Transport Sector Study

May 2018

This study is prepared by the staff of the Asian Infrastructure Investment Bank, with the close support from AECOM as the Bank's consultant over a 5-month period, between 2017 and 2018. The study team is also grateful to the views and support provided by various partners.

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1.0 Executive Summary

The Asian Infrastructure Investment Bank (AIIB) is a multilateral development bank (MDB) with the mission to improve economic and social outcomes for Asia and beyond. As part of this mandate, AIIB aims to provide development finance to transport projects that contribute to the economic growth of Asia, minimize transport emissions and meet the increasingly varied needs of a growing Asia.

AIIB's Transport Strategy ("strategy") is set out in a separate document to be presented to AIIB's Board for approval. The strategy will define AIIB's comparative advantage, lay out the vision and priorities for transport infrastructure, and the implementation and monitoring framework for the Bank.

To support the Transport Strategy, this Study ("study") sets out the background of Asia's transport infrastructure, including existing infrastructure stock, gaps and needs, as well as future trends that inform and guide AIIB's strategy.

1.1. Transport infrastructure landscape

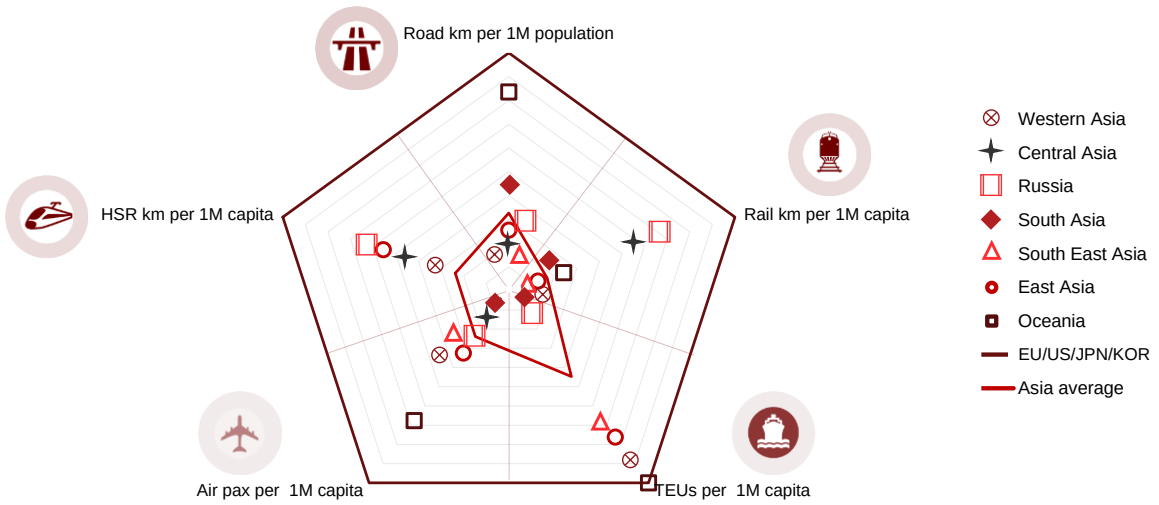
Provision of transport infrastructure is highly uneven across Asia, and in most instances lag behind developed economies

Asia has a large and diverse geography. For most transport sub-sectors, Asia continues to lag behind developed countries in infrastructure provision, as seen in Figure 1.

In terms of assessed demand, roads, rail, and aviation infrastructure demand would be *relatively* higher for Central Asia, Russia, Western Asia and Oceania. This is due to the lower population densities and bigger geographies. On the other hand, demand for high speed rail (HSR) would be *relatively* higher in South Asia, East Asia, and South-East Asia.

Mapping existing infrastructure stock with future needs, a few high-level gaps can be seen. South Asia is relatively underdeveloped in terms of ports, airports and high capacity highways. South-East Asia lags behind in roads and rail. Port infrastructure is less relevant for Central Asia, but access to ports would be key.

Figure 1 Comparative Statistics on Transport Infrastructure per 1 Million Population

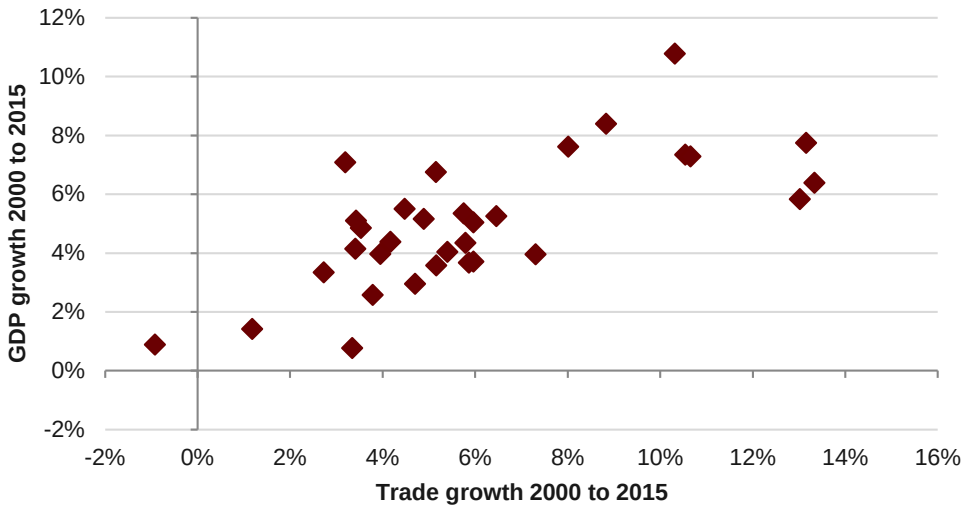


Source: World Bank, AECOM estimates

Trade and economic development are closely linked, and good transport infrastructure is critical in this context

Between 2000 and 2015, Asia-Pacific experienced considerable economic growth. Figure 2 shows that economic growth and trade were closely correlated throughout the region over the same period. The fastest growing economies were those which increased their trade volumes the most. A one percentage point increase in trade volumes was associated with a 0.5 percentage point increase in gross domestic product (GDP). To maintain economic growth in the region, there is a clear need to prioritize investments in transport infrastructure which connect markets and facilitate efficient trade flows.

Figure 2 **Trade and GDP Growth (2000 to 2015) for Countries in Study Region**



Source: World Bank

Asia's transformation over the past decade into a competitive generator of trade has been accompanied by urbanization and rising urban densities, economic growth and a strong increase in tourism. These have led to increased demand for efficient, sustainable, and cross-border transport networks.

Ports and shipping will remain key

In particular, much investment would be needed in the region's port network. Shipping is the most significant transport mode for freight movements, given its considerable cost advantages and efficiencies over road and rail. While there is a risk of overprovision of port infrastructure in some regions, continued improvement in port capacity, efficiency and connections to local hinterlands would assist in facilitating efficient freight movements and support continued growth.

The cost of congestion will rise

Economic growth in developing countries has also led to increased average wages and consequently the value of passenger travel time. As GDP per capita across the region is expected to increase by an average of three percent per annum between 2015 and 2030, the cost of congestion over this period is likely to increase significantly. Increasing congestion will affect the performance of logistic networks, particularly in Central Asia, South-East Asia and Russia which already lag developed nations. An increase in wages is

likely to lead to the willingness of businesses and people to pay more for efficient and sustainable transport solutions.

And rising affluence will also result in higher demand for new infrastructure, upgrading and improved access

Similarly, economic growth will lead to increased passenger travel demand, particularly concentrated in developing countries with a growing middle class. Whilst road is currently the most highly utilized transport mode for passenger travel – accounting for three quarters of all passenger kilometers in the region in 2015, continued liberalization of the aviation sector has increased the supply of air services to meet demand. Passenger demand for more efficient and sustainable transport solutions is coming at a time when the population is undergoing considerable change. Transport infrastructures need to be modified to suit the needs of aging populations and support increased female participation in workforce, new forms of workplaces and lifestyles, and future transport technologies, such as autonomous vehicles and car-sharing.

With large and growing demand for transport, minimizing emission will be a top priority

More effective investments in targeted projects and innovative technologies will be required to minimize transport emissions in the Asia-Pacific region as well. The region generated 2.6 billion tons of domestic transport emissions in 2014 (41 percent of global domestic transport emissions), and is expected to increase its domestic transport emissions to 3.7 billion tons by 2030 (47 percent share of total). This comes at a time when lower growth of domestic transport emissions is expected in Europe and the United States (U.S.).

Multilateral and private sector initiatives are necessary to help fiscally-strapped governments

While governments in Asia are already investing in transport infrastructure to expand the capacity of the systems and deliver the required modifications, additional private sector capital is required to accelerate investments and project delivery. Increased private sector capital will require more certainty on returns, higher project quality, longer periods for project preparation and stronger governance.

Multilateral initiatives are thus crucial to ease the stress on existing transport networks. However, many of these require international cooperation between government and non-government sectors. Existing and planned initiatives provide potential investment and partnership opportunities for AIIB.

1.2. Infrastructure and investment requirements

Differing rates of population growth, economic development and urbanization have resulted in significant variations in infrastructure stocks across the Asia-Pacific. As illustrated in Table 1, more developed regions such as Oceania, East Asia and Russia have had considerably more infrastructure on a per person basis, particularly in the road and rail sectors. A region's infrastructure stock is also influenced by its geographical endowments – land-locked Central Asia does not require local port infrastructure, for example, while Western Asia's higher concentration of airports allows it to take advantage of its proximity to Europe. In general, however, infrastructure provision in the Asia-Pacific lags the more developed regions of Europe and the U.S.

Table 1 Asia-Pacific Transport Infrastructure Provision as at 2015

Key regions	Population (million)	GDP per capita	Infrastructure per 1 million capita				
			Road km	Rail km	TEUs	Air pax	HSR km[1]
Western Asia	250	14,000	3,800	90	190,000	1,100,000	5
Central Asia	50	6,000	5,300	465	-	200,000	5
Russia	150	11,000	6,700	570	30,000	510,000	10
South Asia	1,800	2,000	3,200	50	10,000	80,000	-
South East Asia	650	4,000	2,100	25	140,000	460,000	-
East Asia	1,600	11,000	3,300	60	160,000	410,000	20
Oceania	50	30,000	19,200	195	230,000	1,800,000	-
Total/Average	**4,550**	**7,000**	**3,000**	**75**	**90,000**	**340,000**	**10**

Source: World Bank, AECOM estimates

Future investment requirements were estimated based on projected economic and population growth, changes to economic composition and the effects of urbanization.[2] Required investment by sector and region is outlined in Table 2. An annual investment of US$866 billion is expected to be required to develop, maintain and refurbish transport infrastructure across the Asia-Pacific, equivalent to approximately three percent of the region's GDP.

Investment across the region is expected to be focused on road infrastructure, which comprises nearly 70 percent of total estimated required investment. Majority of these are in the fast-growing and urbanizing regions of South and East Asia (77 percent of total investment combined).

Table 2 Projected Annual Investment Needs of Asia-Pacific (US$ million, 2017 dollars)

Key regions	Air	Port	Rail	Road (incl. Motorway)	MRT	HSR	Total
Western Asia	2,100	1,800	900	29,300	10,600	10,500	55,200
Central Asia	300	-	800	4,400	1,200	400	7,100
Russia	300	200	3,100	19,400	3,800	5,400	32,100
South Asia	3,800	1,900	4,300	201,500	17,500	26,800	255,800
South East Asia	3,700	9,800	800	48,200	12,100	9,200	83,800
East Asia	16,400	20,600	3,900	274,500	72,400	22,600	410,400
Oceania	1,300	400	300	17,100	2,200	-	21,300
Total	**27,900**	**34,700**	**14,100**	**594,400**	**119,800**	**74,900**	**865,800**

Source: World Bank, AECOM estimates. The investment needs of US$865.8 billion per annum is different from ADB's estimates due the following reasons: (i) estimates here include AIIB's regional members in Oceania, Russia, and others; and (ii) estimates here include urban mass rapid transit (MRT) for completeness.

[1] As of 2015, most countries in Asia do not have HSR systems but many countries are planning or exploring HSR.

[2] Note that a low investment stock figure reported in Table 1 does not immediately translate into higher projected investment needs as seen in Table 2. Projected investment needs would depend on geography and economics, amongst other factors.

1.3. Investment challenges

Sustaining an investment rate of more than US$800 billion annually is a substantial task, the difficulty of which is compounded by downturns in the global economic environment and investment challenges within the Asia-Pacific region specifically.

Following the global financial crisis in 2007-2008, many governments took on more debt to spur economic recovery. As a result, governments across the region have become cautious about further borrowing to fund infrastructure expenditure and are increasingly adopting alternative methods to finance infrastructure projects, including for transport.

Although large institutional investors are becoming more prepared to invest in Asian infrastructure, a number of regulatory, political and institutional challenges remain. In particular, private investors highlighted the following issues as some of the factors that increase the risk of investments in the region:

- Resistance to foreign investment
- Lack of transparency
- Lengthy decision-making processes
- Business risk and poor governance
- Financial and operational risks

These are challenges that can neither be resolved quickly nor with AIIB's resources alone. Indeed, many developmental agencies have made efforts to overcome a variety of these issues that continue to evolve. Hence, it is important for AIIB's transport strategy to not only guide its investment choices, but also guide its buildup of necessary in-house capacity and partnerships with other organizations.

1.4. Suggested AIIB Approach

In sum, AIIB can achieve greater impact as a young organization by:

- Clearly defining a set of priorities for the transport infrastructure sector, and adopting a framework to allow effective project selection. The set of priorities should include modal and cross-border connectivity, with considerations for environmental and social sustainability.
- Placing a strong emphasis on economic viability and commercial discipline, to ensure financial sustainability of projects and to crowd in more private capital;
- Working effectively with partners (MDBs, other developmental agencies, private sector and think tanks). While AIIB presently has limited capacity in providing technical assistance, its early participation during project preparation can provide greater confidence around funding, and improve the conditions for projects to reach financial closure successfully.

2.0 Introduction

AIIB is a MDB with a mission to improve social and economic outcomes for Asia and beyond, by investing in sustainable infrastructure and other productive sectors. Through its projects, AIIB aims to connect people, services and markets to foster growth and opportunities, while putting in place and giving assurance of strong environmental, social, and procurement safeguards.

The transport sector is one of AIIB's early focuses, being the second largest sector in terms of financing requirement (after the energy sector). Transport plays a key role in enabling economic development by providing access to goods and basic services, promoting regional integration and facilitating trade. Although Asia's transport infrastructure has improved markedly over time and facilitates trade and cross-border movements over an expansive region, significant gaps remain. Across Asia, investment is required to increase capacity, improve reliability and deliver more customer-focused services. Moreover, the challenge is not just to expand the system, it is also about providing a more intelligent, adaptable and efficient network.

This study presents the background analysis for AIIB's Transport Strategy. It highlights the gaps, needs and trends for transport infrastructure. It also explores several competing choices such as building more roads which Asia needs against the need to curb rising emissions, as well as building infrastructure to meet the gaps today but not locking in obsolescence risk.

The study has been developed considering the infrastructure requirements of the entire Asia-Pacific region. This study does not cover urban mobility, as this sub-sector will be touched upon in another study (on sustainable cities). Nonetheless, where necessary, the infrastructure investment requirement for urban rail is also presented alongside with other transport sub-sectors for completeness.

The geographic scope of the strategy is illustrated in Figure 3, and the specific countries included are listed in Appendix A.[3]

[3] Some non-AIIB member countries have been considered in the study where necessary, for the completeness of analysis.

Figure 3 Geographic Scope of the Transport Study

Section 3.0 of the study gives context to the Transport Sector Strategy by outlining the high-level trends expected to influence the future demand for, as well as the delivery and use of, transport infrastructure across Asia-Pacific. Section 4.0 details the existing transport infrastructure across the region and highlights the investments needed to meet needs by 2030. In Section 5.0, the current level of investments by the public and private sector, as well as the challenges they faced, are explained. Section 6.0 discusses the implications for AIIB, which then helps guide the formulation of AIIB's investment vision, objectives and priorities that are explained in AIIB's Transport Strategy ("strategy").

3.0 Context to the Transport Sector Strategy

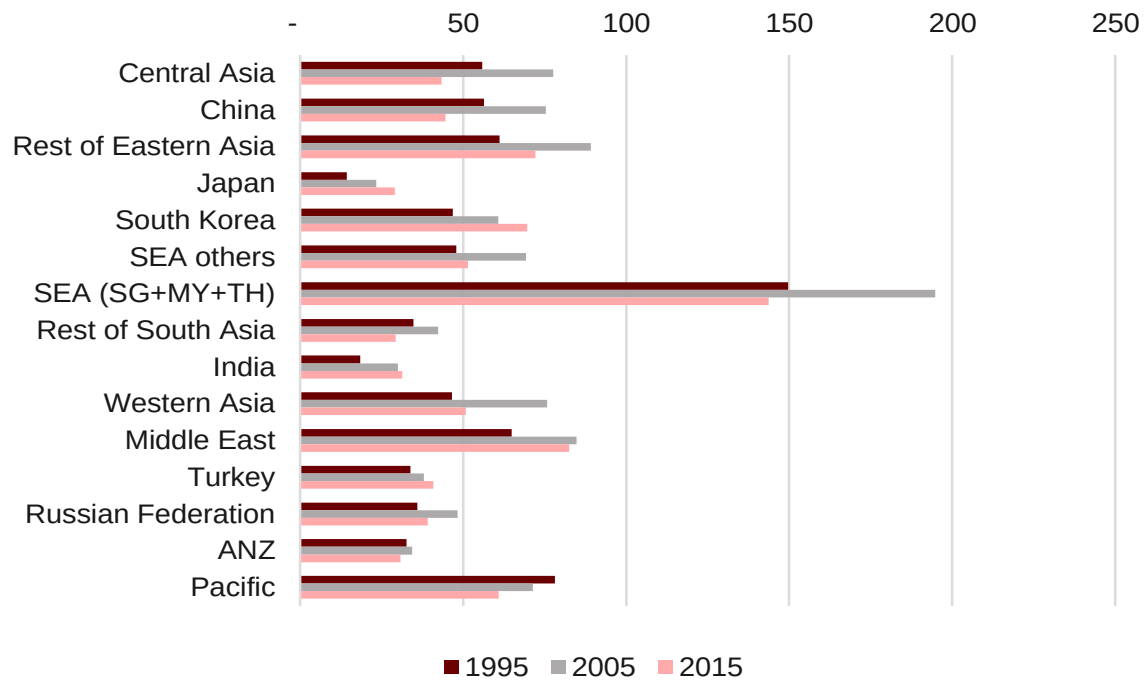
The next decade is likely to see many changes, opportunities and challenges within the transport infrastructure sector. In this study, AIIB, supported by AECOM as consultants, has identified and assessed the high-level trends likely to influence the scope and scale of both passenger and freight transport infrastructure development in Asia-Pacific.

3.1. Trade is linked to economic development

There are wide disparities in trade openness (measured as a percentage of GDP) across the region, as illustrated in Figure 4. For example, the value of trade in the South-East Asian countries of Malaysia, Singapore and Thailand was equivalent to 144 percent of GDP in 2015. This is in contrast to India, which had trade at around 31 percent of GDP.

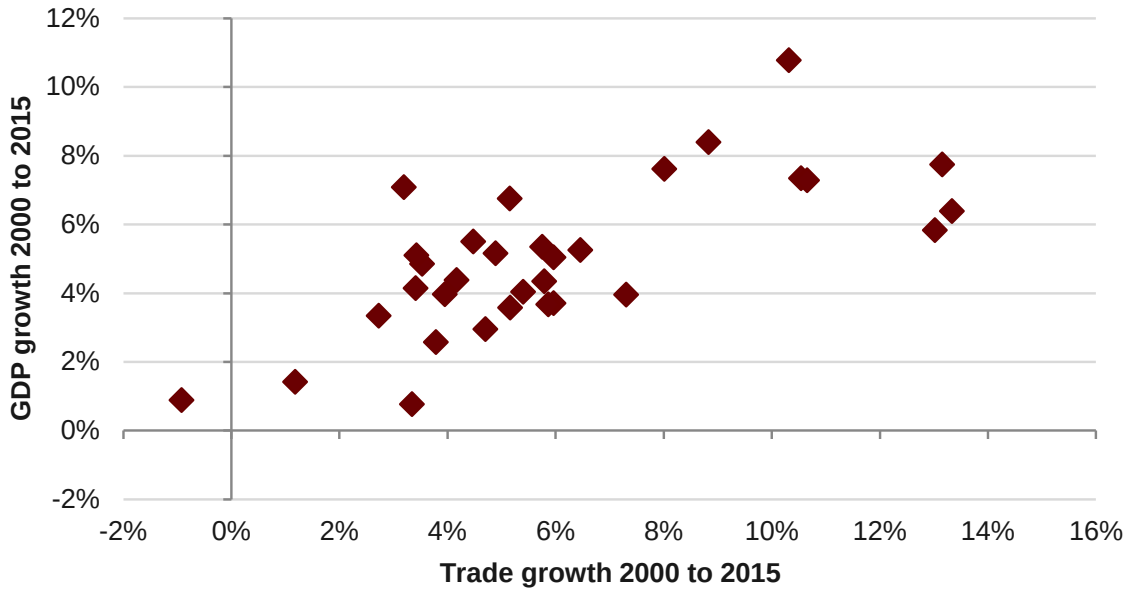
Between 2000 and 2015, the fastest growing economies in the Asia-Pacific were generally those which grew trade volumes the most. A one percentage point increase in trade volumes was associated with a 0.5 percentage point increase in GDP, as illustrated in Figure 5.

Figure 4 Trade as a Percentage of GDP in the Region



Source: World Bank

Figure 5 **Trade and GDP Growth (2000 to 2015) for Countries in Study Region**



Source: World Bank

It is also notable that the Asia-Pacific region has been leading the recovery in world trade since the 2007-2008 global financial crisis[4]. In 2016, Asia-Pacific's trade grew by 1.7%, faster than the growth of world trade at 1.3%. It was also the only region where trade growth accelerated between 2015 and 2016. A key factor for Asia's resilience in trade is its high proportion of intra-regional trade, which stood at 57.3% of Asia's total trade in 2016. Intra-regional trade flows by sub-region for 2015 are presented in Table 3.

Table 3 **2015 Trade Flows by Sub-region, (US$ billion, 2015 dollars)**

Destination> Origin v	South Asia	Oceania	Western Asia	South East Asia	East Asia	Central Asia	Russia
South Asia	32.6	4.7	65.4	27.5	52.5	1.4	3.2
Oceania	10.9	16.3	8.4	24.6	132.2	0.0	0.6
Western Asia	98.6	3.8	116.5	54.9	170.5	5.3	6.2
South East Asia	63.0	41.4	46.1	280.3	394.1	0.6	5.9
East Asia	140.6	78.6	190.4	439.7	1,174.2	18.7	45.8
Central Asia	1.5	0.0	3.5	0.1	16.3	3.1	5.2
Russia	6.2	0.6	25.7	7.8	60.1	15.5	0.7

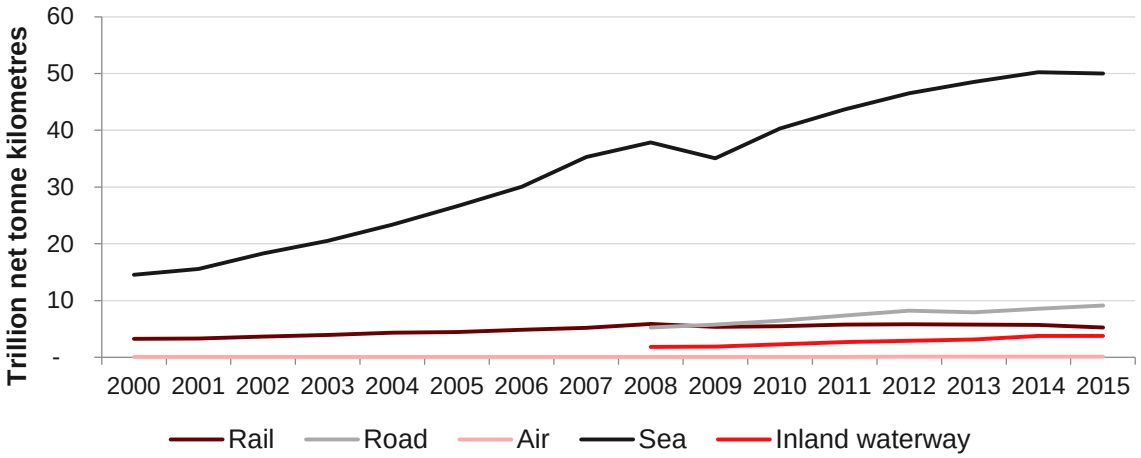
Source: World Bank

Notwithstanding this, by 2050, the trade lanes between Asia and the U.S. are expected to facilitate much higher flows of goods in both directions. There will be increased demand on the supply chain. This is compounded by the relocation of industrial centers inland, such as in China, which further increases transport duration of goods, due to increased inland haulage. High value goods are transported by air, and this demand will also increase.

[4] Asian Development Bank, "Asian Economic Integration Report 2017".

In terms of transport modes, while total freight volumes in the region grew at an annual rate of approximately nine percent between 2000 and 2015, air, sea and inland waterway freight volumes grew at six to eight percent per year. Meanwhile, air freight grew at 17 percent per annum and rail freight at three percent per annum during the same period.

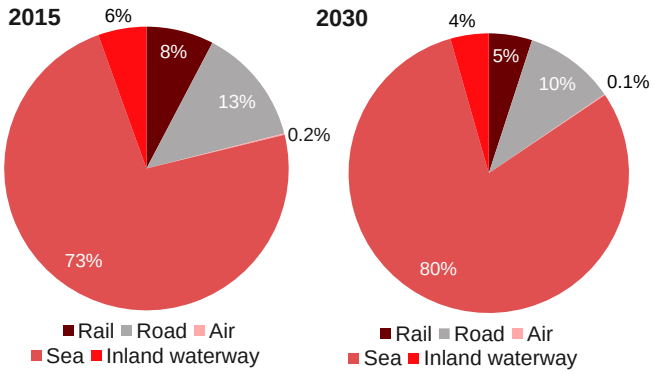
Figure 6 **Asia-Pacific Freight Transport by Mode**



Source: ITF, World Bank, IMF

Sea freight is the most heavily utilized freight mode, delivering 73 percent of total net ton kilometers of freight across the region in 2015. It is expected to increase its market share to 80 percent by 2030, driven by the reliance of the fastest growing economies. Shipping is likely to continue to be the primary means for long-distance transport, particularly for low-value goods, including most goods shipped from Asia to developed economies. Traditional trade routes between developed economies are anticipated to grow at a slower pace.

Figure 7 **Forecast Asia-Pacific Freight Mode Share (Net Ton Kilometers or NTK), 2015 to 2030**



Source: ITF, World Bank, IMF

3.2. AIIB can work with various initiatives aimed at enhancing these trade routes

The development of multiple global trade centers throughout the Asia-Pacific region over the past decades has been accompanied by urbanization, rising densities, economic growth and a strong increase in tourism. These have led to increased demand for efficient, sustainable, and cross-border transport networks. Multilateral initiatives are crucial to ease the stress on

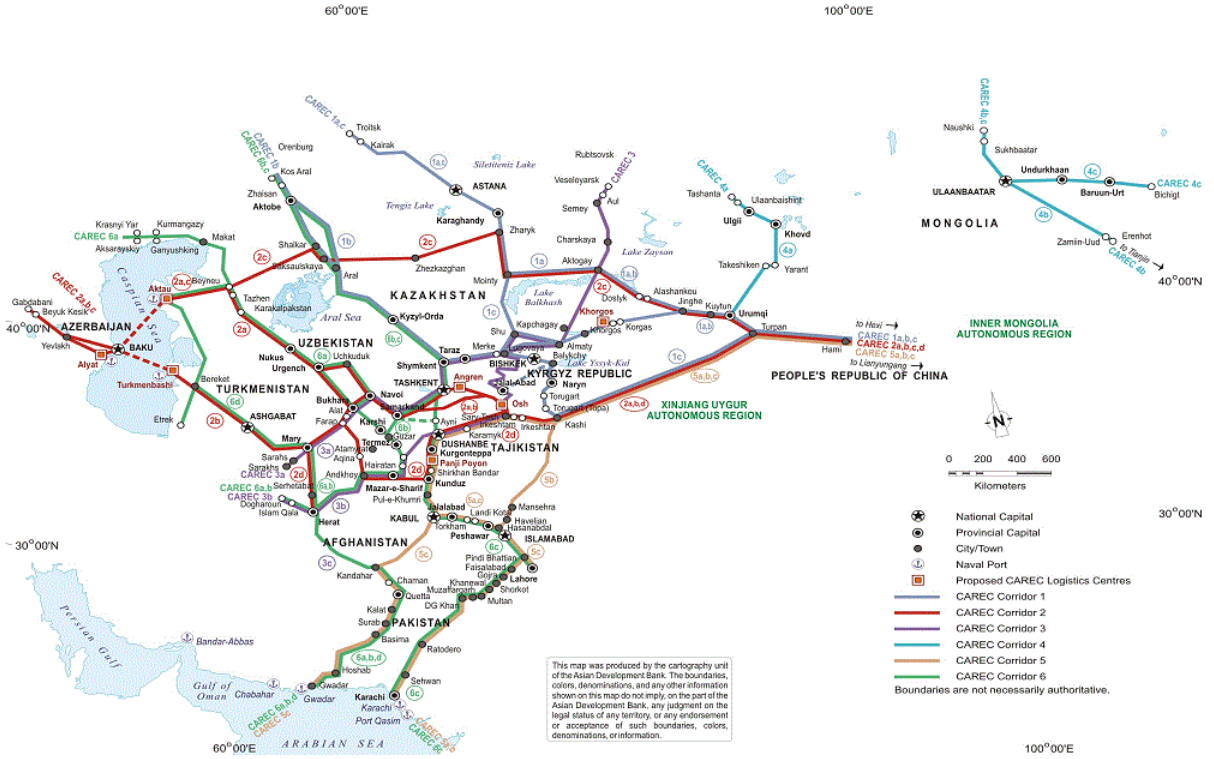
existing transport networks, but require international cooperation of the government and non-government sectors.

There are several regional/sub-regional initiatives that aim to develop better transport connectivity within Asia. This includes, amongst others, the Association of South East Asian Nation (ASEAN) Connectivity initiative, Central Asia Regional Economic Cooperation (CAREC) Program[5], Greater Mekong Sub-Region (GMS) Cooperation Program, One Belt One Road Initiative, and the South Asia Sub-regional Economic Cooperation (SASEC) Program.

- The ASEAN Connectivity initiative aims to achieve seamless and comprehensive integration within ASEAN, including in transport. Amongst others, focus is placed on sustainable infrastructure, digital innovation and seamless logistics. Between 2010 and May 2016, the initiative had made notable progress in in several transport projects, such as the ASEAN Highway Network, and the Singapore-Phnom Penh rail link (as part of the overall Singapore-Kunming rail link).

- The CAREC Program is a partnership of 11 countries and six multilateral development partners working to promote regional cooperation in four priority areas: transport, trade facilitation, energy and trade policy. Six regional economic cooperation corridors have been defined in the region covered by CAREC, as shown in Figure 8. Rail, roads and dry ports are critical components of the transport infrastructure because of the landlocked nature of the countries.

Figure 8 The Six CAREC Corridors



Source: http://www.carecprogram.org/index.php?page=carec-corridors

[5] The 11 countries include Afghanistan, Azerbaijan, China, Georgia, Kazakhstan, Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan; the six multilateral development institutions include the Asian Development Bank (ADB) which serves as CAREC Secretariat, the European Bank for Reconstruction and Development (EBRD), the International Monetary Fund (IMF), the Islamic Development Bank (IsDB), the United Nations Development Programme (UNDP) and the World Bank Group (WBG).

- The GMS Program comprises Cambodia, two provinces of China (Guangxi and Yunnan), Lao People's Democratic Republic, Myanmar, Thailand and Vietnam. One of the main focuses of the program is to strengthen transport linkages, particularly through providing assistance to facilitate cross-border transport of goods and people in the sub-region. This includes infrastructure development, such as roads, bridges, road signs and signals, as well as softer infrastructure, such as single-stop/single-window customs inspections and visa/immigration procedures.

- Under the One Belt One Road initiative, a key trade corridor is the Silk Road Economic Belt that will link land-locked areas of China to non-Chinese ports in Pakistan and Thailand, while providing alternatives to the Malacca Straits. China is also funding roads across the Mongolia Autonomous Region to improve connectivity to Russia and a railway freight route to Europe that bypasses the Trans-Siberian railway currently being upgraded by Russia.

- The SASEC Program brings together Bangladesh, Bhutan, India, Maldives, Myanmar, Nepal and Sri Lanka to boost intra-regional trade and cooperation in South Asia, while also developing connectivity and trade with South-East Asia, through Myanmar, to China and the global market. In particular, it seeks to develop multi-modal cross-border transport networks and improve customs administrations to speed up the time and reduce the cost of moving goods, vehicles and people across borders.

In terms of developmental agencies, several multilateral and bilateral organizations have been active in various Asian sub-regions for decades. For example, in Central Asia, the Asian Development Bank has worked with CAREC for over 20 years. The European Bank for Reconstruction and Development (EBRD) also led projects in the region, with a focus on Kazakhstan. Both ADB and EBRD have also supported railway modernization in Uzbekistan through four loans. In addition, the Japan International Cooperation Agency (JICA) has provided upgrading support for the 200km railway line in Uzbekistan, between Tashguzar and Kumkurgan. A railway network in Kazakhstan was also improved through a JICA loan.

These initiatives create the conditions to improve infrastructure across these various trade links. AIIB can work with various regional initiatives to identify, prepare and finance projects that meet its thematic priorities.

3.3. Fast and reliable logistics transport networks required

With economic growth, GDP per capita across the region is expected to increase on average by three percent per annum from 2015 to 2030. Businesses and people are likely willing to pay more for efficient and sustainable transport solutions as value of time increases. Yet congestion over this period is likely to increase significantly due to the population increase and rapid urbanization. This would affect the performance of logistic networks, particularly in Central Asia, South-East Asia and Russia, which already lag developed nations.

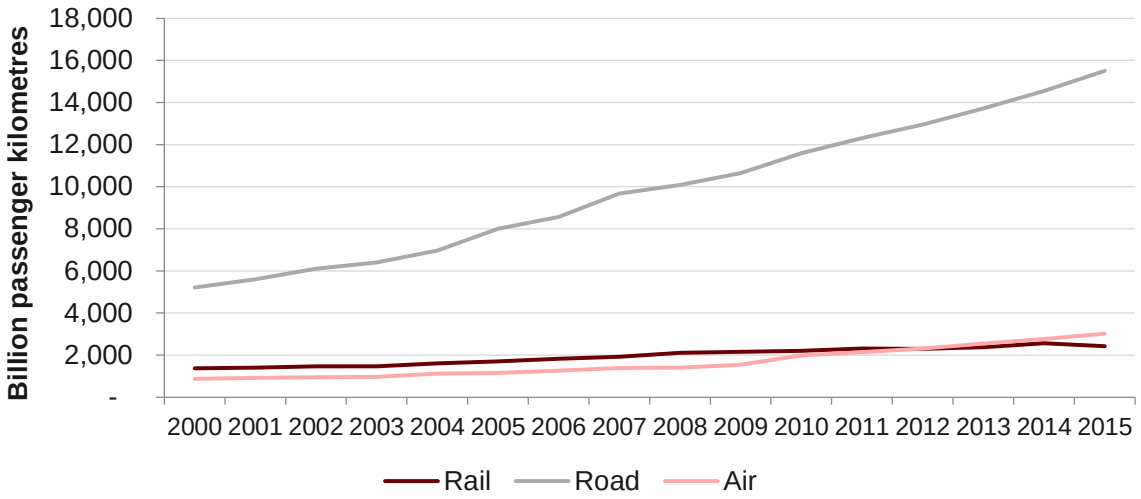
The rising prominence of ecommerce implies an increased need for efficient logistics network that can facilitate just-in-time delivery and effective last-mile transport. Traditional logistics chains that follow a sequential structure of manufacturer, large-scale transport, large centralized warehouses, regional distribution centers and physical stores are slow and require multiple inventories at various stages of the entire chain. These create multiple inefficiencies, including the operating costs of maintaining the various facilities and inventories.

Thus, an effective logistics network would require the integration of transport systems to reflect the physical internet. The physical internet is a concept of an open global logistics system founded on physical, digital and operational connectivity. This approach will rely on standardization of the parcels and the information attached to them. Eventually this can result in significantly reduced logistics costs and increased trade volumes, particularly between ports and their hinterland connectivity.

3.4. Road is the dominant passenger mode

The majority of passenger transport in the region is undertaken by road, as illustrated in Figure 9. Approximately 16 trillion passenger kilometers were undertaken by road in 2015, representing three quarters of all passenger transport across the region. The dominance of road transport is expected to continue, because while per capita car ownership has peaked in some developed countries, continued population and economic growth in developing economies are likely to bring more cars onto roads. To combat congestion and emissions that come about with road transport, many developed and developing economies are investing in public transport systems.

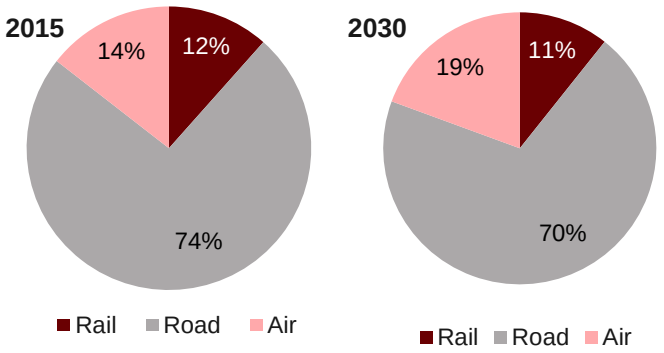
Figure 9 **Asia-Pacific Passenger Transport by Mode**



Source: ITF, World Bank, IMF, OECD

While road transport continues to be the dominant transport mode, long-distance travel is expected to be undertaken increasing by air transport, which has become more popular for the growing middle class. Liberalization of the aviation sector has not only enabled the supply of air services to match existing demand, but has also created new demand through lower prices and the operation of previously uneconomical routes. Air travel is anticipated to increase its market share (passenger-kilometers or pkm) to 19 percent by 2030 (Figure 10) from 14 percent today.

Figure 10 **Forecast Asia-Pacific Passenger Mode Share (Passenger Kilometers), 2015 to 2030**



Source: ITF, World Bank, IMF, OECD

3.5. Increasing urban densities is an opportunity for sustainable and accessible transport solutions

Current major cities (800,000 people or more) within the region are concentrated in East and South Asia as shown in Figure 11. Over the next ten years, the proportion of the population residing in urban areas is projected to increase across the region, particularly within Central and East Asia, as illustrated in Table 4. Continued population growth in these areas is likely to stress existing infrastructure, especially those at risk due to climate change or those that lack robust maintenance and modernization programs. However, the population growth also creates demand and thus opportunities for sustainable and adaptable transport solutions.

For example, densely populated corridors make HSR more economically viable (with lower relative carbon footprint). There will also be more opportunities to integrate transport infrastructure with industrial development, thereby bringing greater benefits to countries and people. There is also an opportunity to integrate inter-city transport with urban mobility solutions, bringing about modal switch and contributing to lower emissions.

Figure 11 **Major cities (800,000 people or more) by Sub-region**

Source: World Bank, each dot represents a major city.

Table 4 **Urban Populations**

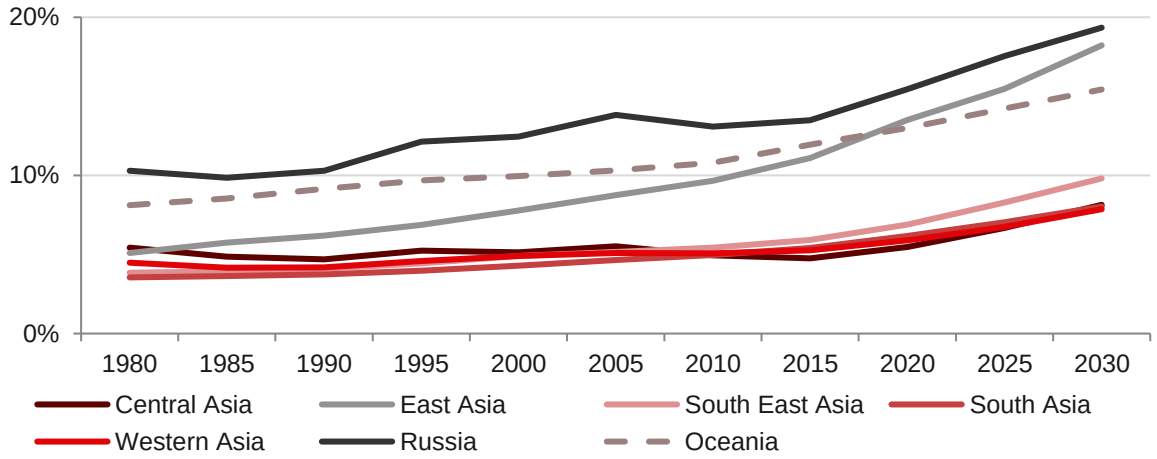
Key regions	Urban population 2017 (million)	Urban population 2017 (%)	Urban population 2030 (million)	Urban population 2030 (%)
Western Asia	190	70%	230	75%
Central Asia	30	40%	40	50%
Russia	110	75%	110	80%
South Asia	670	35%	890	40%
South East Asia	320	50%	410	55%
East Asia	990	60%	1,160	70%
Oceania	30	75%	30	65%
Total	**2,340**	**50%**	**2,870**	**55%**

Source: World Bank

Nevertheless, it has to be noted that some parts of Asia would also undergo significant demographic and social changes. In general, the Asia-Pacific can be divided into two groups: the more developed regions with higher proportions of the population aged over 65, and developing regions such as Western Asia, South Asia and Central Asia, with a lower proportion of population of over 65. East Asia is aging rapidly and is anticipated to transition from very low to very high rates of over 65s by 2030 (

Figure 12).

Figure 12 **Proportion of the Population Aged 65 and Over**



Source: World Bank

The implications of aging societies would depend on factors including location, pre-existing accessibility levels and average physical capacities, health and income of the aged consumers. While overall demand for transport services may decrease with age, the diversity of demand within the population would increase. Transport infrastructure must be accessible, flexible and adaptable to an aging population. This is especially important in urban transport.

Improved transport would also complement efforts to increase participation rates of women in the labor force. In 2014, G20 leaders made a commitment to reduce the gap in participation rates between men and women by 25% by the year 2025. Based on estimates by the International Labor Organization (ILO), the current gap varies across Asia, with Eastern Asia doing better than the world average, while Southern Asia sees a gap of more than 50 percentage points between the male and female labor force participation (see Table 5).

Table 5 **Gender gaps in labor force participation and potential impact of closing these gaps**

Country/Region	2017 Projections			25% Gap Reduction by 2025		
	Labor Force Participation			Additional Labor Force	Additional GDP	
	Men (%)	Women (%)	Gap (Percentage Points)	Millions	%	US$ Billions, PPP
World	76.1	49.4	26.7	203.9	3.9	5,767
East Asia	76.8	61.3	15.5	27.3	2.5	425
Southeast Asia and Pacific	81.2	58.8	22.4	15.9	3.5	1,838
Southern Asia	79.4	28.6	50.8	92.7	9.2	406
Central and Western Asia	73.5	29.4	29.4	5.3	5.7	216

Source: International Labor Organization

More than simply providing access to labor markets, transportation infrastructure allows women to concurrently attain employment, while accessing markets, information, education and health services, and fulfilling the caretaking and household responsibilities.[6]

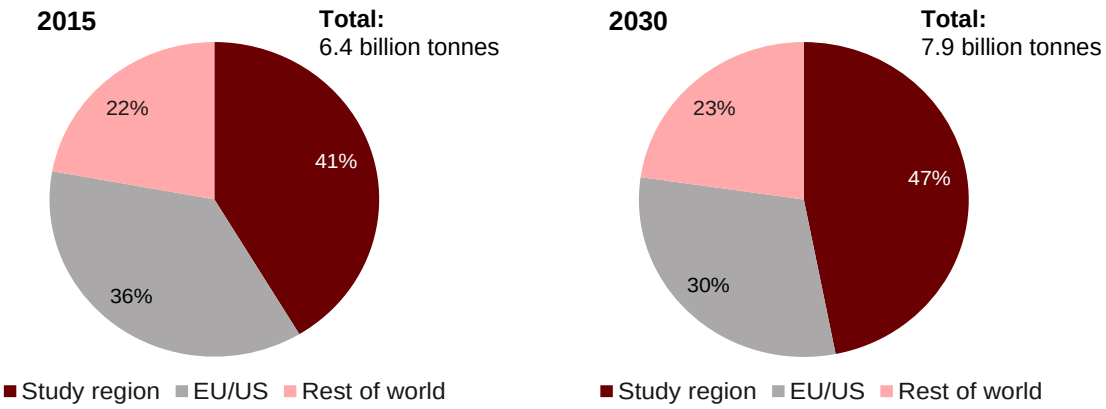
Given these social changes, new approaches to planning, designing and constructing transport infrastructure systems are required.

In addition, urbanization, shifts in global supply chains, and future transport technologies such as autonomous delivery will all impact the demand and use of transport infrastructure. As workplace, jobs and lifestyles continue to evolve, trips are expected to become less homogenous and predictable. The transport infrastructure needs to be inclusive amidst these changes, and encourage more social well-being, cohesion, while remaining safe and accessible.

3.6. Future investment must curb carbon emissions

The region generated 2.6 billion tonnes of domestic transport emissions in 2014 (41 percent of global domestic transport emissions), and is expected to increase its domestic transport emissions to 3.7 billion tonnes by 2030 and contribute to 47 percent of total transport emissions (see Figure 13). This comes at a time when only minimal growth is expected in domestic transport emissions in U.S. and Europe.

Figure 13 Forecast Global Transport Emissions, 2015 to 2030



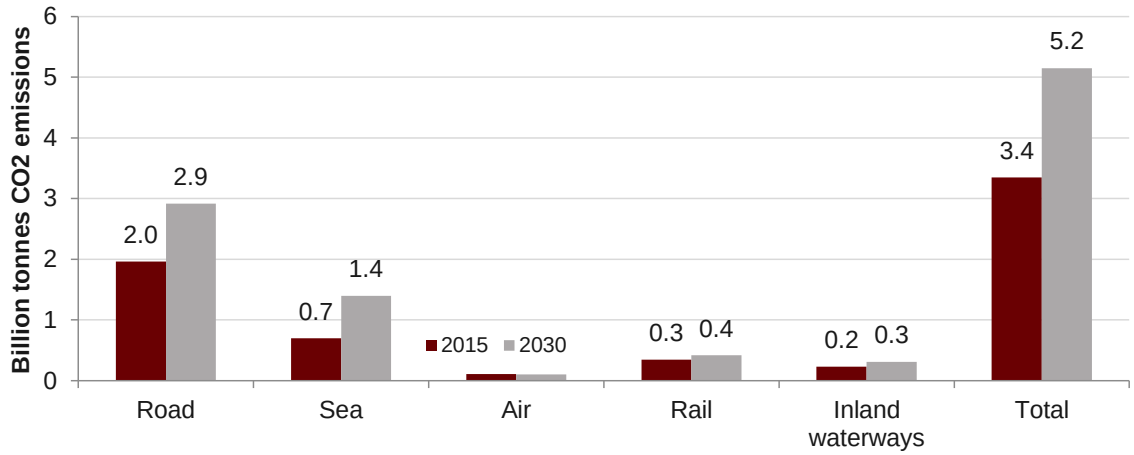
Source: International Energy Agency, U.S. Energy Information Administration

However, as Asia-Pacific experiences rapid economic growth, an emerging middle class throughout parts of developing Asia seeks lower pollution to attain higher levels of livability. This requires consideration for the environmental impact of transport infrastructure investments.

The aviation sector has traditionally been the largest emitter of all modes on a per unit basis. Air travel accounted for less than 0.5 percent of freight transported in the Asia-Pacific, but it generated seven percent of all freight emissions. On the other hand, sea freight comprised three quarters of freight transported in the Asia-Pacific in 2015 but accounted for less than half of total freight related emissions (see Figure 14).

[6] See ADB (2016), 'Female Labor Force participation in Asia – Constraints and Challenges'

Figure 14 **Estimated Domestic and International Freight Transport Emissions by Mode in the Asia-Pacific**



Source: Various sources, AECOM analysis

Thus, within a certain travel distance (e.g. 1000 kilometers), where population densities make it economically viable, rail and high-speed rail (HSR) transport would be preferred over aviation projects due to relatively lower carbon emissions per passenger kilometer. Modernization of existing rail infrastructure, especially on corridors with high passenger volumes, can help minimize emissions. On the other hand, aviation infrastructure should be supported where economics and geographies make it more feasible and effective. Furthermore, technology, including the use of greener fuels, has continuously made air travel less carbon intensive. For instance, although air travel is currently the highest per passenger kilometer emitter in the transport sector, yet its efficiency has improved by more than 20 percent between 2001 and 2011. The ITF also anticipates a further 30 percent improvement between 2015 and 2030.

Where road projects are concerned, it should be recognized that these are the most urgent needs for developing countries to create market access for the population. To balance out the environmental considerations, externalities should be priced in, and there should be long term plans to encourage greener transport modes and technologies. For instance, several cities have reduced car use by limiting vehicle access. Countries in Europe and China have also announced their intention to ban fossil fuel car production within the next 20-30 years. Public transport solutions, especially urban rail systems, as well as driverless vehicles and sharing technologies are also efficient alternatives to cars and trucks and are also being encouraged in major cities to improve transport capacity and address congestion and pollution issues.

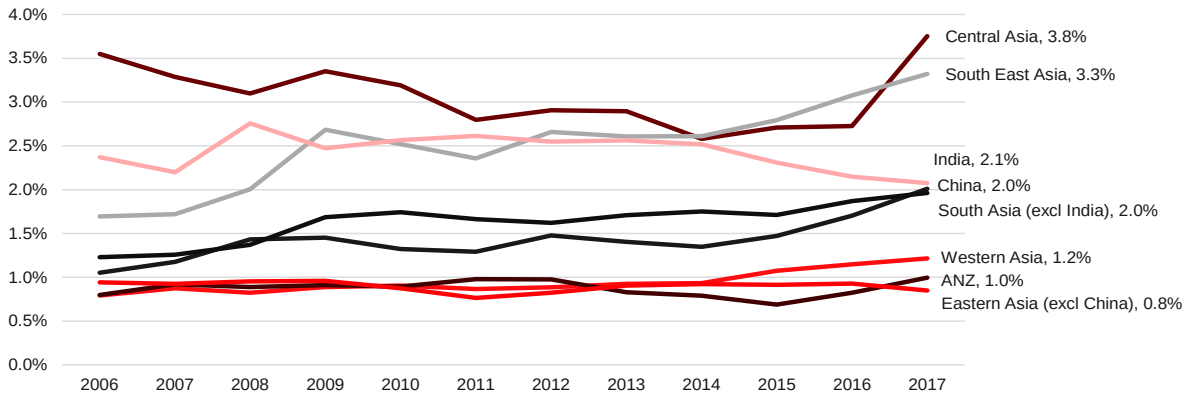
3.7. Rapid technological change and the rise of alternative transport solutions

Development of new technologies and alternatives to existing transport systems can be costly and time consuming. While infrastructure in Asia is currently largely funded by the public sector[7] (see Figure 15), private sector capital has the potential to accelerate investments. However private sector involvement invariably requires more certainty on returns, higher quality as well as broader government planning and project preparation processes.

[7] Oliver Wyman estimates that the public sector currently funds 90 percent of infrastructure development in the region.

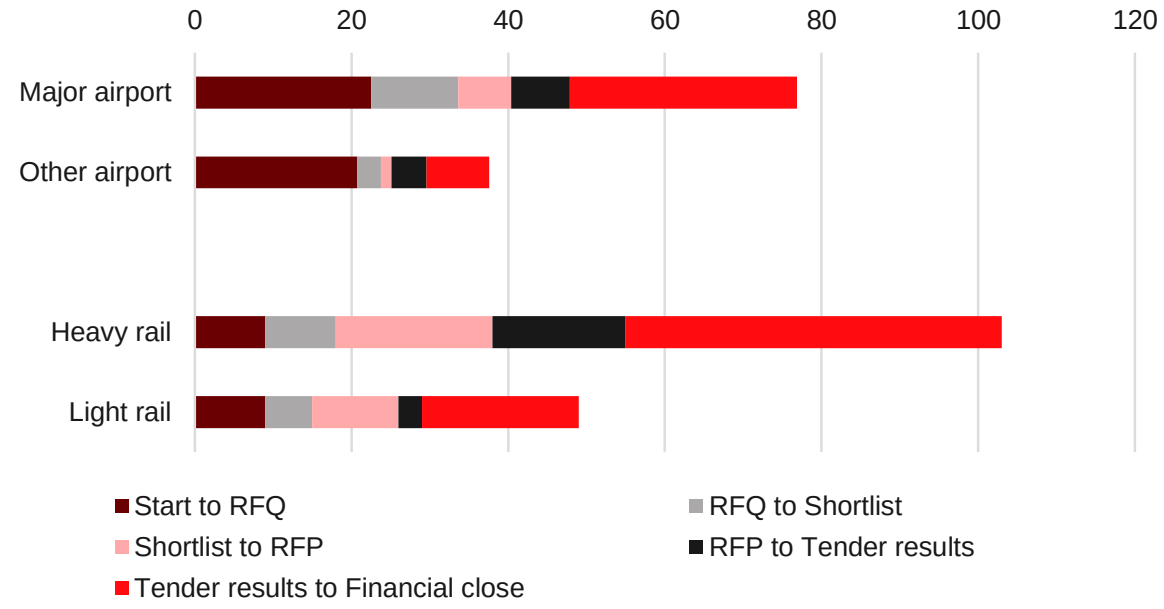
As project timelines usually exceed political cycles, private investors are wary of long project delays or lack of implementation. As such, effective leadership and governance structures are crucial to keep projects going through political transitions (see Figure 16). PPPs require comprehensive preparation, strong governance frameworks and complex commercial models that allow for transfer of political risks away from investors.

Figure 15 **Public Investment as Percentage of GDP on Road and Rail Infrastructure Across the Asia-Pacific**



Source: CIC

Figure 16 **Project Preparation Timeframes (Months)**



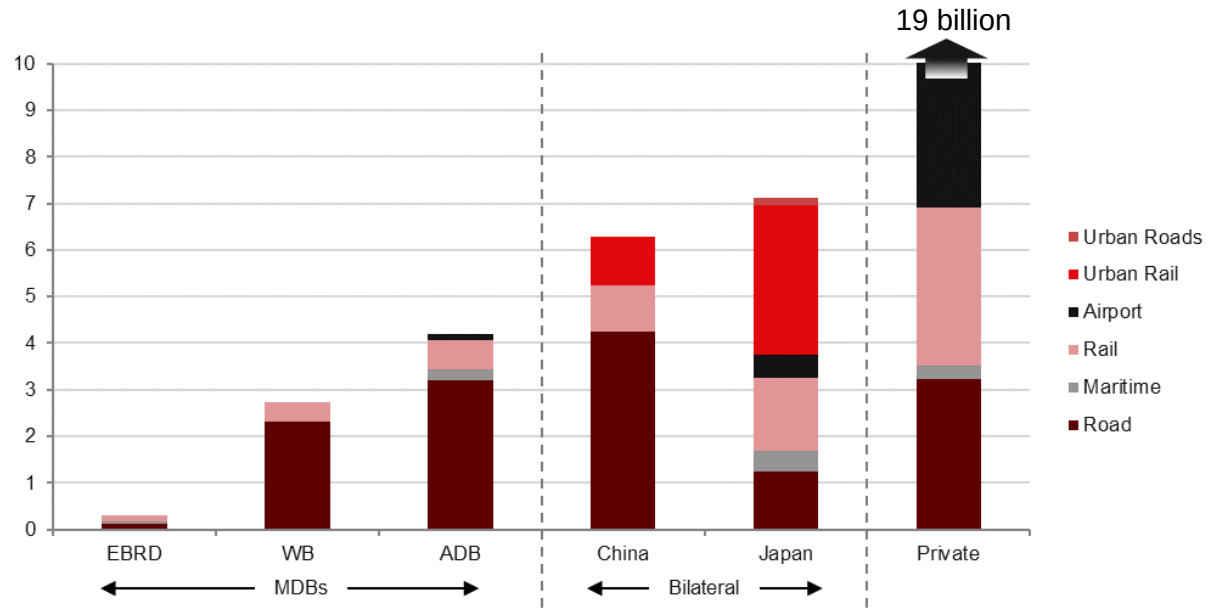
Source: AECOM analysis

3.8. Non-government investors focus on road and rail

Multilateral development banks (MDBs) provide finance to the tune of US$20-25 billion per year across the Asia-Pacific, as shown in

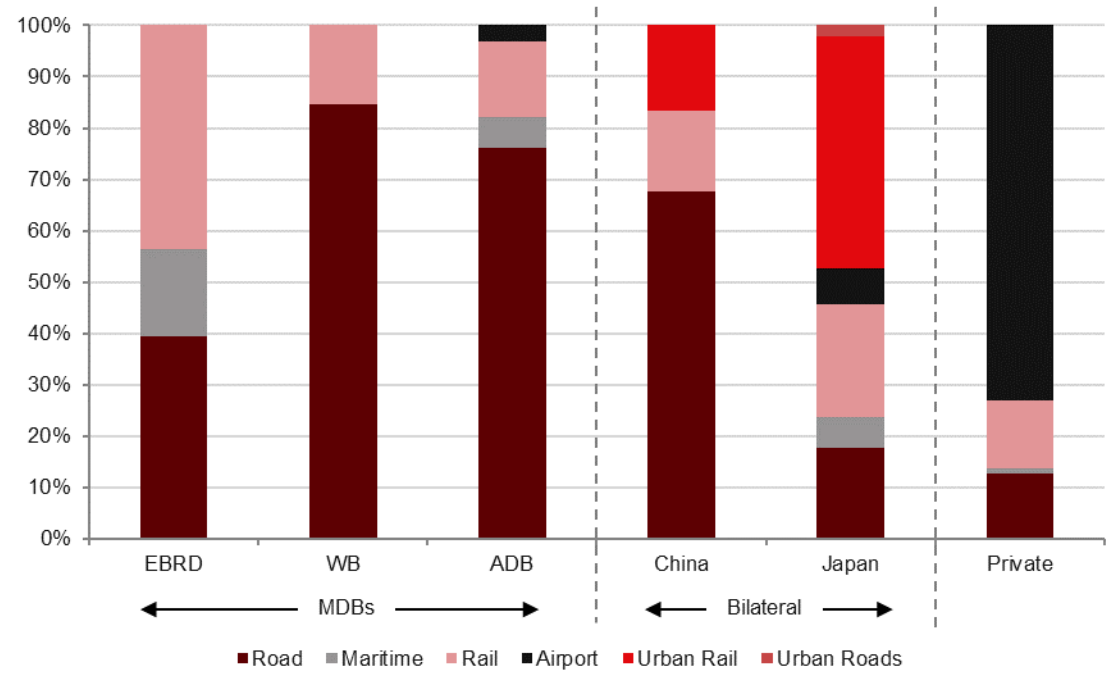
Figure 17. MDBs generally have a different focus compared to bilateral developmental agencies and the private sector. For example, the ADB and WB have traditionally focused on roads. In contrast, loans by Japanese developmental agency, JICA, have traditionally focused on rail, while Chinese developmental agencies (including China Development Bank and China Export and Import Bank) have focused on both road and urban rail. Meanwhile, the private sector has focused more on airports relative to road and rail.

Figure 17 **2015-2016 Infrastructure Loans to the Region (US$ billion, 2015 dollars)**



Source: World Bank, ADB, JICA and EBRD

Figure 18 **2015-2016 Loans Split by Sub-sectors**



Source: World Bank, ADB, JICA and EBRD

3.9. Private investments participated mainly in roads and airports projects

World Bank's Private Participation in Infrastructure (PPI) dataset provides investment commitments involving the private sector in low and middle-income countries. From the data, it can be seen that for transport infrastructure, private investments flowed mainly to roads and airport sub-sectors (see Table 6). In addition, airport projects have seen a significant increase in private sector participation in the past 5 years, while ports have seen a decline both in terms of investment value as well as share of investment.

Table 6 **Private Sector Participation in Transport Infrastructure in AIIB's Low and Middle-Income Countries**

Sub-sector	Investment USD million (2012-2016)	Share	Project Count	Investment USD million (2007-2011)	Share	Project Count
Airports	67,617	35%	27	7,665	7%	30
Ports	6,311	3%	41	19,629	18%	73
Railways	34,877	18%	18	16,050	15%	21
Roads	84,222	44%	173	64,459	60%	232
Grand Total	**193,026**	**100%**	**259**	**107,803**	**100%**	**356**

Source: World Bank

4.0 Transport Infrastructure Investment Needs

The existing infrastructure stock per capita by region is presented in Table 7.

Table 7 Asia-Pacific Transport Infrastructure Stock in 2015

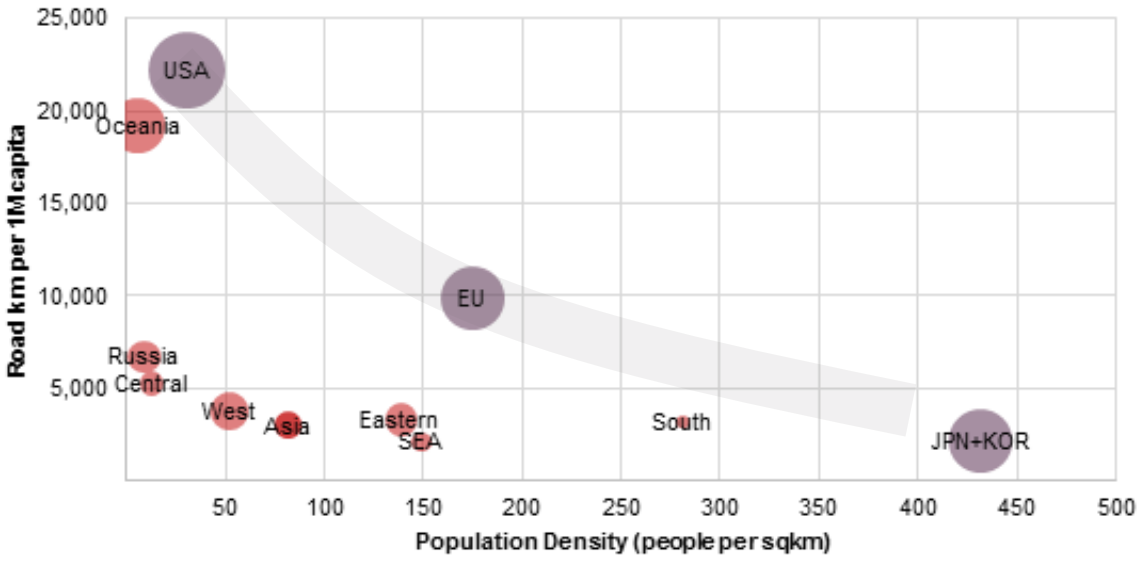
Key regions	Population (million)	GDP per capita	Infrastructure per 1 million capita				
			Road km	Rail km	TEUs	Air pax	HSR km
Western Asia	250	14,000	3,800	90	190,000	1,100,000	5
Central Asia	50	6,000	5,300	465	-	200,000	5
Russia	150	11,000	6,700	570	30,000	510,000	10
South Asia	1,800	2,000	3,200	50	10,000	80,000	-
South East Asia	650	4,000	2,100	25	140,000	460,000	-
East Asia	1,600	11,000	3,300	60	160,000	410,000	20
Oceania	50	30,000	19,200	195	230,000	1,800,000	-
Total/Average	**4,550**	**7,000**	**3,000**	**75**	**90,000**	**340,000**	**10**

Source: World Bank

4.1. Roads

Road infrastructure in the Asia-Pacific had lagged developed regions such as the U.S. and Europe on a per capita basis, even after adjusting for differences in population densities. Density appeared to influence road provision in developed countries as shown in Figure 19, suggesting that regions such as South Asia would stand to benefit from investment in high capacity transit modes.

Figure 19 Asia-Pacific Road Infrastructure km per 1 Million Capita in 2015

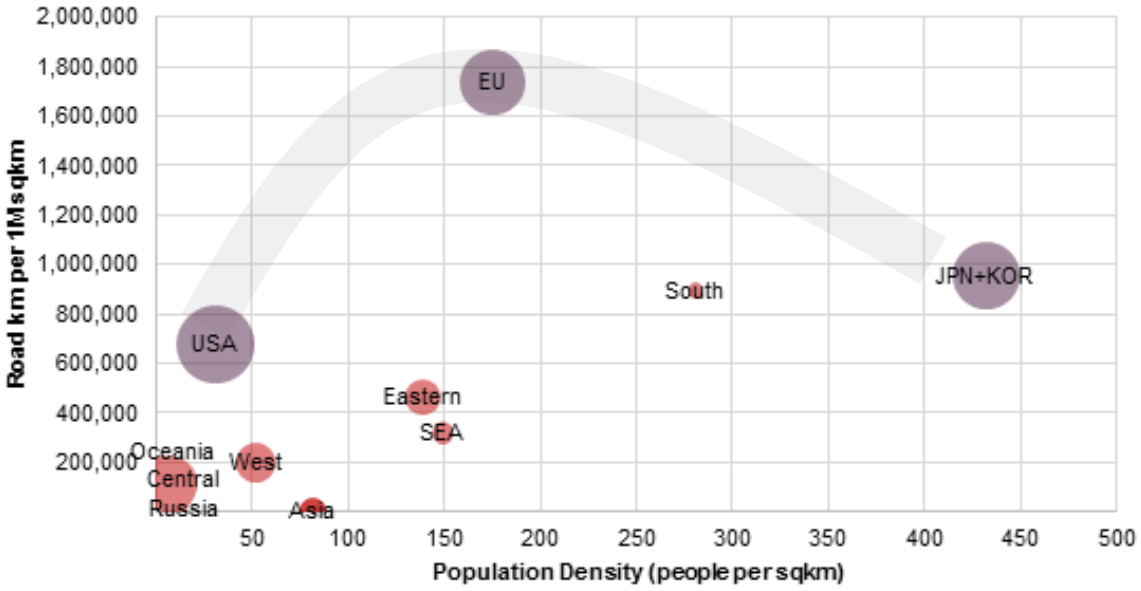


Bubble size represents GDP per capita

Source: World Bank, AECOM analysis

Similar gaps in the provision of road infrastructure between developed comparators and the region were present when provision was measured on a per square kilometre basis. Although the provision of road infrastructure was similar to the U.S. when measured relative to total land size, the gap to Europe was further exacerbated.

Figure 20 **Asia-Pacific Road Infrastructure per Square Kilometre in 2015**



Bubble size represents GDP per capita
Source: World Bank, AECOM analysis

Roads are expected to continue to support most freight and passenger traffic in the foreseeable future (see Table 8) and the development of an Asia-wide expressway network is essential to link markets together efficiently. A core network of toll roads is preferred as the revenue gained would allow the relevant countries to fund maintenance, essential especially since the roads are likely be heavily used by trucks. Tolls can also internalize the costs of the negative externalities associated with road transport.

Table 8 **Road Infrastructure and Investment Forecast**

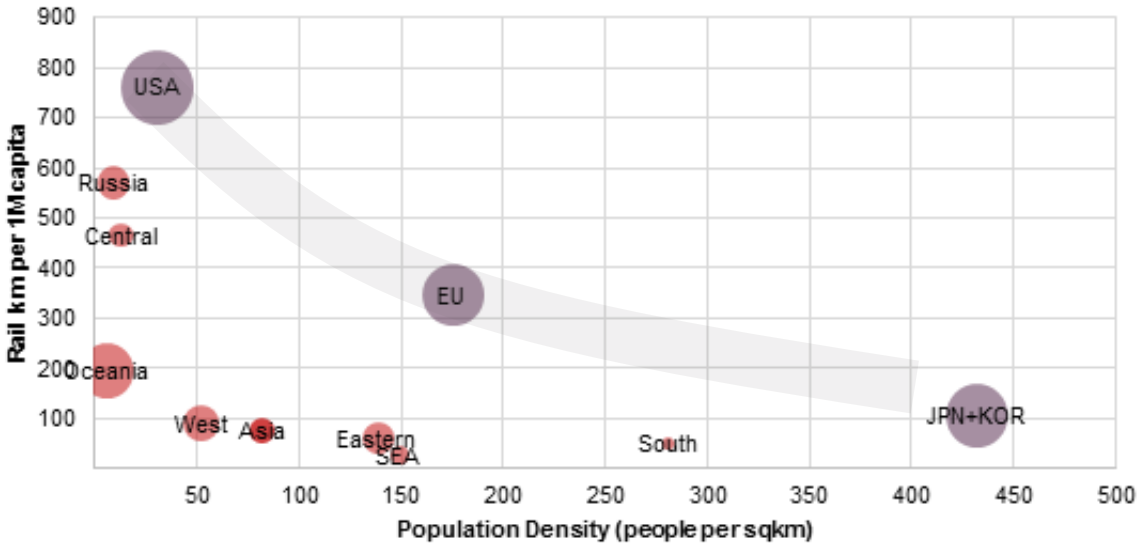
Key regions	Road km 2017	Road km 2030	Motorway km 2017	Motorway km 2030	Cost p.a. (US$ million, 2017 dollars)	Cost p.a. (% of GDP)
Western Asia	1,000,000	1,100,000	15,000	18,000	29,300	1.0%
Central Asia	300,000	300,000	4,000	4,000	4,400	1.6%
Russia	1,000,000	1,100,000	4,000	11,000	19,400	1.3%
South Asia	6,000,000	7,700,000	17,000	37,000	201,500	5.7%
South East Asia	1,400,000	1,800,000	10,000	16,000	48,200	1.8%
East Asia	5,700,000	7,900,000	152,000	214,000	274,500	1.5%
Oceania	1,000,000	1,000,000	6,000	10,000	17,100	1.0%
Total	**16,400,000**	**20,900,000**	**208,000**	**310,000**	**594,400**	**1.9%**

Source: AECOM estimates, based on projections from historical trends between length of rail network and development in each region

4.2. Rail

Rail infrastructure provision varied significantly across the region. Considerable investment in rail would be required in Oceania, West, East and South-East Asia to bring these regions in line with the benchmark comparator group of the U.S., EU and Japan/South Korea (see Figure 21). In particular, India would need refurbishment expenditure to maintain the rail network given its extremely high rail intensity in passenger kilometer per track. This is likely to require substantial investments in network and rolling stock upgrades over time.

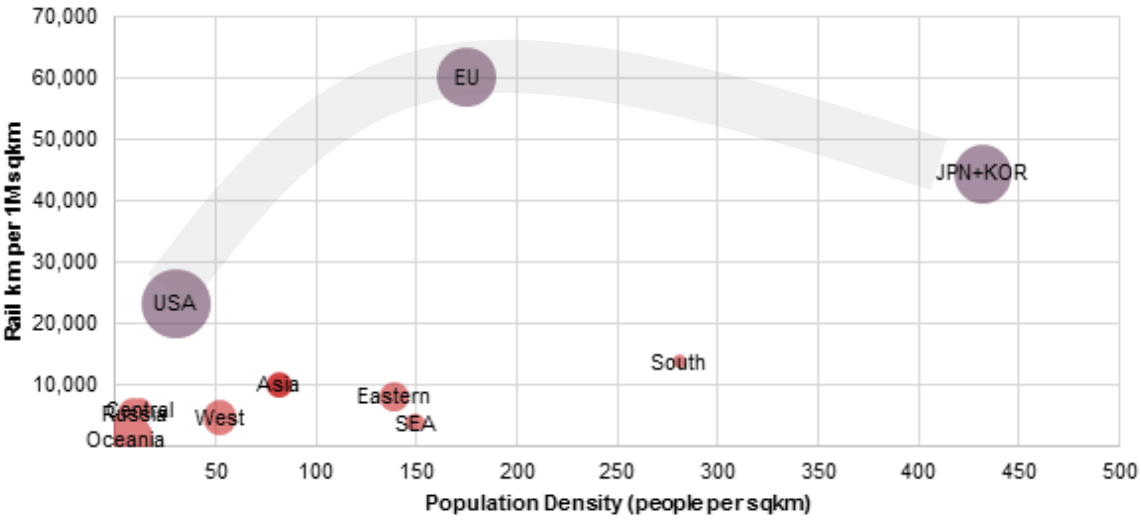
Figure 21 Rail Infrastructure per 1 Million Capita in 2015



Bubble size represents GDP per capita
Source: World Bank, AECOM analysis

Figure 22 shows that as population density increased, the provision of rail infrastructure on a per square kilometre basis also increased slightly across the region. However, rail infrastructure still lagged the developed country comparator group.

Figure 22 Rail Infrastructure per Square Kilometre as at 2015



Bubble size represents GDP per capita
Source: World Bank, AECOM analysis

Efficient urban transit systems are essential at both ends of any intercity transit system. The most common transit networks in the developed world had been mass rapid transit, suburban rail around cities and regional rail. High level estimates of rail infrastructure needs are shown below in Table 9.

Table 9 Rail Infrastructure and Investment Forecast

Key regions	Rail km, 2017	Increment to 2030 (km)	Cost p.a. (US$ million, 2017 dollars)
Western Asia	22,400	1,300	900
Central Asia	23,300	200	800
Russia	86,100	2,000	3,100
South Asia	90,200	9,700	4,300
South East Asia	16,900	1,500	800
East Asia	94,400	5,700	3,900
Oceania	9,800	100	300
Total	**343,100**	**20,500**	**14,100**

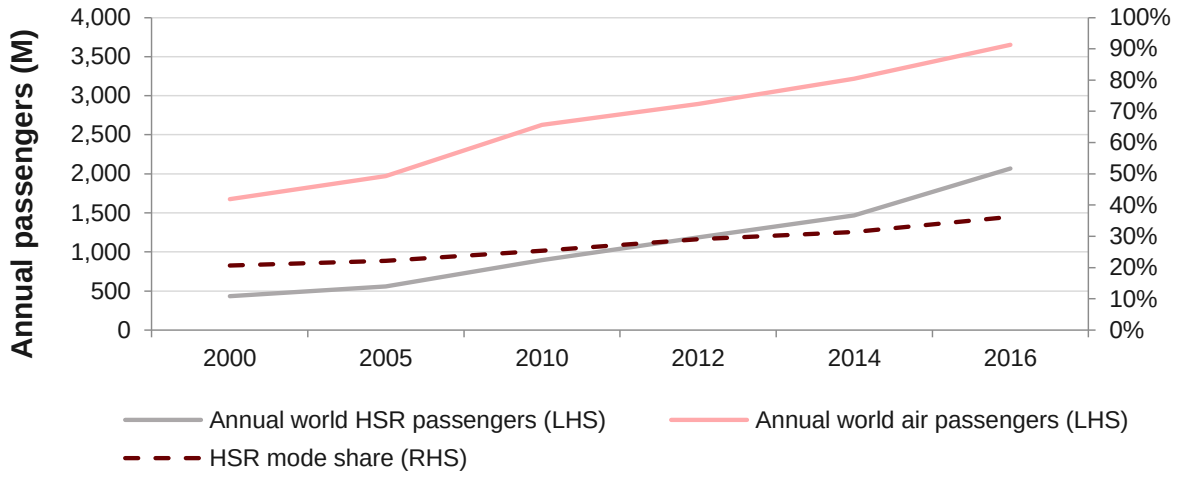
Source: AECOM estimates, based on extrapolation of historical trends between length of rail network and development in each region

4.3. High speed rail

The study defines high speed rail (HSR) as dedicated lines allowing speeds equal to or greater than 250km/h, or upgraded lines capable of speeds of about 200km/h, or upgraded lines with HSR features on which speeds are adapted to topographical, relief, or zoning constraints

While HSR technology had long been limited to Japan and a few European countries, the international network had grown significantly since 2000, primarily driven by the expansion of China's network. As illustrated below, HSR's mode share relative to air travel increased by approximately 15 percent between 2000 and 2016.

Figure 23 Annual Passengers by Air and HSR Worldwide (millions)

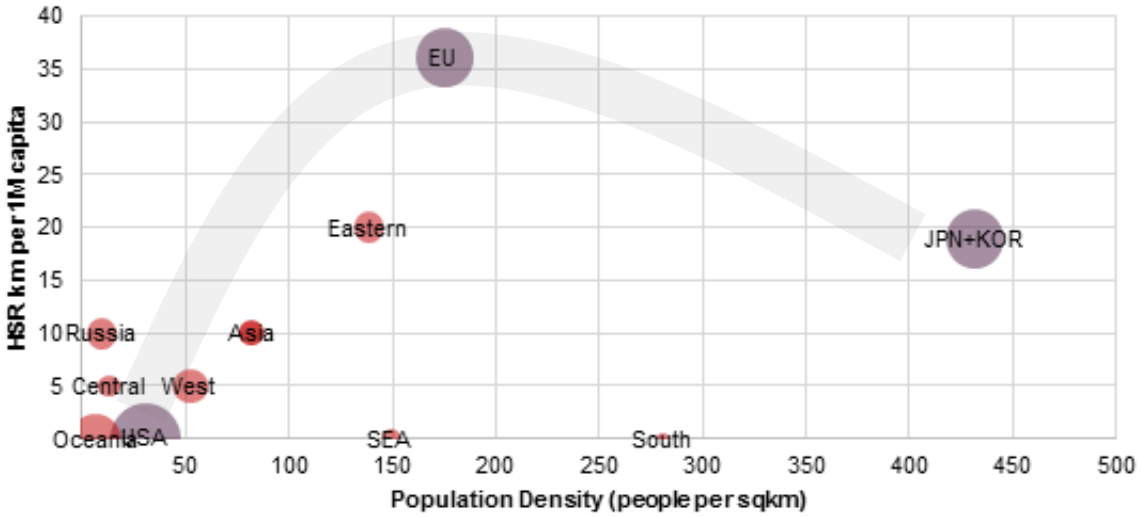


Source: World Bank, AECOM analysis

Recovery of capital costs is a key issue in the development of HSR networks, as illustrated by the financial troubles of Eurostar and Taiwan HSR. HSR networks need to attract sufficient ridership and generate required revenue for long-term sustainability. This requires large (and dense) cities at the optimal separation distances, the ability to set fares at market levels, and integration between cross-border HSR systems to efficient urban transit systems.

Substantial population clusters located within 250-600km of each other are crucial for HSR travel to be competitive against air transport. Figure 24 demonstrates the relationship between population density and the prevalence of HSRs in developed countries. This distance results in travel times of between one to three hours, low enough to encourage considerable mode share transfer from aviation, which requires sometimes lengthy transfers from airport infrastructures located outside the central business districts (CBD) to final destinations. As at 2015, the less populated regions of Russia, Central Asia and Oceania had less substantial HSR networks in comparison to Eastern Asia, Japan (JPN) and Korea (KOR).

Figure 24 Population Densities and HSR in 2015



Bubble size represents GDP per capita.
Source: World Bank, AECOM analysis

For the purpose of evaluating investment needs, it is assumed that 600km is the threshold separation distance for HSR viability and that high-speed transit would be built once domestic MRT systems are built to feed into HSR nodes. Forecasts of HSR infrastructure investment are presented in Table 10. A lag of five years was assumed due to the requirement of building MRT lines first.

Table 10 HSR Infrastructure and Investment Forecast

Key regions	HSR km, 2017	Increment to 2030 (km)	Cost p.a. (US$ million, 2017 dollars)	Cost p.a. (% of GDP)
Western Asia	3,500	3,000	10,500	0.3%
Central Asia	400	50	400	0.1%
Russia	2,400	1,400	5,400	0.3%
South Asia	1,400	10,000	26,800	0.7%
South East Asia	1,200	3,100	9,200	0.3%

Key regions	HSR km, 2017	Increment to 2030 (km)	Cost p.a. (US$ million, 2017 dollars)	Cost p.a. (% of GDP)
East Asia	29,500	1,750	22,600	0.1%
Oceania	-	-	-	0.0%
Total	**38,400**	**19,300**	**74,900**	**0.2%**

Source: AECOM estimates, based on projections from historical trends between length of rail network and development in each region

Box 1: HSR development must be balanced against shorter term investments

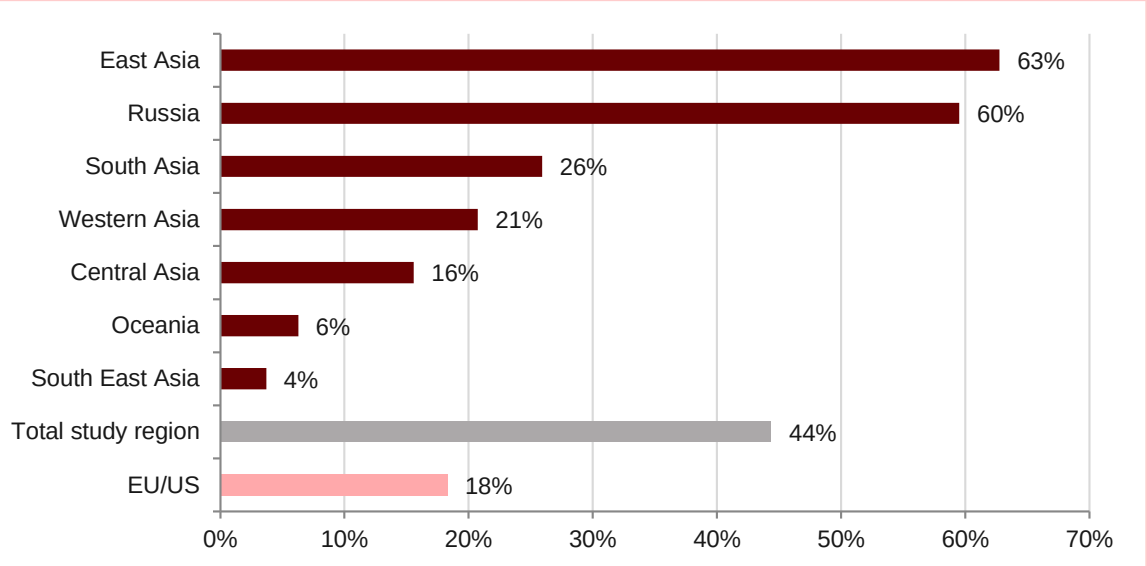
The decision to develop an HSR network instead of further electrification of the existing rail network needs to be made at a corridor level on an individual project basis. In the shorter term, electrification of the most highly utilised routes and procurement of improved rolling stock are likely to provide greater benefit than the development of HSR networks.

In general, electrification should be preferred over a new corridor if there is sufficient passenger demand and network speeds allow good connectivity between locations. Across the region, the focus of network electrification should be within areas outside major cities. Many of these locations suffer from inferior rolling stock and route networks.

South East Asia has a particularly low rate of rail electrification. Decentralized government decision-making across South East Asia has made it difficult to construct and maintain large scale modern rail infrastructure, and this is often raised as a key factor behind underdeveloped transport infrastructure across the region. However, cooperation has been improving under the 'ASEAN Master Plan on Connectivity' and the 'One Belt One Road' initiative, with more than 40,000km of modern rail infrastructure now planned or under construction.

In general, electrification of rail networks in the region compared well to the U.S. and Europe as at 2017 as shown in Figure 25. However, this result was driven by China and Russia. Much of the rail network in other developing areas with Asia-Pacific requires further electrification.

Figure 25 Electrified Proportion of Rail Network

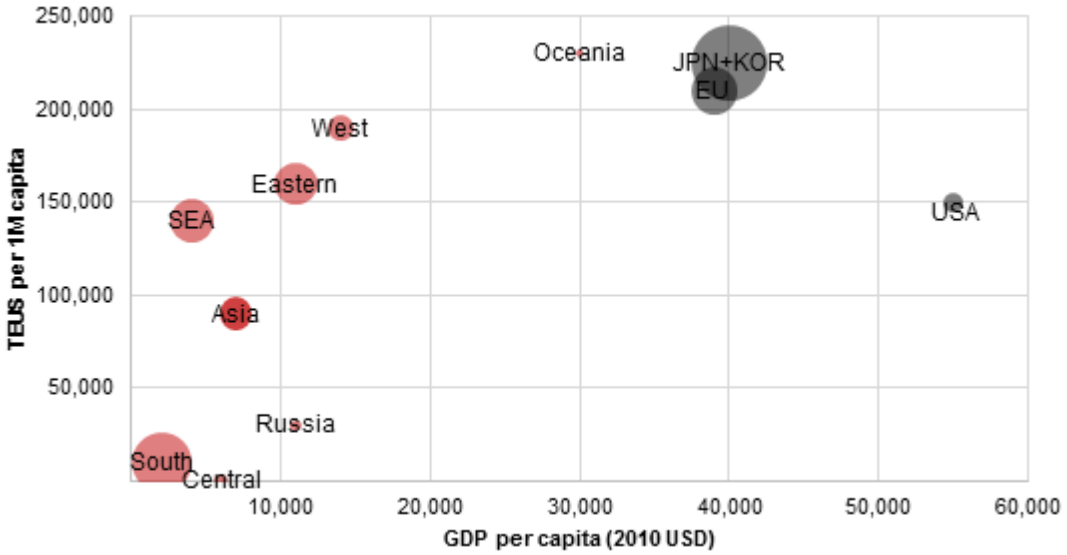


Source: Various sources, AECOM analysis

4.4. Ports

Asia's growth over the past decade had transformed the region into a collection of trade centers which rival North America and Europe. With strong support from governments, the container throughput per capita in 2015 was close to higher than more developed regions. One exception was South Asia where trade as a percentage of GDP is still relatively low, as shown in Figure 26. This indicates a potential growth area as the economies develop. For Central Asia (and to a certain extent Russia), trade has depended more on inland transport as these are landlocked countries.

Figure 26 Trade via Port and GDP in 2015



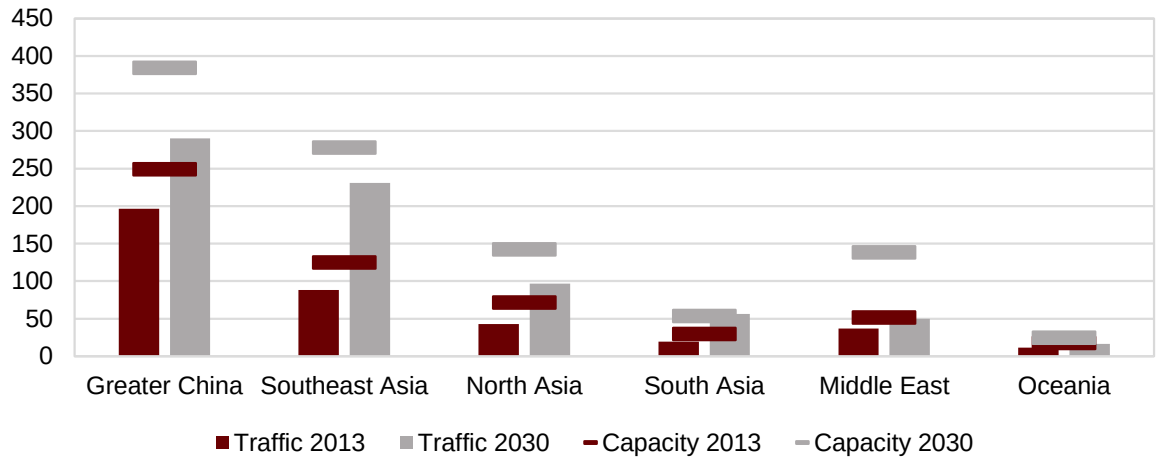
Bubble size represents GDP per capita.
Source: World Bank, AECOM analysis

An International Trade Foundation (ITF) assessment of existing port volumes against capacity expansions showed that ports should be able to accommodate the projected container volumes, except in South Asia (see

Figure 27). On the other hand, overcapacity is projected for the Middle-East.

Despite the apparent port capacity available across much of the region, congestion and access to ports is an important issue. The ITF projected that in 2017, capacity requirements would be highest within 50km of key trade centers and ports. In Asia, surface freight requirements are projected to be 40 percent higher than today's capacity but this increase is 70 percent around ports and key trade centers. Most international freight transport generally involve intermodal transshipment and storage activities at logistic hubs such as terminals or distribution centers located near to ports. Optimizing their locations and connections to ports could thus reduce the time and cost of hinterland freight movements.

Figure 27 **Port Container Traffic and Capacity Projection (million TEUs)**



Source: ITF

Table 11 **Port Infrastructure and Investment Forecast**

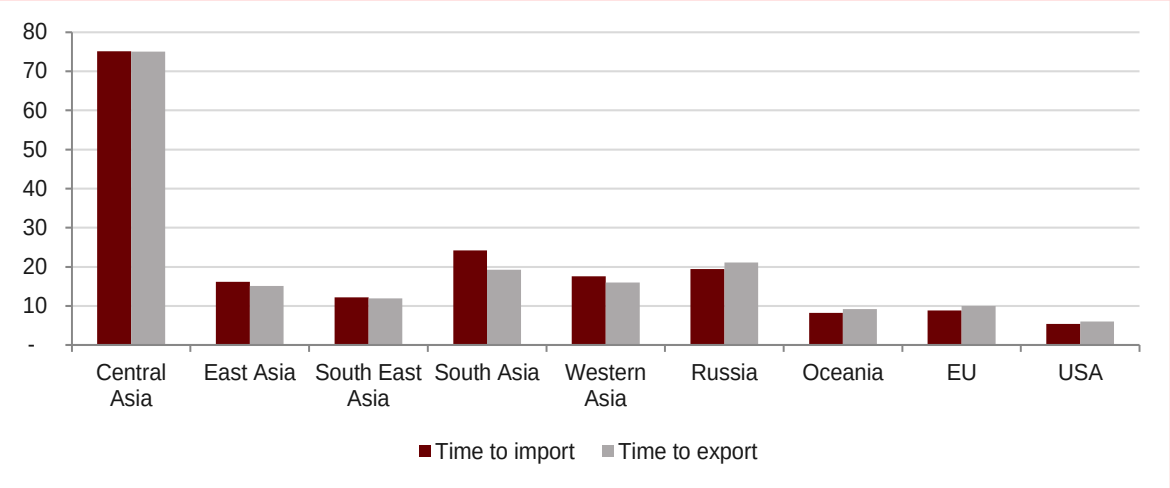
Key regions	TEUs 2017	Increment to 2030 (TEUs)	Cost p.a. (US$ million, 2017 dollars)	Cost p.a. (% of GDP)
Western Asia	51,000,000	24,000,000	1,800	0.1%
Central Asia	-	-	-	0.0%
Russia	4,000,000	3,000,000	200	0.0%
South Asia	28,000,000	32,000,000	1,900	0.1%
South East Asia	120,000,000	172,000,000	9,800	0.4%
East Asia	297,000,000	351,000,000	20,600	0.1%
Oceania	12,000,000	5,000,000	400	0.0%
Total	**512,000,000**	**587,000,000**	**34,700**	**0.1%**

Source: AECOM estimates, based on projections from historical trends between length of rail network and development in each region

Box 2: Central Asia requires an integrated approach

The time and cost to import and export goods were relatively consistent across the Asia-Pacific. With a trade time of 10-25 days, import and export time for the majority of the region was greater than the import/export times to Europe and the U.S. Nevertheless, the difference is not that large for most of the regions.

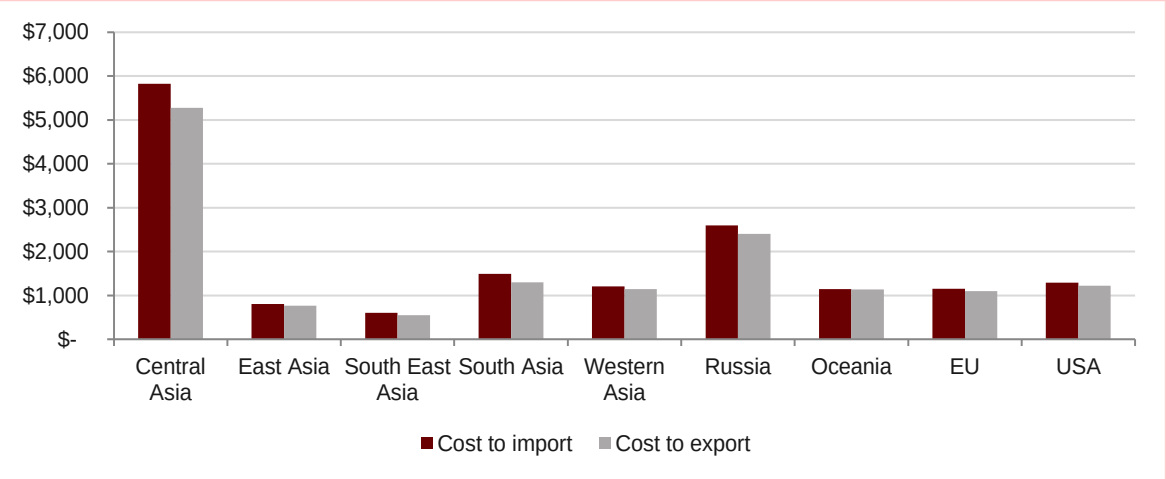
Figure 28 Time to Import and Export (days) by Region, 2014



Source: World Bank, AECOM analysis

Similarly, the cost to import/export goods was US$1,000 per container or less for most of the regions. This was consistent with import/export costs across Europe and the U.S., and include time and cost to transport goods between port and warehouse (assumed to be located in the largest city within country), complete all customs and border procedures and load/unload goods at the port.

Figure 29 Cost to Import and Export (US$ per container, 2014 dollars) by Region, 2014



Source: World Bank, AECOM analysis

However, import/export time and costs to landlocked Central Asia are significantly greater (and to a certain extent, Russia). At approximately 75 days and US$5,500 to import/export a container, trade access to Central Asia is limited. Trade to the region requires transport of goods through multiple transit countries, increasing time and cost.

This a core issue for both Asian and European markets as the region is the primary trade

corridor from Europe to China and the Middle East, and is also a source of significant energy exports to Europe. Four of the five Central Asian countries benefit from favourable access to the EU's market.

With reliance on multiple countries for freight to reach ports, improvements in one country alone will not improve overall trade flows in the region. A joint approach to infrastructure development and management, non-tariff measures, corridor management and border crossing procedures is required.

4.5. Airports

Demand for passenger air travel has increased significantly in high economic growth areas. Tourism in the region increased over five percent per annum over the last 10 years, and the International Air Transport Association (IATA) forecasts Chinese demand for air travel demand will exceed that of the U.S. by 2025 (Figure 30). Growth in demand is also expected to be very strong in South Asia. However, growth is projected to slow across most key markets between 2015 and 2030, compared to growth rates observed between 1970 and 2015, as shown in Table 12. Investment in airport infrastructure by region is presented in Table 13.

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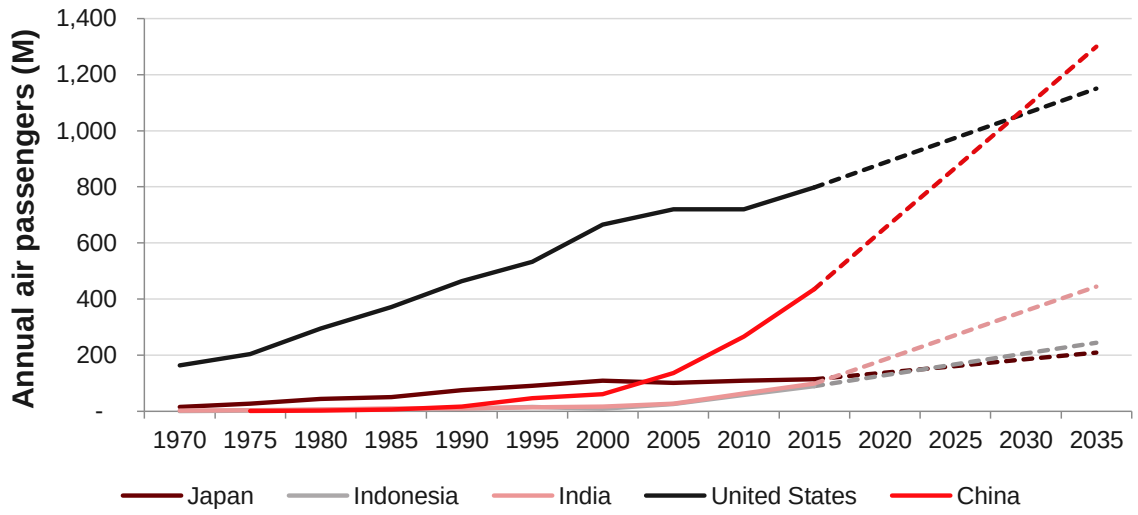
Figure 30 IATA Forecast of Annual Air Passengers, Selected Countries



Source: World Bank, IATA

Table 12 Compound Annual Passenger Volume Growth Rates

Key regions	1970-1985	1985-2000	2000-2015	2015-2030
Japan	7.9%	5.2%	0.3%	3.3%
Indonesia	14.7%	2.9%	15.8%	5.7%
India	9.9%	3.1%	12.3%	9.0%
United States	5.6%	4.0%	1.2%	1.9%
China	n.a.	15.3%	13.9%	6.3%
Total	**6.1%**	**4.5%**	**3.9%**	**4.3%**

Source: World Bank, IATA

Table 13 Airport Infrastructure and Investment Forecast

Key regions	Air pax, 2017 (million)	Increment to 2030 (million)	Cost p.a. (US$ million, 2017 dollars)	Cost p.a. (% of GDP)
Western Asia	290	100	2,100	0.1%
Central Asia	10	20	300	0.1%
Russia	75	10	300	0.0%
South Asia	160	220	3,800	0.1%
South East Asia	330	280	3,700	0.1%
East Asia	810	1,150	16,400	0.1%
Oceania	100	80	1,300	0.1%
Total	**1,775**	**1,860**	**27,900**	**0.1%**

Source: AECOM estimates, based on projections from historical trends between length of rail network and development in each region

4.6. Summary

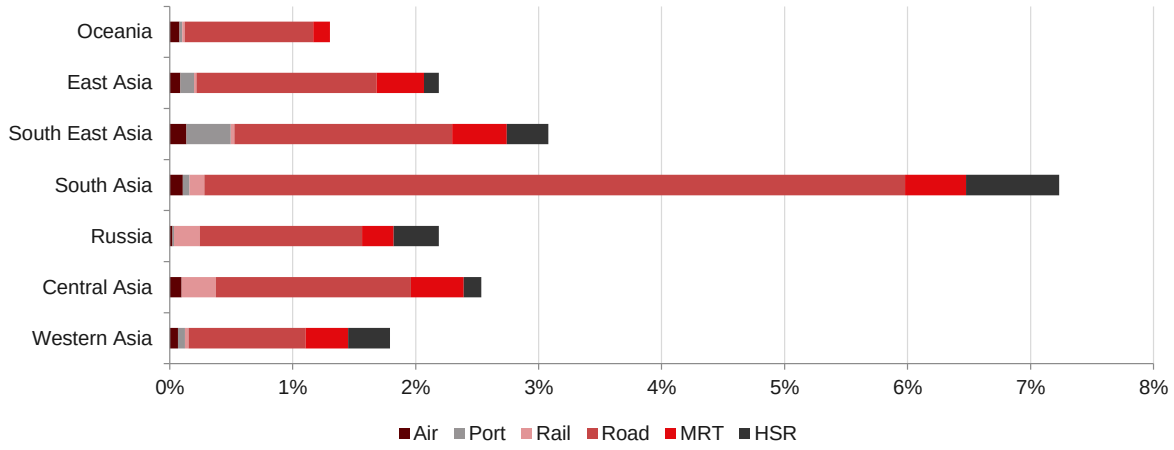
In order to address the infrastructure gaps of the Asia-Pacific it is estimated that more than $800 billion of annual investment is required to develop, maintain and refurbish transport infrastructure, equivalent to approximately three percent of GDP.

Table 14 Annual Investment Needs by Asset Class (US$ million, 2017 dollars)

Key regions	Air	Port	Rail	Road (incl. Motorway)	MRT	HSR	Total
Western Asia	2,100	1,800	900	29,300	10,600	10,500	55,200
Central Asia	300	-	800	4,400	1,200	400	7,100
Russia	300	200	3,100	19,400	3,800	5,400	32,100
South Asia	3,800	1,900	4,300	201,500	17,500	26,800	255,800
South East Asia	3,700	9,800	800	48,200	12,100	9,200	83,800
East Asia	16,400	20,600	3,900	274,500	72,400	22,600	410,400
Oceania	1,300	400	300	17,100	2,200	-	21,300
Total	**27,900**	**34,700**	**14,100**	**594,400**	**119,800**	**74,900**	**865,800**

Source: World Bank, AECOM estimate s. The investment needs of US$ 865.8 billion per annum is different from ADB's estimates due the following reasons: (i) estimates here include AIIB's regional members in Oceania and Russia; (iii) estimates here includes urban mass rapid transit (MRT) for completeness.

Figure 31 Annual Investment Needs by Asset Class as Percentage of GDP in 2017



Source: AECOM estimates

5.0 Investment Stakeholders

Sustaining an investment rate of more than US$ 800 billion a year is a substantial task, the difficulty of which is compounded by downturns in the global economic environment and investment challenges within the Asia-Pacific region specifically.

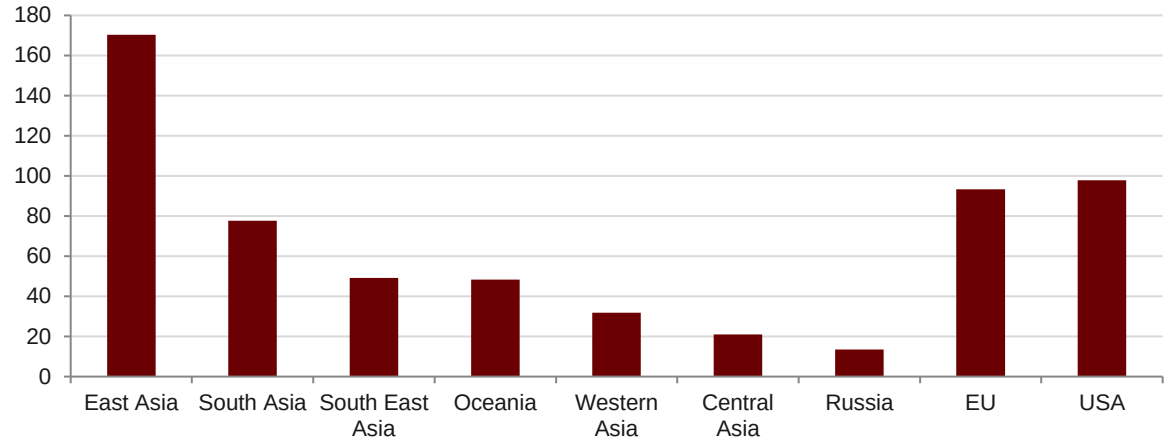
5.1. Public sector investment ability is constrained

In general, public debt levels across much of the Asia-Pacific compare favorably to that of Europe and the U.S. However, fiscal constraints to public investment exist to varying degrees across the region. While Russian public debt as a proportion of GDP was amongst the lowest in the world (approximately 15 percent in 2015), public debt in Eastern Asia was significant (Figure 32).

Following the global financial crisis in 2007-08, many governments took on more debt to spur economic recovery. Figure 33 illustrates this growth in public debt, from 82 percent of GDP across the region in 2008, to 108 percent by 2015. The strongest growth in debt was observed in East Asia, Oceania and South Asia

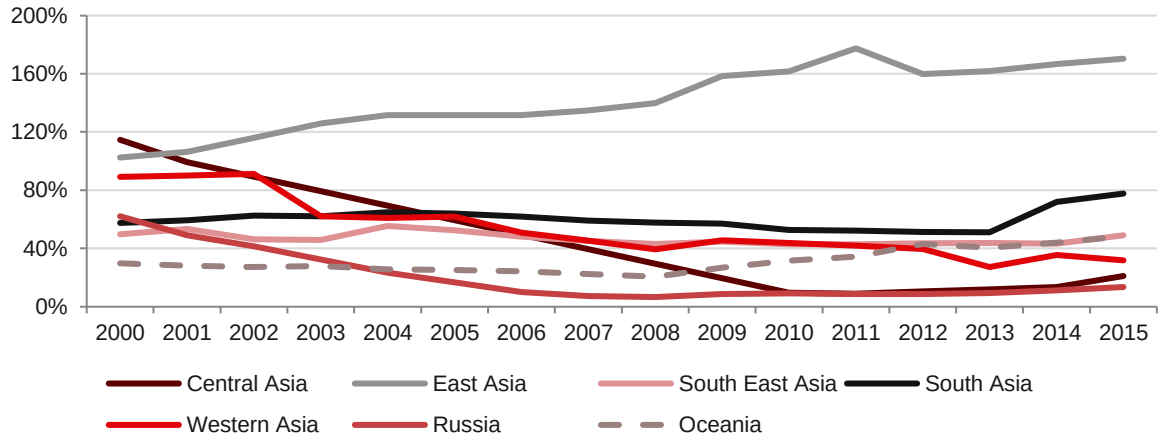
As a result, governments across the region have grown cautious recently about additional borrowing to fund infrastructure expenditure and are increasingly adopting alternative methods to finance transport infrastructure projects. These alternatives include value capture policies, congestion charging and transit-oriented developments.

Figure 32 Central Government Debt as a Percentage of GDP in 2015



Source: World Bank

Figure 33 Evolution of Central Government Debt as a Percentage of GDP in 2015



Source: World Bank

5.2. Regulatory reforms are required to encourage private investment

With the exceptions of Australia and New Zealand, infrastructure investment across the Asia-Pacific has historically been undertaken almost exclusively by central governments with little private sector involvement. As such, there had been limited need to create suitable business environments across Asia to encourage private sector investment.

More recently, infrastructure markets across Asia have become increasingly open to private investment. Public private partnerships (PPPs) can effectively provide necessary investment to deliver infrastructure projects, and this had led to significant growth in specialist infrastructure funds in the region.

Growth in the number and value of funds committed is expected to continue, as large international institutional investors become more prepared to invest in Asian infrastructure. As such, while developing economies in the region had already been required to implement regulatory reforms to encourage investment, a number of regulatory, political and institutional challenges remain for investors wishing to take advantage of the strong demand in the developing economies of Asia. Specifically, these include:

- **Resistance to foreign investment:** Some jurisdictions allow the government much discretion in selecting industries or projects for investment. Governments have the ability to restrict foreign investment not considered to be in its interest or which competes with state-owned enterprises or favored domestic companies.

- **Lack of transparency:** Law and policy can be formulated by governments internally with limited transparency, such that changes can be unpredictable and difficult to navigate.

- **Lengthy decision-making processes:** Working through government decision-making can result in delays and cost overruns. Disputes can be slow to resolve through the legal system, and arbitration agreements could be difficult to enforce.

- **Business risk and governance issues:** Lack of transparency and accountability across the public sector, combined with restricted media freedom, can encourage corruption. Across the region, competition between government departments for control over investment has resulted in overlapping jurisdictions and bureaucratic processes which can create opportunities for corruption.

- **Financial and operational risks:** Uncertainty in availability of government budget makes it hard for the project to be bankable, and currency risks exist where there are political uncertainties. Secondly, operations and maintenance risk can also arise due to lack of good ecosystem overall. For instance, the long-term viability of rail projects is threatened by inherent power supply and safety issues.

Box 3: Feedback from Investors and Project Owners

Several interviews were held with investors and construction companies to understand their views on the challenges and opportunities in infrastructure financing within the region, as well as their thoughts on AIIB's role.

AIIB's role

First, **AIIB could be a thought leader in the region**, and not simply a loan provider. This would require AIIB to take on a more pro-active role in the following:

a. Advise and take part in deal structuring, project preparation, due diligence and engagement with private investors;
b. Advise on maintenance and operation of infrastructure assets, or engage services of international expertise; and
c. Bundle projects for integration; and
d. Facilitate the harmonization of laws and management, especially cross border projects.

AIIB should pursue PPPs actively, by considering all funding mechanisms including equity, loans and guarantees, providing guarantees to address deal issues, or providing funding beyond initial equity commitment should the need arises. AIIB should also develop a bigger risk appetite and allow for faster validation processes. Building ahead of demand, and taking on bigger projects with a focus on difficult parts of them (for example an access road to a key asset) would also make AIIB stand out from other MDBs.

Third, **AIIB could also take on more non-sovereign projects**, and crowd in private capital. This would be a large differentiator for AIIB and allow it to be in a new space not filled up with existing bilateral relations and agreements. To encourage more private capital, a direct draw or a form of insurance could be made from AIIB to private capital suppliers to cover exchange rate risk, repatriation risk, terrorism, domestic violence and other political risk. Financing in local currency could also address volatility of exchange rate. However, appropriate hedging would need to be done and this could be expensive if the currency is volatile.

Fourth, **AIIB can become an intermediary for procurement**. It could develop standard processes, contracts and frameworks, that recipient countries would have to comply with, but could be altered to suit specific country situations where needed. For instance, across Australia and Canada, risk transfer processes are similar but slightly different. This consistency provides an overall understanding of process, with exceptions treated on a case-by-case basis.

Opportunities in Asia

Ports in India, Indonesia, Philippines, Sri Lanka as well as Black Sea ports in Turkey and Georgia are areas for potential investments. Container ports have greater opportunities than bulk ports, however these two can also coexist and complement each other; key is to formalize relationships with key shipping lines. For regions that are relatively developed in port capacity, the opportunity would be on automation, improving productivity and safety.

Toll roads have high potential as well, particularly in Indonesia, which has seen a large privatization wave with 20 government concessions auctioned recently.

Greenfield airports in India, Philippines, Vietnam, Myanmar and Iran have large potential for growth due to increase in tourism – however, greenfield projects often require new legislation and pricing regimes. This presents an opportunity for AIIB.

In the **cross-border rail** industry, a major challenge is in the standardization of gauge, which no one is driving. For instance, India, Sri Lanka and Bangladesh adopt the uni-gauge system, whereas ASEAN countries generally adopt narrow gauge networks.

Urban rail transport is the fastest developing transport sector in Asia, driven by increasing urbanization across the region. Growth is particularly strong in China, India, and ASEAN countries. Metro networks are considered the best option to address gridlock. In India, approximately 50 cities are looking at developing metro networks –there is 300km existing operational urban rail, with a further 350km in the pipeline. The target is to have 2500km of urban rail by 2030-35, with 6 metros in Utter Pradesh by 2025. A potential way of making these urban rail projects more bankable is to pair then up with real estate components (the Philippines and Indonesia are key markets).

6.0 Key Implications

First, given the large needs relative to AIIB's financing capacity, the Bank will have to prioritize effectively. Project selection is crucial. AIIB should aim to finance strategic projects that can bring about greater integration across transport modes, within and across countries. Some assessment of projects' strategic value, how well they are integrated with national plans, how important they are in the overall network should be built into the project selection criteria.

Second, managing the rising carbon emission of transport will have to be a top priority. Transport a "hard to abate" sector. Many transport modes like aviation and shipping would rely on fossil fuel in the foreseeable future. The demand for such transport and infrastructure will rise quickly in line with trade and affluence. Furthermore, the demand for vehicles and road infrastructure will remain very large. Emissions from Asia will rise quickly. AIIB can address these dilemmas by financing infrastructure that encourage modal switch to achieve lower emissions, and/or infrastructure that bring about higher carbon efficiency. In this regard, rail is superior compared to aviation over short-medium distances. Upgrading of rail through electrification will also bring about higher carbon efficiency. Finally, AIIB can prioritize projects that bring about greater emission reducing innovation to Asia.

Third, unlike the power sector, transport sector infrastructure is characterized by a higher degree of competition, including strategic interactions between players. Within domestic boundaries, competition tends to be between modes. For example, rail and high- speed rail will have to compete against aviation. Outside domestic boundaries, ports and airports also compete against each other. As noted in the study and by various other organizations, there already appears to be an oversupply of ports in some regions. Furthermore, there are also strategic interactions between the infrastructure suppliers and users. For example, the economic viability of ports and airports is often also linked to specific shippers or airlines, resulting in strategic interactions. To ensure economic sustainability, AIIB will have to build in a robust cost-benefit analysis in its project selection and assessment.

Fourth, transport infrastructure will have to be robust to technology and social changes. While it is not the key focus of this study, it is also clear that technology is changing rapidly in the transport sector. Examples include rise of electric or driverless cars, much larger cargo ships, and increasing viability of HSR. Looking ahead, technological development may well bring about greener shipping and aviation. Defensively, AIIB has to ensure that the infrastructure it finances do not lock in assets that could become obsolete. On the more positive note, AIIB can also put in investment that scales up these technology across Asia. On the social front, Asia will also face significant changes such as having an older demographics. Transport infrastructure will have to build in or be upgraded to cater to changing needs.

Finally, it is worth noting that the financing landscape is crowded. MDBs are traditionally strong in road infrastructure, and have also provided grants and technical assistance. Commercial banks and export credit agencies have a large market share for more commercially oriented sub-sectors. Furthermore, transport infrastructure require a higher degree of integration to achieve efficiency in connectivity (especially cross-border). It is often a networked infrastructure, unlike a standalone power generation plant. As a result, transport infrastructure planning tends to have long gestation periods. Cross-border projects will also require a high degree and long periods of policy coordination.

While the energy sector presents a larger infrastructure demand need in Asia, the transport infrastructure sector arguably presents the bigger challenge. These will test AIIB as a

relatively young and lean organization. AIIB can achieve greater impact as a young organization by

- Clearly defining a set of priorities for the transport infrastructure sector, and adopting a framework to allow effective project selection. The set of priorities should include modal and cross border connectivity, and environment sustainability;

- Placing a strong emphasis on economic viability and commercial discipline of projects so that it elevates the quality of infrastructure financing in the region such that it facilitates more private capital projects, and crowds in more private capital; and

- Working effectively with partners (MDBs, other developmental agencies, private sector and think tanks). While AIIB presently has limited technical assistance capacity, its early participation during project preparation phase can provide greater confidence around funding, and improve the conditions for projects to be closed successfully.

Appendix

Appendix A List of Countries and Economies Included in Study

Region	Countries / Economies	
Central Asia	Kazakhstan	Turkmenistan
	Kyrgyz Republic	Uzbekistan
	Tajikistan	
East Asia	China	Japan
	Hong Kong SAR, China	Mongolia
	Macao SAR, China	Korea, Rep
Oceania	Australia	Marshall Islands
	New Zealand	Micronesia, Fed States
	Fiji	Nauru
	New Caledonia	Northern Mariana islands
	Papua New Guinea	Palau
	Solomon Islands	American Samoa
	Vanuatu	Tonga
	Guam	Tuvalu
	Kiribati	
Russia	Russian Federation	
South Asia	Afghanistan	Maldives
	Bangladesh	Nepal
	Bhutan	Pakistan
	India	Sri Lanka
	Iran, Islamic Republic	
South East Asia	Brunei Darussalam	Philippines
	Cambodia	Singapore
	Indonesia	Thailand
	Lao PDR	Timor Leste
	Malaysia	Vietnam
	Myanmar	
Western Asia	Armenia	Lebanon
	Azerbaijan	Oman
	Bahrain	Qatar
	Cyprus	Saudi Arabia
	Georgia	Syrian Arab Republic
	Iraq	Turkey
	Israel	United Arab Emirates
	Jordan	Yemen, Republic
	Kuwait	