.01	0.03	0.09	0.13	0.17	0.24	0.71	1.29	0.28	-0.06	1.52
Philippines	0.19	0.00	-0.01	-0.04	0.46	0.97	13.08	0.07	13.76	25.10	0.03	39.82
Singapore	3.74	0.15	0.04	1.25	1.50	0.67	1.36	4.86	7.86	6.06	-0.11	13.92
Sri Lanka	6.43	0.00	0.01	0.00	0.01	-0.01	0.03	6.15	8.20	29.30	0.02	40.82
Taiwan	0.75	0.04	0.06	0.12	0.16	0.34	0.40	0.64	1.80	1.79	-0.04	3.57
Thailand	4.64	0.02	0.51	0.11	0.22	0.05	0.18	0.44	7.86	41.68	0.02	51.58
Viet Nam	57.57	1.05	-0.20	-0.01	-0.02	-0.03	-0.03	0.20	17.14	47.47	56.86	124.81
United States	0.27	0.00	0.00	0.02	0.04	0.04	0.04	0.19	0.52	0.88	-0.01	1.39
Russia	-0.05	0.00	0.00	0.00	0.00	0.00	0.01	-0.03	-0.03	0.56	0.00	0.54
European Union	-0.15	0.00	0.01	0.07	0.09	0.09	0.15	0.01	0.86	0.88	-0.03	1.72
ASEAN10	6.11	1.34	0.23	1.06	13.37	10.37	23.16	2.92	42.08	31.19	6.33	80.87
EAS16	1.02	0.15	0.04	0.16	1.52	1.23	2.65	1.25	5.93	7.87	0.68	14.73
World	0.34	0.04	0.01	0.08	0.49	0.40	0.84	0.46	2.20	2.94	0.19	5.41

BIMP-EAGA = Brunei Darussalam–Indonesia–Malaysia–The Philippines East ASEAN Growth Area, BIMP-EAGA+ = BIMP-EAGA and surrounding regions, BIMSTEC = Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation, EWEC = East–West Economic Corridor, IMT = Indonesia–Malaysia–Thailand Growth Triangle, IMT+ = IMT and surrounding regions, MIEC = Mekong–India Economic Corridor, NSEC = North–South Economic Corridor, NTB = non-tariff barrier, SEZ = special economic zone.
Source: IDE/ERIA-GSM simulation result.

Development scenario

We have eight economic corridor development and subregional development scenarios: (1) Mekong–India Economic Corridor (MIEC), (2) Greater Mekong Subregion (GMS) East–West Economic Corridor (EWEC), (3) GMS North–South Economic Corridor (NSEC), (4) Indonesia–Malaysia–Thailand Growth Triangle (IMT), (5) IMT and surrounding regions (IMT+), (6) Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth Area (BIMP-EAGA), (7) BIMP-EAGA and surrounding regions (BIMP+), and (8) Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC). We have four sectoral development scenarios—all infrastructure development (All Infra.); NTB reduction (NTB); SEZ development in Cambodia, Lao PDR, Myanmar, and Viet Nam (SEZ); and combination of those three sectoral development scenarios (All-All). The impact of all scenarios is summarised in Table 7.2.

In each scenario is a combination of different types of trade and transport facilitation measures:

- Road development and improvement which provide a new road section or reduce time at the specific road section in the model
- Railway development and improvement which provide a new rail section or reduce time at the specific rail section in the model
- Sea route establishment and enhancement which provide a new sea section or reduce time at the specific sea section in the model
- Port construction and upgrade which reduce time and costs at loading, unloading, and trans-shipping goods at the port and prevent congestion
- Airport upgrade which reduces time and costs at loading, unloading, and trans-shipping goods at the airport and prevents congestion
- Border post upgrade and border facilitation which reduce time and costs for passing the border and prevent congestion
- SEZ development which raises the productivity parameter of the specific region in the model
- NTB reduction where NTB in manufacturing and services sector in the specific economy is lowered

(1) Mekong–India Economic Corridor (MIEC)

Figure 7.3 illustrates the economic effect of the MIEC. The simulation is based on the scenario that SEZ development in the GMS in 2015 is associated with one-shot productivity improvement. The scenario also assumes connectivity improvements, the development of Dawei, and associated one-shot productive improvement at Dawei in 2020. The following lists the scenario with more details.

2015

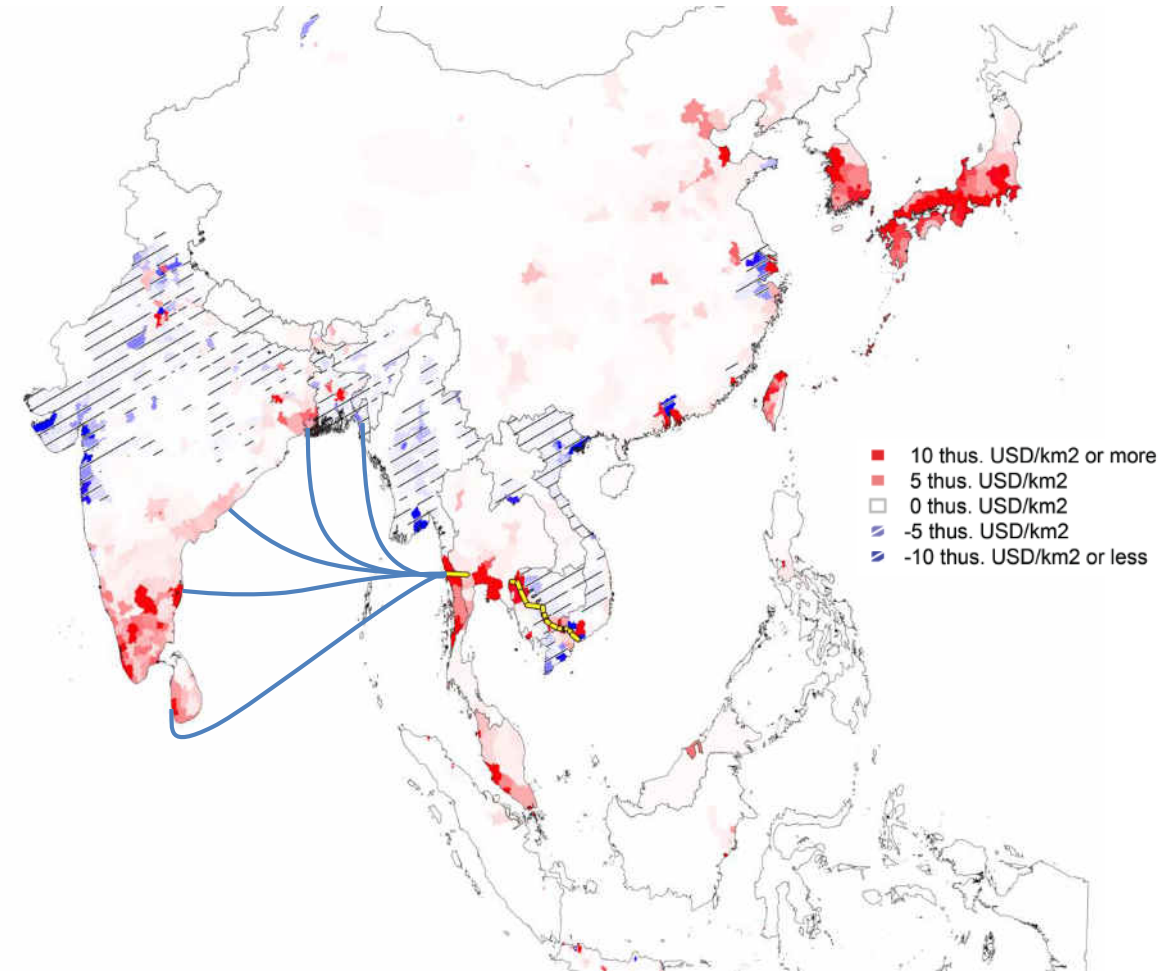
(a) Productivity improvement by five percent at Ho Chi Minh City, Bien Hoa, Svay Rieng, Phnom Penh, Kandal, Batdambang, Sisophon, and Krong Preah Sihanouk

2020

(a) Road improvement along National Roads No. 1 and 5 in Cambodia
(b) Road improvement between Moc Bai and Cai Mep Port in Viet Nam
(c) Road improvement between Kanchanaburi and Dawei Port
(d) Connection of Dawei with Chittagong, Kolkata, Visakhapatnam, Chennai, and Colombo by sea routes equivalent to internationally important routes
(e) Border facilitation at borders between Poipet and Aranyaprathet, Bavet and Moc Bai, and Phu Nam Ron and Thiki
(f) Productivity improvement by 50 percent at Dawei
(g) Port and airport expansion to prevent congestion:
    - Port Dawei
    - Port Bangkok
    - Port Laem Chabang
    - Port Map Ta Phut
    - Port Sihanoukville
    - Port Saigon
    - Port Cai Mep
    - Port of Colombo
    - Port Visakhapatnam
    - Port Madras
    - Port Chittagong
    - Port Calcutta
    - Port Haldia
    - Airport Don Muang International
    - Airport Suvarnabhumi International

- Airport U Taphao International
- Airport Phnom Penh International
- Airport Tansonnhat International
- Airport Netaji Subhash Chandra Bose International
- Airport Chennai International

Figure 7.3. Economic Impact of Mekong–India Economic Corridor (2030, Impact Density)



Note: Data not available for North Korea and Timor-Leste. Data not available for Jammu and Kashmir.
Source: IDE/ERIA-GSM simulation result.

The top gainers in percentage of 10 years' cumulation will be Dawei, Myanmar (939.65 percent); Phnom Penh, Cambodia (389.17 percent); and Dong Nai, Viet Nam (388.05 percent). It is noteworthy that other countries such as Japan, South Korea, Malaysia, and Singapore will have a high positive impact even though we did not include any improvements or development for those countries. Myanmar will have a relatively smaller positive impact (9.80 percent) than Cambodia (144.45 percent) and Viet Nam (57.57

percent) due to the lack of link between Dawei and other regions in the country in this scenario. As discussed in previous studies, Myanmar should combine MIEC development with domestic corridor development and regulatory reform to fully benefit from the Dawei and MIEC projects.

Table 7.3. Top 10 Gainers of Mekong–India Economic Corridor (Cumulative Impact during 2021–2030/ GDP in 2010)

	Region	Country	%
1	Dawei	Myanmar	939.7
2	Phnom Penh	Cambodia	389.2
3	Dong Nai	Viet Nam	388.1
4	Kawthoung	Myanmar	254.5
5	Ho Chi Minh City	Viet Nam	244.2
6	Kandal	Cambodia	183.5
7	Sihanoukville	Cambodia	145.8
8	Banteay Meanchey	Cambodia	136.7
9	Svay Rieng	Cambodia	123.5
10	Battambang	Cambodia	123.5

Source: IDE/ERIA-GSM simulation result.

(2) GMS East–West Economic Corridor (EWEC)

The EWEC scenario assumes a one-shot productivity improvement by five percent in 2015 at Thakhek, Savannakhet and Pakse, Lao PDR, and in 2020 at Hpa An, Myawaddy, and Yangon, Myanmar on the EWEC. The scenario also assumes improvements in hard infrastructure in Lao PDR, Myanmar, and Viet Nam and soft infrastructure at Myanmar–Thailand, Thailand–Lao PDR, and Lao PDR–Viet Nam borders in 2020. The following lists the scenario with more details.

2015

(a) Productivity improvement by five percent at Thakhek, Savannakhet, and Pakse

2020

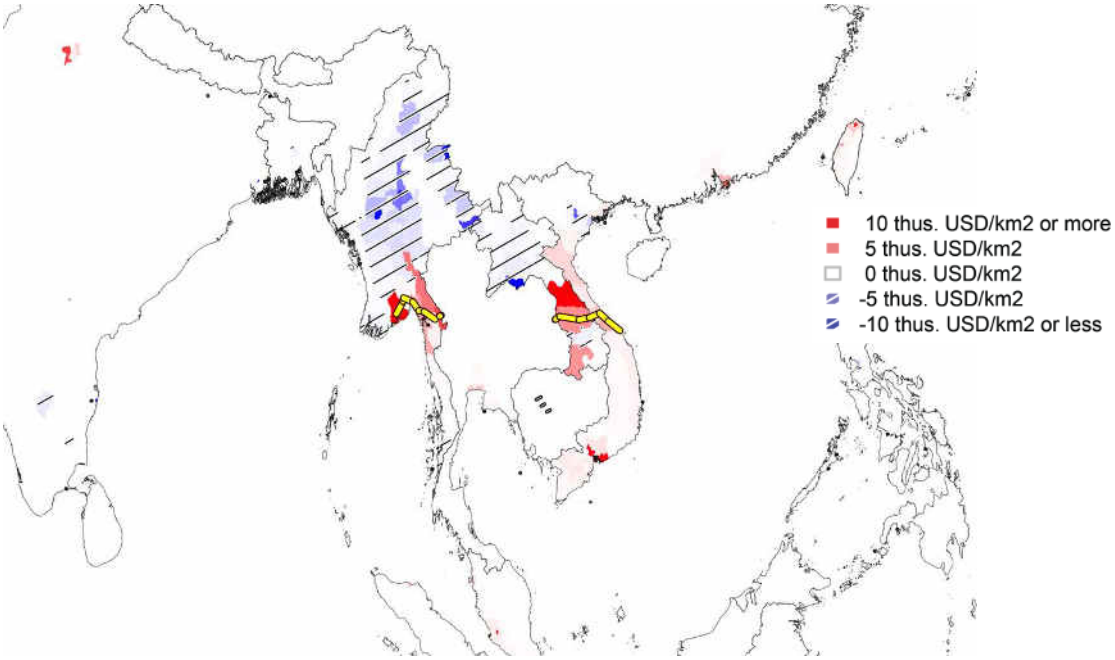
(a) Road improvement between Da Nang to Lao Bao in Viet Nam
(b) Road improvement between Densavanh to Kaysone Phomvihane in Lao PDR
(c) Road improvement between Kawkareik to Yangon in Myanmar
(d) Border facilitation at borders between Myawaddy and Mae Sot, Mukdahan and Kaysone Phomvihane (Savannakhet), and Densavanh and Lao Bao

(e) Productivity improvement by five percent at Hpa An, Myawaddy, and Yangon

(f) Port and airport expansion to prevent congestion:

- Port Da Nang
- Port Yangon
- Airport Yangon International
- Airport Danang International

Figure 7.4. Economic Impact of East–West Economic Corridor (2030, Impact Density)



Source: IDE/ERIA-GSM simulation result.

Table 7.4. Top 10 Gainers of East–West Economic Corridor (Cumulative Impact during 2021–2030/ GDP in 2010)

	Region	Country	%
1	Yangon	Myanmar	226.3
2	Khammouan	Lao PDR	216.4
3	Myawaddy	Myanmar	207.6
4	Hpa-An	Myanmar	76.0
5	Savannakhet	Lao PDR	74.7
6	Champasak	Lao PDR	66.2
7	Thaton	Myanmar	19.4
8	Quang Tri	Viet Nam	17.3
9	Thua Thien-Hue	Viet Nam	16.3
10	Mawlamyine	Myanmar	14.3

Source: IDE/ERIA-GSM simulation result.

EWEC in this scenario is extended to Yangon from Hpa An, where road improvements are not assumed in the MIEC scenario. We assume road improvement in Viet Nam, Lao PDR, and Myanmar and no improvement in Thailand. The top gainers from this scenario will be Yangon, Myanmar (226.26 percent); Khammouan, Lao PDR (216.44 percent); and Myawaddy, Myanmar (207.63 percent). Hpa-An, Myanmar (75.97 percent) and Savannakhet, Lao PDR (74.72 percent) will follow after the three top regions.

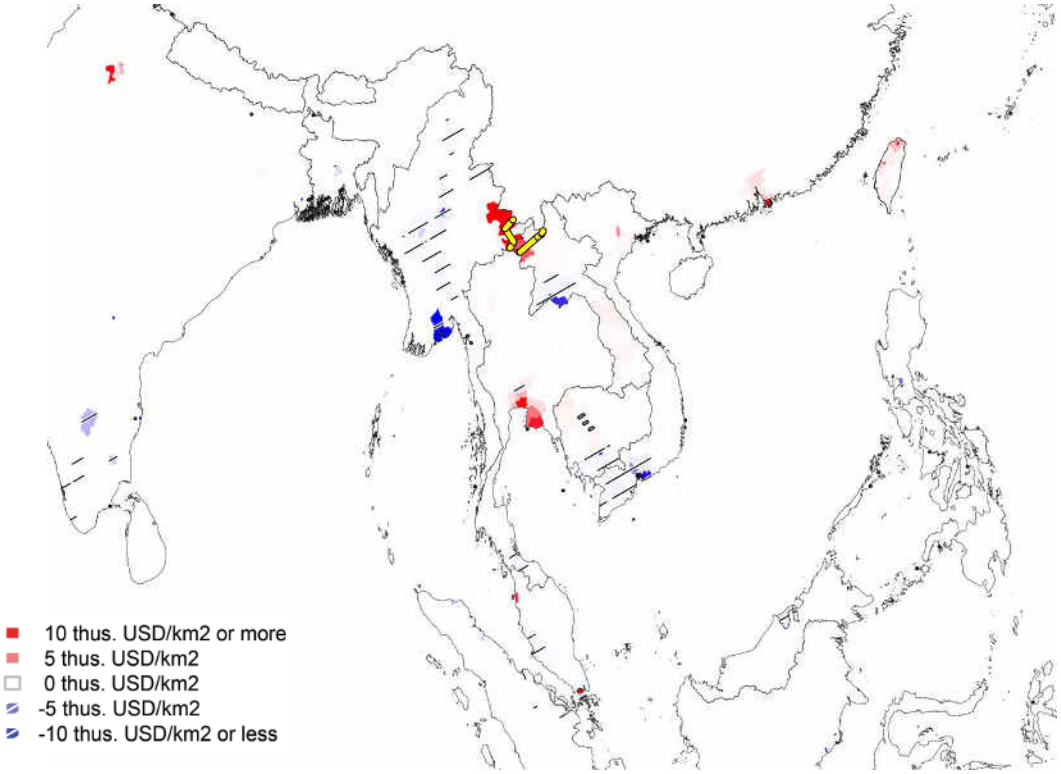
(3) GMS North–South Economic Corridor (NSEC)

The NSEC scenario assumes a five percent productivity improvement in Myanmar; road improvement at the Lao PDR and Myanmar sections; and cross-border facilitation at China–Lao PDR, China–Myanmar, Lao PDR–Thailand, and Myanmar–Thailand borders in 2020. The scenario also assumes expansion of ports in Thailand and airports in China and Thailand. The following lists the scenario with more details.

2020

(a) Road improvement between Tachileik to Daluo in Myanmar
(b) Road improvement between Houayxay and Boten in Lao PDR
(c) Border facilitation at borders between Mae Sai and Tachileik, Daluo and Mong La, Chiang Khong and Houayxay, and Boten and Mohan
(d) Productivity improvement by five percent at Tachileik and Kengtung
(e) Port and airport expansion to prevent congestion:
    - Port Bangkok
    - Port Laem Chabang
    - Port Map Ta Phut
    - Airport Don Muang International
    - Airport Suvarnabhumi International
    - Airport U Taphao International
    - Airport Chiang Rai International
    - Airport Wujiaba

Figure 7.5. Economic Impact of North–South Economic Corridor (2030, Impact Density)



Source: IDE/ERIA-GSM simulation result.

Table 7.5. Top 10 Gainers of North–South Economic Corridor (Cumulative Impact during 2021–2030/ GDP in 2010)

	Region	Country	%
1	Tachileik	Myanmar	433.6
2	Kengtung	Myanmar	187.4
3	Bokeo	Lao PDR	118.9
4	Louang-Namtha	Lao PDR	10.9
5	Khammouan	Lao PDR	7.1
6	Oudomxai	Lao PDR	6.4
7	Pailin	Cambodia	5.3
8	Phongsali	Lao PDR	5.2
9	Monghpyak	Myanmar	5.2
10	Louang Prabang	Lao PDR	5.0

Source: IDE/ERIA-GSM simulation result.

Because better connectivity has already been achieved between Ha Noi and Kunming, including Noi Bai–Lao Cai Expressway, the NSEC in this scenario, which includes only unfinished projects, excludes the Kunming–Ha Noi section. The three top beneficiaries

of NSEC will be Tachileik, Myanmar (433.62 percent); Kengtung, Myanmar (187.40 percent); and Bokeo, Lao PDR (118.94 percent). The NSEC will have the smallest impact on ASEAN (0.23 percent) as a whole compared with the MIEC (6.11 percent), EWEC (1.34 percent), and other subregional integration scenarios.

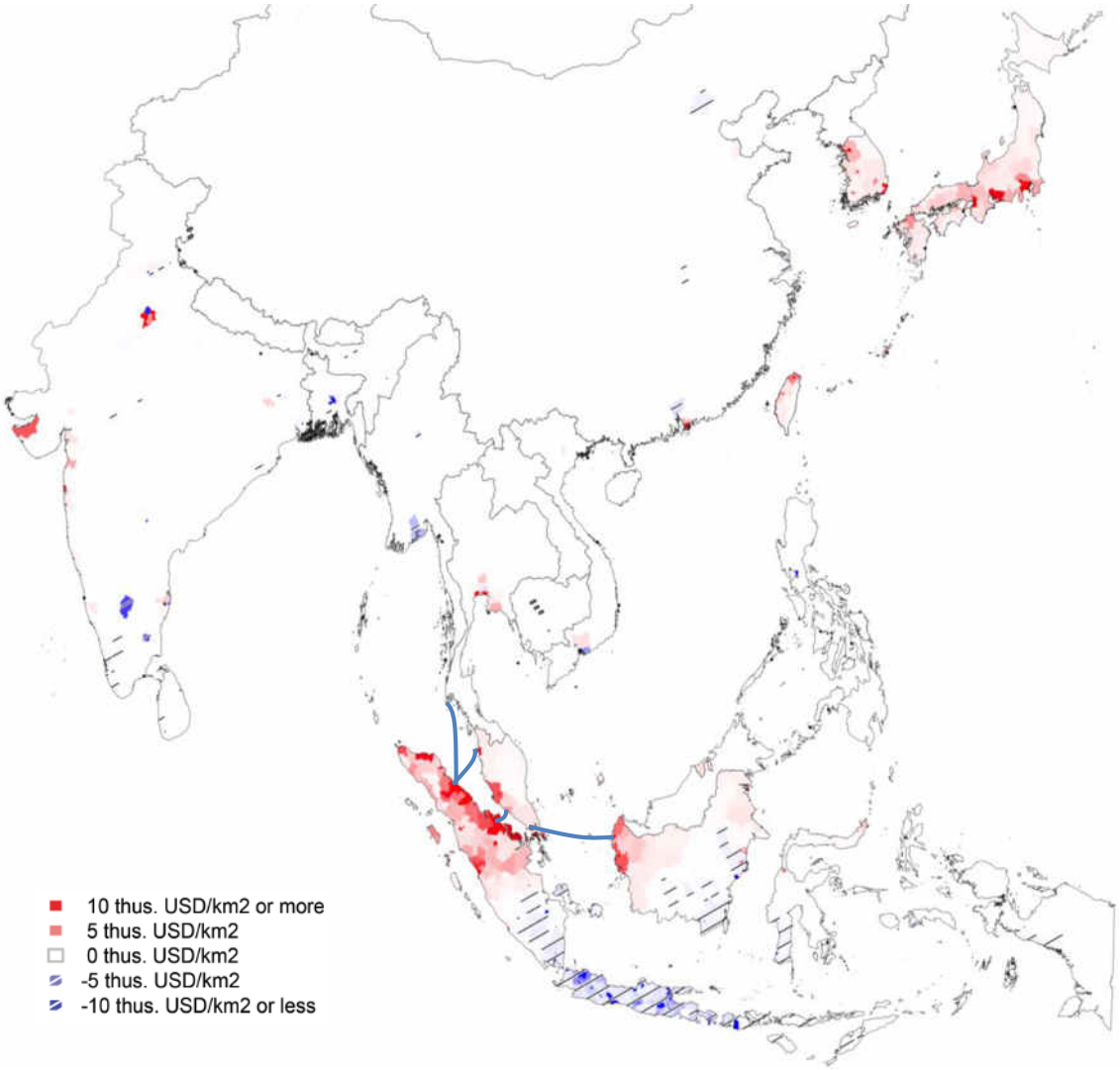
(4-1) Indonesia–Malaysia–Thailand Growth Triangle (IMT)

2020

(a) New RoRo route between Tanjung Pelepas and Sambas
(b) New RoRo route between Malacca and Dumai
(c) New RoRo route between Penang and Belawan and Phuket and Belawan
(d) Port and airport expansion to prevent congestion:
    - Port Dumai
    - Port Malacca
    - Port Belawan
    - Port Penang
    - Port Phuket
    - Airport Penang International
    - Airport Phuket International

This scenario includes proposed RoRo routes in the Master Plan on ASEAN Connectivity (MPAC) and some additional routes. Top gainers will be Kota Pontianak, Indonesia (78.12 percent); Kota Singkawang, Indonesia (62.00 percent); and Kota Medan, Indonesia (59.54 percent). The top gainer country from the scenario is Indonesia (2.20 percent), followed by Singapore (1.25 percent).

Figure 7.6. Economic Impact of Indonesia–Malaysia–Thailand Growth Triangle (2030, Impact Density)



Note: Data not available for North Korea and Timor-Leste. Data not available for Jammu and Kashmir.
Source: IDE/ERIA-GSM simulation result.

Table 7.6. Top 10 Gainers of Indonesia–Malaysia–Thailand Growth Triangle (Cumulative Impact during 2021–2030/GDP in 2010)

	Region	Country	%
1	Kota Pontianak	Indonesia	78.1
2	Kota Singkawang	Indonesia	62.0
3	Kota Medan	Indonesia	59.5
4	Kota Banda Aceh	Indonesia	50.2
5	Bengkayang	Indonesia	40.4
6	Kota Pekanbaru	Indonesia	40.0
7	Kota Tarakan	Indonesia	39.9
8	Kota Sabang	Indonesia	39.7
9	Kota Tebingtinggi	Indonesia	39.7
10	Pontianak	Indonesia	39.4

Source: IDE/ERIA-GSM simulation result.

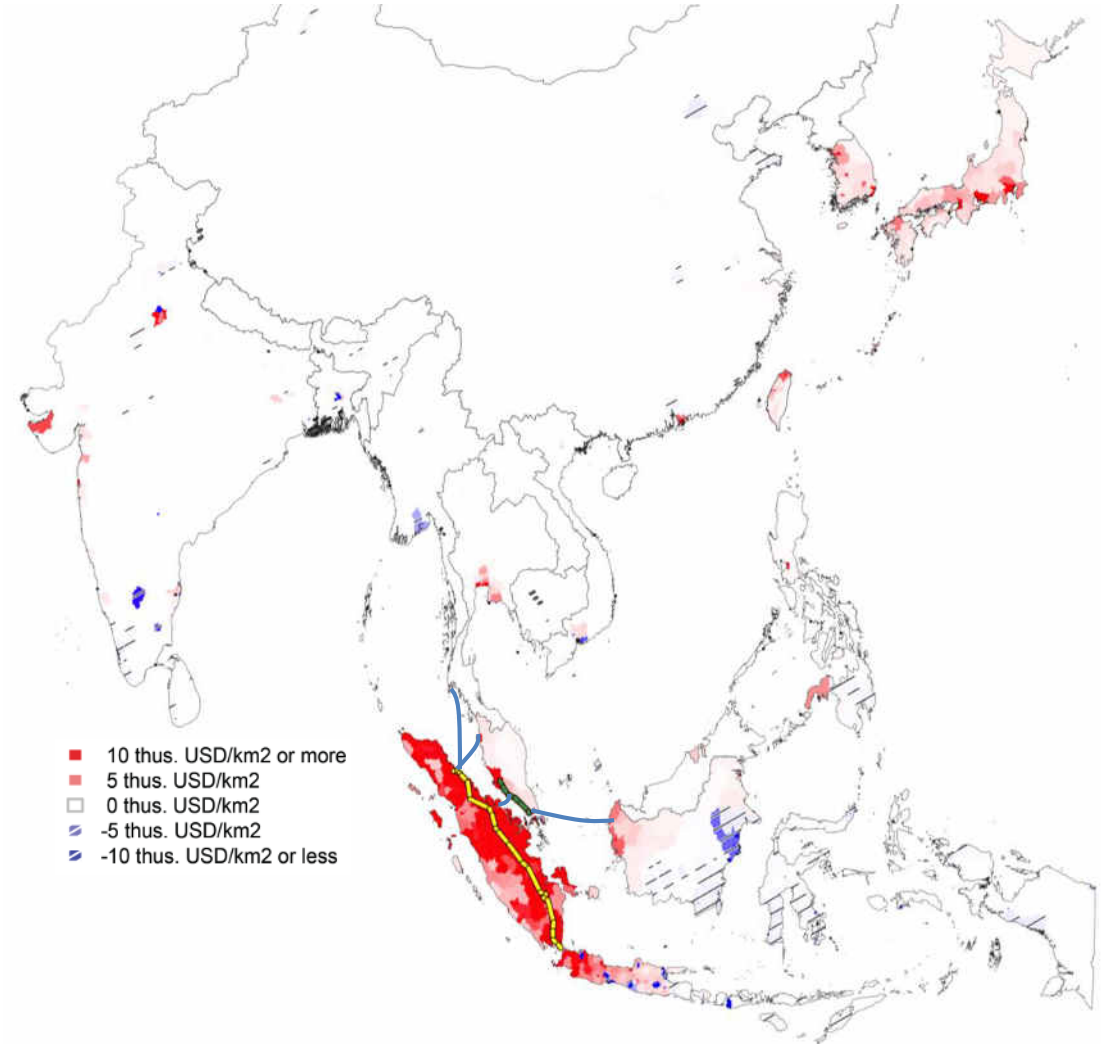
(4-2) Indonesia–Malaysia–Thailand Growth Triangle Plus (IMT+)

2020

(a) Road improvement along Trans-Sumatran Highway between Medan and Bakaheuni
(b) Kuala Lumpur–Singapore High-Speed Rail Link
(c) New RoRo route between Tanjung Pelepas and Sambas
(d) New RoRo route between Malacca and Dumai
(e) New RoRo route between Penang and Belawan and Phuket and Belawan
(f) Port and airport expansion to prevent congestion:
    - Port Dumai
    - Port Malacca
    - Port Belawan
    - Port Penang
    - Port Phuket
    - Port Kelang
    - Port Jakarta
    - Airport Penang International
    - Airport Phuket International
    - Airport Kuala Lumpur International
    - Airport Soekarno Hatta International

In this IMT+ scenario, we added the Trans-Sumatran Highway between Medan and Bakaheuni, a high-speed rail link between Kuala Lumpur and Singapore, and port and airport expansions in Kuala Lumpur and Jakarta. The economic impact of the IMT+ scenario on ASEAN would be more than 10 times bigger than the original IMT scenario. The top gainers will be Kota Medan (394.28 percent), Kota Pekanbaru (327.17 percent), and Kota Lhokseumawe (296.86 percent) of the island of Sumatra in Indonesia. Top gainer country from the scenario is Indonesia (35.01 percent), followed by Singapore (1.50 percent). IMT+ will have a considerably bigger impact on ASEAN (13.37 percent) compared with the IMT (1.06 percent).

Figure 7.7. Economic Impact of IMT+
(2030, Impact Density)



IMT+ = Indonesia–Malaysia–Thailand Growth Triangle and surrounding regions.
Note: Data not available for North Korea and Timor-Leste. Data not available for Jammu and Kashmir.
Source: IDE/ERIA-GSM simulation result.

Table 7.7 Top 10 Gainers of IMT+
(Cumulative Impact during 2021–2030/GDP in 2010)

	Region	Country	%
1	Kota Medan	Indonesia	394.3
2	Kota Pekanbaru	Indonesia	327.2
3	Kota Lhokseumawe	Indonesia	296.9
4	Kota Tebingtinggi	Indonesia	294.1
5	Kota Banda Aceh	Indonesia	278.5
6	Kota Pematang Siantar	Indonesia	275.9
7	Kota Jambi	Indonesia	267.2
8	Kota Binjai	Indonesia	240.7
9	Kota Tanjungbalai	Indonesia	222.0
10	Kota Langsa	Indonesia	216.1

IMT+ = Indonesia–Malaysia–Thailand Growth Triangle and surrounding regions.
Source: IDE/ERIA-GSM simulation result.

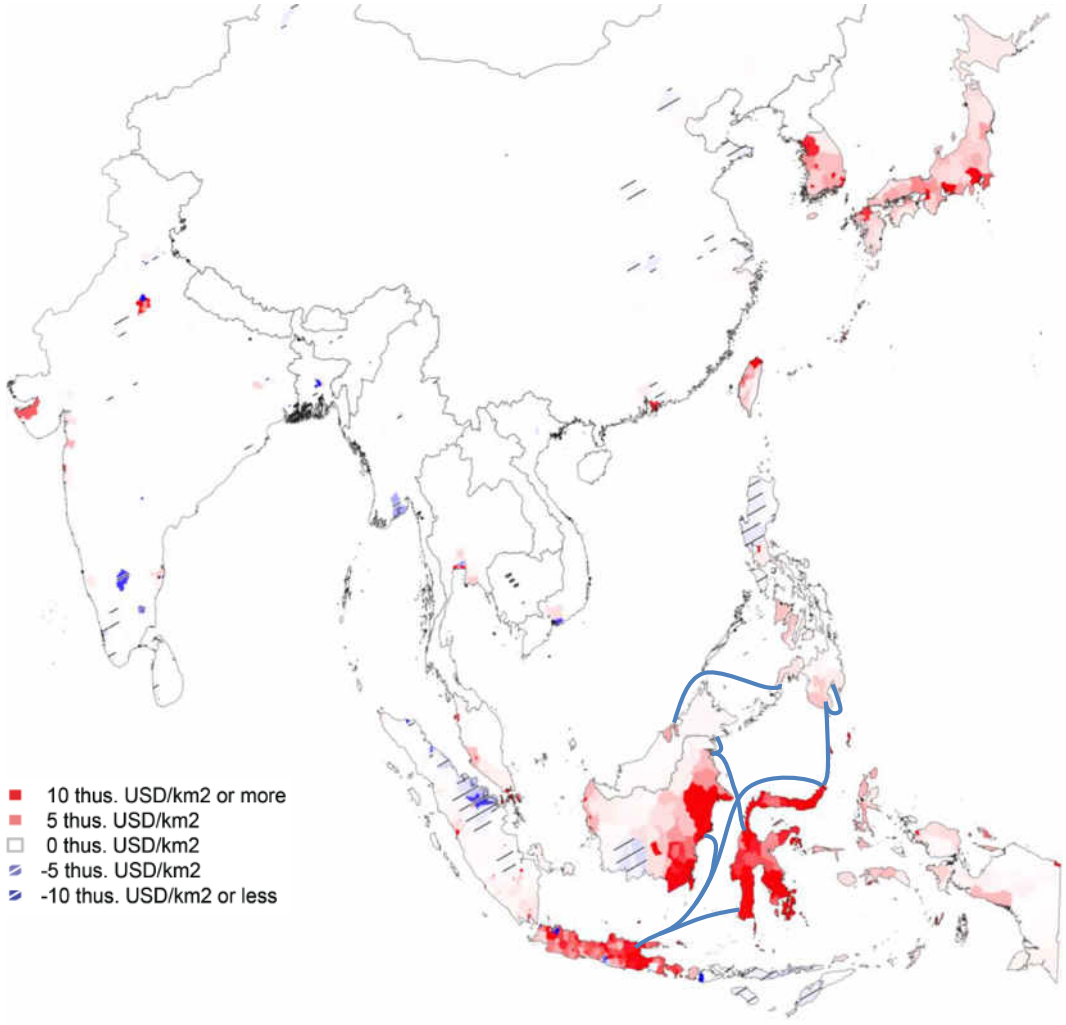
(5-1) Brunei Darussalam–Indonesia–Malaysia–The Philippines East ASEAN Growth Area (BIMP-EAGA)

2020

(a) New RoRo route along Davao–General Santos–Bitung
(b) New RoRo route between Zamboanga and Muara
(c) New RoRo route along Tawau–Tarakan–Palu
(d) Sea route improvement between Surabaya and Makassar
(e) Sea route improvement between Surabaya and Balikpapan
(f) Sea route improvement between Surabaya and Bitung
(g) Port expansion to prevent congestion:
    - Port Makassar
    - Port Balikpapan
    - Port Bitung
    - Port General Santos

As in the IMT scenario, the BIMP scenario includes proposed RoRo routes in MPAC and some additional routes. Top beneficiary regions will be Kota Makassar (513.76 percent), Kota Pare-pare (468.24 percent), and Kota Manado (455.73 percent) of the island of Sulawesi in Indonesia. Top gainer country is Indonesia (27.30 percent), followed by Brunei Darussalam (1.00 percent). BIMP will bring 10.37 percent of the economic impact to ASEAN.

Figure 7.8. Economic Impact of BIMP-EAGA
(2030, Impact Density)



BIMP-EAGA = Brunei Darussalam–Indonesia–Malaysia–The Philippines East ASEAN Growth Area.
Note: Data not available for North Korea and Timor-Leste. Data not available for Jammu and Kashmir.
Source: IDE/ERIA-GSM simulation result.

Table 7.8. Top 10 Gainers of BIMP-EAGA
(Cumulative Impact during 2021–2030/ GDP in 2010)

	Region	Country	%
1	Kota Makasar	Indonesia	513.8
2	Kota Pare-pare	Indonesia	468.2
3	Kota Manado	Indonesia	455.7
4	Kota Balikpapan	Indonesia	402.3
5	Kendari	Indonesia	364.2
6	Kota Samarinda	Indonesia	351.1
7	Kota Bitung	Indonesia	339.1
8	Kota Tomohon	Indonesia	326.5
9	Kota Palu	Indonesia	317.2
10	Kota Kendari	Indonesia	317.0

BIMP-EAGA = Brunei Darussalam–Indonesia–Malaysia–The Philippines East ASEAN Growth Area.
Source: IDE/ERIA-GSM simulation result.

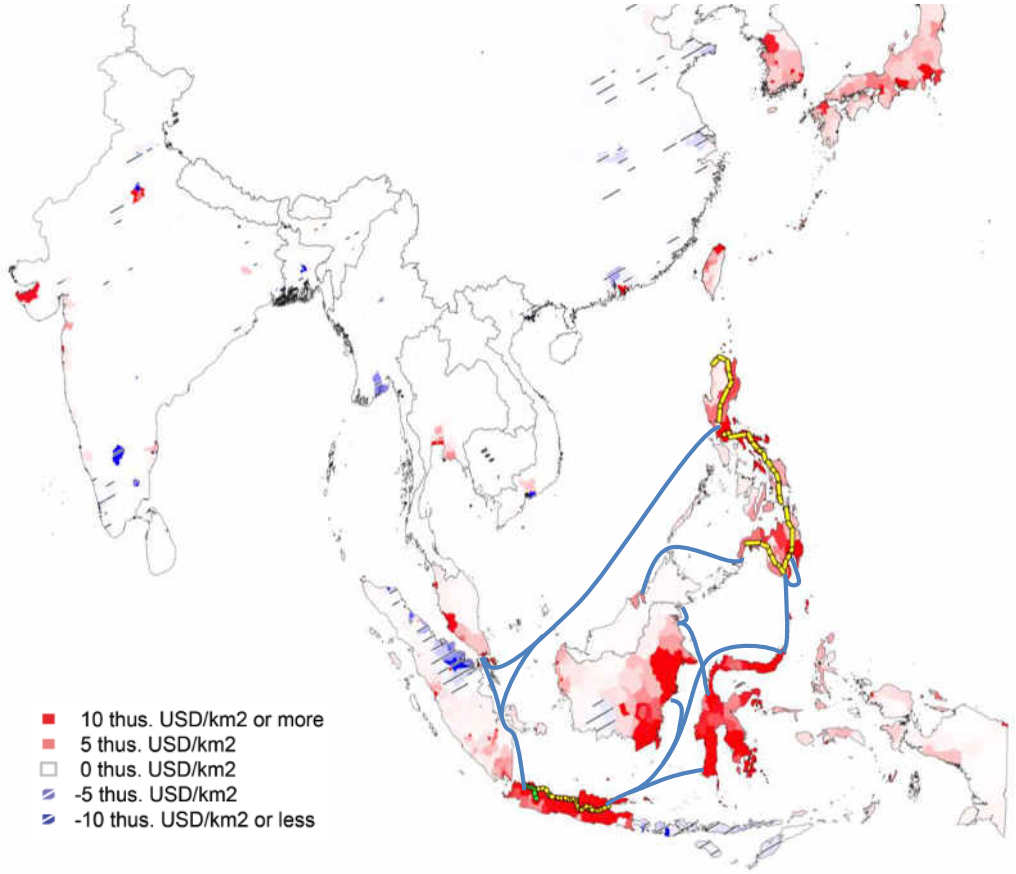
(5-b) Brunei Darussalam–Indonesia–Malaysia–The Philippines East ASEAN Growth Area Plus (BIMP-EAGA+)

2020

(a) Road improvement along Trans-Java Highway between Cirebon and Surabaya
(b) Road improvement along Pan-Philippine Highway between Laoag and Guiguinto, Santo Tomas and Matnog, Allen to Liloan, and Lipata and Ipil
(c) New RoRo route along Davao–General Santos–Bitung
(d) New RoRo route between Zamboanga and Muara
(e) New RoRo route along Tawau–Tarakan–Palu
(f) Sea route improvement between Manila and Singapore, Singapore and Jakarta, and Jakarta and Manila
(g) Sea route improvement between Surabaya and Makassar
(h) Sea route improvement between Surabaya and Balikpapan
(i) Sea route improvement between Surabaya and Bitung
(j) Jakarta–Bandung High-Speed Railway
(k) Port and airport expansion to prevent congestion:
    - Port Makassar
    - Port Balikpapan
    - Port Bitung
    - Port General Santos
    - Port Jakarta
    - Port Semarang
    - Port Surabaya
    - Port Manila
    - Airport Ninoy Aquino International
    - Airport Soekarno Hatta International

We added expressway construction between Cirebon and Surabaya in Indonesia and along the Pan-Philippine Highway in the Philippines, and sea route improvement among Singapore, Manila, and Jakarta. Kota Makassar (544.93 percent), Kota Pare-pare (496.66 percent), and Kota Manado (469.94 percent) will gain the most. It must be noted that those top three regions are the same as those in the BIMP scenario and they gain more than the previous scenario. BIMP-EAGA+ will also have a considerably bigger economic impact on ASEAN (23.16 percent), particularly Indonesia (57.88 percent) and the Philippines (13.08 percent), compared with BIMP-EAGA (10.37 percent on ASEAN, 27.30 percent on Indonesia, and 0.97 percent on the Philippines).

Figure 7.9. Economic Impact of BIMP-EAGA+
(2030, Impact Density)



BIMP-EAGA+ = Brunei Darussalam–Indonesia–Malaysia–The Philippines East ASEAN Growth Area and surrounding regions.
Note: Data not available for North Korea and Timor-Leste. Data not available for Jammu and Kashmir.
Source: IDE/ERIA-GSM simulation result.

Table 7.9. Top 10 Gainers of BIMP-EAGA+
(Cumulative Impact during 2021–2030/GDP in 2010)

	Region	Country	%
1	Kota Makasar	Indonesia	544.9
2	Kota Pare-pare	Indonesia	496.7
3	Kota Manado	Indonesia	469.9
4	Kota Balikpapan	Indonesia	420.7
5	Kendari	Indonesia	382.4
6	Kota Samarinda	Indonesia	376.2
7	Kota Bitung	Indonesia	349.5
8	Kota Tomohon	Indonesia	337.2
9	Kota Kendari	Indonesia	332.6
10	Kota Palu	Indonesia	331.5

BIMP-EAGA+ = Brunei Darussalam–Indonesia–Malaysia–The Philippines East ASEAN Growth Area and surrounding regions.
Source: IDE/ERIA-GSM simulation result.

(6) Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)

2020

(a) Road improvement between Kawkareik and Yangon, and Payagyi and Tamu in Myanmar

(b) Road improvement between Moreh and Kolkata, Raxaul and Kolkata, and Petrapole and Kolkata in India

(c) Road improvement between Benapole and Teknaf in Bangladesh

(d) Road improvement between Birgunj and Kathmandu in Nepal

(e) Border facilitation at borders between Mae Sot and Myawaddy, Tamu and Moreh, Petrapole and Benapole, and Raxaul and Birgunj

(f) Productivity improvement by five percent at Hpa-An, Myawaddy, Mandalay, Yangon, and Kyaukpyu

(g) Sea route improvement at selected routes:

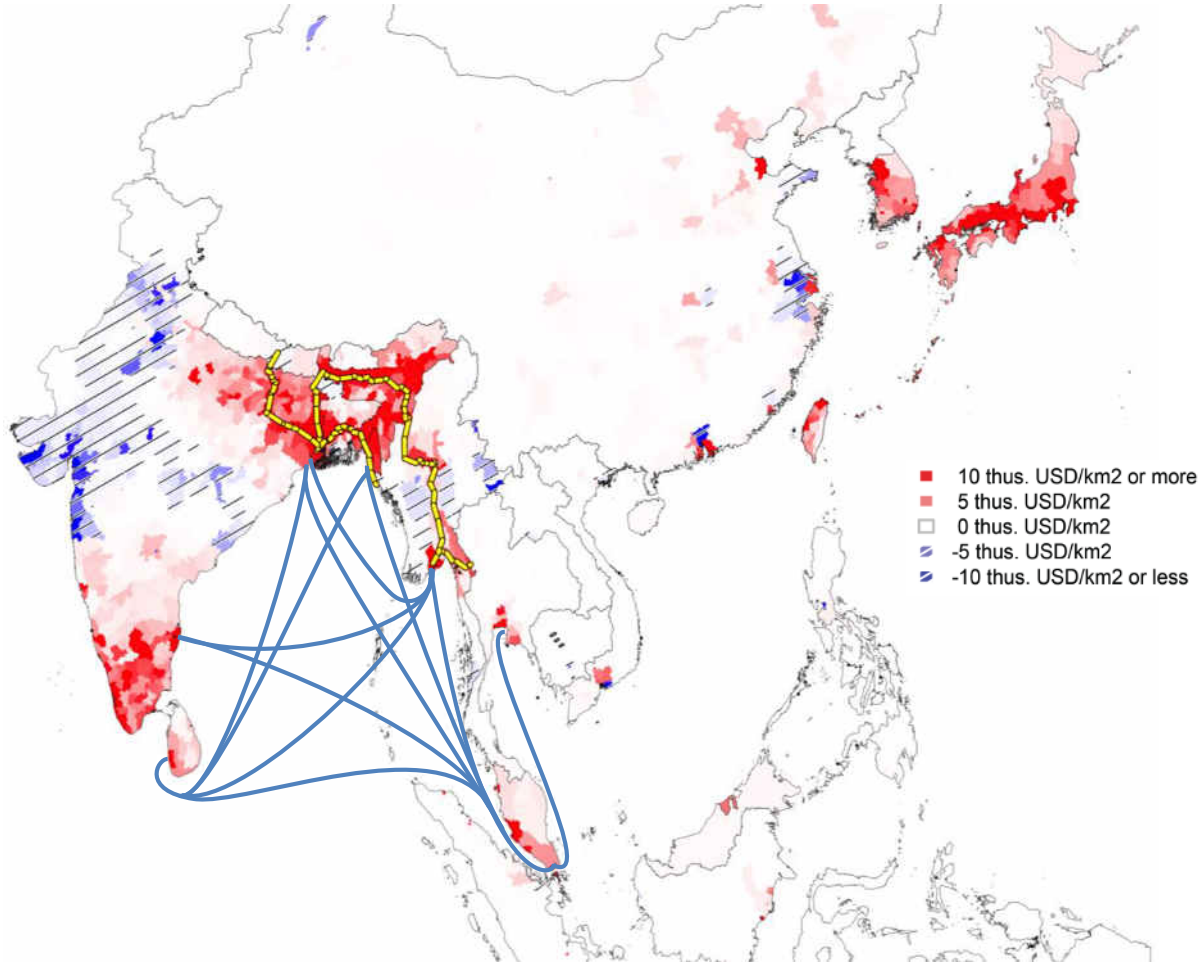
- Port Laem Chabang–Port Singapore
- Port Singapore–Port Yangon
- Port Chittagong–Port Singapore
- Port Haldia–Port Singapore
- Port Madras–Port Singapore
- Port of Colombo–Port Singapore
- Port Calcutta–Port Yangon
- Port Yangon–Port Madras
- Port Yangon–Port of Colombo
- Port of Colombo–Port Haldia
- Port of Colombo–Port Chittagong

(h) Port and airport expansion to prevent congestion:

- Port Chittagong
- Port Haldia
- Port Madras
- Port of Colombo
- Port Yangon
- Airport Yangon International
- Airport Netaji Subhash Chandra Bose International
- Airport Zia International
- Airport Chennai International

Figure 7.10. Economic Impact of BIMSTEC

(2030, Impact Density)



BIMSTEC = Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation.
Note: Data not available for North Korea. Data not available for Jammu and Kashmir.
Source: IDE/ERIA-GSM simulation result.

Table 7.10. Top 10 Gainers of BIMSTEC
(Cumulative Impact during 2021–2030/GDP in 2010)

	Region	Country	%
1	Kohima	India	593.0
2	West Imphal	India	437.6
3	Dimapur	India	411.1
4	Mandalay	Myanmar	355.6
5	Senapati	India	299.2
6	Churachandpur	India	293.2
7	Phek	India	284.4
8	Wokha	India	277.6
9	East Imphal	India	265.1
10	Zunheboto	India	263.5

BIMSTEC = Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation.
Source: IDE/ERIA-GSM simulation result.

The scenario consists of road improvement among Thailand, Myanmar, India, Bangladesh, and Nepal; sea route improvement among Singapore, Bangkok, Yangon, Chittagong, Kolkata, Chennai, and Colombo; and related expansion of ports and airports. Kohima, India (593.02 percent); West Imphal, India (437.56 percent); and Dimapur, India (411.08 percent) will have the largest impact from the scenario. At the country level, Myanmar is the top gainer (76.70 percent), followed by India (6.61 percent). The economic impact on ASEAN is 2.92 percent.

(7) All Infrastructure Development

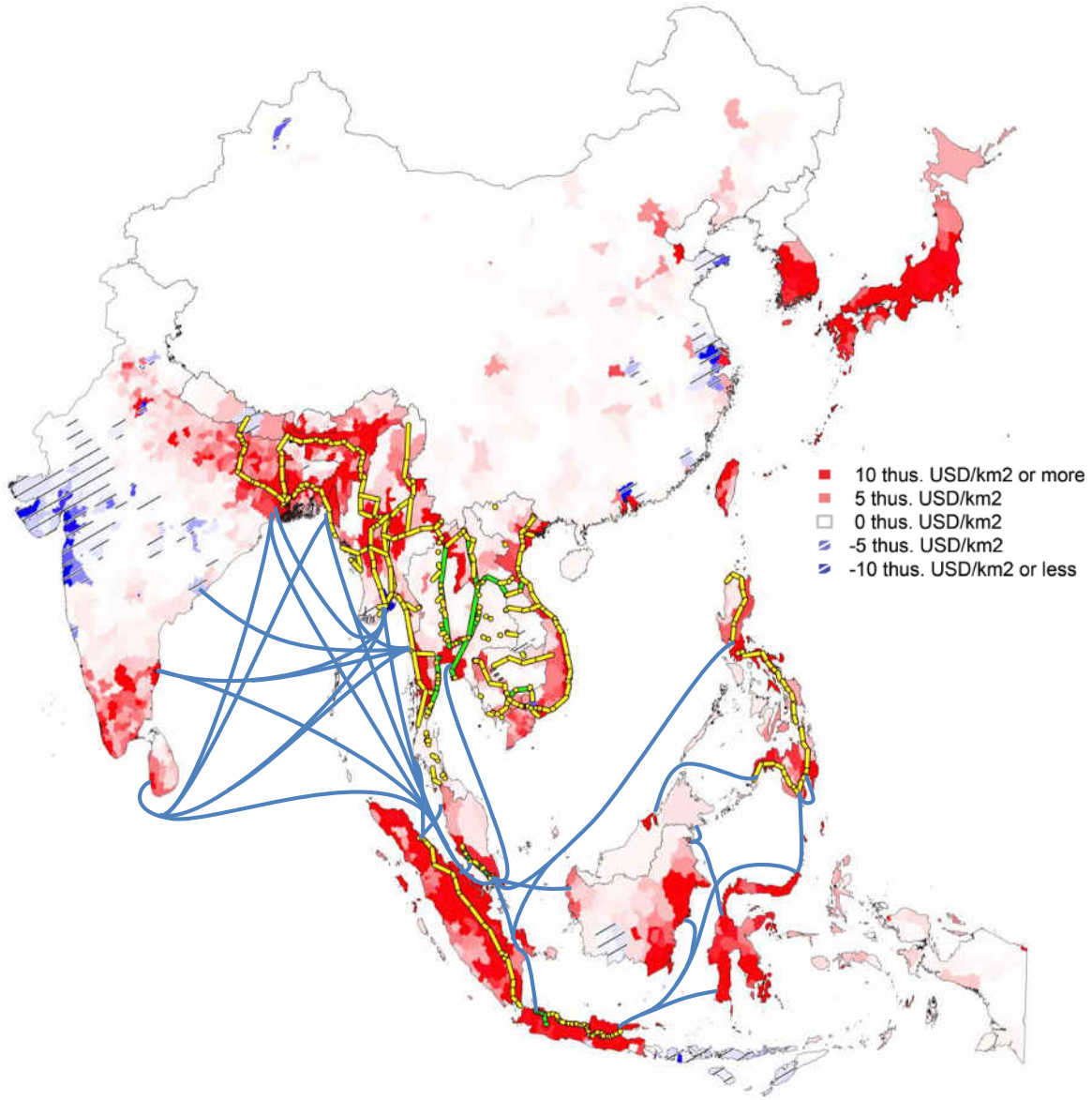
This scenario considers all infrastructure projects for subregional developments, including the following:

(a) Road improvement as shown in Figure 7.11. It includes domestic road improvement in Cambodia, Myanmar, and Lao PDR; expressway construction between Ha Noi and Ho Chi Minh City, and other developments stated in the previous scenarios.
(b) New railway in Thailand, Malaysia, Singapore, and Indonesia
(c) Border facilitation in ASEAN countries—between ASEAN countries and between an ASEAN Member State and a surrounding country.
(d) Sea route improvement for specific sea corridor routes in the MIEC, IMT+, BIMP-EAGA+, and BIMSTEC scenarios
(e) Port and airport expansion to prevent congestion in whole East Asia

Gainers from this scenario are Kawthoung, Myanmar (2,020.06 percent); Tachileik, Myanmar (979.91 percent); and Dawei, Myanmar (869.97 percent). Those regions will benefit from being connected to other parts of Myanmar and to other countries through improvements of domestic and international corridors. This scenario will bring significantly large economic gains to ASEAN (42.08 percent), particularly Indonesia (91.87 percent), the Philippines (13.76 percent), and CLMV countries (Cambodia, 24.86 percent; Lao PDR, 61.85

percent; Myanmar, 89.19 percent; and Viet Nam, 17.14 percent) than other subregional integration scenarios.

Figure 7.11. Economic Impact of All Infrastructure Development (2030, Impact Density)



Note: Data not available for North Korea and Timor-Leste. Data not available for Jammu and Kashmir.
Source: IDE/ERIA-GSM simulation result.

Table 7.11. Top 10 Gainers of All Infrastructure Development (Cumulative Impact during 2021–2030/GDP in 2010)

	Region	Country	%
1	Kawthoung	Myanmar	2020.1
2	Tachileik	Myanmar	979.9
3	Dawei	Myanmar	870.0
4	Myeik	Myanmar	769.0
5	Kohima	India	593.4
6	Samdrup-Jonkha	Bhutan	571.3
7	Kengtung	Myanmar	562.5
8	Kota Makasar	Indonesia	544.9
9	Samtse	Bhutan	512.5
10	Kota Pare-pare	Indonesia	497.3

Source: IDE/ERIA-GSM simulation result.

(8) Non-tariff Barriers

(a) Additional NTB reduction from 2016 to 2025 every year for selected countries:

Country	%	Country	%
Bangladesh	1.46	**Malaysia**	1.44
Bhutan	2.12	**Myanmar**	3.48
Brunei Darussalam	2.18	**Nepal**	2.45
Cambodia	1.31	**Philippines**	1.05
China	1.69	**Sri Lanka**	1.42
India	1.80	**Thailand**	1.30
Indonesia	1.97	**Viet Nam**	1.23
Lao PDR	1.81		

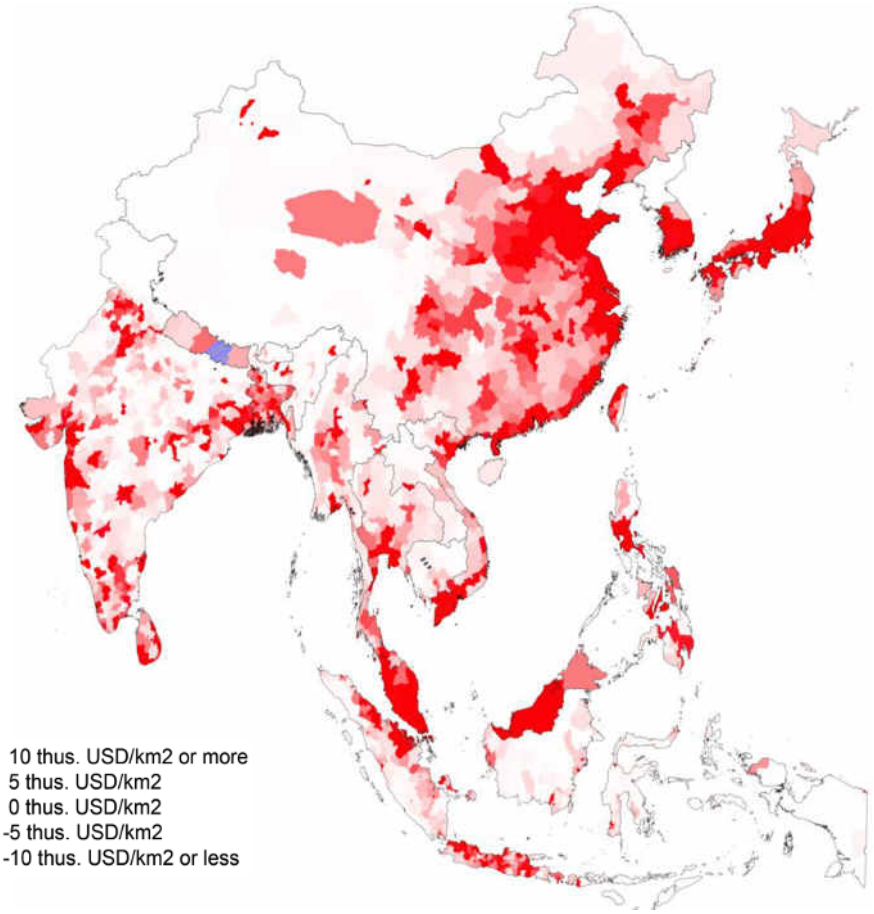
Source: Authors' assumption.

We assume an aggressive regulatory reform where country A, for example, gradually reduces NTBs from 2016 to 2025 up to the level of country B, which is 10 ranks higher than country A in terms of the estimated NTB value among 185 economies. This assumption requires country A to drastically raise its competitiveness in the world to 10 ranks higher. It can only be achieved through a combination of regional cooperation and each economy's own effort.

Most regions will be positively impacted by overall regulatory reforms. Top gainers will be Kota Lhokseumawe, Indonesia (283.77 percent); Dong Nai, Viet Nam (135.98 percent); and Cilacap, Indonesia (135.78 percent). Like the All Infra. scenario, the NTB scenario will generate a significant economic impact on ASEAN (31.19 percent) and each

member state, particularly Brunei Darussalam (82.07 percent), Malaysia (54.36 percent), Viet Nam (47.47 percent), and Thailand (41.68 percent).

Figure 7.12. Economic Impact of NTB Reduction (2030, Impact Density)



NTB = non-tariff barrier.
Note: Data not available for North Korea and Timor-Leste. Data not available for Jammu and Kashmir.
Source: IDE/ERIA-GSM simulation result.

Table 7.12. Top 10 Gainers of NTB Reduction (Cumulative Impact during 2021–2030/GDP in 2010)

	Region	Country	%
1	Kota Lhokseumawe	Indonesia	283.8
2	Dong Nai	Viet Nam	136.0
3	Cilacap	Indonesia	135.8
4	Kota Cilegon	Indonesia	134.7
5	Binh Duong	Viet Nam	131.8
6	Kota Balikpapan	Indonesia	122.9
7	Samut Sakhon	Thailand	114.5
8	Rayong	Thailand	111.1
9	Jamnagar	India	104.4
10	Samut Prakarn	Thailand	96.1%

NTB = non-tariff barrier.
Source: IDE/ERIA-GSM simulation result.

(9) Special Economic Zone

(a) One-shot productivity improvement for specific SEZ sites in CLMV countries

This scenario assumes a one-shot increase in productivity by five percent in SEZ sites in Cambodia, Lao PDR, and Viet Nam in 2015, and Myanmar in 2020. An exceptional productivity improvement is assumed in Dawei where a new SEZ development project will improve productivity by 50 percent:

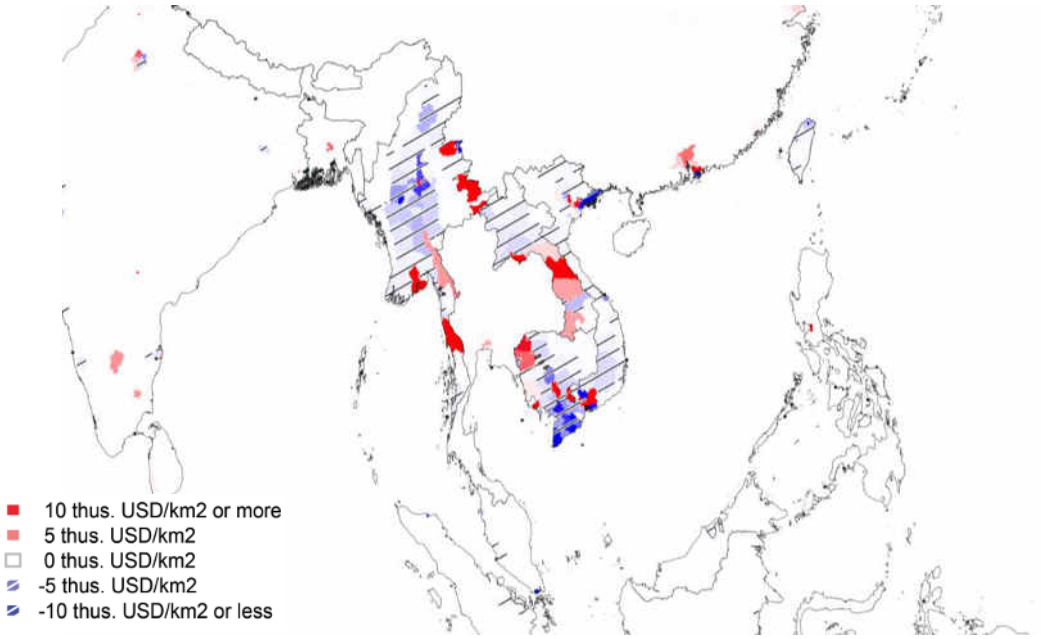
By 5 percent in 2015	By 5 percent in 2020	By 50 percent in 2020
● Ha Noi	● Hpa-An	● Dawei
● Ho Chi Minh	● Myawaddy	
● Bien Hoa	● Mandalay	
● Hai Duong	● Muse	
● Sisophon	● Yangon	
● Batdambang	● Tachileik	
● Phnom Penh	● Kengtung	
● Krong Preah Sihanouk	● Kyaukpyu	
● Svay Rieng		
● Ta Khmau		
● Kaoh Kong		
● Vientiane Capital		
● Pakxanh		
● Thakhek		
● Khanthabuly		
● Pakse		

Source: Authors' assumption.

As shown in Figure 7.13, this scenario mainly benefits only the regions that have SEZs. Those that will experience the largest impact are Dawei, Myanmar (722.79 percent); Dong Nai, Viet Nam (380.51 percent); and Phnom Penh, Cambodia (361.62 percent). Most regions in CLMV countries will be negatively impacted compared with the baseline scenario in 2030. At the country level, the top beneficiary countries are CLMV—Cambodia (125.39 percent), Lao PDR (79.06 percent), Myanmar (70.54 percent), and Viet Nam (56.86 percent). The assumption that only CLMV countries will improve productivity can negatively impact the rest of East Asian countries. However, the estimated negative economic impact is not

significant (-0.12 percent on Brunei Darussalam, -0.11 percent on Singapore); ASEAN as a whole will have 6.33 percent higher growth.

Figure 7.13. Economic Impact of SEZ in CLMV (2030, Impact Density)



CLMV = Cambodia, Lao PDR, Myanmar, Viet Nam; SEZ = special economic zone.
Source: IDE/ERIA-GSM simulation result.

Table 7.13. Top 10 Gainers of SEZ in CLMV (Cumulative Impact during 2021–2030/GDP in 2010)

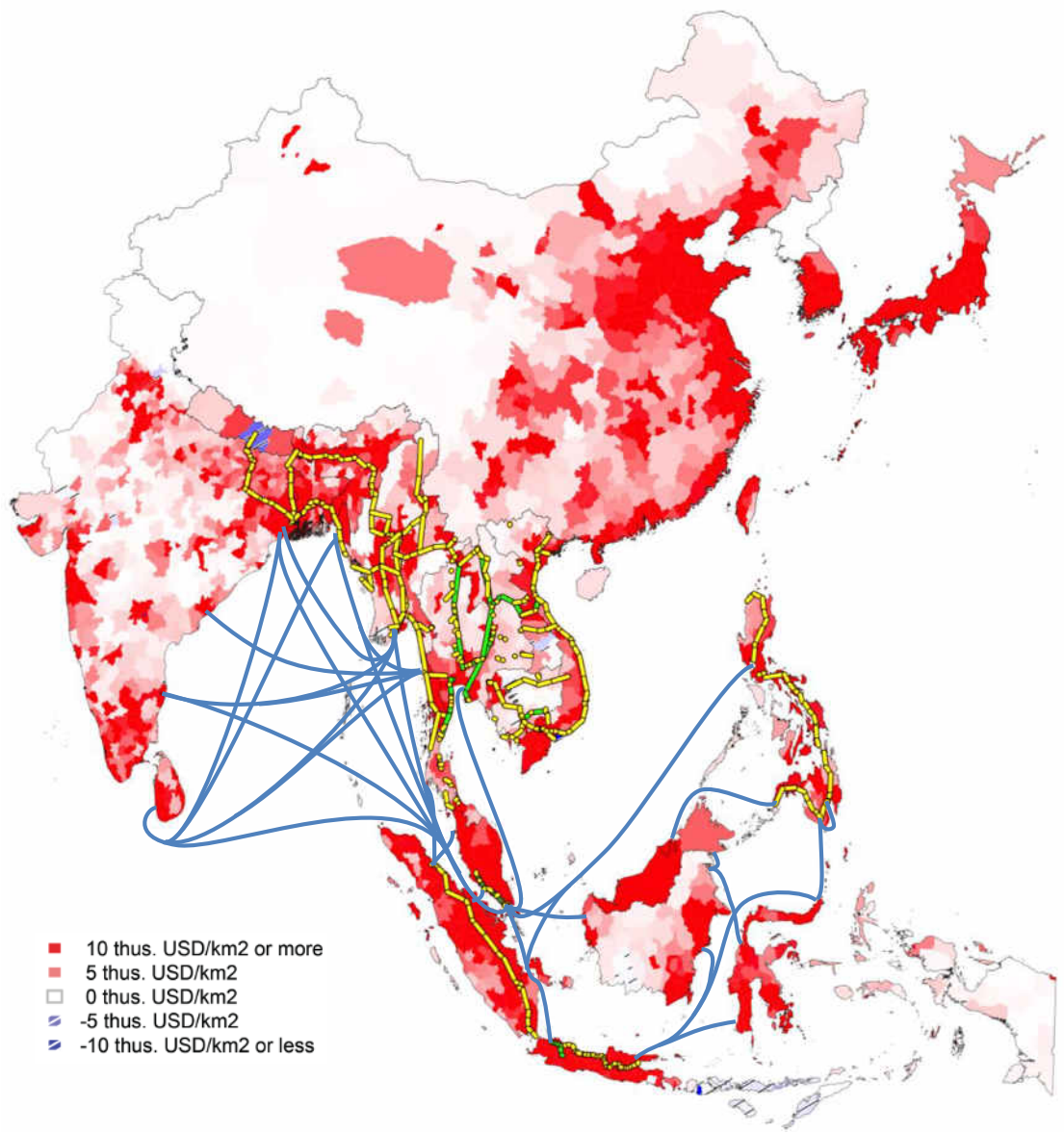
	Region	Country	%
1	Dawei	Myanmar	722.8
2	Dong Nai	Viet Nam	380.5
3	Phnom Penh	Cambodia	361.6
4	Mandalay	Myanmar	277.9
5	Ho Chi Minh City	Viet Nam	234.8
6	Tachileik	Myanmar	229.6
7	Yangon	Myanmar	206.1
8	Khammouan	Lao PDR	193.6
9	Vientiane capital	Lao PDR	193.0
10	Kandal	Cambodia	172.1

CLMV = Cambodia, Lao PDR, Myanmar, Viet Nam;
SEZ = special economic zone.
Source: IDE/ERIA-GSM simulation result.

(10) All-All

(a) All improvements of infrastructure, NTB reduction, and SEZ

Figure 7.14. Economic Impact of All-All Improvement
(2030, Impact Density)



Note: Data not available for North Korea and Timor-Leste. Data not available for Jammu and Kashmir.
Source: IDE/ERIA-GSM simulation result.

Table 7.14. Top 10 Gainers of NTB Reduction
(Cumulative Impact during 2021–2030/GDP in 2010)

	Region	Country	%
1	Dawei	Myanmar	2163.7
2	Kawthoung	Myanmar	2026.4
3	Tachileik	Myanmar	1336.5
4	Kengtung	Myanmar	797.8
5	Myeik	Myanmar	780.9
6	Kohima	India	594.0
7	Samdrup-Jonkha	Bhutan	575.0
8	Kota Lhokseumawe	Indonesia	570.9
9	Kota Makasar	Indonesia	558.0
10	Kota Balikpapan	Indonesia	539.5

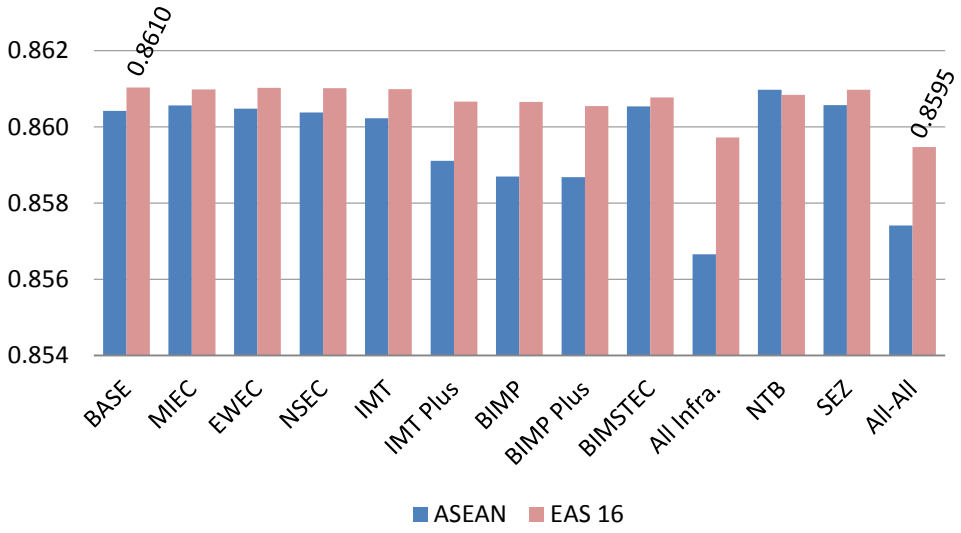
NTB = non-tariff barrier.
Source: IDE/ERIA-GSM simulation result.

This scenario assumes all infrastructure development, reduction in NTB, and SEZ development, which are assumed in other scenarios. The combination of all improvements will largely impact most of the regions. The top three gainers will be Dawei, Myanmar (2,163.71 percent); Kawthoung, Myanmar (2,026.38 percent); and Tachileik, Myanmar (1,336.46 percent). ASEAN as a whole gains 80.87 percent additional growth. Top gainers are CLMV countries—Cambodia (160.30 percent), Lao PDR (156.58 percent), Myanmar (193.82 percent), and Viet Nam (124.81 percent)—as well as Indonesia (118.50 percent) and Brunei Darussalam (88.33 percent).

7.3. Impact on Gini and Traffic

Figure 7.15 shows the impact of each scenario on the spatial Gini of ASEAN and EAS 16 countries.

Figure 7.15. Economic Impact on Gini (2030)



Source: IDE/ERIA-GSM simulation result.

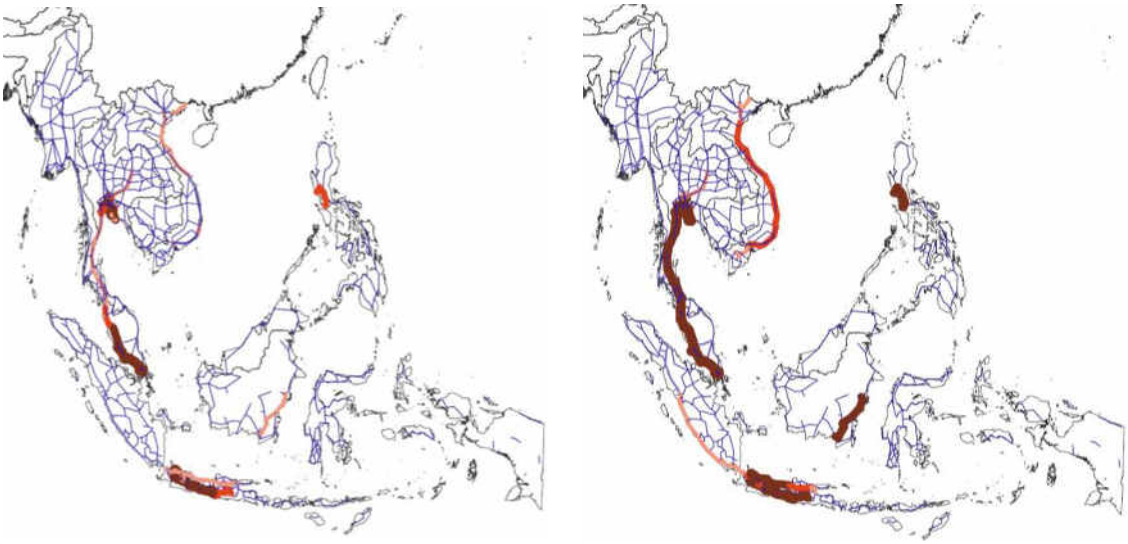
Compared with the baseline scenario, all scenarios will reduce spatial Gini of EAS 16 countries, while MIEC, EWEC, BIMSTEC, NTB, and SEZ scenarios will increase the Gini of ASEAN. 'All-All' scenario will reduce Gini coefficients for both ASEAN and EAS 16. We find that BIMP-EAGA, BIMP-EAGA+, and All Infra. scenarios have a larger impact on reducing Gini coefficients.

Reduced NTBs have a relatively small impact on the Gini of the EAS but worsen that of ASEAN. It is probably because regulatory reform will benefit large cities or existing clusters more than smaller cities or rural areas, although most of the regions will be positively impacted. This comparison of Gini coefficient informs that strategic infrastructure development can disperse and distribute the benefit towards smaller cities and rural areas. It should be noted that the reduction in NTBs will cause a large economic impact as illustrated above.

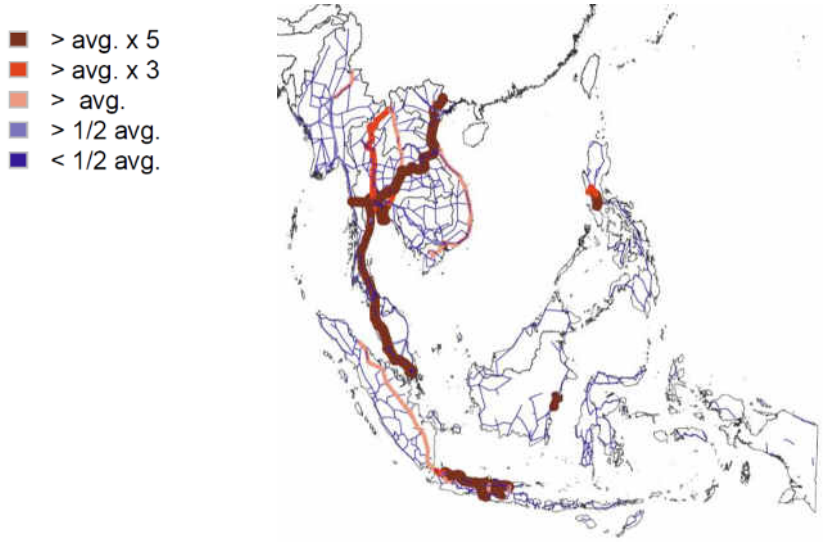
Figures 16 and 17 see the traffic change for the intermediate goods of the automotive industry and the electronics and electric appliances industry. If we do not have any infrastructure and other facilitation measures as in the baseline scenario, traffic volume will be enlarged from 2010.

Figure 7.16. Traffic of Automotive Intermediate Goods in ASEAN

2010 Baseline **2030 Baseline**



2030 All-All

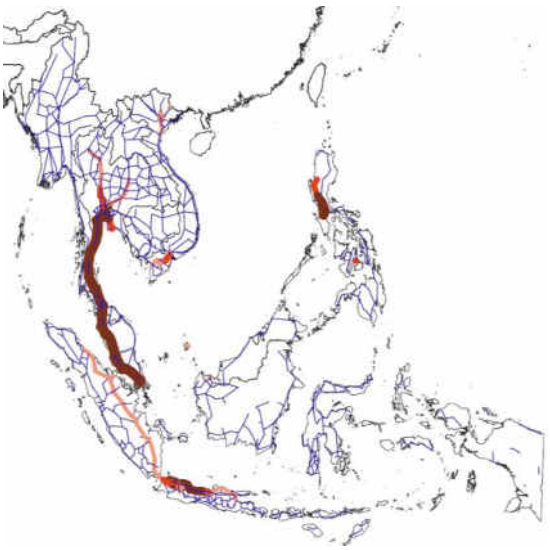


Note: For all three figures, *avg.* is average traffic volume of ASEAN in 2030 in the baseline scenario.
Source: IDE/ERIA-GSM simulation result.

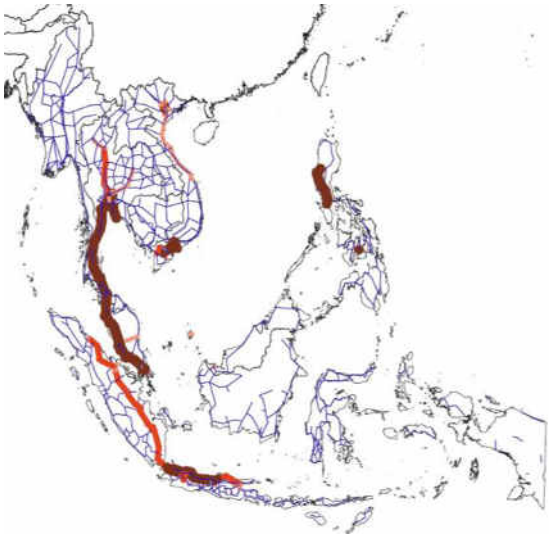
However, if we have overall development as in the All-All scenario, we will see new transport corridors such as Ha Noi–Bangkok–Dawei, NSEC, and Trans-Sumatran Highway. It implies that there are underlying demands for those corridors and we must provide sufficient capacity to meet the demand. At the same time, regions along the corridors can attract more firms and industries utilising increasing transport demand.

Figure 7.17. Traffic of E&E Intermediate Goods in ASEAN

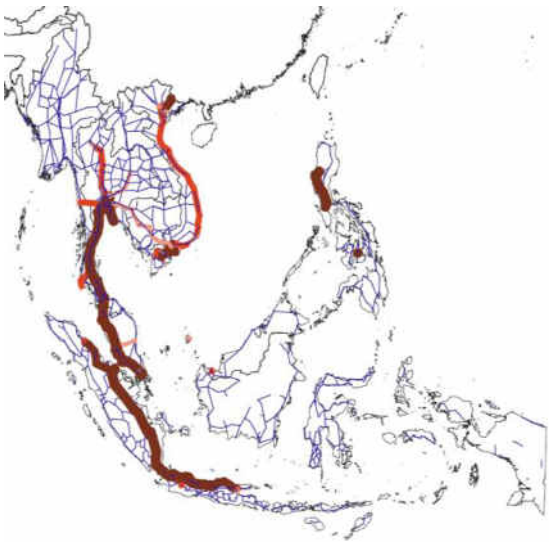
2010 Baseline

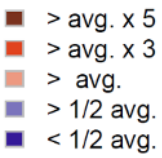


2030 Baseline



2030 All-All





E&E = electronics and electrical appliances.

Source: IDE/ERIA-GSM simulation result.

Appendix 1. List of Prospective Projects

Country	Sector	Project Name	Region	Tier
Brunei Darussalam	Road/Bridge	Construction of Temburong Bridge	BIMP+	Tier 2
Brunei Darussalam	Road/Bridge	Pulau Muara Besar Project	BIMP+	Tier 2
Brunei Darussalam	Road/Bridge	Construction of Telisai Lumut Highway	BIMP+	Tier 2
Brunei Darussalam	Port/Maritime	Muara container terminal extension	BIMP+	Tier 2
Cambodia	Road/Bridge	Phnom Penh–Ho Chi Minh City Expressway (E-1)	Mekong	Tier 1
Cambodia	Road/Bridge	Phnom Penh–Sihanoukville Expressway (E-4)	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 1 (Phase 4: 4 km from Phnom Penh)	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 2 and No. 22	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 3 Upgrading to AC	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 5 (from Chroy Chang Var–Prek Kdam)	Mekong	Tier 2
Cambodia	Road/Bridge	Rehabilitation of National Road No. 5 from Prek Kdam Bridge to Poipet	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 5 Improvement Project (Battambang–Sri Sophorn Section) (North: 81.2 km)	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 5 Improvement Project (Thlea Ma'Am–Battangbang + Sri Sophorn–Poipet Sections) (Center: 148.3 km)	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 5 Improvement Project (Prek Kdam–Thlea Ma'Am Section) (I) (South: 135.4 km)	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 6A (PK44 to PK290)	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 11 (Neak Leoung–Thnal Toteoung)	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 21	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 27 and Koh Thoom Bridge	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 43 (Treng Troyeung–Tvear Thmay)	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 48 upgrading to AC	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 51 (Thnal Toteung–Oudong)	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 55 (Prusat–Thma Dar)	Mekong	Tier 2

Cambodia	Road/Bridge	National Road No. 58 (Poipet–Ph'Ong)	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 60B (Kapo–Kampong Thma)	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 70B (Tonle Bet–Peam Ro)	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 71C and Kroch Chhmar Bridge	Mekong	Tier 2
Cambodia	Road/Bridge	National Road No. 72, No. 7, No. 71	Mekong	Tier 2
Cambodia	Road/Bridge	Rehabilitation of National Road No. 76 (171.8 km): Banlong triangle border point (C–L–VN)	Mekong	Tier 3
Cambodia	Road/Bridge	Chroy Thom Bridge	Mekong	Tier 2
Cambodia	Road/Bridge	Rehabilitation of Japan–Cambodia Friendship Bridge (Chroy Changvar Bridge)	Mekong	Tier 2
Cambodia	Road/Bridge	Bypass around Phnom Penh city	Mekong	Tier 2
Cambodia	Road/Bridge	New Border Check Point in Poipet for Cargo	Mekong	Tier 2
Cambodia	Road/Bridge	Technical assistance for strengthening capacity for road and bridge maintenance	Mekong	Tier 2
Cambodia	Road/Bridge	Vehicle Registration and Inspection project	Mekong	Tier 2
Cambodia	Road/Bridge	The Project for Development of Traffic Management System in Phnom Penh	Mekong	Tier 2
Cambodia	Railway	Northern Line emergency repair	Mekong	Tier 2
Cambodia	Railway	Northern Line Bridge rehabilitation	Mekong	Tier 2
Cambodia	Railway	Phnom Penh City Rail Transit project	Mekong	Tier 2
Cambodia	Railway	Project for public transportation service in Phnom Penh	Mekong	Tier 2
Cambodia	Railway	Project for urban transport planning in the municipality of Phnom Penh	Mekong	Tier 2
Cambodia	Railway	SKRL missing link: Poipet–Sisophon (48 km)	Mekong	Tier 2
Cambodia	Railway	SKRL missing link: Bat Deng (Phnom Penh) – Loc Ninh (255 km)	Mekong	Tier 2
Cambodia	Railway	Rail link: Sisophon–Siem Reap (105 km)	Mekong	Tier 2
Cambodia	Railway	Rail link: Siem Reap–Skun (239 km)	Mekong	Tier 2
Cambodia	Railway	Rail link: Snoul–Stung Treng (273 km)	Mekong	Tier 3
Cambodia	Port/Maritime	Sihanoukville port multi-purpose terminal	Mekong	Tier 2
Cambodia	Port/Maritime	Project for Strengthening Competitiveness of Sihanoukville Port Package 1	Mekong	Tier 2

Cambodia	Port/Maritime	Project for Strengthening Competitiveness of Sihanoukville Port Package 2	Mekong	Tier 2
Cambodia	Port/Maritime	Phnom Penh New Port Improvement Project	Mekong	Tier 2
Cambodia	Port/Maritime	Development of inland water facilities along the Mekong, Basac, Tonlesap rivers	Mekong	Tier 2
Cambodia	Industrial Estate/SEZ	Techno Park Poipet	Mekong	Tier 2
Cambodia	Industrial Estate/SEZ	Poipet SEZ	Mekong	Tier 2
Cambodia	Energy/Power	Steung Hauv Power Station (Phase 2: 100 MW)	Mekong	Tier 2
Cambodia	Energy/Power	Coal Power Plant in Sihanoukville (Phase 1: 270 MW)	Mekong	Tier 2
Cambodia	Energy/Power	Coal Power Plant in Sihanoukville (Phase 2: 135 MW)	Mekong	Tier 2
Cambodia	Energy/Power	Coal Power Plant in Sihanoukville (Phase 3: 135 MW)	Mekong	Tier 2
Cambodia	Energy/Power	Coal Power Plant in Sihanoukville (Phase 4: 135 MW)	Mekong	Tier 2
Cambodia	Energy/Power	Coal Power Plant in Sihanoukville (Phase 5: 135 MW)	Mekong	Tier 2
Cambodia	Energy/Power	Coal Power Plant in Sihanoukville (Phase 6: 135 MW)	Mekong	Tier 2
Cambodia	Energy/Power	Transmission Line (230 KV) Phnom Penh–Sihanoukville along NR4	Mekong	Tier 2
Cambodia	Energy/Power	Transmission Line (230 KV) Phnom Penh–Bavet	Mekong	Tier 2
Cambodia	Energy/Power	Transmission Line (230 KV) Kratie–Stung Treng	Mekong	Tier 2
Cambodia	Energy/Power	Transmission Line (115 KV) Phnom Penh WPP–EPP and GS4 (GIS)	Mekong	Tier 2
Cambodia	Energy/Power	Transmission Line (230 KV) Kratie–Kompong Cham	Mekong	Tier 2
Cambodia	Energy/Power	Transmission Line (230 KV) Phnom Penh–Kompong Cham	Mekong	Tier 2
Cambodia	Energy/Power	Transmission Line (230 KV) Kompong Cham–Siem Reap	Mekong	Tier 2
Cambodia	Energy/Power	Phnom Penh City Transmission and Distribution System Expansion Project	Mekong	Tier 2
Cambodia	Telecommunication	Optical submarine cable system AAG	Mekong	Tier 2
Cambodia	Telecommunication	Optical +G182:G186 submarine cable system ASE	Mekong	Tier 2
Cambodia	Telecommunication	Greater Mekong Telecommunication Backbone Network Project	Mekong	Tier 2
Cambodia	Urban Development	Sihanoukville Comprehensive Development	Mekong	Tier 2
Cambodia	Others	Emergency Life-saving Center Development Project	Mekong	Tier 2

Indonesia	Road/Bridge	Toll road connecting Cileunyi (near Bandung)−Sumedang−Dawuan (to central Java)	BIMP+	Tier 2
Indonesia	Road/Bridge	Manado–Bitung toll road	BIMP+	Tier 2
Indonesia	Road/Bridge	Toll road: Medan−Binjai	IMT+	Tier 2
Indonesia	Road/Bridge	Toll road: Medan−Kualanamu−Tebing Tinggi	IMT+	Tier 2
Indonesia	Road/Bridge	Toll road: Pekanbaru−Kandis−Dumai	IMT+	Tier 2
Indonesia	Road/Bridge	Toll road: Palembang−Indralaya	IMT+	Tier 2
Indonesia	Road/Bridge	Kemayoran–Kampung Melayu Toll Road	BIMP+	Tier 1
Indonesia	Road/Bridge	Sunter–Rawa Buaya–Batu Ceper Toll Road	BIMP+	Tier 1
Indonesia	Road/Bridge	Serpong–Balaraja Toll Road	BIMP+	Tier 2
Indonesia	Road/Bridge	Pasir Koja–Soreang Toll Road	BIMP+	Tier 2
Indonesia	Road/Bridge	Jayapura (Papua) circular line	BIMP+	Tier 3
Indonesia	Road/Bridge	Jayapura–Wamena–Mulia (Papua) road	BIMP+	Tier 3
Indonesia	Road/Bridge	Tanjung Priok Access Toll Road, DKI Jakarta	BIMP+	Tier 1
Indonesia	Road/Bridge	Balikpapan–Samarinda Toll Road, East Kalimantan	BIMP+	Tier 3
Indonesia	Road/Bridge	Pandaan–Malang Toll Road, East Java	BIMP+	Tier 3
Indonesia	Road/Bridge	Trans-Sumatra Toll Road (Palembang–BandarLampung)	BIMP+	Tier 2
Indonesia	Road/Bridge	ITS (Intelligent Transport Systems) in JABODETABEK	BIMP+	Tier 1
Indonesia	Road/Bridge	East Jakarta industrial area (Cikarang) road network development	BIMP+	Tier 1
Indonesia	Road/Bridge	Batu Ampar–Muka Kuning–Hang Nadim Toll Road, Riau Island	IMT+	Tier 2
Indonesia	Road/Bridge	Trans Kalimantan	BIMP+	Tier 3
Indonesia	Railway	Railway connecting Soekarno Hatta Airport and Halim Airport	BIMP+	Tier 1
Indonesia	Railway	Surabaya MRT construction project	BIMP+	Tier 1
Indonesia	Railway	Jakarta MRT: North−South line extension	BIMP+	Tier 1
Indonesia	Railway	Jakarta MRT: East–West line	BIMP+	Tier 1
Indonesia	Railway	Java high speed railway construction	BIMP+	Tier 1
Indonesia	Railway	Bandung Light Rail Transit (LRT), West Java	BIMP+	Tier 2

Indonesia	Railway	Manggarai (Jakarta)–Bekasi quadrupling track	BIMP+	Tier 1
Indonesia	Railway	Medan–Kualanamu (North Sumatra) elevated track	IMT+	Tier 2
Indonesia	Railway	Development of South Sumatera Monorail (Palembang)	IMT+	Tier 2
Indonesia	Railway	Development of Batam Railway, Riau Island	IMT+	Tier 2
Indonesia	Railway	Pulau Baai–Muara Enim Railway, Bengkulu–South Sumatera	IMT+	Tier 3
Indonesia	Railway	Trans-Sulawesi railway pahse1(Makassar–Parepare)	BIMP+	Tier 2
Indonesia	Railway	The East Kalimantan railway project	IMT+	Tier 3
Indonesia	Railway	Jakarta LRT 1st phase (Cibubur–Cawang–Dukuh Atas)	BIMP+	Tier 1
Indonesia	Railway	Jakarta LRT 2nd phase (Cibubur–Bogor, Dukuh Atas–Palmerah–Senayan and Palmerah–Bogor)	BIMP+	Tier 1
Indonesia	Port/Maritime	Cilamaya (its alternative) port development	BIMP+	Tier 1
Indonesia	Port/Maritime	Survey and Investigation of the Straits of Malacca and Singapore	IMT+	Tier 2
Indonesia	Port/Maritime	Banda Aceh port development	IMT+	Tier 2
Indonesia	Port/Maritime	Belawan port development	IMT+	Tier 2
Indonesia	Port/Maritime	Kuala Tanjung port development	IMT+	Tier 2
Indonesia	Port/Maritime	Dumai port development	IMT+	Tier 2
Indonesia	Port/Maritime	Batam port development	IMT+	Tier 3
Indonesia	Port/Maritime	Padang port development	IMT+	Tier 2
Indonesia	Port/Maritime	Panjang port development	IMT+	Tier 2
Indonesia	Port/Maritime	Pangkal Pinang port development	IMT+	Tier 3
Indonesia	Port/Maritime	Tanjung Priok port development	BIMP+	Tier 1
Indonesia	Port/Maritime	Cilacap port development	BIMP+	Tier 2
Indonesia	Port/Maritime	Tanjung Perak port development	BIMP+	Tier 1
Indonesia	Port/Maritime	Lombok port development	BIMP+	Tier 3
Indonesia	Port/Maritime	Kupang port development	BIMP+	Tier 3
Indonesia	Port/Maritime	Pontianak port development	BIMP+	Tier 3
Indonesia	Port/Maritime	Palangkaraya port development	BIMP+	Tier 3

Indonesia	Port/Maritime	Banjarmasin port development	BIMP+	Tier 3
Indonesia	Port/Maritime	Maloy port development	BIMP+	Tier 3
Indonesia	Port/Maritime	Makasaar port development	BIMP+	Tier 2
Indonesia	Port/Maritime	Bitung port development	BIMP+	Tier 2
Indonesia	Port/Maritime	Halmahera port development	BIMP+	Tier 3
Indonesia	Port/Maritime	Ambon port development	BIMP+	Tier 2
Indonesia	Port/Maritime	Sorong port development	BIMP+	Tier 3
Indonesia	Port/Maritime	Jayapura port development	BIMP+	Tier 3
Indonesia	Port/Maritime	Merauke port development	BIMP+	Tier 3
Indonesia	Port/Maritime	Development of Baubau Port, South Sulawesi	BIMP+	Tier 3
Indonesia	Port/Maritime	Development of Garongkong Port, South Sulawesi	BIMP+	Tier 3
Indonesia	Airport	Karawang new airport	BIMP+	Tier 1
Indonesia	Airport	Development of New Bali Airport, Bali	BIMP+	Tier 2
Indonesia	Airport	Kulonprogo International Airport, DI Yogyakarta	BIMP+	Tier 2
Indonesia	Airport	Expansion of Mutiara Airport, Palu, Central Sulawesi	BIMP+	Tier 3
Indonesia	Airport	Expansion of Komodo Airport, Labuhanbajo, East Nusa Tenggara	BIMP+	Tier 3
Indonesia	Airport	Expansion of Radin Inten Ⅱ Airport, Lampung	IMT+	Tier 2
Indonesia	Airport	Expansion of Juwata Airport, North Kalimantan	BIMP+	Tier 3
Indonesia	Airport	Expansion of Sentani Airport, Papua	BIMP+	Tier 3
Indonesia	Airport	Expansion of Tjilik Riwut Airport, Central Kalimantan	BIMP+	Tier 3
Indonesia	Airport	Expansion of Fatmawati Sekarno Airport, Bengkulu	IMT+	Tier 3
Indonesia	Airport	Expansion of H. AS. Hananjoeddin Airport, Bangka - Belitung Island	IMT+	Tier 3
Indonesia	Airport	Expansion of Matahora Airport, Southeast Sulawesi	BIMP+	Tier 3
Indonesia	Airport	Expansion of Sultan Babullah Airport, North Maluku	BIMP+	Tier 3
Indonesia	Energy/Power	Central Java coal-fired steam power plant (up to 2,000 MW)	BIMP+	Tier 2
Indonesia	Energy/Power	Upper Cisokan pumped storage hydroelectric power plant (1,040 MW)	BIMP+	Tier 1

Indonesia	Energy/Power	Fulu Lais geothermal power plant project (1&2, 2x55 MW)	BIMP+	Tier 1
Indonesia	Energy/Power	Sarulla geothermal power plant	BIMP+	Tier 3
Indonesia	Energy/Power	Takalar steam coal power plant (2x115 MW) in South Sulawesi	BIMP+	Tier 3
Indonesia	Energy/Power	Sumsel (South Sumatera) 8, 9, 10 Coal power plant (3,000 MW)	IMT+	Tier 3
Indonesia	Energy/Power	Darajat geothermal power plant	BIMP+	Tier 3
Indonesia	Energy/Power	Muaralabuh geothermal power plant	IMT+	Tier 3
Indonesia	Energy/Power	Rajabasa geothermal power plant	IMT+	Tier 3
Indonesia	Energy/Power	Kamojang geothermal power plant	BIMP+	Tier 2
Indonesia	Energy/Power	Lumut Balai geothermal power plant	IMT+	Tier 3
Indonesia	Energy/Power	Lahendong geothermal power plant expansion	BIMP+	Tier 3
Indonesia	Energy/Power	Karama Hydro Power Plant, West Sulawesi	BIMP+	Tier 3
Indonesia	Energy/Power	Jawa–Sumatra transmission connection	BIMP+	Tier 2
Indonesia	Energy/Power	Tebo Mine Mouth Coal Fired Steam Power Plant (2×200 MW), Jambi	IMT+	Tier 3
Indonesia	Energy/Power	Coal-Fired Power Plant Indoramayu	IMT+	Tier 3
Indonesia	Energy/Power	The 500 KV power transmission network in Sumatra	IMT+	Tier 2
Indonesia	Energy/Power	Power transmission network Kalimantan–Jawa	BIMP+	Tier 2
Indonesia	Energy/Power	Jawa-5 (FTP2) power station/Baten	BIMP+	Tier 1
Indonesia	Energy/Power	Jawa-7 power station/Banten	BIMP+	Tier 1
Indonesia	Energy/Power	Jawa-4 power station (Expansion of Tj Jati B)/Jawa Tengah	BIMP+	Tier 3
Indonesia	Energy/Power	Riau Kemitraan power plant	IMT+	Tier 3
Indonesia	Energy/Power	Jawa-1 power station/Jawa Barat	BIMP+	Tier 2
Indonesia	Energy/Power	Jawa-8 power station (Expansion of Cilacap)/Jawa Tengah	BIMP+	Tier 2
Indonesia	Energy/Power	Hydroelectric power station; Karangkates IV & V (2x50 MW), Kesamben (37 MW) and Lodoyo (10 MW)	BIMP+	Tier 3
Indonesia	Energy/Power	Abadi LNG Project	IMT+	Tier 2
Indonesia	Energy/Power	Central West Java 500 kV Transmission Line	BIMP+	Tier 2

Indonesia	Energy/Power	Gunung Salak (377 MW) geothermal power plant	BIMP+	Tier 1
Indonesia	Energy/Power	Rantau Dadap (110 MW) geothermal power plant	IMT+	Tier 2
Indonesia	Energy/Power	South Sumatra Biomass power 200–1,000 MW (Phased)	IMT+	Tier 2
Indonesia	Urban Development	MRT Lebak Bulus sta. square development	BIMP+	Tier 1
Indonesia	Urban Development	Academic research cluster development	BIMP+	Tier 1
Indonesia	Water Supply/Sanitation	Water supply/sanitation in DKI Jakarta−Bekasi−Karawang	BIMP+	Tier 1
Indonesia	Water Supply/Sanitation	Umbulan water supply project (engineering service)	BIMP+	Tier 1
Indonesia	Water Supply/Sanitation	Integrated solid waste final disposal and treatment facility for greater Bandung area	BIMP+	Tier 2
Indonesia	Water Supply/Sanitation	Lamongan Regency Water Supply, East Java	BIMP+	Tier 2
Indonesia	Water Supply/Sanitation	Batam Solid Waste, Riau Island	IMT+	Tier 2
Indonesia	Water Supply/Sanitation	Pondok Gede Water Supply	BIMP+	Tier 1
Indonesia	Water Supply/Sanitation	DKI Jakarta Sewage Treatment Plant, DKI Jakarta	BIMP+	Tier 1
Indonesia	Others	Project for Procurement of Satellites and Information Center for Earth Observation	BIMP+	Tier 2
Lao PDR	Road/Bridge	Upgrade of NR 1A: Lantui to Boun-Nua	Mekong	Tier 3
Lao PDR	Road/Bridge	Upgrade of NR 1C: Pakmong–Phoulao	Mekong	Tier 3
Lao PDR	Road/Bridge	Upgrade of NR 1F: Mahaxay–Settamouak	Mekong	Tier 3
Lao PDR	Road/Bridge	NR No.1J: Attapeu−Cambodian border	Mekong	Tier 3
Lao PDR	Road/Bridge	Upgrade of NR 4A, NR 4B: Hongsa–Xiengmen	Mekong	Tier 3
Lao PDR	Road/Bridge	Upgrade of NR 6: Phoulao–Nam Soi	Mekong	Tier 3
Lao PDR	Road/Bridge	Upgrade of NR 8 East–West Transport Route; AH15 (Ban Lao–Nan Phao) (215 km)	Mekong	Tier 2
Lao PDR	Road/Bridge	Improvement of NR 9: East–West Economic Corridor (184 km)	Mekong	Tier 2
Lao PDR	Road/Bridge	Upgrade of NR12: Tang Beng–Na Phao Border (91 km)	Mekong	Tier 2
Lao PDR	Road/Bridge	Upgrade of NR 13N and 13S: Phase 1: [13N] Sikeut–Phonhong, [13S] Don Noun -Ban Hai Bridge; Phase 2: [13N] Phonghong–Vang Vieng, [13S] Ban Hai–Paksan	Mekong	Tier 2
Lao PDR	Road/Bridge	Upgrade of NR 13N: AH11, AH12 (Pakmong–Louang Prabang)	Mekong	Tier 3

Lao PDR	Road/Bridge	Upgrade of NR 13N: Oudomxay–Pakmong	Mekong	Tier 3
Lao PDR	Road/Bridge	Upgrade of NR14A: Mounlapamok-Pakselamphao	Mekong	Tier 3
Lao PDR	Road/Bridge	Upgrade of NR 14B: from Junction National Road No. 16 to Border of Lao PDR with Thailand and Cambodia	Mekong	Tier 3
Lao PDR	Road/Bridge	National Road No. 16: Pakse–Xekong Direct Route Paving/Reconstruction	Mekong	Tier 3
Lao PDR	Road/Bridge	Upgrade of NR16B: From Xekong to Viet Nam Border	Mekong	Tier 3
Lao PDR	Road/Bridge	Upgrade of NR 17B: Sing–Xiengkok	Mekong	Tier 3
Lao PDR	Road/Bridge	Nasak–Khokkaodo Mekong Bridge	Mekong	Tier 3
Lao PDR	Road/Bridge	Luang Prabang–Chomphet Mekong Bridge	Mekong	Tier 3
Lao PDR	Road/Bridge	Xekong Bridge	Mekong	Tier 3
Lao PDR	Railway	Boten–Vientiane Rail Link	Mekong	Tier 2
Lao PDR	Railway	SKRL Spur Line (L): Vientiane−Thakek−Mu Gia	Mekong	Tier 2
Lao PDR	Railway	Savannakhet–Laobao Railway	Mekong	Tier 2
Lao PDR	Railway	Thakhek–Pakse–Vangtao Railway	Mekong	Tier 3
Lao PDR	Port/Maritime	Xiengkok River Port	Mekong	Tier 3
Lao PDR	Port/Maritime	Ban Mom River Port	Mekong	Tier 3
Lao PDR	Port/Maritime	Vientiane Logistics Park (VLP)	Mekong	Tier 2
Lao PDR	Airport	Expansion of the Vientiane International Airport Terminal	Mekong	Tier 2
Lao PDR	Airport	Tonpheung Airport, Bokeo Province (Golden Triangle)	Mekong	Tier 3
Lao PDR	Airport	Nong Khang Airport	Mekong	Tier 3
Lao PDR	Airport	Xeno New Airport	Mekong	Tier 2
Lao PDR	Airport	Xayaburi New Airport	Mekong	Tier 3
Lao PDR	Industrial Estate/SEZ	Industrial Estate Development in Pakse SME SEZ, Champasak Province	Mekong	Tier 2
Lao PDR	Industrial Estate/SEZ	VITA Park, Phase 2 Development	Mekong	Tier 2
Lao PDR	Industrial Estate/SEZ	Phoukhyo SEZ	Mekong	Tier 3
Lao PDR	Industrial Estate/SEZ	Upgrade of Border Trading Zone in Dansavanh (Savannakhet) into SEZ	Mekong	Tier 2

Lao PDR	Energy/Power	Central Power Transmission Interconnection: Houameng-Napia-Dan Xi-Na Bong-Mahaxay-Seno (500 kV)	Mekong	Tier 2
Lao PDR	Energy/Power	East–West Corridor Power Transmission and Distribution Project in the Lao PDR: Transmission and Distribution (T&D) system in the Savannakhet and Salavan provinces	Mekong	Tier 3
Lao PDR	Energy/Power	Nam Ngiep 1 Hydropower (290 MW)	Mekong	Tier 2
Lao PDR	Energy/Power	Xepian-Xenamnoy Hydropower (410 MW)	Mekong	Tier 2
Lao PDR	Energy/Power	Xayaburi Hydropower (1,285 MW)	Mekong	Tier 2
Lao PDR	Energy/Power	Xekaman 1 Hydropower (322 MW)	Mekong	Tier 2
Lao PDR	Energy/Power	Nam Tha 1 Hydropower (168 MW)	Mekong	Tier 3
Lao PDR	Energy/Power	Xekatam Hydropower (61 MW)	Mekong	Tier 3
Lao PDR	Energy/Power	Nam Ngum 1 Hydropower Station Expansion	Mekong	Tier 2
Lao PDR	Energy/Power	Nam Ngum 3 Hydropower (480 MW)	Mekong	Tier 2
Lao PDR	Energy/Power	Nam Theun 1 Hydropower (720 MW)	Mekong	Tier 2
Lao PDR	Energy/Power	Don Sahong Hydropower (260 MW)	Mekong	Tier 3
Lao PDR	Energy/Power	Nam Ou 1, 3, 4, 7 Hydropower (670 MW)	Mekong	Tier 3
Lao PDR	Energy/Power	Phou Ngoy Hydropower (977 MW)	Mekong	Tier 2
Lao PDR	Energy/Power	Nam Phak Hydropower (150 MW)	Mekong	Tier 2
Lao PDR	Energy/Power	Nam Bak 1 Hydropower (160 MW)	Mekong	Tier 2
Lao PDR	Energy/Power	Hongsa Lignite Mine Mouth Power (1,878 MW) – Full Operation	Mekong	Tier 2
Lao PDR	Energy/Power	Kalum Lignite Thermal Power (600 MW)	Mekong	Tier 2
Lao PDR	Energy/Power	Solar Power Plant Development in Xaythany District	Mekong	Tier 3
Lao PDR	Energy/Power	Wind Power Plant Development in Savannakhet, Attapeu, Salavan, and Xekong	Mekong	Tier 3
Lao PDR	Water Supply/Sanitation	Thakhek Water Supply Development Project	Mekong	Tier 3
Lao PDR	Others	Thanaleng Border-Crossing Infrastructure Improvement	Mekong	Tier 2
Lao PDR	Others	Nam Phao Border-Crossing Point (NR 8)	Mekong	Tier 2
Lao PDR	Others	Na Phao Border-Crossing Point (NR 12)	Mekong	Tier 2

Lao PDR	Others	Lalay Border-Crossing Point (NR 15)	Mekong	Tier 3
Malaysia	Road/Bridge	Pan Borneo Highway (Sabah-Sarawak)	BIMP+	Tier 3
Malaysia	Road/Bridge	West Coast Expressway (Banting-Taiping)	IMT+	Tier 1
Malaysia	Road/Bridge	Gurney Drive to Bagan Ajam Undersea Tunnel	IMT+	Tier 1
Malaysia	Railway	Klang Valley Mass Rapid Transit (MRT)	IMT+	Tier 1
Malaysia	Railway	Double Track (Gemas–Johor)	IMT+	Tier 1
Malaysia	Railway	LRT project in Penang	IMT+	Tier 1
Malaysia	Port/Maritime	Tok Bali Port (Kelantan)	IMT+	Tier 1
Malaysia	Port/Maritime	Kuantan Port Expansion	IMT+	Tier 1
Malaysia	Airport	Langkawi International Airport expansion	IMT+	Tier 1
Malaysia	Airport	Sultan Ismail Petra Airport (Kota Bharu Airport) expansion	IMT+	Tier 1
Malaysia	Airport	New air traffic control centre project	IMT+	Tier 1
Malaysia	Airport	Kulim Airport	IMT+	Tier 1
Malaysia	Energy/Power	Hulu Terengganu Hydroelectric Project (212 MW)	IMT+	Tier 1
Malaysia	Energy/Power	Tanjung Bin Coal-fired new power plant (1,000 MW)	IMT+	Tier 1
Malaysia	Energy/Power	Prai Combined-cycle gas turbine (CCGT) power project	IMT+	Tier 1
Malaysia	Energy/Power	Ulu Jelai New Hydroelectric Power Plant (372 MW)	IMT+	Tier 1
Malaysia	Energy/Power	Balingian Coal-fired Power Plant Project	BIMP+	Tier 3
Malaysia	Energy/Power	Baleh Hydroelectric Dam (Sarawak)	BIMP+	Tier 3
Malaysia	Energy/Power	Baram Hydroelectric Dam (Sarawak)	BIMP+	Tier 3
Malaysia	Energy/Power	Manjung 5 power plant	IMT+	Tier 1
Malaysia	Energy/Power	Project 3B coal-fired power plant at Jimah	IMT+	Tier 1
Malaysia	Energy/Power	Sarawak-Peninsular Malaysia (SARPEN) HVDC Transmission Project	BIMP+ IMT+	Tier 1
Malaysia	Urban Development	Iskandar Malaysia	IMT+	Tier 1
Malaysia	Water Supply/Sanitation	Kaiduan Dam and Water Treatment Plant (Sabah)	BIMP+	Tier 2
Malaysia	Water Supply/Sanitation	Langat 2 Water Treatment Plant (Selangor)	IMT+	Tier 1

Myanmar	Road/Bridge	Thilawa Access Road (Infrastructure Development Project in Thilawa Area Phase II)	Mekong	Tier 2
Myanmar	Road/Bridge	Southern Economic Corridor (2-lane road between Dawei and Thai border)	Mekong	Tier 2
Myanmar	Road/Bridge	Kaladan Multimodal Transit Transport Project (Road)	Mekong	Tier 2
Myanmar	Road/Bridge	Yangon–Madalay Highway Upgrading Project	Mekong	Tier 2
Myanmar	Road/Bridge	Mawlamyine–Yee–Dawei–Myeik–Kawthaung Road	Mekong	Tier 2
Myanmar	Road/Bridge	Meiktila–Taunggyi–Kyaing Tong (Kengtung)–Tachileik Road	Mekong	Tier 2
Myanmar	Road/Bridge	New Thaketa Bridge Construction	Mekong	Tier 2
Myanmar	Road/Bridge	Yangon Inner Ring Road	Mekong	Tier 2
Myanmar	Road/Bridge	Yangon Outer Ring Road	Mekong	Tier 2
Myanmar	Road/Bridge	Yangon Arterial Road Construction	Mekong	Tier 2
Myanmar	Road/Bridge	Yangon Flyover Construction Project	Mekong	Tier 2
Myanmar	Road/Bridge	Thailand Myanmar Second Friendship Bridge	Mekong	Tier 2
Myanmar	Road/Bridge	Korea–Myanmar Friendship Bridge	Mekong	Tier 2
Myanmar	Road/Bridge	Access to Hanthawaddy New International Airport (Road)	Mekong	Tier 2
Myanmar	Road/Bridge	Loilem–Kyaing Tong Road	Mekong	Tier 2
Myanmar	Road/Bridge	Route No. 8: Kawkareik–Mawlamyine–Thaton (East–West Economic Corridor Road Improvement Project) Kawkareik–Eindu (ADB)	Mekong	Tier 2
Myanmar	Road/Bridge	Route No. 8: Kawkareik–Mawlamyine–Thaton (East–West Economic Corridor Road Improvement Project) Bridges and Bypass (JICA Loan)	Mekong	Tier 2
Myanmar	Road/Bridge	The Project for Improvement of Road Construction and Maintenance Equipment in Rakhine State	Mekong	Tier 2
Myanmar	Road/Bridge	The Project for Improvement of Road Construction and Maintenance Equipment in Kachin State and Chin state	Mekong	Tier 2
Myanmar	Railway	Access to Hanthawaddy New International Airport (Railway)	Mekong	Tier 2
Myanmar	Railway	Yangon Mandalay Rail Line Modernization Work	Mekong	Tier 2
Myanmar	Railway	Yangon Circular Railway Line Upgrading Project	Mekong	Tier 2

Myanmar	Railway	Mandalay–Myitkyina Track and Signaling Upgrading Project	Mekong	Tier 2
Myanmar	Railway	Bago–Dawei Track Upgrading Project	Mekong	Tier 2
Myanmar	Railway	Tamu–Kale–Segyi–Monywa–Mandalay Rail Line Project	Mekong	Tier 2
Myanmar	Railway	Muse–Kyaukpyu Rail Transportation System	Mekong	Tier 2
Myanmar	Port/Maritime	Thilawa Port Expansion	Mekong	Tier 2
Myanmar	Port/Maritime	Dawei SEZ Development Project Full Phase (Deep Sea Port)	Mekong	Tier 2
Myanmar	Port/Maritime	Kyaukpyu SEZ Development Project (Deep Sea Port)	Mekong	Tier 2
Myanmar	Port/Maritime	Kaladan Multimodal Transit Transport Project (Port)	Mekong	Tier 2
Myanmar	Port/Maritime	Yangon Port Expansion Project	Mekong	Tier 2
Myanmar	Port/Maritime	Pathein Deep Sea Port	Mekong	Tier 2
Myanmar	Port/Maritime	Mandalay Inland Port Establishment	Mekong	Tier 2
Myanmar	Port/Maritime	Mandalay Semeikhon Port Project	Mekong	Tier 2
Myanmar	Port/Maritime	Kyaikkhami Regional Port	Mekong	Tier 3
Myanmar	Other Transportation	Yangon BRT Project	Mekong	Tier 2
Myanmar	Other Transportation	Development of CNS/ATM Master Plan	Mekong	Tier 2
Myanmar	Other Transportation	Ayeyarwady Integrated River Basin Management Project (AIRBM): Inland water transport facilities improvement and development	Mekong	Tier 2
Myanmar	Railway	The Project for Installation of Operation Control Center System and Safety Equipment	Mekong	Tier 2
Myanmar	Other Transportation	Project for Port EDI for Port Modernization	Mekong	Tier 2
Myanmar	Airport	Hanthawaday International Airport	Mekong	Tier 2
Myanmar	Airport	Yangon International Airport (Expansion)	Mekong	Tier 2
Myanmar	Airport	Mandalay International Airport	Mekong	Tier 2
Myanmar	Airport	Upgrading of Dawei Airport	Mekong	Tier 2
Myanmar	Industrial Estate/SEZ	Thilawa SEZ Development Project: Zone A	Mekong	Tier 2
Myanmar	Industrial Estate/SEZ	Thilawa SEZ Development Project: Zone B	Mekong	Tier 2

Myanmar	Industrial Estate/SEZ	Dawei SEZ Development Project: Initial Phase (Dawei SEZ and Cross Boarder Corridor Development)	Mekong	Tier 2
Myanmar	Industrial Estate/SEZ	Dawei SEZ Development Project Full Phase (Dawei SEZ and Cross Boarder Corridor Development)	Mekong	Tier 2
Myanmar	Industrial Estate/SEZ	Kyaukpyu SEZ Development Project	Mekong	Tier 2
Myanmar	Industrial Estate/SEZ	Myotha Industrial Park	Mekong	Tier 2
Myanmar	Industrial Estate/SEZ	Amata City & Tiki Industrial Park	Mekong	Tier 2
Myanmar	Industrial Estate/SEZ	ICT Park at Thanlyin, Yangon	Mekong	Tier 2
Myanmar	Industrial Estate/SEZ	Myawaddy-Phaan Industrial Park	Mekong	Tier 2
Myanmar	Energy/Power	Upper Yeywa Hydropower Project	Mekong	Tier 2
Myanmar	Energy/Power	Shweli 3 Hydropower Project	Mekong	Tier 2
Myanmar	Energy/Power	Tha Htay Hydropower Project	Mekong	Tier 2
Myanmar	Energy/Power	Laymro Hydropower Project	Mekong	Tier 2
Myanmar	Energy/Power	Hutgyi Hydropower Project	Mekong	Tier 2
Myanmar	Energy/Power	Billin Hydropower Project	Mekong	Tier 2
Myanmar	Energy/Power	Thilawa Power Development Project	Mekong	Tier 2
Myanmar	Energy/Power	Mawlamyine Combined Cycle Power Project	Mekong	Tier 2
Myanmar	Energy/Power	Thaton Combined Cycle Gas Turbine Power Plant	Mekong	Tier 2
Myanmar	Energy/Power	Thaketa Combined Cycle Power Project	Mekong	Tier 2
Myanmar	Energy/Power	Kungyangon Coal-fired Power Project	Mekong	Tier 2
Myanmar	Energy/Power	Myeik Coal-fired Power Project	Mekong	Tier 2
Myanmar	Energy/Power	Mawlamyine Coal-fired Power Project	Mekong	Tier 2
Myanmar	Energy/Power	Myingyan Power Generation Project (225 MW)	Mekong	Tier 2
Myanmar	Energy/Power	Mandalay Solar Power Project	Mekong	Tier 2
Myanmar	Energy/Power	Magway Solar Power Project	Mekong	Tier 2
Myanmar	Energy/Power	Power Distribution Improvement Project in Yangon	Mekong	Tier 2
Myanmar	Energy/Power	National Power Transmission Network Development Project Phase I	Mekong	Tier 2

Myanmar	Energy/Power	Power Sector Improvement Project in the Greater Yangon (Phase I)	Mekong	Tier 2
Myanmar	Energy/Power	Urgent Rehabilitation and Upgrade Project (Phase I)	Mekong	Tier 2
Myanmar	Energy/Power	Major Regional City Distribution Network Improvement Project	Mekong	Tier 2
Myanmar	Energy/Power	M3-Block Gas Project	Mekong	Tier 2
Myanmar	Energy/Power	1280MW coal-fired power plants in Mon State	Mekong	Tier 2
Myanmar	Energy/Power	The Project for Rehabilitation of Baluchaung No. 2 Hydropower Plant	Mekong	Tier 3
Myanmar	Telecommunication	Communication Network Improvement Project	Mekong	Tier 2
Myanmar	Telecommunication	Expanding Community ICT Center (CIC) activities to improve rural life in Myanmar	Mekong	Tier 2
Myanmar	Telecommunication	The Project for Development of ICT System for Central Banking	Mekong	Tier 2
Myanmar	Water Supply/Sanitation	Lagunbyin Water Supply Project	Mekong	Tier 2
Myanmar	Water Supply/Sanitation	Project for Urgent Expansion of Water Supply System in Mandalay City	Mekong	Tier 2
Myanmar	Water Supply/Sanitation	Mandalay Urban Service Improvement Project	Mekong	Tier 2
Myanmar	Water Supply/Sanitation	Ayeyarwady Integrated River Basin Management Project (AIRBM): Water resource management system, capacity development, water / meteorological measurement and information system improvement	Mekong	Tier 2
Myanmar	Water Supply/Sanitation	Megala Dam Project	Mekong	Tier 2
Myanmar	Others	Regional Development Project for Poverty Reduction (Phase 1)	Mekong	Tier 3
Myanmar	Others	The Project for National Single Window and Customs Modernization by Introducing Automated Cargo Clearance System	Mekong	Tier 2
Philippines	Road/Bridge	Arterial Road Bypass Project, Phase II (Arterial highway bypass construction project (ii))	BIMP+	Tier 2
Philippines	Road/Bridge	Cavite–Laguna (CALA) Expressway Project (The CALA East−West national road project)	BIMP+	Tier 2
Philippines	Road/Bridge	Metro Manila C6 Expressway Project	BIMP+	Tier 1
Philippines	Road/Bridge	NLEX–SLEX Connector Road Project	BIMP+	Tier 1
Philippines	Road/Bridge	Central Luzon Link Expressway (CLLEx), Phase I	BIMP+	Tier 2

Philippines	Road/Bridge	Metro Manila Priority Bridges Seismic Improvement Project (Improvement of Existing Bridges along Pasig River and Marikina River (near Manila)	BIMP+	Tier 1
Philippines	Road/Bridge	Metro Manila Skyway Stage 3	BIMP+	Tier 1
Philippines	Road/Bridge	Laguna Lakeshore Expressway Dike Project	BIMP+	Tier 1
Philippines	Road/Bridge	Panguil Bay Bridge Project	BIMP+	Tier 2
Philippines	Road/Bridge	Cebu Bus Rapid Transit (BRT) Project	BIMP+	Tier 2
Philippines	Road/Bridge	R-7 Expressway	BIMP+	Tier 1
Philippines	Road/Bridge	Cebu North Coastal Road	BIMP+	Tier 2
Philippines	Road/Bridge	Metro Manila Interchange Construction Project, Phase VI	BIMP+	Tier 1
Philippines	Road/Bridge	Sen. Gil Puyat Avenue–Makati Avenue–Paseo de Roxas Underpass Project	BIMP+	Tier 1
Philippines	Road/Bridge	Global City to Ortigas Center Link Road	BIMP+	Tier 1
Philippines	Road/Bridge	C3 Missing Link (San Juan to Makati/Sta. Ana Oval)	BIMP+	Tier 1
Philippines	Road/Bridge	Improvement and Operation & Maintenance of Kennon Road and Marcos Highway	BIMP+	Tier 3
Philippines	Road/Bridge	NAIA Expressway Project (Phase II)	BIMP+	Tier 1
Philippines	Road/Bridge	Plaridel Bypass Toll Road Project	BIMP+	Tier 2
Philippines	Road/Bridge	NLEX East Expressway	BIMP+	Tier 2
Philippines	Road/Bridge	Davao City Bypass Construction Project	BIMP+	Tier 2
Philippines	Road/Bridge	Iba-Tarlac Road (Capas-Botolan Road) Project	BIMP+	Tier 3
Philippines	Road/Bridge	Panay (Metro Iloilo)–Guimaras–Negros (Metro Bacolod) Island Bridges	BIMP+	Tier 2
Philippines	Road/Bridge	Samal Bridge Project	BIMP+	Tier 3
Philippines	Road/Bridge	Dalton Pass East Alignment (Phase II)	BIMP+	Tier 3
Philippines	Road/Bridge	Camarines Sur Toll Expressway Project	BIMP+	Tier 2
Philippines	Road/Bridge	Tagum-Davao-General Santos High Standard Highway	BIMP+	Tier 2
Philippines	Road/Bridge	Pasig–Marikina Expressway	BIMP+	Tier 1
Philippines	Road/Bridge	South Luzon Expressway Toll Road 4 (Sto. Tomas to Lucena Toll Road) (SLEX TR4)	BIMP+	Tier 2
Philippines	Road/Bridge	CLLEx Phase II and Operation and Maintenance of Phases I and II	BIMP+	Tier 2

Philippines	Railway	Light Rail Transit (LRT) Line 2 East Extension (Manila LRT: 2nd line extension)	BIMP+	Tier 1
Philippines	Railway	LRT Line 1 South Extension Project (Manila LRT: 1st line south extension)	BIMP+	Tier 1
Philippines	Railway	North-South Railway Project (South Line)	BIMP+	Tier 2
Philippines	Railway	LRT Line 6 Project Construction, Operation and Maintenance	BIMP+	Tier 1
Philippines	Railway	MRT Line 7	BIMP+	Tier 1
Philippines	Railway	Metro Manila Central Business District Transit System Project	BIMP+	Tier 1
Philippines	Railway	Ortigas–Taytay LRT Line 4 Project	BIMP+	Tier 1
Philippines	Railway	MRT 3 Capacity Expansion Project	BIMP+	Tier 1
Philippines	Railway	Metro Manila Subway	BIMP+	Tier 1
Philippines	Railway	North–South Commuter Railway (formerly Manila–Malolos Commuter Line)	BIMP+	Tier 2
Philippines	Railway	LRT 2 West Extension	BIMP+	Tier 1
Philippines	Port/Maritime	Development of New Cebu Container Port (Cebu Port: Development of new Cebu port)	BIMP+	Tier 2
Philippines	Port/Maritime	Davao Sasa Port Modernization Project (Davao Port: Development of quay crane and expansion of container terminal)	BIMP+	Tier 2
Philippines	Port/Maritime	Cagayan de Oro Port Development Project	BIMP+	Tier 3
Philippines	Port/Maritime	Maritime Safety Capability Improvement Project for the Philippine Coast Guard	BIMP+	Tier 2
Philippines	Port/Maritime	Central Spine Roll-on/Roll-off (RoRo)	BIMP+	Tier 2
Philippines	Port/Maritime	General Santos City Port (Makar Wharf Expansion) Project	BIMP+	Tier 3
Philippines	Other Transportation	C-5 Modern Bus Transit System Project	BIMP+	Tier 1
Philippines	Other Transportation	Road Transport Information Technology (IT) Infrastructure Project (Phase II)	BIMP+	Tier 2
Philippines	Airport	Mactan-Cebu International Airport Passenger Terminal Building Project	BIMP+	Tier 2
Philippines	Airport	Development, Operations and Maintenance of Bacolod–Silay Airport	BIMP+	Tier 2
Philippines	Airport	Development, Operations and Maintenance of Davao Airport	BIMP+	Tier 2
Philippines	Airport	Development, Operations and Maintenance of Iloilo Airport	BIMP+	Tier 2

Philippines	Airport	Development, Operations and Maintenance of Laguindingan Airport	BIMP+	Tier 2
Philippines	Airport	Development, Operations and Maintenance of New Bohol (Panglao) Airport	BIMP+	Tier 2
Philippines	Airport	Puerto Princesa Airport Development Project	BIMP+	Tier 2
Philippines	Airport	Busuanga Airport Development Project	BIMP+	Tier 2
Philippines	Airport	San Fernando Airport	BIMP+	Tier 2
Philippines	Airport	Clark International Airport Project	BIMP+	Tier 2
Philippines	Airport	NAIA Development Project (New Manila International Airport Development)	BIMP+	Tier 1
Philippines	Airport	Sangley International Airport	BIMP+	Tier 2
Philippines	Industrial Estate/SEZ	Clark Green City Project	BIMP+	Tier 2
Philippines	Energy/Power	Masinloc Coal-fired Thermal Power Plant Expansion Project	BIMP+	Tier 2
Philippines	Energy/Power	Integrated Bataan Liquefied Natural Gas Terminal, Power Plants and Bataan to Manila Gas Pipeline Project (BATMAN 2)	BIMP+	Tier 2
Philippines	Energy/Power	Chiller Energy Efficiency Project	BIMP+	Tier 2
Philippines	Energy/Power	Batangas–Manila (BatMan) 1 Natural Gas Pipeline Project	BIMP+	Tier 1
Philippines	Energy/Power	600 MW Mariveles Coal-fired Power Plant Expansion Project	BIMP+	Tier 2
Philippines	Energy/Power	Rehabilitation, Operation, and Maintenance of the Angat Hydro Electric Power Plant (AHEPP) Auxiliary Turbines 4 and 5	BIMP+	Tier 2
Philippines	Energy/Power	Batangas Liquefied Natural Gas Regasification Terminal Project	BIMP+	Tier 2
Philippines	Energy/Power	Pagbilao LNG Hub Terminal Project	BIMP+	Tier 2
Philippines	Energy/Power	AG&P Energy City Project	BIMP+	Tier 2
Philippines	Energy/Power	Pagbilao Coal-fired Power Plant	BIMP+	Tier 2
Philippines	Water Supply/Sanitation	Bulacan Bulk Water Supply Project	BIMP+	Tier 2
Philippines	Water Supply/Sanitation	Angat Water Transmission Improvement Project	BIMP+	Tier 2
Philippines	Water Supply/Sanitation	New Centennial Water Supply Source - Kaliwa Dam Project	BIMP+	Tier 2
Philippines	Water Supply/Sanitation	Design and Construction of Parañaque Water Reclamation Facility 1	BIMP+	Tier 1
Philippines	Water Supply/Sanitation	Water Supply and Wastewater Project in Boracay Island	BIMP+	Tier 2
Thailand	Road/Bridge	Motorway: Bang Pa in–Saraburi–Nakhon Ratchasima	Mekong	Tier 2

Thailand	Road/Bridge	Motorway: Bang Yai–Ban Pong–Kanchanaburi	Mekong	Tier 1
Thailand	Road/Bridge	Motorway: Pattaya–MapTa Phut	Mekong	Tier 1
Thailand	Road/Bridge	Motorway: Nakhonpathom–Cha Um	Mekong	Tier 2
Thailand	Road/Bridge	Motorway: Bang Pain–Nakhonsawan	Mekong	Tier 2
Thailand	Road/Bridge	Road network to support 2nd Moey bridge	Mekong	Tier 2
Thailand	Road/Bridge	Road network to support Mukdahan border, highway no. 12 (Kalasain–Baan Nakrai) section 1	Mekong	Tier 2
Thailand	Road/Bridge	Road network to support Klong Yai border, highway no. 3 (Trat–Hat Lek), section 1 (35 km.), expand to 4 lanes	Mekong	Tier 2
Thailand	Road/Bridge	Highway improvement such as highway no. 4 (Krabi–Huay Yod), highway no.12 (Kalasin–Sondej), highway no. 304 (Bangpakong–Chachoengsao) and highway no. 3138 (Ban Bueng–Ban Kai)	IMT+	Tier 2
Thailand	Road/Bridge	Project to develop highway along EWEC	Mekong	Tier 2
Thailand	Road/Bridge	Inter-city Motorway: Hat Yai–Thai–Malaysia border	IMT+	Tier 2
Thailand	Road/Bridge	Highway improvement: Lomsak–Phetchabun	Mekong	Tier 2
Thailand	Road/Bridge	4-lane road construction and border checkpoint at Aranyaprathet - Poipet	Mekong	Tier 2
Thailand	Road/Bridge	Sirat–Bangkok Outer Ring Road Expressway Project	Mekong	Tier 1
Thailand	Road/Bridge	Third-Stage Expressway System - North Sections	Mekong	Tier 1
Thailand	Road/Bridge	Rama III–Western Outer Ring Road Expressway Project	Mekong	Tier 1
Thailand	Road/Bridge	Kathu–Patong Expressway Project, Phuket province	IMT+	Tier 2
Thailand	Road/Bridge	Buraphawithi–Pattaya Expressway Project	Mekong	Tier 1
Thailand	Road/Bridge	Udonrattaya–Ayuthaya Expressway Project	Mekong	Tier 1
Thailand	Road/Bridge	Chalongrat–Nakornayok–Saraburi Expressway Project	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Extension Blue line (Hualumpong−Bangkae and Bang Sue-Thapra)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Extension Blue line (Bangkae–Phutthamonthon Sai 4)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Dark green line (Morchit−Saphanmai–Kukot)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Dark green line (Kukot–Lamlukka)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Dark green line (Baering–Samutprakan)	Mekong	Tier 1

Thailand	Railway	Bangkok MRT: Dark green line (Samutprakan–Bangpu)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Orange line (Talingchan–Cultural center)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Orange line (Cultural center–Minburi)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Purple line (Bang Yai–Bang Sue)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Purple line (Taopoon–Ratburana)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Pink line (Khae Rai−Min Buri)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Yellow line (Lat Phrao−Samrong)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Dark Red line (Bang Sue–Rangsit)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Dark Red line (Rangsit–Thammasart)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Light Red line (Bang Sue–Talingchan)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Light Red line (Bang Sue–Huamak) and Dark Red line (Bang Sue–Hualampong)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Light Red line (Talingchan–Salaya)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Light Red line (Talingchan–Sirirat)	Mekong	Tier 1
Thailand	Railway	Bangkok MRT: Dark Red line (Hualampong–Mahachai)	Mekong	Tier 1
Thailand	Railway	Airport Rail Link: (Donmuang–Bang Sue–Phayathai)	Mekong	Tier 1
Thailand	Railway	Railway Denchai–Chiang Rai–Chiang Khong	Mekong	Tier 2
Thailand	Railway	Double track: Jira, Nakhon Rachasima–Khon Kaen	Mekong	Tier 2
Thailand	Railway	Double track: Prachuab Khirikhan–Chumporn	IMT+	Tier 2
Thailand	Railway	Double track: Nakhon Pathom–Hua Hin	Mekong	Tier 2
Thailand	Railway	Double track: Lopburi–Paknampho	Mekong	Tier 2
Thailand	Railway	Double track: Mabkabao–Jira junction, Nakhon Ratchasima	Mekong	Tier 2
Thailand	Railway	Double track: Hua Hin–Prachuab Khirikhan	Mekong	Tier 2
Thailand	Railway	Double track: Chachoengsao–Klongsibkao–Kaeng Koi	Mekong	Tier 2
Thailand	Railway	Railway Baan Pai–Nakhon Phanom	Mekong	Tier 2
Thailand	Railway	High speed rail: Bangkok–Pattaya–Rayong	Mekong	Tier 1
Thailand	Railway	Railway development (Double track) Surat Thani−Phang Nga (Thanoon)	IMT+	Tier 2

Thailand	Railway	Railway: Nongkhai–Kaeng Koi–Map Ta Phut–Bangkok	Mekong	Tier 1
Thailand	Railway	Double track: Baan Phu Nam Ron–Kanchanaburi–Bangkok–Chachoengsao–Laemchabang and Bangkok–Chachoengsao–Aranyaprathet	Mekong	Tier 1
Thailand	Railway	High speed train project: Bangkok–Chiang Mai	Mekong	Tier 1
Thailand	Railway	High speed train: Bangkok–Hua Hin	Mekong	Tier 1
Thailand	Railway	High speed rail: Chiang Khong–Denchai–Ban Pachi	Mekong	Tier 2
Thailand	Railway	Double track: Songkla–Satun	IMT+	Tier 2
Thailand	Railway	Light rail: Phuket airport–Chalong intersection	IMT+	Tier 2
Thailand	Railway	Brown Line: Khae Rai–Lamsali (Bueng Kum)	Mekong	Tier 1
Thailand	Port/Maritime	Pakbara deep sea port construction	IMT+	Tier 2
Thailand	Port/Maritime	Songkla deep sea port 2 construction	IMT+	Tier 2
Thailand	Port/Maritime	Deep sea port construction in Chumporn	IMT+	Tier 2
Thailand	Port/Maritime	Construction of water freight transport station to save energy in Angthong	Mekong	Tier 2
Thailand	Port/Maritime	Freight optimization projects in Pasak river	Mekong	Tier 2
Thailand	Port/Maritime	Construction of lift dam for navigation in Chaophraya river and Nan river	Mekong	Tier 2
Thailand	Port/Maritime	Samutsakhon port construction	Mekong	Tier 2
Thailand	Port/Maritime	Multi-purpose port in Khlong Yai, Trat	Mekong	Tier 2
Thailand	Port/Maritime	Transportation capacity improvement in Saen Saep canal and Chaophraya river	Mekong	Tier 2
Thailand	Port/Maritime	Coastal Terminal Development Project of Bangkok Port	Mekong	Tier 1
Thailand	Port/Maritime	Coastal Terminal Development Project (A) of Laem Chabang Port	Mekong	Tier 1
Thailand	Port/Maritime	Single Rail Transfer Operator at Laem Chabang Port, Phase 1	Mekong	Tier 1
Thailand	Port/Maritime	Laemchabang port phase 3	Mekong	Tier 1
Thailand	Airport	Project to develop U-Tapao Airport into a commercial airport.	Mekong	Tier 1
Thailand	Airport	Suvarnabhumi airport: Phase 2	Mekong	Tier 1
Thailand	Airport	Don Muang Airport Terminal 2 renovation	Mekong	Tier 1
Thailand	Airport	Phuket Airport Expansion	IMT+	Tier 2

Thailand	Airport	Chiang Mai Airport Expansion	Mekong	Tier 2
Thailand	Airport	Mae Sot airport expansion.	Mekong	Tier 2
Thailand	Industrial Estate/SEZ	Southern Region Cargo Distribution Center at Thungsong (CDC)	IMT+	Tier 2
Thailand	Industrial Estate/SEZ	Establishment of Special Economic Zone in Mae Sot, Tak	Mekong	Tier 2
Thailand	Industrial Estate/SEZ	Establishment of Special Economic Zone in Mukdahan	Mekong	Tier 2
Thailand	Industrial Estate/SEZ	Establishment of Special Economic Zone in Aranyaprathet, Sa Kaew	Mekong	Tier 2
Thailand	Industrial Estate/SEZ	Establishment of Special Economic Zone in Had Lek, Trat	Mekong	Tier 2
Thailand	Industrial Estate/SEZ	Establishment of Special Economic Zone in Sadao, Songkla	IMT+	Tier 2
Thailand	Industrial Estate/SEZ	Establishment of Special Economic Zone in Nong Khai	Mekong	Tier 2
Thailand	Industrial Estate/SEZ	Establishment of Special Economic Zone in Chiang Rai, Phase 2	Mekong	Tier 2
Thailand	Industrial Estate/SEZ	Establishment of Special Economic Zone in Kanchanaburi, Phase 2	Mekong	Tier 2
Thailand	Industrial Estate/SEZ	Establishment of Special Economic Zone in Nakhon Phanom, Phase 2	Mekong	Tier 2
Thailand	Industrial Estate/SEZ	Establishment of Special Economic Zone in Narathiwat, Phase 2	IMT+	Tier 2
Thailand	Energy/Power	Krabi coal power plant	IMT+	Tier 2
Thailand	Energy/Power	New power plant to replace Mae Moh power plant 4-7	Mekong	Tier 2
Thailand	Energy/Power	Coa power plant in Tepa, Songkla	IMT+	Tier 2
Thailand	Energy/Power	Construction of underwater cable and distribution system to the islands (Kood and Mak island in Trat province)	Mekong	Tier 3
Thailand	Energy/Power	Construction of underwater cable to Tao island in Surat Thani province	IMT+	Tier 3
Thailand	Energy/Power	The development of electricity generated system by renewable energy in Kood island and Mak island in Trat province	Mekong	Tier 3
Thailand	Energy/Power	Project to develop transmission line and distribution system, phase 1	Mekong	Tier 2
Thailand	Energy/Power	The development of Micro-Grid in Maesareang, Mae Hong Son province	Mekong	Tier 3
Thailand	Energy/Power	Transmission line and distribution system development, phase 1	Mekong	Tier 1
Thailand	Energy/Power	Power plant construction from garbage of the Provincial Administration Organization (PAO), Nonthaburi	Mekong	Tier 1
Thailand	Energy/Power	Power plant construction from garbage of Nakhon Ratchasima Municipality	Mekong	Tier 2
Thailand	Energy/Power	1st phase of Natural Gas Pipeline Network	Mekong	Tier 2

Thailand	Energy/Power	The 4th Natural Gas Transmission Pipeline (Rayong–Kaeng Khoi)	Mekong	Tier 2
Thailand	Energy/Power	Nakhornsawan On-shore Natural Gas Pipeline phase 1 and 2	Mekong	Tier 2
Thailand	Energy/Power	Nakhon Ratchasima Waste-energy 2,000 MW	Mekong	Tier 2
Thailand	Telecommunication	The international submarine cable system	Mekong	Tier 2
Thailand	Telecommunication	2 million ports broadband project for 2015–2019	Mekong	Tier 2
Thailand	Urban Development	Saensuk Municipality in Chon Buri's Muang district is piloting a three-year 'smart city' scheme from this year to 2017.	Mekong	Tier 1
Thailand	Urban Development	Amata Science City in Chon Buri's Nakorn district	Mekong	Tier 1
Thailand	Water Supply/Sanitation	Waste water treatment plant project in Minburi, Thonburi, Bueng Nong Bon, and Klong Toey	Mekong	Tier 1
Thailand	Water Supply/Sanitation	Water diversion from Yuam river to the Bhumibol dam in Tak	Mekong	Tier 2
Thailand	Water Supply/Sanitation	Water diversion from Khong–Loey–Chi–Moon	Mekong	Tier 2
Thailand	Water Supply/Sanitation	Toxic Industrial Waste Disposal Management Master Plan (2015–2019)	Mekong	Tier 2
Thailand	Water Supply/Sanitation	Establishment of industrial-waste disposal sites	Mekong	Tier 2
Thailand	Others	The Development of Thailand Earth Observation System	Mekong	Tier 2
Thailand	Others	The development of GNSS Continuously Operating Reference Stations and the creation of the new service by the QZSS utilization promotion	Mekong	Tier 1
Viet Nam	Road/Bridge	Expansion of National Road 1A	Mekong	Tier 3
Viet Nam	Road/Bridge	Expansion of Ho Chi Minh Route	Mekong	Tier 3
Viet Nam	Road/Bridge	Expansion of National Road 9: Cua Viet–Lao Bao, 118 km, Grades II–III, 2–4 lanes	Mekong	Tier 2
Viet Nam	Road/Bridge	Expansion of National Road 22: Ho Chi Minh–Moc Bai, 58 km, Grades I–II, 4–6 lanes	Mekong	Tier 1
Viet Nam	Road/Bridge	Hanoi Ring Road: No. 1 (East–West axis)	Mekong	Tier 1
Viet Nam	Road/Bridge	Hanoi Ring Road: No. 2 (including Nhat Tan Bridge and Dong Tru Bridge)	Mekong	Tier 1
Viet Nam	Road/Bridge	Hanoi Ring Road: No. 3 (including Phu Dong Bridge 2)	Mekong	Tier 1
Viet Nam	Road/Bridge	Hanoi Ring Road: No. 4 (including Hong Ha Bridge and Duong Bridge)	Mekong	Tier 1
Viet Nam	Road/Bridge	Hanoi Ring Road: No. 5	Mekong	Tier 1

Viet Nam	Road/Bridge	Ring Road: Road from Phu My Bridge–Rach Chiec 2 Bridge	Mekong	Tier 1
Viet Nam	Road/Bridge	Ring Road: Road from Rach Chiec 2 Bridge–Go Dua Intersection	Mekong	Tier 1
Viet Nam	Road/Bridge	Ring Road: An Lac Intersection–Nguyen Van Linh Road	Mekong	Tier 1
Viet Nam	Road/Bridge	Ring Road: Tan Van–Nhon Trach	Mekong	Tier 1
Viet Nam	Road/Bridge	Ho Chi Minh City Ring Road: No. 2	Mekong	Tier 1
Viet Nam	Road/Bridge	Ho Chi Minh City Ring Road: No. 3	Mekong	Tier 1
Viet Nam	Road/Bridge	Ho Chi Minh City Ring Road: No. 4	Mekong	Tier 1
Viet Nam	Road/Bridge	Highway: Hai Phong–Ha Long	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Hanoi–Bac Giang	Mekong	Tier 1
Viet Nam	Road/Bridge	Highway: Bac Giang–Lang Son	Mekong	Tier 2
Viet Nam	Road/Bridge	Hanoi–Hai Phong Highway	Mekong	Tier 1
Viet Nam	Road/Bridge	Highway: Noi Bai–Ha Long	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Hoa Lac–Cau Coi	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Hoa Lac–Hoa Binh	Mekong	Tier 1
Viet Nam	Road/Bridge	Highway: Ninh Binh–Hai Phong	Mekong	Tier 1
Viet Nam	Road/Bridge	Highway: Tan Vu–Lach Huyen	Mekong	Tier 1
Viet Nam	Road/Bridge	Highway: Ninh Binh–Thanh Hoa (Nghi Son)	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Thanh Hoa (Nghi Son)–Ha Tinh (Hong Linh)	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Ha Tinh (Hong Linh)–Quang Binh (Bung)	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Quang Binh (Bung)–Quang Tri (Cam Lo)	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Quang Tri (Cam Lo)–Da Nang (Tuy Loan)	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Da Nang–Quang Ngai	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Quang Ngai–Binh Dinh	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Binh Dinh–Nha Trang	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Nha Trang–Phan Thiet	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Phan Thiet–Dau Giay	Mekong	Tier 2

Viet Nam	Road/Bridge	Highway: Dau Giay–Lien Khuong (Da Lat)	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Trung Luong–My Thuan	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: My Thuan–Can Tho	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: CanTho–Chau Doc, An Giang	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Can Tho–Soc Trang	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Ha Tien–Rach Gia–Bac Lieu	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Can Tho–Ca Mau	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Ho Chi Minh City–Moc Bai	Mekong	Tier 1
Viet Nam	Road/Bridge	Highway: Ho Chi Minh City–Thu Dau Mot–Chon Thanh	Mekong	Tier 1
Viet Nam	Road/Bridge	Highway: Long Thanh–Ben Luc	Mekong	Tier 1
Viet Nam	Road/Bridge	Highway: Bien Hoa–Vung Tau	Mekong	Tier 1
Viet Nam	Road/Bridge	Highway: Hong Linh–Huong Son	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Cam Lo–Lao Bao	Mekong	Tier 2
Viet Nam	Road/Bridge	Highway: Quy Nhon–Pleiku	Mekong	Tier 3
Viet Nam	Road/Bridge	Bach Dang Bridge (Part of Hai Phong–Ha Long Highway)	Mekong	Tier 2
Viet Nam	Road/Bridge	Hanoi–Hai Phong Bridge	Mekong	Tier 1
Viet Nam	Road/Bridge	Cao Lanh Bridge (Tien River)	Mekong	Tier 2
Viet Nam	Road/Bridge	Vam Cong bridge (Hau River)	Mekong	Tier 2
Viet Nam	Road/Bridge	The Feasibility Study on High-Speed Railway Project on Hanoi–Vinh	Mekong	Tier 1
Viet Nam	Road/Bridge	The Feasibility Study on High-Speed Railway Project on Ho Chi Minh–Nha Trang	Mekong	Tier 1
Viet Nam	Road/Bridge	North–South Expressway Construction Project (Ho Chi Minh City–Dau Giay Section) Phase (III)	Mekong	Tier 1
Viet Nam	Road/Bridge	Mu Gia–Tan Ap–Vung Ang Expressway	Mekong	Tier 2
Viet Nam	Road/Bridge	Research on Land Slide Prevention on Viet Nam's national highway	Mekong	Tier 2
Viet Nam	Railway	Lao Cai–Hanoi Railway Upgrading (in Kunming–Haiphong Transport Corridor) - Phase 2	Mekong	Tier 2
Viet Nam	Railway	Railway: Upgrade of Hanoi–Hai Phong (Gia Lam–Hai Phong) railway line	Mekong	Tier 1

Viet Nam	Railway	Railway: Bien Hoa–Vung Tau	Mekong	Tier 1
Viet Nam	Railway	Hanoi urban railway: Route No. 1 (Ngoc Hoi–Yen Vien, Nhu Quynh)	Mekong	Tier 1
Viet Nam	Railway	Hanoi urban railway: Route No. 2 (Noi Bai–Downtown–Thuong Dinh)	Mekong	Tier 1
Viet Nam	Railway	Hanoi urban railway: Route No. 2A (Cat Linh–Ha Dong)	Mekong	Tier 1
Viet Nam	Railway	Hanoi urban railway: Route No. 3 (Nhon–Hanoi Railway Station–Hoang Mai)	Mekong	Tier 1
Viet Nam	Railway	Hanoi urban railway: Route No. 4 (Dong Anh–Sai Dong–Vinh Tuy/Hoang Mai–Thanh Xuan–Tu Liem–Thuong Cat–Me Linh)	Mekong	Tier 1
Viet Nam	Railway	Hanoi urban railway: Route No. 5 (South of Westlake–Ngoc Khanh–Lang Hoa Lac)	Mekong	Tier 1
Viet Nam	Railway	Ho Chi Minh City urban railway: No. 1	Mekong	Tier 1
Viet Nam	Railway	Ho Chi Minh City urban railway: No. 2	Mekong	Tier 1
Viet Nam	Railway	Ho Chi Minh City urban railway: No. 3a	Mekong	Tier 1
Viet Nam	Railway	Ho Chi Minh City urban railway: No. 3b	Mekong	Tier 1
Viet Nam	Railway	Ho Chi Minh City urban railway: No. 4	Mekong	Tier 1
Viet Nam	Railway	Ho Chi Minh City urban railway: No. 5	Mekong	Tier 1
Viet Nam	Railway	Ho Chi Minh City urban railway: No. 6	Mekong	Tier 1
Viet Nam	Railway	Loc Ninh–Ho Chi Minh City Railway	Mekong	Tier 1
Viet Nam	Railway	Strengthening Urban Railway training capacity	Mekong	Tier 1
Viet Nam	Railway	Hanoi–Ho Chi Minh City Railway Line Bridges Safety Improvement Project	Mekong	Tier 1
Viet Nam	Railway	Hanoi–Vinh high speed	Mekong	Tier 1
Viet Nam	Railway	HCMC–Nha Trang high speed	Mekong	Tier 1
Viet Nam	Port/Maritime	Lach Huyen Port (Hai Phong)	Mekong	Tier 1
Viet Nam	Port/Maritime	Da Nang port improvement project (II)	Mekong	Tier 1
Viet Nam	Port/Maritime	Upgrading of Can Tho port	Mekong	Tier 2
Viet Nam	Port/Maritime	Vung Ang port expansion	Mekong	Tier 2
Viet Nam	Port/Maritime	Upgrading Ports and Seaway	Mekong	Tier 2
Viet Nam	Airport	Long Thanh International Airport	Mekong	Tier 1

Viet Nam	Airport	Expansion of Tan Son Nhat International Airport	Mekong	Tier 1
Viet Nam	Airport	Expansion of Noi Bai International Airport	Mekong	Tier 1
Viet Nam	Airport	Expansion of Cat Bi International Airport, Hai Phong	Mekong	Tier 1
Viet Nam	Airport	Expansion of Da Nang International Airport	Mekong	Tier 1
Viet Nam	Airport	Expansion of Chu Lai Airport	Mekong	Tier 2
Viet Nam	Airport	Air Traffic Flow Management in Viet Nam	Mekong	Tier 2
Viet Nam	Industrial Estate/SEZ	Information Technology Park in Hanoi	Mekong	Tier 1
Viet Nam	Industrial Estate/SEZ	Information Technology Park in Ho Chi Minh City	Mekong	Tier 1
Viet Nam	Industrial Estate/SEZ	Hoa Lac Hi–Tech Park (Phase 2)	Mekong	Tier 1
Viet Nam	Industrial Estate/SEZ	Da Nang Hi-Tech Park	Mekong	Tier 1
Viet Nam	Industrial Estate/SEZ	Saigon Hi-Tech Park (Phase 2)	Mekong	Tier 1
Viet Nam	Industrial Estate/SEZ	Biotech Park in Hanoi	Mekong	Tier 1
Viet Nam	Industrial Estate/SEZ	Biotech Park in Da Nang	Mekong	Tier 1
Viet Nam	Industrial Estate/SEZ	Biotech Park in Ho Chi Minh City	Mekong	Tier 1
Viet Nam	Industrial Estate/SEZ	High-tech Agriculture Park in Da Lat	Mekong	Tier 3
Viet Nam	Industrial Estate/SEZ	High-tech Agriculture Park in Ho Chi Minh City Phase 2	Mekong	Tier 1
Viet Nam	Industrial Estate/SEZ	High-tech Agriculture Park in Can Tho	Mekong	Tier 3
Viet Nam	Industrial Estate/SEZ	Rental Factory Development Project for SMEs in Nhon Trach 3	Mekong	Tier 1
Viet Nam	Energy/Power	Duyen Hai power plant III #1, #2, #3	Mekong	Tier 2
Viet Nam	Energy/Power	Duyen Hai power plant II #1, #2	Mekong	Tier 2
Viet Nam	Energy/Power	Long Phu power plant I #1, #2	Mekong	Tier 2
Viet Nam	Energy/Power	O Mon combined cycle power plant III	Mekong	Tier 2
Viet Nam	Energy/Power	Lai Chau Hydro power plant #1, #2, #3	Mekong	Tier 2
Viet Nam	Energy/Power	Thai Binh power plant I #1, #2	Mekong	Tier 2
Viet Nam	Energy/Power	Vinh Tan power plant I #1, #2	Mekong	Tier 2
Viet Nam	Energy/Power	Vung Ang power plant I #2	Mekong	Tier 2

Viet Nam	Energy/Power	O Mon combined cycle power plant IV	Mekong	Tier 2
Viet Nam	Energy/Power	O Mon combined cycle power plant II	Mekong	Tier 2
Viet Nam	Energy/Power	Nghi Son power plant II #1, #2	Mekong	Tier 2
Viet Nam	Energy/Power	Van Phong power plant I #1, #2	Mekong	Tier 2
Viet Nam	Energy/Power	Vinh Tan power plant VI #1, #2	Mekong	Tier 2
Viet Nam	Energy/Power	Vinh Tan power plant III #1, #2, #3	Mekong	Tier 2
Viet Nam	Energy/Power	Song Hau power plant I #1, #2	Mekong	Tier 2
Viet Nam	Energy/Power	Vung Ang power plant II #1, #2	Mekong	Tier 2
Viet Nam	Energy/Power	Son My combined cycle power plant I #1, #2, #3, #4, #5	Mekong	Tier 2
Viet Nam	Energy/Power	Bac Ai Pumped Storage Hydro power plant #1, #2, #3	Mekong	Tier 2
Viet Nam	Energy/Power	Dong Phu Yen Pumped Storage hydro power plant #1, #2, #3	Mekong	Tier 2
Viet Nam	Energy/Power	Ninh Thuan nuclear power plant I #1, #2	Mekong	Tier 2
Viet Nam	Energy/Power	Ninh Thuan nuclear power plant II #1, #2	Mekong	Tier 2
Viet Nam	Energy/Power	Gas Power Plant from Blue Whale Gas Field	Mekong	Tier 2
Viet Nam	Energy/Power	Long Son refinery plant	Mekong	Tier 2
Viet Nam	Energy/Power	Nghi Son refinery plant	Mekong	Tier 2
Viet Nam	Energy/Power	Vung Ro refinery plant	Mekong	Tier 2
Viet Nam	Energy/Power	Nam Van Phong refinery plant	Mekong	Tier 2
Viet Nam	Energy/Power	Nhon Hoi refinery plant	Mekong	Tier 2
Viet Nam	Energy/Power	Don Duong Pumped Storage Hydropower Project	Mekong	Tier 2
Viet Nam	Telecommunication	Feasibility Study on the Possibility of Overseas Development of Japan's Integrated Broadcasting Communications System in Socialist Republic of VN	Mekong	Tier 1
Viet Nam	Urban Development	Dong Anh Urban City N5	Mekong	Tier 1
Viet Nam	Urban Development	Binh Quoi New Urban Area	Mekong	Tier 1
Viet Nam	Urban Development	North of Cam River Urban Area in Hai Phong	Mekong	Tier 1
Viet Nam	Water Supply/Sanitation	Song Da Water Supply Plant Phase 2	Mekong	Tier 1

Viet Nam	Water Supply/Sanitation	Song Hong Water Supply Plant	Mekong	Tier 1
Viet Nam	Water Supply/Sanitation	Duong River Water Supply Plant Phase 1	Mekong	Tier 1
Viet Nam	Water Supply/Sanitation	Hoa Lien Water Supply Plant (Da Nang)	Mekong	Tier 1
Viet Nam	Water Supply/Sanitation	Tan Hiep Water Plant Phase II	Mekong	Tier 1
Viet Nam	Water Supply/Sanitation	Thu Duc Water Plant No 4	Mekong	Tier 1
Viet Nam	Water Supply/Sanitation	Kenh Dong Water Plant II	Mekong	Tier 1
Viet Nam	Water Supply/Sanitation	Yen Xa Waste Water Treatment Plant	Mekong	Tier 1
Viet Nam	Water Supply/Sanitation	Binh Hung Waste Water Treatment Plant Phase 2	Mekong	Tier 1
Viet Nam	Water Supply/Sanitation	Nieu Loc Thi Nghe Waste Water Treatment Plant	Mekong	Tier 2
Viet Nam	Others	Hoa Lac Hospital	Mekong	Tier 1
Viet Nam	Others	Bach Mai 2 Hospital	Mekong	Tier 1
Viet Nam	Others	Viet Duc 2 Hospital	Mekong	Tier 1
Viet Nam	Others	Cho Ray 2 Hospital	Mekong	Tier 1
Viet Nam	Others	Relocation of National University of Hanoi to Lang Hoa Lac	Mekong	Tier 1
Viet Nam	Others	Can Tho University Improvement Project	Mekong	Tier 3
Viet Nam	Others	Project for Disaster and Climate Change Countermeasures Using Earth Observation Satellite	Mekong	Tier 2
China	Road/Bridge	Jinghong–Daluo Expressway	Mekong	Tier 2
China	Road/Bridge	Yunnan Pu'er Regional Integrated Road Network Development Project	Mekong	Tier 3
China	Railway	Yuxi–Mohan Railway	Mekong	Tier 2
China	Railway	Dali–Ruili Railway	Mekong	Tier 2
China	Railway	Kunming South Railway Station	Mekong	Tier 2
China	Other Transportation	Further Maintenance and Improvement of the Upper Mekong River Navigation Channel from the PRC (at Landmark 243) and Myanmar to Luang Prabang, in the Lao PDR	Mekong	Tier 2
China	Industrial Estate/SEZ	Guangxi Nanning China–Brunei Agricultural and Industrial Park	Mekong	Tier 2
India	Road/Bridge	Expressway: Chennai−Bangalore	Mekong	Tier 1
India	Road/Bridge	Satellite Ring Road in Bangalore	Mekong	Tier 1

India	Road/Bridge	National Highway No. 207: Expansion in Bangalore	Mekong	Tier 1
India	Road/Bridge	4-laning Siliguri–Guwahati, National Highway 31C	Mekong	Tier 2
India	Road/Bridge	4-laning Kolkata–Siliguri, National Highway 34	Mekong	Tier 2
India	Road/Bridge	Peripheral ring road around Chennai	Mekong	Tier 1
India	Railway	High speed railway: Chennai–Bangalore	Mekong	Tier 1
India	Railway	Bangalore METRO: Phase II	Mekong	Tier 1
India	Port/Maritime	New container port at Diamond Harbor	Mekong	Tier 1
India	Airport	Sriperumbudur international airport	Mekong	Tier 1
India	Industrial Estate/SEZ	One Hub Chennai	Mekong	Tier 1
India	Industrial Estate/SEZ	Sojitz–Motherson Industrial Park	Mekong	Tier 1
India	Industrial Estate/SEZ	Vasantha Narasapura Industrial Park Phase II	Mekong	Tier 1
India	Industrial Estate/SEZ	Mahindra Industrial Park Chennai	Mekong	Tier 1
India	Energy/Power	Chennai−Bangalore−Mangalore gas pipeline	Mekong	Tier 1
India	Energy/Power	Tamil Nadu Transmission System Improvement Project	Mekong	Tier 1
India	Energy/Power	Andhra Pradesh State coal-fired power plant	Mekong	Tier 3
India	Energy/Power	Tamil Nadu, Ramanadhapura Mega Solar 1,000 MW	Mekong	Tier 2
India	Energy/Power	Tamil Nadu, Tirunelveli Wind Power 5,000 MW	Mekong	Tier 2
India	Water Supply/Sanitation	Chennai Desalination Plant Project	Mekong	Tier 1
Brunei, Malaysia	Energy/Power	Power Interconnection of Sarawak–Brunei–Sabah	BIMP+ IMT+	Tier 2
Cambodia, Lao PDR	Road/Bridge	Selamphao Bridge	Mekong	Tier 3
Cambodia, Lao PDR	Energy/Power	Transmission Line (230KV) Stung Treng–Laos	Mekong	Tier 2
Cambodia, Viet Nam	Road/Bridge	Long Binh (Long An)–Chrey Thom Bridge	Mekong	Tier 2
Cambodia, Viet Nam	Road/Bridge	Cross-border facilities at Moc Bai−Bavet	Mekong	Tier 2
Cambodia, Viet Nam	Railway	Phnom Penh–Loc Ninh Railway	Mekong	Tier 2
Cambodia, Viet Nam	Energy/Power	Lower Se San 2 hydropower plant	Mekong	Tier 2
Cambodia, Lao PDR, Myanmar,	Telecommunication	ASEAN Smart Network Projects	Mekong	Tier 1

Thailand, Viet Nam				
Cambodia, Lao PDR, Myanmar, Thailand, Viet Nam	Others	Cooperation in the field of Cyber Security	Mekong	Tier 1
Indonesia, Malaysia	Energy/Power	Trans Borneo Power Grid Project (Sarawak–West Kalimantan) (Part of ASEAN Power Grid)	BIMP+	Tier 2
Indonesia, Malaysia	Energy/Power	Sumatra–Peninsular Malaysia HVDC Interconnection Project	IMT+	Tier 1
Lao PDR, Thailand	Road/Bridge	Fifth Thai–Lao friendship bridge: Bueng Kan and Pakxan	Mekong	Tier 3
Lao PDR, Thailand	Road/Bridge	Sixth Thai–Lao friendship bridge: Ubon Ratchathani and Saravan	Mekong	Tier 3
Lao PDR, Thailand	Energy/Power	Nabong 500 kV Substation Transmission Facility	Mekong	Tier 2
Lao PDR, Viet Nam	Energy/Power	Lao PDR–Viet Nam Power Transmission Interconnection (Hat Xan–Plei Ku)	Mekong	Tier 2
Lao PDR, Cambodia, Thailand	Energy/Power	South Power Transmission Interconnection: Seno–Nathone (Saravan)–Sekong–B. lak 25 (Champasak)–B. Hat–Cambodia; B. lak 25 (Champasak)–Thailand (500 kV)	Mekong	Tier 2
Lao PDR, China, Thailand	Energy/Power	North Power Transmission Interconnection: Boun Tai–Na Mo 2–Pakmong–Luang Prabang 2 (230 kV); China–Na mo 2–M. Houn–Thailand (500 kV); M. Houn–M. Nan–Napia (500 kV)	Mekong	Tier 2
Malaysia, Singapore	Railway	High Speed Rail Link (KL to Singapore)	BIMP+	Tier 1
Malaysia, Singapore	Railway	The Malaysia–Singapore Rapid Transit System (RTS)	IMT+	Tier 1
Myanmar, Thailand	Energy/Power	Myanmar–Thailand power transmission	Mekong	Tier 2
Thailand, Myanmar, India	Road/Bridge	Trilateral Highway	Mekong	Tier 2
China, Myanmar	Road/Bridge	Ruili–Kyaukpyu Expressway	Mekong	Tier 2
China, Myanmar	Road/Bridge	Kyaing Tong–Monglar Road (Part of Daluo [China]–Tachileik [Myanmar] Highway)	Mekong	Tier 2
China, Myanmar	Railway	SKRL missing link: Thanbyuzayat–Three Pagoda Pass (110 km)	Mekong	Tier 3
China, Thailand	Energy/Power	PRC–Lao PDR–Thailand 600 HVDC Interconnection	Mekong	Tier 2
China, Viet Nam	Road/Bridge	Ha Long–Dongxing Highway	Mekong	Tier 2

China, Viet Nam	Road/Bridge	Pingxiang–Hanoi Highway	Mekong	Tier 2
China, Viet Nam	Industrial Estate/SEZ	Joint PRC—Viet Nam Cross-Border Economic Zones (CBEZs)	Mekong	Tier 2
China, Viet Nam	Energy/Power	Interconnection project: Malutang (Yunnan) to Soc Son (Viet Nam)	Mekong	Tier 2

Source: ERIA CADP research team.

Appendix 2. Non-Tariff Barriers in IDE/ERIA-GSM

As depicted in Figure 7A, the transport costs in IDE/ERIA-GSM comprise direct costs such as freight rates and tariffs, and indirect costs such as time costs, social and cultural barriers, and non-tariff barriers (NTBs). The freight rates are a function of distance travelled, travel speed per hour, physical travel cost per kilometre, and holding cost for domestic/international trans-shipment at border crossings, stations, ports, or airports. Time costs depend on travel distance, travel speed per hour, time cost per hour, holding time for domestic/international trans-shipment at border crossings, stations, ports, or airports.

The sum of tariffs and NTBs (TNTBs) is estimated by employing the log odds ratio approach initiated by Head and Mayer (2000); namely, we estimate industry-level border barriers for each country. Our explanatory variables include the above-calculated sum of physical transport and time costs and the ratio of a country's per capita GDP to its domestic per capita GDP. We also introduce the ratio of geographical distance with a country to domestic distance, defined as two-third times the radius of the domestic country concerned. To control for the effect of cultural disparity on differences in imports/consumption, we introduce a border-sharing dummy, a linguistic commonality dummy, and a colonial relationship dummy.

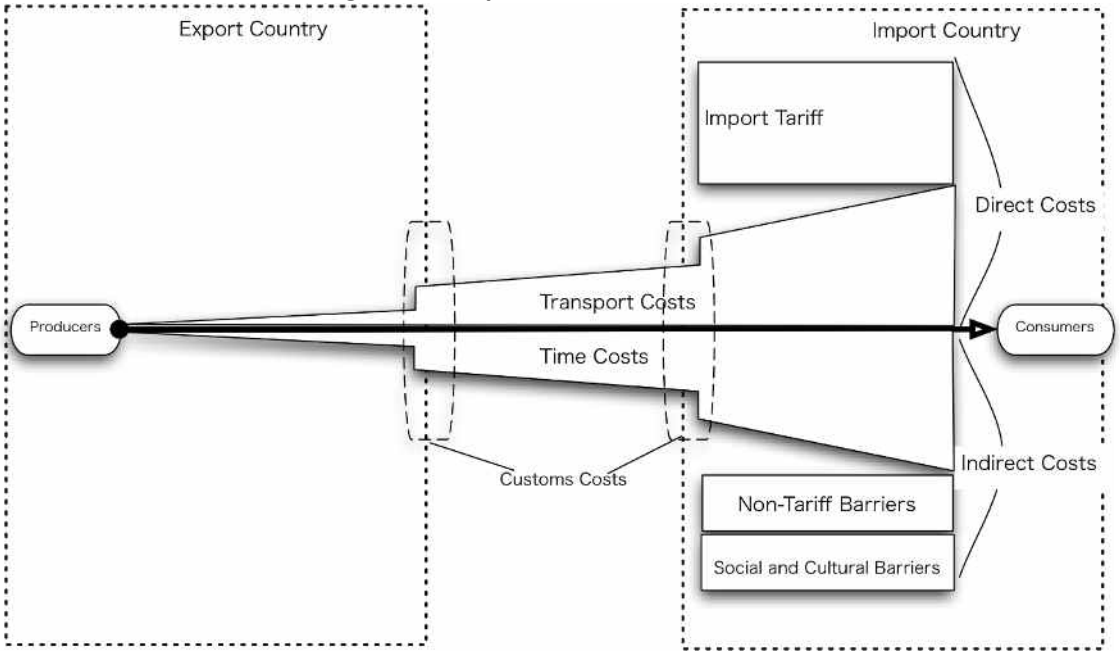
With this methodology, we estimate industry-level TNTBs for 69 countries. TNTBs for the remaining sampled countries is obtained by prorating their TNTBs according to each country's per capita GDP. Then, we obtain NTBs by subtracting tariff rates from TNTBs.

Another important setting on transport cost is the 'cumulation rule' in multilateral free trade agreements/areas (FTAs), particularly ASEAN + 1 FTAs and AFTA. Based on the estimate in Hayakawa (2014), we formalise the effect of the diagonal cumulation rule among ASEAN + 1 FTAs as 3 percent below NTBs in trading among members after each FTA's entry into force, in addition to the effects of ordinary FTAs, i.e. member countries enjoy 6 percent below NTBs in trading among members, based on the estimation in Hayakawa and Kimura (2015). This means that the trade among multilateral FTAs enjoys 9 percent reduction in NTBs.

In the simulation process, we first obtain the optimum routes and mode by each

origin–destination and industry according to Warshall-Floyd Algorithm, considering freight rates and time costs. Once the transport costs along the optimum route and mode are calculated, we add the tariffs, the costs of social and cultural barriers, and NTBs to it, if the origin and the destination cities are in different countries.

Figure: Transport Costs in IDE/ERIA-GSM



Source: Authors.

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