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Risk and reward in Asia's golden age of infrastructure investment

A report by The Economist Corporate Network



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Preface

Risk and reward in Asia's golden age of infrastructure investment is an Economist Corporate Network (ECN) report sponsored by Panduit. ECN conducted the research and wrote the report independently. The findings and views expressed in this report are those of the ECN only and do not necessarily reflect the views of the sponsor.

Andrew Staples was the author of the report. Pamela Qiu contributed to the research and edited the report. The design and layout of the report was done by Daljeet Singh.

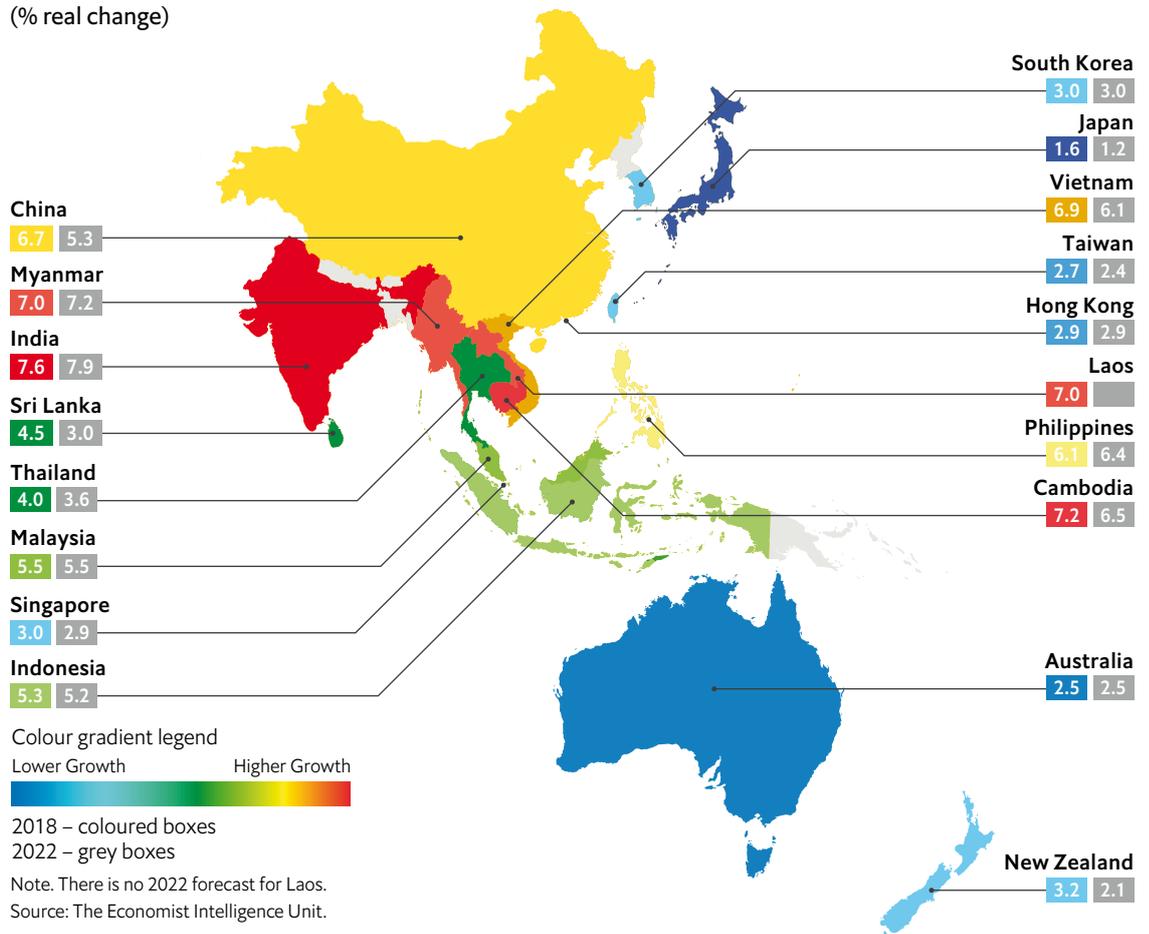
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1. Introduction

Asia¹ is the world's fastest-growing regional economy and is the destination for over a third of global foreign direct investment (FDI). The Economist Intelligence Unit (EIU) forecasts that Asia and Australasia's real GDP will grow by an average of 4.2% a year in 2018-22, which is a faster rate than that expected for the global economy (2.8%). The Association of South-East Asian Nations (ASEAN) will average an even higher growth rate of 4.8% a year, while the real GDP of China, the world's second-largest economy, is forecast to moderate from 6.4% growth in 2018 to 5.3% by 2022. By contrast, India, the world's fastest-growing large economy, will see its rate of expansion accelerate to an annual average of 7.7% over the same period.

Figure 1: Asia GDP growth forecast, 2018 and 2022
(% real change)



¹ Asia is defined here as encompassing Australia, Cambodia, China, Hong Kong, India, Indonesia, Japan, Laos, Malaysia, Myanmar, New Zealand, the Philippines, Singapore, Sri Lanka, South Korea, Taiwan, Thailand and Vietnam.

In tandem with economic growth, Asia is undergoing transformation with changes in the social and economic structure of emerging and middle-income countries, rapid urbanisation, an emerging middle class, and strong growth in intraregional economic integration, investment and trade. It is also a region

of enormous diversity with major differences in levels of economic development and industrialisation, the maturity and efficiency of national institutions, and national political and social traditions.

The EIU's long-term forecast assumes that by 2050 Asia will account for around 53% of global GDP, up from around a third at present. Yet although this positive scenario appears to be in the post, delivery is not necessarily guaranteed. Without the required increase in infrastructure spending, as well as further improvements to the business environment, the shine may come off Asia's economic success.

Asia's growth and diversity makes for a complex, but hugely attractive, market for infrastructure actors and related industries. Where are the opportunities for engineering, procurement and construction companies and other businesses? What are the risks? This report from The Economist Corporate Network (ECN) surveys the relevant issues, challenges, risks and opportunities for businesses seeking both to contribute to, and benefit from, Asia's golden age for infrastructure development.

The following section surveys the main dynamics shaping Asia's infrastructure environment, before shifting focus to energy and transport.

2. Asia's golden age of infrastructure investment

Infrastructure has made a major contribution to Asia's growth performance. Over 50 years of research has shown that investment in infrastructure improves an economy's output capacity, growth, productivity and regional connectivity, as well as lowers transaction costs and fosters the development of production networks and crossborder supply chains. Yet the relationship between infrastructure and growth in Asia has been uneven, with considerable differences in levels of market and social development, market structure, urbanisation, incomes and social benefits between regions and countries.

Recent reports by PwC, McKinsey & Company and the Asian Development Bank (ADB) point to a significant gap between current levels of infrastructure investment and future requirements in the period to 2030. There are marked differences in requirements between countries, although these needs are greatest in Asia's low- and middle-income emerging economies, which will require average new investment equivalent to around 5.9% of GDP in each year until 2030 (excluding India). For 2016-20, excluding China and after adjustment for climate-change adaptation costs, the investment requirement is around 5% of GDP, compared with current investment of 3.8%. In China, the supply gap is 1.2% of GDP, reflecting that country's significant investment in roads, energy, transport and water-resources infrastructure since 2001. In Indonesia, however, the challenge is greater with a requirement of 5% of GDP, and in India the estimated requirement is 5.3%.

Bridging the infrastructure gap requires both public and private funding and new models of financing

Figure 2: Estimated infrastructure investment needs by region, 2016–30
(US \$ bn in 2015 prices)

Region	Investment needs	Baseline		Climate-adjusted estimates (a)		
		Annual average	Investment needs as a % of GDP	Investment needs	Annual average	Investment needs as a % of GDP
East Asia	13,781	919	4.5	16,062	1,071	5.0
South Asia	5,477	365	7.6	6,347	423	8.8
South-east Asia	2,759	184	5.0	3,147	210	5.7

Notes

East Asia: People's Republic of China; Hong Kong, China; Republic of Korea; Mongolia; Taipei, China.

South Asia: Afghanistan, Bangladesh, Bhutan, India, Pakistan, Sri Lanka, Maldives, Nepal.

South-east Asia: ASEAN 10.

a. Climate change adjusted figures include climate mitigation and climate proofing costs, but do not include other adaptation costs, especially those associated with sea level rise.

Source: Asian Development Bank, *Meeting Asia's Infrastructure Needs*, 2017.

² The US\$26trn figure assumes additional efforts to mitigate climate change. Without these costs, the estimate falls to US\$22.6trn, or US\$1.5trn per year.

In US dollar terms, the ADB projects that developing Asia will need to invest US\$26trn between 2016 and 2030, or US\$1.7trn per year, if the region is to maintain its growth momentum, eradicate poverty and respond to climate change.² This compares with an estimated US\$881bn currently invested annually. Of the total climate-adjusted investment needs over 2016-30, US\$14.7trn will be for power

Figure 3: Estimated infrastructure investment needs by sector, 2016–30

(US \$ bn in 2015 prices)

Sector	Baseline estimates			Climate-adjusted estimates		
	Investment needs	Annual average	Share of total	Investment needs	Annual average	Share of total
Power	11,689	779	51.8	14,731	982	56.3
Transport	7,796	520	34.6	8,353	557	31.9

Source: Asian Development Bank, *Meeting Asia's Infrastructure Needs*, 2017.

infrastructure and US\$8.4trn for transport. Investment in telecommunications will reach US\$2.3trn, with water and sanitation costs at US\$800bn over the period.

Between 2016 and 2030 investment needs will be US\$14.7trn for power and US\$8.4trn for transport

Bridging the infrastructure gap

The infrastructure deficit is greatest in Asia's emerging economies, and the major challenge for the region is sourcing the investment capital to deliver new investment. The ADB's forecasts indicate that around 2% of the 5% funding gap can be raised from public sources through fiscal reforms, the user-pays principle, an increase in public debt and reprioritising state budget priorities. Around 3% of GDP will therefore need to be provided by private investors, which equates to approximately US\$250bn a year over 2016-20. Given these huge funding requirements, recent initiatives from regional powers—namely China and Japan—provide a welcome source of investment and technology.

Regional rivalries, local benefits

Geopolitics, in the form of competition between China and Japan for regional influence, is a further dynamic shaping the infrastructure environment in Asia. This rivalry is not particularly new, but has been given greater impetus by recent developments, including the election in 2012 of Shinzo Abe as Japan's prime minister and China's increasingly external focus.

Japan has been a leading investor in developing Asia since the 1970s, particularly in South-east Asia, where Japanese manufacturers have created complex regional production networks. Increasing infrastructure exports to developing Asia is also a central component of "Abenomics", Mr Abe's plan to revitalise the Japanese economy. Doing so creates external markets for companies in Japan, where domestic demand is sluggish, and has the added strategic value of shoring up the country's influence in the face of a perceived leadership challenge from China. To retain its influence in infrastructure in the region, Japan announced the "Partnership for Quality Infrastructure" in 2015, which will provide approximately US\$110bn for "quality infrastructure" to developing Asia in the period to 2020. In addition, the Japanese government—stung by losing out to Chinese competitors for lucrative infrastructure projects, such as Indonesia's Jakarta-Bandung high-speed rail project—has set a goal of Japanese companies exporting ¥30trn (US\$280bn) worth of infrastructure packages by 2020.

China is a relatively new player in Asia's infrastructure market but appears intent on making up for lost time. The president, Xi Jinping, proposed the Belt and Road Initiative (BRI)—composed of the Maritime Silk Road and the Silk Road Economic Belt—and the establishment of the Asian Infrastructure Investment Bank (AIIB)³ in 2013. The ambition of the BRI is huge: Mr Xi aims to re-establish China's ancient trading routes with neighbours and countries further afield. There are three main routes

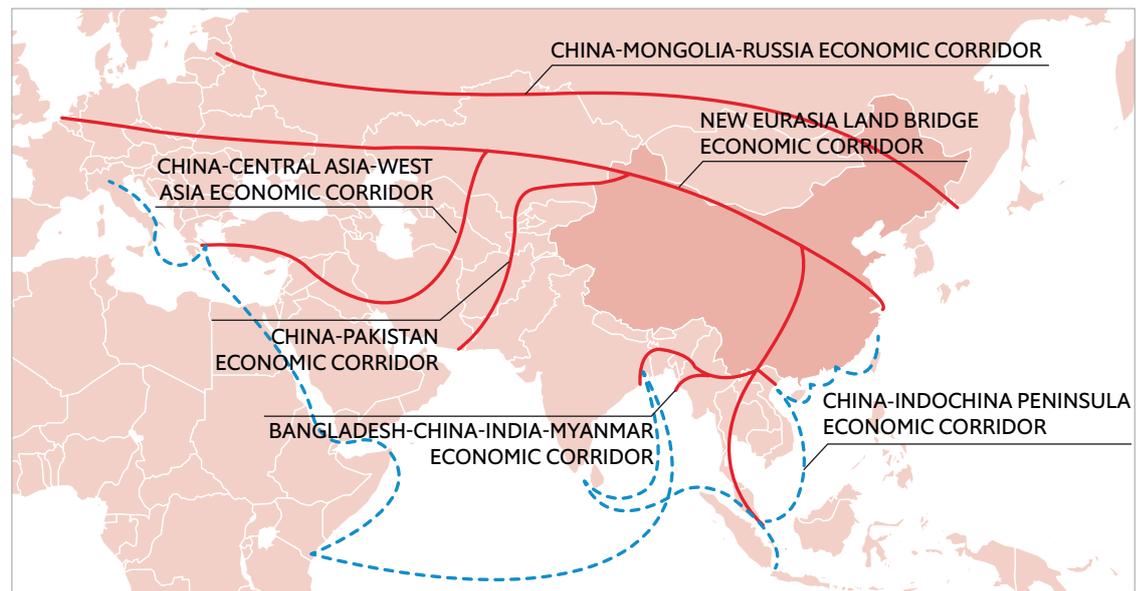
China and Japan's infrastructure rivalry can benefit emerging economies

covering more than 60 countries: the ancient Silk Road, starting from Xi'an and ending in Istanbul, passing through parts of Pakistan and Central Asia; the Bangladesh, China, India and Myanmar route; and the Maritime Silk Route connecting China's coastal Fujian province with South-east Asia and the rest of the world. China also links its proposed Economic Corridor through the Pakistan-occupied part of Kashmir as part of the Silk Road project.

Through the BRI, China is underwriting billions of dollars' worth of infrastructure investment to link its economy with Europe, and is spending around US\$150bn per year in the 68 countries that have signed up to the scheme. The BRI's primary strategic aim is to create a vast China-centric economic and trading area to rival the transatlantic one dominated by the US.

The BRI also presents a timely opportunity for domestic firms to secure external markets as demand for infrastructure in China diminishes and overcapacity concerns (in steel, for example) increase. The BRI has an unmistakable political angle, which has created unease in some countries (particularly Japan and India) nervous about China's growing influence in the region and beyond. Yet China's initiative undoubtedly brings much-needed investment to the region—a fact not lost on infrastructure-hungry, but cash-strapped, governments in the region.

Figure 4: The Belt and Road Initiative
Economic corridor framework



Source: The Economist Intelligence Unit.

This jockeying for strategic influence offers benefits for smaller economies faced with bridging the infrastructure spending gap identified above. Smaller economies such as Indonesia and the Philippines find themselves in the happy position of being courted by two well-endowed suitors, each offering attractive financing for much-needed infrastructure projects. Competition between China and Japan may also lower the cost of the high-quality infrastructure that developing nations covet, but may not necessarily be able to afford.

³ The AIIB was formally launched in 2015 with US\$100bn in capital from 57 countries. These did not include Japan and the US, which were concerned that the bank was a power play by China and a direct challenge to existing financing mechanisms, including the Japanese-backed ADB and the US-backed World Bank. The AIIB describes itself as “a multilateral development bank with a mission to improve social and economic outcomes in Asia and beyond”. As at March 2018 the bank had 64 member states, with a further approved 20 prospective members.

Since assuming office in 2014, the Indonesian president, Joko Widodo (known as Jokowi), has made infrastructure planning and construction a priority as a means to stimulate economic growth and ease bottlenecks in transport and services. His administration launched an ambitious infrastructure development plan in 2015, which sought to raise Rp2,877trn (US\$210bn) in private investment to build infrastructure including water supply networks, ports and power plants over a five-year period.

A similar drive is seen in the Philippines, where the president, Rodrigo Duterte, hopes to invoke a “golden age” for development by raising government spending on infrastructure from the equivalent of around 5% of GDP to 7% over the next five years. The aim is to reduce the country’s currently large infrastructure deficit, which has for many years put it at a competitive disadvantage to many of its neighbours. According to the Swiss-based World Economic Forum, although the Philippines is ranked 90th out of 144 countries in terms of infrastructure in the latest iteration of its Global Competitiveness Index, many of the other large economies in ASEAN are well ahead, including: Vietnam (76th), Indonesia (62nd), Thailand (44th), Malaysia (24th) and Singapore (2nd).

Competition between China and Japan, coupled with a strong focus on improving infrastructure from emerging nations and a desire to close the investment gap, are thus combining to create something of a golden age for infrastructure investment in the region. Asia, in other words, is poised for a significant expansion of investment in public infrastructure.

With this initial survey of the regional context for infrastructure investment complete, the remainder of this report focuses on energy and transport infrastructure given the importance of these sectors in facilitating continued economic growth in the region.

Asia is poised for a significant expansion of investment in public infrastructure

Summary points

- Asia is expected to deliver robust economic growth driven by growing affluence, urbanisation, positive demographic structures (although this varies among countries) and deepening regional connectivity.
- Competition for influence and market share in the region between China and Japan presents developing economies with an opportunity to secure high-quality infrastructure with attractive funding.
- Failure to invest sufficiently, and at an adequate pace, is a key risk to continued economic growth and development.
- Energy and transport networks will see the biggest investments.

FOCUS ON RISK Realising the opportunity, reducing risk

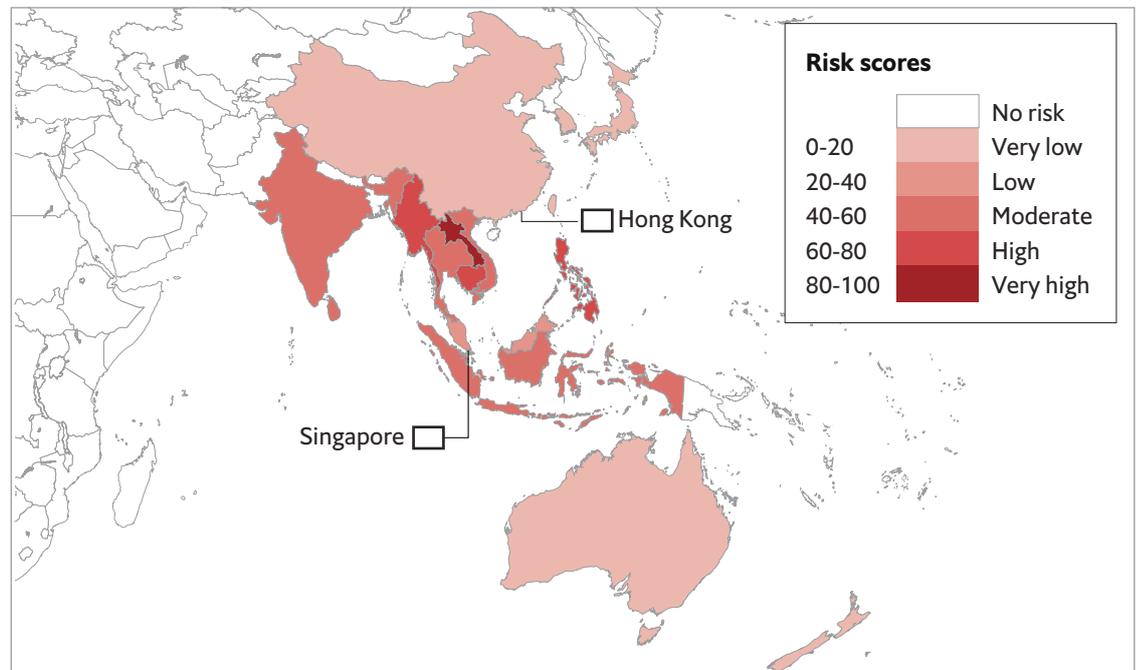
Although this demand for infrastructure represents a tremendous opportunity, failure to follow through by funding and realising key projects will create bottlenecks, representing costs to business that in turn retard economic growth. Indonesia, for instance, has some of the highest logistics costs in the region, accounting for more than 20% of GDP, as a result of poor road and retail distribution networks across the archipelago. In India, raising the quality of infrastructure—which is in a deplorable state—is the key to unlocking the country's growth potential, yet the main obstacle for the government and state administrations will be to speed up the myriad approval processes that can delay projects for ten years or more. (According to the World Bank's *Doing Business* report, India was ranked 185th out of 190 countries in 2017 in terms of the ease of obtaining construction permits.)

The EIU monitors this risk through its operational risk model and the assessment of infrastructure risk in Asia is presented in the heat map below. High-income economies are, unsurprisingly, assessed as low-risk locations in terms of the quality of infrastructure. Higher-risk economies, however, all share common issues around power networks, road and rail networks, retail and distribution networks, and information-technology (IT) infrastructure. Please refer to the appendix for a full assessment of the infrastructure risk measures.

Viewed from the perspective of, say, a consumer-goods company seeking to capitalise on rapid consumer demand growth in ASEAN, the darker regions of the map represent challenging business environments where the risks may outweigh the rewards. For engineering, procurement and construction contractors, however, the same locations highlight where demand for their services will be strongest.

Figure 5: Infrastructure risk in Asia

Assesment as of May 2018



Source: The Economist Intelligence Unit.

3. Energy infrastructure: powering regional growth

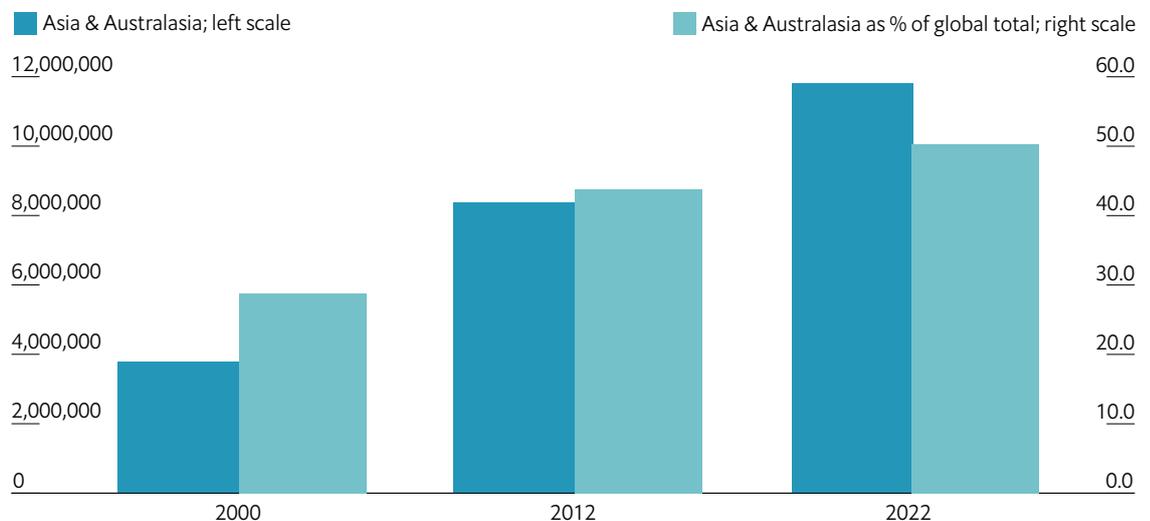
Asia's demand for energy is rapidly expanding

Asia's robust economic growth and expanding population is generating rapid energy demand growth. The EIU expects global energy demand to increase at an average annual rate of 1.9% between 2017 and 2021 with growth driven mainly by Asia, where demand is set to rise by an annual average of 2.7%. China will continue to provide much of the momentum and will remain the largest consumer of energy, followed by the US. In India, energy demand growth will be relatively strong, although slightly slower than in 2013-17 and this emerging Asian economy will maintain its place as the world's third-largest energy consumer.

Asia to account for just over half of global electricity consumption by 2022

Gross domestic electricity consumption in Asia and Australasia stood at 2,894,440 ktoe in 2000, which then accounted for 31.5% of global consumption. Average annual growth of around 5.9% took these figures to 5,128,339 ktoe and 42.1% respectively by 2012. In the decade to 2022, demand in the region is expected to reach 6,212,986 ktoe, or 45.1% of global demand, although the average annual growth rate will by then fall to around 2.1%. This expansion of demand in Asia reflects faster rates of economic growth, industrialisation in emerging economies, higher incomes and energy consumption per head and greater access to the grid in poorer regions, all of which stimulate power demand. Among major Asian economies, the EIU forecasts average annual growth of 6% in China, 7.7% in India and 5.1% in Indonesia in 2018-22. Other ASEAN economies will also continue to show strong growth over this period.

Figure 6: Gross domestic electricity consumption, 2000-22
(ktoe)



Source: The Economist Intelligence Unit.

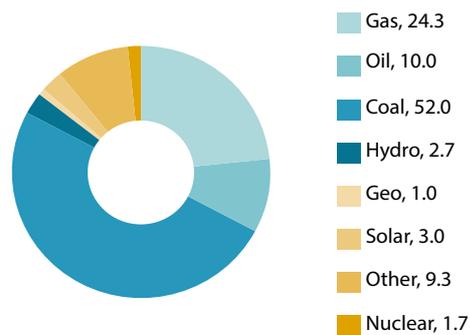
Looking further ahead, the International Energy Agency forecasts that South-east Asia's energy demand will grow by two-thirds by 2040, accounting for one-tenth of the rise in global demand. Meeting this demand will be a huge challenge, particularly in the context of climate-change commitments made at the 2015 Paris Climate Change Conference (also known as COP21).

Getting the right mix

How this demand will be met in terms of the energy mix is one of the most important policy issues facing governments in the region. As figure 6 shows, fossil fuels will continue to be the most important source of power generation, accounting for 86.3% of total generation in the region in 2018, although this is set to decline to 80.4% by 2022. Coal is cheap and coal-fired power stations are relatively quick to build and inexpensive to run, which is one reason why an expansion in coal-fired power generation in Asia and Australasia (4%) will exceed global growth of 2.4% between 2017 and 2021. Although growth in coal-fired power generation in China and India will slow markedly during this period, other Asian markets—such as India, the Philippines, Vietnam and Thailand—will see significant expansion.

Figure 7: Electricity generation by fuel in Asia and Australasia

(% of gross domestic energy consumption)



Source: The Economist Intelligence Unit.

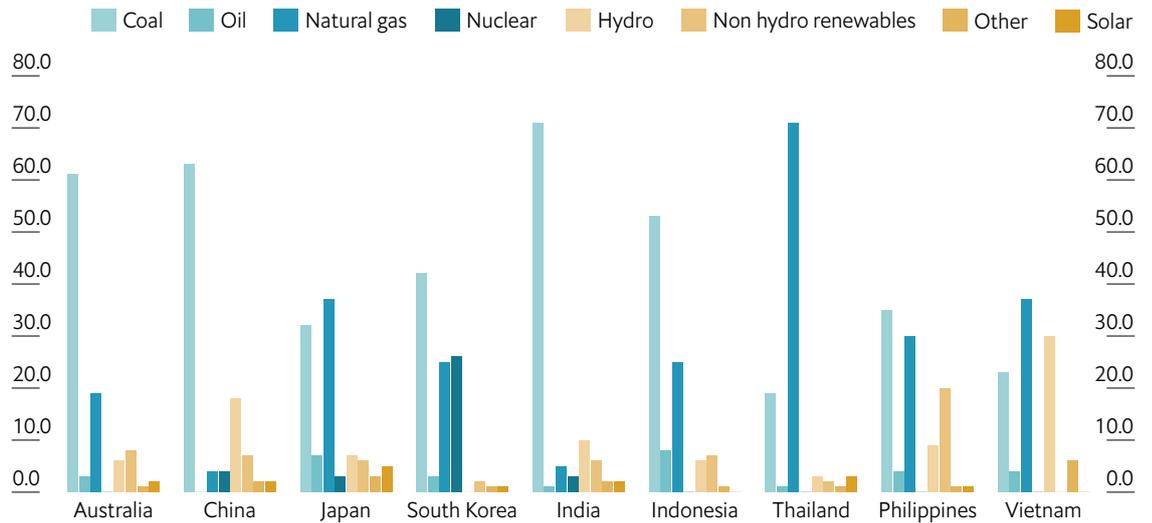
What do these issues look like at national level and, as governments raise targets for energy sector investment while shifting to a low-carbon growth model, where are the opportunities? The following section provides an overview of the energy sector in selected countries and highlights the outlook for investment.

Summary points

- Demand for energy in Asia is expanding rapidly and is expected to account for just over half of global electricity consumption by 2022.
- Fossil fuels will continue to be the biggest contributors to power generation.
- Under COP21 commitments, governments in the region are promoting greater use of renewables.
- Governments will seek to make greater use of public-private partnership (PPP) funding mechanisms in an attempt to bridge the infrastructure funding gap.

Figure 8: Power generation by source, selected Asian countries, 2018

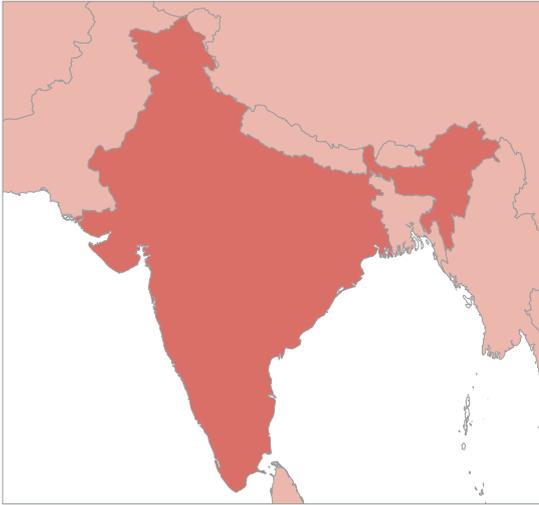
(% of total)



Note. "Other" includes combustible fuels such as biomass.

Source: Economist Intelligence Unit estimates.

Outlook for investment: energy



India

India is already the world's third-largest consumer of energy, and in the next five years its energy demands are set to increase faster than any other economy apart from China's. Surging electricity consumption will be driven by economic growth, a push towards manufacturing and an expanding population, which is projected to reach 1.5bn by 2030.

The energy sector will need significant investment. Although generation capacity has increased substantially, the government will have to introduce price reforms, asset sales and regulatory reform to revitalise the sector.

The government is seeking to promote a sharp shift towards renewable power generation. Under COP21 commitments, India set a target to increase non-fossil-fuel power generation to 40% of total installed capacity by 2030. The government is targeting 175 GW of installed renewable capacity by 2022. However, coal will still account for the bulk of new generating capacity being added to the country's energy base.

India also aims to reduce its dependence on energy imports through policies that include increased hydrocarbon production; the exploration of unconventional sources such as coal-bed

methane and shale gas; and increased foreign acquisitions by Indian companies.

The government is firmly in favour of nuclear power and is likely to intensify efforts to boost the nuclear sector. Solar power will also see rapid growth as the costs of production continue to fall. The government views this as a crucial source of future renewable energy.

Indonesia

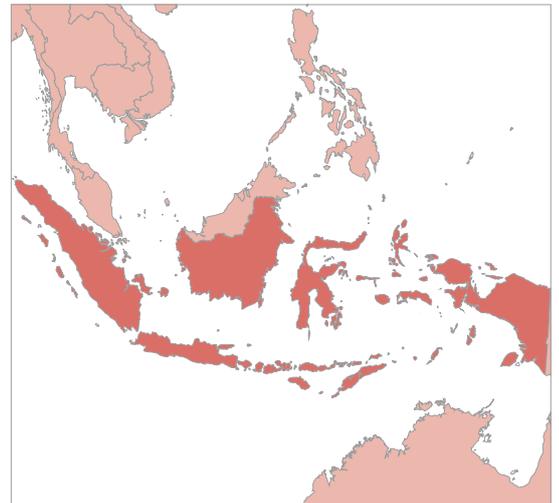
Indonesia's energy consumption reached 248m tonnes oil equivalent (toe) in 2017 and is expected to increase to 311m toe by 2022, reflecting average annual growth of 4.5% in 2018-22. The share of combustible fuels in total generation will remain dominant, although renewables usage for electricity, especially wind power, will begin to take off. Non-hydro renewables will account for just 10% of total generation capacity by 2022.

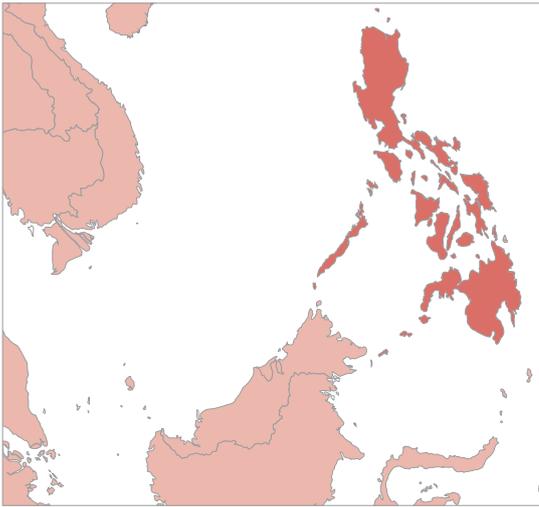
Indonesia will remain a major energy producer and exporter, but oil and gas production is expected to fall slightly in the coming years largely owing to a lack of investment caused by regulatory uncertainty regarding the upstream hydrocarbons sector.

Construction of power plants will face severe delays and continue to undermine faith in the PPP system, as will protests by local residents and environmental activists and delays in the construction of a coal plant in Batang. The government will fall far short of its goal of bringing 35 GW of new capacity online by end-2019.

As part of an effort to attract foreign investment, Indonesia offered 15 oil and gas blocks to bidders under a production-sharing contract scheme in 2017, although interest from operators was limited. Industry participants often highlight slow returns and the high risk of political involvement as the main reasons why they frequently pursue opportunities elsewhere. In 2016 Indonesia offered 17 blocks for bidders, but only one was awarded.

Wind power is developing in Indonesia, in the light of ambitious plans to have renewables account for a larger proportion of the power mix by the middle of the next decade. Installed wind generation capacity is expected to more than quadruple between 2018 and 2022, reaching 271.5 MWe by 2022.





Philippines

The Philippines' electricity consumption is poised to expand by an average of 4.4% a year in 2018-22. The country has 15,665 MW of dependable capacity, which can meet current demand. However, power supply will remain unreliable, especially in the southern region of Mindanao, where many of the new coal-fired plants to be constructed in the coming years will be built. To increase energy supply, the Philippines is seeking US\$135bn of investment in power projects from China and Japan. Such investment, and the 23 new coal-fired power plants scheduled to come online by 2020, is expected to boost capacity by 43 GW by 2040.

Fossil fuels will remain the main source of energy, but the country will also continue to exploit alternative energy sources. The EIU expects renewable sources (including combustible renewables and waste) to account for about 37% of total energy consumption by 2022, down slightly from 38% in 2016.

The Philippines has invested considerable funds in alternative energy. By 2017 installed geothermal capacity was around 2,118 MWe (or 9% of the country's total energy capacity) and growth in this area is likely to remain well supported. A 12-MW extension of the Maibarara

geothermal plant came online in March 2018. The Philippines is also promoting the use of wind power, but this source of energy currently accounts for only a small proportion of total energy generation (305 GWh in 2017) and consumption. Like wind power, solar power is a small industry in the Philippines. In 2016 solar generation amounted to an estimated 123 GWh. Under the revised energy plan solar energy will remain marginal, although developers of renewable energy resources are eligible for wide-ranging fiscal incentives, including exemption from income tax for seven years.

Thailand

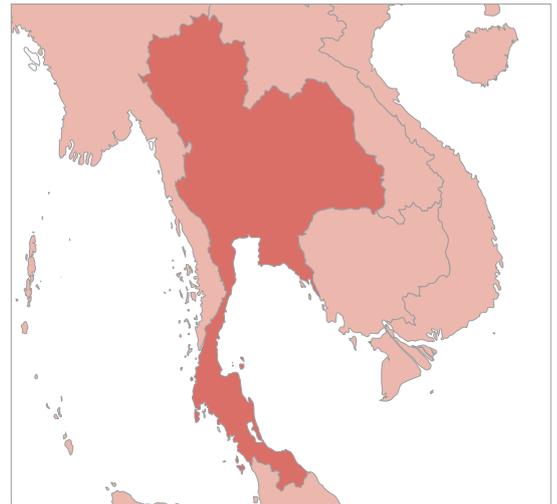
Thailand is South-east Asia's second-largest consumer of energy. The EIU estimates gross domestic consumption in 2017 at 142m toe, below the figure of 243m toe in Indonesia but above those of Malaysia (95m toe) and the Philippines (54m toe).

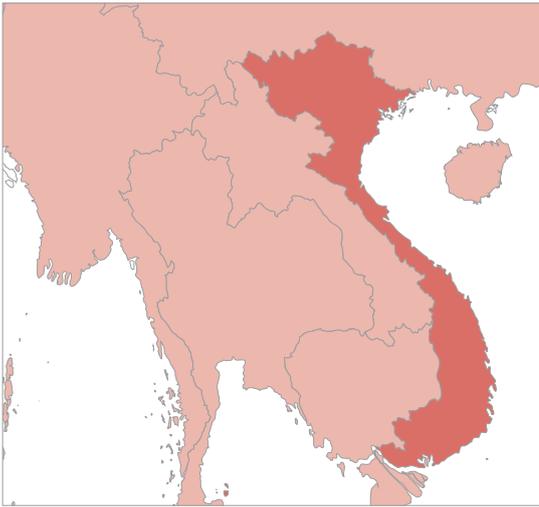
Fossil fuels will continue to dominate Thailand's energy mix. The proportion of electricity generated by gas-fired power plants will increase from around 27.7% of the energy mix in 2017 to about 28.9% in 2022. After dipping to about 11% in 2015-16, coal will increase slightly as a source of energy, with a share of around 13.2% of power generation in 2022.

As a result of declining domestic reserves, Thailand will import more natural gas, but in the longer term the government is seeking to diversify energy sources. The Power Development Plan 2015 proposes to more than double the capacity of alternative energy sources by 2036, primarily in solar and biomass, and to import additional hydropower from neighbouring nations. Nuclear power options are still on the table, but have been subject to delays owing to public opposition.

Non-combustible renewables play a minimal role in Thailand's energy production. At 4.3% of total electricity production in 2016, hydropower is the country's primary source of renewable energy. However, barring major investment in the sector, which is not expected, hydropower will fall to 2.5% of electricity production by 2021. Solar will increase in importance, rising from 4.8% of electricity capacity in 2016 to 7.2% in 2021.

Thailand has set a solar-capacity target of 6 GW by 2035. We estimate that the country's solar capacity amounted to about 2.6 GW at end-2017, more than three times higher than in 2013.





Vietnam

Gross domestic energy consumption reached 81m tonnes oil equivalent (toe) in 2017 and is expected to grow by an average of 3.4% a year in 2018-22. Although Vietnam is an important producer of oil and natural gas, it no longer produces a surplus of crude oil due to declining output from its existing fields. It will therefore need to begin importing liquefied natural gas (LNG) in the next few years in order to meet its electricity generation demands.

In January 2017 the government approved a master plan to achieve a huge increase in output in the gas sector. Under the plan, the authorities aim to double Vietnam's gas output to 21bn cu metres by 2035. Projected imports of LNG will bring in a total of 1bn-4bn cu metres over 2021-25 and 6bn-10bn cu metres in 2026-35. To this end, it is estimated that around US\$19.1bn of investment for infrastructure is needed by 2035.

The government is committed to investing close to US\$40bn in electricity generation, transmission and distribution infrastructure by 2020. An additional US\$108bn is earmarked for 2021-30. The authorities have stated that the bulk of this funding will come from loans.

The government is aiming to install 800 MW of wind power by 2020, 2,000 MW by 2025 and 6,000 MW by 2030. These are ambitious targets, considering that wind power capacity stood at just 135 MW in 2015. That said, there is undoubtedly considerable potential for the development of wind energy in Vietnam, assuming that sufficient financing can be raised. In November 2016 GE (US) and Mainstream Renewable Power (Ireland) signed a deal to build three wind power projects with a total capacity of 940 MW, costing US\$2bn. In October 2017 the US Trade and Development Agency agreed to support the development of a 100-MW wind farm in southern Vietnam; a US company, DNV GL, will be responsible for the project design and feasibility study.

FOCUS ON FUNDING Filling the funding gap

The major challenge facing the region is finding the finance to meet the cost of new investment. Several policy initiatives have been recommended by multilateral development agencies and the IMF, including reprioritisation of spending programmes, the elimination of poorly targeted subsidies, the creation of more fiscal space with a widening of the tax base, and reforms aimed at improving the efficiency of tax administration. Moreover, opportunities exist in some Asian countries for wider use of user-pays charges and the raising of utility charges to meet the full costs of production. These initiatives will be welcome, but the scale of the infrastructure gap suggests that private-sector funding will become increasingly necessary.

Private participation in infrastructure

Private-sector participation in infrastructure accounts for an average of 10% of Asian infrastructure investment, although there are significant differences between countries. Private finance increases a

nation's pool of capital for infrastructure investment and introduces greater rigour to the procurement and operational stages of the project. Private-sector participation will need to grow from US\$63bn to US\$250bn, or 3% of GDP, annually over 2016-30. To increase private participation, regional governments will need to improve the institutional and regulatory enabling environment for private investment. The policies to improve conditions include long-term infrastructure planning, a pipeline of bankable projects, optimal risk sharing, viability-gap funding and a more transparent project bidding process.

Although PPPs may provide greater private-sector investment, this method of procurement may not be optimal for all infrastructure projects. PPP investment is high risk, requires economies of scale, involves steep transaction costs and as a long-term incomplete contract, requires mechanisms for speedy resolution of disputes and embedded options for dealing with change. A further limitation on the use of PPPs is the requirement for long-term financing and investor appetite, with most projects in Asia taking place in the energy generation, transport, oil and gas, and property sectors.

4. Transport infrastructure: getting goods and people where they need to go

Transport infrastructure has played a critical role in the rapid economic growth of Asia. Roads, railway networks and ports facilitate the movement of raw materials, intermediate goods and finished projects upon which the region's export-oriented model of economic development has depended. More recently, improved regional connectivity and the liberalisation of trading regimes under the World Trade Organisation or through bilateral and regional trading agreements, and the rapid development of the Chinese economy, has led to an increase in intra-regional trade, which further stimulates the demand for transport infrastructure. Decades of rapid economic growth have also resulted in the emergence of a more affluent society. These new consumers are driving demand for goods and services, which in turn requires further investment in logistics and travel infrastructure.

Driven by trade and consumer demand, transport-related infrastructure spend is set to expand rapidly

Asia's transport infrastructure challenge is thus huge and multifaceted. Get it right and the region ought to enjoy continued growth and development. Fail to invest at the right pace and bottlenecks will increase costs, damage competitiveness and productivity, and ultimately stifle growth. Recognising this challenge, transport has been one of the ADB's main sectors of focus over the past four decades, accounting for 32% of the Bank's total lending. Transport-related infrastructure is set to expand rapidly in Asia, which is already the world's largest market by far. PwC expects that transport infrastructure investment in the Asia-Pacific region will reach around US\$900bn per year by 2025.

Asia's rapid growth in demand for energy and transport are two sides of the same coin: both reflect the megatrends driving economic growth, as identified in the introduction of this report. Growing affluence, for instance, has led to a surge in air travel, further fuelled by the emergence of low-cost carriers such as AirAsia (whose tagline is "Now Everyone Can Fly"). The International Air Transport Association (IATA) forecasts that the Asia-Pacific region will be the source of more than half of all new air passengers globally over the next two decades. By 2036 the IATA expects the region to see an additional 2.1bn annual passengers, representing an overall market size of 3.5bn and growing at an annual rate of 4.6%. Along the way, China is set to overtake the US as the world's largest aviation market by 2022, while the UK will be surpassed by India (2025) and Indonesia (2030). Such growth represents a significant infrastructure challenge, which governments will be unable to meet through public financing alone. India recently announced plans to increase the number of airports in the country from around 100 at present to 150-200 by 2035. In an interview, India's minister of civil aviation, Suresh Prabhu, estimated that the expansion could cost more than US\$60bn and that most of this is expected to be financed by the private sector.

Growing affluence will result in an additional 2.1bn air passengers per year by 2036

Accelerating urbanisation is resulting in dense concentrations of consumers who are driving Asia's e- and m-commerce revolution. This, in turn, requires a re-engineering of logistics infrastructure and supply chains, upgraded port facilities, as well as improved road and rail infrastructure to get goods to consumers. Urban populations also stimulate demand for mass transit systems, as well as smarter and more sustainable solutions to urban transport challenges and pollution. In 2016 Vietnam's commercial

hub, Ho Chi Minh City, was home to more than 7.5m vehicles, representing an increase of almost 7% from the previous year, according to the city's Department of Transport. At the same time, public transport represented only 5% of total traffic. Combined with poor infrastructure, traffic jams cost Ho Chi Minh City US\$820m each year in lost productivity. A recent study shows that, without the implementation of smart transport solutions, traffic congestion will cost the city an estimated US\$97bn by 2045.

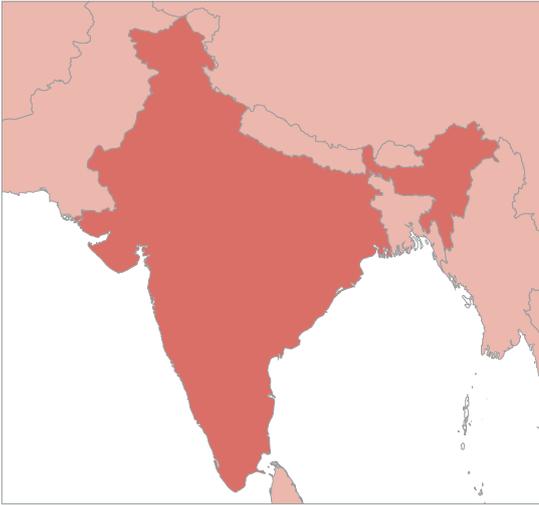
These trends are perhaps most clearly seen in the ASEAN economies, and in the increasing number of urban hubs. The region currently has around 50 cities with populations of over 500,000, which will continue to drive an overwhelming share of its economic development in the next decades. The EIU projects that the number of middle-class households in ASEAN will more than quadruple, from 38m in 2015 to over 161m by 2030. This surge in the urban consumer class will translate into an ever-increasing strain on infrastructure and much higher demand for services. As a result, ASEAN cities, as well as those in India and beyond, will continue to grapple with urbanisation management challenges, which they must address in order to create more liveable and more competitive centres of sustained growth.

How are these trends shaping the transport infrastructure market at national level? What are priority sectors identified by governments? The following section provides an overview of the transport infrastructure sector in selected countries and highlights the outlook for investment.

Summary points

- Transport infrastructure has underpinned Asia's economic success story, but the region now faces a significant funding gap even as demand surges.
- Megatrends including growing affluence and urbanisation are creating new demands for transport-related infrastructure.
- While governments are increasing transport-related infrastructure spending, private-sector firms will be the main financiers.

Outlook for investment: transport



India

Raising the quality of infrastructure is the key to unlocking India's growth potential. Port facilities are overstretched. Both road and rail links are rundown. However, the last few budgets have all allocated significantly increased funding for infrastructure development and the government is prioritising the expansion of transport infrastructure. The government has a ten-year agenda for infrastructure development that includes a network of high-speed trains, more small airports and a project to develop coastal port cities and improve their links to the hinterland. There has also been an uptick in foreign investment in infrastructure. However, the main obstacle for the government and state administrations will be to speed up the myriad approval processes that can delay projects for ten years or more.

At the top of the agenda is modernisation of India's railways, which remain a public monopoly. Plans include a project of introducing high-speed trains between major cities. Low-cost airport terminals are to be developed to promote air connectivity to smaller towns and reforms in 2016 permit 100% FDI in brownfield airports. The modernisation of existing ports, and development of new ones, will complement the Sagar Mala project to develop coastal port cities and connect

them by road, rail, ports and airports. In January 2018 the government approved a revised model concession agreement on PPPs in port projects. These measures are intended to help to revive India's port development: as many as 11 PPP model projects in the sector are currently help up owing to regulatory reasons or a lack of funds.

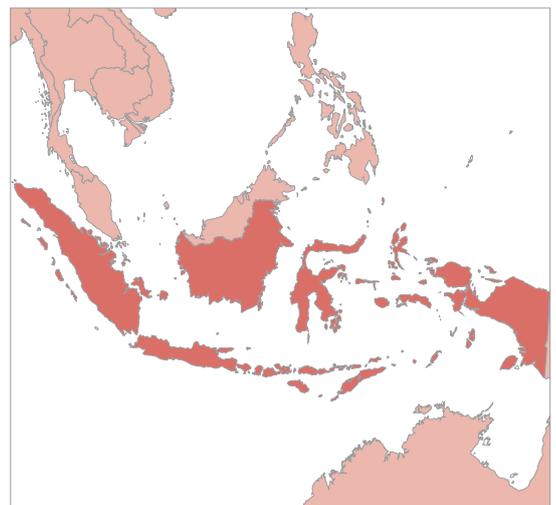
A fillip to India's infrastructure investment is also being provided through the increasingly close ties between India and Japan. Japanese public- and private-sector investments are likely to focus on the New Delhi-Mumbai corridor, which involves constructing major highways and railways between these two cities over the next decade.

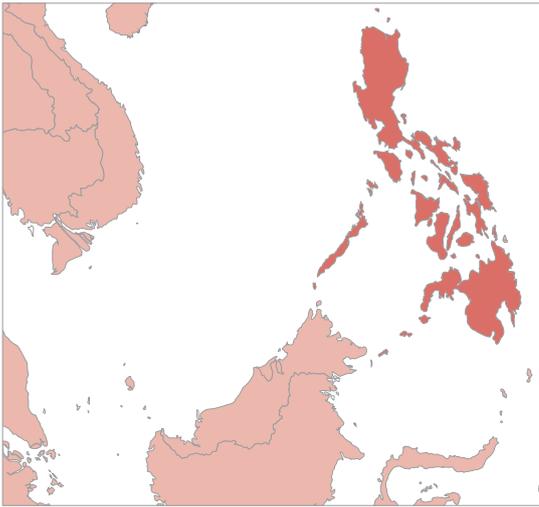
Indonesia

Indonesia scores poorly in practically all subcategories of infrastructure, but the rail and road networks are of particular concern. Moreover, it is reliant on a handful of overcrowded airports and ports, which are inadequate to accommodate major vessels.

In 2015 the president pledged to build US\$500bn-worth of new infrastructure amounting to 225 projects over five years. Around a quarter of these are new toll roads in 13 out of the country's 34 provinces, with the government also targeting the construction or renovation of 24 seaports and 15 airports. Major investment is being undertaken at Indonesia's largest port, Tanjung Priok, in the capital, Jakarta. The government allocated Rp387.3trn for infrastructure in 2017 and Indonesia's infrastructure drive will improve the overall business environment over the coming years.

Most projects, however, will not be completed on schedule owing to problems in land acquisition and project financing. The government committee tasked with overseeing implementation has noted that only 20 of Jokowi's priority projects (or 9% of the target) have been completed. These include a new terminal at Soekarno-Hatta International Airport in Jakarta, which in January 2018 was linked to the capital by a new 38-km rail link, as well as six new airports and a handful of power plants, dams and ports. The Jakarta-Bandung high-speed rail and the Jakarta Bay reclamation project will both face significant delays during the forecast period. Long toll roads can be among the most challenging infrastructure projects given the number of individual land parcels, which require acquisition across multiple political constituencies.





Philippines

Transport infrastructure in the Philippines is underdeveloped, although there are vast differences between the growth poles (the National Capital Region; the economic zones at the former US military bases at Subic and Clark; and the Calabarzon region south of the capital, Manila) and the poorer regions in Mindanao and parts of the Visayas. Businesses located in and around the major commercial centres will find transport to be functional, although delays and traffic jams are a big problem.

The government has made infrastructure—led by transport projects—a priority, pledging to increase public spending from the equivalent of 5% of GDP to more than 7% by 2021. Mr Duterte plans to accelerate infrastructure development by moving away from the PPP model and cumbersome (but transparent) public bidding procedures favoured by his predecessor, Benigno Aquino, and towards a system based on greater central government spending and official development assistance (ODA) from such countries as China and Japan.

In March 2018, for instance, the Japan International Co-operation Agency (JICA) signed a loan agreement with the government for the Metro Manila Subway Project, the Philippines' first. Also

in March, the JICA signed a further loan agreement for the construction of a four-lane bypass to alleviate traffic congestion in the northern part of Metro Manila. As the government expedites financing by preferring to use ODA loans, the number of feasibility studies for planned projects should rise.

Road quality varies by region; less than half of the network is all-weather. This is a concern as, according to the ADB, road transport is by far the dominant subsector, accounting for 98% of passenger traffic and 58% of cargo traffic.

Port services are adequate at major locations, although congestion has caused major delays at the Port of Manila. Air services have generally been improving, although the country needs to upgrade and expand its list of 71 registered airports. The railway system is very limited. Several new rail lines are also planned and the government has approved for tender a P211bn (US\$4.1bn) rail project north of Manila and a P35bn rail line in Mindanao.

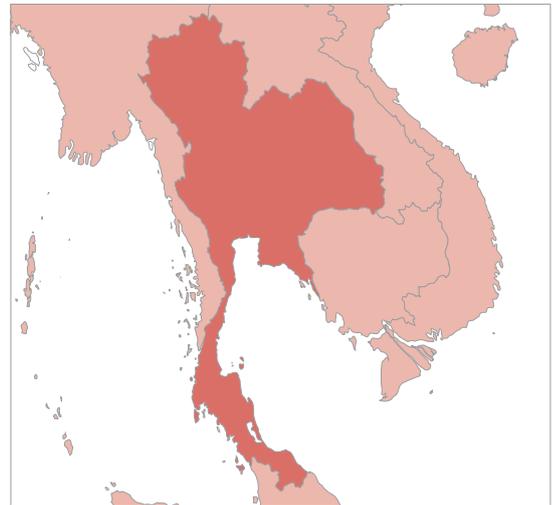
Thailand

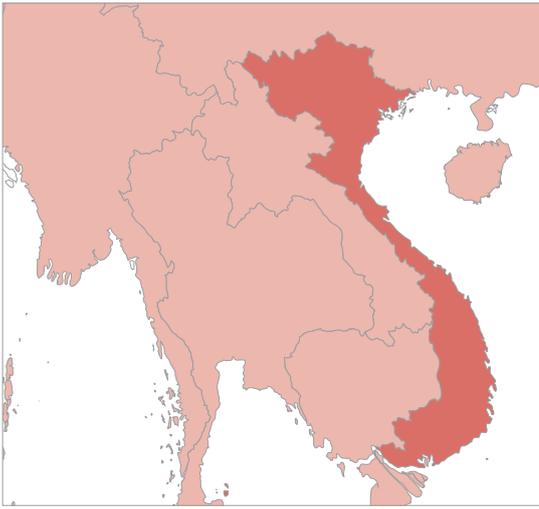
Thailand's infrastructure is generally adequate, but bottlenecks in some areas exist and can raise production and distribution costs. In 2016 the government approved an infrastructure plan for 2017 worth Bt895.8bn (US\$26.8bn) encompassing 36 transport infrastructure projects covering rail, road, air and seaports. Railway development accounts for 73.3% of the package, while expressways and motorways make up 18.7%.

Although the junta has moved a number of projects nearer to the construction phase, the medium-term prospects for a high-speed train linking Thailand and China, via Laos, which was originally agreed in 2010, are still unclear. Funding to build a section of the line between the Thai capital, Bangkok, and the north-eastern province of Nakhon Ratchasima was approved in mid-2016, but further sections are yet to be greenlighted. This rail project and others have been slow to progress owing to doubts over their commercial viability and wrangling over financing with Chinese and Japanese investors.

The government is keen to build new mass-transit routes in Bangkok, where traffic congestion remains a problem, and has approved major rail and road projects that would improve connectivity between large cities and with Thailand's neighbours. Priority projects include road and rail upgrades on the eastern seaboard to link with Bangkok, and the expansion of the U-Tapao International Airport, 140 km south-east of the capital. This, and the expansion of Bangkok's second international airport, Don Mueang International Airport, represent part of an estimated Bt194bn upgrade to the country's six major airports. The total capacity of the six major airports will rise significantly, from the current 75m passengers per year.

The Eastern Economic Corridor, a new, large-scale special economic zone east of the capital, aims to develop higher-value-added industries. This will be facilitated by a transport infrastructure upgrade in the form of the expansion of the Laem Chabang and Map Ta Phut seaports, the U-Tapao international airport, the construction of a Bangkok-Rayong high-speed rail line and the extension of an existing motorway.





Vietnam

Although improving, Vietnam's infrastructure is poor and presents risks to business. The standard of the rail network will remain poor, but the government is upgrading the country's ports and airports. Significant extension of the road network is unlikely, but a high proportion of major roads are paved and there will be further improvements to the main road arteries, making interprovincial travel easier.

Although transport infrastructure serving specific areas (particularly the manufacturing zones in the north and south) is relatively developed, large parts of Vietnam, including the central coastal region, are still constrained by underinvestment. However, the country is expanding its highway and airport network, with plans to build a new airport at Long Thanh to serve the commercial hub of Ho Chi Minh City, for example. The government is also planning to develop other airports to enable them to serve as major international airports for the three regions of the country.

The government is also developing new ports capable of accommodating larger vessels, although this, and the upgrading of existing ports, is not expected to proceed fast enough.

However, the authorities are determined to make progress. An announcement in 2015 that the government plans to reduce its stake in the state-owned shipping line, Vinashin, and a stake in Saigon and Hai Phong ports to 20%, was a welcome signal, as it suggests that the ports may be managed instead by a private company, which would be more likely to operate efficiently. Nonetheless, both port and airport facilities will generally remain inadequate to meet the demands placed on them by the rapid expansion of international trade and tourism.

The National Assembly (parliament) passed an amended version of the Law on Railways in June 2017, with an aim to revitalise Vietnam's train networks by encouraging private investors to plough money into new projects. In recent years railways have struggled to fight off the challenge posed by budget airlines.

5. Conclusion

This paper has surveyed the main dynamics shaping Asia's infrastructure market. A central claim is that developing Asia faces a significant infrastructure funding gap which, if left unfilled, will act as a serious drag on future prospects for growth and development. The report has focused on the infrastructure sectors of critical importance: energy and transport. Both face common challenges around the availability of funds for investment, funding models, regulatory regimes and demands made by climate-change commitments. More positively, surging demand in these sectors also represents a tremendous opportunity.

The balance of new infrastructure will need to be provided by private investment mainly with PPPs, greater institutional investment and green bonds. Lifting private investment in these and other sectors of Asia's economies will require government initiatives that provide a more conducive environment for private participation with removal of barriers to investment, capital flows and capital markets, and removal of limitations on access to "prohibited" industries.

There has perhaps never been a better opportunity—or incentive—for governments, international institutions and the private sector to come together and invest in the capacity needed for the region so that it can enjoy the benefits of continued economic growth and development. Doing so will help to make Asia's presumed golden age for infrastructure a reality.

Appendix

Infrastructure risk measures

	Port facilities	Air transport facilities	Retail and distribution network	Telephone network	Road network	Power network	Rail network	IT infrastructure	Natural disaster economic risk	Cyber security, preparedness
Australia	1	0	1	0	1	1	1	0	0	0
Cambodia	2	3	3	0	3	3	4	3	4	2
China	1	1	2	1	1	1	0	2	1	1
Hong Kong	0	0	0	0	1	0	0	0	0	0
India	3	2	2	2	3	3	3	2	2	1
Indonesia	2	2	3	0	3	2	2	3	2	1
Japan	1	1	1	0	1	1	0	0	2	1
Laos	4	2	3	3	4	2	4	3	4	4
Malaysia	1	0	1	1	2	1	2	1	0	0
Myanmar	3	2	4	3	3	3	4	4	4	2
New Zealand	0	0	1	0	1	1	2	0	3	0
Philippines	3	2	2	1	3	3	4	1	3	1
Singapore	0	0	0	0	0	0	0	0	0	0
Sri Lanka	1	2	3	2	3	1	3	2	0	1
South Korea	1	1	1	0	1	0	1	0	0	0
Taiwan	0	0	1	0	1	1	1	0	2	1
Thailand	2	2	2	1	2	3	3	2	0	2
Vietnam	2	2	3	1	3	3	3	1	3	2

Note: Indicators are scored in a range for 0 (no risk) to 4 (severe risk)

Source: The Economist Intelligence Unit, March 2018.

Note.

The operational risk model considers ten separate risk criteria: security, political stability, government effectiveness, the legal and regulatory environment, macroeconomic risks, foreign trade and payments issues, labour markets, financial risks, tax policy, the standard of local infrastructure

When considering infrastructure risk, the model asks: What is the risk that port facilities, air transport, the retail and wholesale distribution networks, the telephone network and the ground transport network will prove inadequate to business needs? What is the risk that power shortages will disrupt business activities? What is the risk that the information technology infrastructure will prove inadequate to business needs? What is the risk that the economy will suffer significant disruption owing to a major disaster? What is the risk that the country is not able to withstand cyber-attacks?

Appendix 2

Outlook for infrastructure: North Asia

CHINA

China's infrastructure has been upgraded in recent years, not least because public investment spending has provided a method of sustaining strong economic growth. Power shortages will be rare in 2018-19 as a glut of generating capacity increases. Motorways link almost all major cities, but in some regions the road network is still inadequate for the growing volume of goods traffic. Meanwhile, an impressive high-speed rail network has emerged and will be expanded further. Air transport networks are well developed, and the logistics industry is growing rapidly—although it remains inadequate for business needs.

The next few years will see a further nationwide improvement in rail connectivity, ports and airports, particularly in western areas. As inter-regional connections reach a high standard, more attention will be paid to investment in transport infrastructure within cities, such as urban light rail. National retail distribution networks are improving. Power supplies are generally reliable and will improve further with power pricing reforms.

In March 2018 China's National Energy Administration outlined supply plans that use all forms of energy. Although pollution concerns support moves to reduce the use of coal, it will still provide the bulk of energy output in the forecast period (2018-22), with clean-coal technology increasingly rolled out. Natural-gas use will rise as Russian supplies come on stream by pipeline from October 2019.

Wind, solar and hydro energy are being developed rapidly. Hydropower is the leading source of renewable energy in China, providing an estimated 342 GW of capacity (equivalent to 19% of total installed power capacity) in 2017. China's wind power capacity accounted for around 35% of the worldwide total in 2017, according to the Global Wind Energy Council. In that year around 4% of China's total power generation was derived from wind. The 13th five-year plan (FYP), covering 2016-20, raised the government's target for wind power capacity to at least 210 GW by 2020. China became the world's largest solar market in 2013 and has now overtaken Germany to become the 'largest producer of solar energy globally. Under the latest FYP, the government is aiming for 110 GW of solar capacity by 2020—a target which has already been easily surpassed. The EIU forecasts that capacity will rise to around 280 GW by 2022.

Five nuclear power plants will be commissioned in 2018, with work beginning before the end of the year on a further six to eight. Including further planned developments, the government aims to increase nuclear capacity to 58 GW (6% of installed capacity) by 2020, from 35 GW in March 2018.

In December 2017 China launched its long-awaited emissions trading scheme, opening up the world's largest carbon market. The scheme will initially apply to almost all the country's power generation plants, which produce about a third of China's emissions. Along with toughening air-quality standards, the scheme will help to crimp demand for coal for electricity supply.

Investments along the Belt and Road

Chinese overseas direct investment (ODI) activities in countries along the “Belt and Road” have taken place long before the strategy was first proposed in 2013. The political and financial support for the BRI, however, has created an additional incentive for Chinese companies to explore these markets, or even to rebrand existing investments under the BRI umbrella. Since 2010, for example, officials have planned a railway between Kunming (the capital of China’s Yunnan province) and Vientiane (the capital of Laos) as part of a larger rail infrastructure project connecting China to Singapore—and since end-2013 Chinese officials have cited this rail project as a signature example of BRI collaboration. The majority of BRI projects are in infrastructure construction, largely in the form of foreign contracted projects backed by discounted loans from China. Such lending can go directly to recipient governments and is typically conditional on using it to fund a specific infrastructure project involving a Chinese company. Repayment of the loan can sometimes take place in the form of resources. China’s policy banks also loan directly to Chinese companies implementing BRI projects.

Although data on concessional lending are opaque, the latest figures from the Export-Import Bank of China (one of China’s main policy lenders) indicate that its outstanding concessional loans stood at Rmb252.2bn (US\$41.2bn) at end-2014. This number is likely to have risen significantly over the past two years, with Chinese media reporting that around 50 state-owned enterprises (SOEs) participated in roughly 1,700 BRI projects between 2014 and 2017.

Although BRI investments are a political priority, Chinese companies have been hesitant about investing in BRI countries, where levels of operational risk are high. Indeed, there have been

several prominent stalled projects. In August 2017 a land-rights dispute stalled a US\$5bn Chinese rail project in Indonesia and in November Nepal cancelled a US\$2.5bn deal with a Chinese corporation to construct the country’s biggest hydropower plant, owing to irregularities in the project bidding process; Pakistan also cancelled a similar hydropower project because of disagreements over financing and ownership conditions. Moreover, whereas the central authorities can facilitate SOE-led projects in BRI countries through concessional lending, they have fewer levers to persuade private Chinese firms—who have driven ODI flows in recent years—to follow as well.

There are signs that the Chinese government is looking to ameliorate the risks associated with the BRI in order to push up investment. In August 2017 the Ministry of Finance and the State Council (the cabinet) published separate policy documents on BRI investments by SOEs, setting broad parameters covering due diligence, feasibility and ensuring the operational maintenance (and success) of BRI projects. Services firms are also reporting that Chinese loan- or insurance-issuing institutions, such as Sinosure and China’s various policy banks, are now applying higher standards in BRI project applications.

Stepped-up regulation will not guarantee the success of BRI projects, but it does suggest that China is looking for a sustainable model. This is important because the BRI will also help to achieve a number of policy objectives: for instance, further issuance of renminbi-denominated loans will promote internationalisation of the currency. Besides enhancing China’s geopolitical influence, the implementation of Chinese-led projects in developing markets will help to expand Chinese regulatory norms and technical standards, which, in turn, may create momentum and opportunities for Chinese consumer-facing companies to tap new markets.

JAPAN

In many aspects of its infrastructure Japan will remain a global leader in the coming years. The country boasts one of the world's most sophisticated telecoms systems, and the quality of its road, rail and air transport networks is also high. Further improvements in the quality of Japan's infrastructure will continue through the construction of new motorways, Shinkansen (high-speed train) links and airports. More public infrastructure projects will be open to private-sector management and PPPs will be expanded. However, Japan's infrastructure will remain vulnerable to natural disasters such as earthquakes, tsunamis and volcanic eruptions.

Foreign interest in investment in Japanese infrastructure assets is likely to remain a sensitive issue. However, the government will attempt to adjust regulations to allow more joint ventures between local and foreign firms operating in areas such as environmentally friendly technology, biotechnology and healthcare.

The main area of uncertainty regarding infrastructure is the extent to which Japan's nuclear sector will restart after being shut down by a devastating earthquake and tsunami in 2011. The slow restart so far has hurt economic growth and Japan's trade position.

The Nuclear Regulation Authority (NRA) has received applications to restart 25 nuclear reactors, seven of which have so far been approved, but only four of these are currently in operation; the other three could be restarted by September 2018. Japan has 17 reactors that have not yet filed restart applications with the NRA which might never be brought back online. Japan is unlikely to have more than 15 reactors in operation by 2022 and, consequently, the proportion of total electricity production accounted for by nuclear plants by 2022 will be far less than before the 2011 disaster. There are plans to build new nuclear reactors, mostly to replace some of those either being—or expected to be—decommissioned, but it is unlikely that any new capacity will be brought online before 2022.

Airport capacity will continue to expand during the forecast period. Japan's tourist boom, now into its sixth year, and the hosting of the Olympic Games in the capital, Tokyo, in 2020, will continue to fuel demand for more airport capacity. The government's target for annual tourist arrivals in 2020 is 40m (up from 24m in 2016), and capacity at Tokyo's two main international airports, Narita and Haneda, is being increased. The government's efforts to turn Japan into an air transport hub for Asia face stiff competition from established centres, such as Hong Kong and Singapore.

Known worldwide for its efficiency and punctuality, Japan's bullet-train service will continue to expand and improve in the forecast period. The seven companies that make up the Japan Railways Group have ambitious long-term plans for further expansion, including the introduction of a Maglev train in 2027 that will operate at twice the speed of current bullet trains. The rail companies will also reduce journey times on bullet trains between major cities. This means that Shinkansen services will compete more strongly with domestic airlines, the more damaging environmental impact of which will give the bullet trains a growing advantage in terms of their ability to win greater market share.

Tokyo 2020 Olympics

Tokyo hosted the first ever Olympic Games to be held in Asia in 1964. Japan was then in the midst of its post-war economic boom and the Games were taken as an opportunity both to upgrade the country's infrastructure dramatically, including the Tokaido Shinkansen railway and the construction of the Metropolitan Expressway, and announce Japan's return to the world stage.

Tokyo today is the capital of the world's third-largest economy and boasts world-standard infrastructure. Yet the 2020 Olympic Games, awarded to Japan in 2013, are similarly viewed (at least by the organisers and central government) as an opportunity for Tokyo to showcase new technologies and upgraded cities on the global stage. Although some of the plans have been revised owing to cost concerns, Tokyo has been busy building new roads, railway lines and stations, commercial developments, hotels and an ambitious waterfront redevelopment in the run-up to 2020. The Japanese government has set aside ¥400bn (US\$3.7bn) in order to host the Games. A large proportion of that fund is going towards the reconstruction of the National Olympic Stadium.

Much of this upgrading will further facilitate the development of international tourism to Japan, which has been booming in recent years. Perhaps more

important, however, is the opportunity for the private sector (both Japanese and foreign affiliated firms) to showcase new technologies to global markets.

The automotive sector, for instance, is looking to roll out autonomous and more energy-efficient vehicles. Nissan and a mobile gamemaker, DeNA, trialled an autonomous-driving taxi service in Yokohama in March 2018, with a view to launching the service to the public in the early 2020s. Hydrogen-powered buses have been proposed to ferry athletes and the press around the Olympic Village, itself powered by hydrogen. According to media reports, the Tokyo government plans to spend ¥40bn in the next five years to improve hydrogen energy use leading up to the Olympics. The government aims to have 6,000 fuel cell vehicles and 35 charging stations in operation by 2020.

Next-generation telecoms technology, such as 5G wireless systems, will also feature prominently. The Japanese public broadcaster, NHK, will offer coverage of the games in Super 8K—which is 16 times sharper than high-definition televisions—while the authorities are also promoting humanoid robots to provide multi-language support for tourists and real-time translation apps.

Industry opportunities therefore range from construction to technology (big data and sensing, connectivity and cyber-security), energy and next-generation urban mobility.

SOUTH KOREA

As South Korea is one of the world's most densely populated countries, upgrading infrastructure systems to keep up with economic growth is a constant challenge. Transport and telecoms links are good by regional standards, although the road network is highly congested. Concerns remain, however, in the area of energy provision. Not only is South Korea heavily dependent on oil, but its attempts to promote alternative energy sources, such as nuclear power, are being met with environmental protests. Cumulative and ongoing investments in roads, railways, bridges and ports make South Korea's transport infrastructure highly efficient.

The government has ambitions to make South Korea a regional transport hub. Since it opened in 2001 Incheon International Airport has emerged as one of Asia's main air transport hubs. Furthermore, a new hub airport construction project will take off in the coming years under a plan to expand the existing Gimhae International Airport near Busan, South Korea's second-largest city, into a full-scale gateway airport.

South Korea is one of the world's most oil-intensive industrialised countries, and energy demand is growing at a rate well above the OECD average. This is forcing the government to pursue policies designed to increase energy efficiency, improve energy security and raise the share of energy that it obtains from renewable and cleaner sources. According to the government's latest long-term energy strategy, the proportion of the country's energy obtained from renewable resources will increase to 11% by 2035, from around 3% at present. South Korea's slow progress towards renewable energy build-out reflects its high dependence on nuclear energy, which generates about a quarter of the country's electricity. Although South Korea already boasts the sixth-highest nuclear-generation capacity in the world, the government plans to construct an additional 13 reactors by 2029, in addition to the 24 reactors currently in operation. It is likely that the administration will continue its nuclear strategy in order to keep up with its climate-change commitments.

Electricity supply has been monopolised by the state-owned Korea Electric Power Corporation, which also controls power-generation subsidiaries, including Korea Hydro & Nuclear Power. How best to open up the power grid to private competition remains a long-term unresolved issue in South Korea. The government implements demand-side incentives for electricity conservation while maintaining tight price controls on the supply side. This basic framework will not change much in the coming years.

Despite government attempts to create a more foreign-friendly investment environment, South Koreans regularly voice concern about foreign takeovers of domestic companies. Foreign investment in electric power generation is permitted, but foreigners may not acquire more than 30% of installed capacity. Foreign investment of up to 50% is permitted for power transmission and supply.

Foreign investment must not exceed 50% in most transport ventures, including airlines and coastal water transport for passengers and freight. Investment of up to 49% is permitted in programme distribution, cable networks and in wired, wireless, satellite-based and other telecoms services.

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The Economist Corporate Network is The Economist Group's advisory service for organisational leaders seeking to better understand the economic and business environments of global markets.

Delivering independent, thought-provoking content, The Economist Corporate Network provides clients with the knowledge, insight, and interaction that supports better-informed strategies and decisions. The Network is led by experts with in-depth understanding of the geographies and markets they oversee. Its membership-based operations cover Asia Pacific, the Middle East and Africa.

Through a distinctive blend of interactive conferences, specially designed events, C-suite discussions, member briefings and high-calibre research, The Economist Corporate Network delivers a range of macro (global, regional, national, territorial) as well as industry-focused analysis on prevailing conditions and forecast trends. Find out more at www.corporatenetwork.com

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Access China is a unique service that will help your business to succeed in China. It is the only single source of data, analysis and forecasts for all 31 provinces and 292 of China's largest cities, providing you with a comprehensive understanding of China today, but more importantly giving you confidence that you will still understand China in ten and twenty years' time.

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