INTERNATIONAL UNION
OF RAILWAYS

UIC Asia-Pacific
Vision 2050

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EXECUTIVE SUMMARY

The goal of the document, produced by the Sustainable development Foundation with the coordination of UIC Asia-Pacific region, is to contribute to the realization of a UIC vision for Asia-Pacific to 2050.

The vision has been formulated by following these 3 steps:

- Defining the general scenario, divided by topic, representing the future context on which to project the role of the railways;
- Analysing the current role of railways in the transport market of Asia;
- Prospect a role of UIC and the railways towards 2050 and the main axes of action in order to play this role.

Furthermore, the document contains a more in-depth analysis at a sub-regional level. This part of the study complements the contributions from the replies to the questionnaire sent by UIC AP to its members active in the region, summarized in Annex I, and the country profiles for all countries in the Asia-Pacific region, summarized in Annex II.

The outcome of this process has been the delivery of a vision for UIC Asia-Pacific and a technical framework to be used for future UIC AP action plans.

This executive summary briefly reports the main findings of the document.

Economical, environmental and social analysis of Asia-Pacific region

The UIC Asia-Pacific region's countries account approximately for a third of the world **GDP**, at market exchange rate. Currently (2013), the comprehensive GDP of the UIC Asia-Pacific region reaches 16 210 billion USD. Based on GDP adjusted for purchasing power parity (PPP), the weight of Asia-Pacific economy is even stronger. In 2013, the total GDP of the UIC Asia-Pacific region was 42% of the world economy, with the three largest Asian economies alone (China, India, Japan) reaching 27%.

The growing weight of the Asia-Pacific region economies observed in the last years is the result of a different and **higher growth rate** than other economic areas of the world. The extraordinary economic growth accompanying Asia-Pacific emerging economies coupled with the integration into global markets is largely due to the development of global supply chains and heightened international mobility of capital. The rapid development of information and communication technologies (the ICT revolution), the lower transportation costs and the vast wage differences between developed and developing nations allowed a more granular division of labour worldwide, generating the so-called "second unbundling".

From 1990 to 2010, in Asia the number of extremely poor declined by 745.4 million. Asia also stands out if the "moderate poverty" line of $2/day/person is used: the number of moderately poor declined by 566.31 million in Asia between 1990 and 2010, while increasing far less in other regions.

The analysis of **Millennium Development Goals** (MDG) indicators shows that the Asia-Pacific region is generally aligned to the targets. The developing economies in the region have made substantial progress toward universal primary education, gender parity, reduction of child mortality, improvement of maternal health.

Despite Asia's recent growth resulting in a dramatic decrease in poverty, income inequalities have continued to rise. **Inequality** as measured by the Gini coefficient has been rising in a number of countries in Asia-Pacific. Another indicator of inequality, the ratio of the income of the top quintile to the income of the bottom quintile of the population, is relatively high – ranging between 6 and 9 in a number of countries – and in a few cases increasing.

The population of Asia is still for the most part rural when compared to other parts of the world, the Americas and Europe in particular; still, it is the region of the world that according to UN will have the highest **urbanization rates** together with Africa, reaching 64% of population in 2050. Between 2014 and 2050, the urban areas are expected to grow by 404 million people in India and 292 million in China. In 1990 there were 10 cities with more than 10 million inhabitants, half of which in Asia. Today, the number of megacities has nearly tripled to 28: 16 of those are in the Asia-Pacific region. This being said, in Asia most of the population is concentrated in urban areas with less than 500 000 inhabitants, and the fastest growing urban agglomerations are medium-sized cities and cities with less than 1 million inhabitants located in Asia.

With these growth rates, the increase in **energy consumption** implies a progressively larger claim on global energy resources. Despite a slight downturn due to the economic recession that emerged in 2009, Asian energy demand has continued to rise, driven by population increase and rapid economic growth. The region accounted for more than 46% of global energy demand in 2012. Most Asian economies require imports in order to meet energy demand. PRC, a net exporter of energy until the early 1990s, has now become a large importer of oil. India's oil import volumes increased from 1.6 mb/d in 2000 to 2.5 mb/d in 2009 and are expected to reach 14 mb/d by 2050.

The Asia-Pacific region is characterised by an outdated electric production system, a massive use of coal and a strong dependence on fossil fuels in the transport sector. This implies an increase of **CO_2 emissions** with rates even higher than for energy consumption increase. The Asia-Pacific CO_2 emissions have more than doubled in the last 22 years, mainly because of an upsurge in energy consumption but also due to the constant rise of the carbon intensity per unit of consumed energy.

Transport scenario

According to the IPCC WGIII AR5 scenario, the **world transport demand** – for both passenger and freight – will grow in the next decades until 2050, with most of this growth happening in emerging countries, where higher rates of income and population growth are forecasted. All scenarios analysed by IPCC show how, due to a strong correlation between passenger mobility and disposable income, the highest rate of growth will be in non-OECD countries, Asia-Pacific countries in particular.

The IEA (ETP 2012), in the 6DS and 4DS scenarios, conjectures that the global **passenger demand**, in a business-as-usual (BAU) perspective, will double between 2010 (baseline) and 2050, with an average rate of 19.3% in 10 years. The IEA assumes that passenger demand will rapidly increase, in particular in non-OECD Asia-Pacific countries, because of multiple factors: among those, the forecasted growth in population and income.

According to ITF/OECD forecasts a shift in world **freight patterns** with an increase of global activity by 350% tonne-km in the 2010-2050 period. The Asia-Pacific region is already by far the most important region for container trade. The world's ten leading container ports are located in East and Southeast Asia with the only exception of Jebel Ali, port of Dubai.

The ITF Outlook 2013 estimated that in 2050 the **number of vehicles** circulating at global level will double or even grow fourfold compared to 2010 levels (from 835 million vehicles

estimated in 2010 to 1.8 or 3.3 billion vehicles) if no measures are taken to contain the spread of private vehicles and if the world economic growth will have the same speed it had before world financial crisis of 2007/2008: a high or very high growth rate is expected in Asia, because of the strict relationship between prosperity and spreading of private mobility. For former Soviet Union countries the growth rate foreseen is more moderate, but anyway twice the amount of the growth in North America, Europe and OECD Pacific countries (Japan, South Korea, Australia and New Zealand).

Railways

Railway activity in Asia-Pacific in 2010 was 79% of global demand for passenger service and 58% for freight service. China, Russia and India alone account for 54% of rail freight transport worldwide and India, China, Russia and Japan account for 74% of passenger traffic.

Even in terms of **modal share** in the different national transport markets, the Asian railways feature some of the best performances in the world. In the passenger sector, the modal share of railways in India stands out, followed by Japan and China; in the freight sector, Russia runs most of its freight by rail, while China and India have a rail modal share of more than 60% in freight.

The socio-economic development process observed in the last decades has obviously involved the transport sector as well. In general, in countries that had a higher development such as China and India (but also in some North-Central Asian countries), demand for railway has increased in absolute terms, both for passenger and for freight. However, railway has lost market share in favour of competing modes (aviation and road for passenger, road and waterways for freight).

The Asia-Pacific **rail infrastructure** represented 30% of the world's railway lines in 2010, growing from 23% in 1975. Even though rail infrastructure is increasing, it is not reaching the growth levels of road infrastructure. Paved roads have increased by 321% between 1975 and 2010, with a Compound Annual Growth Rate (CAGR) of 4.2% compared to the 0.3% of rail.

In comparing the density of rail and road infrastructure per capita in Asia-Pacific, it can be that the huge population increase in the region (66% between 1975 and 2010) was more than matched by the expansion of road construction, not so much so by rail: road density increased by 154% since 1975 (when it was 0.9 m per capita), compared to rail density which in fact *decreased* by 33% in the same period. Road density in 2010 was 2.3 m per inhabitant, nearly 30 times higher than rail density.

The analysis of infrastructure density over GDP clearly shows how gross domestic product in the 29 Asia-Pacific countries considered is being used to fund the construction of road infrastructure much more than the construction of rail infrastructure: the amount of road infrastructure in the region per dollar of GDP has increased by 53% between 1975 and 2010, while in the same period the same indicator for rail decreased by 60%.

Electric railways are taking an increasing importance in Asia-Pacific: while only 17% of railway lines were electrified in 1975, this ratio became 31% in 2000 and 39% in 2010; anyway there is still a long way to go to reach the level of the European Union, where more than half of the lines are electrified, but there is a clear progress towards more electrified railways, which are more efficient and less polluting.

High-speed lines have also grown dramatically, especially in China: China makes up more than half of the high-speed lines in the region. However, it is easy to note how high-speed rail is only present in four of the countries of the region, despite the growing urbanization and need for people interconnection in Asia.

The beginning of the 21st century has brought renewed interests for a **long distance inland connection** between Asia and Europe, especially with the booming Asian trade and the increasing pressure to ship containerised freight in a time sensitive manner over long distances. This is one of the central topics both for the Asia-Pacific region and globally, due to technical, socio-economic and geopolitical reasons.

Therefore, there are several national, regional and cross-region initiatives in development since many years.

In the framework of its Transport Division activities, the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) carried out a project called 'Operationalization of international intermodal transport corridors in North-East and Central Asia'. Under the project, **four railway corridors** have been identified based on existing routes of the Trans-Asian Railway (TAR).

- the Northern Corridor connecting China, Kazakhstan, Mongolia, Russia and the Korean Peninsula (1995, refined in 1999);
- the ASEAN and Indo-China sub-regional network covering Cambodia, China, Indonesia, Lao PDR, Malaysia, Myanmar, Singapore, Thailand and Viet Nam (1996);
- the Southern Corridor connecting Thailand and the southern Chinese with Turkey through Bangladesh, India, Iran, Myanmar, Pakistan, Sri Lanka (1999);
- the North-South Corridor linking Northern Europe to the Persian Gulf through Russia, Central Asia and the Caucasus region (2001).

The Euro-Asian Transport Links (EATL) project, a joined initiative between the United Nations Economic Commission for Europe (UNECE) and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), has identified **nine rail corridors** that link Asia and Europe for priority development and cooperation.

The European Union (EU) has promoted different initiative to extend its transport networks into neighbouring states to its north and east: the Pan-European corridors and the "Transport Corridor Europe-Caucasus-Asia" (**TRACECA**) programme, a multilateral agreement between the EU and 14 other Asian states promoting optimal integration of the international transport corridor Europe-Caucasus-Asia into Trans-European Networks (**TENs**).

The Central Asia Regional Economic Cooperation (**CAREC**) Program involves nine countries of Central Asia, People's Republic of China and six multilateral institutions with the aim of facilitating regional transport and trade, and improving trade policy. The plan to link Central Asia to global markets has already led to the construction and rehabilitation of 7,672 km of quality road and rail links between key cities and towns, also connecting innumerable communities along routes that often trace the ancient Silk Road. Almost $19.6 billion had been invested from 2001 to 2014 in 107 CAREC-related transport projects along the six CAREC corridor routes, where the potential for economic development and returns is greatest.

Actually the **TransSib Railway**, the backbone of Russian railways, is the main link of the North route for the Trans-Eurasian Connection. All railways of the countries along the TransSib corridor (Russian Federation, Kazakhstan, Mongolia) are members of the Organisation for Cooperation Railway Lines (OSJD) and of the Coordinating Council on Trans-Siberian Transportation (CCTT).

Since 1992, ADB's **Great Mekong Subregion (GMS)** Program has been an initiative similar to CAREC. GMS is comprised of 6 countries – Cambodia, LAO PDR, Myanmar, Thailand and Vietnam and the provinces of Yunnan and Guangxi in China – and its strategic thrusts are strengthening infrastructure linkages, facilitating public and private cross-border trade. To develop the railway network in 2012 was created the Greater Mekong Railway Association

(GMRA), a non-legal intergovernmental forum under the GMS Program, with the goal of ensuring that all GMS countries are connected to a GMS rail network by 2020.

In 2011 the Asian Development Bank Institute (ADBI) estimated that the total investments required for regional infrastructure projects for Asian connectivity to meet demand for the identified 1,202 regional projects is valued at approximately US$ 320 billion, with an average infrastructure investment need of about US$ 29 billion per year for the period 2010-2020. Of this total, investments for railway projects needed account for about 40%.

Asia-Pacific Perspectives 2050

Asia is in the midst of a truly historic transformation. If it continues to grow on its recent trajectory, it could, by 2050, account for more than half of global Gross Domestic Product, trade and investment, and enjoy widespread affluence. Indeed, this result is filled with multiple risks and challenges, e.g. inequities within countries, the risk falling into the *Middle Income Trap*, intense competition for finite natural resources, rising disparities across countries and sub-regions, global warming and climate change including increased natural disasters. Despite the very different conditions in the countries that are part of the region, it is possible to draw the contours of the **great challenges** facing the region as a whole:

- growth with inclusion,
- fostering regional cooperation and integration,
- managing massive urbanisation,
- fighting climate change and resource depletion.

In this context, the **role of railways** can be traced along four key priorities/challenges:

- increase or maintain the market share of railways offering innovative transport services for a rapidly evolving socio-economic environment;
- promote and sustain the integration and cooperation at a regional and sub-regional level;
- promote transit oriented development and well-integrated urban and suburban railway network;
- improve continuously the environmental performance of railways.

Future projections of the mobility indicators correlated with economic growth, increase of disposable income, population and urbanisation show that the transport sector is one of the most sensitive and strategic sectors for **“green growth”**. Railways are an essential instrument for its performance in terms of environmental, social and economic impacts. This character implies that promoting, investing and fostering railway transport is not just a strategic issue of any industrial sector but a strategic instrument to boost *green growth* approach worldwide.

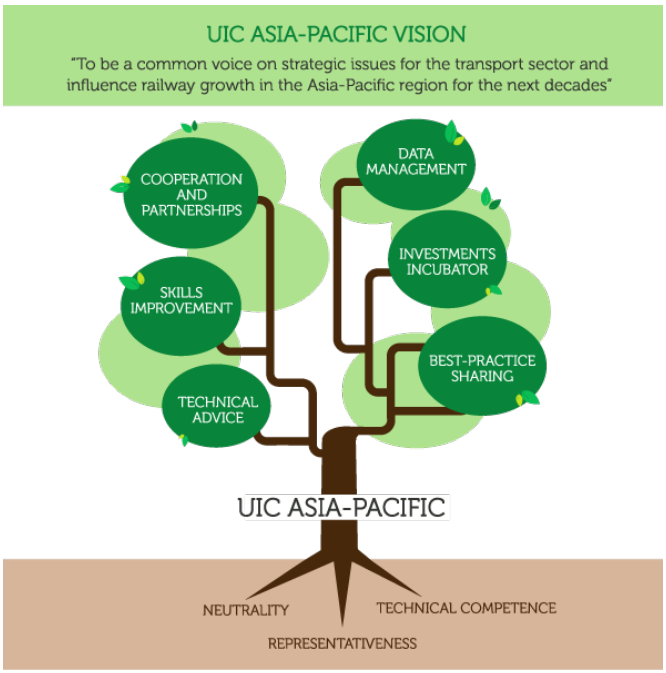
UIC Asia-Pacific: a vision for 2050

The vision statement for the UIC Asia-Pacific railways proposed here is:

“To be a common voice on strategic issues for the transport sector and influence railway growth in the Asia-Pacific region for the next decades”.

Between what UIC Asia-Pacific is today (mission, core values, core competencies) and what it aspires to be in the future (the vision) a bridge has to be built, with the activities of the Regional Assembly as bricks. The central activities have to be the Action Plans, which select, promote and guide specific working projects.

The UIC Asia-Pacific action needs to cover a regional and sub-regional level and it has to be able to represent the UIC AP region's position with international organisations and intergovernmental agencies, with national authorities and governments and with the railway manufacturing industry.



In order to take this role in the future, the UIC Asia-Pacific region needs to leverage the core competencies of the UIC organisation towards the organisation internally, towards members and towards external parties. The **core competencies** of UIC are identified as:

- *Neutrality*: UIC is neutral with respect to all members;
- *Representativeness*: UIC represents a vast number of railways worldwide, not only as a sector and a trade association, but also as a mode of transport to be promoted to reach strategic objectives at various levels;
- *Technical competence*: UIC has expertise on a wide array of railway topics, through the know-how developed in the field by all its members worldwide.

In order to reach the vision outlined in the previous section, the UIC Asia-Pacific region has to focus in the period leading to 2050 on a series of action areas. These areas leverage the core competencies to effectively foster the role of railways in the region and give UIC Asia-Pacific a central role in the development of the transport sector.

The **strategic action areas** identified are:

- *Cooperation and partnerships with the multilateral organisations active in the region*: from the main intergovernmental organisations such as ADB, EDB, UNESCAP, ASEAN, to the railway organisations such as OSJD and CAREC. The cooperation can take different forms: stronger partnerships (e.g. Memorandums of Understanding or Cooperation Agreements) or specific actions such as development programmes for new infrastructure or urban railway service.
- *Data quality improvement*: there is still in the region a "data gap" to be filled by UIC. Railways in the region have a wealth of data that needs to be collected, shared among members and used on one hand for the improvement of the quality of railway service in the region, and on the other hand to promote a more productive cooperation with

international bodies and investors. The data on a number of topics could be collected: e.g. production, safety, infrastructure, energy consumption and CO2 emissions, modal shift, new projects, etc.

- Being an *incubator for investments* in Railways: the Regional Assembly and the UIC headquarters will leverage their technical competences and their connections with national and regional institutions to foster public and private investments in the region.
- *Best-practice sharing and technology transfer between Members*: Asia-Pacific railways often face similar problems, so it would be beneficial for them to share among each other the issues met, the lessons learned and the innovative solutions found, and to start a productive dialogue with European railways based on "lessons learned".
- *Technical Advice and Peer Review*: UIC can offer its services and competence to support public and private entities for the study of new projects, as well as for the elaboration and the evaluation of tenders.
- *Skills Improvement*: UIC Asia-Pacific members will put their technical competences in service of the common good, through capacity building initiatives such as training sessions, workshops, e-learning or staff exchange.

The activities of the UIC Asia-Pacific region mainly encompass single projects rather than fixed activities. It is thus necessary to build a framework that can support in the definition and production of the projects for the future **Action Plan**. A framework has been delivered, that can be described as a "matrix" which has on one axis the well-known UIC technical cooperation areas (Passenger, Freight and Rail System) and on the other axis a set of high-priority objectives to reach the Vision of UIC Asia-Pacific:

- Cost reduction and efficiency improvement,
- Harmonisation and standardisation,
- Regional Integration (New Pillar),
- Research and Innovation,
- Quality and Customers (New Pillar),
- Environmental Sustainability (New Pillar),
- Urban Development (New Pillar),
- Safety,
- Security,
- Expertise development and training (New Pillar).

Each project of the future Action Plan will be represented inside the matrix: obviously, some projects may be related to different areas and/or objectives, even though there is usually a main area/objective of focus.

Framework Matrix for future UIC Asia-Pacific projects

	Passenger	Freight	Rail System
Cost reduction / Efficiency Improvement			
Harmonisation / Standardisation			
Regional Integration			
Research and Innvovation			
Quality and Customers			
Environmental Sustainability			
Urban Development			
Safety			
Security			
Expertise development and training			

AIM AND STRUCTURE OF THE REPORT

The UIC Asia-Pacific (UIC AP) region is extremely vast and heterogeneous. Advanced and mature economies like Japan, South Korea, Russian Federation and Australia coexist with emerging economies in different stages of development. Nevertheless, the salient aspect of the region is the socio-economic process that took place in the last decades, a process that has implicated the most populous countries on Earth: China and India, which together make up more than a third of the world's population.

The goal of this work is to contribute to the formalisation of a UIC vision for Asia-Pacific railways to 2050.

The vision will be formulated by following these steps:

- Defining the general scenario, divided by topic, representing the future context on which to project the role of the railways;
- Analysing the current role of railways in the transport market of Asia;
- Prospect a role of UIC and the railways towards 2050 and the main axes of action in order to play this role.

The first chapter of this report outlines this unprecedented development process, from an **economic and demographic point of view**. The description deals with the main factors of economic growth: scale of economic output, productivity of work (supply-side), aggregated demand (investments, internal demand and net external demand) and industry structure. The demographic evolution is reported with the population growth in the region (past and future), the transformations concerning the active part of the population (demographic dividend) and the urbanisation processes that usually go hand-in-hand with the economic development phases.

Obviously, an economic development of this magnitude had significant impacts on the distribution of wealth, on the levels of human development, on the consumption of resources and – last but not least – on the environment. The impacts are followed by the outline of future scenarios in the region. The 2008 financial crisis is not over yet and the economic climate – both at a global and at a local level – is much more uncertain than it was in the last decade. In this context, the report will describe two scenarios elaborated by the Asian Development Bank (ADB) on the future of the region.

The second chapter focuses on the **state of the art of railway sector**: activity, infrastructure and a short insight into the railway market reform implementation.

The third chapter will show the **transport** past **trends** in the UIC Asia-Pacific region, to then deal with future **scenarios**. Several organisations (IEA, ITF and IPCC) have produced future scenarios, which will be analysed here with a special focus on the estimates and projections concerning railways.

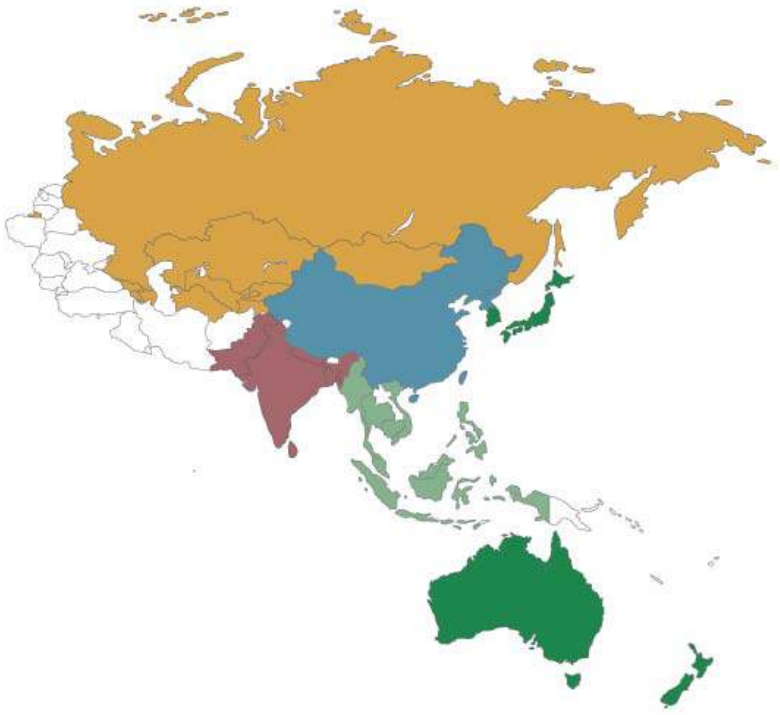
The fourth chapter contains a more **in-depth analysis at a sub-regional level**. This part of the study complements the contributions from the replies to the questionnaire sent by UIC AP to its members active in the region, summarized in Annex I, and the country profiles for all countries in the Asia-Pacific region, summarized in Annex II.

The final chapter contains the synthesis and the perspectives. Starting from the scenarios and from the analysis of the current role of railways in the transport market of Asia, some underlying themes will be selected. These themes will contribute to define the role of railways and the UIC contribution in the Asia-Pacific region, by delineating the main axes of action in order to play this role. The chapter will summarise what the UIC Asia-Pacific region represents today and what it does, starting from the analysis of UIC worldwide and the activities of UIC Asia-Pacific in the 2013-2016 Action Plan. The outcome of this process will be a proposal for a **vision for UIC Asia-Pacific** and a **framework for future action plans**.

1. ECONOMIC AND DEMOGRAPHIC OVERVIEW OF THE REGION

The UIC Asia-Pacific region covers the Asian countries around the Pacific Rim, Central Asia, South-East Asia, the Indian Sub-Continent and Oceania. The countries included are 29: Armenia, Australia, Azerbaijan, Bangladesh, Cambodia, China, Chinese Taipei, Myanmar, Georgia, India, Indonesia, Japan, Kazakhstan, Democratic People's Republic of Korea, Republic of Korea, Kyrgyzstan, Malaysia, Mongolia, Nepal, New Zealand, Pakistan, Philippines, Russian Federation, Sri Lanka, Tajikistan, Thailand, Turkmenistan, Uzbekistan and Vietnam.

Fig. 1-1: UIC Asia-Pacific region and sub-regions used in this Report



The area studied in this report is vast and heterogeneous, from several points of view: social, political and economic. It includes some of the world's largest and most competitive economies, such as Japan, South Korea and Taiwan (part of the so-called *Asian Tigers*), Russian Federation, Australia and New Zealand; but it also encompasses many emerging economies, among which the two giants India and China, together with smaller and less-developed countries such as Nepal and Tajikistan.

Table 1-1: Sub-regions defined in this Report

North and Central Asia	South Asia	East Asia	South-East Asia	Pacific
• Armenia • Azerbaijan • Georgia • Kazakhstan • Kyrgyzstan • Mongolia • Russia • Tajikistan • Turkmenistan • Uzbekistan	• Bangladesh • India • Nepal • Pakistan • Sri Lanka	• China • Chinese Taipei • Dem. Rep. Korea	• Cambodia • Indonesia • Malaysia • Myanmar • Philippines • Thailand • Vietnam	• Australia • Japan • New Zealand • Republic of Korea

This report groups the UIC Asia-Pacific countries in five sub-regions, shown in Fig. 1-1 and Table 1-1. These sub-regions are used in some analyses, as they group countries according to their socio-economic, geographic and/or economic traits.

The *North and Central Asia* sub-region is composed mainly of countries formerly belonging to the Soviet Union, with the exception of Mongolia, which was considered to be in the Soviet sphere of influence. This is by far the largest sub-region in Asia-Pacific, and some of its countries are central to the passage of infrastructure connecting Europe with the Eastern part of Asia. The *South Asia* region coincides with its common definition, geographically and historically consistent. *East Asia* comprises China and two countries tied with China for different reasons: North Korea and Chinese Taipei. *South-East Asia*'s countries are all members of ASEAN, which has a significant role in their policy. Lastly, the *Pacific* sub-region is made of countries which are all OECD members (and they are the only OECD members in the UIC Asia-Pacific region); furthermore, they can all be considered as islands (South Korea is a "political island" as it is only connected to the continent through North Korea) and as such cannot have international land rail connections.

There are vast differences and – until recently – only limited physical and economic links among the main sub-regions. Unlike the common roots that link many European countries, Asian nations are not linked by a common history, culture, religion or heritage and there are no common linguistic backgrounds. Often, Asian countries have stronger economic and social ties with nations outside Asia than with nations within the region. The Asian economies are not just very diversified in terms of different development stages, but also by vocation: they have diversified resource endowments and different economic systems (planned economies, market economies, mixed economies), which caused some of them to become agricultural countries, some manufacturing countries, some of them exporters of raw materials.

Despite these differences it is possible to find a common trait that unites this complex area. Asia is currently at the centre of an unprecedented (by speed and breadth) development process which in a few decades has completely transformed the world's economic and political scenario. Certainly, this process is heavily influenced by Asia's two population giants, the People's Republic of China (PRC) and India, but the development performance is impressively broad-based.

1.1 GROWTH

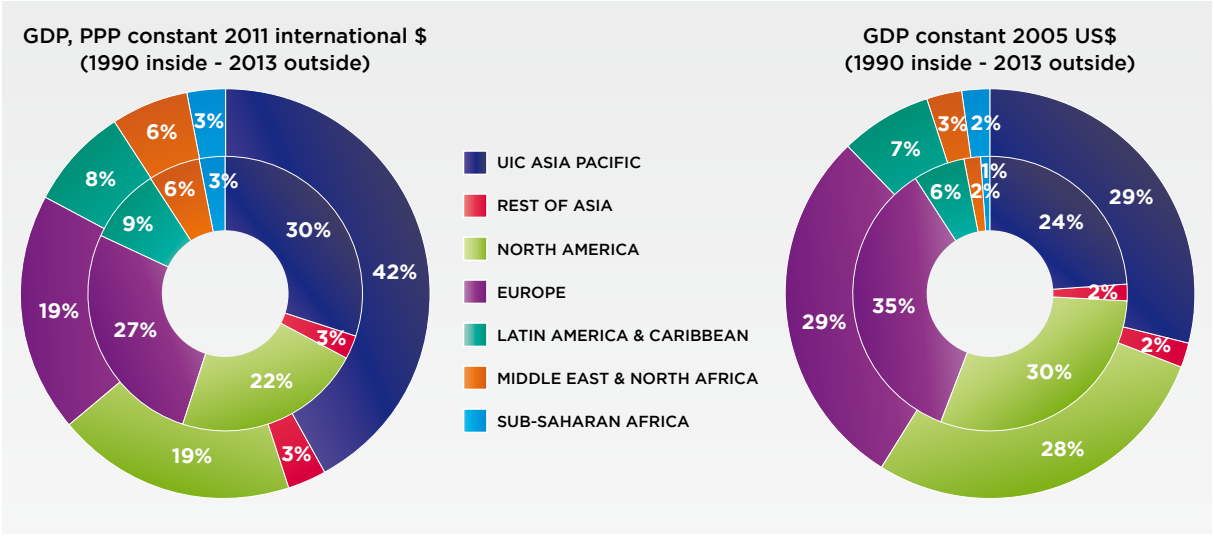
1.1.1 Economic scale and Growth of Asia-Pacific

The UIC Asia-Pacific region's countries account approximately for a third of the world GDP at market exchange rate, including some of the world's largest economies[1], as shown in Fig. 1-2. The economies of China, India and Japan, by themselves, represent 70.2% of the region's GDP and 20.1% of the world's GDP[2]. The overall weight of Asian economies in the world has grown extensively in the last two decades, going from 23.5% in 1990 to 29.1% in 2013 (latest available year). Currently (2013), the comprehensive GDP of the UIC Asia-Pacific region reaches 16 210 billion USD; China overtook Japan in 2010 as the largest economy in Asia and the second largest economy in the world, after the USA.

Comparisons based on exchange rates, however, systematically under-represent the relative purchasing power for all the countries covered in this report, as movements in exchange rates can be influenced by fluctuations of speculative capital flows and interventions by governments or central banks. Furthermore, comparisons based on exchange rates typically underestimate the size of a developing economy and the perceived welfare of its residents. By taking into account the international price differentials, the relative size of economies can be more adequately measured.

Based on GDP adjusted for purchasing power parity (PPP), the weight of Asia-Pacific economy is even stronger. China alone has overtaken Japan as the largest Asian economy since 1998, and its size was 96.4% relative to the US in 2013. India surpassed Japan, replacing it as the second largest economy of Asia in 2008. In 2013, the total GDP (PPP) of the UIC Asia-Pacific region was 42% of the world economy, with the three largest Asian economies alone reaching 27%.

Fig. 1-2: Share of World GDP (PPP and market exchange rate) 1990 and 2013

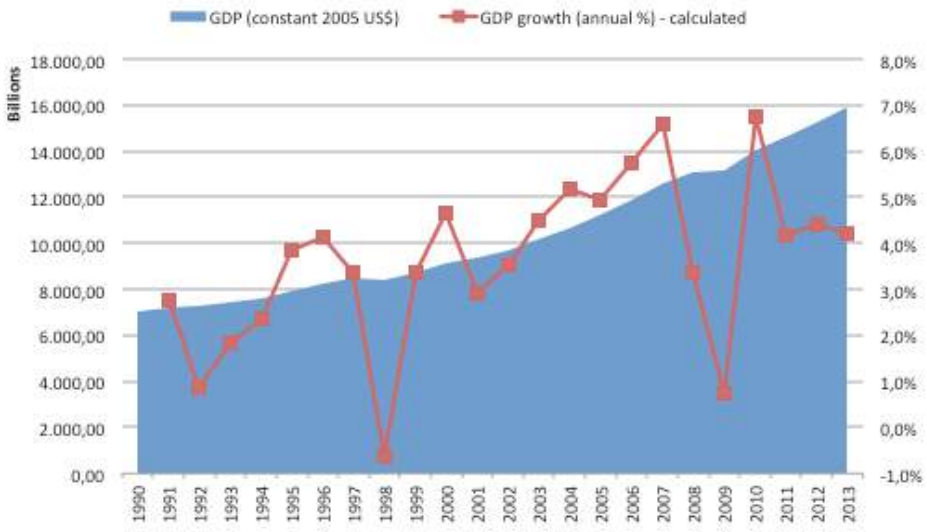


Source: World Bank, International Monetary Fund

1. The quality of economic statistics varies widely across the region. There are data problems affecting inter-country comparisons: the use of different standards of national income accounting, the degree to which shadow and informal economies are under-recorded and the use of out-dated base years for the calculation of real GDP.
2. At market exchange rate.

The growing weight of the Asia-Pacific region economies observed in the last years is the result of a different and higher growth rate than other economic areas of the world. From 1990 onwards, the average growth of the Asia-Pacific region (see Fig. 1-3) was 3.6%, while the world growth stood at around 2.7%. The 1990-2013 average rate of growth of the region was driven mostly by the growth rates of some large countries as China (10.2%), India (6.4%), South Korea (5.1%) etc., countries that have a major weight in the economy of the whole area.

Fig. 1-3: Asia-Pacific GDP and GDP Growth (constant 2005 USD, exchange rate)



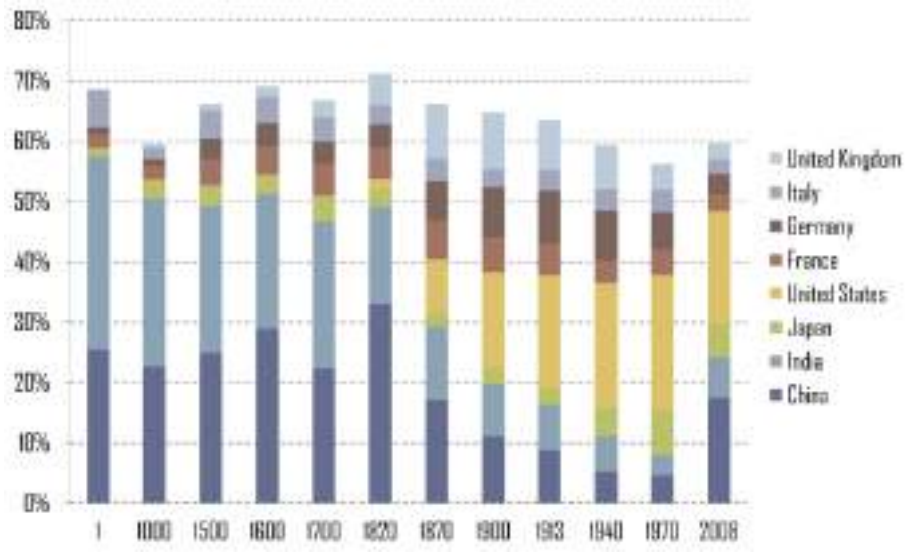
Source: Susdef elaboration on World Bank data

The period 1990-2013 covers the major crisis in developing East Asian economies in 1997-98 and the smaller Dot-Com Crash of 2001, as well as the recent great recession of 2007-09. The trend line increases thanks largely to PRC's continued superior growth performance and India's acceleration of growth since 2004, with the contribution of other dynamic emerging markets in the region – e.g. Bangladesh, Cambodia, Indonesia, Kazakhstan, Viet Nam. Latecomers in the region including Lao PDR, Myanmar, and Vietnam[3] have started participating in production networks and jump-starting industrialisation, particularly since the global financial crisis began. This trend took place despite the slower growth of the "Asian tiger economies", the stagnation of Japan, the fluctuating phases of the Russian economy and the lower growth rate of mature and high-income economies such as Australia and New Zealand.

Many analysts argue that it is necessary to look at the tremendous long-term growth of many Asian countries and consider it in the framework of an overall return of Asia to occupy again a crucial role in the world economy, like it had in the middle of the 18th century, before the Industrial Revolution, when Asia[4] accounted for around 60% of the world economy (Maddison 2007, see Fig. 1-4).

3. With Cambodia, CLMV economies.
4. Here Asia does not exactly correspond to the UIC Asia-Pacific region.

Fig. 1-4: Share of selected countries in the global economy throughout the centuries (in 1990 USD, purchasing power parity)



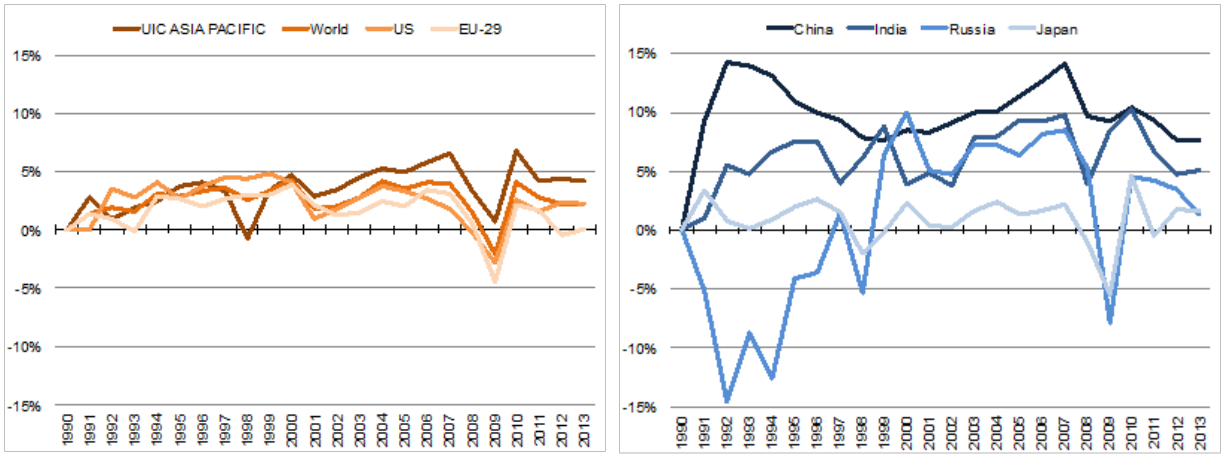
Source: Elaboration of "The Geography of Transport Systems" on data compiled by A. Maddison, University of Groningen

The share of Asia in the global economy steadily declined to a minimum close to 15% around 1950 while the West grew much faster in the last two centuries. Asia started to re-emerge after 1950, spurred by Japan and then followed by the rise of the *newly industrialized economies* as Hong Kong, the Republic of Korea, Singapore[5] and Taipei, China[6]. Starting in the 1980s, first Malaysia and Thailand, then the People's Republic of China, followed by India, Indonesia and Viet Nam, gave this growth a further boost.

The current importance of Asia-Pacific economies is mainly due to an annual growth rate greater than the world average (as shown in Fig. 1-5), connected to the fact that those growth rates concerned countries, such as China and India, with a remarkable specific weight in terms of GDP, compared to the region and to the entire world.

5. Singapore is not included in the UIC Asia-Pacific region.
6. For these economies the International Monetary Fund (IMF) coined the name NIE-4, also commonly known as the «four little dragons» or «four tiger economies» of Asia, due to the fast growth experienced on the basis of rapid industrialization.

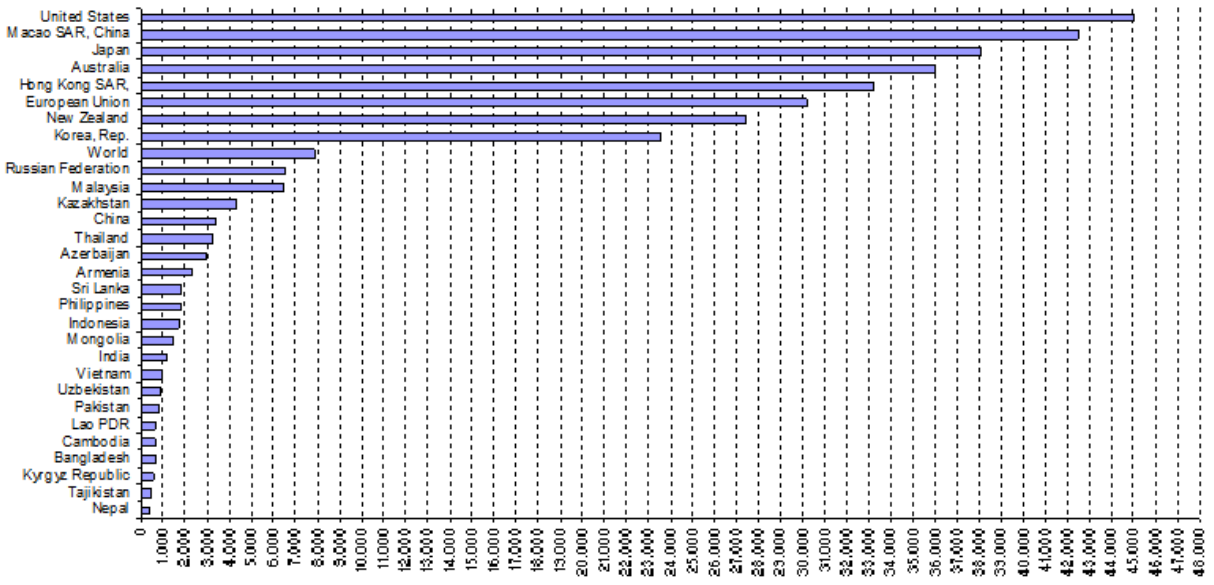
Fig. 1-5: Trends of growth rates of world regions (left) and countries in the Asia-Pacific region (right), 1990-2013



Source: World Bank

The performance comparison based on whole-economy GDP does not allow pointing out the real and perceived wellbeing of countries. This is because Asia is the world's most populous region in 2012 with 60% of the world's population, and China and India alone account for more than one-third of the world's population. For this reason, only the measurement of wealth based on per capita GDP can define the prosperity level of a country compared to another[7].

Fig. 1-6: Asia-Pacific Gross National Income (GNI) per capita (USD PPP, Purchasing Power Parity), 2013



Source: World Bank

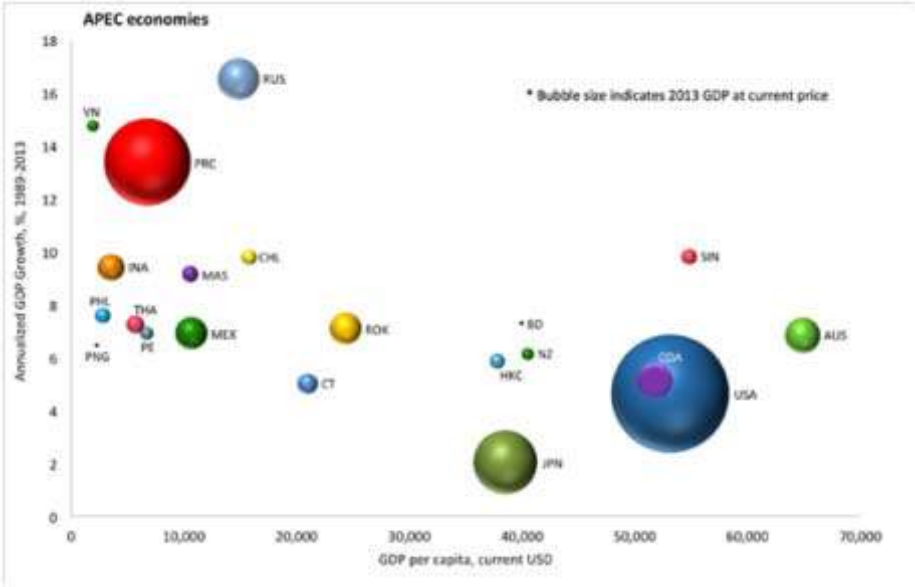
7. Income distribution is yet another issue.

According to the World Bank Atlas method[8], the 29 countries of UIC Asia-Pacific region belong to four different prosperity levels. Analysing the GNI per capita (based on purchasing power parity)[9] of UIC Asia-Pacific region economies, shown in Fig. 1-6, six countries belong to the Low-income economies, thirteen to Lower-middle-income economies, six to Upper-middle-income economies and four to the High-income economies. Nowadays the Asia-Pacific region has become more of a middle-income area thanks to the economic growth of last decades, although the level of per capita wealth is generally still very far from the USA and from more developed Asia-Pacific countries such as Japan, Australia or NIE countries.

From 1990 to present, the higher growth rates occurred in the low-income countries, and vice versa. This trend is in line with the law of diminishing returns, even in the presence of economies of scale due to the new manufacturing and trading models experienced in Asia during the recent decades.

The phenomenon of differential growth that leads less developed economies to achieve gradually the level of per capita wealth of mature economies ("catching up"), is strictly related to the initial level of per capita income. Catching up with the per capita GDP level of advanced economies is a long-term process that could take several decades to accomplish. Empirical evidence suggests there may be a negative correlation between per capita GDP level and the speed of catching up, although with exceptions. With the possibility of adopting successful practices and technologies from the more advanced economies, less advanced economies are poised to experience faster growth in per capita GDP, enabling them to catch up to average income level. However, as income levels approach those of the more advanced countries, their economic growth rates are expected to gradually decline over time (OECD 2013).

Fig. 1-7: Negative Correlation between GDP Growth rates and GDP per capita in APEC Countries

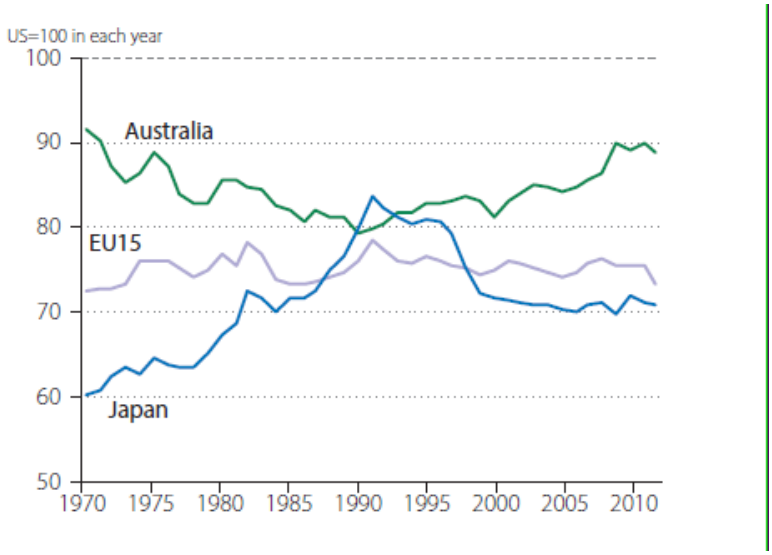


Source: Asia-Pacific Economic Cooperation

8. The low-income economies are defined as those with a GNI per capita, calculated using the World Bank Atlas method, of $1 045 or less in 2013; middle-income economies are those with a GNI per capita of more than $1 045 but less than $12 746; high-income economies are those with a GNI per capita of $12 746 or more. Lower-middle-income and upper-middle-income economies are separated at a GNI per capita of $4 125.
9. PPP GNI is gross national income (GNI) converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GNI as a U.S. dollar has in the United States. GNI is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. Data are in current international dollars based on the 2011 ICP round.

In terms of per capita GDP at constant prices using PPP, Japan was the first country in Asia to start catching up with the US. By 1970, as clearly demonstrated by Fig. 1-8, its per capita GDP was 60% of the US, quite a distance ahead of other Asian countries. Japan has been closing the gap with the US steadily until 1991 (84%), but the gap widened again when the impact of the long recession of the 1990s started to manifest itself. In recent years, Japan's per capita GDP level has stabilized to around 70–73% of the US.

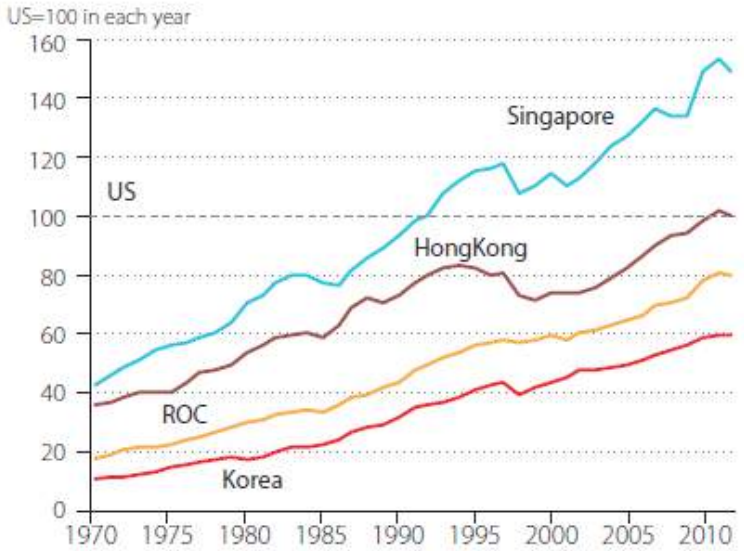
Fig. 1-8: Per Capita GDP of Japan, the EU15 and Australia relative to the US, 1970–2012 (GDP at current market prices per person, using 2011 PPP, relative to the US)



Source: Asian Productivity Organization

The Asian Tigers, shown in Fig. 1-9, experienced the greater convergence towards the per capita income of United States. Not only they were inching to the top, but they were constantly closing the gap with the US, starting from a level of 42% the US in 1970. Except for the impressive performance of Singapore which is excluded from the scope of this study, Hong Kong holds the second place, with a per capita GDP similar to the US. Chinese Taipei and Korea are behind the two others Asian tigers respectively at 80% and 60% of per capita GDP of the US.

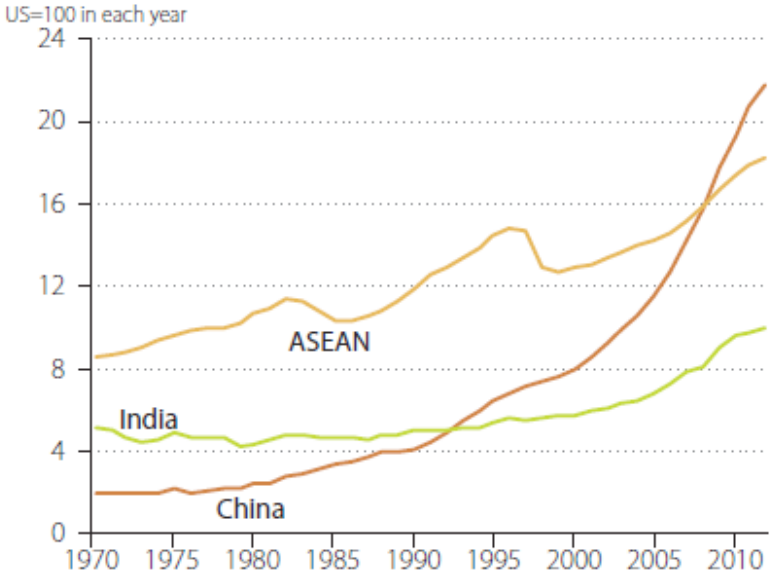
Fig. 1-9: Per Capita GDP of the Asian Tigers relative to the US, 1970–2012
(Ratio of per capita GDP at constant market prices, using 2011 PPP, relative to the US)



Source: Asian Productivity Organization

The relative performance of China and India, the two most populous countries in the world, is diminished in this measure due to their population, with their per capita GDP at 21.7% and 9.9% of the US in 2012, respectively (see Fig. 1-10). However, this should not taint the remarkable progress made over the past decades, especially of China, for which the per capita GDP was less than 2% of the US in 1970. China's relative per capita GDP has increased tenfold in four decades.

Fig. 1-10: Per Capita GDP of China, India, and ASEAN relative to the US, 1970–2012
(Ratio of per capita GDP at constant market prices, using 2011 PPP, relative to the US)



Source: Asian Productivity Organization

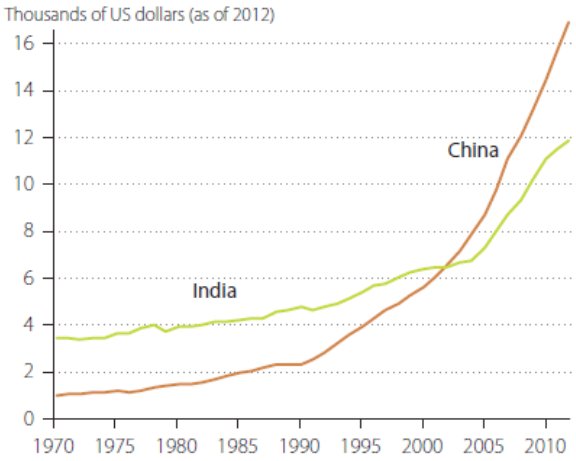
1.1.2 Productivity

Productivity performance is crucial to a country's future economic prospects because, as the factors of input (labour and capital devoted to production) cannot increase indefinitely, its gains enable an economy to produce more for the same amount of input.

There are large differences between Asia-Pacific countries in terms of labour productivity. If we consider the productivity as GDP per worker in US dollars, it is possible to split the Asia-Pacific region into two groups of countries. A first group composed of the developed countries such as Japan, Korea, Hong Kong and Australia, with a productivity rate similar to the US (102.6 thousand USD in 2012, at constant basic prices per worker using GDP 2011 PPP), and a second group made by the emerging economies, including the two largest economies of the area: China (16.9 thousand USD) and India (11.9 thousand USD), with values lower than 25% of the average American productivity rates.

The productivity increase during the last decades overturned this ranking and now emerging economies are registering growth rates higher than mature economies. China's relative performance against the US moved up from 2% in 1970 to 7% in 2000 and 16% in 2012; the corresponding figures are 6%, 8%, and 12% for India. The figures can be seen in Fig. 1-11.

Fig. 1-11: Labour Productivity Trends of China and India, 1970–2012
(GDP at constant basic prices per worker, using 2011 PPP, reference year 2012)

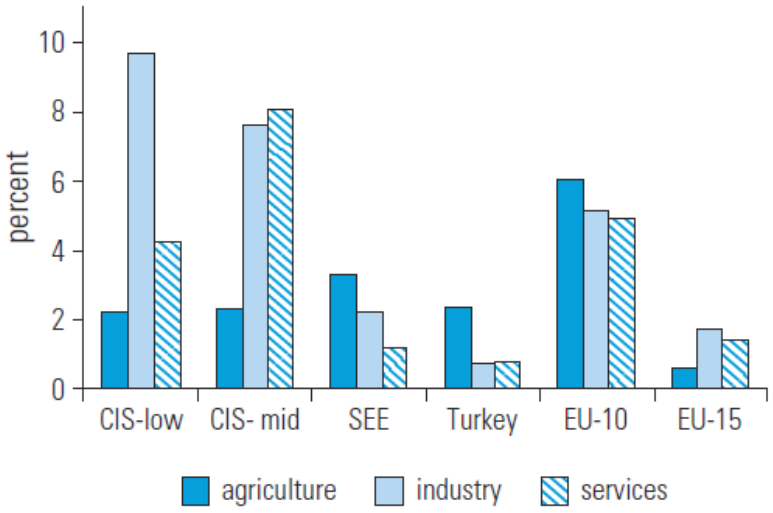


Source: Asian Productivity Organization

In the latest period, 2005–2012, China has been sustaining rapid productivity growth. Its growth accelerated to an average of 9.5% per year in 2005–2012 from 7.1% per year in 1995–2000 and 8.6% per year in 2000–2005. This compares with India at 6.9%, 3.4%, and 2.6% over the same periods. Labour productivity growth amongst the Asian Tigers was steady, ranging from 2.6% to 3.3% on average per year in 2000–2005. Japan's labour productivity growth performed closer to that of other mature economies. Broadly speaking, countries that are catching up faster with the US in per capita GDP are also catching up faster in labour productivity. Among the countries that are catching up with the US in per capita GDP, the Asian Tigers have made a tremendous effort in improving their relative labour productivity over the past four decades.

It is possible to observe similar increases in labour productivity for Central and North Asia countries. According to OECD, the labour productivity of CIS countries has increased with much greater rates than European countries, as shown in Fig. 1-12.

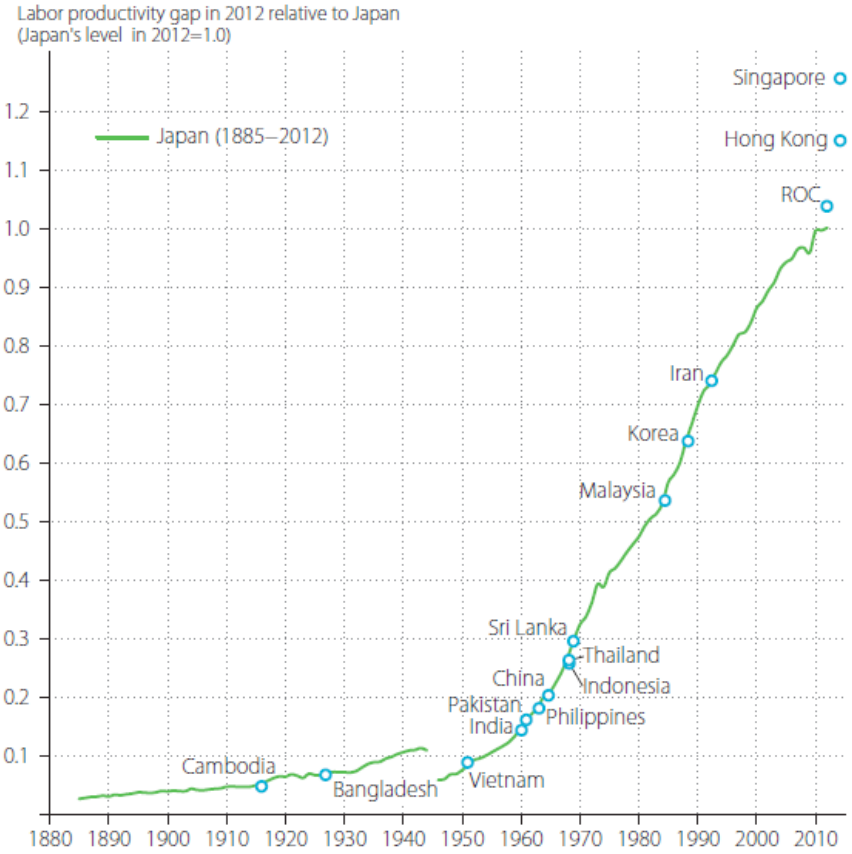
Fig. 1-12: Labour productivity growth in CIS countries, 1999-2004



Source: Organisation for Economic Co-operation and Development

It is important to observe that even with strong rates of growth, it will still take a long time for the productivity rates of less efficient countries to reach the productivity levels of countries currently more efficient, due to the significant differences between countries. It is possible to identify where countries are today in terms of hourly productivity performance against a backdrop of Japan's historical experience: the results are shown in Fig. 1-13. The two countries with the lowest hourly productivity in 2012 (Cambodia and Bangladesh) have levels corresponding to Japan's in the 1920s. Even if they manage Japan's long-term productivity growth of 2.9% on average per year, this means it will take them over a century to catch up with the Asian leader's current position. Even China, the country that has been leading the catch-up effort with productivity growing three times faster than Japan's long term average, is – as most Asian countries – clustered around Japan's level in the 1950s and early 1970s.

Fig. 1-13: Labour Productivity Trends of Japan during 1885–2012 and Levels of Asian Countries in 2012 (GDP at constant basic prices per hour, using 2011 PPP)



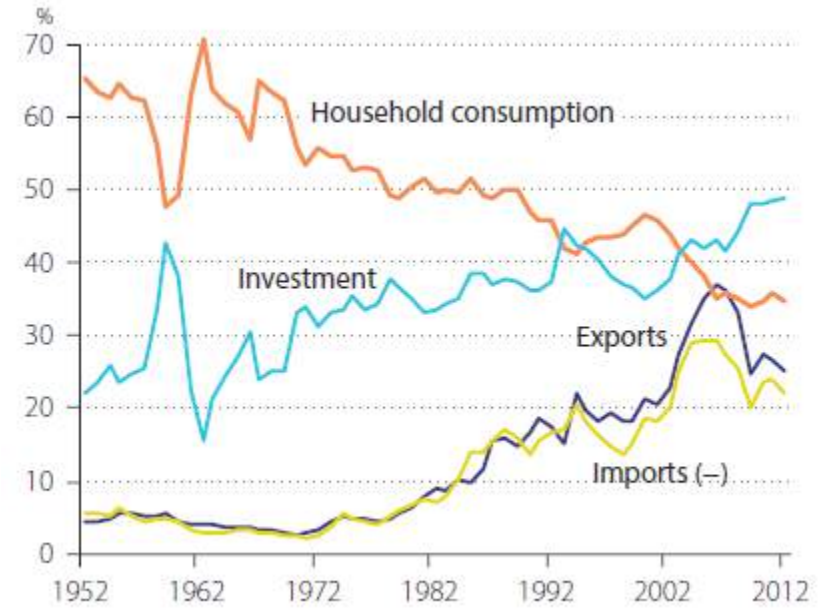
Source: Asian Productivity Organization

Even analysing the Asian productivity in a Total Factor Productivity (TFP) perspective, which is GDP per unit of combined input, the Asian emerging economies experienced faster TFP growth than the US over the period 1970-2012, with China sprinting away from the pack. Over the past four decades, economic growth in Asia has been predominantly explained by the contribution of capital input, but the role of TFP growth should not be underestimated. In the past two decades, the contribution of capital input (especially of non-IT capital) has been getting progressively smaller in Asia, falling to a share of below 55% on average, while the contribution of TFP is getting progressively more significant.

1.1.3 Expenditure

Household consumption is the biggest component of final demand in Asia-Pacific countries. In recent years the consumption ratio has dropped, largely reflecting the trend in China. China's household consumption has been trending downward as a share of GDP: it fell from 55.6% in 1970 to 46.7% in 2000, as displayed in Fig. 1-14. This compares with the early Communist era when household consumption was more volatile and at a higher level of over 60% of GDP: China was less well-off then. Household consumption share and investment share mirror each other: as the decline in household consumption share accelerated in the 2000s, plummeting to 34.7% in 2012, the investment share rose rapidly to 48.7% of GDP from 35.1% in 2000. Investment has overtaken household consumption as the largest component in GDP expenditure since 2004. There is also a notably rapid rise in exports as a share of GDP since the 1980s when China began to open its economy, with a peak of 37% in 2006 before softening to 24.9% in 2012. With a low consumption ratio, coupled with a huge rise in investment and exports, China faces strong internal and external imbalances.

Fig. 1-14: Final Demand Shares in GDP of China, 1952–2012
(Share of final demands with respect to GDP at current market prices)



Sources: Asian Productivity Organization

The share of household consumption in GDP tends to drop in the Asian countries that are undergoing rapid development as well. As countries get richer, the household consumption share tends to rise. Indeed, countries with low income and a high dependent population (under-15, over-65) sustain a high consumption ratio to GDP.

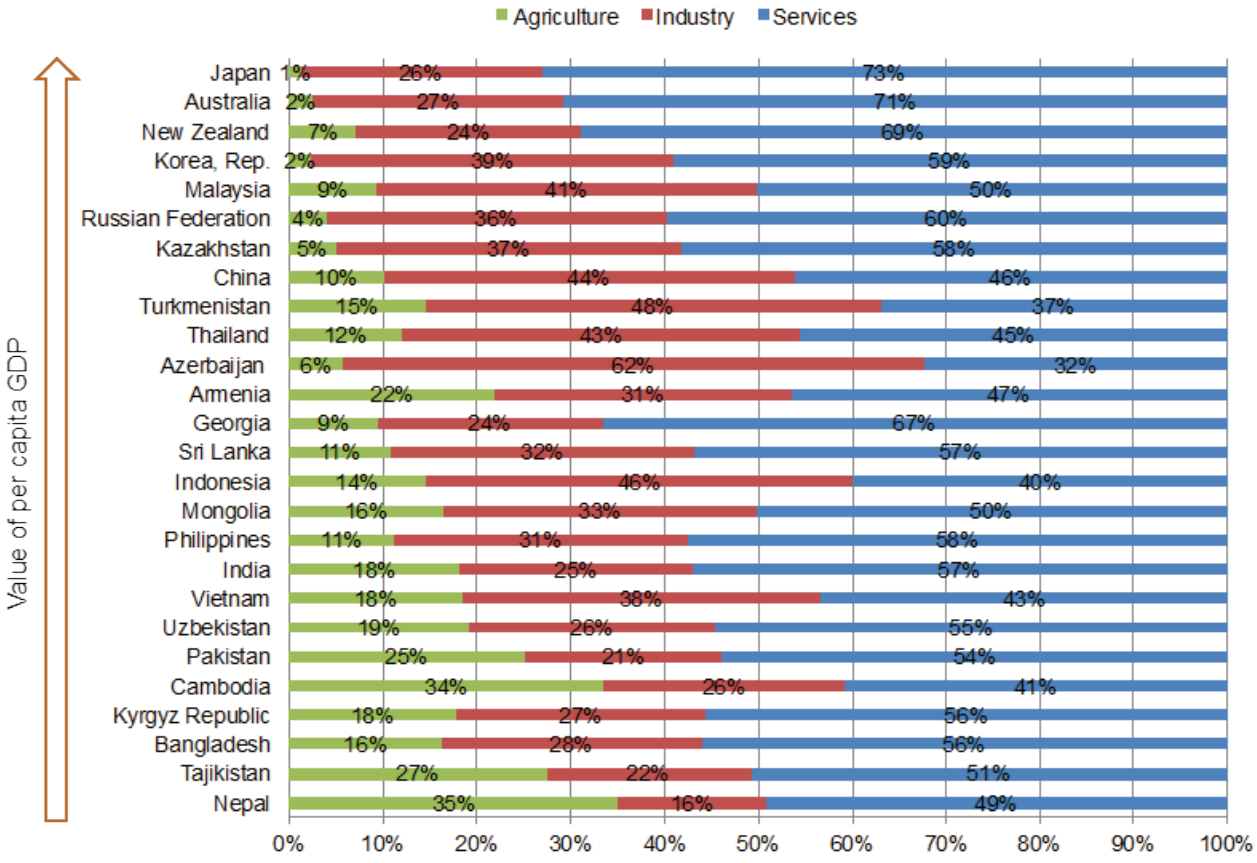
Overall, Asia invests more than the US/EU15 as a share of its GDP, and lately this gap has been widening. Australia's investment share is a particular case, as it has historically been in the middle between that of Asia and the US/EU15. Central and North Asian economies are unusually skewed toward net exports because of their large availability of raw materials, especially in the energetic field. South Asia is the only Asian region that consistently runs a fluctuating trade deficit over the years. Lately, it has become sizable at 7.6% of GDP in 2012.

Overall, Asian countries invest significantly more than the US and EU15 as a share of GDP. East Asia has the highest investment ratio among the Asian regions. While South Asia caught up in 2007, since then the paths of the two sub-regions diverged in opposite directions. Now South Asia is converging with ASEAN countries, the investment intensity of which has not recovered since the Asian financial crisis of the late 1990s.

1.1.4 Industry structure

It is possible to determine the path of economic development and identify the countries' respective stages based on their characteristics by analysing the industry structure of Asia-Pacific economies. A country's industry structure transforms with its economic development. Generally there is a negative correlation between the share of agriculture in total GDP and per capita GDP. As the income levels move up, finance, real estate and business activities increase.

Fig. 1-15: Asia-Pacific - Share of value added per sector (% of GDP), 2013[10]



Source: World Bank

Fig. 1-15 shows the industry structure of UIC Asia-Pacific region countries. Manufacturing is a significant sector, accounting for over 15% of total value added in most Asia-Pacific economies. It is particularly prominent in China, Korea, Thailand, Philippines, Malaysia, and Indonesia, in which higher productivity growths have been measured in 1990-2013. Manufacturing is dominated by machinery and equipment in the richer Asia-Pacific economies, while low-income countries are mostly oriented on light manufacturing such as textiles and the food industry, usually activities with lower added value.

Manufacturing is the most important sector for the Chinese economic growth between 1990 and 2012 and the contribution of the services sector has started to grow slightly during the last decade. The manufacturing sector has played a key role also for Thailand, Korea and Chinese Taipei, even during the Asian recession, but like in advanced economies, the services sector is equally important as the construction industry, real estate and financial sector, especially in Hong Kong.

10. Data not available for North Korea and Myanmar.

In ASEAN, the contribution of manufacturing was reduced to 25% in 2000–2012 from 33% in the 1990s, while wholesale and retail trade, hotels and restaurants increased from 16% to 18%. In contrast, growth in India has always been more driven by services, the contribution of which rose from 51% in the late 1980s to 64% in 2000–2012, while manufacturing usually contributes one-fifth or less.

It is the weight of the mining sector that defines the oil-exporting countries. Among Asia-Pacific countries the mining sector has the greatest share in Azerbaijan, Turkmenistan, Kazakhstan, Mongolia, Uzbekistan and Russia, all countries of North and Central Asia with respectively 38%, 34%, 32%, 27%, 21% and 18% of GDP. The oil-exporting countries have different industry structures from other countries: the mining sector is volatile and could determine rapid changes of economic growth reflecting the energy prices. For this reason Kazakhstan is diversifying its own industrial structure, while the Russian Federation has not managed to do the same.

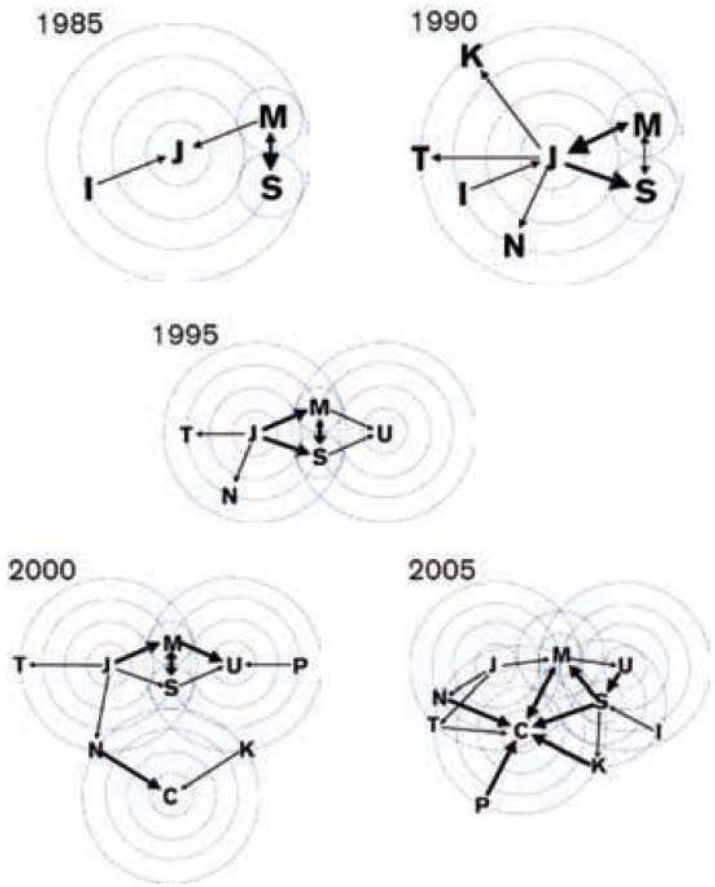
The agricultural sector is still very important for countries such as Myanmar, Nepal and Lao PDR. Generally, the agriculture output increased in all Asia-Pacific countries, showing that the lower contribution to the GDP is due to the relative rise of other sectors instead of a lower performance of the sector itself.

1.1.5 Global Value Chain

The extraordinary economic growth accompanying Asia-Pacific emerging economies coupled with the integration into global markets is largely due to the development of global supply chains and heightened international mobility of capital. The rapid development of information and communication technologies (the ICT revolution), the lower transportation costs and the vast wage differences between developed and developing nations allowed a more granular division of labour worldwide, generating the so-called "second unbundling" (Baldwin E. and WTO 2013). As is well known, the globalisation's second unbundling is marked by the reversal of the big income divergence between countries: the *South* industrialization corresponding to the *North* de-industrialisation, the rise of new form of trade, a new form of industrialisation path where it is faster to join rather than to build industrial supply chains and, finally, a new political economy of liberalisation accompanied by unilateral opening of borders by the new emerging economies. East Asia has been the most advanced region in taking advantage of the second unbundling. In 1985, there were only four key players in the region: Indonesia, Japan, Malaysia and Singapore. By 1990 the number of key players had increased with the addition of the Republic of Korea, Chinese Taipei and Thailand. Then in 1995, the United States came into the picture with Malaysia and Singapore becoming the supply chain bridges with East Asia. In the year 2000[11], China began to emerge as the third regional giant.

11. On the eve of China's accession to the WTO.

Fig. 1-16: Evolution of regional supply chains in East Asia: 1985–2005[12]



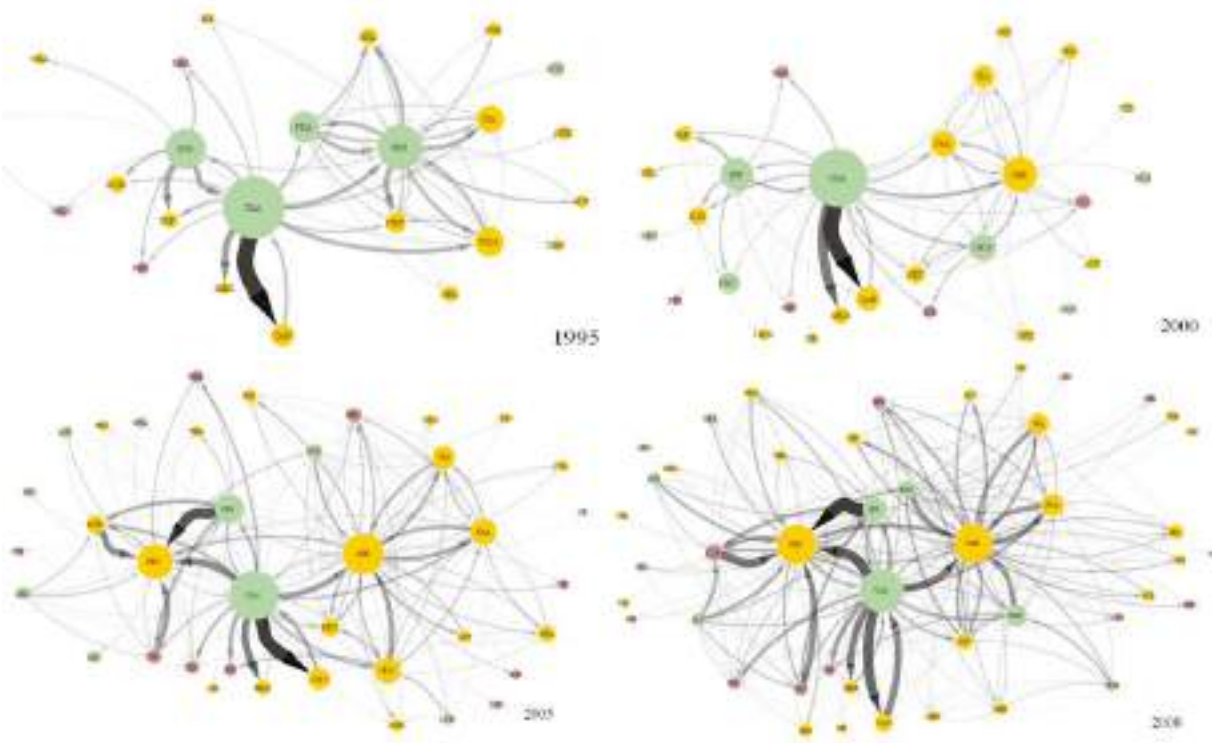
Source: World Trade Organization

Fig. 1-16 shows the evolution of supply chains in East Asia from 1985 to 2005. China entered the arena with strong production linkages to the Republic of Korea and Chinese Taipei. It then gained access to Japanese supply chains through the latter. The United States also brought in a new supply chain from the Philippines. Thus the basic structure of the tri-polar production network in the Asia-US region was completed showing, thereafter, a dramatic development. By 2005, the centre of the network had completely shifted to China, pushing the United States and Japan to the periphery. China became the core market for the products of the region from which final consumption goods were produced for export to the US and European markets.

As seen above, the global supply chain is really not very global but regional. Most of the large numbers – which indicate a strong supply chain relationship – are in the regional blocks, the so-called *Factory Asia*, *Factory North America*, and *Factory Europe*. The analysis of regional value chains shows how the Asian subcontinent and North and Central Asia are not part of the same value chain. As shown in the map in Fig. 1-17 where there are only the top 5% of bilateral trade flows connections over time, the Russian Federation is much more connected with Germany than with China. The Russian Federation's participation in global value chains is mainly driven by downstream links. This high degree of forward participation is, among others, closely linked to Russia's large exports of natural resources.

12. China(C), Indonesia (I), Japan (J), Republic of Korea (K), Malaysia (M), Philippines (P), Singapore (S), Thailand (T), Chinese Taipei (N) and United States (U).

Fig. 1-17: Value added embodied in countries' gross exports, based on the OECD-WTO TIVA database[13]



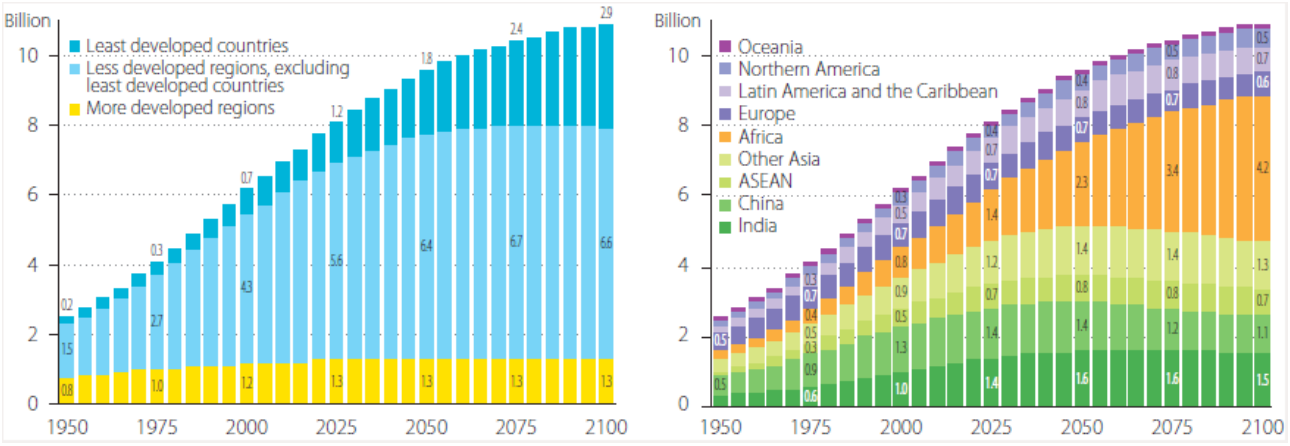
Source: Ferrarini B. (2013)

1.1.6 Population and Urbanisation

According to the United Nations, the world's population is estimated to reach 7.1 billion in 2012, of which Asia-Pacific countries account for 57%. The region is by far the most populous in the world. China and India account for 19.4% and 17.5% of the world's population, respectively. The growth rate of the world's population has slowed from its peak of around 2% in the 1970s to today's 1.20% per year. With falling fertility rates, the UN projects that the world's population growth rate will decelerate to 0.49% per year by 2050. Even so, the world population will still increase by one-third in the next 40 years, from 6.9 billion to 9.5 billion and a further 13% to 10.8 billion by 2100. Much of this increase is expected to come from high-fertility countries in Africa, Asia and Latin America (see Fig. 1-18).

13. A force-directed algorithm is applied to lay out the data as network maps. The size of the nodes is relative to the countries' total gross exports. The width of the edges is relative to the intensity of value-added transfers. Green nodes (80-100%) denote countries with the highest share (top quintile) of domestic value added as a share of total gross exports. Orange (60-80%) and pink nodes (40-60%) correspond to countries whose exports embody higher shares of foreign value added.

Fig. 1-18: Distribution of the World's Population in Different Regions, 1950–2100

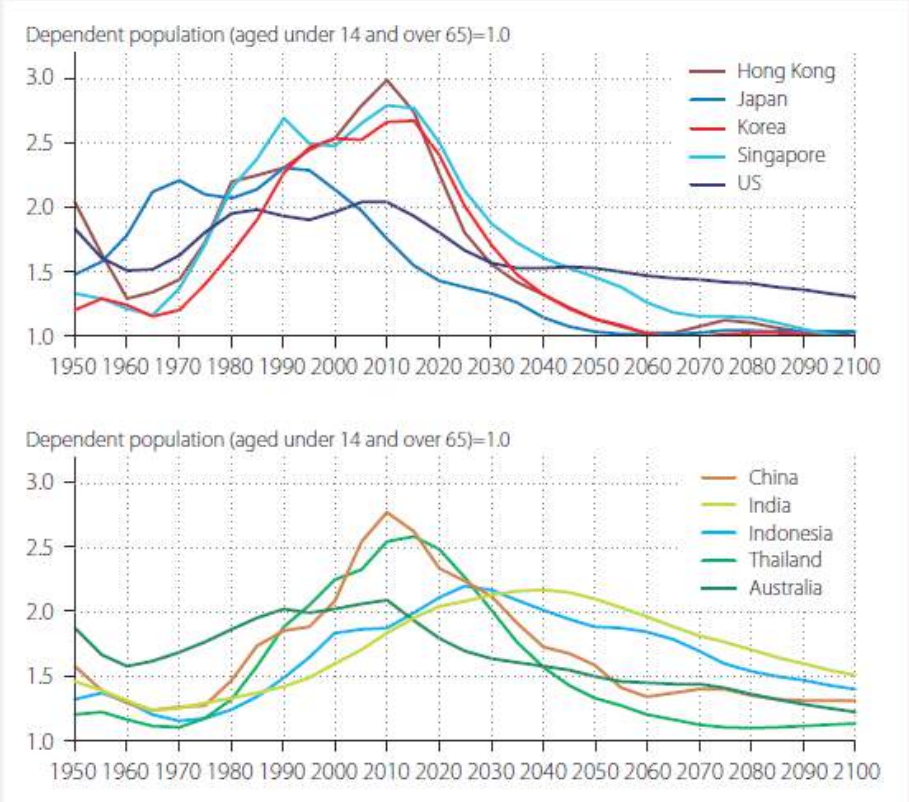


Source: APO elaboration on UN Department of Economic and Social Affairs data (World Population Prospects: The 2012 Revision)

According to the projections, Asia's share will decline from its 57% today to 54.1% in 2050 and 43.4% in 2100. China's population is expected to more or less stabilize around the current level. China has socially engineered the change with its one-child policy, which has made its current population 300–400 million lower than it would have been otherwise. In less than two decades, India is projected to overtake China as the most populous country in the world. The world's fertility rate is converging to the replacement level (the level at which a country's population stabilizes). The rapid ageing of societies is a particular concern in Japan, Republic of Korea and PRC, while Pakistan, the Philippines and many Central Asian republics still have high population growth rates.

The ratio of the working population (aged 15-64) to dependent population (aged under 14 and over 65) since 1950 and up to 2100 (UN projections) is expected to change over time. The higher the ratio, the more favourable its demography for economic growth: a favourable demography can produce a virtuous cycle of wealth creation if it is combined with appropriate health, labour, financial, human capital and effective economic policies. Japan could have capitalized the *demographic dividend* in the 1960s, when its GDP growth was over 10% on average per year for ten years. Similarly China, Hong Kong, Korea, Singapore, and Thailand experience such a *demographic dividend* in the 2000s and 2010s, whereas, based on projections, Indonesia will have to wait for such opportunity until the 2020s and 2030s, and India until the 2040s (see Fig. 1-19).

Fig. 1-19: Demographic Dividend, 1950–2100



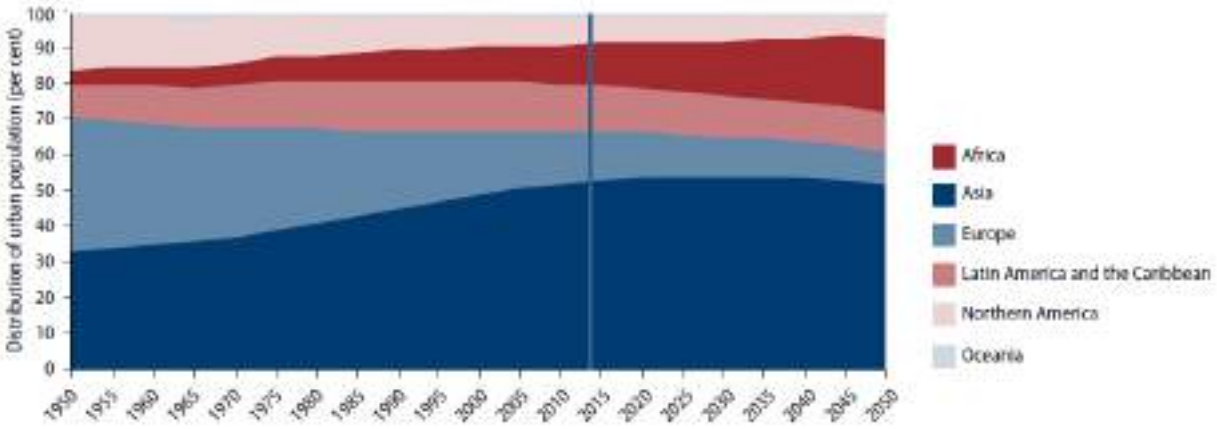
Source: APO elaboration on UN data, World Population Prospects: The 2012 Revision.

Over the past six decades the world has gone through a process of rapid urbanisation. In 1950, 70% of people worldwide lived in rural settlements and 30% in urban settlements. In 2014, 54% of the world's population is urban. According to the UN, this tendency of a continuous increase in urban population will continue at least until 2050 when the distribution between cities and countries will be reversed compared to 1950.

The population of Asia[14] is still for the most part rural when compared to other parts of the world, the Americas and Europe in particular; still, it is the region of the world that according to UN will have the highest urbanisation rates together with Africa, reaching 64% of population in 2050. An apparent paradox is that a vast majority of the world's rural inhabitants live in Asia, but the projected growth is fastest. India has the largest rural population (857 million), followed by China (635 million). Together, these two countries account for 45 per cent of the world's rural population. Bangladesh, Indonesia and Pakistan follow, each with over 100 million rural inhabitants. Despite its lower level of urbanisation though, 53% of the urban population in the world lives in Asia, as shown in Fig. 1-20.

14. As said earlier, the UIC Asia-Pacific region is larger than the Asia region considered by UN; however, in terms of description of demographic trends this distinction is irrelevant.

Fig. 1-20: Distribution of urban population in the world, 1950-2050



Source: UN

China has the largest urban population (758 million), followed by India (410 million). These two countries account for 30% of the world's urban population and the strongest increase in the world's urban population in the future. Between 2014 and 2050, the urban areas are expected to grow by 404 million people in India and 292 million in China.

In 1990 there were 10 cities with more than 10 million inhabitants, half of which in Asia (see Fig. 1-21). Today, the number of megacities has nearly tripled to 28: 16 of those are in the Asia-Pacific region. Tokyo is the world's largest city with an agglomeration of 38 million inhabitants, followed by Delhi with 25 million, Shanghai with 23 million, and Mumbai is sixth with around 21 million inhabitants. By 2020, Tokyo's population is projected to begin to decline, although it will remain the world's largest agglomeration in 2030 with 37 million inhabitants, followed closely by Delhi, whose population is projected to rise swiftly to 36 million.

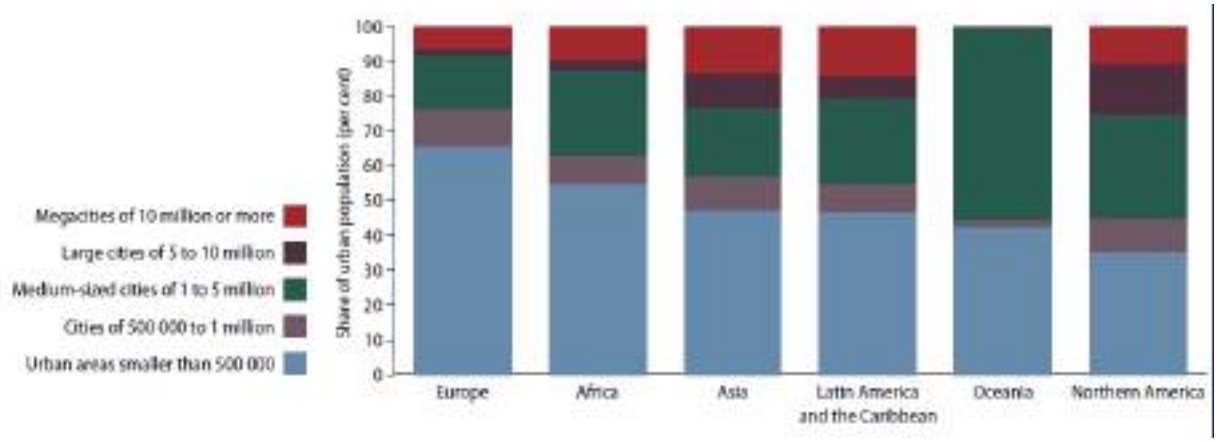
Fig. 1-21: Location of urban agglomerations with at least 500 000 inhabitants, 2014

Source: UN

China alone has six megacities and ten cities with populations between 5 and 10 million in 2014, and it will add one more megacity and six more large cities by 2030. Four of India's cities with 5 to 10 million inhabitants presently are projected to become megacities in the coming years (Ahmadabad, Bangalore, Chennai and Hyderabad), for a total of seven megacities projected in the country by 2030. Outside of China and India, Asia has 7 other megacities and 11 other large cities in 2014.

This being said, in Asia most of the urban population is concentrated in areas with less than 500 000 inhabitants, as shown in Fig. 1-22; and the fastest growing urban agglomerations are medium-sized cities and cities with less than 1 million inhabitants located in Asia. Some cities have experienced population decline since 2000, most of which are located in low-fertility countries of Asia, and between these a few cities in Japan and the Republic of Korea (for example, Nagasaki and Busan) and several cities in the Russian Federation have experienced population decline between 2000 and 2014.

Fig. 1-22: Population distribution by city size varies across major areas in 2014



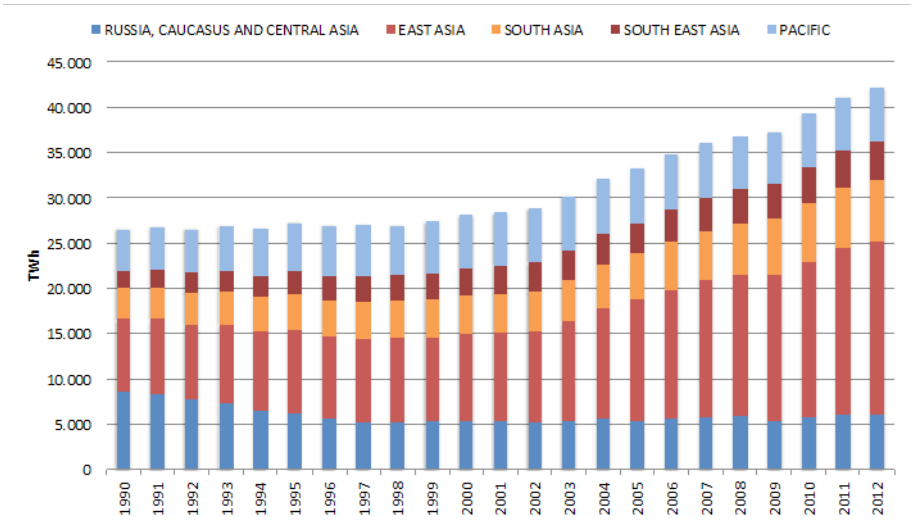
Source: UN

1.2 IMPACTS

1.2.1 Energy, emissions, environment

Despite a slight downturn due to the economic recession that emerged in 2009, Asian energy demand has continued to rise, driven by population increase and rapid economic growth. As shown in Fig. 1-23, the final energy consumption of the region nearly doubled in 22 years, going from 26 536 TWh in 1990 to 42 183 TWh in 2012, with an average annual increase of 2.13%.

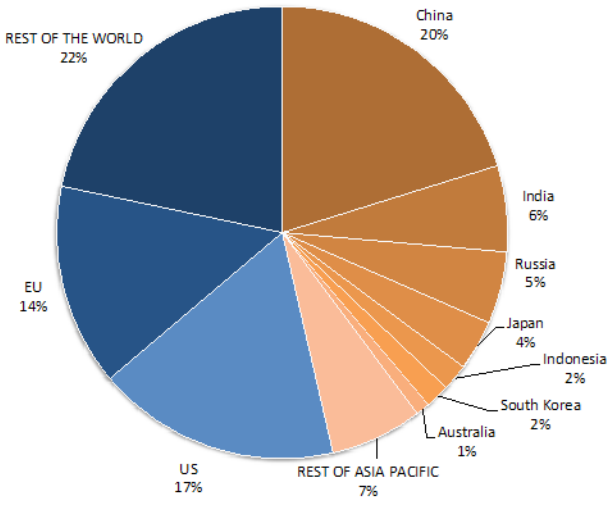
Fig. 1-23: Final energy consumption in the 5 sub-regions



Source: Susdef elaboration on World Bank Data

The region accounted for more than 46% of global energy demand in 2012, as can be seen in Fig. 1-24. The UIC Asia-Pacific region's share of global energy demand far exceeds the shares of Europe and North America, which were about 15% and 18%, respectively. Due to population growth and rapidly rising incomes in the PRC over the last 2 decades, its share of the region's energy use now exceeds 50%. The PRC consumes over three times as much energy as India and nearly six times that of Japan.

Fig. 1-24: Energy Use by Global Region and by Economy in Asia-Pacific, 2012



Source: Susdef elaboration

The largest contributor to the growth in energy demand is the East Asia region, i.e. mainly the Popular Republic of China; East Asia's consumption grew by an average of 4.10% annually. This growth actually went up to 6.75% annually in the 2001-2012 timeframe, which means quadruplicating the energy consumption in 20 years.

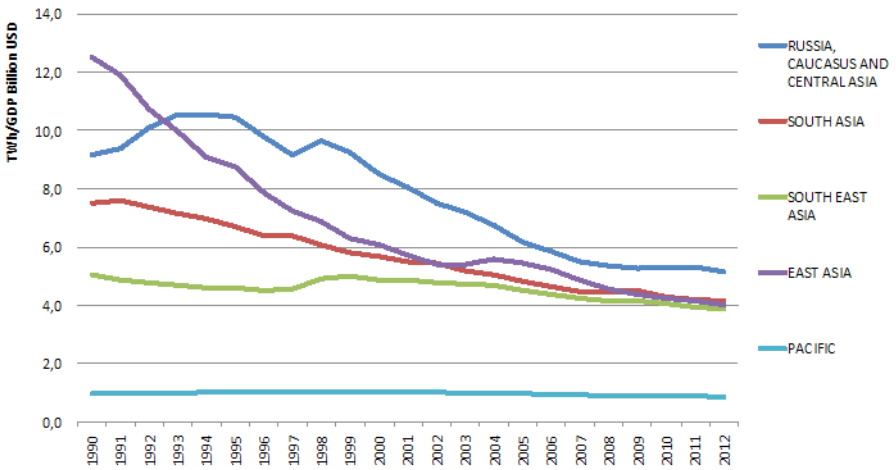
The South-East Asia and South Asia sub-regions have slightly lower growth rates, respectively 3.65% and 3.26%. Those are extremely high rates, that – if sustained – will cause energy consumption to double in 20 years.

The Pacific sub-region increases its consumption with an annual average growth of 1.12%, while the Russia-Caucasus-Central Asia sub-region actually registers a drop in energy consumption, going from 8.67 TWh in 1990 to 6 TWh in 2012. Nevertheless, these two sub-regions – which together make up 14% of the total consumption in the UIC Asia-Pacific region – have higher pro-capita consumption than the other sub-regions: twice that of East Asia, four times South-East Asia and 7 times higher than South Asia.

Looking in particular at electricity consumption, it is interesting to note that per capita electricity consumption rose by at least 200% in 13 developing member economies of the region between 1990 and 2011. That same consumption decreased in North and Central Asia due to considerable price increases for power.

As can be seen in Fig. 1-25, the quantity of final energy needed to produce a point of GDP has decreased, but not radically when compared to the absolute growth rate of consumption, especially in the last decade. The performance of the different sub-regions shows that the advanced economies (the Pacific sub-region) have lower energy intensity over GDP. This clearly indicates that population and economic growth must be decoupled from energy demand in emerging economies.

Fig. 1-25: Energy consumption intensity over GDP



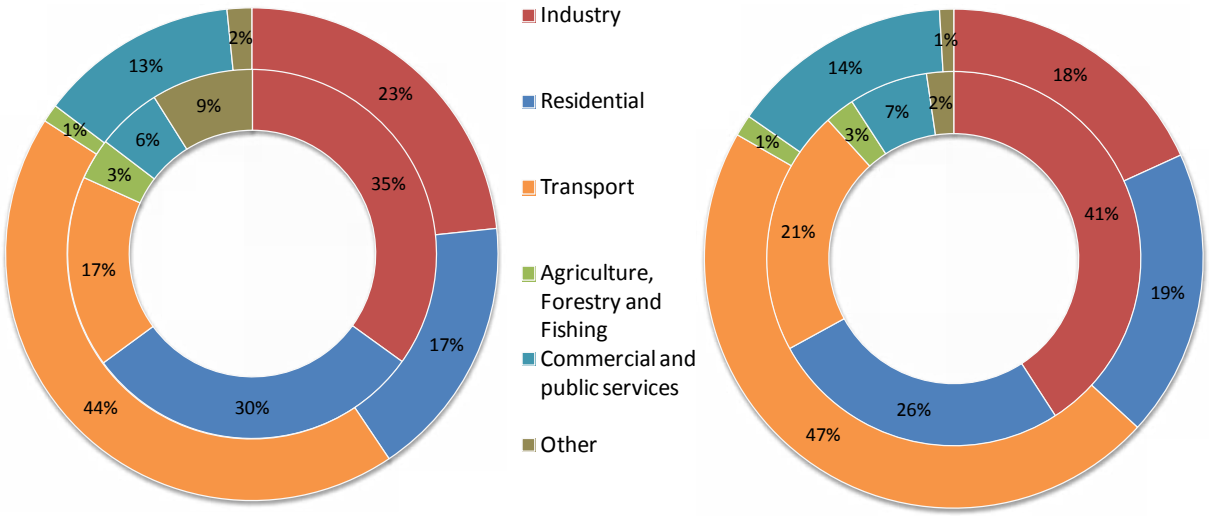
Source: Susdef elaboration

With these growth rates, the increase in energy consumption implies a progressively larger claim on global energy resources. Most Asian economies require imports in order to meet energy demand. PRC, a net exporter of energy until the early 1990s, has now become a large importer of oil; the oil import volume of 4 million barrels per day (mb/d) in 2009 is projected to reach 20 mb/d by 2050. Rapid growth in gas demand resulted in initiating LNG imports in 2006; gas imports are projected to reach 174 billion cubic meters (bcm) by 2050.

India's oil import volumes increased from 1.6 mb/d in 2000 to 2.5 mb/d in 2009 and are expected to reach 14 mb/d by 2050. India would also need to increase its gas imports at a rather rapid pace, particularly after 2020, to reach 140 bcm by 2050. The ASEAN countries, once major exporters of oil and gas, have now become net importers of oil, and are likely to become net importers of gas in the next three decades. The oil import requirement is expected to reach 2.8 mb/d by 2030 and 5.4 mb/d by 2050 while oil import dependency increases from 25% in 2008 to 88% in 2050. Energy production in North-Central Asia amounted to about 320 million tonnes of oil equivalent (Mtoe) in 2007, half of which was exported. The total oil production in the sub-region was 2.5 mb/d and is expected to reach 5.4 mb/d in 2030, driven by an increase in Kazakhstan's oil production. Turkmenistan also has substantial gas resources, estimated at 7.9 trillion cubic feet (tcf), to sustain exports in the long-term. The Russian Federation's gas supply is expected to expand from 646 bcm in 2007 to 920 bcm in 2050 (ADB 2011).

The share of economic sectors in final energy consumption has not changed drastically between 1990 and 2012 in the UIC Asia-Pacific region. Industry has grown from 34% to 41% and transport from 17% to 21%, while the residential sector consumption has decreased from 30% to 26% (see Fig. 1-26). A comparison with the US shows how the share of final energy consumption is radically different: in the United States, transport is the most energy-hungry sector, while in Asia-Pacific this role is taken by the industry sector.

Fig. 1-26: Asia-Pacific (inside) and US (outside) final energy consumption by sector – 1990 (left) and 2012 (right)

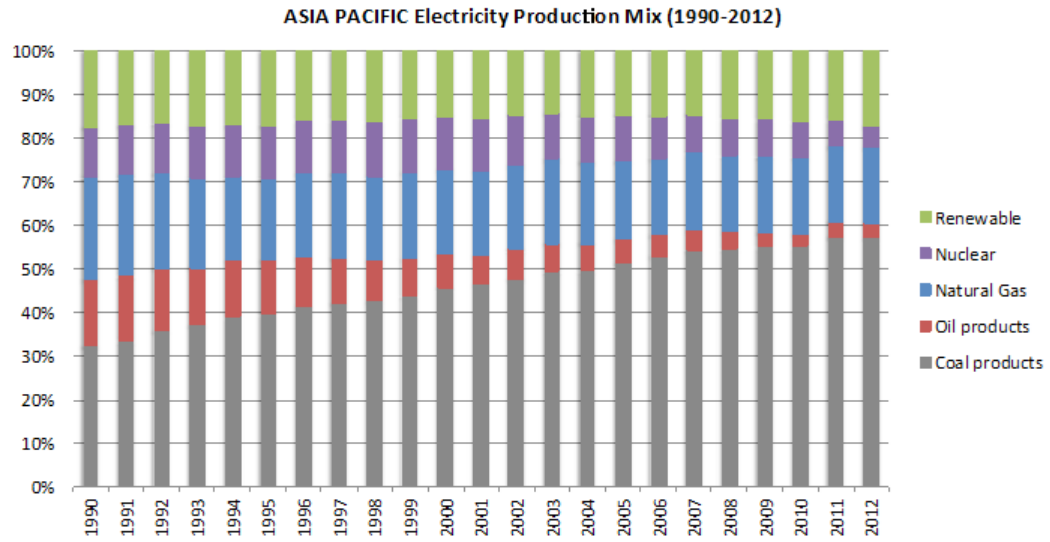


Source: Susdef elaboration on World Bank Data

In global final energy demand, oil products continue to dominate, accounting globally for 40% of final energy demand in 2012 (particularly for transport). In Asia-Pacific, the share of oil products in final energy demand is slightly lower at 31%.

Worldwide, electricity comes second with a share of 18%, increasing rapidly. In recent years, most growth in electricity demand has occurred in non-OECD countries. China (with a 22% share) overtook the United States in 2012 to become the world's largest electricity producer. In absolute terms, electricity demand growth is largely covered by fossil fuels: between 2001 and 2011, coal accounted for 59% of the increase in electricity generation in non-OECD countries, whereas natural gas (86% share of growth) was the fuel of choice in OECD countries (IEA 2014). Fig. 1-27 shows the growing importance of coal and gas in Asia (57% and 17% respectively in 2012)and the trend of the last two decades.

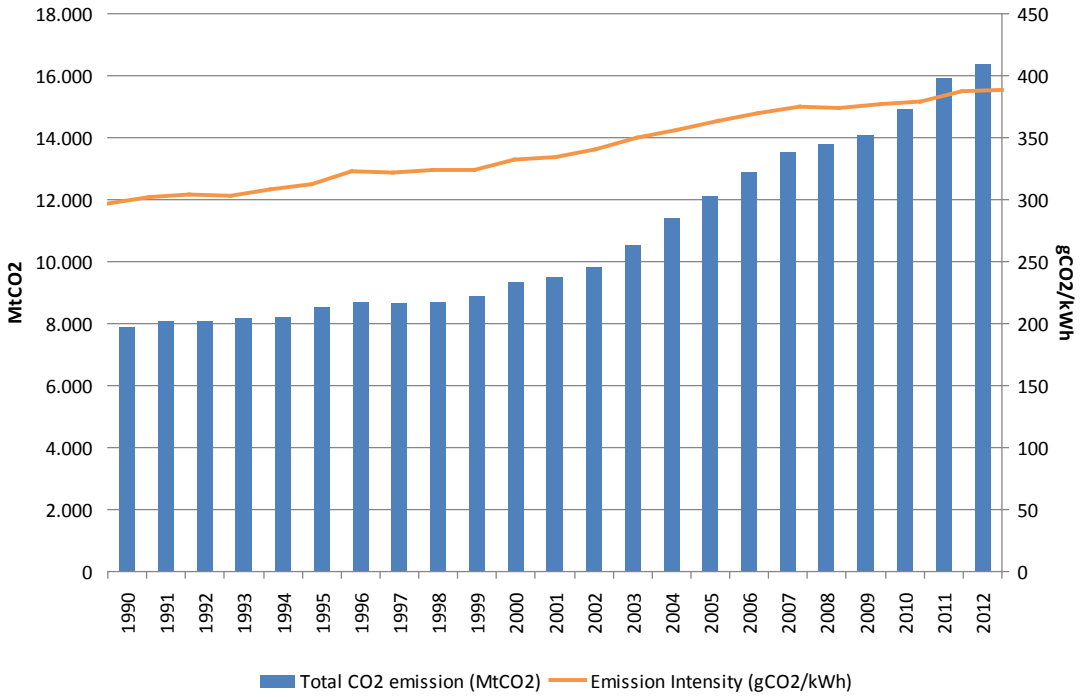
Fig. 1-27: Electricity production mix trend in the UIC Asia-Pacific region, 1990-2012



Source: Susdef elaboration

The Asia-Pacific region is characterised by an out-dated electric production system, a massive use of coal and a strong dependence on fossil fuels in the transport sector. This implies an increase of CO_2 emissions with rates even higher than for energy consumption increase. The Asia-Pacific CO_2 emissions have more than doubled in the last 22 years, mainly because of an upsurge in energy consumption but also due to the constant rise of the carbon intensity per unit of consumed energy. This is clearly demonstrated by the trends in Fig. 1-28.

Fig. 1-28: Trend of CO2 Emissions (left) and carbon intensity of final energy used (right), 1990-2012



Source: Susdef elaboration

East, South and North-Central Asia are the sub-regions with the poorest performance in this area: the average annual rate of carbon intensity increase between 1990 and 2012 was respectively 5.3%, 2.7% and 2.6%. The efficiency of Asia-Pacific electric plants is low on average: for instance, the average efficiency of India's coal-fired power plants is 33.1%. Specific emissions from its coal plants, at over 1 100 gCO_2/kWh, are well above the global state-of-the-art level of around 750 gCO_2/kWh. The share of CO_2 emissions amplifies the weight of the East Asia sub-region (i.e. China) which accounts for around 52% of emissions, compared to 45% of energy consumption.

1.2.2 Social development

There are no concurrent estimates on the global number of people that in the last few years have managed to get above the poverty threshold, commonly defined at $1/day of income per person. Some authors estimate that between 2005 and 2010, the total number of poor people around the world fell by nearly half a billion people, from over 1.3 billion in 2005 to under 900 million in 2010 (Chandy, Gertz 2011 – see Table 1-2). There is complete agreement, nonetheless, that the sharpest fall in poverty occurred in Asia thanks to the huge economic growth attained in the last decades.

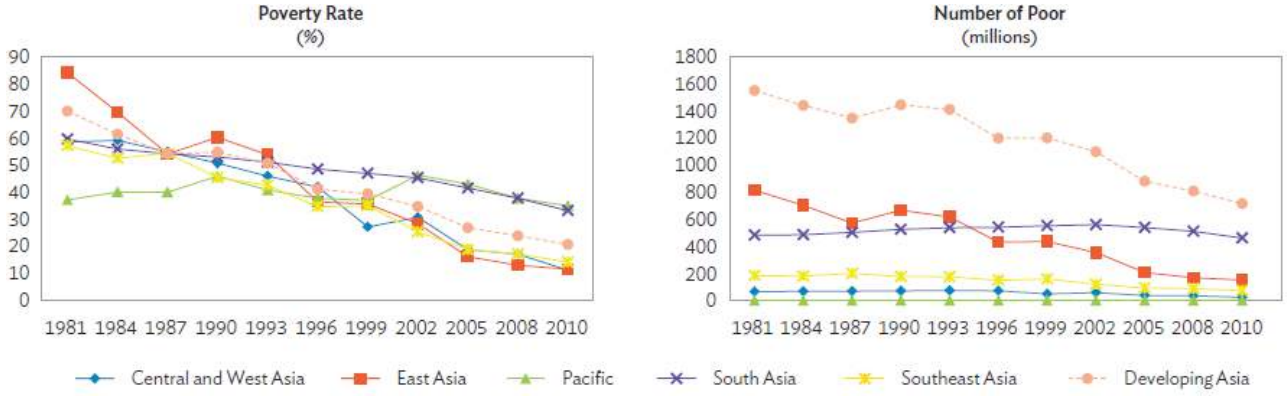
Table 1-2: Regional and Global Poverty, 2005, 2010, 2015

	Number of poor (millions)			Poverty rate (% population)		
	2005	2010	2015	2005	2010	2015
East Asia	304.5	140.4	53.4	16.8%	7.4%	2.7%
Europe and Central Asia	16.0	8.4	4.3	3.4%	1.8%	0.9%
Latin America and Caribbean	45.0	35.0	27.3	8.4%	6.2%	4.5%
Middle East and North Africa	9.4	6.7	5.4	3.8%	2.5%	1.9%
South Asia	583.4	317.9	145.2	40.2%	20.3%	8.7%
Sub-Saharan Africa	379.5	369.9	349.9	54.5%	46.9%	39.3%
World	1,337.8	878.2	585.5	25.7%	15.8%	9.9%

Source: Chandy, Gertz 2011

From 1990 to 2010, in Asia the number of extremely poor declined by 745.4 million –against 693.5 million globally. Asia also stands out if the "moderate poverty" line of $2/day/person is used: the number of moderately poor declined by 566.31 million in Asia between 1990 and 2010, while increasing far less in other regions, as shown in Fig. 1-29. Within Asia, poverty reduction has varied across sub-regions and by economy. East Asia – led by the People's Republic of China (PRC) – has done best by far. Extreme poverty fell from about 60.2% in 1990 to 11.6% in 2010, with the PRC reducing the number of extremely poor by 527.64 million. India, the second most populous country, reduced its extremely poor by 48.26 million (ADB 2014).

Fig. 1-29: Poverty rate (left) and number of poor (right) trend in Asia, 1981-2010



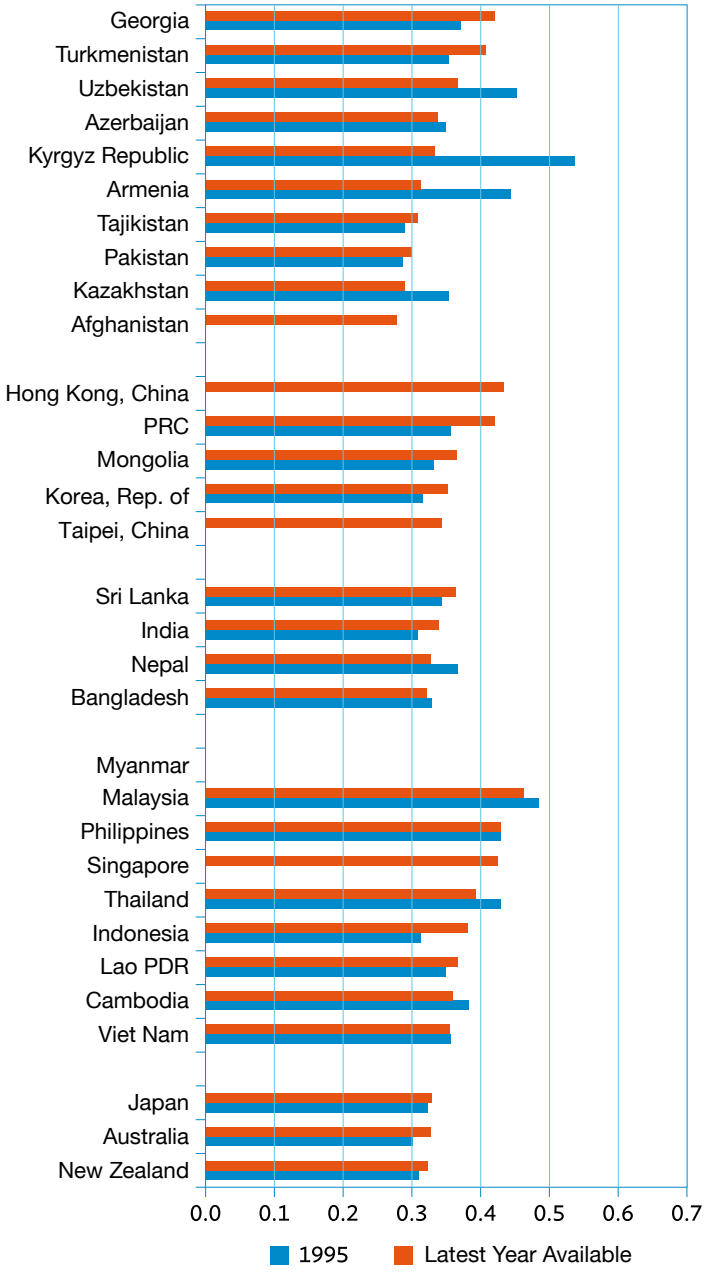
Source: ADB 2014

For the Asia-Pacific region, the extreme poverty rate is projected to decline from 20.7% in 2010 to 12.7% in 2015, 5.8% in 2020 and about 2.5% in 2025. Using World Bank $1.25 poverty line criterion, this means extreme poverty will be technically "eradicated" by 2025. These projections support other studies even more optimistic.

Still, some researchers consider that for Asia and the Pacific, the $1.25 poverty line is inadequate because its underestimates the minimal costs actually faced by the poor. Recently ADB has dedicated an in-depth analysis on this topic, coming to the conclusion that by updating and contextualising the poverty evaluation parameters to the Asia-Pacific socio-economic reality, there were almost 1.75 billion extremely poor people in Asia in 2010, not the 733.06 million commonly reported using the $1.25 poverty line. In 2030, the number of extremely poor could still be more than 700 million, or 17.1% of the region's population, indicating that poverty reduction will remain a major Asian development challenge for decades to come.

Despite Asia's recent growth resulting in a dramatic decrease in poverty, income inequalities have continued to rise. Inequality as measured by the Gini coefficient (see Fig. 1-30) has been rising in a number of countries in Asia-Pacific. Another indicator of inequality, the ratio of the income of the top quintile to the income of the bottom quintile of the population, is relatively high – ranging between 6 and 9 in a number of countries – and in a few cases increasing.

Fig. 1-30: Gini Coefficient, 1995 and Latest Year Available

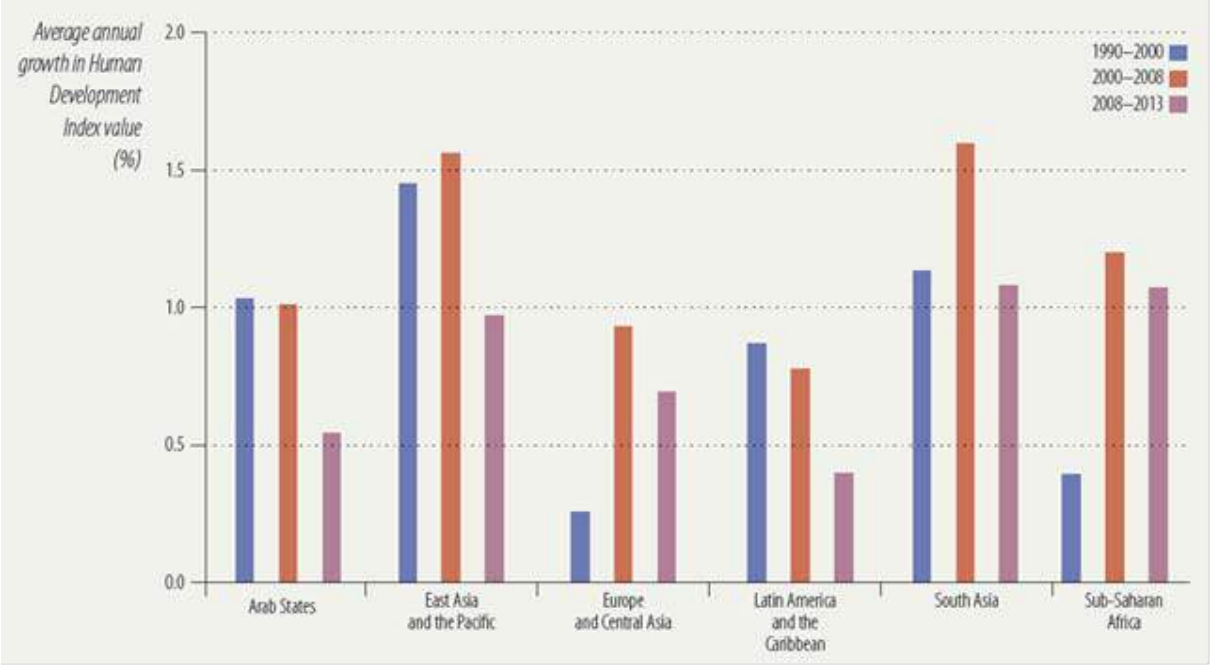


Source: World Bank

The analysis of Millennium Development Goals (MDG) indicators shows that the Asia-Pacific region is generally aligned to the targets. Most of the economies have achieved the target of halving extreme poverty; progress has been made in generating decent jobs as reflected in the decline in the proportion of the working poor. The developing economies in the region have made substantial progress toward universal primary education, gender parity, reduction of child mortality, improvement of maternal health.

According to the *Human Development Report 2014, Sustaining Progress: Reducing Vulnerabilities and Building Resilience* (UNDP 2014), most AP developing countries are continuing to advance, although progress slowed in 2008–2013, compared to 2000-2008.

Fig. 1-31: Improvement on the Human Development Index



Source: UNDP

The deceleration is evident in all three components of the Human Development Index (HDI): growth in gross national income (GNI) per capita (particularly in Central Asia); growth rates of life expectancy at birth and growth of expected years of schooling.

Asian Development Bank argues (ADB 2014) that developing economies in Asia-Pacific region have made substantial progress toward universal primary education, gender parity, reduction of child mortality, improvement of maternal health.

Though there has been general improvement in expected primary school completion, fewer economies have achieved the 95% target. The expected primary school completion rates improved in most economies, and there had been significant increases in primary school completion rates in Cambodia, the Lao PDR, Mongolia, and Tajikistan. However, only 16 economies are expected to achieve this target by 2015, and these do not include the most populated economies of Bangladesh, India, Indonesia, Pakistan, and the PRC.

The Lao People's Democratic Republic (Lao PDR) had made the greatest improvement in net enrollment with increases of at least 30 percentage points. A few economies however—including Azerbaijan, Indonesia, the Philippines and Sri Lanka—have regressed. The largest declines in net enrollment ratios in primary education were in the Philippines and Sri Lanka with reductions of 9.8 and 5.9 percentage points, respectively.

The literacy rates of 15–24-year-olds, mostly over 95%, are generally high across the region. However, in several economies where the youth literacy rates are below 85%, gender disparity is in favor of males.

Central and West Asia (excluding Pakistan), PRC and some Pacific economies reported youth literacy rates of at least 99%.

Fig. 1-32: Human Development Index and Its Components: Education[15]

HDI RANK		Human Development Index (HDI)	Literacy rate		Gross enrolment ratios			Education quality						
			adult	youth	Population with at least some secondary education	Pre-primary	Primary	Secondary	Tertiary	Primary school dropout rates	Primary school teachers trained to teach	Performance of 15-year-old students (*Average score OECD countries)			Primary school teachers trained to teach	Pupil-teacher ratio, primary school	Public expenditure on education
												Reading (*496)	Mathematics (*494)	Science (*501)			
			(% ages 15 and older)	(% ages 15-24)	(% ages 25 and older)	(% of children of pre-age school)	(% of primary school age population)	(% of secondary school age population)	(% of tertiary school age population)	(% of primary school cohort)	(%)				(%)	(number of pupils per teacher)	(% of GDP)
2	Australia	0,933			97,1	95	104	133	83	0,7		512	504	521			5,1
7	New Zealand	0,910			95,2	93	100	120	81			512	500	516		14,6	7,4
15	Republic of Korea	0,891			82,9	118	104	97	101	1,0		536	554	538		17,9	4,9
17	Japan	0,890			86,4	87	103	102	60	0,1		538	536	547		17,1	3,8
57	Russian Federation	0,778	99,7	99,7	90,9	90	99	85	75	3,9		475	482	486		19,6	4,1
62	Malaysia	0,773	93,1	98,4	69,4	78	101	67	37	0,8		393	432	425		16,5	3,1
70	Kazakhstan	0,757	99,7	99,8	99,3	54	105	98	45	0,7		398	421	420		12,1	5,9
73	Sri Lanka	0,750	91,2	98,2	74	87	99	99	14	2,7	82				82	24,4	1,7
76	Azerbaijan	0,747	99,8	100	95,5	27	96	100	20	1,8	100				95	9,1	2,0
79	Georgia	0,744	99,7	99,8	92	58	106	87	28	6,9	95				100	11,9	2,4
87	Armenia	0,730	99,6	99,8	94,4	51	102	96	46	4,4	77				77	19,3	2,3
91	China	0,719	95,1	99,6	65,3	62	128	87	24			570	613	580		18,2	
103	Mongolia	0,698	97,4	95,7	84,7	86	117	103	61	7,0	99				100	27,6	5,5
103	Turkmenistan	0,698	99,6	99,8													3,0
108	Indonesia	0,684	92,8	98,8	44,5	42	109	81	27	12,0		396	375	382		18,6	3,6
116	Uzbekistan	0,661	99,4	99,9		25	93	105	9	1,9	100				100	15,6	
117	Philippines	0,660	95,4	97,8	64,8	51	106	85	28	24,2						31,4	3,4
121	Viet Nam	0,638	93,4	97,1	65	77	105		25	2,5	100	508	511	528	100	18,9	6,3
125	Kyrgykistan	0,628	99,2	99,8	95,6	25	106	88	41	2,9	72				72	23,9	6,8
133	Tajikistan	0,607	99,7	99,9	92,4	9	100	86	22	2,0	94				100	22,4	4,0
135	India	0,586	62,8	81,1	38,7	58	113	69	23							35,2	3,8
136	Cambodia	0,584	73,9	87,1	15,5	15	124	45	16	34,1	100				58	40,2	2,2
142	Bangladesh	0,558	57,7	78,7	26,7	26	114	51	13	33,8	58				100	46,9	2,6
146	Pakistan	0,537	54,9	70,7	33,2	49	93	37	10	39,9	84				85	42,5	2,5
150	Myanmar	0,524	92,7	96,1	17,8	9	114	50	14	25,2	100				100	28,2	0,8

Source: UNDP on UNESCO, OECD and World Bank data

15. Adult literacy rate: Percentage of the population ages 15 and older who can, with understanding, both read and write a short simple statement on their everyday life. Gross enrolment ratio: Total enrolment in a given level of education (pre-primary, primary, secondary or tertiary), regardless of age, expressed as a percentage of the official school-age population for the same level of education. Performance of 15-year-old students in reading, mathematics and science: Score obtained in testing of skills and knowledge of 15-year-old students in these subjects essential for participation in society.

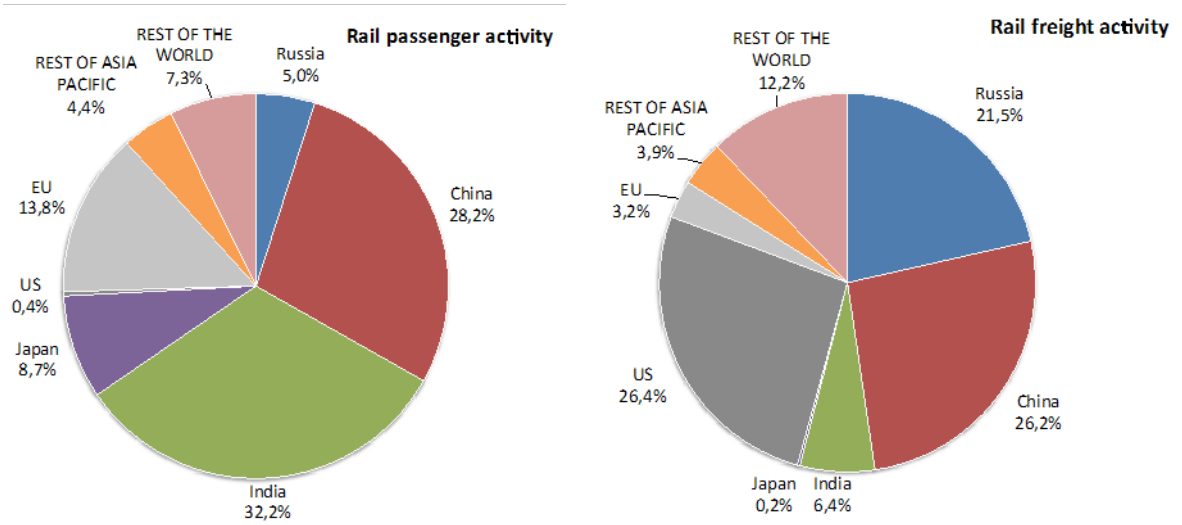
2. STATE OF THE ART OF THE RAILWAY SECTOR IN THE REGION

2.1 TRANSPORT AND RAIL ACTIVITY

2.1.1 Rail activity

The UIC Asia-Pacific region includes some of the largest world railway markets. As shown in Fig. 2-1 and Table 2-1, railway activity in Asia-Pacific in 2010 was 79% of global demand for passenger service and 58% for freight service. China, Russia and India alone account for 54% of rail freight transport worldwide and India, China, Russia and Japan account for 74% of passenger traffic.

Fig. 2-1: Share of rail activity of Asia-Pacific in the world, 2010



Source: UIC

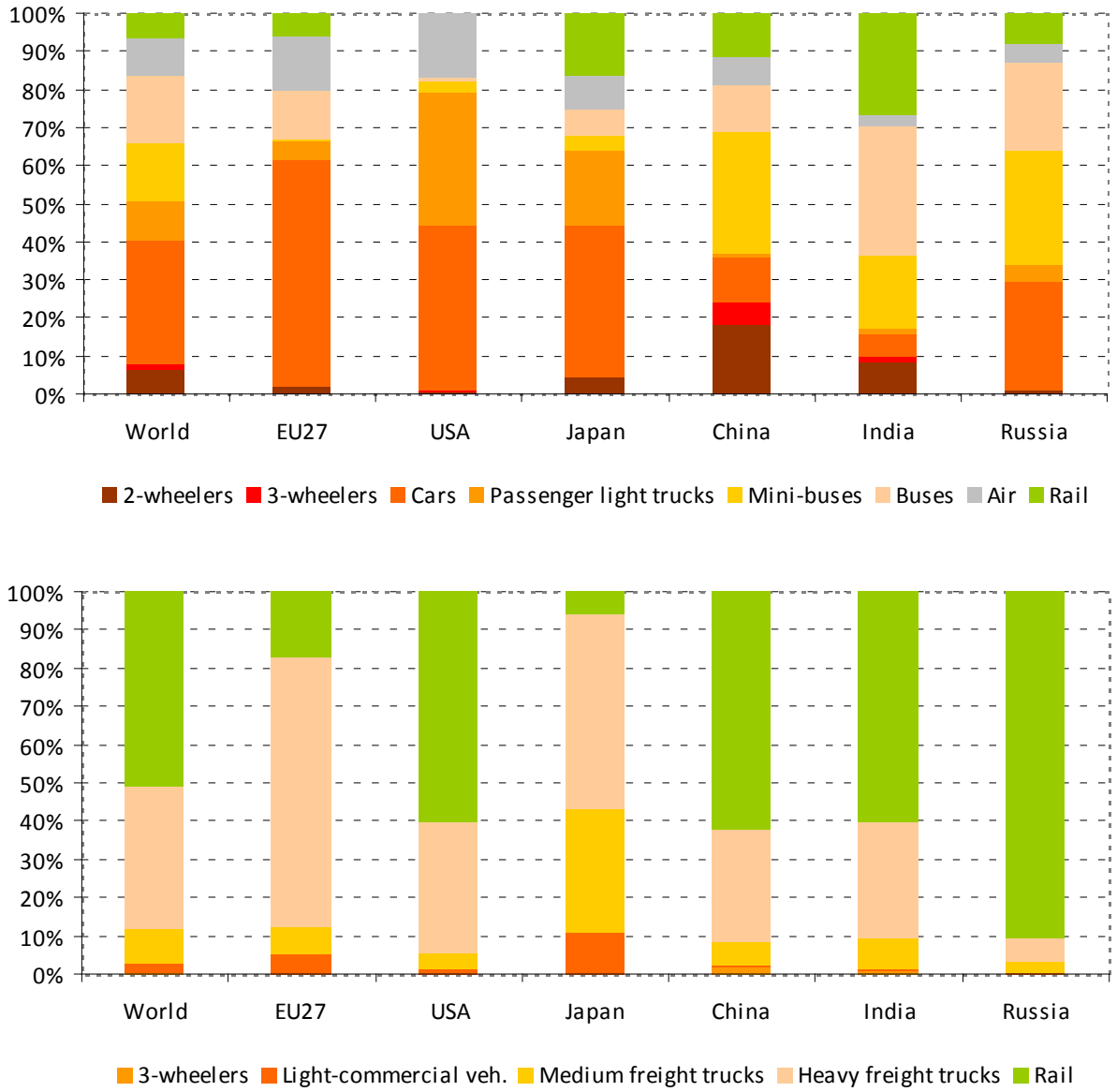
Table 2-1: Railway activity in Asia-Pacific countries, 2010

	Railway activity 2010					
	Passenger			Freight		
	pkm transported by rail (million)	share of total Asia Pacific rail passenger activity	rail share of total passenger activity	tkm transported by rail (million)	share of total Asia Pacific rail freight activity	rail share of total freight activity
North and Central Asia	162,165	7.4%	30.6%	2,285,412	41.9%	87.7%
Russia	139,028	6.3%	49.7%	2,011,308	36.9%	91.0%
Kazakhstan	15,448	0.7%	10.9%	213,174	3.9%	72.6%
Kyrgyzstan	99	0.004%	1.4%	738	0.01%	36.5%
Tajikistan	33	0.001%		808	0.01%	
Turkmenistan	1,811	0.1%		11,992	0.2%	
Uzbekistan	2,905	0.1%	4.1%	22,282	0.4%	47.6%
Mongolia	1,220	0.1%	45.2%	10,287	0.2%	84.9%
Azerbaijan	917	0.04%	5.2%	8,250	0.2%	42.1%
Georgia	655	0.03%	10.0%	6,228	0.1%	90.9%
Armenia	50	0.002%	2.0%	346	0.01%	59.5%
Southern Asia	920,223	41.8%	74.3%	607,445	11.1%	32.4%
India	903,465	41.0%		600,548	11.0%	35.2%
Nepal						
Pakistan	9,453	0.4%	3.1%	6,187	0.1%	3.6%
Bangladesh	7,305	0.3%		710	0.01%	
Sri Lanka				0	0.0%	
South-Eastern Asia	32,010	1.5%	31.5%	11,721	0.2%	24.5%
Indonesia	22,724	1.0%		5,452	0.1%	
Malaysia	4,908	0.2%		1,483	0.03%	
Vietnam	4,378	0.2%	6.0%	3,901	0.1%	9.7%
Myanmar				885	0.02%	99.6%
Cambodia						
Philippines						
Thailand						
Eastern Asia	807,647	36.7%	35.0%	2,452,051	45.0%	36.1%
China (+Hong Kong +Macau)	791,158	35.9%	34.5%	2,451,185	45.0%	36.1%
Chinese Taipei	16,489	0.7%		866	0.0%	
North Korea						
Pacific	279,103	12.7%	17.7%	93,879	1.7%	16.6%
South Korea	33,012	1.5%	29.4%	9,452	0.2%	43.0%
Japan	244,591	11.1%	21.4%	20,255	0.4%	7.4%
Australia	1,500	0.1%	0.5%	64,172	1.2%	25.6%
New Zealand						
TOTAL ASIA PACIFIC	2,201,149		38.2%	5,450,507		45.9%

Source: UIC and Susdef elaboration

Even in terms of modal share in the different national transport markets, the Asian railways feature some of the best performances in the world, as can be seen in Fig. 2-2. In the passenger sector, the modal share of railways in India stands out, followed by Japan and China; in the freight sector, Russia runs most of its freight by rail, while China and India have a rail modal share of more than 60% in freight, a similar rate as the United States.

Fig. 2-2: Estimates of modal share worldwide and in select countries for passenger (top) and freight (bottom), 2010



Source: IEA ETP 2014

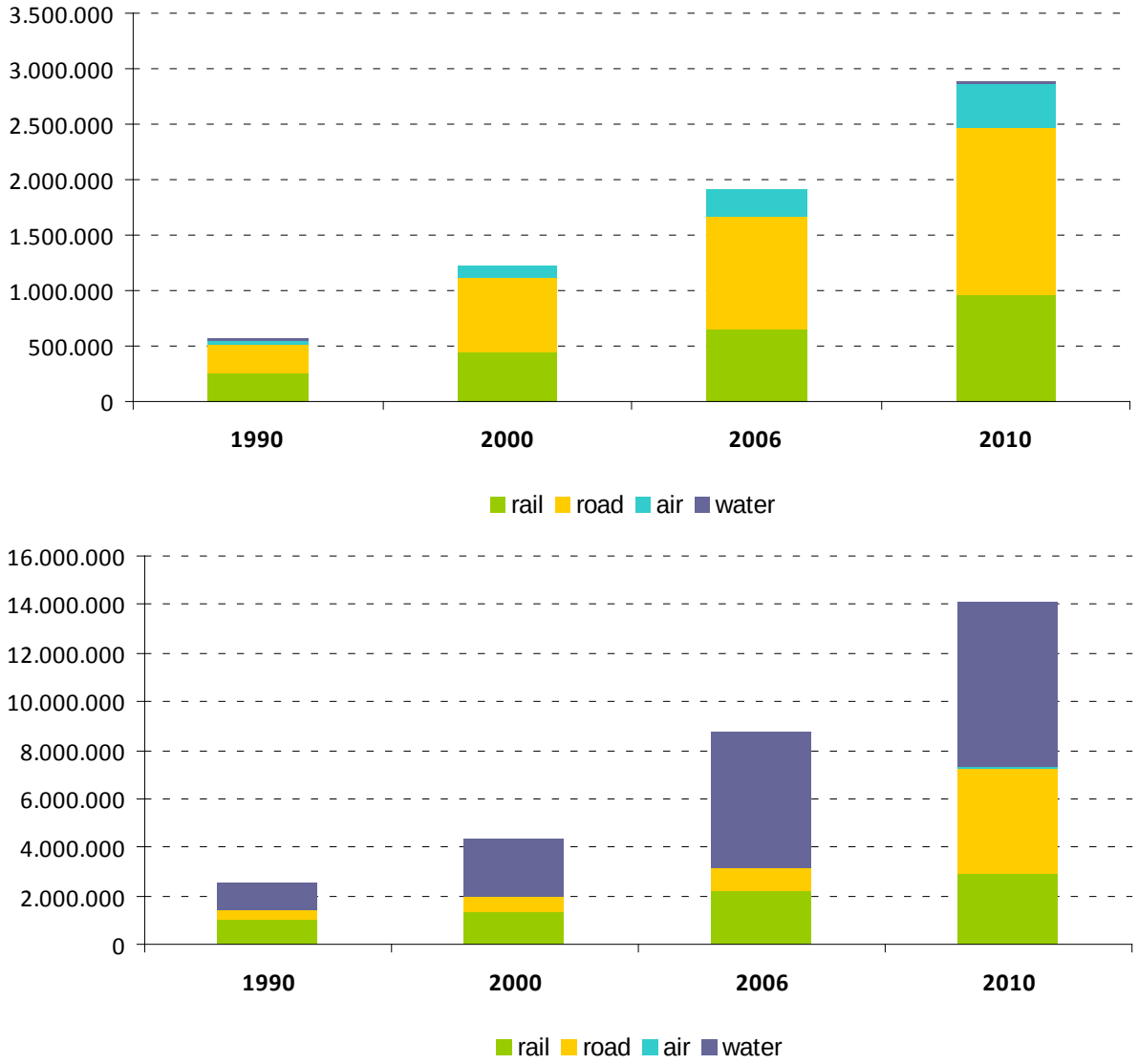
2.1.2 Modal split trends

The socio-economic development process observed in the previous section has obviously involved the transport sector as well. The underlying trends of the transport sector in the last decades reflect the differences in the development pathways of the different countries and sub-regions of Asia-Pacific.

In general, in countries that had a higher development such as China and India (but also in some North-Central Asian countries), demand for railway has increased in absolute terms, both for passenger and for freight. However, railway has lost market share in favour of competing modes (aviation and road for passenger, road and waterways for freight).

China in particular shows a continuous and radical growth for all modes, for both passenger and freight transport, as displayed in Fig. 2-3. Passenger railways double every 10 years the transported volumes, while freight railways triplicate the volumes in 20 years. Nevertheless, the growth of road transport is even more intensive, especially for road freight in the last few years. The share of rail freight in 2010, which was still of 20%, was much more favourable to rail in 1990 compared to road. For passenger service, rail and road were serving about the same amount of passenger-km in 1990, while in 2010 road clearly prevails.

Fig. 2-3: China modal split trend in passenger (top, million pkm) and freight (bottom, million tkm) transport

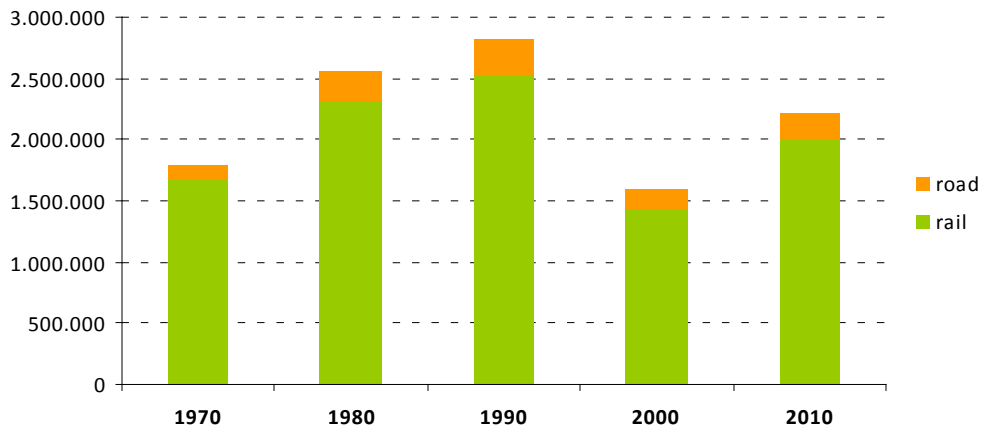


Source: Susdef elaboration from World Bank, OECD, UIC and Chinese national transport statistics

To show an example of a different situation, Russia has a rail market share historically very high compared to other modes, both for passenger and freight. The share of rail passengers between 1970 and 2010 decreased, going from 65% to 50% of the market. For the railway sector, Russia is a special case: the rail market share in freight goes from 76% in 1970 to 59% to 2010. However, when excluding pipelines (which have had a growing importance in the last decades for transporting oil and gas), the modal share of railways to road has always been over 90%.

The Russian Federation also displays a different trend with respect to other areas of Asia-Pacific: the overall volume of internal transport does not increase constantly between 1970 and 2010, but shows a drop between 1990 and 2000 (following the GDP trend), as can be seen in Fig. 2-4.

Fig. 2-4: Russian freight surface transport (million tkm)



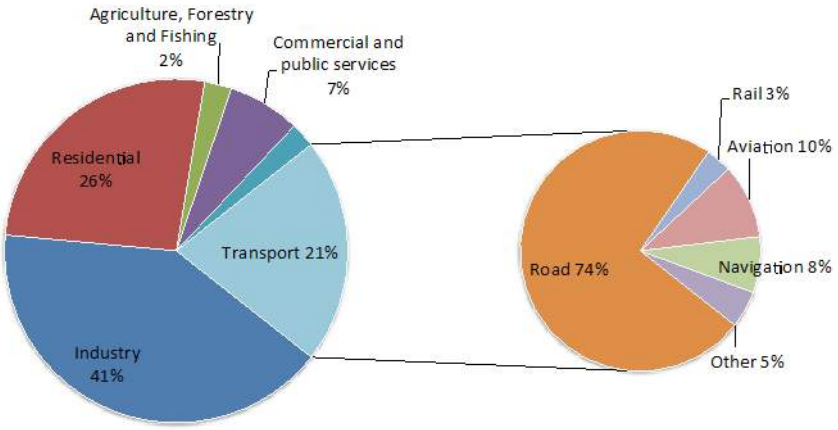
Source: Susdef elaboration from World Bank, OECD, UIC and Russian transport statistics

The case of Japan's railways is quite different from other Asian countries as Japan is a mature economy, but it also has different features from other developed economies such as Europe. In Japan, the passenger market share is favourable to rail with a rail/road share which declined between 1970 and 1990 then stabilized around 30%: that is the highest share of rail in OECD countries. In the freight sector, the railways' modal share constantly declined between 1970 and 2010, losing both in absolute volumes and in market share. In 2010 the share of freight rail represents the 3.9% of the total internal market and 9% of the volumes transported by road transport.

2.1.3 Trends on energy and CO_2 emissions

The general trend of passenger and freight transport shows how land transport in the UIC Asia-Pacific region is getting the upper hand and eroding the market share of railways. The immediate consequences of this trend are visible in Fig. 2-5, showing the weight that road transport has in the final energy consumption of the region.

Fig. 2-5: Asia-Pacific energy consumption by sector and by transport mode, 2012

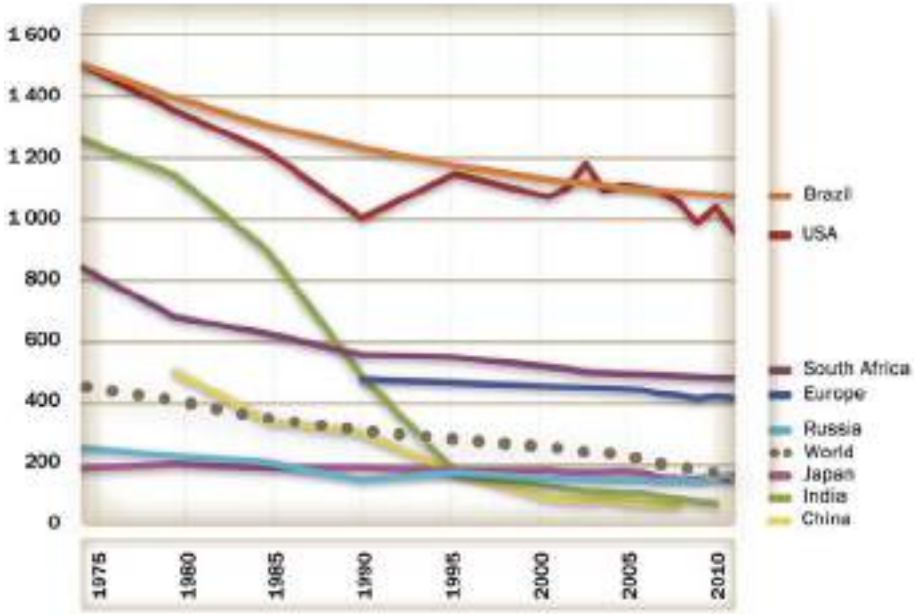


Source: Susdef elaboration

As is well known, railways contribute with a very low share (3%) to the energy consumption of the transport sector. This share is much lower than the weight of railways in the modal split, thanks to a lower specific consumption with respect to other modes. On top of that, railways are the transport mode which is less dependent from the use of fossil fuels, due to their rate of electrification. Japanese and Russian railways have a high portion of electricity use in their energy consumption (nearly 90% and 70%, respectively) while India and China both use little more than 30% of electricity in their total railway energy consumption.

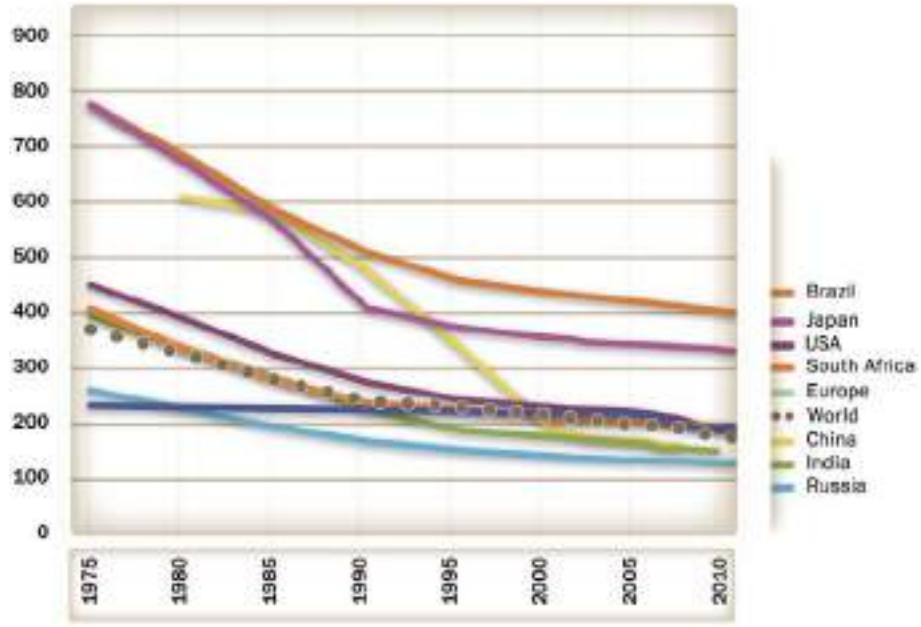
Despite that, Chinese, Indian and Russian railways are characterised by energy intensity values lower than the world average both in passenger and in freight (see Fig. 2-6 and Fig. 2-7). Japan has very favourable energy intensity in passenger transport, not so much in freight. Compared to other railways in the world, the larger railways in the UIC Asia-Pacific region are characterised, in general, by lower energy intensity. These performances are mainly due to a very high load factor vis-à-vis the other railways.

Fig. 2-6: Railway passenger specific energy consumption in selected countries, 1975-2010 (kJ/pkm)



Source: IEA/UIC 2013

Fig. 2-7: Railway freight specific energy consumption in selected countries, 1975-2010 (kJ/tkm)

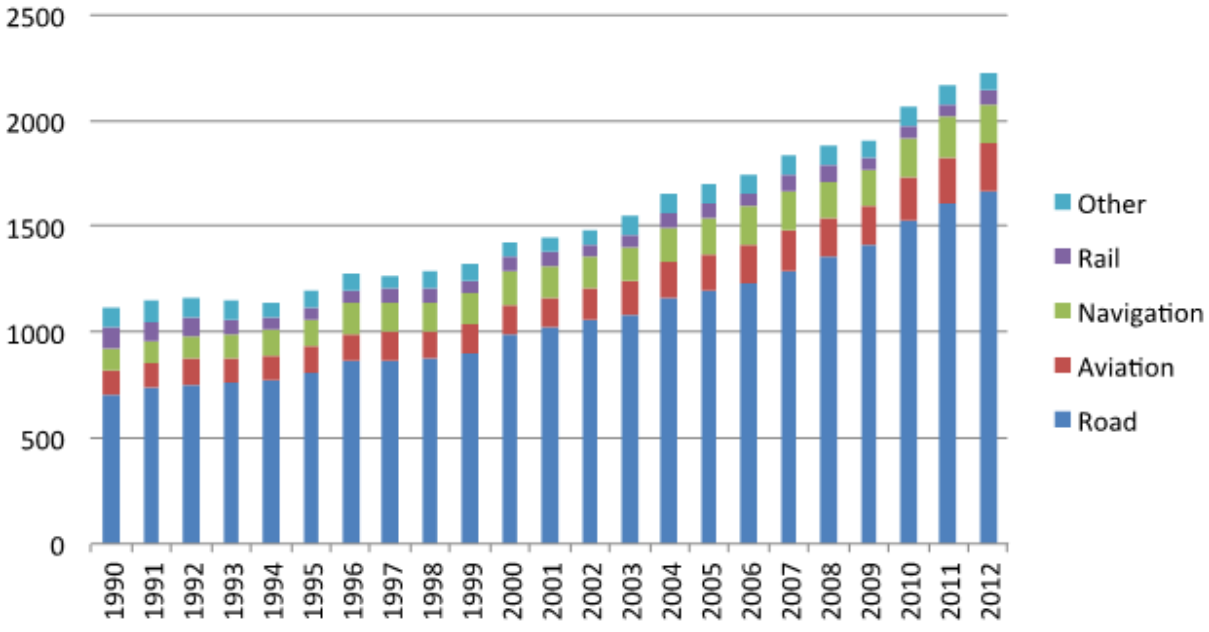


Source: IEA/UIC 2013

The road sector as well has progressively reduced the energy intensity of its emissions thanks to the technological innovation in its vehicles: e.g. the high rate of dieselisation in India, the hybrid cars in Japan, the electric 2-wheelers in China. However, these improvements did not absorb the upsurge in energy consumption due to the exponential growth of demand in the road sector.

The consequence in terms of CO_2 emissions follows in large part the trend of energy consumption. Road sector emissions, as displayed in Fig. 2-8, grow at an average annual rate of 4% between 1990 and 2012: in that timeframe, road emissions went from 63% to 75% of total transport emissions in Asia-Pacific.

Fig. 2-8: Total CO2 emissions by transport mode, 1990-2012 (MtCO2)



Source: Susdef elaboration

2.1.4 Rail industry structure, market regulation and reforms

Since the 70's in the western world there has been a consolidation of the awareness that the improvement of railway performances was not only a technical issue, but also an organisational issue both internal to the companies themselves and related to the transport market in general (and the railway sector in particular).

The main aim was an improvement in terms of effectiveness (specifically a greater attention to the customer) and efficiency (increase of profitability and reduction/rationalisation of government spending). The archetype of a 70's railway company[16] was the national state-owned railway with the following characteristics:

- It is under full public ownership;
- It operates as a department of a ministry, or a public entity with an administrative reporting relationship to that ministry;
- It offers both passenger and freight transport services;
- It is vertically integrated in managing railway infrastructure and train operations;
- It undertakes a range of non-core railway activities.

The renovation process, which started assuming different forms in different countries, used to have four main policy building blocks, often linked or grouped together:

- Business organisation,
- Market competition,
- Unbundling/Separability,
- Core and Non-core Activities.

The business organisation focuses its attention on the organisational aspect of the company, considering it essential for the activation of specific renovation processes. The main forms of business organisation are: a state-owned enterprise (SOE) operating under a specific railways law or state-owned enterprise law; a state-owned company (SOC) under companies law; a privately-owned company under companies law.

Another policy block is oriented at the introduction in the railway market of the competition with the aim of questioning the natural monopoly of railways. The main modes of rail market competition are competition *within* the market (multi-operator) and competition *for* the market (bidding for exclusive right to operate).

The third policy block deals with the unbundling or functional separation of the operational units, with the goal of creating different levels of competition. The main dimensions of separability are the *horizontal* separation into business enterprises matched to geography or market function and the *vertical* separation into infrastructure and train operating functions.

The fourth policy type deals with the distinction between core and non-core activity, linked to the fact that often railways may be involved in functions that are not directly related to the operation of trains, such as social and recreational, employee services, railway materials and manufacturing, business support services and "Extended" businesses.

Nowadays in UIC Asia-Pacific the dominant model is the archetype of national railway companies. For example, the Indian Railway Company was nationalised in 1951, and virtually the entire rail system became part of the Government of India. The Ministry of Railways (MOR) oversees the Indian railway sector through the Indian Railway Board, MOR (IRB). The MOR (IRB) exercises all central government policy powers and administers, supervises, and directs the entities that provide most of the rail services. The MOR (IRB) also fulfills most industry regulatory roles, except for safety oversight and railway rates appeals.

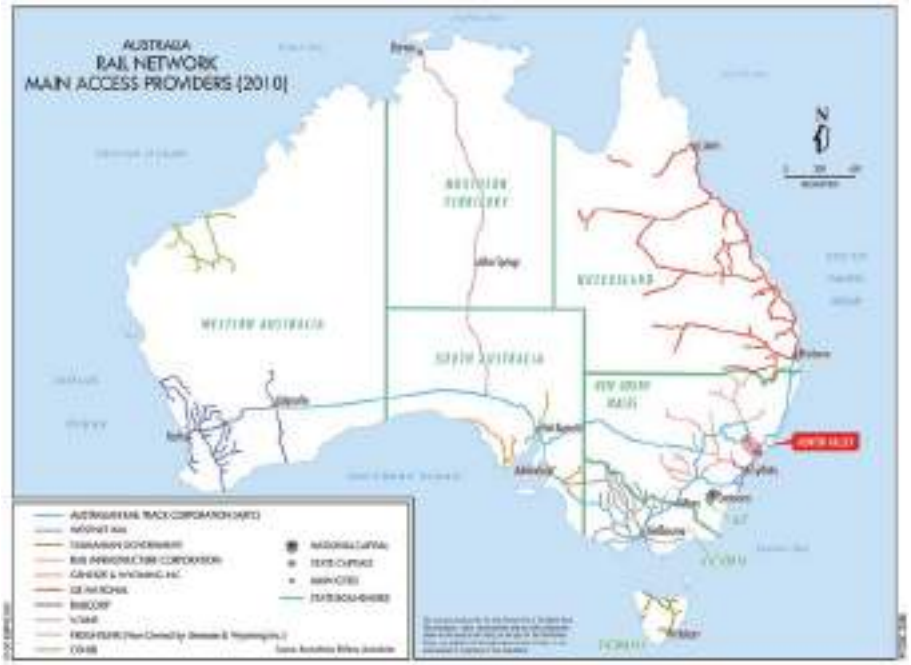
16. Actually, before that time, the original archetype of railway companies consisted of private railways operating their service on an infrastructure built with private capital.

Indian Railways (IR) is the generic term used to refer to the network of railway infrastructure and services that are delivered by 16 geographically-based Zonal Railway authorities (ZRs). Each ZR has separate responsibilities and operates its own livery. But the MOR (IRB) is fully responsible for establishing, merging, or abolishing these ZRs, and for ZR governance. India's railways are governed by the 1989 Railways Act which allowed also the exercise of non-government railways. Now, a few separate special-purpose railways exist as joint ventures between MOR and other entities such as the Kutch Railway Company Ltd., and the Konkan Railway Corporation Ltd. However, the ZRs still carry over 99% of railway traffic.

Completely opposite is the case of Australian railways. The ownership and management arrangements for Australia's rail infrastructure and rail operations are generally divided into "below" rail (track management) and "above" rail (operators of trains and rolling stock). These functions are performed by a mix of Government and private sector operators. In November 1996, the Australian Government announced a major rail reform package that included: the sale of the Australian National Railways Commission (AN); the sale of the National Rail Corporation (NRC); and the establishment of Australian Rail Track Corporation (ARTC) to manage access to the interstate rail network. ARTC was established to provide a single point of access for the standard gauge interstate track whose shares are wholly owned by the Australian Government. ARTC was incorporated on 1998 under the Corporations Law, while the AN train services were all privatised.

The current status of each process of reform of the railway market is analysed with greater depth in the chapter devoted to the analysis at the sub-regional level.

Fig. 2-9: Australian railway network



Source: Australian Railway Association

2.1.5 Human resources development

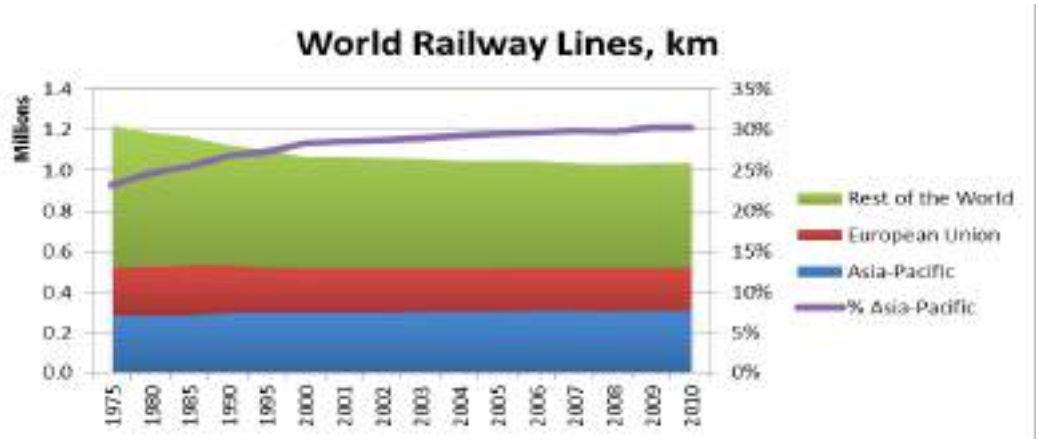
Railways in many countries of Asia-Pacific region with dense and developed rail network maintain their status of one of the most important national employers. The engineering and rolling stock development, innovation, information and logistics technology, being widely used within railways, implies growing demand for highly qualified and skilled staff and workforce, consequently for special education and training programs of different levels.

2.2 INFRASTRUCTURE

2.2.1 Length of the infrastructure

The Asia-Pacific rail infrastructure, as shown in Fig. 2-10, represented 30% of the world's railway lines in 2010, growing from 23% in 1975. Europe, in comparison, holds 20% of the world's railway lines, and this proportion has been almost the same since 1975. While the number of world railway lines has decreased, the rail infrastructure in the Asia-Pacific region has grown (by 10% between 1975 and 2010) and has taken a larger importance in the global picture.

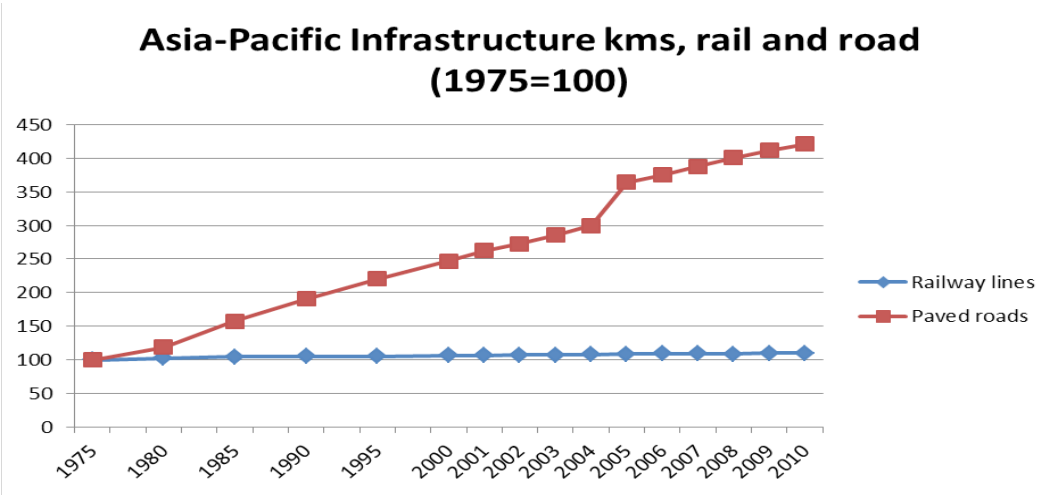
Fig. 2-10: World railway lines trend, 1975-2010 (km)



Source: Susdef elaboration from UIC data

Even though rail infrastructure is increasing, it is not reaching the growth levels of road infrastructure (see Fig. 2-11). Paved roads have increased by 321% between 1975 and 2010, with a Compound Annual Growth Rate (CAGR) of 4.2% compared to the 0.3% of rail.

Fig. 2-11: Asia-Pacific infrastructure km trend, 1975-2010 (1975=100)



Source: Susdef elaboration from UIC data

2.2.2 Infrastructure density

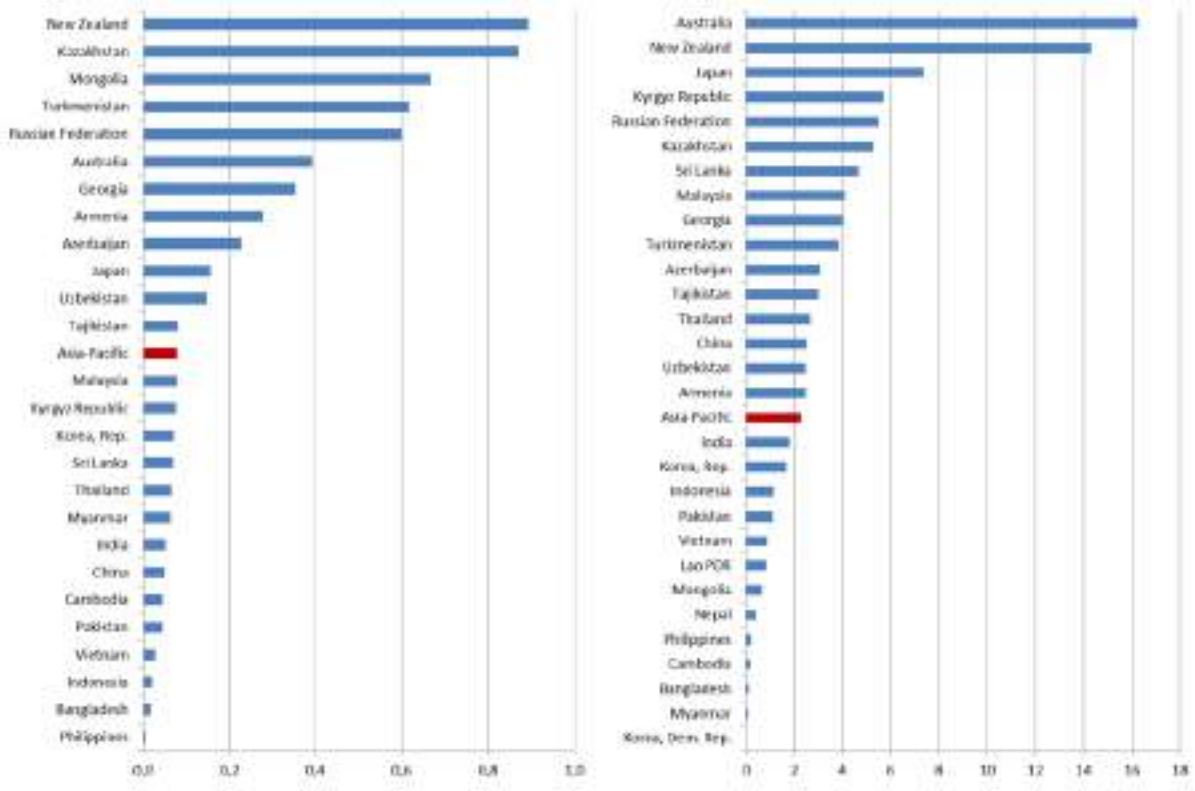
2.2.2.1 Infrastructure density over land

Asia is a large continent, with wide uninhabited areas. Rail infrastructure density over land in 2010 was 6.5 m of railway line per km², compared with a world average of 8 m of railway line per km². This is much lower than the density of rail infrastructure in the USA (24.7 m per km²) and in Europe (nearly 50 m per km²).

Of all the countries in the Asia-Pacific region, Japan is without contest the country with the densest infrastructure, with levels of density higher than Europe. Japan is followed by South Korea and by the Caucasian countries, which have a small area and have benefited from a high infrastructure construction in Soviet times. Sri Lanka also has a comparatively high density of rail infrastructure. At the other end of the spectrum lie large countries with desert regions, such as Australia and Mongolia, and countries where the rail network is poorly developed due to geographic constraints, such as the Philippines archipelago (more than 7 000 islands) and the mountainous Kyrgyz Republic (the country with the highest average elevation in the world: 2 750 m above sea level).

It is also interesting to compare the density of rail infrastructure to the density of road infrastructure in the region, as Fig. 2-12 does: compared to the meager 6.5 m of railway line per km², there are 188 m of paved roads per km² in the whole region. That means that for every square kilometre in Asia-Pacific, there are nearly 30 times as many paved roads as there are rail lines. Considering a road activity in pkm and tkm that is not much higher than rail activity. Furthermore, while rail density has been almost constant since 1975 (it was 5.9 m per km² at the time), road density more than quadrupled in the same timeframe (in 1975, road density was 45 m per km²).

Fig. 2-12: Rail (left) and road (right) infrastructure density over land area, 2010 (m/km²)



Source: Susdef elaboration from UIC and World Bank data

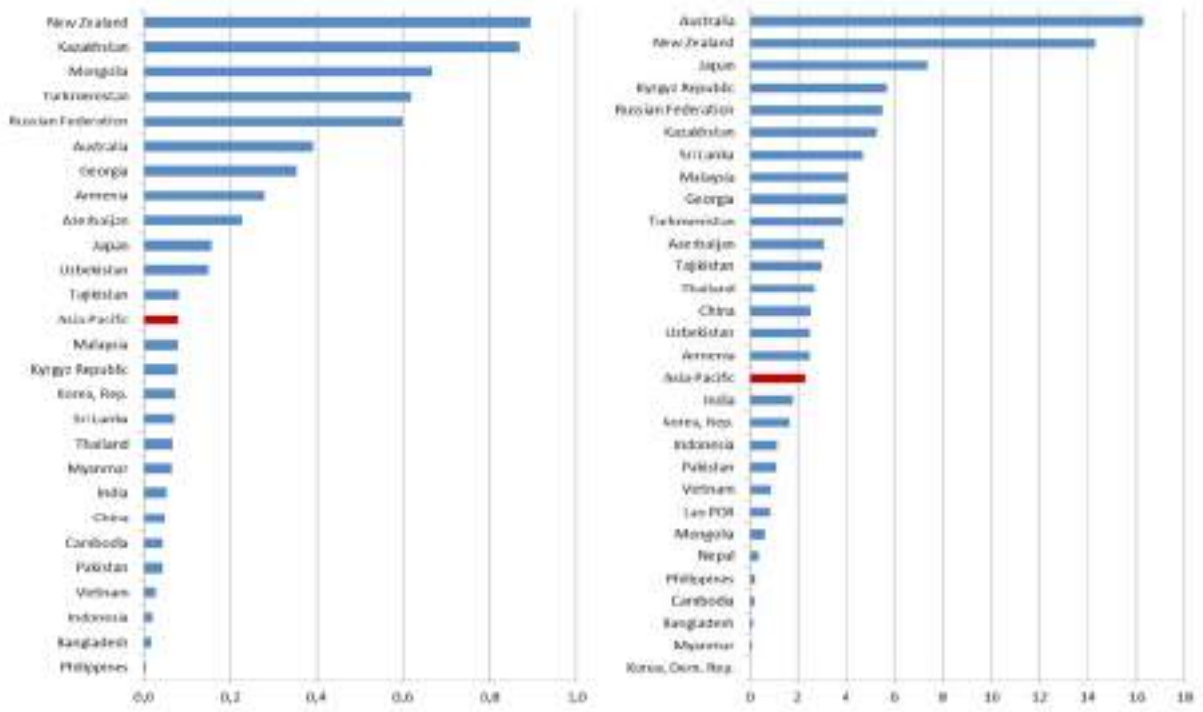
2.2.2.2 Infrastructure density over population

Transport infrastructure is needed to move people and goods; therefore this indicator of density is more relevant than the density over land area in order to evaluate the effectiveness of the infrastructure in a region.

In the whole region examined (the 29 countries of Asia-Pacific), the density of rail infrastructure is 0.08 m of railway lines per inhabitant. This is half of the world average (which is 0.15), and much less than the density in Europe (0.42) and the United States of America (0.73).

The rail density per inhabitant, as Fig. 2-13 shows, is higher in scarcely populated countries either well-developed (New Zealand or Australia), or countries central to Asian infrastructure (Russia and Central Asia), that are in the middle of Eurasian corridors. On the opposite side, there are countries with a high population and an underdeveloped network, where there could be a good margin of improvement for railway infrastructure.

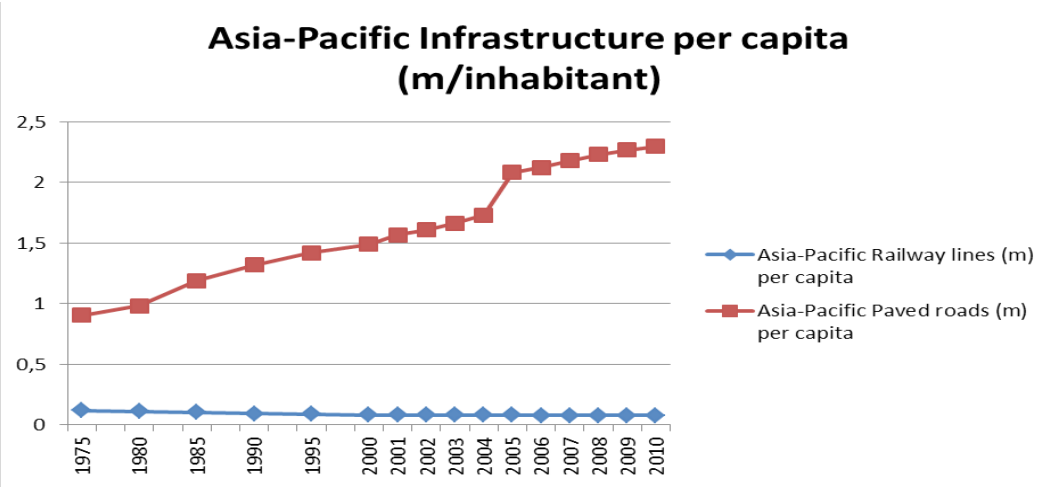
Fig. 2-13: Rail (left) and road (right) infrastructure density over population, 2010 (m/inhabitant)



Source: Susdef elaboration from UIC and World Bank data

In comparing the density of rail and road infrastructure per capita in Asia-Pacific, it can be seen in Fig. 2-14 that the huge population increase in the region (66% between 1975 and 2010) was more than matched by the expansion of road construction, not so much so by rail: road density increased by 154% since 1975 (when it was 0.9 m per capita), compared to rail density which in fact *decreased* by 33% in the same period. Road density in 2010 was 2.3 m per inhabitant, nearly 30 times higher than rail density.

Fig. 2-14: Trend of infrastructure per capita in the UIC Asia-Pacific region, 1975-2010 (m/inhabitant)



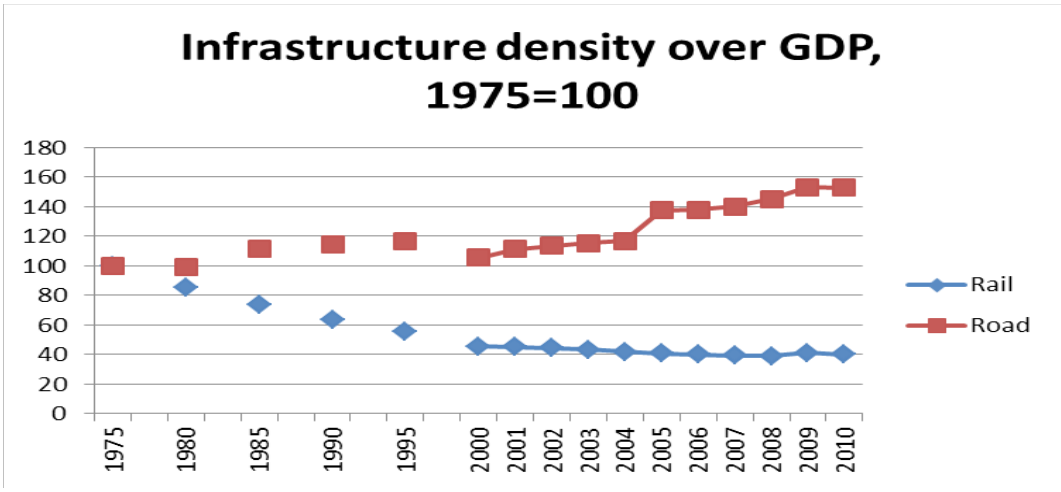
Source: Susdef elaboration from UIC and World Bank data

2.2.2.3 Infrastructure density over GDP

The gross domestic product of the Asia-Pacific region had an enormous growth in the last decades: 75% only in the period 2000-2010. There is an indicator that can clearly show whether this growth has brought more investments to rail: the infrastructure density over GDP, which measures the km of infrastructure present in the region per dollar of GDP (measured in constant 2005 U.S. Dollars).

The analysis of this indicator clearly shows how gross domestic product in the 29 Asia-Pacific countries considered is being used to fund the construction of road infrastructure much more than the construction of rail infrastructure. As displayed in Fig. 2-15, the amount of road infrastructure in the region per dollar of GDP has increased by 53% between 1975 and 2010, while in the same period the same indicator for rail decreased by 60%.

Fig. 2-15: Trend of infrastructure density per GDP in the UIC Asia-Pacific region, 1975-2010 (1975=100)

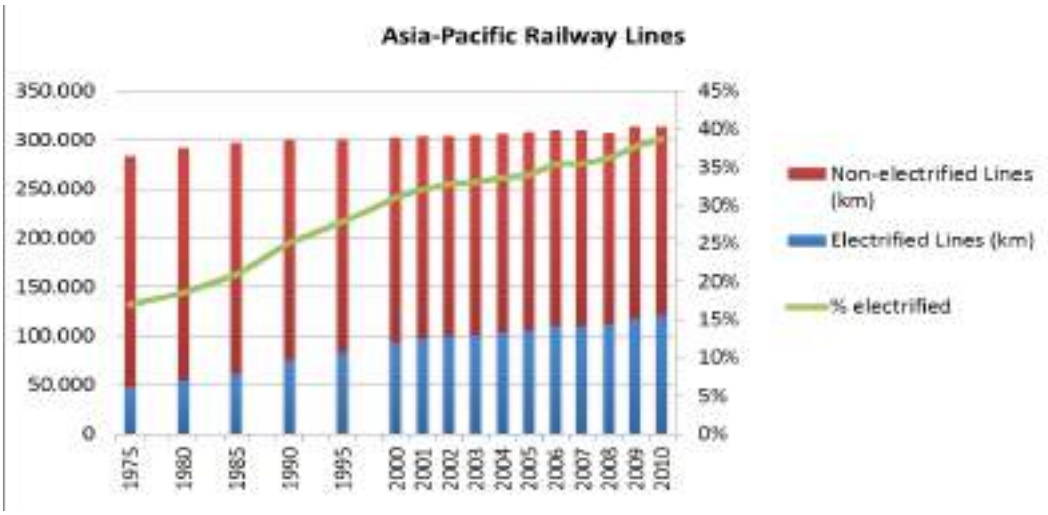


Source: Susdef elaboration from UIC and World Bank data

2.2.3 Electrification

Electric railways are taking an increasing importance in Asia-Pacific: while only 17% of railway lines were electrified in 1975, this ratio became 31% in 2000 and 39% in 2010, as displayed in Fig. 2-16. There is still a long way to go to reach the level of the European Union, where more than half of the lines are electrified, but there is a clear progress towards more electrified railways, which are more efficient and less polluting.

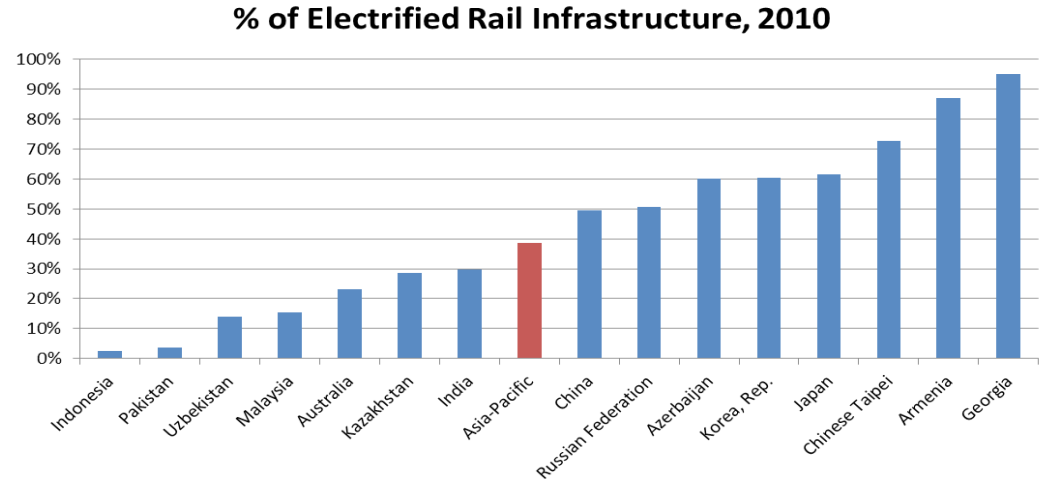
Fig. 2-16: Trend of railway lines in Asia-Pacific, 1975-2010 (km)



Source: Susdef elaboration from UIC data

Fig. 2-17 shows the level of electrification in 2010 in the countries of the region where the network is at least in part electrified: nearly half of the countries have in fact no electrified lines. The situation is radically different according to the countries. The Caucasus, Russia and the developed East Asian countries, as well as China and Taipei, have a level of electrification higher than average; all the other Asia-Pacific countries have little electrification or none at all.

Fig. 2-17: Share of electrified rail infrastructure, 2010

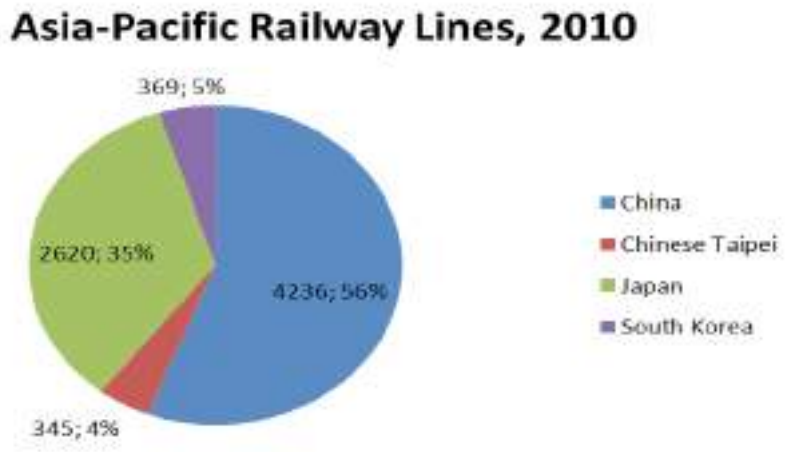


Source: Susdef elaboration from UIC data

2.2.4 High-Speed Lines

High-speed lines have also grown dramatically, especially in China: China makes up more than half of the high-speed lines in the region. However, it is easy to note in Fig. 2-18 how high-speed rail is only present in four of the countries of the region, despite the growing urbanisation and need for people interconnection in Asia.

Fig. 2-18: Asia-Pacific High-Speed Railway lines, 2010 (km and share of total)



Source: Susdef elaboration from UIC data

2.2.5 Integration and interconnection

2.2.5.1 Trade Flows between Europe and Asia

Within the general framework of globalisation and market liberalisation, trade growth between Europe and Asia has accelerated rapidly in recent years, partly as a result of the development of Eastern Asian countries, mainly China, but also due to the emergence of the economies of Russia and Central Asian countries, as well as that of other countries such as Turkey and India. This has resulted in a wider spatial dissemination of trade flows, not just between the extremities of the two continents, but also amongst major centres and hubs within the interior of the Eurasian continent.

Trade flows analysis indicates in general a high percentage of Asian exports to Europe, representing mainly China's domination in Asia's trade with Europe. Asia's imports are divided between Europe and Asia. Moreover, the highest share of CIS countries exports and imports is to and from European countries. Besides the trade between Europe and Asia, trade amongst Asian countries themselves is also beginning to develop. The latter is, therefore, crucial for defining the main routes for international trade between Asia and Europe.

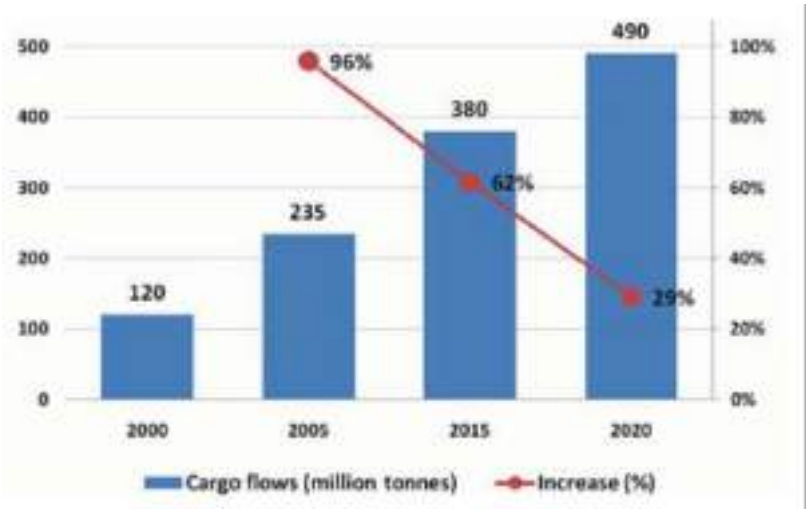
China's main exports to Europe are finished goods – accounting for about 95% in monetary terms. These include office equipment, transport equipment, textiles, chemicals and other items. These commodities are suitable for containerised shipment. China imports mainly finished goods from Europe. Those account for almost 90% of total imports and fall into two main commodity groups: machinery and power and electrical equipment.

The structure of China's trade with the CIS is somewhat different. China's main exports to the CIS are finished products. Textiles account for one third of total exports while power industry equipment, household items, office equipment and cars around 10% each. China's main imports from the CIS are fuel and energy products (over two-thirds of total export),

agricultural raw materials, chemical fertilisers and metals (around 5%). These bulk cargoes have to be shipped in on flat-trailers rather than in containers.

Before the global crisis, the EurAsEC Integration Committee[17] (see Fig. 2-19) estimated that total cargoes would reach 490 million tonnes by 2020, i.e., four times the volume transported in 2000.

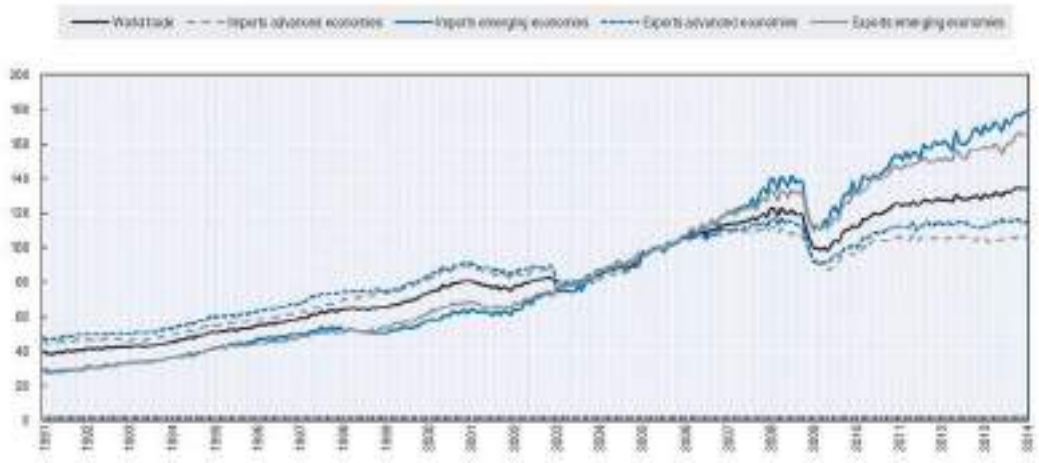
Fig. 2-19: Potential cargo flows between EurAsEC countries



Source: Eurasian Development Bank 2009 (quoting EurAsEC Integration Committee)

As emphasised by the EDB in the aftermath of 2008 economic downturn, several adjustments have to be made to any estimates of future trade between Europe and Asia given the global financial and economic crisis. The recession-stricken countries of Western Europe are experiencing a considerable contraction in domestic demand and, as a result, have reduced the volumes they import from Asia, especially commodities from China. The latter, being an export-orientated economy, is stimulating domestic demand and reducing its reliance on exports. However, it is reasonable to expect that exports to developed countries (primarily the US and Europe) will remain a priority for the developing Chinese and Asia-Pacific economies.

Fig. 2-20: World trade index (2005=100)



Source: International Transport Forum on CPB Netherlands Bureau for Economics Policy Analysis, World Trade Monitor, 2014

17. The Eurasian Economic Community (EAEC or EurAsEC) was a regional organisation between 2000 and 2014 which aimed for the economic integration of its member states. On October 2014 an agreement on the termination of the Eurasian Economic Community was signed in Minsk after a session of the Interstate Council of the EAEC. The Eurasian Economic Community was terminated from 1 January 2015 in connection with the launch of the Eurasian Economic Union.

On the basis of ITF estimations (ITF 2015), trade-related international freight is projected to grow by a factor of 4.3 by 2050. Future growth is driven by changes in the product composition of trade and by growth in the average hauling distance, caused by changes in the geographical composition of trade.

Some 85% of total international freight volume is carried by sea. The share of road freight in global trade will increase from 6% to 10% by 2050, driven by increasing intra-regional trade, especially in Asia. Maritime transport is the backbone of international trade, with over 80% of world cargo bay volume transported by sea. Based on data provided by the EU Statistical Agency Eurostat for the period 2009-2010, shown in Fig. 2-21, the bulk of EU27 trade (both imports and exports) with Asia, represented by China, continues to be transported by sea. The second largest share corresponds to air transport, while rail accounts for the lowest share.

Fig. 2-21: EU27 trade (both imports and exports) with Asia in value (billion Euros)

EU 27 with China	Oct. 2009	Nov. 2009	Dec. 2009	Jan.-Dec. 2009	Jan. 2010	Feb. 2010	Mar. 2010	Apr. 2010	May. 2010	Jun. 2010
SEA	11610	9957	10015	126925	11916	11348	12993	11268	12797	15266
RAIL	116	107	88	1239	109	79	124	128	135	147
AIR	3872	4871	3846	43638	3926	3656	4575	4109	4864	4708

Source: Eurostat

Transportation of transit cargo by sea (transoceanic service) has some strong advantages, such as a low delivery cost. The competitiveness of maritime transport is based on the principle of economies of scale: ships can carry more volume than other transport modes at lower costs per unit. The growth of container trade in the Euro-Asian route has fostered the use of larger and more efficient vessels and rates that have fallen to extremely low levels.

2.2.5.2 Eurasian landbridge background

International containerised cargo volumes shipped between Asia (mostly China) and Europe using rail or road transport are currently very limited. According to UNECE/UNESCAP estimation for 2010, rail transport using the Trans-Siberian Railway, which with its branches represents the most important railway connection between Europe and Far East Asia, may account for up to 3-4 % of the current volume, mainly from Northern China (UNECE 2012). ADB, according to available data estimation in 2009, states that only 74 551 TEU of the 17.7 million TEU transported from Europe to Asia in 2008 were shipped by rail via Dostyk (0.42%), including 0.35% from Europe to Asia.

The beginning of the 21st century has brought renewed interests for a long distance inland connection between Asia and Europe, especially with the booming Asian trade and the increasing pressure to ship containerised freight in a time sensitive manner over long distances.

The main competitive advantage offered by land transit routes is speed of delivery, which is two to three times faster compared with the sea routes linking East Asia with Europe. This advantage has to be heavily exploited, especially by rail transport, where a considerable proportion of “time-sensitive” transit can be redirected.

While rail freight routes are more expensive than maritime shipping, the 20 to 25-day rail transit times are twice as fast as their oceangoing counterparts, presenting a very attractive business opportunity for high-value-added products. The overall volume of containers traded between Asia and Europe and within Asia represents a sizeable market. The relocation of production facilities from the coastline to central China will increase average transport distance and further raise the attractiveness of combined rail solutions which have a competitive edge in medium to long distances.

Trains could be more competitive in both time and cost when production areas are situated relatively far from China’s and India’s ports and production is destined to the South or East European countries.

There are other technical advantages that call for the diversification of existing routes and the opening up of alternative ones by land between Europe and Asia. The East Asian ports are approaching their full capacity. There is also growing concern for congestion and saturation problems with regard to land access to ports, as well as safety and security issues from maritime traffic concentrating at certain points along the defined routes between maritime hubs.

Traffic concentration, both at port and hinterland level is particularly evident in the case of China, where there are several constraints in access to the hinterland. Obviously, this problem is symmetric in Europe where the saturation of ports in Northern Europe is progressing.

Port volumes worldwide are projected to increase nearly fourfold by 2050 with similar growth in most of the shipping-related emissions in ports. ITF emphasises that shipping-related Particulate Matter (PM) emissions in port cities are responsible for approximately 60 000 cardiopulmonary and lung cancer deaths annually.

In addition to the technical reasons quoted above, efficient and integrated inland routes could become an effective tool for economic development and integration of the Euro-Asian region, including a greater participation in the globalisation process by Central Asia's landlocked countries.

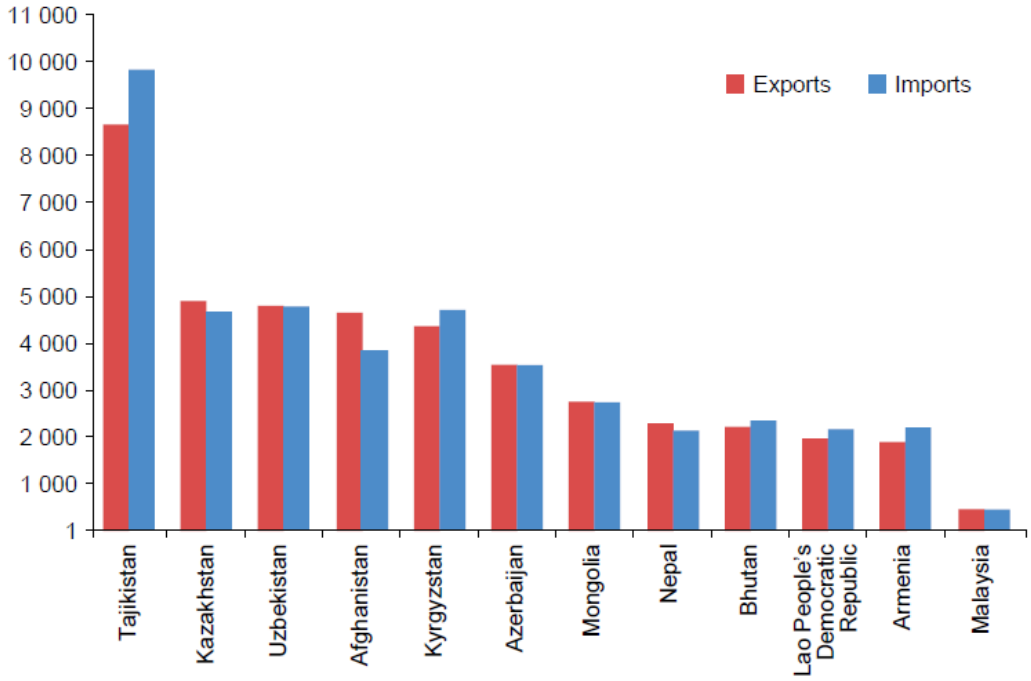
Of the 31 landlocked developing countries in the world, 9 are located in Central Asia (Afghanistan, Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, Mongolia, Tajikistan, Turkmenistan and Uzbekistan).

There has long been evidence that lack of access to and great distance from the sea are geographic restraints that suppressed both per capita income and economic growth. In absolute per capita incomes, landlocked countries often fail to compete against coastal ones, mainly due to their low participation in world trade. Therefore, their dependence on a limited number of commodities for their export earnings, lack of territorial access to the sea and remoteness from world markets makes landlocked developing countries, as a group, among the poorest of developing countries.

This is due to the extra costs and time goods spend in transit and at border crossings before reaching their nearest ports. Studies have found that international investors are discouraged from investing in landlocked developing countries because of the high costs and poor quality of transport services.

In 2013, as shown in Fig. 2-22, the average cost of exporting goods from a landlocked country in the region was 8.5 times higher than it was from Malaysia, a country with one of the lowest trade costs, while the average cost of import was 9.2 times higher.

Fig. 2-22: Average cost of importing and exporting containers: comparison of ESCAP landlocked developing countries and Malaysia



Source: World Bank 2014

Changing the perspective towards a land bridge, the geographic and geo-economic location of Central Asian landlocked countries gives them significant strategic potential for freight transit as a pivot between Eurasia's two macro-regions – the European Union (EU) and the East Asian-Pacific region (APR), mainly China.

In general, the development of a series of intercontinental railway corridors that can connect different regions of the globe is strategically important in order to:

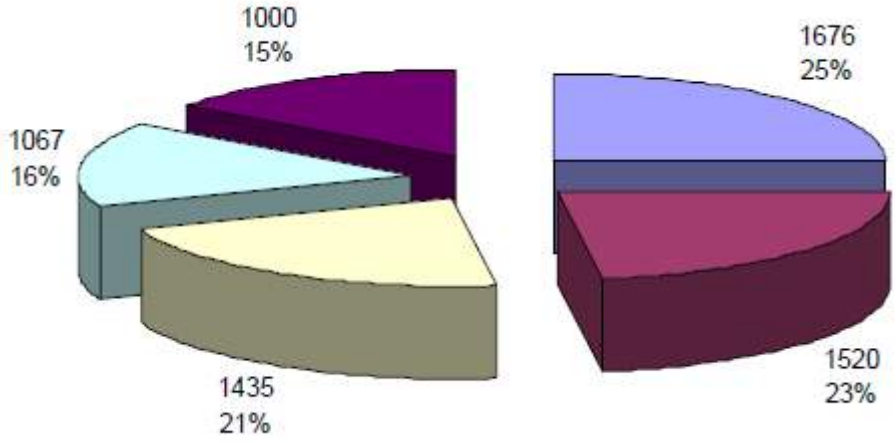
- Develop the intra-regional Asia-Pacific economic integration;
- Increase the performance of the Asian railway network;
- Guarantee that railways can compete in efficiency and quality of service with road transport for medium and long distance transport.

There is an ample global consensus on fostering the international railway corridors, demonstrated at high level by a proposal approved in 2014 by the General Assembly of the United Nations recognizing the importance of corridors in the international cooperation for sustainable development (UN 2014a). The Vienna Programme of Action for Landlocked Developing Countries for the Decade 2014-2024, adopted at the second United Nations Conference on Landlocked Developing Countries, also identified the interconnection of landlocked countries as a primary objective. Specifically, the goals are to reduce travel time along corridors (300-400 km per 24 hours), significantly reduce the time spent at borders and significantly increase intermodal connectivity between road, rail and ports.

These objectives show that there are still several issues to be solved in order to facilitate the development of corridors. A palpable example is the *break of gauge*. Geopolitical reasons have created in the continent a number of large networks which are incompatible with one another due to the use of a different gauge: from the meter-gauge (1 000 mm) used in

South-East Asia to the standard gauge (1 435 mm) used in China and the broad (1 524 mm) gauge used in the former Soviet Union countries. India still has a mix of gauges inside its territory (broad gauge, meter gauge and narrow gauge), although there is an on-going Indian Railways project – project Unigauge – that is working to convert all gauges to the broad Indian gauge (1 676 mm).

Fig. 2-23: Distribution of rail track gauge over the Trans-Asian Railway Network



Source: UNESCAP (2013b)

As shown in Fig. 2-23, none of these gauges is so dominant that it could call for a reconstruction of the other networks (which would anyway not be feasible due to the high costs involved), so the only solution for cross-border travel is some operation at the borders where the break-of-gauge happens. Either the passengers or goods transported are moved to a different train, or the train undergoes a "bogie change" whereby the train is equipped with a new set of wheels for the different track gauge. Some trains are fitted with variable gauge axles and can cross breaks of gauge almost without interruptions; however, these types of rolling stock are seldom used on Asian railways. Therefore, the operations to surmount the break of gauge are usually lengthy and reduce the efficiency of international rail transport.

One of the issues in promoting rail freight transport over maritime freight transport is that while a ship only has to deal with two pieces of land infrastructure (the port of departure and the port of arrival), a freight train needs to pass through the infrastructure of a number of countries. This usually entails changing several gauges and dealing with the variable reliability of infrastructure throughout the countries crossed.

2.2.5.3 Corridor initiatives

The development of inland transport routes between Europe and Asia and between Asian sub-regions represents one of the central topics both for the Asia-Pacific region and globally, due to technical, socio-economic and geopolitical reasons. Therefore, there are several national, regional and cross-region initiatives in development since many years. This section will refer specifically to the international rail corridors – largely used for freight – whereby usually international corridors also take into account other functions (e.g. different transport modes). This section will showcase the main initiatives in development for the Asia-Pacific region regarding railway corridors.

Corridor definition

A corridor defines a space that is dedicated to or has an increased density of activities toward particular functions. Transport corridors are defined as networks that yield geographic areas where trips tend to cluster.

The UNECE's Inland Transport Committee defines an international transport corridor as part of a national or international transport system which maintains considerable international cargo and passenger transportation between certain geographic regions and includes the rolling stock and immovable structures of all modes of transport working on the respective route, and all technological, organisational and legal conditions for such transportation.

According to the EU, an international transport corridor consists of main transport communications (existing or under construction) with related equipment and infrastructure which connect large traffic junctions, and employ various modes of transport for international transportation of cargoes and passengers at the points of their maximum concentration.

The United States Department of Transportation notes that a transportation corridor is defined as a combination of discrete, adjacent surface transportation networks (e.g. freeway, arterial, rail networks) that link the same major origins and destinations.

Trans Asian Railway (TAR)

In the framework of its Transport Division activities, the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) carried out a project called 'Operationalization of international intermodal transport corridors in North-East and Central Asia' with the main objective of supporting countries to identify priority intermodal transport corridors linking countries in North-East and Central Asia. Under the project, six intermodal corridors have been identified based on existing routes of the Asian Highway (AH) and the Trans-Asian Railway (TAR).

The TAR project was initiated in the early 1960s to offer efficient rail transport services both within the Asian region, and between Asia and Europe. The original TAR concept was to provide a continuous, 14 000 kilometre rail link between Singapore and Istanbul, with the potential to reduce transit times and costs between countries in the region and possibly extending into Europe and Africa.

The network has extended to 117 000 km of railways across 28 countries through three phases of the project:

- The Network Identification by four corridor studies (1994-2001) that are:
  - the Northern Corridor connecting China, Kazakhstan, Mongolia, Russia and the Korean Peninsula (1995, refined in 1999);
  - the ASEAN/Greater Mekong Subregion and Indo-China sub-regional network covering Cambodia, China, Indonesia, Lao PDR, Malaysia, Myanmar, Singapore, Thailand and Viet Nam (1996);
  - the Southern Corridor connecting Thailand and the southern Chinese with Turkey through Bangladesh, India, Iran, Myanmar, Pakistan, Sri Lanka (1999);
  - the North-South Corridor linking Northern Europe to the Persian Gulf through Russia, Central Asia and the Caucasus region (2001).
- The Network Operationalization by demonstration runs of container block trains (1997-2005);
- The Network Formalization by negotiation and finalization of the Intergovernmental Agreement on the Trans-Asian Railway Network (2001-2006).

This Agreement entered into force in June 2009. Under the terms of the Agreement, a working group will be established to regularly discuss policies and issues relating to the development of the rail network.

Fig. 2-24: The Trans-Asian Railway Network

According to UNESCAP data, in 2001 the TAR network (see Fig. 2-24) still includes 10 500 kilometres of missing links[18] in total. While continuous rail infrastructure already connects North-East Asia and Europe, the infrastructure is somewhat less consistent in other sub-regions when it comes to cross-border rail connections.

As the TAR network traverses an extensive geographical area, it is understandable that its constituent countries have different standards and levels of development. In their most visual form different standards have resulted in the adoption of different track gauges by national railways: the mainline railway networks that make up the TAR are comprised of five different track gauges, as mentioned in section 2.2.5.2.

Euro-Asian Transport Links (EATL)

The Euro-Asian Transport Links (EATL) project started with Phase I (2002-07) as a joint undertaking between the United Nations Economic Commission for Europe (UNECE) and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).

18. A "missing link" is an absence of physical connection between the railway networks of neighbouring countries, or an absence of continuous railway infrastructure within one country.

The EATL project has identified main Euro-Asian rail (and road) routes for priority development and cooperation. In Phase II (2008-13), UNECE identified nine rail corridors that link the two continents. One of the key activities of EATL Phase II was the revision (updating) of the EATL priority transport infrastructure projects submitted under Phase I and the development of a new international investment plan for EATL Project Phase II that would entail a consistent and realistic short, medium and long term investment strategy for the identified EATL Phase II routes. This included an extensive inventory of specific road, rail, inland waterway, maritime port, inland terminals and other infrastructure projects for the 27 participating countries, together with their estimated budget and pragmatic investment time plan for their implementation.

Fig. 2-25: EATL Railway routes

Source: UNECE (UN Economic Commission for Europe)

There are 311 proposed projects by the participating countries, with a total cost of $215 billion; 121 are railway projects (39%), with an estimated value of $75 billion, representing 35% of the total investment cost. The railway projects are classified as follows:

- 62% of the railway projects belong to Category I (projects which have secured funding and are on-going and expected to be completed in the near future), with an estimated value of $28.7 billion, representing 38% of the total investment cost for rail projects.
- 16% of the railway projects belong to Category II (projects which may be funded or their plans are approved and are expected to be implemented rapidly), with an estimated value of $9.2 billion, representing 12% of the total investment cost for rail projects.
- 2% of the railway projects belong to Category III (projects requiring some additional investigation for final definition before financing and implementation), with an estimated value of $2.7 billion, representing 4% of the total investment cost for rail projects.

- 19% of the railway projects belong to Category IV (projects requiring some additional investigation for final definition before financing and implementation), with an estimated value of $31.3 billion, representing 41% of the total investment cost for rail projects.
- 1% of the rail projects have been completed, with an estimated value of $3.6 billion, representing 5% of the total investment cost for rail projects.

Phase III of the EATL project (2013-15), coordinated by the UNECE, aims at making the EATL overland links operational. It is focused at both coordination and facilitation of financing of infrastructural projects, as well as facilitating and removing physical and administrative bottlenecks when crossing borders in overland transport between Europe and Asia.

Transport Corridor Europe-Caucasus-Asia (TRACECA)

The "Transport Corridor Europe-Caucasus-Asia" (TRACECA) programme was initiated by a multilateral agreement signed in 1998 between the EU and 14 other states as comprehensive road, rail and sea transport corridors to link the EU through Southeast Europe to the South Caucasus and on into Central Asia.

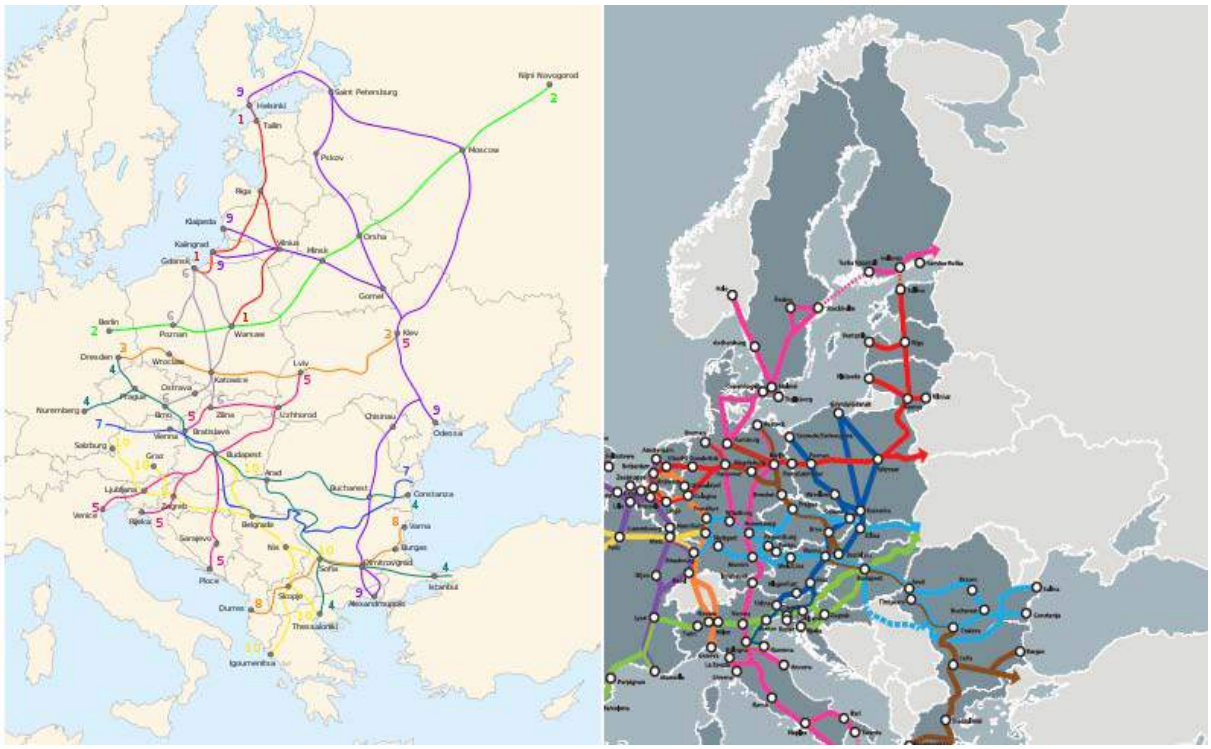
The main technical objective of the TRACECA programme is promoting optimal integration of the international transport corridor Europe-Caucasus-Asia "TRACECA" into Trans-European Networks (TENs) while the political premise of TRACECA is to diversify from the Moscow-centric routes of the former Soviet Union (TRACECA routes do not pass through Russia, as shown in Fig. 2-26).

Fig. 2-26: TRACECA rail and road network

Source: TRACECA

The EU has promoted another initiative to extend its transport networks into neighbouring states to its north and east: the Pan-European corridors or axes, extending north and north-east into Belarus, Ukraine and Russia. These corridors have subsequently been integrated in the TEN-T network (see Fig. 2-27).

Fig. 2-27: Pan-European and TEN-T (2013) corridors



Source: European Union

CAREC

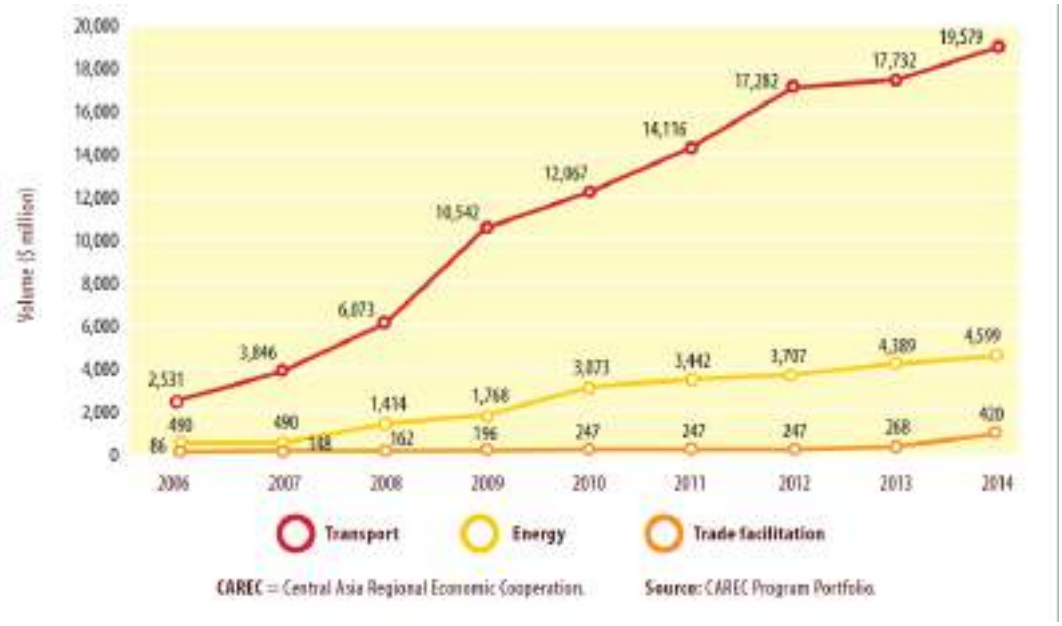
The Central Asia Regional Economic Cooperation (CAREC) Program is a practical, projects-based, and results-oriented partnership that promotes and facilitates regional cooperation in transport, trade, and energy.

CAREC comprises 10 countries: Afghanistan, Azerbaijan, the People's Republic of China, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan. Six multilateral institutions support the work of the CAREC member countries: Asian Development Bank, European Bank for Reconstruction and Development, International Monetary Fund, Islamic Development Bank, United Nations Development Programme and World Bank. The Asian Development Bank serves as the CAREC Secretariat.

Increasing integration between the People's Republic of China (PRC) and Japan to the east, the Russian Federation to the north, and India and Pakistan to the south, is leading to unprecedented opportunities for Central Asian countries to grow. CAREC is helping make that growth happen by facilitating regional transport and trade, and improving trade policy.

From 2001 to 2014, the program invested $24.6 billion in regional infrastructure and initiatives to promote connectivity and trade, helping the mostly landlocked countries reach out to global markets. The deepening regional trade links are also opening up previously unexploited resources, including huge energy resources. Infrastructure rollout has increased the mobility of people and goods, and laid the foundation for on-going improvements in living standards of 300 million people across Central Asia's vast geography.

Fig. 2-28: Volume of Approved CAREC-Related Projects, by Sector, Cumulative since 2001



Source: CAREC

The plan to link Central Asia to global markets has already led to the construction and rehabilitation of 7 672 km of quality road and rail links between key cities and towns, also connecting innumerable communities along routes that often trace the ancient Silk Road.

Almost $19.6 billion had been invested from 2001 to 2014 in 107 CAREC-related transport projects along the six CAREC corridor routes, where the potential for economic development and returns is greatest. At the end of 2014, 70 of the projects were on-going. Priority infrastructure work along the six corridors is now focused on the construction and upgrade of roads and rail lines. The aim is to create a seamless transport network by 2020. By 2013, about 4 970 km of roads along the six corridors, and 3 190 km of railway construction and rehabilitation had been completed.

The proposed investment projects under the CAREC Transport and Trade Facilitation Strategy (TTFS) 2020 are estimated at 38 for road, 17 for rail, 5 for civil aviation, 2 for ports and shipping, 6 for logistic centres and 13 for trade facilitation.

The complete set of corridors is listed below:

1. Europe-East Asia, from China across to west Kazakhstan, with over $3 billion of funding from ADB, World Bank, EBRD and IsDB (Islamic Development Bank) for 2 715 km of roads in Kazakhstan;
2. Mediterranean-East Asia, road and rail networks from China into Kyrgyzstan, Uzbekistan and Turkmenistan, and then across the Caspian Sea into the South Caucasus and Black Sea, with support from the same IFIs;
3. Russia-Middle East and South Asia, with a North-South route running from Siberia across all Central Asian states into Afghanistan and Iran;
4. Russia-East Asia (without passage through Central Asia);
5. East Asia-Middle East and South Asia, with road connection from China into Kyrgyzstan and Tajikistan, and then on into Afghanistan and Pakistan 6. Europe-Middle East and South Asia, with road and rail networks from west Kazakhstan and Uzbekistan to be extended into Afghanistan.

Fig. 2-29: Six Central Asia Regional Economic Cooperation Corridors

Source: CAREC

Eurasian Economic Union/EurAsEC initiative

In the post-Soviet period there have been three overlapping political institutions and cooperation arrangements that are relevant to transport policy: the CIS (all former Soviet republics except the Baltic states), the EurAsian Economic Community then Eurasian Economic Union and the customs union of Belarus, Kazakhstan and Russia. In the Eurasian Economic Union, there are motorway and railway corridors running East-West and North-South, and a number of new corridors are under construction.

The TransSib Railway is the backbone of Russian railways. TransSib stands for the network of railways connecting Moscow with Vladivostok via Yekaterinburg, Omsk, Novosibirsk, Irkutsk, Ulan-Ude, Chita and Khabarovsk. The route is about 10 000 km long and is operated by 9 of the 17 rail territorial branches of RZD: Moscow Railway (Moscow), Gorky Railway (Nizhnij Novgorod), Sverdlovsk Railway (Yekaterinburg), South Urals Railway (Chelyabinsk), West Siberian Railway (Novosibirsk), Krasnoyarsk Railway (Krasnoyarsk), East Siberian Railway (Irkutsk), Zabaikal Railway (Chita), Far Eastern Railway (Khabarovsk). TransSib has branch lines to Mongolia and China in the east through frontier stations Naushki, Zabaykalsk, Grodekovo, Hasan and to Kazakhstan in the southern Ural region though the frontier station Petropavlovsk.

The TransSib network is double-track and fully electrified on the entire main route (at 25kv AC or 3 kv DC). There are a few one-way segments on its branch lines that are not electrified and there are 36 stations located along the TransSib that are specially equipped for handling containers. This includes 13 terminals for the handling of 40ft containers.

The Trans-Siberian railway network is the main link of the North route for the Trans-Eurasian Connection. Using its branch lines to Kazakhstan, Mongolia and China in the Eastern part and linkages via Belarus/Poland or Ukraine to Western Europe, it offers several possibilities to connect Europe with China. These routes correspond with the already established UN TAR Northern corridor:

- TransSib – China via Kazakhstan (TransSib - Trans-Kazakh route);
- TransSib – China via Mongolia (TransSib - Mongolian route);
- TransSib – China via Zabaykalsk (TransSib - Manchurian route).

Among these routes, the TransSib - Mongolian route offers the shorter distance for rail transport between Moscow and Beijing and the TransSib - Trans-Kazakh route is favourable for the transportation to and from Western China. The TransSib - Manchurian route is the shortest route for transportation between Moscow and the ports at the Yellow Sea or to locations in Northeast China.

All railways of the countries along the TransSib corridor (Russian Federation, Kazakhstan, Mongolia) are members of the Organisation for Cooperation Railway Lines (OSJD) and of the Coordinating Council on Trans-Siberian Transportation (CCTT).

Organization for Railway Cooperation (OSJD)

OSJD is an international organisation focusing on developing international railway traffic and exchanging information between member countries. It has established five commissions: Transport Policy, Transport Law, Freight Traffic, Passenger Traffic, and Infrastructure and Rolling Stock.

Fig. 2-30: OSJD Corridors

Source: OSJD

The railway links among the member countries of the OSJD (see Fig. 2-30) are notable for lengthy routes (8 000 to 10 000km) with two changes of gauge size during transport in a single direction (1 435mm- 1 520mm-1 435mm) and a large number of border crossings en route. In addition, transport operations on OSJD routes between Europe and Asia are

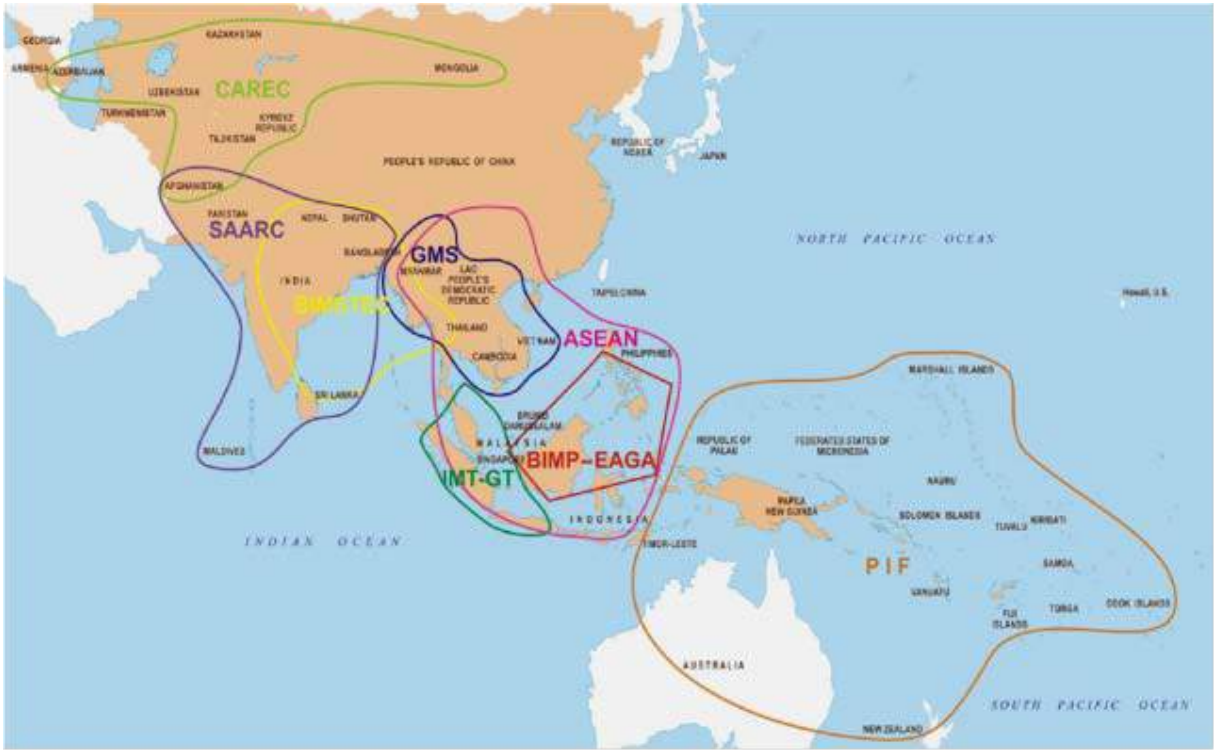
governed by regulations, which differ somewhat from those prevailing in Western Europe. In 1996, 13 main railway routes between Europe and Asia were identified by the OSJD on the basis of flows of goods between countries on the two continents. Between 1996 and 2001, the OSJD performed the analysis of technical and operational indicators and technical equipment of these 13 routes, collected data on infrastructure and border crossing and studied ways of improving the freight transport technology. Taking into account that the geography of transport flows is continuously changing due to numerous factors, the OSJD is constantly adapting and refining its strategies for the development of intercontinental links along the main railway routes. For example, its programme of work for 2005-2015 calls for the development within the Organization of comprehensive plans for the improvement of transport and the development of transport corridors. The Comprehensive Plans for OSJD Corridors No. 1, 9 and 11 were completed in 2006 and endorsed by the 34th session of the OSJD Ministerial Meeting held in Sofia in 2006, and Comprehensive Plans for corridors No. 2, 3, 4, 6, 10 and 12 were adapted at the 35th OSJD Ministers Conference in Warsaw in 2007.

Greater Mekong Railway Association

Since 1992, the ADB's Great Mekong Subregion (GMS) Program has been an initiative similar to CAREC. The GMS is comprised of 6 countries – Cambodia, LAO PDR, Myanmar, Thailand and Vietnam and the provinces of Yunnan and Guangxi in China – and its strategic thrusts are:

- Strengthening infrastructure linkages;
- Facilitating cross-border trade and investment and tourism;
- Enhancing private sector participation and competitiveness;
- Developing human resources;
- Protecting the environment and promoting the sustainable use of shared natural resources.

Fig. 2-31: The different international organisations operating in South and South East Asia



Source: ADB

As described in more detail in section 4.3, efforts to build a connected railway network in SE Asia began with the Singapore-Kunming Railway Link concept (SKRL) in the late 1990's. In 2006, the Trans-Asian Railway Network Agreement (TAR) designated the SKRL as one of the Trans Asian Railways. In 2009, the Asian Development Bank commissioned the development of a strategy for connecting GMS railways. One of the key recommendations of the strategic framework was to form an association to develop the railway network. The formation of the Greater Mekong Railway Association (GMRA) was ratified at the 18th GMS Ministerial Meeting in Nanning (PRC) on 12-13 December 2012.

GMRA is a non-legal intergovernmental forum under the GMS Program. The goals of GMRA are to:

- Ensure that all GMS countries are connected to a GMS rail network by 2020;
- Promote the development of a seamless GMS rail network by:
  - Agreeing on technical standards of interoperability;
  - Streamlining and harmonizing procedures for cross border movement of goods and people;
- Develop the institutions and procedures to effectively integrate the national railways across the GMS;
- Ensure that railways, rolling stock and equipment are modern and sufficient to meet the demand for rail services;
- Involve the private sector, as required, in the planning and development of the GMS railway network.

Political and economic engagement

In 2011 the Asian Development Bank Institute (ADBI)[19], aiming to assess the magnitude of national infrastructure financing needs and financing gaps of Asian economies by key sectors, estimated the needs for 32 Asian developing economies during the 2010-2020 period by using a "bottom-up" approach based on identified regional infrastructure projects across Asia[20]. The "bottom-up" approach used reviews of infrastructure investment demand at the project level, specifically for regional or cross-border projects.

The study used varied sources, including multilateral and bilateral development institutions and the investment estimations accounted planned infrastructure projects into the following programs:

- Pan-Asian Network and for rail sector, Trans Asian Railways (TAR) projects;
- Sub-regional cooperation initiatives including the Central Asia Regional Economic Council (CAREC), the South Asia Sub-regional Economic Council (SASEC), the Greater Mekong Sub-region (GMS)
- Other sub-regional and cross-sub regional programmes, such as within and between South Asia, Central Asia, Central-South Asia, East Asia-Southeast Asia, and the Association for Southeast Asian Nations (ASEAN).

19. ADBI provides intellectual input for policy makers in ADB's developing member countries.
20. The assessment also used a "top down" econometric approach based on the projected growth of key economic parameters such as GDP and population.

During the 2010-2020 ten-year period, the national financing needs for connectivity of 32 ADB developing member countries covered by the ADBI paper are expected to need almost US$ 8.22 trillion (in 2008 U.S. Dollars) for infrastructure investment, as displayed in Fig. 2-32. This amounts to US$ 747 billion in annual investment needed over 2010-2020. Around 68% of this is needed for new capacity investments in infrastructure and around 32% is needed for maintenance or replacement of existing assets. In general, the total projected infrastructure investment requirements are equal to about 6.5% of Asian estimated 2010-2020 GDP. Of the total investment approximately 35% is estimated to be needed for transport infrastructure.

Fig. 2-32: National Infrastructure Investment Needs in Asia, 2010-2020: Per Sub-region and Per Sector (2008 US$ billions)

Sector / Subsector	East and Southeast Asia	South Asia	Central Asia	The Pacific	Total
Electricity	3,182.46	653.67	167.16	-	4,003.29
Transportation	1,593.87	1,196.12	104.48	4.41	2,898.87
Airports	57.73	5.07	1.41	0.10	64.31
Ports	215.20	36.08	5.38	-	256.65
Rails	16.14	12.78	6.03	0.00	34.95
Roads	1,304.80	1,142.20	91.65	4.31	2,542.97
Telecommunications	524.75	435.62	78.62	1.11	1,040.10
Telephones	142.91	6.46	4.45	0.05	153.87
Mobiles	339.05	415.87	71.97	0.95	827.84
Broadband	42.78	13.29	2.21	0.11	58.39
Water and Sanitation	171.25	85.09	23.40	0.51	280.24
Water	58.37	46.12	8.60	0.14	113.22
Sanitation	112.88	38.97	14.80	0.36	167.02
Total	5,472.33	2,370.50	373.66	6.02	8,222.50

Source: ADB Institute

The total investments required for regional infrastructure projects for Asian connectivity to meet demand for the identified 1 202 regional projects is valued at approximately US$ 320 billion (see Fig. 2-33), with an average infrastructure investment need of about US$ 29 billion per year for the period 2010-2020. Of this total, investments for railway projects needed account for about 40%.

Fig. 2-33: Asia's Total Regional Indicative Investment Needs for Identified and Pipeline Infrastructure Projects by Regional/Sub-regional Program: 2010-2020 (US$ Million)

Regional / Sub- regional Program	Energy	Transport					Grand Total
		Airport / Port	Rail	Road	TF / Logistics	Total	
AH	-	-	-	17,425.0	-	17,425.0	**17,425.0**
TAR	-	-	107,469.0	-	-	107,469.0	**107,469.0**
ACP*	-	51,446.0	-	-	-	51,446.0	**51,446.0**
CAREC	15,667.0	1,347.7	5,131.3	12,932.9	9,925.1	29,337.0	**45,004.0**
GMS	2,603.8	200.0	1,523.0	3,972.0	163.0	5,858.0	**8,461.8**
ASEAN	11,583.0	-	16,800.0	-	-	16,800.0	**28,383.0**
BIMP-EAGA	100.0	-	-	-	-	-	**100.0**
SASEC	133.0	-	-	-	203.0	203.0	**336.0**
Other**	61,926.6	-	-	-	89.5	89.5	**62,018.1**
Total	**92,015.4**	52,993.7	130,923.3	34,329.9	10,380.6	**228,627.4**	**320,642.8**

Source: ADB Institute

Those numbers show the magnitude of investments needed for Asia-Pacific infrastructure including railway networks; in particular for the regional projects considered by the ADBI estimates along the corridors described above (e.g. TAR and CAREC).

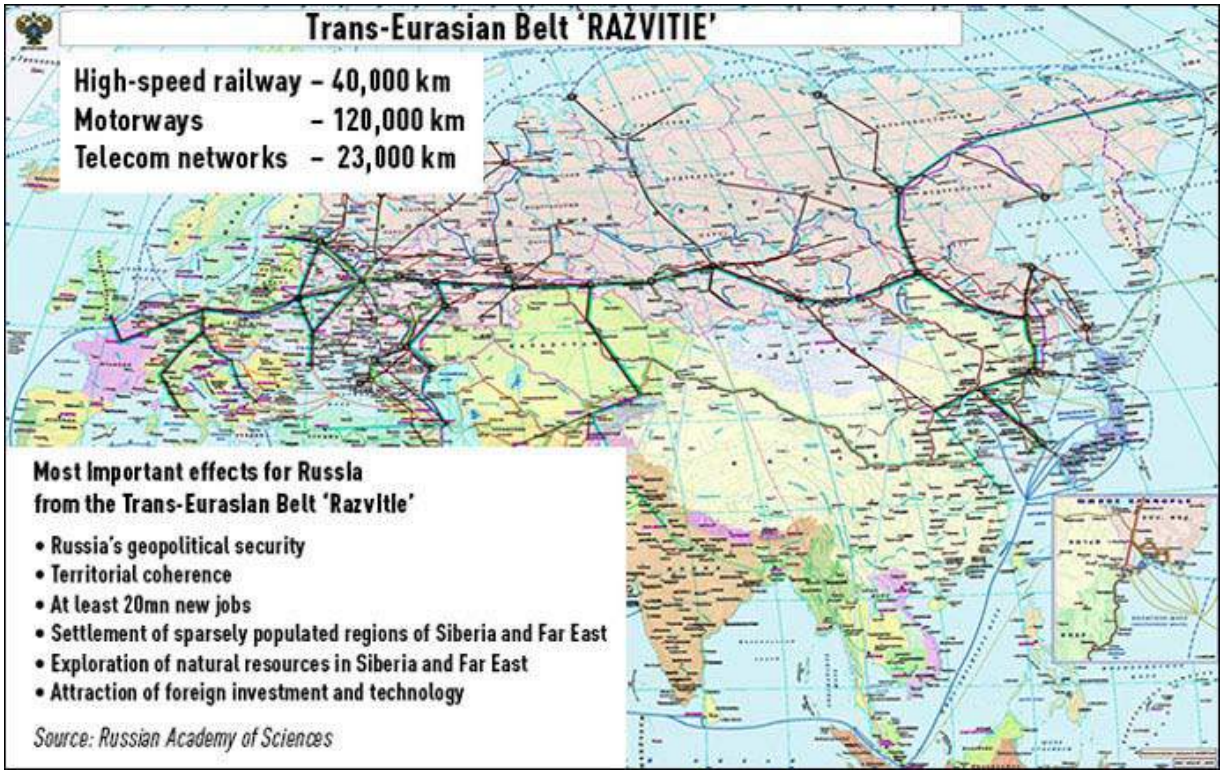
Regional infrastructure enhances competitiveness and productivity, which could help in economic recovery and in sustaining growth in the medium to long-term. Regional infrastructure also helps increase the standards of living and reduce poverty by connecting isolated places and people with major economic centres and markets, narrowing the development gap among Asian economies. It also promotes environmental sustainability, facilitates regional trade integration and the acceleration of regional cooperation, and helps increase regional demand and intraregional trade necessary to rebalance Asia's economic growth. The infrastructural development of the Asian continent, for regional integration and connectivity, is without a doubt one of the key challenges of the AP region in the 21st century.

To promote interconnectivity and economic integration in the region and cooperate with existing multilateral development banks, in 2014 the Asian Infrastructure Investment Bank (AIIB) was created. AIIB is a multilateral development bank (MDB) focused on the development of infrastructure and other productive sectors in Asia, including among others energy and power, transportation and telecommunications, rural infrastructure and agriculture development, water supply and sanitation, environmental protection, urban development and logistics.

The purpose of the Bank is to: (i) foster sustainable economic development, create wealth and improve infrastructure connectivity in Asia by investing in infrastructure and other productive sectors; and (ii) promote regional cooperation and partnership in addressing development challenges by working in close collaboration with other multilateral and bilateral development institutions.

Besides being a major sponsor of the AIIB, the People's Republic of China has announced at the end of 2014 that they would contribute US$ 40 billion towards a "Silk Road Fund" destined to the development of infrastructure, particularly transport infrastructure (including rail) in Central and South Asia.

Fig. 2-34: Map of the Trans-Eurasian Belt “Razvitie”



Another important initiative has been presented in June 2015 by Russian Railways with the support of the Russian Academy of Sciences, called “Razvitie” (“Development” in Russian). The multi-modal corridor includes railways, roads and telecommunication networks, and aims to strengthen the current backbone, increase its ramifications and push its reach to the northernmost and easternmost limits of Siberia.

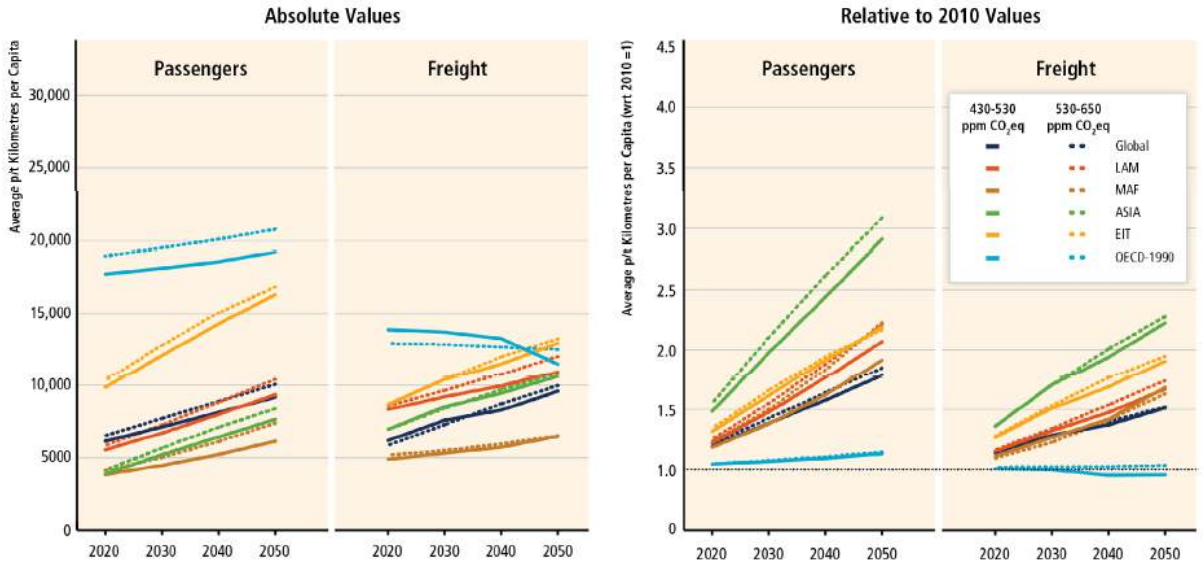
3. TRANSPORT SCENARIO

The focus of this section is on the transport sector. The study starts from the analysis of the current situation and the past trends in the UIC Asia-Pacific region, to subsequently tackle future perspectives. Scenarios from the International Energy Agency (IEA), the International Transport Forum (ITF) and the Intergovernmental Panel on Climate Change (IPCC) will be described, with particular attention on the forecast regarding railways.

3.1 TRANSPORT DEMAND: ESTIMATES FOR 2030 AND 2050

The world transport demand in the near future is a crucial challenge for the reduction of the impacts of mobility. It is extremely complex to make predictions and estimates and to build future scenarios. According to the IPCC WGIII AR5 scenario[21], transport demand – for both passenger and freight – will grow in the next decades until 2050 (see Fig. 3-1), with most of this growth happening in emerging countries, where higher rates of income and population growth are forecasted. All scenarios analysed by IPCC show how, due to a strong correlation between passenger mobility and disposable income, the highest rate of growth will be in non-OECD countries. IPCC estimates that freight demand grows with lower rates than passenger demand, with a decoupling between demand growth and GDP forecasted to happen earlier in the passenger sector.

Fig. 3-1: Per-capita passenger and freight demand in different regions based on scenarios differing by CO_{2eq} concentration levels in 2100 (average pkm and tkm per-capita per year)



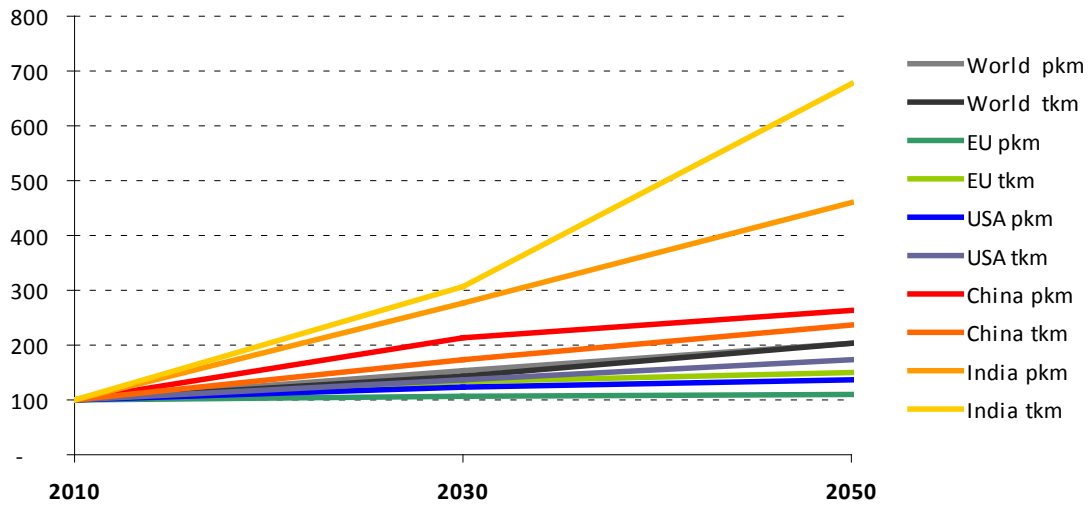
Source: IPCC (Intergovernmental Panel on Climate Change)

The IEA (ETP 2012), in the 6DS and 4DS scenarios, conjectures that the global passenger demand, in a business-as-usual (BAU) perspective, will double between 2010 (baseline) and 2050, with an average rate of 19.3% in 10 years (see Fig. 3-2). In the Avoid/Shift scenario,

21. The IPCC WGIII AR5 is based on the analysis of more than 1200 existing scenarios.

where some measures to slow demand growth are evaluated, the 10-year growth rate is reduced to 17.6%. The IEA assumes that passenger demand will rapidly increase, in particular in non-OECD countries, because of multiple factors: among those, the forecasted growth in population and income[22]. The global growth will be partially mitigated by the stabilisation of transport demand in OECD countries. In a BAU scenario, the forecasted growth rates of freight transport demand is not lower than passenger transport demand growth rates, while in the Avoid/Shift scenario the 10-year growth rate goes from 19.5% (BAU) to 16.7%.

Fig. 3-2: Growth of passenger and freight transport demand according to the IEA 6DS and 4DS scenarios, for World, EU, USA, China and India (2010=100)



Source: International Energy Agency

The International Transport Forum (ITF) of the OECD has revised its estimates[23] on the growth of transport demand downwards, taking into account the revisions of the forecasts on global economic growth with the medium-long term impacts of the 2008 crisis in the transport sector. The 2013 ITF Outlook focuses its scenarios (2050 horizon) according to different hypotheses of global economic growth, where it is assumed that the 2008 shock had permanent effects on global production and a standard rebound is not possible.

The estimates on 2050 demand are different according to the assumptions of economic growth and the policies chosen: policies favourable to privately owned cars (*Private transport oriented/high roads*) or favourable to public transport *(Public transport oriented/ low roads)*. The 2013 ITF Outlook forecasts that the passenger demand[24] in 2050 will evolve in correlation with the growth of GDP, the prices of fuels and the development of urban transport, with a growth factor of 1.9 to 3.7 compared to 2010. In the *central* scenario the growth factor is 2.4, with a low GDP growth, and 2.9 for the *baseline* scenario. ITF confirms that the growth distribution is different for OECD and non-OECD countries according to different growth factors (respectively between 1.3-2 and 2.9-6.5), as are different the modal shares of private cars and 2-wheel vehicles. The growth rates estimated at 2050 by ITF for land freight transport are also quite different for OECD and non-OECD countries: between 42% and 124% for the former, and between 100% and 430% for the latter, compared to 2010.

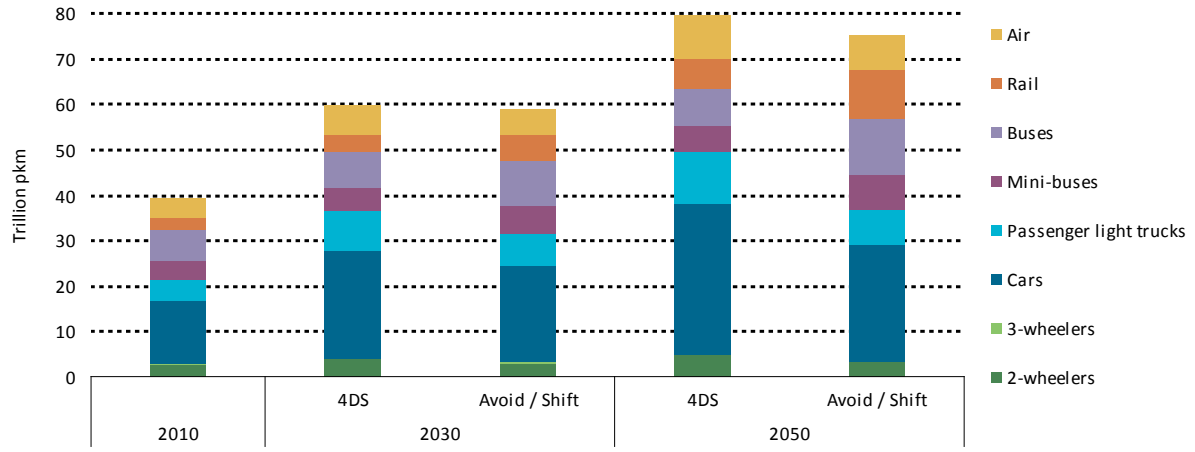
22. The passenger transport demand in 2050 according to IEA will be around 80 trillion pkm. The estimates contained in ETP 2012 are consistent with the estimates made in 2009.
23. The scenarios are still defined from the IEA Mobility Model
24. In the 2013 Outlook the estimates are expressed in vehicle-km, and not in passenger-km.

3.2 MODAL SHARE: IEA 2DS AND 4DS SCENARIO (2030 AND 2050)

The IEA Avoid/Shift sub-scenario analyses the potential effects of policies oriented to modal shift and to the reduction of transport demand. The evaluation of policies is based on the ASI (*Avoid/Reduce, Shift, Improve*) strategy: *Avoid/Reduce* the movement of passengers and freight wherever possible, *Shift* transport to more sustainable modes (e.g. non-motorised transport, railways, public transport) and *Improve* the efficiency and emissions of vehicles.

In the passenger sector, the Avoid/Reduce policies are considered to have more significant effects in the long term, while by 2030 the modal shift is expected to have a greater effect on the reduction of the environmental impact of mobility[25]. Fig. 3-3 displays the IEA projections of passenger traffic volumes and modal share to 2030 and 2050.

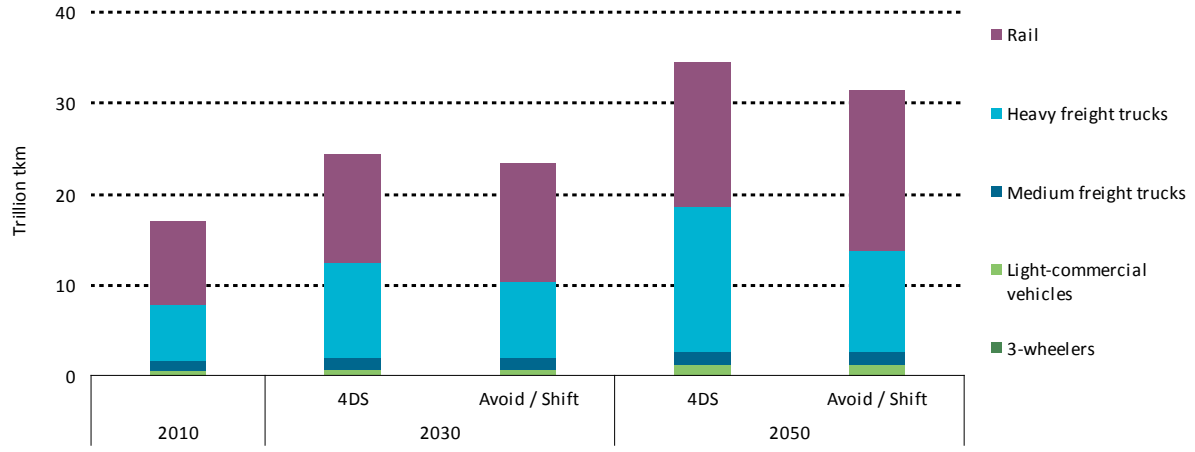
Fig. 3-3: Volumes of passenger traffic and modal share estimated by IEA



Source: IEA ETP 2012

Passenger railway transport, both on medium-long range and on urban/suburban distances, can increase considerably and reduce the weight of road transport and aviation. In the land freight transport sector as well (see Fig. 3-4), the impact of policies oriented to modal shift on rail is relevant and can be up-and-running in the medium term.

Fig. 3-4: Volumes of freight traffic and modal share estimated by IEA



Source: IEA ETP 2012

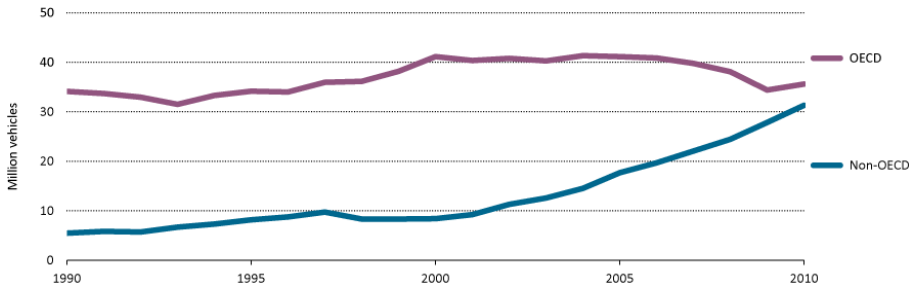
25. IEA stresses the important contribution that can come from modal shift particularly in an urban environment, where a higher growth and concentration of population is expected in the next decades. An intelligent growth of the cities can reduce the distance and number of movements, and promote the use of more sustainable transport modes such as public transport, cycling and pedestrian mobility.

The combination of the effects of the scenarios *Avoid/Shift* and *Improve* can trigger a reduction in emissions of the transport sector by around 8 GtCO2eq by 2050 compared to the 4DS scenario, with a contribution of 1.4 and 6.6 GtCO2eq from the Avoid/Shift and the Improve scenario respectively.

3.3 MOTORISATION

The vehicles sold in the year 2013 at world level amounted to 85.7 million, growing by around 4.7% compared to 2012, which had already seen an increase of 5% from 2011. Cars represent 75% of total vehicles, with about 65 million units sold (+4.7% from 2012). The road vehicles market in 2013 was particularly supported by the level of sales in China (+13.9%). 25% of the whole world market was in China, with Asia being responsible for less than half (44%) of global demand. The light-duty vehicles[26] (LDV) market is rapidly growing in non-OECD countries and is by now reaching the same sales levels of OECD Countries, as shown in Fig. 3-5.

Fig. 3-5: LDV sales at world level, 1990-2010 (million vehicles)



Source: IEA ETP 2012

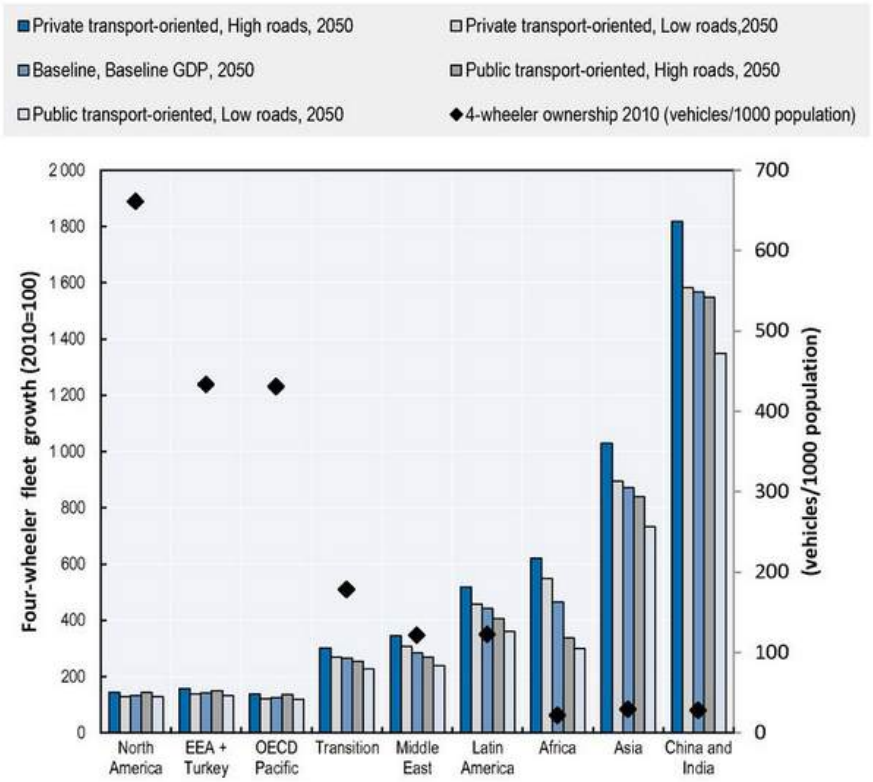
The Outlook 2013 from the International Transport Forum (ITF) presents scenarios (*horizon 2050*) on the forecast of the vehicle fleet size for different world areas according to different assumptions on the global economic growth (low/high) and the type of policies adopted (*Private transport oriented/high roads* or *Public transport oriented/low roads*).

The ITF Outlook 2013 estimated that in 2050 the number of vehicles circulating at global level will double or even grow fourfold compared to 2010 levels (from 835 million vehicles estimated in 2010 to 1.8 or 3.3 billion vehicles) if no measures are taken to contain the spread of private vehicles and if the world economic growth will have the same speed it had before world financial crisis of 2007/2008. According to ITF, the vehicle fleet growth rate will not be homogeneous all over the world: a low growth rate or stabilisation is expected in advanced economies (Europe, USA and OECD Pacific), while a high or very high growth rate is expected in Asia, because of the strict relationship between prosperity and spreading of private mobility (see Fig. 3-6).

For former Soviet Union countries the growth rate foreseen is more moderate, but anyway twice the amount of the growth in North America, Europe and OECD Pacific countries (Japan, South Korea, Australia and New Zealand).

26. Cars and commercial vehicles under 3.5 tonnes.

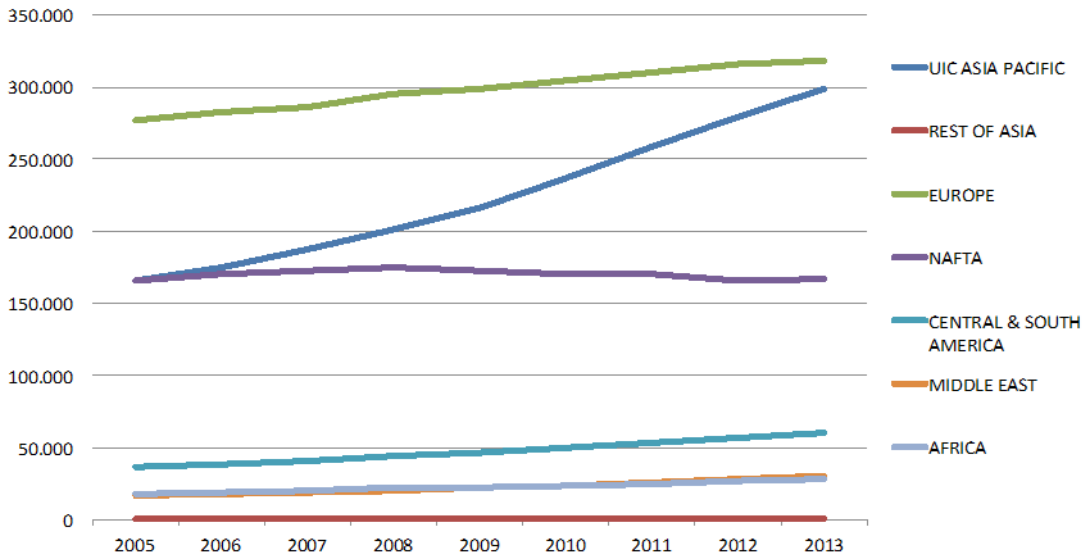
Fig. 3-6: Growth rate between 2010 and 2050 in the vehicle fleet by different world areas and different scenarios



Source: ITF 2013 Outlook

Vehicles in use in 2012 are more than a billion units[27]: they were less than 900 million units in 2005. The fleet growth rate from 2005 is stable and a little lower than 4% for every type of vehicle, with no significant differences between cars and commercial vehicles. The distribution between the two macro categories is essentially stable with cars representing two-thirds of vehicles in use. The fleet growth rate is driven by the Asia/Oceania/Middle East area, as clearly indicated in Fig. 3-7.

Fig. 3-7: Trend of private cars used in the world between 2005 and 2012 (thousands)

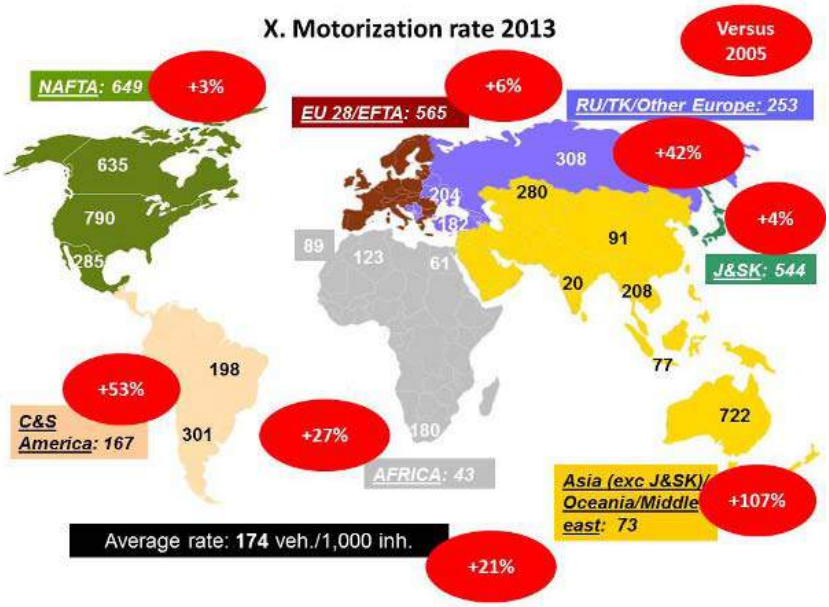


Source: World Bank

27. OICA data.

In terms of size, different world areas present a significantly different weight, reflecting the difference in the degree of development of the economies and particularly in disposable income. The Asia/Oceania/Middle East area passes from being responsible of 27% of total fleet in 2005 to 49% in 2013, representing the biggest vehicle fleet of the world, surpassing the NAFTA[28] area which features in 2013 the 18% of world fleet and the European Union responsible for 35% of the fleet. Motorisation rates (see Fig. 3-8) reflect this diversification, with emerging economies presenting shares significantly different from the major advanced economies.

Fig. 3-8: Motorisation rates (number of road vehicles per 1 000 inhabitants), 2012



Source: OICA (International Organization of Motor Vehicle Manufacturers)

3.4 TRADE AND TRANSPORT

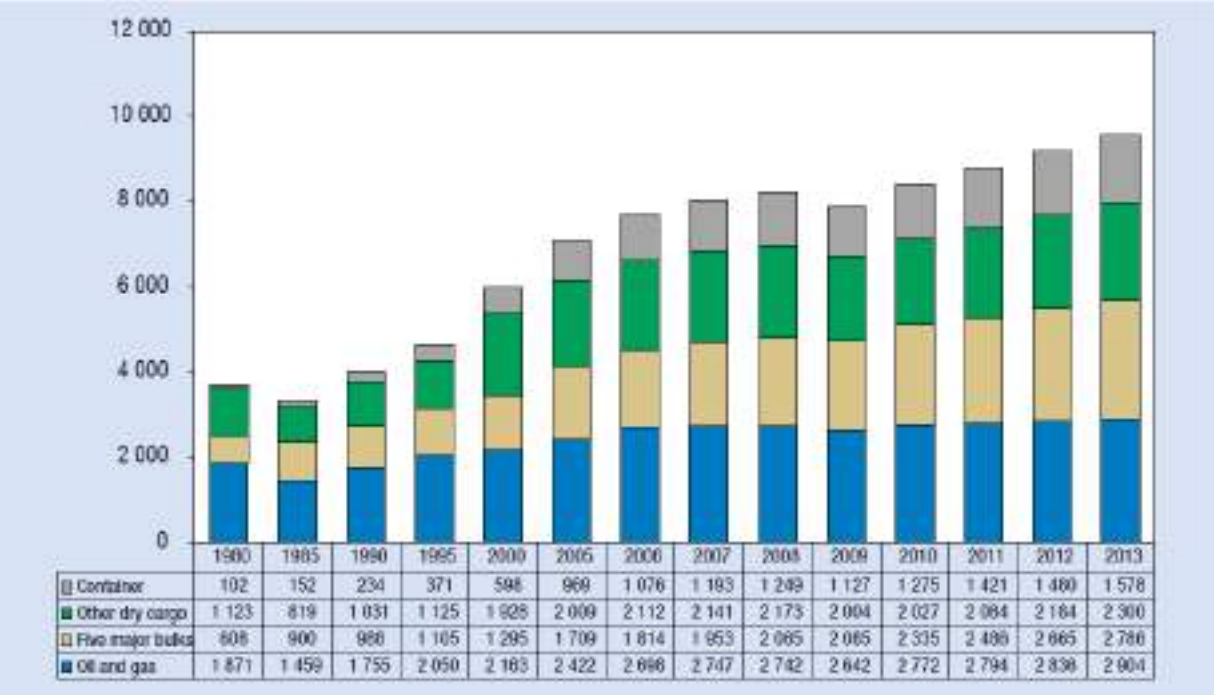
Activity in the transport sector is closely related to the level of trade: global trade is a specific driver of maritime and air transport volumes.

Global trade has grown faster than global output over the past decade, even though the international financial crisis of 2008 had a huge impact on trade volumes. The rebound was equally quick after the shock, but growth rates slowed down. The lower growth rates of global trade can be attributed to weak export growth from advanced economies and in particular to weak demand in these economies, with low import demand growth and a slower growth of exports from emerging economies.

The backbone of international trade is maritime transport, with over 80% of world cargo volumes transported by sea. The global growth of maritime transport activity, shown in Fig. 3-9, is driven by dry-cargo shipments, in particular by continued rapid growth in dry bulk volumes fuelled by growing Asian demand for iron ore and coal. China has contributed significantly to the growth of seaborne trade in recent years and continues to generate impressive import volumes, although iron-ore import growth has recently slowed down compared with the previous levels, with coal filling the gap. Growth in containerized trade (TEU[29]) is slowing recently because of the drop in Europe's import demand, in particular from Asia.

28. North American Free Trade Agreement
29. TEU: Twenty-foot Equivalent Unit, a standardised measure of volume for containers.

Fig. 3-9: International seaborne trade, selected years (Millions of tons loaded)



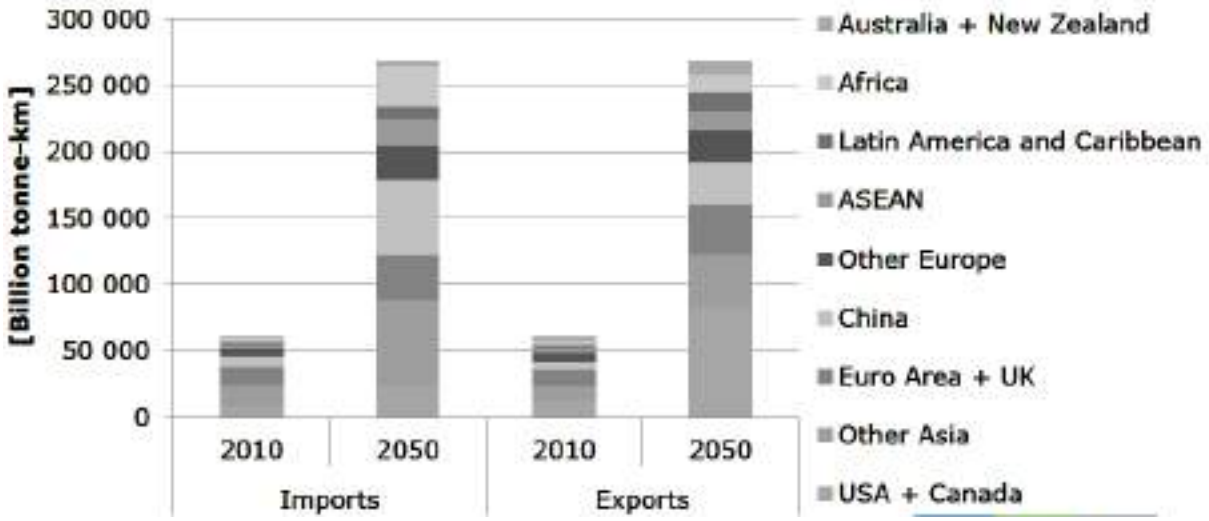
	1980	1985	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Container	102	152	234	371	598	969	1 076	1 193	1 249	1 127	1 275	1 421	1 480	1 578
Other dry cargo	1 123	819	1 031	1 125	1 928	2 009	2 112	2 141	2 173	2 004	2 027	2 084	2 184	2 300
Five major bulks	608	900	988	1 105	1 295	1 709	1 814	1 953	2 065	2 065	2 335	2 489	2 665	2 786
Oil and gas	1 871	1 459	1 755	2 050	2 183	2 422	2 668	2 747	2 742	2 642	2 772	2 794	2 838	2 904

Source: UNCTAD (United Nations Conference on Trade and Development)

Reflecting to a large extent their increased participation in the world trading system, Asia-Pacific developing countries continued to contribute larger shares to international seaborne trade. In 2012, Asia accounted for about 40% of global goods loaded and about 60% of goods unloaded in 2012. Some analysts are forecasting that the value of world merchandise trade will more than double between 2010 and 2020 and that China's exports to Europe will be valued at almost twice those of the United States' exports to Europe (Ernst and Young, 2011 and UNCTAD, 2013).

The global activity for container transport was about 50 million TEU in 1996 and grew to more than 160 million TEU in 2013. In 2012 Trans-Pacific flows amounted to 20 million TEU, an amount equivalent to Europe-Asia-Europe flows, while transatlantic flows were only about 6 million. In 1996 those volumes amounted respectively to 8, 4 and 3 million. According to ITF/OECD forecasts, in 2050 non-OECD countries will account for one third of world trade against the 15% in 2010. The ITF international freight model predicts a shift in world freight patterns with an increase of global activity by 350% tonne-km in the 2010-2050 period, as displayed in Fig. 3-10.

Fig. 3-10: Shift in world freight patterns 2010-2050

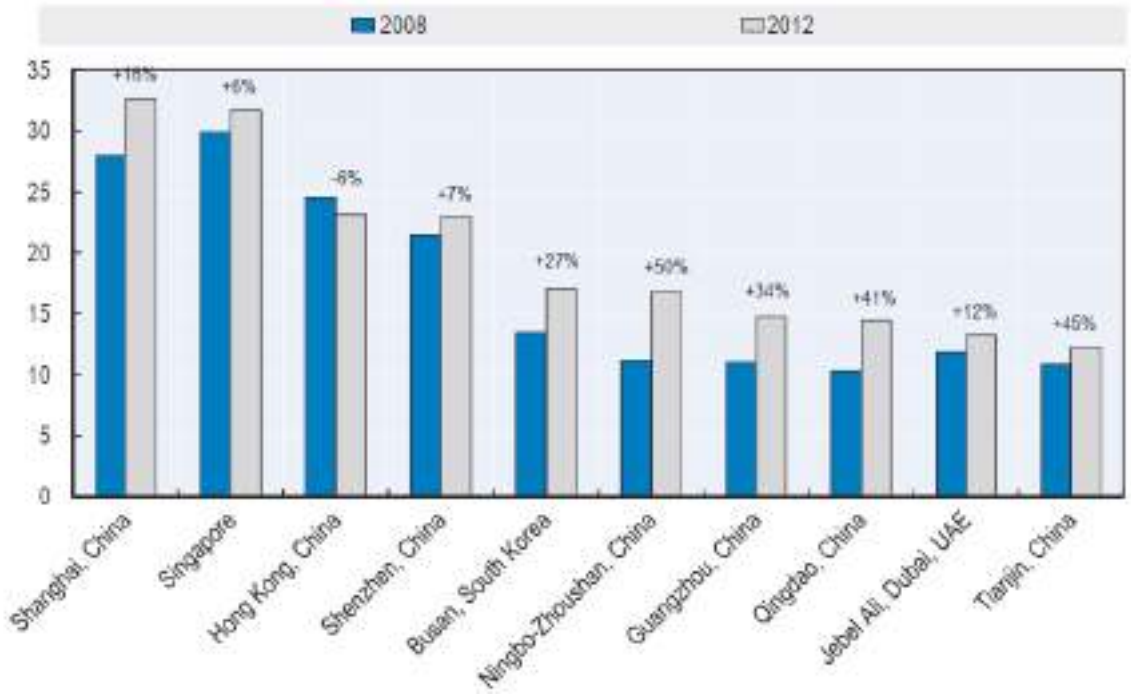


Source: ITF/OECD

According to ITF, maritime transport will keep being predominant (97.8%) but there will be an increase of road share (1.8%) by 40% compared to 2010, while freight average hauling distance increase by 17%. In 2050, according to ITF estimates, the freight volume patterns will change largely due to a shift of trade volumes: North Atlantic remains important, but it will be surpassed by North Pacific and a strong increase in volume in the Indian Ocean and the Suez Canal will be registered.

The Asia region is already by far the most important region for container trade. The world's ten leading container ports (see Fig. 3-11) are located in East and Southeast Asia with the only exception of Jebel Ali, port of Dubai.

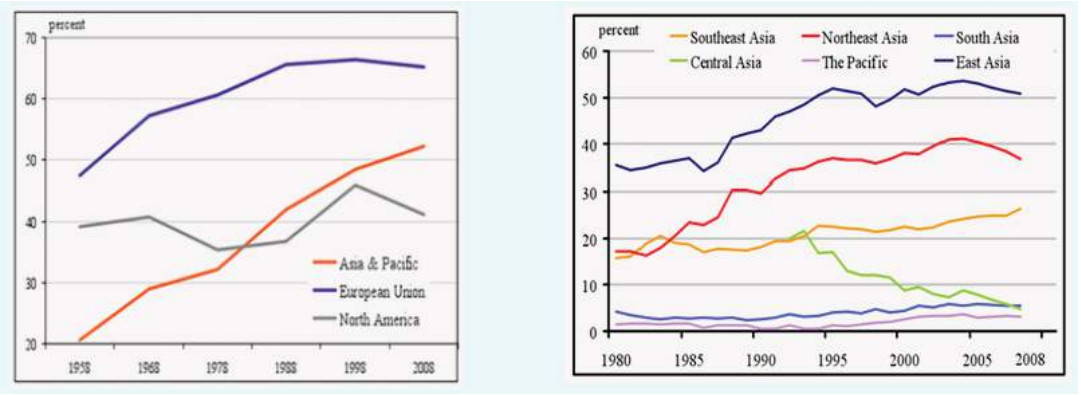
Fig. 3-11: The 10 leading world ports in terms of container traffic (TEU) and annual % change



Source: ITF based on World Shipping Council and Containerisation International

The Asia-Pacific intra-regional trade has been integrating rapidly since 1960: its share rose from about 20% to over 50% in 2008, as shown in Fig. 3-12. Its trade to GDP ratio has been growing at a constant rate and now equals EU levels. Driven in particular by a rise in China's domestic demand as well as increased intra-Asian and South–South trade, international seaborne trade performed better than the world economy, with volumes increasing at an estimated 4.3 per cent in 2012, nearly the same rate as 2011.

Fig. 3-12: Share of intra-regional trade[30]



Source: ITF 2013

Largely driven by market forces and complemented by national policies, economic interdependence in East and Southeast Asia has grown rapidly in recent decades. Intricate regional production networks and supply chains have been established in industries such as electronics and cars. This process has resulted in a fragmentation of production – as explained in the first chapter – and led the process of regional and global integration. PRC has become the main assembly plant for "Factory Asia" and emerged as a significant exporter for other East and Southeast Asian economies, as well as a base for exporting final goods to the rest of the world. This level of trade integration exceeds that of North America.

30. Figures refer to total trade (exports plus imports). The intra-regional trade share of region i is defined as IT share i = (Xii+Mii)/(Xi+Mi), where Xii = exports of region i to region i; Mii = imports of region i from region i; Xi=total exports of region i; and Mi = total imports of region i.

4. KEY ELEMENTS OF ASIA-PACIFIC RAILWAYS AT SUBREGIONAL LEVEL

The compilation of the present report was preceded by a data collection effort by UIC, which sent out a questionnaire to all railways of the UIC Asia-Pacific region. UIC received replies from six companies:

- Australasian Centre for Rail Innovation (Australia),
- KTZ (Kazakhstan),
- KRRI (Republic of Korea),
- Ulaanbaatar Railways (Mongolia),
- RZD (Russian Federation),
- Vietnam Railways (Vietnam).

The summary of the responses for those railways is available in Annex A. For all other regions, this chapter provides an overview of the key elements of railways in the five macro-regions outlined in section 1 and shown in Fig. 1-1: North and Central Asia, East Asia, South Asia, South-East Asia, and Pacific. The macro-region outlines try to fill in the elements for the countries where no railway has filled out the questionnaire.

In Annex to this report, 29 Country Profiles have been made available, one for each country in the region. These Country Profiles include some basic geographic, economic and environmental data, as well as more specific data on the railway infrastructure and activity for the country.

4.1 NORTH AND CENTRAL ASIA

4.1.1 Economic outlook

The Asia-Pacific North and Central Asian sub-region covers Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, the Russian Federation, Tajikistan, Turkmenistan, Uzbekistan and Mongolia. The overall GDP of the sub-region rose since the 2000s, with an average growth rate of 6.4% before the global economic recession. The growth began to slow from 2009. Restrained global demand for energy, gold and non-precious metals has slowed growth in those resource-based economies, particularly in the Russian Federation, which accounts for 80% of the sub-region's GDP.

4.1.2 Rail activity development

In the recent past the demand for transport has followed the overall trend of the economic cycle. Regarding land transport, generally railways dominate the freight sector and maintain a stable market share compared to road transport, although with a slight decrease. On the contrary, in the passenger sector the situation is reversed, with the exception of the Russian Federation where the modal share of railways is around 50% but continuously

eroded by modal competitors. Nowadays the motorisation index, the use of road vehicles and the kilometres travelled are growing due to the improvement of per-capita GDP. Also, civil aviation contributes to progressively reduce rail traffic in the passenger sector in large countries such as Russia and Kazakhstan.

The Eurasian Development Bank (EDB) defined a medium-term outlook on passenger and freight traffic, based on different scenarios and variables for socioeconomic development until 2020, for Russian Federation and Kazakhstan: those countries lead the sub-region in terms of GDP, population and transport demand. To assess the development prospects for the passenger and freight rail markets, the EDB used a negative and an optimistic scenario ("base" and "innovative"). The assumptions underlying the "base" scenario are the resumption ("second wave") of the global economic crisis between 2014 and 2017 and the continuing recession in Russia accompanied by a drastic reduction in investment and a fall in the exchange rate of the Russian rouble. Conversely, the "innovative" scenario includes the sustainable recovery of the global economy, and growing demand for raw materials and industrial products in world markets. Freight differences for 2020 in the two scenarios are significant: in the case of Russia freight traffic would increase from 2 196 billion tkm in 2013 to 2 400 (base) or 3 550 (innovative) billion tkm in 2020. In the case of Kazakhstan, freight is expected to grow from 229 billion tkm in 2013 to 250 (base) or 380 (innovative) billion tkm in 2020. For passenger transport, in Russia it is expected that by 2020 the demand for rail passengers increases by 32% compared to 2013 in the pessimistic scenario and by 66% in the optimistic scenario.

Suburban traffic in Russia will continue to decline, but the replacement of suburban trains with more comfortable and faster service will also help attract passengers, especially where the road network is overloaded; domestic traffic in the high-speed segment in Russia will increase; there will be increasing competitive pressure from air and road transport in the long distance passenger carriage market.

In the medium term, the demand for freight transport will continue to grow in relation to global and Asia-Pacific growth, although at lower rates than before 2009 because of a slowdown in the growth of India and China. An important factor for future growth is linked to the capacity of the area to be able to attract a substantial part of the trade between East and South-East Asia, Pacific and Europe.

4.1.3 Rail infrastructure development

The sub-regional railway network extension did not increase except for some cases, for example Turkmenistan and Uzbekistan. On the contrary the road network is constantly expanding, particularly in the Russian Federation and Kazakhstan. Overall, the sub-region must deal with the need to modernize the rail network in order to increase productivity, safety and reliability.

Generally, in the freight sector, the railways of the sub-region aim to enlarge their market share on land freight transport, thanks to large increases in productivity. For this purpose the main factors are: the increase in capacity and coverage of the network, the increase in axial loads, the adaptability to the construction of longer trains compatible with the container traffic (high cube and double stacked containers), the building of logistics facilities near the strategic nodes. The competitive advantage of rail freight transport is mainly in the transport of some product categories, such as energy and non-energy commodities, as well as long distances. Both of these underlying conditions are present in the countries of the sub-region. Some railways in the region are pushing integration initiatives: for example Russian Railways (RZD) and Kazakh Railways (KTZ), with the addition of Belarusian Railways, have created the United Transport and Logistics Company in order to transport container cargo across the region and with Europe.

North and Central Asia is the connecting point of the Eurasian railway land-bridge. All countries of the sub-region are crossed by the main rail freight corridors between East Asia, Pacific and Europe. Russian Railways have started the development of the High-Speed Rail (HSR) network through both the reconstruction of existing lines between key regional centres to handle high-speed services using fast trains running at 160 km/h to 200 km/h and through the development of dedicated "super speed" routes for trains operating at 350 km/h along selected corridors. The development of rail transport will largely depend on infrastructure modernisation and the creation of dedicated freight corridors, capitalising on the double dividend of improving efficiency and developing transit potential.

4.2 EAST ASIA

4.2.1 Economic outlook

The sub-region is formed by: China, Hong Kong, Macao and the Democratic People's Republic of Korea. Due both to a general lack of data regarding the Democratic People's Republic of Korea and to an obvious matter of proportions, in economic and transport terms, the description of the sub-region largely overlaps with that of its dominating country: the People's Republic of China (PRC).

The slowdown of growth in China in recent years has stopped, but it is unlikely that the Chinese economy may grow to levels experienced before the global crisis, unless the economy is rebalanced by a strongly expanding domestic consumption. The slowing of growth in China is having a negative impact on other economies in the region and in the world economy. During 2013 China has launched an extensive reform package, in which the underlying theme is to make the economy more balanced, sustainable, market-oriented and efficient. The planned reforms include the acceleration of the pace of liberalisation of interest rates, the convertibility of the Chinese Yuan, the restriction of monopolies, a new operational framework for major companies, and the ability for private investors to take part in government investment projects. Particular attention is given to measures to tackle the growing inequalities between rural and urban areas. The stimulus packages announced by China in 2014 should help further to contain the deceleration of growth.

The main important goals of the China's 12th Five Year Plan are:

- Develop China's western regions,
- Protect the environment and improve energy efficiency,
- Continue transitioning to an economy driven by domestic consumption instead of exports,
- Improve the lives of Chinese citizens,
- Develop seven priority industries, with the aim of increasing their GDP contributions from 2% of GDP to 8% by 2015.

Three of these seven industries align with the theme of sustainable growth (energy savings and environmental protection, new energy, and clean energy vehicles) while the other areas are consistent with China's ambition to move up the value chain (biotechnology, new materials, new IT and high-end manufacturing).

4.2.2 Transport outlook

The future changes that will affect the Chinese economy and society will have a great influence in the transport sector. The continued shift of business and development in Western China will change transport demand while the planned infrastructure and housing improvements will impact the movement of raw materials. Thus the switch of focus to domestic consumption could have deep implications on dampening the level of international exports and imports and boosting domestic transportation demand for both goods and people. In general both of these trends are not favourable, in the mid-term, to rail transport.

The market share of rail transport in tonne-kilometres and added value of the goods transported is in steady decline. Loads of bulk materials that constitute most of the Chinese rail freight market will continue to grow and, generally, the rail sector will continue to dominate the domestic freight transport market at least for the next 10 years. China‘s economy still depends heavily upon high volume, long-distance movements of coal and coke, metal ores, iron and steel, petroleum products, grain, fertilizers and other bulk products. The average transit distance of freight is relatively high and, as a result, the Chinese rail system carries more than one-third of the country‘s inland freight task (including inland waterways but excluding coastal shipping). Moreover, burgeoning international trade is creating the concentrated flows of containers that suit railways. But the international experience suggests that with the progress of the economy, the new industries will tend to need a lower intensity of transport compared to traditional industries, requiring transport standards (competitiveness, timeliness and security) closer to those currently offered by road transport.

Similarly, the rising incomes of people will not only lead them to travel more, but also to demand standards of comfort always higher. To date, while the total rail traffic in China is increasing, the modal share of passengers is dropping slowly, notwithstanding an unprecedented increase in rail traffic driven by the rapid expansion of high-speed services. Besides, in its public investment programme of recent years, China has put more emphasis on building highways rather than railroads. In recent years, the relative rate of investments dedicated to the highway system was on average about seven times higher than the investment in railways, especially per unit of traffic carried. To support efficient transportation of goods and people further west in the country, and to further the objective of greater domestic consumption, the 12th Five-Year Plan provides a continued extension of the road network. The government’s freeway development plan calls for the construction of seven new freeways originating from Beijing, nine new expressways running north to south, and 18 ‘thruways’ running east to west. For more rural areas, the stated objective is to ensure that by 2015 all townships and 90% of villages are accessible by vehicles.

It is likely that in the future, China will increasingly be faced with the desire of its people to travel in private cars and move goods by road without any restrictions, and at the same time manage the environmental and social impacts of these options, such as the consumption of land, greenhouse gas emissions, road safety and increasingly congested networks.

On the contrary the emphasis that the 12th Five-Year Plan gives to the environment promotes green transport and therefore railways. China’s plans for passenger rail include extending its High Speed Rail network, connecting every city with a population of at least 500 000 and investing RMB 700 billion annually in rail projects. Rail freight transportation is an attractive low-carbon option, and it is likely that the key theme of sustainability in the future will provide a further boost to rail freight. On the other hand, a shift away from coal for power generation could also have a negative impact on the rail industry (and the bulk shipping industry) as 80% of coal for power plants is currently transported by rail.

Although the details of the 13th Five-Year Plan (2016-20) for railway development, drafted by the National Railway Administration and submitted to higher authorities for deliberation in January 2015, have not yet been revealed, railway experts predict that railway development in less developed regions, as well as the growth of intercity and suburban routes will be a priority and that investment in these areas will remain high. Following the completion of major high-speed railway lines across China, the focus will be shifted onto facilitating short trips via the construction of intercity railways among city clusters and building suburban railways for commuters. Congestion and air pollution raise the importance of metro and light rail developments in urban agglomerations, where private investment can have a particularly strong added value.

4.2.3 Rail activity development

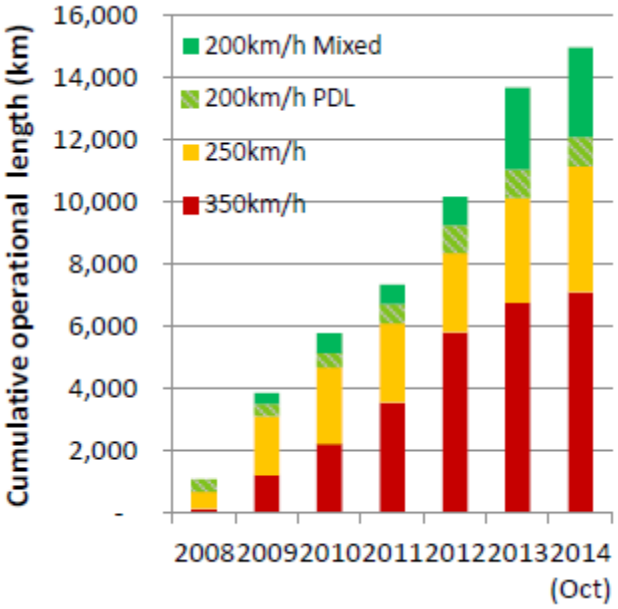
In 1949, China had only 22 000 km of poorly maintained and war-damaged railway line, less than 1 000 km of which was double-tracked with none being electrified. Since then, the railway system has been turned into a vital element of China's national transport system and a key contributor to China's extraordinary record of economic growth. Today, China Rail is the biggest carrier of rail freight and the second biggest carrier of passenger transport in the world. It has the largest combined rail traffic of any national railway system in the world, carrying about a quarter of the world's railway traffic on about 7% of the global route-km of public railway.

China's railway traffic has been rising rapidly. In 1980, China Railways (CR) was the third busiest rail freight carrier globally, accounting for 8.5% of the world's rail freight traffic; by 2005, it was the second busiest freight carrier (after the US Class I system) and carried nearly 25% of the world's freight traffic. In 1980 CR was the world's fourth busiest railway in terms of passenger traffic; by 2005 it had become the biggest passenger carrier, generating about 26% of the world's passenger traffic. Taking freight and passenger traffic together, China's railway system is now the world's busiest railway.

Since 1990, however, there has been a shift of shorter-distance passengers to road transport. The shift is partly due to better short and medium-distance bus services and partly due to CR's policy of actively discouraging short-distance passengers in order to release capacity for longer-distance rail travel. The average distance travelled by passengers on the national railway system has nearly doubled, from 275 km in 1990 to 534 km in 2008. Travel time has been reduced by increasing service speeds and reducing train stops. Shorter-distance passengers still represent a significant proportion of total trips on CR, though: trips of less than 100 km represented 23% of passengers in 2006 but only 3% of passenger-km. However, short-distance rail travel is declining rapidly, particularly for those passengers traveling under 50 km whose numbers have been reducing at over 8% per year.

In 2013, China Railway High-Speed (CRH) reached an estimated 672 million trips or 32% of all rail trips. HSR lines carried 530 million trips, or about 25% of all rail trips, on less than 11% of the rail network. HSR lines carried a total of 214.1 billion passenger-km and CRH trains 221.7 billion passenger-km. The average CRH trip was 330 km. In 2013, twice as many domestic trips were taken on CRH services (672 million) than by air (327 million domestic trips) with an average air trip of 1 363 km. For short trips (under 150 kilometres), car and bus often remain competitive, especially if the HSR station is located far from the city centre, while for trips of over four hours on HSR lines (over 1 000 km), air is still an attractive option. Nevertheless, the reliability, frequency and comfort of CRH services create strong competition for most middle-distance trips. For short-distances, a number of cities have started using CRH as a commuting option, like the Baoding connecting to Beijing and Shijiazhuang (Hebei).

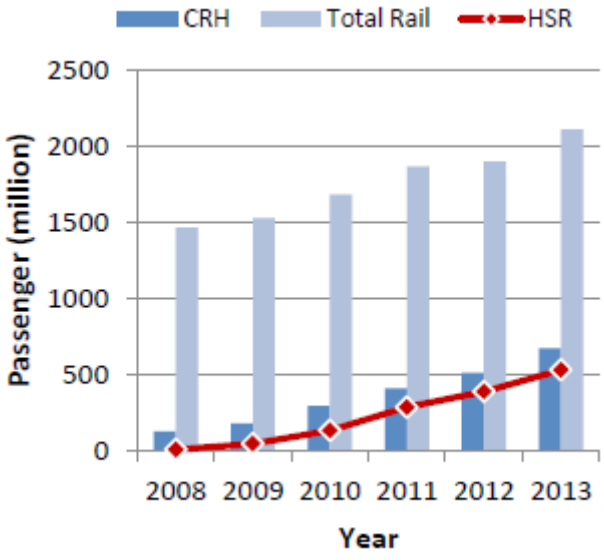
Fig. 4-1 Length of China HSR and 200 km/h lines by year by category 2008-2014 (October)



Source: World Bank on data from Yearbooks of China Transportation & Communications, China Railway Yearbooks, and Planning & Statistics Department of CRC

A large proportion of HSR riders belong to the 25-55 age group, with many travelling for business (62% based on a Tianjin-Jinan case study), with HSR facilitating an increase in trip frequency for businesses. The average length of travel for CRH passengers was about 330 km in 2013, but the actual length varies substantially per line. A broad range of travellers of different income levels choose the HSR for its comfort, convenience, safety and punctuality over existing alternatives.

Fig. 4-2 Rail Passenger Traffic Including CRH and HSR Line Traffic

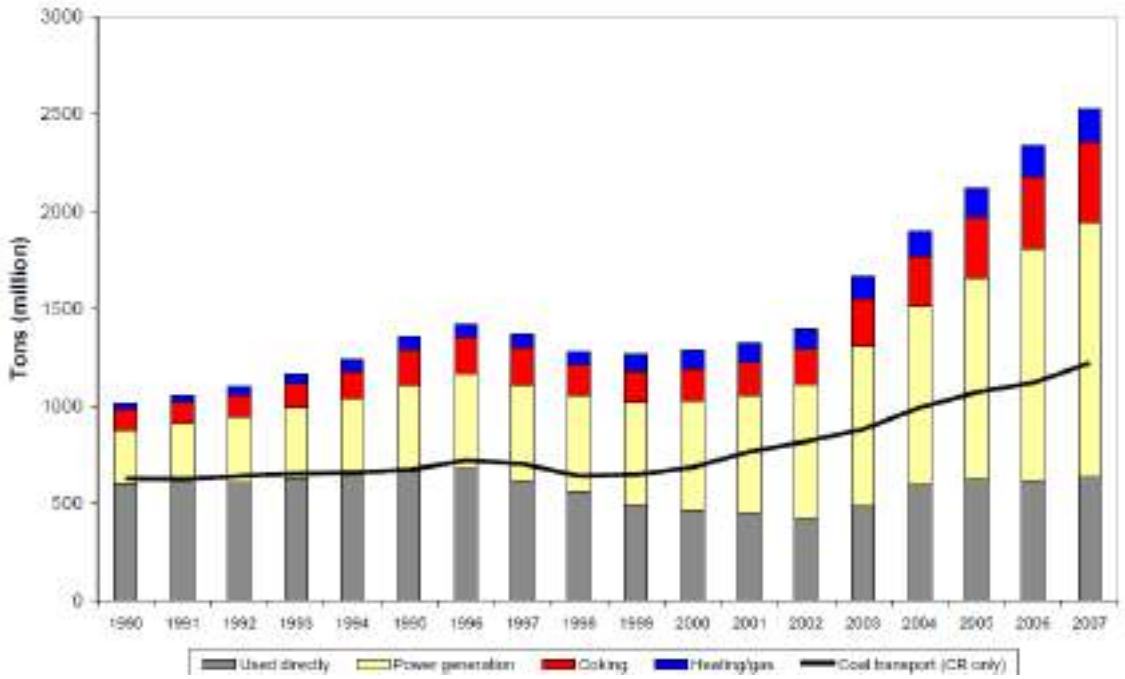


Source: World Bank on data from China Statistics for 2008-2012, Planning & Statistics Department of CRC for 2013

Between 1990 and 1996 freight grew at a modest, but steady rate. Between 1996 and 2000 it was virtually static (with a dip reflecting the economic slowdown in 1998), but since 2000 it has grown at some of the fastest rates ever experienced in China, primarily because of the strong growth in coal and steel production. Almost all the freight traffic growth has come from coal and bulk commodities, with building materials tonnage declining by 30% and other freight (mostly manufactured products of various types) was more or less constant. The dominance of coal and bulk commodities reflects not only the comparative advantage of rail but also the political priorities under which CR has allocated capacity, which has been to coal, grain, oil and fertilizers and with a preference towards the longer-distance movements.

Partly as result of these priorities, manufactured goods – including containerized traffic – represent only about 5% of tonnage handled and around 10% of tonne-kilometres. With the recent attention given to developing the rail container business, manufactured goods are expected to approximately double their share of the railway market by 2020. But even with such growth, CR will at that time still be a railway which predominantly handles bulk and semi-bulk freight.

Fig. 4-3 Coal consumption by use and rail transport of coal, 1990-2007



Source: World Bank – Tracks from the past, transport for the future: China's Railway Industry 1990-2008 and its future plans and possibilities

The volume of iron and steel transported by rail has doubled since 1990 and it is now transported by rail from a much wider range of origins. As with most traffic, the short-distance movements have been attracted to road haulage and 65% is now moving inter-regionally compared to around 50% in 1990. The two largest traffic generators are Anshan (Liaoning) and Baotou in Inner Mongolia; other major plants are at Wuhan, Kunming and Panzizhua (Yunnan), Jiuquan (Gansu), Taiyuan, Handan and Ma-anshan (Jiangsu). Oil and petroleum traffic has doubled since 1990 and consists of both flows of crude oil to refineries and the distribution of refined product to major centers. The major flows of crude oil are from the Urumqi region (including some imports from Kazakhstan) to Lanzhou and imports from Siberia to Daqing and in smaller volumes via Mongolia to northern China. Oil products are distributed from the refineries as well as from trans-shipment points at coastal ports.

Traffic associated with agriculture and forestry, including inputs such as fertilizer and outputs such as grain and timber, increased by over 60% between 1990 and 2005. Over 40% of the total traffic comes from the north-east, including substantial timber flows from Russia, which are then transported south.

The volume of construction materials (mostly stone and gravel but also including cement) has fallen by 30% since 1990. Almost all this reduction has been in shorter-distance movements, particularly in the north and north-east, which have almost certainly converted to road transport as a result of more efficient road haulage and the low priority this traffic has been given on rail.

4.2.4 Rail infrastructure development

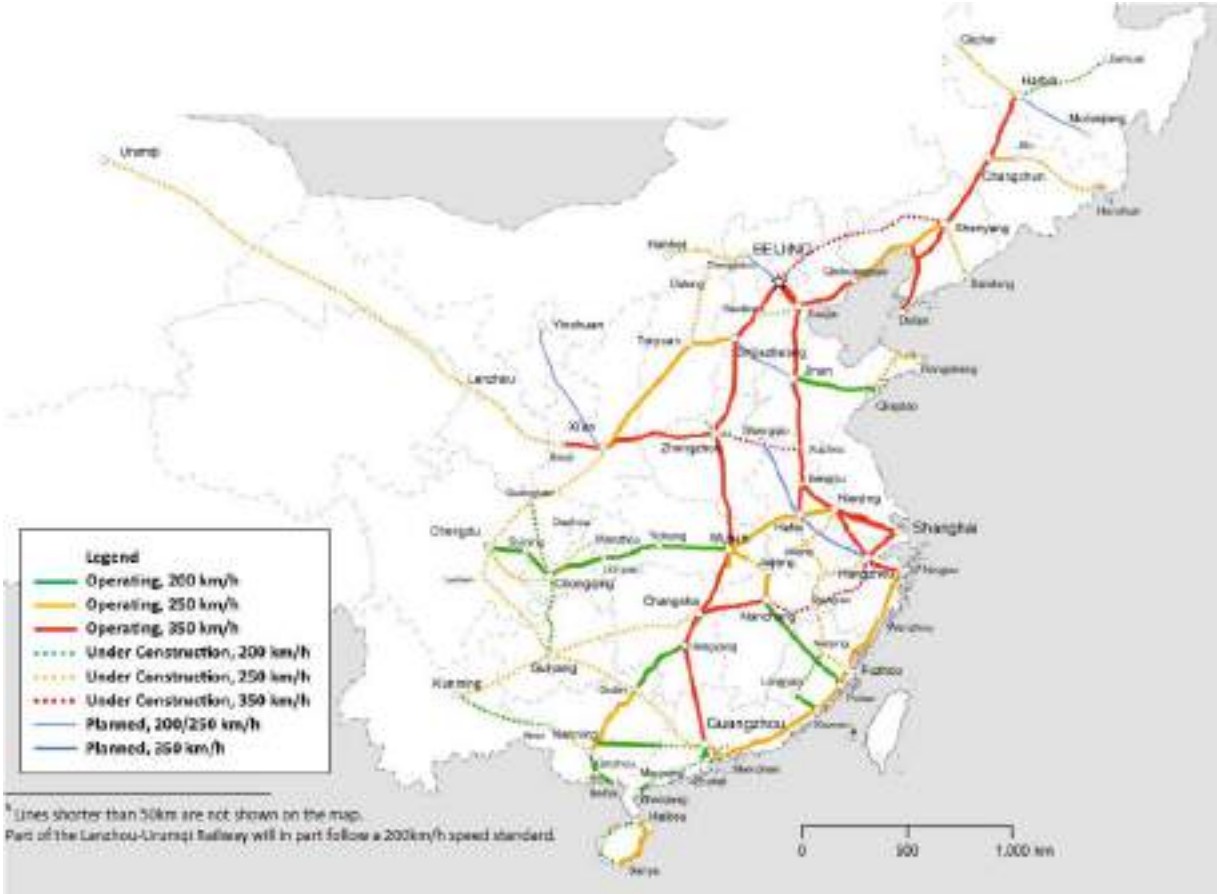
Despite the increase in network size in recent years, Chinese traffic densities per route-km are nearly twice the next highest (Russia) and far higher than India and the US Class I system. Freight wagon productivity (net tonne-km/wagon) is also the highest in the world. The rail network density over land in China (in terms route-km per million km^2 of land area) is only a fraction of that in the USA, India, Japan and the European Union. Moreover, in terms of route-km per million people, China's rail network density over population is more than a tenth of that of Russia, USA or Canada; 12% of that of the European Union and about a third of that of Japan.

It is therefore unsurprising that China's comparatively sparse rail infrastructure is so heavily used, and that it carries a quarter of the world's railway traffic on around 6% of the world's rail network. As might be expected, the demand is constrained by capacity on the busiest routes and during the busiest periods. As a result there is a significant amount of diversion of traffic to higher-cost road transport, and probably an even greater suppression of demand. The major challenge for Chinese Railways has been to improve the capacity and quality of infrastructure to meet growing demand and prevent railways from becoming a bottleneck on China's economic and social development.

China is the first country with a GDP per capita below US $7 000 to have invested in developing a comprehensive HSR network. The circumstances in China in terms of long distances, high density of population, well interspaced large cities, and its economic rebalancing strategies are propitious for the long-term success of such a system. Its effectiveness depends on attracting large volumes of passengers willing to pay substantially higher fares than for conventional train services.

The first phase of the Chinese high-speed involved speeding 6 000 km of main lines and the introduction of a new generation of trains able to operate at a top speed of 250 km/h. 2007 saw the introduction of China Rail-High Speed (CRH) services operated by China Railways: most CRH trains still had to share heavily-used tracks with freight trains resulting in still moderate station-to-station speed, even if the top speed had markedly improved. In 2008, the first of a new generation of passenger dedicated HSR lines (PDL) started operating. In particular, the Beijing–Tianjin intercity HSR line opened in August 2008 with a maximum speed of 350 km/h and an average station-to-station speed of 240 km/h. Since then, the Chinese HSR network has continued to expand to reach 12 183 line-km in 2014.

Fig. 4-4 China Railway-HSR and new 200 km/h Railways (Operational, under construction and planned3, as of October 1, 2014)



Source: World Bank

The map in Fig. 4-4 shows the HSR routes that are operational, under construction, or in the current plan of China Railway Corporation (CRC).

Although China has built several new railway transport corridors over the past decade, and upgraded many others through double tracking and electrification, freight capacity has remained constrained throughout the period. The request for freight loading continues to exceed the 110 000 wagons loaded daily. Travel times for freight trains have been reduced through the removal of bottlenecks and the modernisation of marshalling yards but freight commercial speeds have increased by only 10% over the period.

Regional economic development will be supported through an expansion of the western railway network and improvements in the central and eastern areas. In total, about 16 000 km of new lines are planned. They include:

- four new lines to international borders in the north-west and south-west (1 600 km),
- twenty new lines to augment the regional network serving Xinjiang, Sichuan, Gansu, Inner Mongolia and Tibet (9 600 km),
- seven new lines in the central and eastern regions (1 500 km).

The four new lines to international borders will provide new transport corridors to the adjacent countries in the south and southwest (Kyrgyzstan, Vietnam, Laos and Myanmar). The expansion of the western regional network includes six new corridors linking the region

to the remainder of the network, as well as fourteen internal links. The new lines in the central and eastern regions are mostly of regional significance only. The most important is the Dongbiandao line in north-east China which will link Mudanjiang and Dalian via Tumen and Dandong running along an eastern corridor by the Russian and North Korean borders.

In 2007, at least partly in response to the unexpectedly fast growth in rail freight since the MLRNP was prepared, an expanded investment program was announced which aimed to see a railway network of 120 000 kilometres by 2020, an increase of 20 000 km over the original plan. This plan includes several further 200 km/h lines for fast passenger and mixed freight operations, as well as an expanded network in western China.

4.2.5 Rail industries and market reform

In China, till 2013, the Ministry of Railways (MOR) supervised the rail sector, combining strategy, policy and regulatory functions and administering China Rail (CR), the network of infrastructure and transport services operated by the 18 regional rail authorities (RRAs). The MOR had overall control of policy, technical standards, planning and investment, finance and system-wide train and rolling stock dispatching.

The railway sector was governed by the 1991 Railway Law, which was similar to railway laws in many countries. The Railway Law permits and encompasses four types of railways:

- State railways: administered by the department responsible (MOR) till 2013;
- Local railways: administered by local government authorities, which could include provincial governments or city administrations;
- Industrial railways: administered by industrial enterprises or other units to provide their own rail transport services, normally within their own boundaries;
- Private railway sidings: branch railway lines administered by enterprises or other units, connected to another railway line.

In March 2013, the State Council broke up the Railway Ministry into the State Railways Administration (SRA) to oversee railway regulation and the China Railway Corporation (CRC), a state-owned company, to operate the national railways. The National Railway Administration is a sub-ministerial bureau assigned to the Ministry of Transport while the China Railway Corporation is a ministerial-level state company under the State Council reporting directly to the central government. It will be financed by the Ministry of Finance and regulated by MOC and SRA. According to the reform plan MOR's railway planning and policy making functions are entrusted to the Ministry of Communications (MOC). CRC will transport passengers and freight, and will be responsible for operating and managing the country's rail network. CRC will draft investment plans for railway construction, and put forward to the government proposals to fund and build the lines. CRC is also responsible for implementing railway projects and is accountable, as the main responsible body, for safety. The 18 regional railway bureaus, employing about 2 million people, will form the backbone of CRC.

4.3 SOUTH-EAST ASIA

4.3.1 Economic outlook

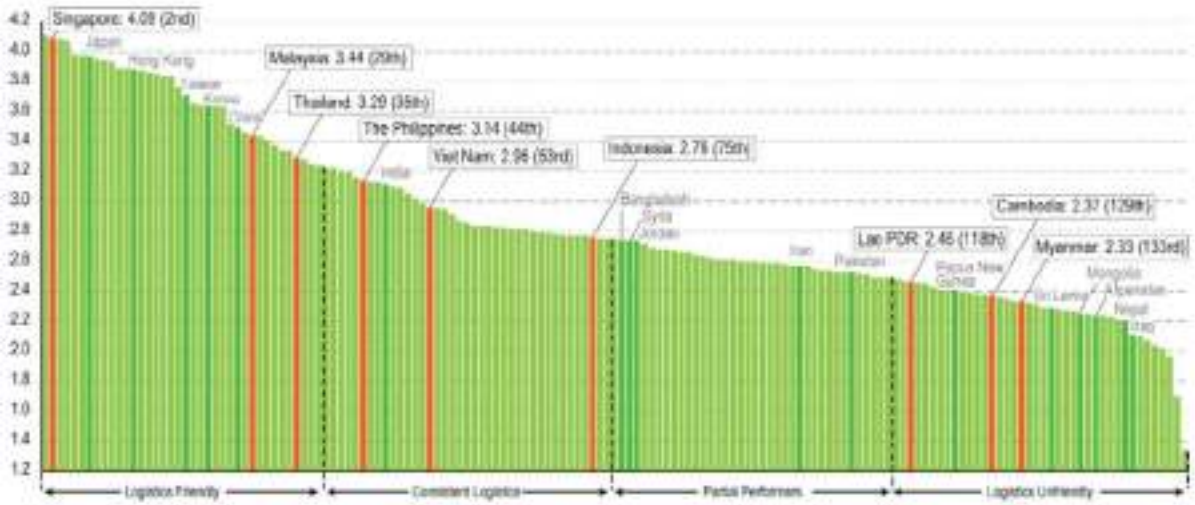
The UIC South-East Asian sub-region covers Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand and Vietnam. The remarkable economic growth in many countries of the South-East Asia sub-region has been a success story of economic development in the world. In achieving this growth, the sub-region as a whole has successfully attracted foreign direct investment (FDI), upgraded industrial structure and integrated into the world economy through participation in the regional production and distribution networks.

The South-East Asia sub-region has proved its economic dynamism by quickly recovering the pre-crisis growth rate after the outbreak of the global economic crisis. To date it can be seen that the growth momentum in the sub-region slowed somewhat in 2013. The sluggish global economic recovery held back exports, particularly in the first half of the year. Growth in domestic demand also decelerated in the large emerging economies, such as Indonesia, due to monetary tightening in response to higher inflation and capital flight. Domestic demand in Thailand was adversely affected by rising household debt and political uncertainty. In contrast, the economy of the Philippines grew rapidly. The least developed countries in the sub-region, namely Cambodia and Myanmar, maintained high growth rates, underpinned in part by steady inflows of foreign investment, especially in the resource sector. Modest inflation enabled the economies of the sub-region to ease monetary policy, which supported domestic demand amid weak external demand. Fiscal reforms moved forward in several economies in an attempt to restore fiscal sustainability following large-scale stimulus measures taken during the global economic downturn. As for 2014, growth is generally expected to be moderate, especially in economies with large domestic markets. Financial market volatility, which could arise from monetary policy normalisation in the United States, is a downside risk.

4.3.2 Transport outlook

There is significant variation across the countries of this sub-region in terms of land area, population, and economy. Recently, the economy of the sub-region has progressively improved in various aspects but large gaps among countries are still applicable to logistics and trade environment. Fig. 4-5 shows the Logistics Performance Index (LPI) for Asian countries, with South-East Asian countries highlighted.

Fig. 4-5: Logistics Performance Index (LPI) Ranking and Scores 2010



Source: Connecting to compete 2010, Trade Logistics in the Global Economy

Malaysia and Thailand received quite high ratings on logistics and trade environment. Also, logistics and trade performance of Philippines and Indonesia are evaluated favourably. In contrast, Cambodia and Myanmar are still in the process of addressing their performance bottlenecks. Weak logistics competence, undeveloped infrastructure and inefficient trade procedures are major constraints in these countries. The situation of poverty is harsh especially in Cambodia. Additionally, urbanisation has been rapidly expanding and population has been concentrating into several mega-cities. There is a wide gap on human development aspects among the countries of the sub-region too. During the last years, the great economic development has been supported by a continuous improvement of the transport network in the region, with the exception of railway infrastructure. All the countries of the UIC sub-region are members of ASEAN and for this reason are currently guided by the ASEAN Transport Action Plan (ATAP) 2005-2010 that covers transport (maritime, land and air) and transport facilitations.

Considering that currently railways and inland waterways have a very limited role in the sub-region, according to the Plan it is likely that the road sector will continue its dominance in the forthcoming years. With such trend, the ATAP considers that it is vital to improve the quality of roads and road infrastructure in ASEAN member states (AMSs). However, given the climatic and environmental advantages of inland waterways and railways, ATAP believes that efforts are required to improve their share in the transport network.

However, the following facts mean that rail freight, in the future, can only play an ancillary role in the sub-region transport system:

- the economies of the region are very dependent on exports and most of their trade relations are entertained with countries outside the sub-region;
- the countries of the sub-region are characterised by a particular and favourable geographic position related to the main trading global routes (most of the cargos transported between East Asia and India/Europe/Middle East pass thorough the Malacca Strait);
- countries are either islands or countries with a perimeter of coastline extremely large compared to its surface, close to the major cities which are concentrated and productive activities;
- there is a high presence of inland waterways transport.

Transport in the big metropolitan areas is the main future challenge regarding passenger activity in the sub-region. The sub-region is characterized by a high urbanisation rate: 70% of the population lives in urban areas in Malaysia, the Philippines reach a level of nearly 50% and Indonesia follows with 44%. Additionally, comparing the year 1990 with 2010, Malaysia has been rapidly urbanised with over 22% increase and two countries (Indonesia and Vietnam) had over 10% urbanisation growth since 1990. In South-East Asia there are large agglomerations with millions of inhabitants, in continuing strong growth.

Fig. 4-6: Population of Mega-Cities in South-East Asia in 2009

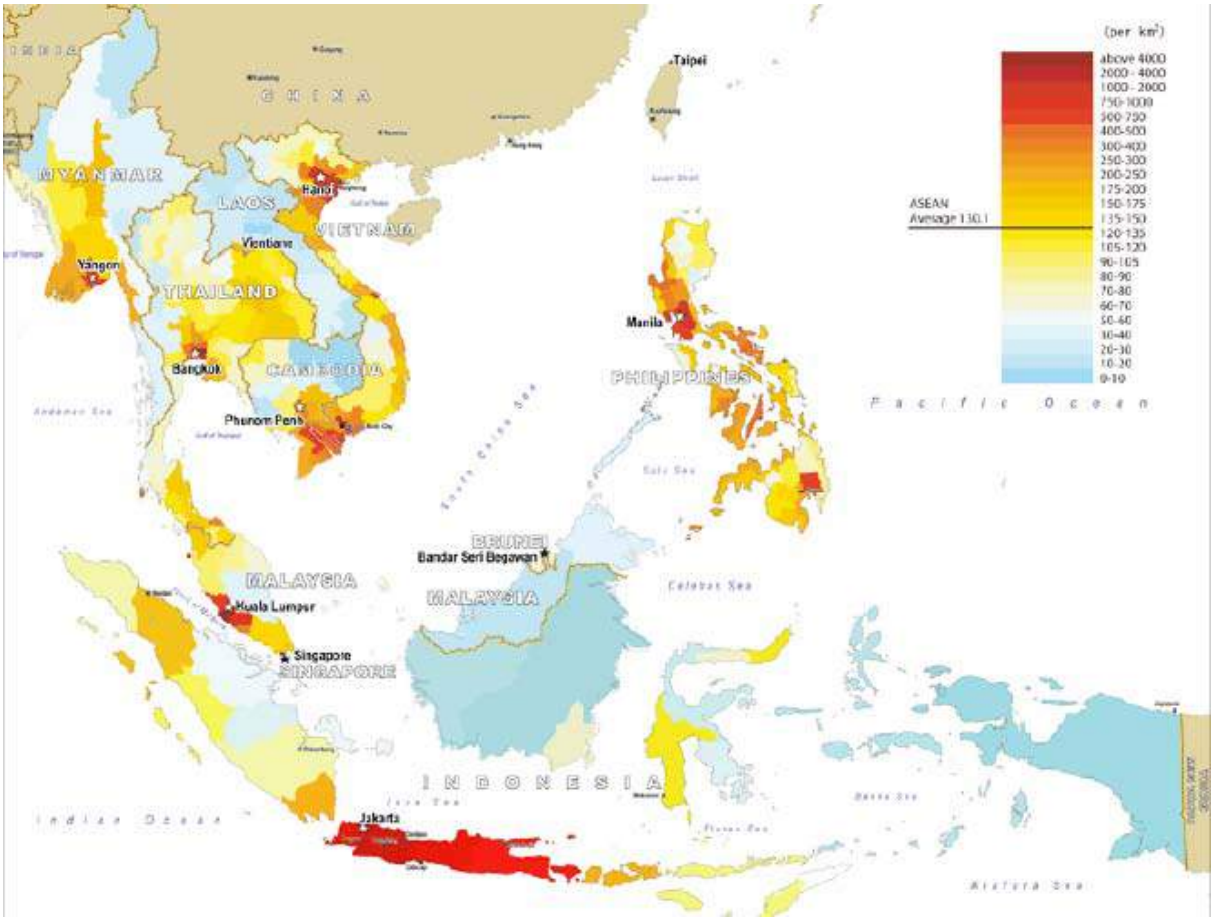
Country	Population (Country)	Mega City	Rank in Mega Cities	Population (Mega City)	Share in National Population
Indonesia	231,547,000	Jakarta	15	15,400,000	6.65%
Malaysia	27,761,000	Kuala Lumpur	66	4,875,000	17.56%
Myanmar	59,981,000	Rangoon	70	4,725,000	7.88%
Philippines	92,227,000	Manila	9	19,600,000	21.25%
Thailand	67,061,000	Bangkok	31	8,900,000	13.27%
Viet Nam	87,211,000	Saigon	50	6,100,000	6.99%

Source: ERIA (Economic Research Institute for ASEAN and East Asia) on Thomas Brinkhoff: The Principal Agglomerations of the World

As a result of rapidly growing motorisation, many cities in the region are facing serious problems, including significant levels of traffic congestion, air pollution from transport sources, high rates of traffic accidents and inadequate access to transport facilities especially for poor and vulnerable groups, such as people with disabilities. Some of the most rapid increases in motorisation have taken place in major cities and capital cities in South-East Asia countries. Motorisation is increasing significantly within ASEAN as an outcome of economic growth. The number of registered motor vehicles continues to escalate, especially motorcycles. This type of vehicle is the most popular within the region due to its relatively low cost and suitability to the environment. In some AMSs like Vietnam, the number of motorcycles represents approximately 95% of the overall vehicle fleet.

The dominant transport mode in cities like Hanoi includes two and three wheelers. The central parts of capitals are particularly congested, with weekday peak-hour traffic speeds reported to be very low resulting in long travel time. The deteriorating urban environment threatens the liveability and productivity of many cities. Public transport has a very important role in urban transportation. According to the ASEAN Transport Action Plan (ATAP) 2005-2010, the example to follow in the future would be Jakarta's successful implementation of the Bus Rapid Transit (BRT) systems, although the share of public transport in the Indonesian metropolis continues to be very low. Although not present among the members of UIC, in the region there is the example of Singapore where the modal share of public transport is more than 70%, thanks to the development of a rail-based mass transit system. The motorisation rate in Singapore is about 195 cars for 1000 inhabitants, one of the lowest in the sub-region. The reason for such system needs to be promoted and developed in other major South-East Asia cities and capitals.

Fig. 4-7: Population Density of Asean members



Source: ERIA

4.3.3 Rail activity development

In South-East Asia freight road transport dominates the modal share. The railway share, except for Myanmar, is negligible. For railway freight tonnage (net tonnes) over the period 1997–2007, apart from Vietnam (with an average annual growth rate of 7% per annum), the South-East Asian countries recorded a negative growth rate. Malaysia and Indonesia recorded a negative average annual growth rate of -4.1% and -0.6%, respectively. Same trend can be observed with the analysis and comparison of tonne-km. Except for Vietnam, no railway was able to improve their tonne-km. Since 2000, Vietnam was able to increase its tonne-km by more than double, i.e. from 1 995 million tons in 2000 to 4 028 million tons in 2008. More than 20% decline in freight tonnes-km was observed in Thailand.

On comparing and analysing the passengers carried by railways then since 2000, no significant differences were observed in the number of passengers carried. It is relevant to analyse and compare this result with the population growth in each respective nation. Despite the significant population growth since 2000, the railways failed to increase their passenger volume capacities. In terms of passenger-km since 2000, except for Vietnam, Myanmar and Philippines, there has not been any significant increase observed in any other country. Indeed, by comparing with 2000 data a declining trend was observed in Cambodia, Indonesia and Thailand. Vietnam and Philippines are the only two nations that have been successful in increasing the passenger-km by more than double since 2000.

The railway industry has been significantly affected by competition with airplane. The competition between train and airplane began with the deregulation of aviation industry and the entrance of low cost carriers in the market. Low cost carriers in the aviation industry have significantly affected rail industry. For example in Indonesia, since 2002, PT KAI has been experiencing a decline in the number of executive class passengers by 40%. The route encountering the toughest challenge is the Jakarta-Surabaya route, since it is the favourite route for land and air transport companies. With regard to this route, the number of passengers of executive/business class train declined significantly by 35% from the figures in the previous year. This decline is clearly shown by the decreasing number of passengers in the first quarter of 2000: the number of passengers was at 81%, but in the first quarter of 2004, it fell to 40%.

4.3.4 Rail infrastructure development

Fig. 4-8: ASEAN Railway Network

Source: ASEAN (Association of Southeast Asian Nations)

In the past, the majority of South-East Asia countries did not give much emphasis to railway promotion and development. In terms of total rail length, Myanmar, Indonesia and Thailand are the leading nations followed by Vietnam, Malaysia, and others. Analysing the rail route length in each member country reveals that since 2000 there has been hardly any significant addition to railway route lengths. As observed in Cambodia, Vietnam, Malaysia and Thailand, only 10% of additional rail length has been added since 2000. In other countries as well, additional lengths were almost negligible. On the contrary, with the exception of Philippines and Malaysia, the road network has constantly been expanding. For example, since 2000, Vietnam made considerable progress and enhanced its road network length by more than ten times, from 15 436 km in year 2000 to 160 089 km in 2007. Vietnam also improved its paved road network by about seven times from 11 206 km in 2000 to 76 241 km in 2007. Thailand and Myanmar also made a substantial progress in enhancing their total road network and paved road network.

On reviewing the current railway network in South-East Asia countries, it was found that there are many missing links in several nations. Currently, the railway network in each nation is not integrated and will require huge investments and resources to have an improved, efficient and effective railway system. In comparison to the cross-border linkages by highways, the railways do not have many linkages between countries. Currently, railway links exist between the following nations:

- Singapore-Malaysia,
- Malaysia-Thailand,
- Thailand-Lao PDR.

Fig. 4-9: Plan of Singapore-Kunming Railway

Source: ASEAN 2010

The main railway infrastructural project in the ASEAN Transport Action Plan (ATAP) 2005-2010 and previous is the Singapore-Kunming Rail Link (SKRL), shown in Fig. 4-9. The SKRL project was proposed at the Fifth ASEAN Summit in December 1995. It is a flagship project of the ASEAN-Mekong Basin Development Cooperation (AMBDC). The SKRL feasibility study examined six alternative routes to link Singapore to Kunming; China's stretch was completed in August 1999. The study covered the technical, economic and financial feasibility of the routes, environmental impact, prioritized routes based on set criteria, financing options, and the appropriate implementation schedule. All six routes have a common sector from Singapore to Bangkok via Kuala Lumpur.

A survey on the implementation of the projects for the SKRL was carried out within the framework of preparing the ASEAN Transport Action Plan (ATAP) 2005-2010, which shows that in 2010:

- Construction of the missing Poipet–Sisophon railway link (Cambodia), guided by the Inter-Ministerial Committee for SKRL, is on-going. The US$148 million cost is supported by the ADB, the Governments of Australia and Malaysia and counterpart resources from Cambodia. A Rehabilitation Project funded by the Asian Development Bank (ADB) is in progress (started in 2008), which also includes the 48 km of missing link from Sisophon to Poipet, and was planned to be completed by 2013.
- For the Link Project Ho Chi Minh City – Loc Ninh Railway (Vietnam) the feasibility study of 129 km has been completed in 2005 and the construction is expected to be completed by 2020.
- For the section between Nam Tok (Thailand) - Three Pagoda Pass - Thanbyuzayat (Myanmar), the Korea Transport Institute (KOTI) under the ASEAN – Korea cooperation will provide an update of feasibility study as the continuation of first study approved in April 2007. The initial project costs were about US$ 491 million and US$ 246 million respectively.
- For spur Lines between Vientiane – Mu Gia – Tan Ap – Vung Ang (Lao PDR/Vietnam) the commencement of the construction is not yet determined.

In the Plan it is evidenced that the progress of Singapore-Kunming Railway Link (SKRL) project has been slowed due to financial constraint and to achieve the target of completion of SKRL project by 2015, the efforts to mobilize financial resources need to be accelerated.

4.3.5 Rail industries and market reform

It is not possible to outline a single vision about the structure of rail market and the reforms already initiated within the sub-region. In Thailand, vertical separation is envisaged through the establishment of a railway authority to manage the infrastructure and oversee investment projects. An independent regulatory body would also be established, and private operators would be encouraged to enter the market.

Currently, the railway in Indonesia is administered by PT. Kereta Api Indonesia (PT KAI), a State-Owned Enterprise (BUMN) conducting the administration of railway transport services. At the end of March 2007, the Parliament ratified Law No. 23/2007 as the revision of Law No. 13/1992, which expressly states that private investors and regional governments are given the opportunity to manage railway transport services in Indonesia. The railway infrastructure is still owned by the Government and trains both for passengers and goods are still operated just by PT KAI. The Government as the owner of railway infrastructure and facilities, delegates the management and maintenance of infrastructure and facilities to PT KAI as the operator. For the maintenance performed by the operator, the Government pays an amount of budget referred to as the infrastructure maintenance operation. In addition, the Government also pays subsidies for economy class passenger transportation by the operator through the budget for public service obligation. While, for the use of railway infrastructures and facilities owned by the Government, the operator is obligated to pay track access charge.

4.4 SOUTH ASIA

4.4.1 Economic outlook

The UIC South Asian sub-region comprises Bangladesh, India, Nepal, Pakistan and Sri Lanka. After a period of great economic expansion in the 2000s, and the global recession, economic growth in the sub-region picked up slightly in 2013, as the economies of India and Sri Lanka expanded at a more rapid rate aided by increased household spending stemming from steady farm incomes and workers' remittances. Energy shortages have constrained economic activities in several of these economies and political tensions and security issues capped the growth in Bangladesh, Nepal and Pakistan. Large fiscal deficits limit fiscal manoeuvrability within the sub-region. Some deceleration in the overall inflation rate occurred, but food inflation remained elevated. Meanwhile, the prospects of quantitative easing tapering in the United States triggered capital market volatility in India. This underscored weak macroeconomic fundamentals, such as large current account deficits financed by short-term external borrowings. The large current account deficits are partly a reflection of large fiscal deficits in the sub-region. Monetary policy has been tightened to stem capital outflows and combat financial market volatility. Despite this, economic growth in the sub-region is projected to further increase in 2014 due to a stronger global economy. Tackling supply-side constraints, especially energy shortages, remains vital for achieving medium-term growth.

4.4.2 Transport outlook

the Government of India in 2010 created the "National Transport Development Policy Committee (NTDPC)" to formulate a long-term transport policy, devoted to setting the conditions for a consistent long-term transport strategy for India (the horizon is 2032, two decades from the beginning of the country's 12th Five Year Plan to the end of its 15th). The Report projects India's requirement for transport over the following 20 years to 2032 and the transport investments needed. According to RITES, the share of railways in total inter-regional freight traffic came down from 89% in 1951 to 65% in 1978-79, 53% in 1986-87 and 30% in 2007-08. Rail and road transport still dominate the transport system in India, carrying about 87% of the total freight traffic in the country in 2007-08. Under the condition of steady GDP growth from 6.9% for the 12th (2016-17) Plan, up to 9% in the 15th (2031-32) Plan, NTDPC has estimated that total freight transport demand is expected to grow at 9.7% per year to reach over 13 000 billion tonne kilometre (btkm) in 2031-32 from about 2 000 btkm in 2011-12. Rail and road freight traffic are projected to grow at about 12% and 8% per annum respectively with a modal share of rail and road that will be in the total freight traffic 35/65 in the 12th Plan, 39/61 in the 13th, 45/55 in the 14th and 50/50 in the 15th Plan. Similar estimates, relating to passenger demand, assess that total passenger traffic will grow at about 15% a year to reach 168 875 billion passenger-kilometres (bpkm) in 2031-32 from 10 375 bpkm in 2011-12. Growth in rail passenger traffic is expected to be around 9% per annum, and for road traffic, 15.4%. Overall, these projections provide an idea of the challenge facing overall transport investment in the country, if India is to achieve sustainable and continuous growth in the next two decades.

Realising the importance of connectivity, the government of Pakistan started a programme of US$ 9 billion: US$ 5 billion for highways, US$ 1.5 billion to modernize Pakistan Railways, and expand its tracks to Afghanistan and Iran. Around US$ 2.5 billion are provided for improving ports, airports etc. Due to fiscal constraints, the programme now would take much longer time to complete. The current dismal performance of the transport sector cost the economy 4-6% of the GDP. The containers dwell time at ports are 7 days, 3 times that of developed countries and East Asia. Road freight takes 4-6 days between ports and in the north of the country twice the equivalent time in Europe and East Asia. Trucking rates for high value commodities are higher than India and Brazil. Rail carries less than 5% of freight and takes 1 to 2 days on the main line (Karachi-Lahore) and even more time on the Karachi-Quetta line.

Sri Lanka and Bangladesh, with a view to sustained economic growth in the coming years, are both facing the need to modernise their transport system.

For Bangladesh there is also a need to focus on the speedy completion of on-going transformational projects in the road and energy sectors, particularly the Dhaka-Chittagong and Dhaka-Mymensingh highway; the double tracking of Dhaka-Chittagong Railway; the Padma ridge; the Dhaka metro rail, and the two Bibiyana gas field based large power plants. The government should prioritize the most transformative projects and provide all necessary resources for completion within a specified timeline. Nepal, one of the poorest States of Asia and the world has a very backward transport system. Recently China has expressed an interest in creating a railway connection between Tibet and Nepal. At the same time India is working to restore the existing rail connection between the two countries.

4.4.3 Rail activity development

Indian Railways have one of the largest and most-used railway networks in the world. India's railway system plays a leading role in carrying passengers and cargo across the country's vast territory, ferrying more than 8.7 billion passengers and some 1 billion tonnes of freight a year (2012-13). Over the years, however, little new infrastructure has been added and most major rail corridors are severely congested. Moreover, freight transportation tariffs – much higher than in most countries – substantially subsidise passenger traffic, and high freight transportation costs have led railways to lose significant market share to the road sector.

According to the "Transport Vision 2020", even with a reduced market share, both in freight and passenger traffic, the demand for rail transport in 2020 will be more than three times the level of freight carried now and more than double the passenger traffic. This massive increase will warrant a heavy investment in capacity building on railways. Railways will continue to be a dominant mode for movement of bulk products (pipelines may take the traffic of petroleum products) and must strive to retain and increase its share in the business of finished products at least over long distances. In the passenger business, Indian railways will lose some share in the long distance travel to airlines. This trend can be slowed if railways will play a big role in medium distance intercity traffic (with journeys up to 5-6 hours), where the door-to-door timings for such distance would compare favourably with air travel.

According to the 12th Five Year Plan on transport (2012-2017), India's transport sector, as a whole, is grossly overstretched. The main transport issues are that the capacity needs are expected to double every decade in the medium term, the transport efficiency is low (the average speed of freight trains is 25 km per hour which is nearly half that of the U.S.), there is an important distortion in the overall transport movement of goods and there is a need to provide transport access to large areas of the country, not yet served by rail. Thus the transport strategy outlined in the plan is the following:

- A more integrated approach is required to be taken on transport as a whole. Policy decisions should be based on life cycle energy costs of different transport modes.
- The sector requires a large increase in investments, strongly focused on capacity expansion of railways over the next 20 years. If a consistent economic growth of 7–10 per cent per annum is to be achieved over the next 20 years, there is a pressing need for unprecedented capacity expansion of railways for both freight and passenger traffic
- Transport reforms are needed in pricing and fiscal areas.
- Transport safety should be a strategic area.
- Transport access is critical for inclusive growth, economic development, access to markets and participation in the political process.
- Human resource development is a key factor in achieving the objective of creating a well-developed and efficient transport system in the country.

- Connectivity of the North-East, both within the region and with the far eastern region, including Myanmar, Bangladesh and Thailand, is one of the focus areas for economic development of the region and expanding economic activities including trade and commerce.

Fig. 4-10: Traffic projections for the 12th Five Year Plan in India

TABLE 15.13
Passenger Traffic Projections for Twelfth Plan

Year	Projected Passengers Originating (Million)				
	Suburban		Non-Suburban		
	Nos.	Ratio	Nos.	Ratio	Total
2012–13	4545	51.25	4323	48.75	8868
2013–14	4855	51.07	4651	48.93	9506
2014–15	5186	50.89	5005	49.11	10191
2015–16	5540	50.71	5385	49.29	10925
2016–17	5917	50.53	5793	49.47	11710

TABLE 15.14
Projection of Originating PKM for Twelfth Plan

Year	Projected PKMs Originating (Billion)				
	Suburban		Non-Suburban		
	Nos.	Ratio	Nos.	Ratio	Total
2012–13	159	13.32	1036	86.68	1195
2013–14	170	12.97	1146	87.07	1316
2014–15	182	12.54	1268	87.46	1450
2015–16	194	12.15	1404	87.85	1598
2016–17	207	11.76	1553	88.24	1760

Source: Indian Ministry of Railways

At the end of the year 2013-2014, Pakistan Railways had a total of 7 791 route-kilometres. This infrastructure is split into two different gauges, i.e., 7 479 kilometres of broad-gauge and 312 kilometres of metre-gauge. The total was 8 561 in 1950.

During the year 2013-2014, the Pakistan Railways carried 47 689 944 passengers making a total of 19 778 556 909 passenger-kilometres, averaging 415 kilometres per passenger. Freight activity in terms of tonne-km fell dramatically between 2009 and 2013, decreasing from 4 846 892 tkm in 2009-2010 a 1 090 332 tkm in 2013-2014. Passenger activity was stable between 2009 and 2013-14, with 20 618 829 pkm. With the same network length, there were 6 million pkm in 1950, with a steady growth from 1950 except a slowdown between 2011 and 2013.

At its inception, Sri Lanka Railways were carrying more freight than passenger. But today, the railway is passenger-oriented. SLR's market share for passenger transport is about 6% and about 0.7% for freight transport. Sri Lanka Railways operate approximately 310 trains which include 45 Long-Distance and 12 Intercity trains and carry about 0.29 million passengers daily. SLR own and maintain 1420 km of rail tracks, 175 locomotives, 900 carriages and the signalling network. At present, the company has a workforce of 14 400 people.

There is only one functioning passenger railway in Nepal. The 59 km narrow gauge railway runs between Janakpur in Nepal and Jainagar in India, close to the border between the two nations, and is of 2 ft 6 in (762 mm) gauge. The line continues to Bijalpura, but that section is currently redundant due to a damaged bridge. The capital, Kathmandu, has no railway connections at all. China plans to extend its Qinghai-Tibet Railway network up to Kerung, the nearest Chinese town from Nepal, by 2020. The Qinghai-Tibet railway already links the rest of China with the Tibetan capital Lhasa.

Fig. 4-11: Plans about a link between China and Nepal

Source: Tibetan Review

4.4.4 Rail infrastructure development

Considering the requirements of the economy and the size of India, the expansion of the Indian railway network has been inadequate. Based on this consideration, the 12th FYP provides an extensive modernisation of the network, an increase of speeds, an improvement in safety and modernisation of rolling stock to meet the needs of a rapidly growing economy. With the aim of decongesting major passenger terminals the 12th FYP provides a high investment rate on dedicated freight corridors resulting in the segregation of passenger and freight traffic. The Dedicated Freight Corridors on the Western and the Eastern routes, shown in the map of Fig. 4-12, are a strategic capacity augmentation initiative taken by Indian Railways and involve the construction of 3 338 km of dedicated freight lines to carry predominantly coal and steel on the Eastern corridor and containers on the Western corridor. The ports in the Western region covering Maharashtra and Gujarat would be efficiently linked to the Northern hinterland and similarly on the Eastern side, while coal would move to the power plants in the North. The average speed of freight trains will go up from 25 kmph to 70 kmph which will reduce the transit time by less than half from the present levels.

Fig. 4-12: Eastern and Western Indian DFC

Source: SkyscraperCity

The DFC is being planned and built by a special company, controlled by the Indian Ministry of Railways: the Dedicated Freight Corridor Corporation of India (DFCCIL). The funding of the Western DFC comes from a Japanese Government loan, while for the Eastern DFC the funding is partly internal (from the Ministry of Railways), partly from an IBRD loan and partly from PPP (Public/Private Partnerships). The total cost of the project is around Rs. 80 000 crore (13 billion USD, 10.5 billion Euros).

The corridor will provide a much-needed relief to the current freight infrastructure and will stimulate modal shift to freight, by joining with a dedicated, reliable, fast infrastructure the Western and the Eastern coasts of India. The market gains will be extremely significant: Ernst&Young (E&Y 2011) estimate a gradual modal shift of 474 billion tonnes of freight initially growing to 1 367 tonnes by 2041. Furthermore, there will also be clear advantages for the environment, with a cumulative CO_2 emissions reduction of 60% in the first 25 years of operation due to modal shift.

A substantial amount of traffic of Indian Railways moves on the route connecting four metropolitan cities—Delhi, Mumbai, Chennai and Kolkata. These 7 main routes along with feeder routes totalling 17 383 Route km have been identified as the “high density network” (HDN).

Fig. 4-13: Railway map of India

Source: PITRODA REPORT

Developing High Speed Rail Corridors and upgrading speeds (increase of speed to 130–140 km/h in certain routes and 160 km/h in others) is another key issue of the 12th FYP. The Ministry of Railways has selected the following six corridors for conducting pre-feasibility studies for development of High Speed Rail Corridors:

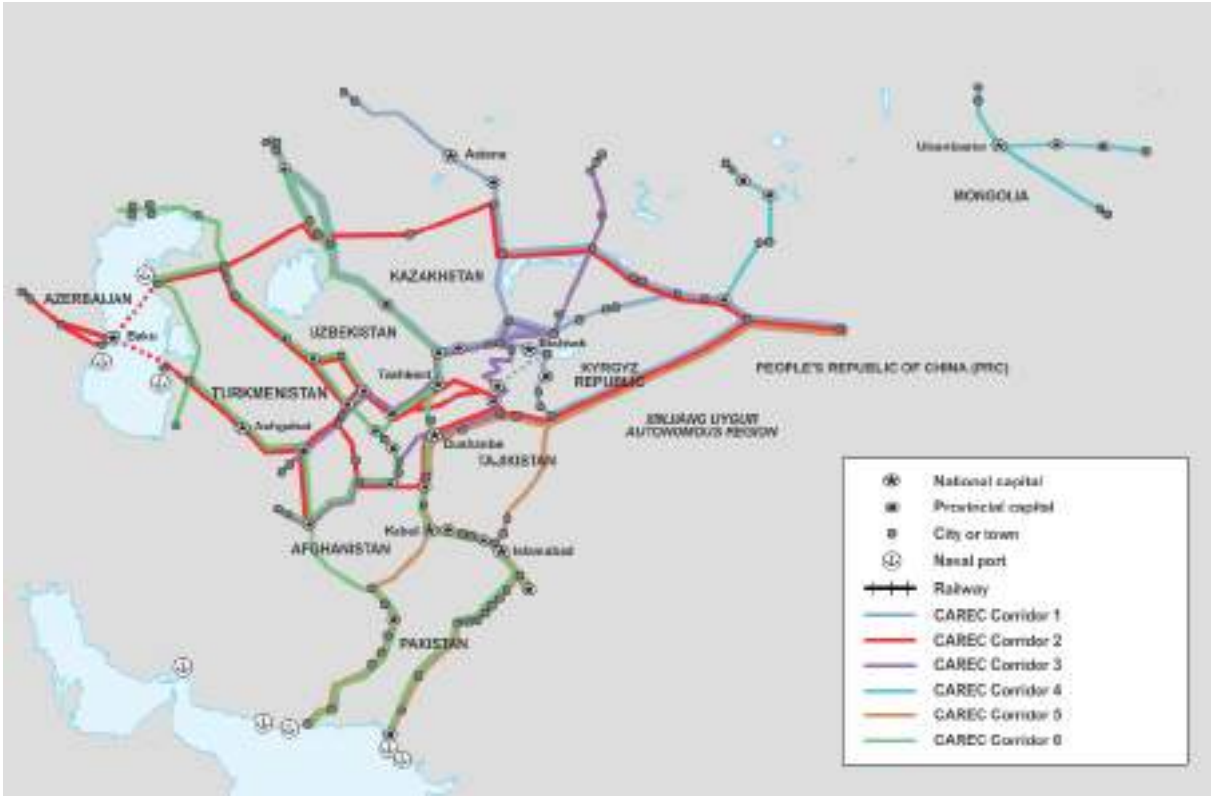
- Delhi–Chandigarh–Amritsar (450 km);
- Pune– Mumbai–Ahmedabad (650 km);
- Hyderabad–Dornakal–Vijaywada–Chennai (664 km);
- Chennai–Bangalore–Coimbatore–Ernakulam (649 km);
- Howrah–Haldia (135 km);
- Delhi–Agra–Lucknow–Varanasi–Patna (991 km).

The on-going infrastructural projects of Pakistan Railways regard principally the doubling of track from Lodhran to Khanewal (121 km), from Khanewal to Raiwind (246 km), from Shahdara Bagh to Lalamusa and from Shahdara Bagh to Faisalabad. The future projects regard the doubling of tracks from Lalamusa to Chaklala and from Golra Sharif to Peshawar Cantt. During 2013-2014 the feasibility studies were started:

- Connection of Gwadar with Karachi;
- Connection from Gwadar to Besima and from Besima to Jacobabad via Khuzdar. This project is under China-Pak Economic Corridor;
- Upgrade and rehabilitation of mainline 1 (ML-1) and new dry port at Havelian (Balder) District Haripur, always under China-Pak Economic Corridor.

Pakistan is among the States involved in the CAREC program. The Central Asia Regional Economic Cooperation (CAREC) Program is a practical, projects-based, and results-oriented partnership that promotes and facilitates regional cooperation in transport, trade, and energy. CAREC comprises 10 countries: Afghanistan, Azerbaijan, the People's Republic of China, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan. Six multilateral institutions support the work of the CAREC member countries: Asian Development Bank (ADB), European Bank for Reconstruction and Development, International Monetary Fund, Islamic Development Bank, United Nations Development Programme, and World Bank. Six CAREC corridors link the region's key economic hubs to each other, and connect the landlocked CAREC countries to other Eurasian and global markets. Pakistan is crossed by corridor 5 (East Asia–Middle East and South Asia) and 6 (Europe–Middle East and South Asia).

Fig. 4-14: CAREC Corridor Network



Source: CAREC

4.4.5 Rail industries and market reform

The Ministry of Railways (MOR) oversees the Indian railway sector through the Indian Railway Board, MOR (IRB). The MOR (IRB) exercises all central government policy powers and administers, supervises, and directs the entities that provide most of the rail services. The MOR (IRB) also fulfils most industry regulatory roles, except for safety oversight and railway rates appeals. Indian Railways (IR) is the generic term used to refer to the network of railway infrastructure and services that are delivered by 16 geographically-based Zonal Railway authorities (ZRs). Each ZR has separate responsibilities and operates its own livery. But the MOR (IRB) is fully responsible for establishing, merging, or abolishing these ZRs, and for ZR governance. The MOR (IRB) appoints ZR general managers, oversees their compliance with MOR (IRB) policies, determines staffing and remuneration policies, allocates rolling

stock, fixes tariffs, approves ZR operating and capital budgets, approves certain capital expenditures above specified limits, and reallocates cash deficits or surpluses of each ZR to maintain financial balance. Production units directly under MOR (IRB) manufacture rolling stock, which is supplied to ZRs, which are responsible for maintenance. The ZRs operate all trains within their territorial jurisdiction, including inter-zonal trains under a system for apportioning revenue, usually collected at the originating station. India's railways are now governed by the 1989 Railways Act (as amended), which replaced the old Indian Railways Act of 1890, under which Government was envisaged primarily as coordinator and regulator. The railway was nationalized in 1951, and virtually the entire rail system became part of the Government of India. The 1989 Railways Act authorized government and non-government railways. Now, a few separate special-purpose railways exist as joint ventures between MOR and other entities such as the Kutch Railway Company Ltd., and the Konkan Railway Corporation Ltd., however, the ZRs still carry over 99% of railway traffic.

Pakistan Railways (PR) is a national state-owned rail transport service of Pakistan, headquartered in Lahore. It is administered by the federal government under the Ministry of Railways. The Ministry of Railways (MoR) is a Cabinet-level Ministry of Government of Pakistan, tasked and primarily responsible for planning, administrating, and establishing the passengers locomotive services, regulating the railway companies, industries and associated organisation. Overall, the control of Pakistan Railways (PR), policy and development of railway network are also managed and administrated by Ministry of Railways.

Sri Lanka Railways (SLR) is a government department functioning under the Ministry of Transport. It is a major transport service provider and is the only rail transport organisation in the country. SLR transports both passenger and freight, and functions under the General Manager of Railways (GMR). The General Manager reports to the Secretary of the Ministry of Transport. SLR has been divided into ten Sub Departments and three Units. Sub Departments are managed by the Heads of the Sub Departments who report directly to the General Manager of Railways. The Telephone Numbers, Fax Numbers and E'Mail Addresses of all the key personnel in Department are given below.

4.5 PACIFIC

The UIC Pacific sub-region includes Australia, Japan, New Zealand and the Republic of Korea. The choice of this group is due to economic and geographic reasons: all four countries are members of OECD characterized by mature and developed economies, and they are all "islands" from a transport point of view as the only country which is not technically an island is South Korea, whose only land border is with North Korea – a country with which it is at war since half a century. A focus on Australia and South Korea is given in the synthesis of questionnaires completed by the railway companies, the analysis of the transport aspects of this sub-region will focus only on Japan and New Zealand.

4.5.1 Economic Outlook

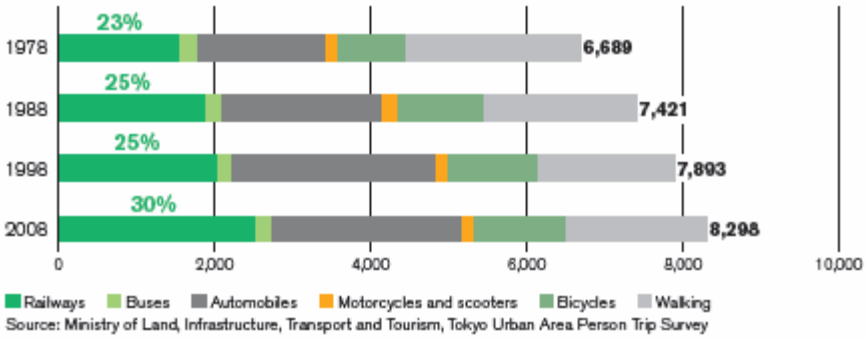
Australia and New Zealand experienced slower growth in 2013. Inflation remained low, although New Zealand was the first developed country globally to raise interest rates in March 2014 in anticipation of a trend towards higher rates in the United States. Both of these countries are committed to fiscal consolidation in the coming years. In 2014, growth is expected to remain relatively sluggish in Australia on weak mining investments, while New Zealand should record a rebound due to on-going reconstruction activities, better prospects for dairy industry and higher net immigration. In Japan and the Republic of Korea, two highly trade-dependent countries, growth picked up by mid-2013, as global growth prospects improved. Japan has been pursuing an aggressive and exceptional monetary policy stance

coupled with strong fiscal stimulus to pull the economy out from deflation. This appears to be working as indicated by recent signs of higher growth and inflation. The country also intends to reform its tax system to address its growing public debt. The Republic of Korea launched sizeable stimulus measures that focused on promoting corporate investment through tax reductions and job creation by initiating public projects. On the external side, despite an increase in the second half of 2013, exports for the year decelerated, which had a negative impact on current account surpluses. Although the net impacts of structural reforms are yet to be seen, the strengthening of the global recovery should help maintain the growth momentum in 2014.

4.5.2 Transport outlook

The Japanese population is in the process of declining as the population ages and the birth rate declines. Even so, railway passengers can still increase by improving the convenience and comfort of riding trains and strengthening rail services. Japanese railways own railway stations, support real estate activity and commercial exploitation of its assets. In this context, Japanese railways influence transport demand in their favour, focusing on commercial and business activities in railway stations. Better rail services increase accessibility and better accessibility increases rail mobility. In the area of Tokyo, railways have consistently gained market share between 1978, increasing its passengers in relative and absolute terms, reaching today 30% of trips.

Fig. 4-15: Trend in the number of trips by transportation mode in Tokyo urban area (10 000 trips)



Source: JR East Group Annual Report 2013

Japanese railway companies are concentrated on improving services and leveraging them to generate revenue and expand their market share; improving the quality of the Tokyo metropolitan area railway network, expanding the intercity transportation network, forging strategies for conserving energy and the environment, utilizing ICT and operating Shinkansen at faster speeds.

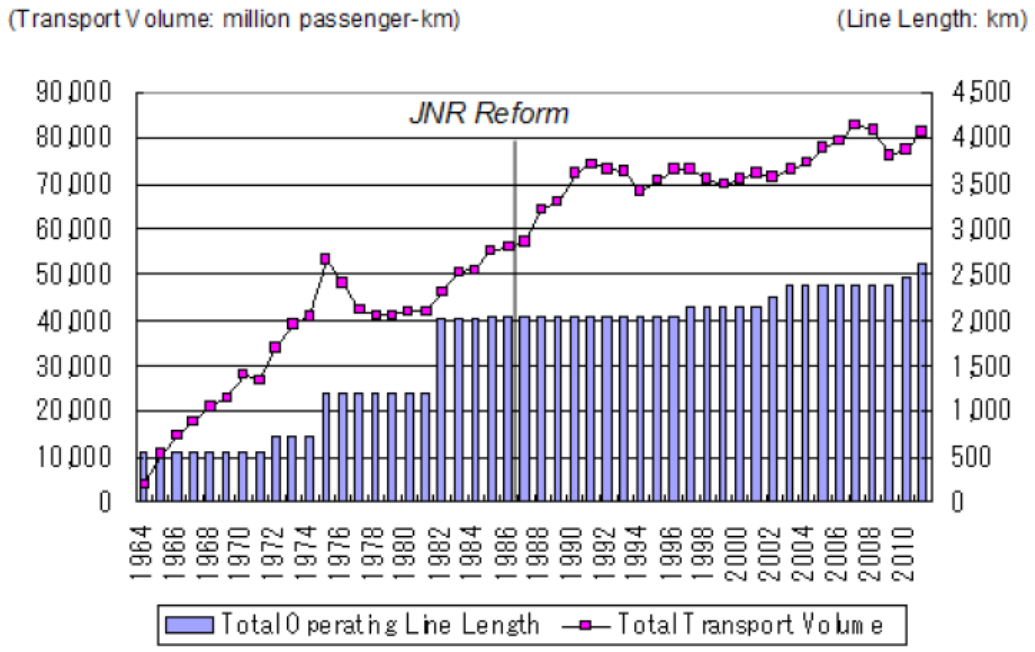
According to the Government Policy Statement on Land Transport 2015, New Zealand's freight is forecast to grow by 58% in tonnes by 2042 (from 236 million tonnes in 2012 to over 373 million tonnes). This rate of growth is slower than forecasted in 2008, but still represents about 1.5% per annum. Road transport is expected to remain the primary mode for freight, accounting for about 70% of tonne kilometres. Vehicle travel is forecasted to grow, albeit at a lower rate than last decades. Demand growth is likely to be concentrated in areas experiencing economic and population growth. The government has made significant investments in metro rail improvements in Wellington and Auckland and, given the expected growth in these areas, it is expected that the investment in urban rail system will expand further. Nevertheless, the railway sector will continue to be marginal compared to road transport.

4.5.3 Rail activity development

In 1950, Japanese railways had 92% of the passenger market (passenger-km) and 52% of the freight market (tonne-km), and they continued making profits through the 1950s and early 1960s. However, from the 1960s, motorisation and air transport progressed dramatically in tandem with the high economic growth, and the modal share of railways decreased. Currently Japan relies on railways for around 30% of its transportation needs, a ratio much higher than in most other developed countries. This high reliance on railways, due to the size of the economy and geographic characteristics, affords railway companies an extremely large source of demand, especially in urban areas.

One of the key aspects which contributed to maintaining a modal share very high in the Japanese passenger sector is undoubtedly linked to the pioneering "Shinkansen" adoption. "Shinkansen" refers to Japan's dedicated high-speed intercity rail system, and it was initially introduced between Tokyo and Osaka in 1964. This event accelerated the development of high-speed railways in other countries too. In Japan its total length and the number of lines have increased since then contributing to the economic development of the country.

Fig. 4-16: Growth in Line Length and Transport Volume of Shinkansen Lines

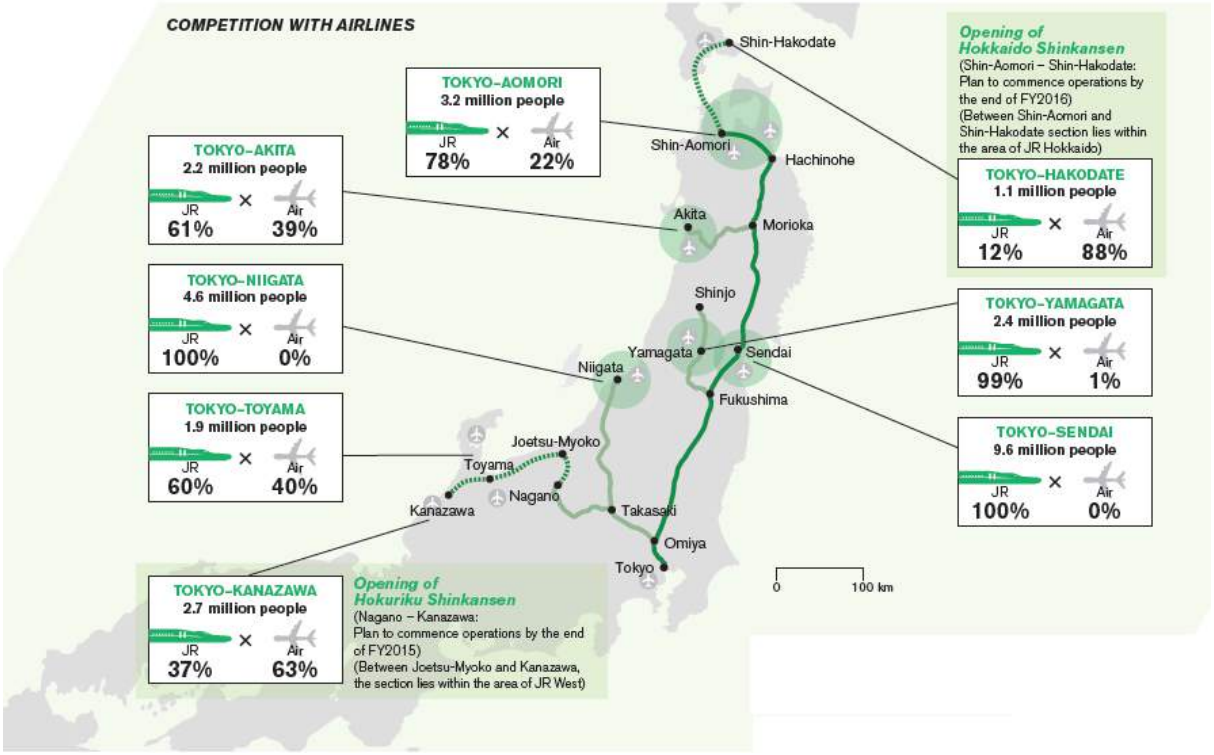


Source: Institute of Transportation Statistics (1995), MLIT (2013)

In the Japanese railways reform, Shinkansen operation was divided among the three Honshu JR passenger companies: JR East, JR Central, and JR West. The Tokaido Shinkansen Line, which operates between Tokyo and Shin-Osaka, has the largest transport volume, and it has increased by 38% in the 24 years since the reform. Although the transport volume of the Hokuriku Shinkansen Line, operating between Takasaki and Nagano, has remained level, all other Shinkansen Lines have increased in traffic volume since the reform or the line's opening. The privatisation caused a concentration of railway services in the most frequently used routes. In particular the lines relating to Tokyo are heavily exploited and have continuous growth rates both in transport supply and demand. The changes in traffic density of different Shinkansen sections indicate that the section closer to Tokyo has increased largely its traffic density. As opposed to this, the sections further from Tokyo lessened their traffic density during the years.

Shinkansen transport is competitive against other transport modes and is increasing its transport revenue by a much higher rate than conventional lines. Along with the increase of the inter-city passengers as in the Tokaido and Sanyo Shinkansen Lines, the number of Shinkansen commuters has been also increasing especially around Tokyo metropolitan area. Japanese high-speed railways have significant external effects such as increasing the land values along the lines. This means that people prefer to live around stations, and railway lines serve to develop residential/commercial areas around stations. The increase of the *Shinkansen commuting passes* sold provides evidence that Shinkansen has expanded the commutable area, especially around Tokyo urban areas. With approximately 36 million people, about 30% of Japan's population is concentrated in the Tokyo area. Moreover, this population is projected to be supplemented for the foreseeable future with people continuing to move in to the area, even though the population of Japan as a whole has begun to decline. The Tokyo area accounts for about 30% of Japan's economic activity, and railways actually account for roughly 50% of all transportation volume in the Tokyo metropolitan area.

Fig. 4-17: Competition of railways with airlines in Japan[31]



Source: JR East Group Annual Report 2013

The share of rail transport in freight is very low. Japanese railways carried 193 million tons in 1970. From then, rail freight has fallen sharply to about 5.6 million tonnes in 1987. Cargo tonnages declined further, reaching about 3 million tons in the last 5 years. Japanese Freight transport is highly containerized (70%).

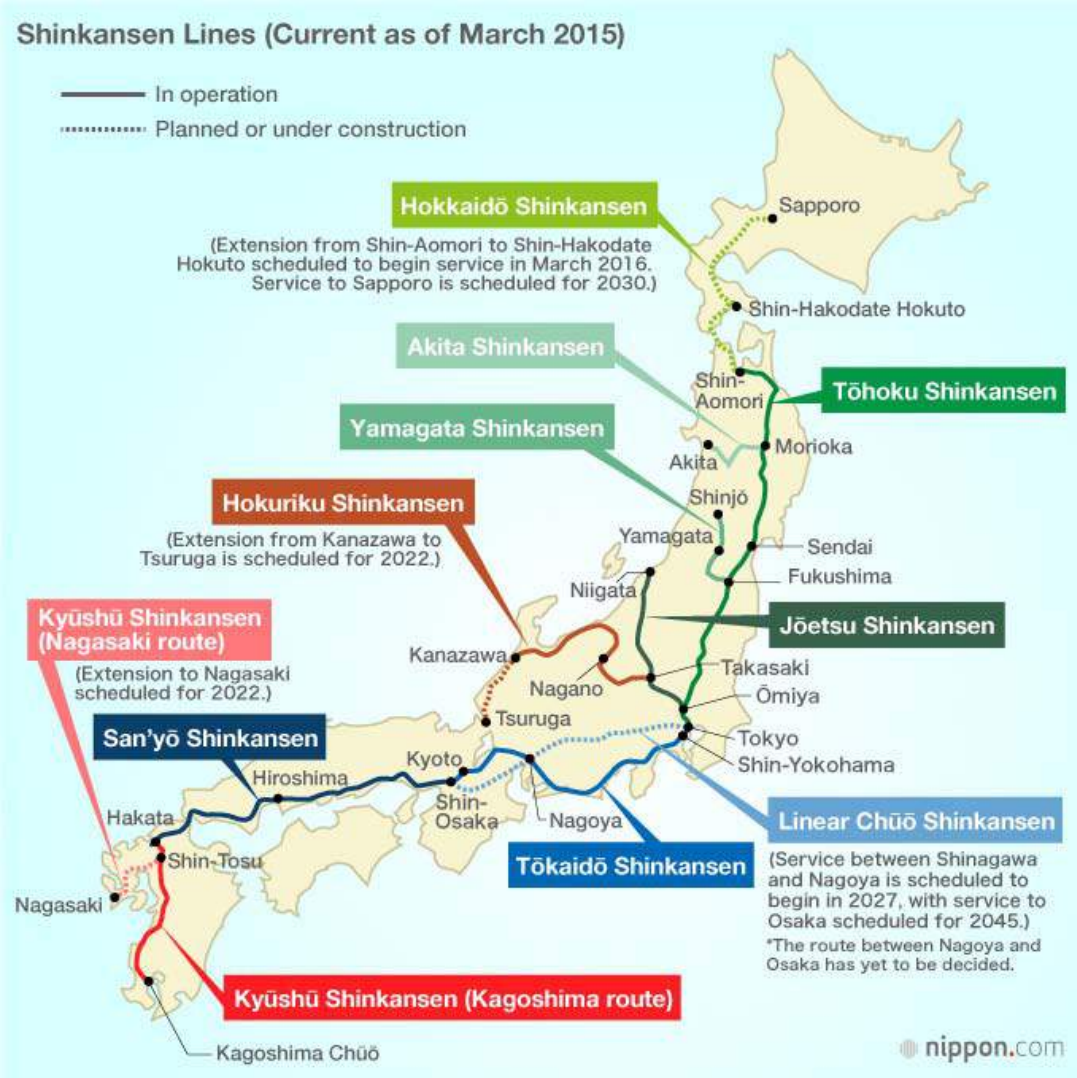
4.5.4 Rail infrastructure development

The total length of Shinkansen Lines in 1987, before the railway reform, was 2 031 km. 816.4 km were built after the reform including Hokuriku Shinkansen's extention to Kanazawa in March 2015. Hokkaido Shinkansen is scheduled to begin service from Shin-Aomori to Shin-Hakodate Hokuto (148.8 km) in March 2016. Besides the HSR network, there are other projects which JR companies have been promoting.

31. The Nagano-Kanazawa section has been completed in March 2015. The section between Shin-Aomori and Shin-Hakodate is scheduled to open at the end of March 2016.

One of these is the Central Shinkansen Line, promoted by JR Central, and another is the Mini-Shinkansen Lines promoted by JR East. The Central Shinkansen Line between Tokyo and Osaka is completely different from the other Shinkansen lines, adopting Maglev technology. Mini-Shinkansen lines are planned to provide faster service to cities not on the Shinkansen. JR East promoted two projects with its own finances: Yamagata Shinkansen (section between Fukushima and Shinjo) and Akita Shinkansen (section between Morioka and Akita). In these sections, the track gauge was changed from conventional-line 1067mm gauge to standard gauge, so that trains with standard gauge bogies could run on those lines.

Fig. 4-18: Shinkansen Route Map



Source: Nippon.com

KiwiRail is responsible for the management of major rail projects in New Zealand. KiwiRail has recently completed the following projects:

- DART - Developing Auckland's Transport Network,
- WRRP - Wellington Region Rail Programme (Kapiti Line double tracking, Wellington Station Entry, Wellington station upgrades, Johnsonville Line, Powering the Trains),
- Infrastructure Projects (Makatote Viaduct, Arahura Bridge,North South Junction).

The future plans include the Wellington Metro Upgrade Project (upgrading tunnels, traction wires, track and signals to improve commuter services), and the Makatote Viaduct Refurbishment (refurbishing the Makatote Viaduct on the NIMT near the National Park).

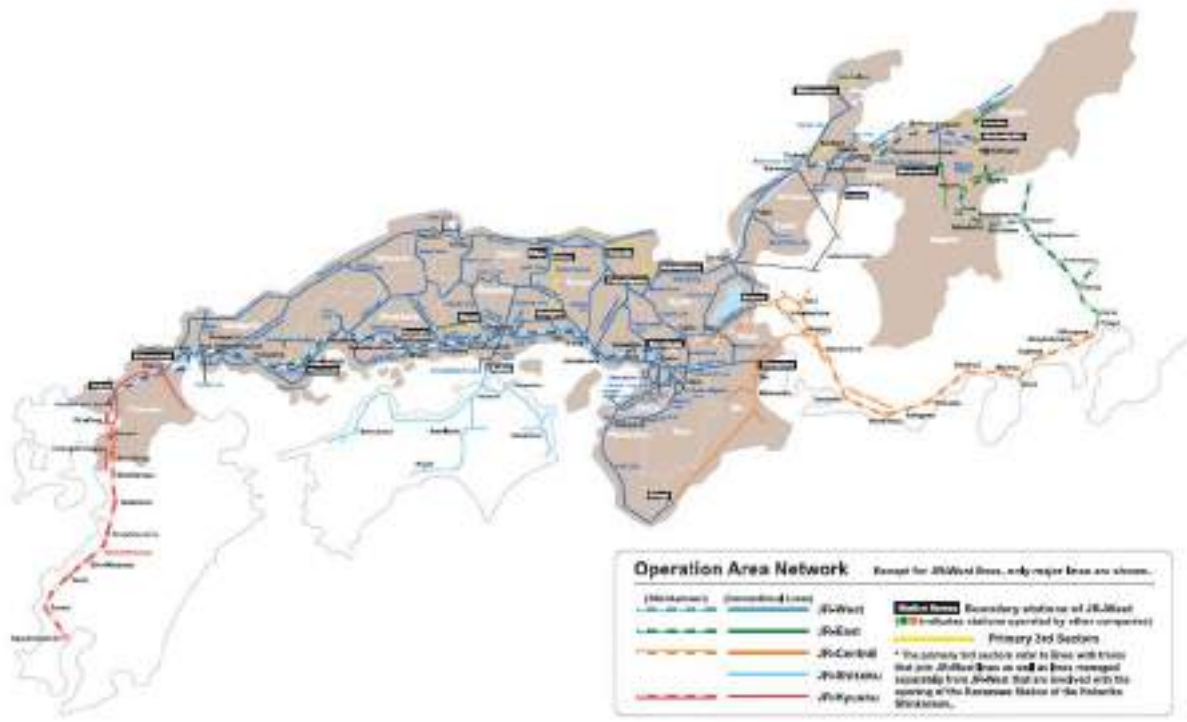
KiwiRail is responsible for building the new infrastructure needed to electrify the network from Papakura to Swanson ($500 Million) and completing other improvements to track infrastructure to enable improved commuter rail services.

4.5.5 Rail industries and market reform

Before the Japanese railways reform in 1987, Under "State Owned Railway Law", all Japanese railways, including Shinkansen, were owned by the government. JNR was a public corporation established by Japan National Railway law. All budget and fare had to be approved by Parliament. As an exception of national ownership, private railway companies were permitted to operate railway business only within limited regional areas. After 1987, national ownership rule of railway was abolished. JNR was divided into 6 regional and 1 freight private companies. The Ministry of Land, Infrastructure, Transport and Tourism(MLIT) supports and supervises the private railway company providing a master plan, various policy menus to facilitate railway construction and supervises the railway companies to ensure safety, security and ease of use. Private railway companies take the initiative of building their own infrastructure, rolling stock and other equipment and have the primary responsibility of finance.

The mention "JR Companies" refers to, collectively, East Japan Railway Company (JR East), Hokkaido Railway Company (JR Hokkaido), Central Japan Railway Company (JR Central), West Japan Railway Company (JR West), Shikoku Railway Company (JR Shikoku), Kyushu Railway Company (JR Kyushu), and Japan Freight Railway Company (JR Freight).

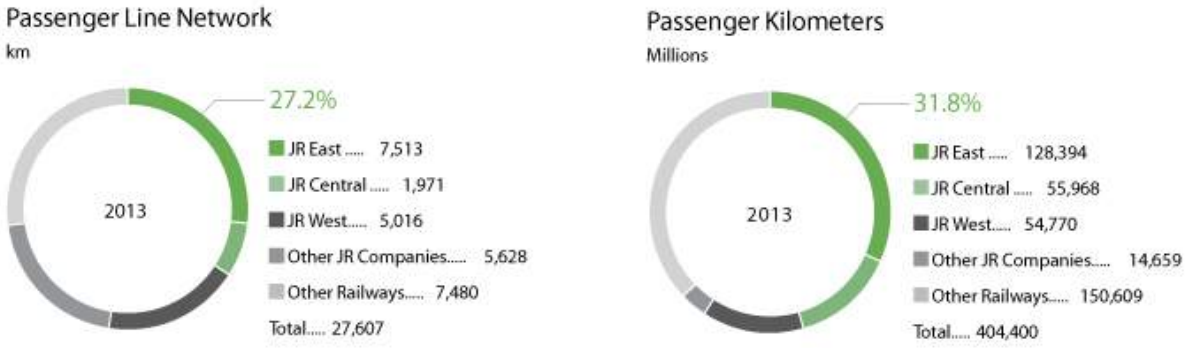
Fig. 4-19: Operation area network of JR West



Source: JR West

In addition to the six companies that were derived from the breakdown of JNR, 16 companies are classified as major private railways. JR companies cover about 70% of the passenger line network but less than 60% of traffic volumes.

Fig. 4-20: Japanese passenger market share



Source: JR EAST Group Annual Report 2015

In the Tokyo area, other private railway companies in addition to JR own over 60% of the 2 650 km network and carry a slightly higher share of 50% in terms of passenger-kilometres.

In 1982, the Railways Department of New Zealand has been transformed into a company, the New Zealand Railways Corporation. In 1990, the main part of the company was transferred to New Zealand Rail Limited, a state-owned company. New Zealand Rail Limited was privatized in 1993 by adopting the name Tranz Rail in 1995. The government bought the metropolitan rail network in Auckland from Tranz Rail in 2002. Following many financial problems that were moving on the state of repair of the railway network, in May 2008, the government has successfully concluded negotiations for the purchase of Tranz Rail (since acquired by toll NZ). The new organisation created to operate services on the railway network is KiwiRail.

5. UIC ASIA-PACIFIC VISION FOR 2050

5.1 ASIA-PACIFIC PERSPECTIVES 2050

The previous chapters provided an outline of the situation in the UIC Asia-Pacific region, with a socio-economic analysis followed by a study of the transport sector, with a focus on railways. This chapter intends to define the actual 2050 vision for the UIC Asia-Pacific region.

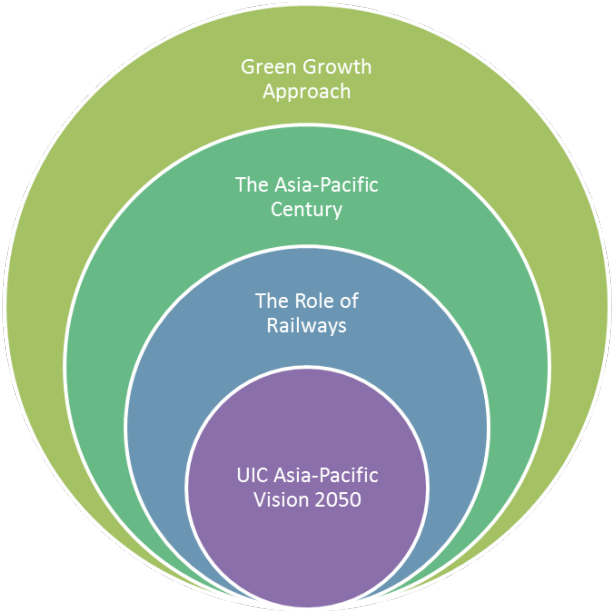
The framework for defining the 2050 UIC Asia-Pacific vision follows a model containing three conceptual levels, visualized in Fig. 5-1:

- A global level referring to the new Green Growth approach;
- A regional level referring to the scenarios that the Asian Development Bank outlined for the Asia-Pacific region for 2050;
- A technical level concerning the role of railways in the region.

The three levels are interconnected and have a different scale: the Green Growth approach inspires the definition of the ADB scenarios, and the role that railways need to have in the region comes from the potential that has to be expressed so as to make the optimistic ADB scenario ("The Asian Century") possible.

In this conceptual structure, the chapter will summarise what the UIC Asia-Pacific region represents today and what it does, starting from the analysis of UIC worldwide and the activities of UIC Asia-Pacific in the 2013-2016 Action Plan. The outcome of this process will be a proposal for a vision for UIC Asia-Pacific and a framework for future action plans.

Fig. 5-1: UIC Asia-Pacific vision conceptual levels



5.1.1 The Green Growth Approach

After 2008, the world economic climate has radically changed. This change has coincided with the emergence at a global level of the awareness that several simultaneous crises were hitting the planet: the economic and financial crisis, the environmental crisis, the energy crisis and also a social crisis, brought upon by the increased inequalities in both developed and emerging countries.

The "Green Growth" (often also called "Green Economy") concept has in fact its origins in Asia-Pacific itself, when the green growth approach was firstly adopted by the Fifth Ministerial Conference on Environment and Development (MCED) in March 2005 in Seoul, with the aim of harmonising economic growth with environmental sustainability. In the aftermath of the 2008 financial crisis, this approach has evolved as a way out of economic stagnations when all G20 countries have adopted green stimulus packages with public investments on infrastructure and incentives aimed at environmental protection.

Table 5-1: Infrastructure Investment in the Stimulus Packages of the Major Asian Economies (US$ billion)

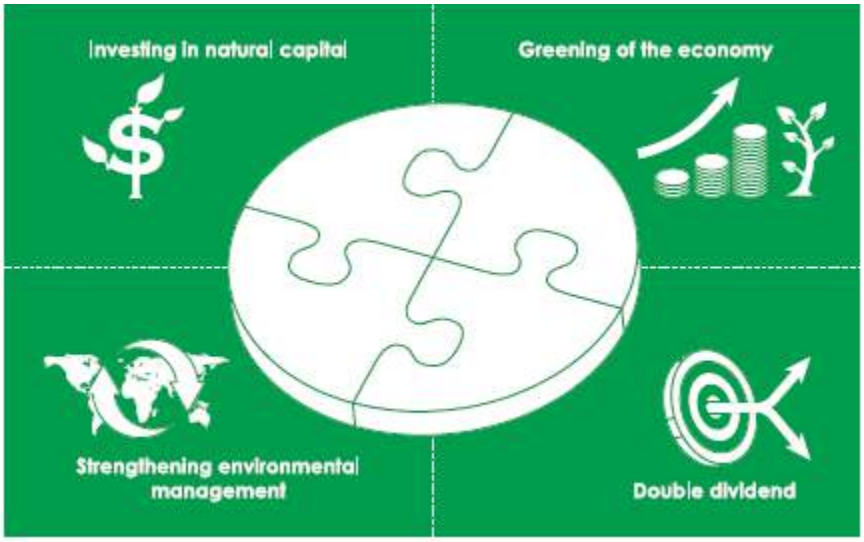
Country	Total Fiscal Stimulus	Infrastructure Component	Infrastructure as % of Total Stimulus	Types of Infrastructure
PRC	600.0	275.0	45.80%	Railways, airports, electrical transmission technology, expressways, telecommunications technologies, rural roads, electricity, gas, water, and irrigation projects
India	60.0	33.5	55.80%	Highway, port, and power sectors
Indonesia	7.7	1.3	16.90%	Communications and transport infrastructure, rural infrastructure, and development of ports and shipping industry
Viet Nam	8.0	4.8	60.00%	Infrastructure spending
Thailand	46.7	30.6	65.50%	Water resource development and road construction in villages and rural areas along with transport, logistics, energy, and telecom improvements
Malaysia	2.0	0.2	8.50%	Low and medium cost housing, upgrade, repair, and maintain police stations and army camps, and public and basic infrastructure project maintenance
Korea	11.0	3.2	29%	Roads, universities, schools, hospitals
Japan	154.55	16	10%+	Yen 1.6 trillion for fostering environmentally friendly technologies, including plans to provide cheaper solar power to homes and up to $2,500 as tax breaks to consumers on purchases of "green" cars; subsidies of 5% on energy efficient televisions and other appliances

Source: Bhattacharyay, B. 2010

According to the Global Green Growth Institute (GGGI), "green growth is the new revolutionary development paradigm that sustains economic growth while at the same time ensuring climatic and environmental sustainability. It focuses on addressing the root causes of these challenges while ensuring the creation of the necessary channels for resource distribution and access to basic commodities for the impoverished". The new approach is focused on the opportunity given by policies for climate change mitigation, responsible use of resources, poverty and inequality eradication rather than the costs that those actions can imply.

The key aspect of the green growth approach is in recognising that there is a common trait to all the crises: a general misallocation of capital (financial, human, energetic and natural capital). This leads to a complete reversal of perspective. As an example, the "green growth" approach completely overturns the alleged incompatibility between economic growth and environment: it makes the promotion of sustainable development an engine of economic growth and an essential instrument to foster economic recovery. In this angle, investments, policies and activities fostering green growth produce an essential re-balance of the allocation of capital.

Fig. 5-2: Effects of Green Growth



Source: UNESCAP 2012

In the green growth framework, the transport sector has a crucial role. It is well known that this sector is an important driver of economic growth and at the same time is one of the major stressors for the environment (due to energy consumption, emissions, harmful effects on ecosystems, etc.) and for the economy and society (e.g. for accidents and congestion). Future projections of the mobility indicators correlated with economic growth, increase of disposable income, population and urbanisation show that the transport sector is one of the most sensitive and strategic sectors for green growth.

To apply the green growth approach in the transport sector means to promote a transition from the current transport system to green transport, defined as a "transport system that supports environmental economic and social sustainability" (OECD 2011).

From an operational point of view, a green transport approach calls for action and investments that:

- Follow an Avoid/Shift/Improve (ASI) strategy, i.e. reduce the mobility demand and pursue accessibility, shifting on more sustainable modes of transport and improving the efficiency of vehicles;

- Enable the background conditions to reduce the distortions in the resource allocations for the transport market, which cause the prevalence of unsustainable modes.

In this transition towards green transport, railways are an essential instrument for its performance in terms of environmental, social and economic impacts. This character implies that promoting, investing and fostering railway transport is not just a strategic issue of any industrial sector but a strategic instrument to boost green growth approach.

5.1.2 Towards 2050 – Transforming risks in opportunities: the Asia-Pacific Century

The long-term socio-economic scenario in the AP region oscillates with extreme uncertainty between an extraordinary future and a failure.

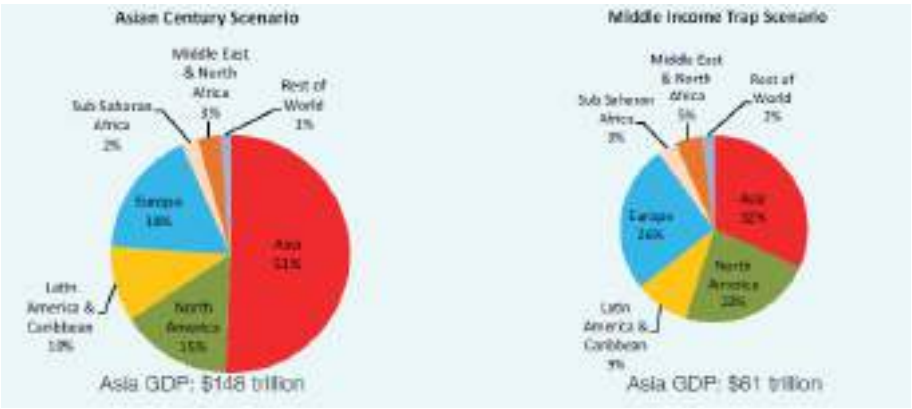
In 2011, the Asian Development Bank (ADB) has produced two scenarios for the Asia-Pacific region[32]. The scenarios, very different, emphasise how the incredible period of socio-economic development that happened in the last decades in the region does not guarantee by itself that the development will continue in the future. The first scenario is evocatively called "The Asian Century" and the second "Middle income trap", and they represent two possible trajectories of how the future may unfold. The report is heavily influenced by the Green Growth approach, both in the identification of the challenges for the region and for viewing the limits of unbridled economic expansion as an opportunity for the future.

The Asian Century scenario essentially extends Asia-Pacific's past success into the future. In this scenario, the Asia-Pacific's GDP (market exchange rates) would increase from $16 trillion in 2010 (base line) to $148 trillion in 2050, or half of global GDP, similar to its share of the global population. With a per capita GDP of $38 600 (PPP), Asia in 2050 would have incomes similar to Europe today. Under this scenario some 3 billion additional Asians would become affluent between now and 2050.

The Middle Income Trap scenario, on the other hand, assumes that the current converging economies will fall into the "Middle Income Trap" in the next 5-10 years, without any of the current non-convergers improving upon their past record; in other words, Asia would follow the pattern of Latin America over the past 30 years. Under this scenario total GDP in 2050 would reach only $61 trillion, not $148 trillion (at market exchange rates) and GDP per capita would be only $20 300, not $38 600, in PPP.

The global output of the two scenarios is shown in Fig. 5-3.

Fig. 5-3: Asian Century vs. Middle Income Trap



Source: ADB/ Centennial Group projections

32. The ADB Asia-Pacific region includes all 29 countries of the UIC Asia-Pacific region except the Russian Federation.

Asia is in the midst of a truly historic transformation. If it continues to grow on its recent trajectory, it could, by 2050, account for more than half of global Gross Domestic Product (GDP), trade and investment, and enjoy widespread affluence. Its per capita income could rise six-fold to reach the global average and be similar to European levels today (though Europe and North America will remain much richer in per capita terms). It thus holds the promise of making some 3 billion additional Asians, until now commonly associated with poverty and deprivation, affluent by today's standards.

By nearly doubling its share of global GDP (at market exchange rates) from 27% in 2010 to 51% by 2050, Asia would regain the dominant global economic position it held some 250 year ago, before the Industrial Revolution. In this sense the optimistic scenario called this possibility the "Asian Century". This promising result, that presupposes that the major economies of the region will experience the current growth trajectory, is plausible but implies a different growth model. In fact, to maintain the current pace of growth it is urgent to address a wide range of challenges, politically very demanding. Asia's rise is by no means preordained.

Indeed, this result is filled with multiple risks and challenges, in particular:

- Large and, in some cases, increasing inequities within countries could undermine social cohesion and political stability.
- Individual countries risk falling into the Middle Income Trap due to a host of domestic economic, social and political challenges.
- Intense competition for finite natural resources (such as energy, water and fertile land) unleashed by this growth, as the newly affluent Asians aspire to higher standards of living.
- Rising disparities across countries and sub-regions could destabilize the region and halt its growth momentum.
- Global warming and climate change (including increased natural disasters), as well as associated water shortages, could threaten agricultural production, coastal populations and numerous major urban areas.

In addition, almost all countries face the overarching challenge of governance and institutional capacity.

This is exposed in the high deviation between the two ADB scenarios presented. The ADB scenarios are of the "what-if" type, and the interest of bringing its macroeconomic forecasts here is to focus on the challenges for the region that are awaiting in the future. According to ADB and the green growth approach the Asia-Pacific region will find its future dimension in tackling the limits of its past growth model. In other words, what could be a risk today for the well-being of the region might instead constitute an opportunity to consolidate the successes obtained and access to a new development phase.

Given the very different conditions in the countries that are part of the region, the policies and actions must adapt to different contexts. Anyway, it is possible to draw the contours of the great challenges facing the region as a whole. The ability of different countries in Asia to achieve the "Asia-Pacific century" will be determined by the ability and success, individually and collectively, in addressing these imperatives:

- Growth with inclusion,
- Fostering regional cooperation and integration,
- Managing massive urbanisation,
- Fighting climate change and resource depletion.

Growth with inclusion: the creation of an Asian middle class

Growth and inclusion need not be mutually exclusive; indeed they can be mutually reinforcing. To sustain growth over the long-term, almost all Asia-Pacific countries must give much higher priority to inclusion and reducing inequalities—rich/poor, rural/urban, educated/uneducated and along ethnic lines.

For the socio-economic growth in Asia-Pacific to be lasting and resilient to outer shocks, it is necessary that it be distributed across all layers of society, allowing all members to participate to the benefits of national wealth increase. As seen in the first chapter, while the economic growth in the region has allowed hundreds of millions of people to emerge from poverty, the inequality of wealth distribution (between the countries and inside the countries themselves) has grown altogether.

On the other hand it is also necessary that emerging economies evolve, transcending an economic model too centred on exports. That is why, in order to proceed towards the "Asian Century", the formation, consolidation and expansion of an Asian middle-class is strategic. This would make it possible to activate those economic stabilisation mechanisms generated by the creation of a robust internal demand; at the same time, the conditions would be set to redistribute the wealth produced more equitably. Such a process cannot be taken for granted: as a matter of fact, even in non-Asian mature economies the inequalities rose in the last decades and wealth is gradually becoming more concentrated.

Regional cooperation and integration: the creation of a great Asian domestic market

The other dimension of the challenges for Asia-Pacific is the regional and sub-regional collaboration and integration.

Emerging economies of AP in particular have benefited from regional and global value chains. In China, for example, the income derived from trade flows within global value chains, measured as "export of domestic value added," increased six-fold between 1995 and 2009, and the number of jobs generated by export of value added increased from 89 million in 1995 to 146 million in 2008. However, not all countries in the AP region have been as successful in terms of expanding trade and attracting more investment to their economies.

On one hand, it is evident that countries and people in the AP region are becoming more and more connected in a variety of ways. On the other, it is less evident how this increasing connectivity has shaped the region's recent development, and what kinds of connectivity will be needed to help to reduce poverty and to achieve more balanced and inclusive growth across the region.

Given that an overwhelming majority of global merchandise trade by volume is carried by sea transport, access to maritime shipping services has been an important factor in facilitating countries' participation in global and regional production networks. Conversely, landlocked developing countries remain at a competitive disadvantage. This is due to the extra costs and time goods spend in transit and at border crossings before reaching their nearest ports.

The recent economic slowdown has exposed the region's vulnerability to fluctuations in the global economy, in particular to spending and investment policies of the United States and of European countries. Thus, attention is shifting to the development of domestic and regional markets as a means of stimulating growth and rising living standards, while creating new trade opportunities for the region's poorer and smaller countries.

The economic integration of countries in a supranational area is functional to an enlargement and a diversification of the internal Asia-Pacific demand and to a need for some Asian countries to rebalance their economies away from exports to the rest of the world.

Massive urbanisation: the creation of liveable cities

The future urbanisation process in Asia-Pacific will be quantitatively and qualitatively without precedent. Managing this process successfully is one of the most complex challenges for the region. Big cities represent an opportunity for the progress of the entire economy when they are rich, dynamic and highly liveable. This can only happen by activating investments, also unprecedented, oriented to a new style of urban development, different from what has been made in the megalopolises of North and South America.

The unforeseen consequences of an uncontrolled urbanisation on mobility vividly represent the uncertainty of Asia's future, suspended between risk and opportunity. On one hand the experience of cities like Singapore, Seoul and Tokyo demonstrate how thanks to compactness, high density and an effective system of public transport it is possible to ensure liveability and efficiency: high percentages of walking and public transport trips together with low per capita CO_2 emissions. On the other hand, urban densities in Asia are decreasing: middle-class demand for automobiles is increasing rapidly. The highest risk is the urban dispersion process, which connected with the use of cars would condition the development of cities for decades to come.

The necessary process of improving the urban quality and the widespread well-being of citizens can become one of the levers with which to ensure a stable, lasting and sustainable economic growth.

Climate change and resource depletion: the creation of an environmentally sustainable society

The anticipated affluence of some 3 billion additional Asians will put tremendous pressures on—and create intense competition for—Earth's finite natural resources. Long before 2050, Asia will surpass North America and Europe as the largest energy consuming block.

Asia-Pacific will account for about 40% of the world's energy consumption by 2050 and concerns about oil security in the region are expected to heighten over the forthcoming decades. This is because of further concentration of oil consumption in the transport sector, among other factors.

The key policy implication for all AP countries is that their future competitiveness and well-being will depend heavily on improving the efficiency of natural resource use and winning the global race to a low carbon future. In general, the growth of Asia-Pacific can be economically stable and sustainable only if associated with an efficient use of natural resources and a reduction of energy and carbon intensity.

This necessity, as well as the need to use an increasing amount of renewable energy, can be one of the decisive factors to activate the development of technologies, innovation and human capital that the great regional emerging economies need to continue on the path of a continuous productivity improvement.

Similar considerations can be made by estimating the impacts on economy deriving from climate change. Annual economic damage in Developing Asian economies would range between 3.1% and 10.6% of GDP in 2100. Agriculture is one of the most sensitive economic sectors affected by climate change, and is an important sector in most Asia-Pacific countries. Even after the recent and strong industrialisation process in the region, the majority of the world's rural population will be concentrated in Asia.

Analysis from various sources and studies shows that dangerous climate change would lead to declining agricultural yields in the vast majority of developing countries: in the case of India, Indonesia and the Republic of Korea the decline in yields would range between 14% and 20%. A global temperature increase of 4.4 °C would lead to sea-level rises as high as

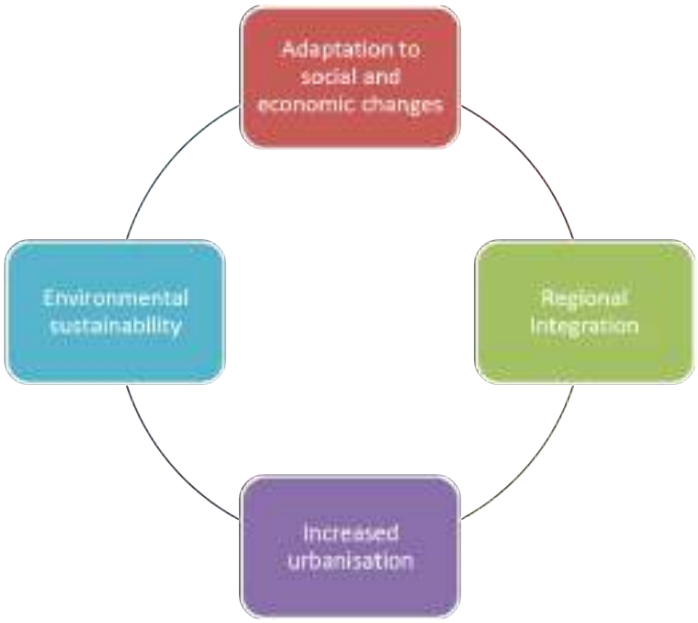
46 cm by 2100. This sea-level rise will threaten a large number of Asian cities. Measured by future populations that will be exposed to such sea-level rises, fifteen of the twenty most exposed cities (and nine out of the top 10) are in Asia (see Fig. 5-4).

Fig. 5-4: Relative vulnerability of coastal deltas as shown by the indicative population potentially displaced by current sea-level trends to 2050[33]

Source: IPCC 2007 following Ericson et al. 2006

5.1.3 The role of railways

The Green Growth approach and the crossroads of the Asia-Pacific century are the key elements to be taken into account in order to define a role of the transport sector (and railways in particular). This role is divided into four key priorities/challenges: the adaptation to the enormous social and economic changes happening in the region; the integration of transports in the region to face the rising demand and the growing interaction between countries inside the region; the explosion of urbanisation in the area, to support the growing population; and the environmental sustainability, which is vital for the liveability of the continent.



33. Extreme = more than 1 million; High = 1 million to 50 000; Medium = 50 000 to 5 000.

5.1.3.1 Adjusting Asia-Pacific railways to social and economic changes

An increased disposable income of the population means that private cars and plane tickets become more affordable: this has as a direct impact on road mobility and aviation demand. The past and current trends show this connection very clearly, as well as the experience in other continents such as Europe and North America that the Asia-Pacific region is striving to reach. Road freight also intends to gain market share: the production of merchandise with higher added value (e.g. technology products) brings about a higher fragmentation and dispersion of supply chains, where road transport can more flexibly respond to demand.

In fact, the increase in demand for road and air transport generates a reaction in the construction of infrastructure: for instance, UNESCAP estimates total investments in road in Asia (new infrastructure and maintenance) at 332 billion USD, compared to just 17 billion USD for rail. The ADB Institute estimates show that to meet growing demand, just developing countries in Asia transport infrastructure require financing for environ US$ 2900 billion at national level and US$ 230 billion at regional level during 2010-2020, of which just US$ 165 billion are rail infrastructures.

The perspective at this juncture is that significant investments will be needed in railways, not just on high-speed railways or on large freight corridors, but also on infrastructure needed for social and economic development objectives, which had been put on the back burner in the past for cost effectiveness reasons.

The Chinese experience exemplifies this orientation: the massive investments on high-speed railways for the congested areas of the country are followed by the increase of network capacity aimed to an increased accessibility of railways throughout the country.

The explosion of overall transport demand, after all, allows for an expansionist strategy of railways: not just modernisation and efficiency but also opening of new markets. Japanese railways, for example, are very effective in exploiting the prime real estate that they own around and inside railway stations by building high-value offices, malls and residences. This strategy allows railway companies to increase urban accessibility by railway, passenger demand and value for money.

There are several technical and economic constraints – always in evolution – that determine the market segments in which railways can be competitive with other less sustainable modes such as cars, light and heavy-duty vehicles and aviation. The necessary condition for the train to be preferred to modal alternatives is that railways are able to offer a competitive product/service on a specific market segment.

Currently, with reference to the experiences collected in different geographic areas and railway systems, the greater potential of railways can be seen mainly in some market segments where the train has the technical means and competitive advantages to gain significant market shares with other modes of transport:

- Passenger transport in congested urban areas;
- Business and leisure intercity passenger market between medium/large urban areas;
- Bulk long distance freight market;
- Intermodal containerized long distance freight market.

When the modal share of railways in these markets is below its potential, an expansion of railway is needed to grant an efficient and sustainable transport system.

5.1.3.2 Fostering regional integration

While the present commercial exchanges of the Asian continent are focused on the interactions of Asian countries with Europe and North America, the gravitational centre of the global economy is gradually shifting towards Asia itself. There will be a higher need of communication between Asian countries, which translates into mobility needs – for people and for merchandises.

Railway infrastructure development can both match this growing transport demand and build up regional integration and cooperation. Developing infrastructure networks and connectivity are essential to integrating core and wider economic activities and basic services in the region. The continental Asian market will grow exponentially to serve the increasing disposable income of its dwellers; and railways are in a good position to transport cost-effectively the bulk of passengers and freight throughout the expanse of the continent.

The TAR network would link pan-Asian and pan-European rail networks at various locations, connecting major ports of Asia and Europe, increasing accessibility of landlocked countries. Railways corridors can make growth more inclusive by sharing its benefits with poorer groups and communities, especially by connecting remote areas and small and landlocked countries to major business centres.

Studies show that the time and cost needed for a container to be transported from Asian to European destinations are comparable, and in some cases distinctly favourable to railways. There are obviously variations due to different factors: the closeness of source and destination to a port, the amount of road transport needed where alternatives are not available, the number of borders crossed etc. Eurasian railway corridors can create a "new silk road" from Asian to European markets, where people and goods could travel from one side to the other of the continent in just a few days. The infrastructure is mostly present but large investments are still required to remove a number of physical and non-physical barriers and fulfil missing links.

The development of a "new silk road" has to pass through a strong harmonisation effort in the region. Research shows that the main bottlenecks in the transport of passengers and freight through Asia are at border crossings, where customs clearance, paperwork and technical operations such as bogie change (for borders with gauge variation) take up hours of precious time. International organisations active in the region are promoting cooperation between Asian countries in order to harmonise regulations and streamline supply chains.

5.1.3.3 Responding to the increased urbanisation

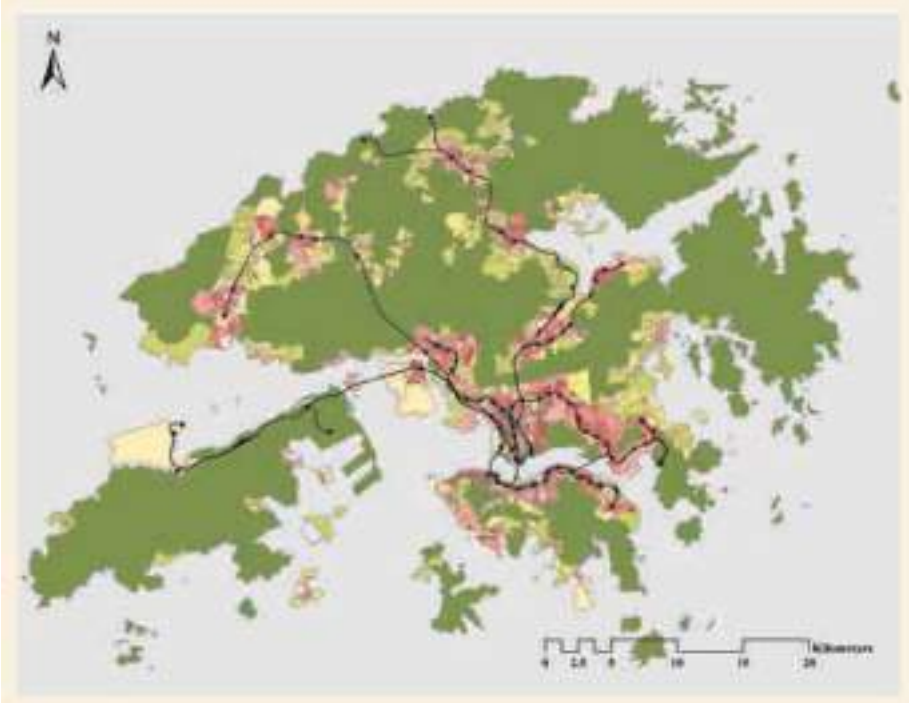
The 21st century is the century of cities. More than half the world's population (54%) currently reside in urban areas; 64% of the population in Asia-Pacific will live in cities by 2050. Cities globally generate about 75% of gross domestic product but at same time consume about 67% of energy and produce about 70% of greenhouse gas emissions.

Cities are the powerhouses of the economy. Efficient mobility in cities creates economic opportunities, encourages social integration, enables trade, facilitates access to markets and services, and makes effective use of resources. For an urban transport system to be efficient and effective, the public transport network needs to serve the main corridors of urban traffic. An adequate provision of public transport helps make cities more dynamic and competitive. In the case of mid-sized to large cities, in order to be effective, the public transport network has to be built with a railway backbone (commuter rail, heavy rail e light rail).

Well-integrated urban railway network and land use fosters economic competitiveness, environmental sustainability and social equity of cities. More specifically, transit-oriented development – which creates articulated densities around transit hubs by locating amenities, employment, retail, and housing in close proximity – is one of the most effective ways to achieve sustainable urban transport.

The World Bank concluded in a study that compact, mixed-use, pedestrian-friendly development organized around a mass transit station is one of the most effective strategic initiatives to address the negative effects of motorisation and identifies rail transit systems as the backbone of urban development. In congested urban areas, high-quality public transport systems are the most efficient way for people to access employment and education, which are crucial for a prosperous society.

Fig. 5-5 Urban population density along mass railway transit lines, Hong Kong SAR, China, 2011



Source: Murakami 2010, World Bank 2013

To reverse unsustainable development trajectories caused by rapid motorisation, cities can unlock unexplored land values to finance transit investments, such as for urban railways, and promote transit-oriented development (TDO) for the well-being of people today and for their sustainable future.

Railways as a mode of transport are also extremely efficient in terms of space, which is key in an urban environment: for the same unit of traffic carried in a unit of time, they consume less land than road infrastructure (even taking into account the slight gradeability of railway lines).

5.1.3.4 Leveraging the greater environmental sustainability of railways

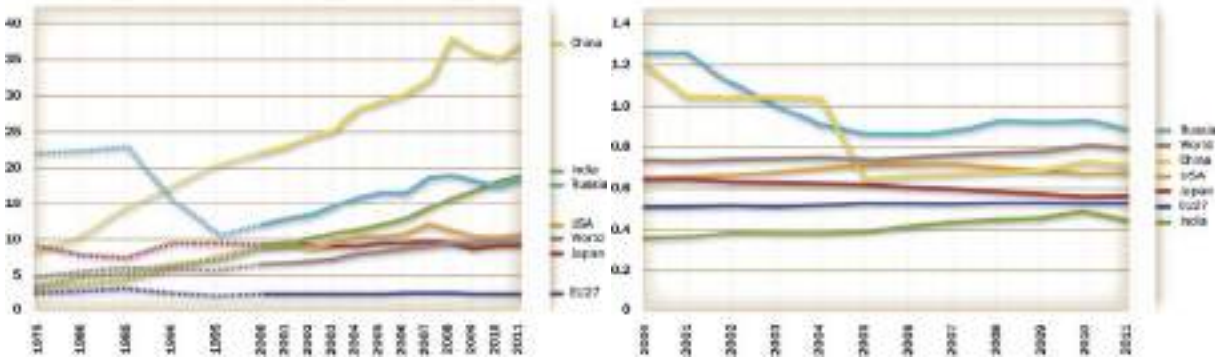
There are no questions that railways are environmentally friendly: in terms of specific impacts, railways are decidedly better than road and aviation, both for passenger and for freight service. Railways have the lowest specific external impacts (per passenger and per freight tonne), so they would gain further competitive advantage from the internalisation of external costs.

The mission and the core business of all the world railways – to transport passengers and freight – is completely in line with the objectives and actions of green transport. Modal shift to rail contributes to the reduction of impacts of the transport sector and to meet the global challenges of mobility and sustainable development.

In land transport, railways have a higher efficiency than road, measured in pkm or tkm transported per unit of infrastructure (an indicator which is also called "occupancy"). In India and China, railways transport at least 40 times more transport units (i.e. the sum of passenger-km and freight tonnes-km) than road per km of infrastructure. This occupancy factor is also growing for railways, while keeping constant for roads.

The higher occupancy level allows railways to support a higher amount of passengers and goods with a smaller infrastructure: when the goal is to satisfy a growing demand of transport (which will be the case in the coming years, particularly in the Asia-Pacific region), railways can do it much more efficiently than roads.

Fig. 5-6: Evolution of railway tracks (left) and paved roads (right) occupancy level, 2000-2011 (million transport units per paved lane-km or rail track-km)



Source: IEA/UIC (2014)

One of the crucial factors for the reduction of energy consumption is the process of electrification of world railways that is in continuous expansion. The electrification of railway transport can have a double impact on carbon intensity: it increases the energy efficiency and it can be matched with the reduction of the emission factor of electricity which can potentially go all the way down to zero if the electricity is entirely produced with renewable sources.

As seen in section 2.2.3, Asia-Pacific rail infrastructures are enjoying an increasing rate of electrification (nearly 40% in 2010), even though there are differences among countries in the region that range from no electrification to nearly complete electrification. The railway sector can leverage the electrification efforts without any additional investment the improvements generated by the progressive decarbonisation of electricity.

While total transport emissions in Asia-Pacific are increasing, the proportion of emissions from railways is decreasing (to about 6% in 2011). The modernisation of railways is bringing about the end of coal as a fuel for trains: India has dropped steam traction since the end of the 1990s, while China has reduced it by two-thirds from 1990 to 2011.

The UIC, in the framework of its "Low Carbon Rail Transport Challenge", has launched in 2014 ambitious 2030 and 2050 targets for energy consumption and CO_2 emissions:

- Reduction in specific average final energy consumption from train operations:
  - 50% reduction by 2030 (relative to a 1990 baseline),
  - 60% reduction by 2050 (relative to a 1990 baseline).
- Reduction in specific average CO_2 emissions from train operations:
  - 50% reduction by 2030 (relative to a 1990 baseline),
  - 75% reduction by 2050 (relative to a 1990 baseline).

These targets will be achieved by railway companies across the world, in aggregate terms. Since the Asia-Pacific region makes up for nearly 80% of passenger railway activity and 54% of freight railway activity, a major effort will obviously be undertaken in the region.

Railways are a traditional social inclusive transport system but the need for the transport companies to gain in efficiency and profitability can gradually affect this feature. The concentration in some markets for example may involve the gradual retreat to serve large areas of territory if sparsely populated.

Several studies have shown that investment in transport policies that benefit the environment, particularly in relation to climate change, will deliver net employment benefits. A job created in a green transport perspective by shifting to rail from other unsustainable mode is definitely a green job

Railways employ about 4 million people in Asia-Pacific (of which 2 million are in China and 1.3 million in India). Labour costs in Asia-Pacific railways represent a significant percentage (up to 60%) of the total operational expenses. Moreover, the construction of railway infrastructure is more labour-intensive than the construction of roads, which creates the fewest jobs of any public infrastructure investment.

In addition, the design and manufacturing of public transport vehicles is a highly job-intensive activity. There is much less automation than in the private car industry, vehicles are produced in smaller series and follow specific criteria defined by operators and authorities, even though the rate of standardisation and automation is likely to increase in the coming years. Infrastructure and vehicles also generate jobs throughout their life cycle, notably for maintenance and renewal.

The trade-off between profitability and social inclusion, as a main pillar of sustainability, has to be handled with great care in railway transport.

5.2 UIC TODAY

5.2.1 UIC Worldwide: mission, activities and core values

UIC is the worldwide professional association representing the railway sector and promoting rail transport.

The original and central mission of UIC, as defined by its founding members, was to harmonise and unify, in the broad sense of the term, international rules and procedures for the construction and operation of railways on an international level. Over time and even more in the coming years, UIC will be increasingly involved in developing strategies and initiatives to improve business performance and increase rail transport investment and executing non-commercial activities, including research, development and technical efficiency.

The mission of UIC[34] is illustrated by the tasks listed below:

- Promote rail transport at world level with the objective of optimally meeting current and future challenges of mobility and sustainable development;
- Promote interoperability, create new world standards for railways (including common standards with other transport modes);
- Develop and facilitate all forms of international cooperation among Members, facilitate the sharing of best practices (benchmarking);

34. The mission and overall objectives for UIC activities result from the statutes that were unanimously adopted by the UIC Members at the General Assembly on 31 March 2009.

- Support Members in their efforts to develop new business and new areas of activities;
- Propose new ways to improve the technical and environmental performance of rail transport, improve competitiveness and reduce costs.

To enable UIC to effectively fulfil its mission, 3 levels have been defined for international cooperation activities:

- Strategic level by the coordination with and between the 6 UIC Regions created as part of the new Governance (the regions include the Asia-Pacific region);
- Technical/professional cooperation level focused on activity sectors such as passenger, freight, rail system and cross-sector activities such as sustainable development, research, safety, security, expertise development;
- Support services level as e.g. finance, human resources, legal, communications and institutional relations.

In the interest of the worldwide railway community, in 2009 UIC defined 5 key areas to be developed in its activities: Environment, Safety and Security, Signalling, Freight / Freight Corridors, Standardisation.

The UIC railway community rests on shared values based on a common history and traditions:

- Unity (UIC is the professional and technical association representing the unity of the railway sector at world level);
- Solidarity (UIC wants to narrow the divide between members with different features and levels of development);
- Universality (UIC's scope of activities is global and embraces the universality of railway topics).

5.2.2 UIC Asia-Pacific region Action Plan 2013-2016

Recently, UIC amplified the role of the "6 UIC Regions" whereby each zone, in parallel with worldwide activities, is able to set its own regional priorities and plans of action.

The UIC Asia-Pacific region has already formulated a 4-year Action Plan for 2013-2016.

To draw up the plan UIC AP surveyed its members in 2010. The Asian members' main needs are listed below:

- Cooperation among countries due to economic stagnation,
- Development of inter-regional business opportunities such as between Europe and Asia-Pacific,
- Reduction of the costs (finance, daily operations and efficient organisation),
- System interfaces & standardisation (OSJD, CEN/CENELEC, IEC, signature of MoUs),
- Interaction with the manufacturing sector,
- Signalling and system control.

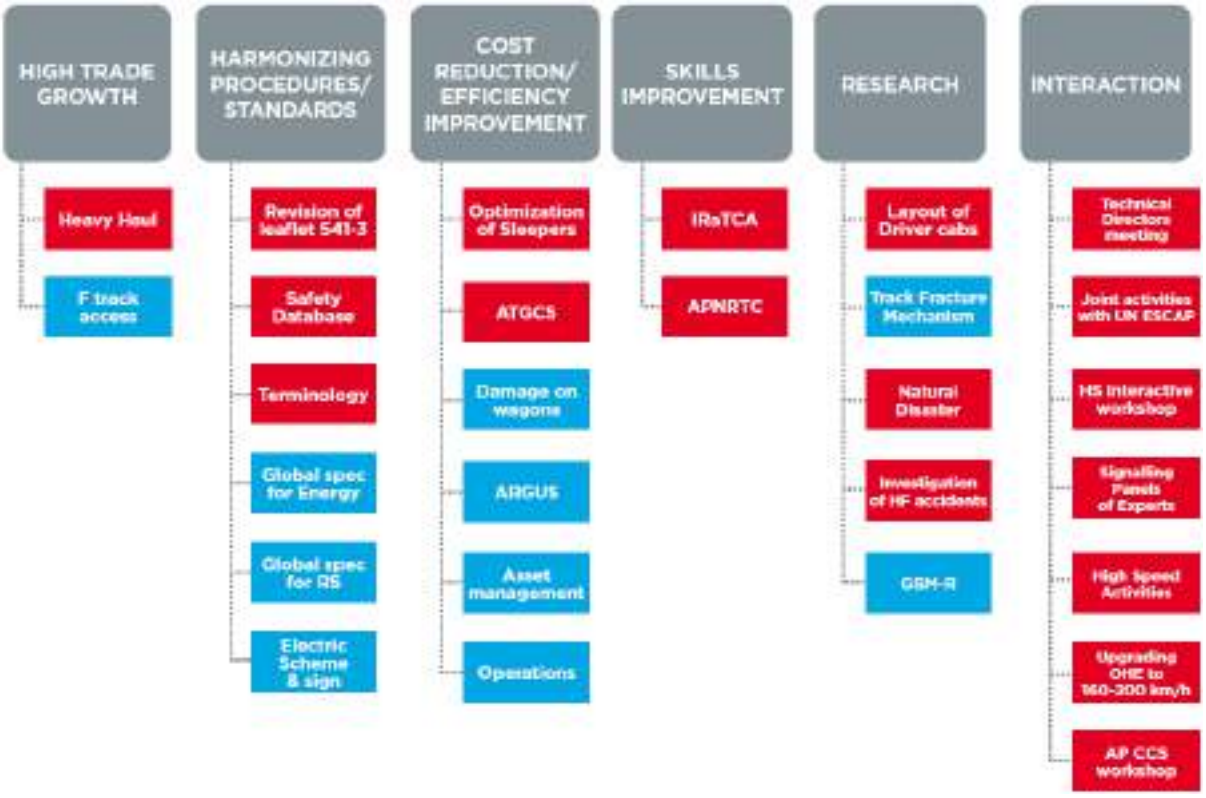
The projects joined to the Action Plan 2013-2016 fall under the following six broad areas:

- High trade growth: Projects which support the high trade growth projected within Asia-Pacific (AP) and between Europe, Middle-East and AP,
- Harmonizing procedures/standards: Projects which aim at harmonizing and standardizing the procedures,

- Cost reduction/efficiency improvement: Projects aiming to reduce the cost of operations and improve the efficiency,
- Skills improvement: Projects which aim to improve the skills of employees,
- Research: Projects which encourage joint railway research,
- Interaction: Projects which interact with members, industry, investors, and customers.

Some projects 2013-2016 have been developed for the Action Plan. Those are divided into three types of Projects: Regional, Multi-Regional and Global.[35]

Fig. 5-7: 2013-2016 Action Plan projects[36]



Source: UIC

The outcomes of the activities that are taking place in the framework of the current Action Plan will be developed in the coming years, in the framework of future action plans. In particular, a major role of UIC (and consequently of the UIC Asia-Pacific Regional Assembly) is to organise workshops where issues are examined and discussed in breadth and depth by experts pertaining to member railways, and propose recommendations that may turn into full-fledged projects. This is the case, for example, of the UIC Asia-Pacific Workshops that have taken place on "Productivity Increase with Heavier and Longer Trains", on "How to Improve Interchange in Cross-Border Traffic" and on "Training Simulators for Locomotive Crews", all of which have resulted in a series of recommendations for activities to be undertaken by UIC and member railways.

35. The list of projects has been updated recently (2015) and global projects are not listed anymore in the new version of the Action Plan 2013-2014. The figure has not been updated.
36. The actions in red were already approved at Asia-Pacific Regional Assembly in 2013.

As can be seen from the list of projects shown in Table 5-2, a comparison between the areas of activity at AP level with the UIC World activities, it appears that the theme "Environment, Energy and Sustainability" is absent, and that there are no projects dedicated to the theme of Commuter and Regional Train Service (CRTS). The budget dedicated to AP regional projects reports that "Interaction" has had the most significant role (around 40%) followed by Research (about 25%) and Skill Improvement (about 20%).

Table 5-2: Asia-Pacific projects included in the Action Plan 2013-2016

PROJECT	LEVEL	AREA	BUDGET
IRaTC A and APNRTC (Asia-Pacific Network of Rail Training Centres)	Regional	SKILL IMPROVEMENT	240
Technical Directors' Meeting	Regional	INTERACTION	40
Joint activities with international Institutions (UN ECE & UN ESCAP & ADB)	Regional	INTERACTION	160
Optimization of sleepers design II	Regional	COST EFFICIENCY/EFFICIENCY REDUCTION	90
Upgrading OHE design to 160-200		INTERACTION	40
The 3rd HS Interactive Workshop: Seminar on Safety and Quality standard of HSR Passenger service	Regional	INTERACTION	65
Layout of driver' cabs in Asian rail vehicle	Regional	RESEARCH	100
Development of Non-destructive Technology and Evaluation System for Prevention of Fracture Damage in Rail	Regional	RESEARCH	50
Asia Pacific Control Command & Signaling Workshop	Regional	INTERACTION	130
Heavy Haul Organisation	Regional	HIGH TRADE GROWTH	80
Training simulators for locomotive crews	Regional	RESEARCH	40
Study of resource use in additionally selected Asian Railway stations	Regional	RESEARCH	60
Natural Disaster Management on Railway Systems	Regional	RESEARCH	40
Signalling Panel of Experts	Multi-Regional	INTERACTION	
High Speed Activities	Multi-Regional	INTERACTION	
International Railway Standards Framework	Multi-Regional	HARMONIZING PROCEDURES/STANDARDS	
Train Bus Applications and Homologation	Multi-Regional	HARMONIZING PROCEDURES/STANDARDS	
Revision of UIC leaflet 541-3: verification tests	Multi-Regional	HARMONIZING PROCEDURES/STANDARDS	
Human Factors in investigation of accidents/incidents	Multi-Regional	RESEARCH	
UIC OS JD Joint WG on ATGCS	Multi-Regional	COST EFFICIENCY/EFFICIENCY REDUCTION	
Global Specification for Interoperability-Rolling Stock	Multi-Regional	HARMONIZING PROCEDURES/STANDARDS	
Global Specification for Interoperability-Energy	Multi-Regional	HARMONIZING PROCEDURES/STANDARDS	
GSM-R for Asia Pacific	Multi-Regional	RESEARCH	
Safety Database	Global	HARMONIZING PROCEDURES/STANDARDS	
UIC/OS JD Terminology group	Global	HARMONIZING PROCEDURES/STANDARDS	
Electric Scheme and Signs	Global	HARMONIZING PROCEDURES/STANDARDS	
Availability and Security Challenges of Open Networks aiming of their use in signaling of railways(ARGUS)	Global	COST EFFICIENCY/EFFICIENCY REDUCTION	

Source: UIC

5.3 UIC AP TOMORROW: A VISION FOR 2050

5.3.1 Vision

A "Vision Statement" defines the optimal desired future state of what an organisation wants to achieve over time, providing guidance and inspiration as a "north star" over the long term.

The central aspect that the UIC Asia-Pacific region railways have to keep in mind is the role that railway transport are expected to take in the region in the near future. Considering the weight of the Asian continent in the current times, that role will be essential also at a global level.

The emergence of the new Green Growth / Green Economy approach offers to railways in Asia-Pacific the opportunity to be primary actors at a national, regional and global level. An effective green growth will not be possible without the development of a green transport system, and an effective green transport system will need railways to take a significant role, particularly in some market segments.

The UIC Asia-Pacific action needs therefore to cover a regional and sub-regional level and it has to be able to represent the UIC AP region's position with international organisations and intergovernmental agencies, with national authorities and governments and with the railway manufacturing industry.

The vision statement for the UIC Asia-Pacific railways proposed here is:

"To be a common voice on strategic issues for the transport sector and influence railway growth in the Asia-Pacific region for the next decades"

In order to take this role in the future, the UIC Asia-Pacific region needs to leverage the core competencies of the UIC organisation towards the organisation internally, towards members and towards external parties. The core competencies of UIC can be identified as:

- **Neutrality:** UIC is neutral with respect to all members;
- **Representativeness:** UIC represents a vast number of railways worldwide, not only as a sector and a trade association, but also as a mode of transport to be promoted to reach strategic objectives at various levels;
- **Technical competence:** UIC has expertise on a wide array of railway topics, through the know-how developed in the field by all its members worldwide.

The UIC Asia-Pacific region is a recent structure that needs to be empowered in order to be more resourceful and useful to its members. To support the members, an effective and efficient functioning of the regional organisation will be essential. Considering the huge size of the region and the potential for development activities in the region, regional contacts need to be established to complement the work with the UIC Regional Director.

As outlined in the past Action Plan, the Asia-Pacific region lacks the strong regional research and institutional support which exists in Europe. Europe is already a recognised political institution, while the Asia-Pacific region is not; however, a large series of intergovernmental institutions, sub-regional cooperation agreements, free trade areas and economic unions are active in the region. A stronger cooperation with those institutional bodies is crucial to develop the UIC AP core competencies.

The on-going cooperation with the Asian Development Bank (Sharing Expertise to Finance Projects and MoU), the Greater Mekong Sub-region and with the United Nations Economic and Social Commission for Asia and the Pacific (with the MoU signed in 2000) are part of this strategy.

At present, UIC AP does not cover with its active members all the railway companies operating in the region. The existing active members represent the sub-regions where the growth prospects are strongest (e.g. China, India, Russia, Kazakhstan). Nevertheless, to promote an effective strategy on inland connections and corridors, some actors – especially Central Asian railways and other stakeholders in these countries, which will influence the productivity of UIC as a whole – should be involved in a more active role in the UIC Asia-Pacific region activities.

It would be appropriate to have, as is the case in Europe, a number of railway research agencies associated with UIC in order to combine all research efforts to ensure sustainable and economic rail transport development.

Between what UIC Asia-Pacific is today (mission, core values and core competencies) and what it aspires to be in the future (the vision) a bridge has to be built, with the activities of the Regional Assembly as bricks. The central activities have to be the Action Plans, which select, promote and guide specific working projects. The goal is to meet the challenges that await the railway sector in Asia-Pacific up to 2050:

- Offer innovative transport services for a rapidly evolving socio-economic environment;
- Promote integration and cooperation at a regional and sub-regional level;
- Increase or maintain the market share of railways;
- Continuously improve the environmental performance of railways.

5.3.2 Strategic Action Areas for UIC Asia-Pacific

In order to reach the vision outlined in the previous section, the UIC Asia-Pacific region has to focus in the period leading to 2050 on a series of action areas. These areas leverage the core competencies to effectively foster the role of railways in the region and give UIC Asia-Pacific a central role in the development of the transport sector.

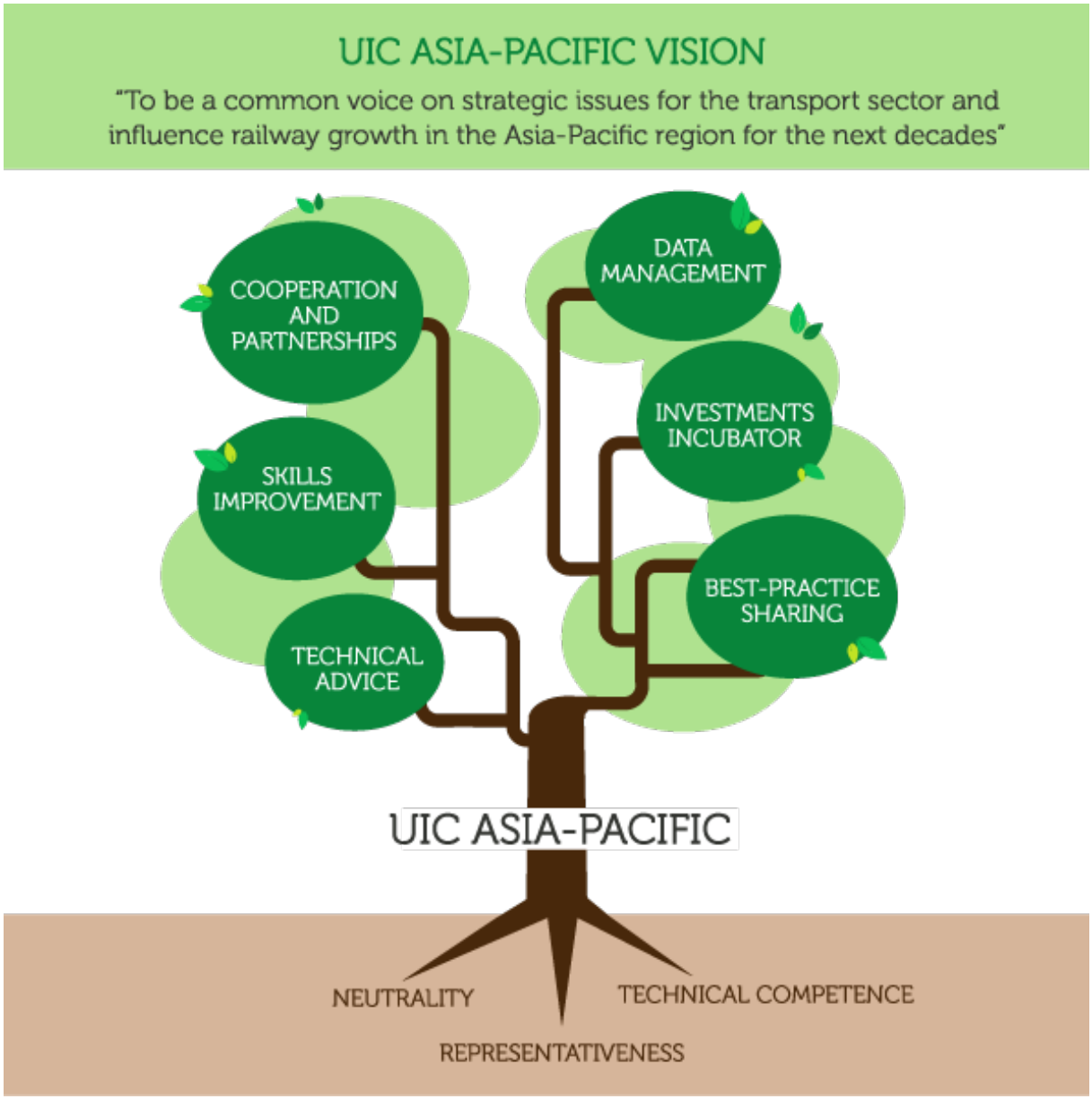
The strategic action areas identified are:

- **Cooperation and partnerships with the multilateral organisations active in the region:** from the main intergovernmental organisations such as ADB, EDB, UNESCAP, ASEAN, to the railway organisations such as OSJD and CAREC. The cooperation can take different forms: stronger partnerships (e.g. Memorandums of Understanding or Cooperation Agreements) or specific actions such as development programmes for new infrastructure or urban railway service.
- **Data quality improvement:** there is still in the region a “data gap” to be filled by UIC. Railways in the region have a wealth of data that needs to be collected, shared among members and used on one hand for the improvement of the quality of railway service in the region, and on the other hand to promote a more productive cooperation with international bodies and investors. The data on a number of topics could be collected: e.g. production, safety, infrastructure, energy consumption and CO2 emissions, modal shift, new projects, etc.
- **Being an incubator for investments in Railways:** the Regional Assembly and the UIC headquarters will leverage their technical competences and their connections with national and regional institutions to foster public and private investments in the region.
- **Best-practice sharing and technology transfer between Members:** Asia-Pacific railways often face similar problems, so it would be beneficial for them to share among each other the issues met, the lessons learned and the innovative solutions found, and to start a productive dialogue with European railways based on “lessons learned”.

- **Technical Advice and Peer Review:** UIC can offer its services and competence to support public and private entities for the study of new projects, as well as for the elaboration and the evaluation of tenders.
- **Skills Improvement:** UIC Asia-Pacific members will put their technical competences in service of the common good, through capacity building initiatives such as training sessions, workshops, e-learning or staff exchange.

Fig. 5-8 summarises visually the strategic actions described above, built on the UIC Asia-Pacific Regional Assembly and its core competencies. The leaves of the tree represent the main "Action Areas" on which to act in order to reach the 2050 Vision for UIC Asia-Pacific outlined in the previous section. The Action Areas describe the main mission of UIC Asia-Pacific and a description of its chief concerns.

Fig. 5-8: Strategic action areas for UIC Asia-Pacific



5.3.3 Framework for future action plans

The activities of the UIC Asia-Pacific region mainly encompass single projects rather than fixed activities. It is thus necessary to build a framework that can support in the definition and production of the projects. While all the Action Areas described in the previous section have to be kept in mind when a project is proposed and implemented, the framework suggested below can be used in the proposal of a project.

The suggested framework can be described as a "matrix" which has on one axis the well-known UIC technical cooperation areas (Passenger, Freight and Rail System) and on the other axis a set of high-priority objectives to reach the Vision of UIC Asia-Pacific:

- Cost reduction and efficiency improvement,
- Harmonisation and standardisation,
- **Regional Integration (New Pillar),**
- Research and Innovation,
- **Quality and Customers (New Pillar),**
- **Environmental Sustainability (New Pillar),**
- **Urban Development (New Pillar),**
- Safety,
- Security,
- **Expertise development and training (New Pillar).**

Fig. 5-9: Framework Matrix for future UIC Asia-Pacific projects

	Passenger	Freight	Rail System
Cost reduction / Efficiency Improvement			
Harmonisation / Standardisation			
Regional Integration			
Research and Innvovation			
Quality and Customers			
Environmental Sustainability			
Urban Development			
Safety			
Security			
Expertise development and training			

The matrix is shown in Fig. 5-9. Each project can be represented inside the matrix: obviously, some projects may be related to different areas and/or objectives, even though there is usually a main area/objective of focus. When a project is proposed, it should:

1. Fit in at least one of the six strategic Action Areas shown in Fig. 5-8
2. Relate to at least one "box" in the matrix, i.e. a specific objective in one cooperation area.

In practical terms, a possible project proposal form could contain questions such as:

- "What is the main strategic action area for this project?" (with the six Action Areas in Fig. 5-8 as possible choice)
- "How does the project relate to the specified action area?"
- "Please specify the main focus of the project in the objective/cooperation area matrix (i.e. Fig. 5-9), and if applicable specify whether the project can have impacts in other areas of the matrix".

Fig. 5-10: Framework Matrix for Heavy Haul project

	Passenger	Freight	Rail System
Cost reduction / Efficiency Improvement		**Heavy Haul (Core Focus)**	
Harmonisation / Standardisation			**Heavy Haul**
Regional Integration			
Research and Innvovation		**Heavy Haul**	
Quality and Customers			
Environmental Sustainability		**Heavy Haul**	
Urban Development			
Safety			
Security			
Expertise development and training			

As an example, a Heavy Haul project related to innovative traction rolling stock (one of the outcomes of the "Productivity Increase with Heavier and Longer Trains" UIC Asia-Pacific Workshop) could have as a main strategic action area "Technical Advice", if the project has the goal of producing a series of innovative ideas for Heavy Haul rolling stock. A possible framework matrix for that project (shown in Fig. 5-10) could have the main focus on cost reduction and efficiency improvement in freight, but it could have also impacts on freight energy efficiency and research, and on harmonisation for the infrastructure (i.e. rail system), with the creation of rolling stock adapted to the different types of infrastructure available throughout the Asia-Pacific region.

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ANNEX A: FOCUS ON SELECTED COUNTRIES

AUSTRALIA

Infrastructure of the region

Inland Rail

The Australian Federal Government has committed to building a piece of national infrastructure by constructing an Inland Railway between Melbourne and Brisbane via central-west NSW and Toowoomba. The key facts for Inland Rail:

- The route will be approximately 1 730 km and will provide a competitive freight price with road.
- Inland Rail will use the existing interstate rail line through Victoria and southern NSW but will require approximately 400 km of track upgrades predominately in NSW and approximately 600 km of new track through northern NSW and south-east Queensland.
- Inland Rail provides a second link between Queensland and southern states, ensuring resilience and redundancy for the existing network and allowing freight travelling from Brisbane to Melbourne to bypass the busy Sydney rail network.

New South Wales

A major intermodal facility in the south west of Sydney to provide a rail 'port shuttle' between Port Botany and the Moorebank precinct, as well as warehousing and a separate terminal for interstate freight, is being progressed by the Australian Government. The port shuttle terminal will have capacity for up to 1.2 million containers, vastly improving efficiency and productivity while relieving congestion on Sydney's roads. The Moorebank Intermodal Terminal will boost productivity and improve transport links in Australia's biggest city by enabling freight travelling through Sydney to and from Port Botany to be transported on rail instead of the road network, providing cheaper and more efficient freight transportation. The interstate terminal will also take pressure off rural and regional roads and enhance the freight rail network, to help make rail freight a real competitor to road freight and benefit everyone in the national supply chain. The total benefits of the project have been estimated at $10 billion. These include:

- The Intermodal Terminal could remove 1.2 million trucks each year from Sydney's roads from 2020—that's equivalent to 3300 trucks per day, relieving widespread traffic congestion;
- Faster freight transport, reduced costs to business, reduced fuel use and emissions;
- Over 2000 full time jobs during construction, with 1700 on-going jobs in the region once the facility and associated warehouses are open.

NSW has some of the largest investments in Australian rail being undertaken today, in order to improve reliability and increase capacity for freight and passengers trains, including e.g.: The Northern Sydney Freight Corridor Program and South West Rail Link.

Victoria

A number of large scale rail projects are underway, for instance:

- Cranbourne-Pakenham Rail Corridor Project that will deliver a 30 per cent capacity boost as well as improve reliability on one of Melbourne's busiest and most crowded rail corridors;
- Investing in Our Rail Network project where The Victorian Government has invested more than $520 million to boost safety, reliability and capacity on Victoria's public transport network;
- Melbourne Rail Link, a project to increase the capacity of Melbourne's rail network by 30 per cent that also deliver a rail link to Melbourne Airport;
- Regional Rail Link: Regional Rail Link in 2015 will increase the size of Victoria's rail network, removing bottlenecks that cause train delays by untangling regional and metropolitan train services as they travel into the heart of the city.

Queensland

The Queensland Government has published a *Transport Coordination and Delivery Plan*. The plan provides a clear strategic framework for making decisions to achieve the government's vision for the transport system. Some projects included in the plan are:

- Bundaberg Port Rail Link Study: In October 2007 Transport and Main Roads (then Queensland Transport) engaged GHD to undertake a study to identify a rail corridor (for freight traffic) to connect the Port of Bundaberg to the existing rail network via the North Coast line;
- Bus and Train (BaT) Project: The Bus and Train (BaT) project is a proposed 5km north-south tunnel that will deliver rail and bus together in a world-first design;
- Moreton Bay Rail Link: The Moreton Bay Rail Link will deliver a 12.6 km dual-track rail line between Petrie and Kippa-Ring. The link is to be completed in 2015;
- New Generation Rollingstock: The Queensland Government's New Generation Rollingstock project will see a significant growth to the rail fleet and supply more services than ever for commuters;
- Richlands: The $475 million Richlands to Springfield rail project is the second stage of the Darra to Springfield Transport Corridor. It is due to be completed in 2014;
- The Carmichael coal, railway and Port Project: The project includes building Australia's largest thermal coal mine in the north Galilee Basin approximately 160km north-west of Clermont in Central Queensland, linked by a new 388 km standard gauge rail line to a new terminal at Abbot Point Port near Bowen.

South Australia

The South Australia State Government has drafted the *State's 2014 Integrated Transport and Land Use Plan*, which includes a modernisation of the rail, bus and O-Bahn networks, an extension of the train to Seaford, the extension of the tram network, the electrification of the Seaford rail line and to Dry Creek.

Western Australia

To provide a *transit map* for the future, the Minister for Transport set up an Independent Panel to oversee the preparation of a public transport network plan for Western Australia. The plan seeks to identify a mass transit network for the next 21 years and to propose projects that will

see construction of infrastructure such as new railways, transit ways and bus lanes to better support public transport and improve the quality of services.

The capacity and efficiency of the existing network will need to be increased by:

- Purchasing new trains and buses;
- Upgrading major bus interchanges and providing faster bus services to transfer passengers to rail services;
- Building new train stations;
- Providing effective access to the system including adequate park and ride facilities.

Tasmania

TasRail is Tasmania's vertically integrated, short haul, freight rail business. It was created in 2009 by combining the *Below Rail* (track) assets with all of the *Above Rail* and Business Assets purchased from Pacific National, including the Emu Bay Railway.

The most important Tasmanian projects:

- Advanced Network Train Control System (ANCS): to realise further improvements in its safety and productivity performance, following the successful commissioning of the first stage of an $11 million project that will see an Advanced Network Train Control System (ANCS) progressively installed across the State's Freight Rail Network;
- Bell Bay Intermodal Terminal Project: a Terminal will be located in the heart of the major industrial precinct at Bell Bay, only 3.5 kilometres to the Port of Bell Bay by rail.

Strategy Goals and key objectives

To facilitate debate and co-ordinate government activities between the federal and state or territorial governments, the Australian Prime Minister convenes a Council of Australian Government (COAG) forum. COAG operates via a series of Standing Councils established to address items of national significance, each with a focus on a specific area of interest. The COAG Transport and Infrastructure Council, is the forum with responsibility for transport and rail affairs and, through a 2011 *Intergovernmental Agreement on Rail Safety Regulation and Investigation Reform*, is working to deliver its stated objectives of improve rail safety for the Australian community and seamless national safety regulation of rail operations.

In meeting these objectives, the Transport and Infrastructure Council will deliver the following outcomes for the rail industry:

- promotion of safety and safety improvement in the delivery of rail transport;
- improve productivity and efficiencies from consistent national requirements;
- decrease regulatory burden.

To support the Strategy Goals and Objectives of the COAG Transport and Infrastructure Council, key principles have been established specifically for transport and rail. The key strategic principles for transport and rail are: 1. Efficiency, 2. Safety, 3. Sustainability, 4. Accessibility and 5. Competitiveness.

Key Elements

Key objectives to ensure security at rail transport facilities

Surface Transport security arrangements are under State and Territory responsibility that is supported by the Office of Transport Security, which works with all jurisdictions to coordinate the dissemination of 'best practice' information on security measures in relation to surface transport security. Implementation of preventive security measures is the responsibility of owners and operators of transport systems.

Security improvements to rail services are undergoing improvements across Australia by State and Territory operators and their contractors. To formalise security arrangements across Governments, COAG has developed an *Intergovernmental Agreement of Surface Transport Security* (2005), which aims to put in place arrangements to protect the community and Australia's surface transport systems. COAG agreed to national transport regulation reforms including the establishment of a National Rail Safety Law and National Rail Safety Regulator. The National Rail Safety Regulator (NRSR) will help overcome inconsistent regulatory practices between the states and territories that have constrained rail transport operators since federation.

Key areas of rail transport research

The Australasian Centre for Rail Innovation (ACRI) is a not-for-profit organisation established to provide professional, independent applied research, strategic analysis and innovative solutions for the Australasian Rail Industry. ACRI's goals and objectives are to support and ensure continued improvement in productivity and sustainability to underpin the competitive position of the Australasian Rail Industry.

The Australasian Centre for Rail Innovation (ACRI) is demonstrating the benefit from the sharing of ideas and mutual collaboration with international rail sector bodies, for example by prioritising the formation of international agreements and including specific strategic objectives around collaboration outside as well as inside Australia.

Formal agreements have been established between ACRI and the following entities, with more opportunities being sought continually:

- The UIC,
- RSSB (UK),
- The Federal Railroad Administration of the Department of Transportation of the USA,
- Rail Manufacturing Co-operative Research Centre.

Human resource development in rail transport

Human Resource Development is addressed by each individual organisation and any development activities are implemented at the organisational level. Organisations implement practices and development activities aimed at addressing their specific and identified needs.

Development activities are generally aimed at ensuring that the organisations' human resources have the skills to perform at their current level of duties, while facilitating the acquisition of higher level skills, to support advancement through promotion to higher duties, as and when appropriate.

There have been discussions amongst some rail operators of the benefits of moving towards the creation of common Human Resource development practices, particularly where these practices are centred on legislative and regulatory requirements. Organisations could

implement common practices dependent on the outcomes they are trying to achieve, or where the organisation is positioned in its development of Human Resources.

In contrast to this, there is the issue of increasing competition amongst rail operators in Australia and New Zealand. For rail operators who are working in a competitive area, it is unlikely that they will want to move towards a centralised, or industry based, model for Human Resource Development.

Regional priorities

Development of rapid and high-speed railway traffic

Currently, Australia does not have a High Speed Rail (HSR) network. However, various studies have been commissioned to investigate the feasibility of introducing high speed rail.

On 31 October 2010, the Terms of Reference were released for a strategic study on the implementation of high speed rail (HSR) on the east coast of Australia. The study, managed by the Department of Infrastructure and Regional Development, was established to inform the Australian Government, the ACT and state governments' consideration of next steps for HSR in Australia. The study was undertaken in two phases.

The Phase 1 report was launched on 4 August 2011. The report identified corridors and station locations and potential patronage, as well as providing an indicative estimate of the cost to build an HSR network.

The Phase 2 study built on the work of Phase 1, but was considerably broader and deeper in objectives and scope, and refined many of the Phase 1 estimates, particularly the demand and cost estimates.

The report found that:

- The HSR network would comprise approximately 1 748 kilometres of dedicated route between Brisbane-Sydney-Canberra-Melbourne;
- The preferred alignment includes four capital city stations, four city-peripheral stations, and stations at the Gold Coast, Casino, Grafton, Coffs Harbour, Port Macquarie, Taree, Newcastle, the Central Coast, Southern Highlands, Wagga Wagga, Albury-Wodonga and Shepparton;
- Once fully operational (from 2065), HSR could carry approximately 84 million passengers each year, with express journey times of less than three hours between Melbourne-Sydney and Sydney-Brisbane;
- The optimal staging for the HSR program would involve building the Sydney-Melbourne line first, starting with the Sydney-Canberra sector. Subsequent stages would be Canberra-Melbourne, Newcastle-Sydney, Brisbane-Gold Coast and Gold Coast-Newcastle;
- The estimated cost of constructing the preferred HSR alignment in its entirety would be around $114 billion (in 2012 dollars);
- The HSR program and the majority of its individual stages are expected to produce only a small positive financial return on investment. Governments would be required to fund the majority of the upfront capital costs;
- If HSR passenger projections were met at the fare levels proposed, the HSR system, once operational, could generate sufficient fare revenue and other revenue to meet operating costs without on going public subsidy;
- HSR would substantially improve accessibility for the regional centres it served, and provide opportunity for—although not the automatic realisation of—regional development.

Despite having no High Speed Rail, Australia does have some fast passenger rail services. In Queensland, the Tilt-Train provides passenger services at speeds of up to 160km/h on the coastal route between Brisbane and Cairns. In Victoria, the recent Regional Fast Rail Project will remove major bottlenecks in Victoria›s rail network by providing dedicated tracks for key services, separating them from metropolitan services and enabling higher train speeds. The project will see a reduction in travelling times and the delivery of more frequent services.

Development of heavy traffic

Australia has substantial heavy haul rail operations, in particular servicing the mining industry (coal and iron ore). Operating at the limits of rail wheel interfaces, companies working out of the Pilbara region have achieved the highest axle loads in rail operations internationally, and continue to push the limits of technology in rail operations. With investment in heavy haul networks continuing to develop there is a clear future for heavy rail in Australia and investment in research to complement this is now being directed through the Australasian Centre for Rail Innovation (ACRI) with its Heavy Haul Agreed Work Program currently ramping up to deliver a range of innovations to support the industry.

Forecast of passenger and freight flows on rail transport

The pressure on rail is set to increase in the coming years, with growth in Australia's freight task projected at 80 per cent, between 2010 and 2030 and significant population growth will continue to increase demand for passenger transport. New Zealand is facing similar challenges; by 2031 rail freight volumes are predicted to increase to 23 million tonnes per annum, or an increase of 70% over the 2006/7 freight task.

Renewal of rolling stock

The Australian and New Zealand Rail Industry is in a period of Rolling stock renewal. New passenger, heavy haul and freight Rolling stock is either currently being implemented, undergoing in-service testing or in the process of being manufactured. A report by the Australasian Railway Association says that over the next 30 years, governments could spend approximately $30 billion on procuring rolling stock for passenger rail.

Key objectives to develop the railway equipment manufacturing industry

The Rail Industry Development Strategy was developed in 2009 to raise the competitiveness of Australian rail suppliers, promote industry capabilities and maximise opportunities. The industry needed to drive the development of a united force to confront opportunities and challenges presented by the next 30 years. "*On Track to 2040"* defined an industry vision, identified 18 priority opportunities among 80 promising applications of local capability and technology, and presents 22 strategic recommendations that will support the industry. In 2040, the Australian Rail Supply Sector will be innovative and cohesive, having developed a strong sense of industry. This united industry will be capable of embracing change, enabling it to respond to international trends and achieve profitable growth on a local and global scale. Opportunities identified through the On Track to 2040 process can be encouraged and supported by: 1) New technology development 2) Asset utilisation 3) Supply chain collaboration 4) Import replacement 5) International opportunities.

Creating a logistics services market

Driven by population growth, globalisation and demographic trends that demonstrate a shift away from historical population centres, transport and logistics in Australia continues to grow rapidly. Industry analysts predict Australia's freight task will double by 2030 and triple by 2050.

Historically, rail freight transport was operated by the state governments. However, following successful deregulation, privatisation and commercialisation of the industry, rail has developed into a competitive national industry. Rail freight's key strength is the efficient transportation of heavy or bulky products over long distances. This freight is typically made up of homogenous products such as coal, iron ore or grain.

Rail freight dominates the east-west corridor (Melbourne-Adelaide-Perth) but due to infrastructure constraints, it is generally considered uncompetitive against road freight on the north-south corridor (Melbourne-Sydney-Brisbane).

Australia's rail transport industry generates $7.3 billion in revenue and consists of 25 operators, primarily located in southern states and resource rich areas.

Bulky product items such as iron ore and coal primarily travel by rail to bulk export ports, and this is the key sector serviced by the rail industry. Intermodal freight accounts for approximately a fifth of all rail transport in Australia.

Rail is predicted to experience rapid growth in the coming years - more than any other mode - and is the obvious choice to overcome Australia's traffic congestion. Figures from the Australian Bureau of Infrastructure, Transport and Regional Economics estimated that our antiquated road, rail and sea infrastructure is costing the Australian economy more than $9 billion per annum. This comprises $3.5 billion of lost business time, $3.6 billion of lost private time and $2 billion in vehicle air pollution costs.

Industry analysts estimate that every 1% of increase in transport efficiency will save the Australian economy $1.5 billion a year. However, operators will need to navigate the challenges of poor infrastructure and rising wage and fuel costs to remain profitable.

Technical regulation policy: technical requirements to infrastructure and rolling stock

The Rail Industry Safety and Standards Board (RISSB) is responsible for the development and management of the rail industry standards, rules, codes of practice and guidelines, all of which have national application. Accreditation Board accredits the RISSB for Standards Development Organisations (ABSDO) as a Standards Development Organisation, and all new standards commenced by RISSB after 31 July 2007 are published as Australian Standards.

- *Infrastructure*
  - The Infrastructure functional area represents many aspects of rail corridor management. Rail Industry Safety and Standards Board (RISSB) is developing 35 Infrastructure Standards that will address the full life cycle management of Australia's rail infrastructure.
- *Rolling stock*
  - The main focus of the Rail Industry Safety and Standards Board (RISSB) Rolling stock functional area is the development of a suite of Rolling stock Standards for the Australian railway industry. There have been 34 subject areas, comprising of more than 130 individual Standards, identified for development with application to conventional Rolling stock on narrow, standard and broad gauges.

KAZAKHSTAN

Development of Railway Transport and Transport Policy in the Region

The Joint-Stock National Company 'Kazakhstan Temir Zholy' is a vertically integrated holding company authorised by the President and the Government of the country to create a transport and logistics operator of the international level. Kazakhstan Temir Zholy (KTZh), is a state-owned enterprise that was set up in 1997 and in 2002 became a joint-stock company. Since 2003, locomotive, passenger and freight operators, and independent rail car owners, have been building up their businesses in the country.

KTZ operates on a railway network stretching over 14 800 km but also manage a seaport, 11 airports in Kazakhstan, and a Special Economic Zone (Khorgos-Eastern Gates) and the 'Khorgos' International Centre for Boundary Cooperation. The Company carries about 43% of the country's total goods. KTZ offers logistics products using the capabilities and potential of different modes and links in the transportation chain. This results in the development of the rail network, as well as sea and air corridors at the same time.

Such a transport market situation, with a dominant position by KTZ, has to be placed on the background of very unusual geographic and economic features of Kazakhstan (vast space, low population density, rich mineral resources hauled over long distances, trade patterns inherited from the former Soviet Union, key location between Europe and Asia, etc.) which make the country's economy one of the most cargo-intensive in the world and explain a high dependency on the transport system.

Being at the interface between Europe and Asia, Kazakhstan possesses considerable transit potential providing the Asian states with geographically non-competitive land transport connection with Russia and Europe.

Infrastructure of the region

Reconstruction and building of new railway lines

After the breakup of the Soviet Union the communications between separate regions of Kazakhstan were difficult due to the necessity to cross the borders with neighbouring countries. In order to avoid such difficulties there were three railway lines constructed in Kazakhstan which ran throughout the territory of the republic:

- railway line Aksu-Konechnaya connected the North of Kazakhstan with the East of Kazakhstan, excluded the transit on Russian territory and reduced the distance on 600 km (2001);
- railway line Khromtau-Altynsarino was linked connecting northern and central regions of Kazakhstan with the west of the country by the shortest route (2003);
- railway line Shar-Novoustkamenogorsk was finished that excluded double intersection of state border with Russia (2008).

In 2012 the following new railway lines were completed:

- railway line Uzen-State border with Turkmenistan became a linking point of Kazakhstan and Turkmenistan, Iran and Persian gulf countries;
- railway line Zhetygen-Korgas allowed to reduce the distance of cargo traffic between Far East countries (Korea, PRC, Japan) and southern regions of Kazakshtan, countries of

Central Asia, Iran, Transcaucasus and further on 500 km, between Persian gulf and Far East – on 1300 km.

In 2014 the following lines were put into temporary operation:

- railway line Arkalyk-Shubarkol, oriented on further network of Kazakhstan rail road and provide a way out from Central Kazakhstan to the North and West with reduction of cargo traffic on 540 km in general, way out to Russia and west European countries;
- railway line Zhezkazgan- Beyneu, connect the industrial developed regions of Eastern, Central and Western Kazakhstan and will be the main step of formation of the shortest railway direction Central Kazakhstan-Aktau port.

In October 2014, the construction of new railway line Borzhakty-Yersay which connects Kuryk port with railway trunk started.

In addition the State program of development and integration of transport system infrastructure of the Republic of Kazakhstan until 2020 provides the construction of bypass railway line around Almaty point. The bypass is a major railway infrastructure in the service of the urban area and the conurbation of Almaty while helping to reduce the deadlines of exported goods delivery out of Kazakhstan and the attraction of transit cargo flows by the shortest route.

Fig. A - 1: Current state of the existing infrastructure in Kazakhstan

Kazakhstan	2000	2005	2010
Railway length (km)	13,545	14,204	14,184
Electrified lines (km)	3,725	4,136	4,056

The density of public railways in in Kazakhstan is 5.4 km (compared to 5 km in Russia). For comparison, the railway density in the US is 23.34 km, in China 9.48 km, and in some European countries (Belgium, Germany, the Czech Republic, Switzerland) over 100 km per 1 000 sq km. In 2010, the length of railway accessible for train service in Kazakhstan totalled 14 184 km, 29% of the network was electrified.

Key elements

One of the priority directions in KTZ is development and strengthening of transit capacity of the Republic of Kazakhstan by means of development of the international transport corridors. Kazakhstan is crossed by a number of transport corridors classified as Northern, Southern, Central and Western corridors of the Trans-Asian Railway line (TAR).

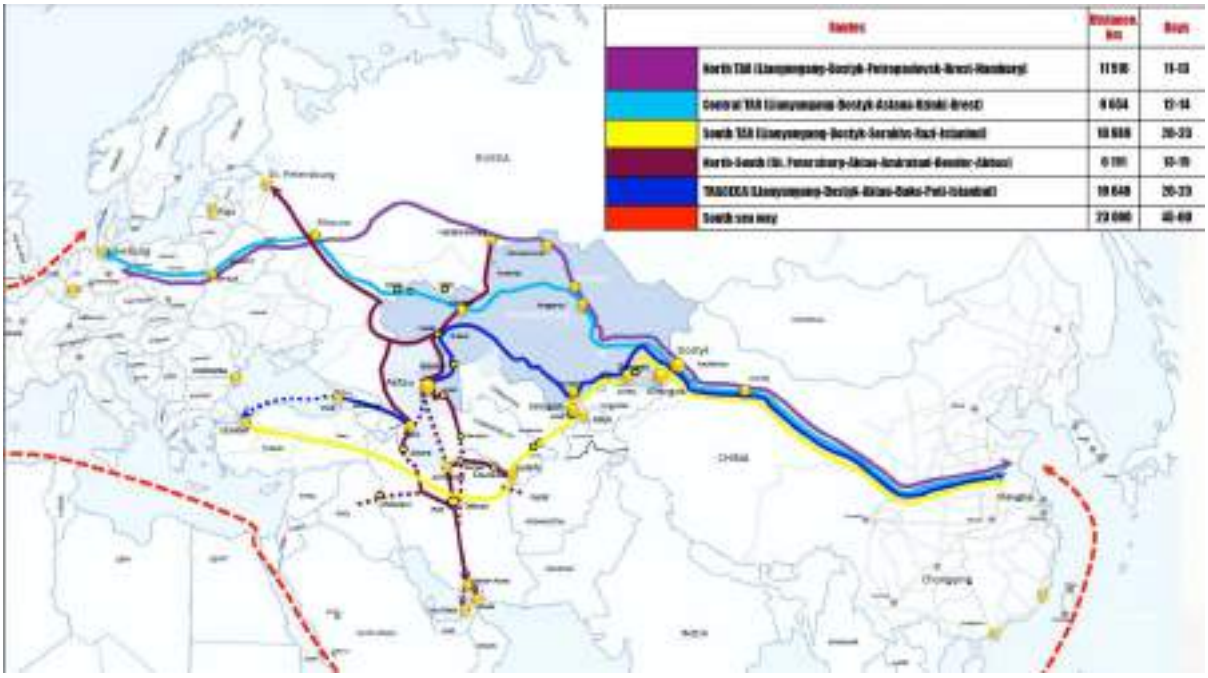
- **The NORTHERN corridor** passes across industrially developed regions of Kazakhstan along a route of Dostyk/Horgos – Aktogay – Sayak – Mointa – Astana – Petropavlovsk. In its borders are located the capital of the republic – the city of Astana and large industrial centers such as Karaganda, Balkhash, Kokshetau. Also territorial and industrial complexes of Zhezkazgan and Pavlodar-Ekibastuz gravitate to a corridor. Along the corridor there are alternative sites and switchyards, the largest of which are Karaganda and Kokchetav. Large container terminals are located at stations Dostyk, Karaganda, Akmola and Kokchetav.
- **The SOUTHERN corridor** passes across industrially developed regions of Southeast and Southern Kazakhstan along a route of Dostyk/Horgos – Aktogay – Almaty – Shue – Arys – Saryagash. Along the corridor there are alternative site and switchyards of Aktogay, Almaty, Shue, Meadow, Zhambyl, Shymkent, Arys. Large container terminals are located at stations Dostyk, Almaty, Zhambyl and Shymkent.

- **The WESTERN corridor** covers territories of the West Kazakhstan, Aktyubinsk, Atyrau and Mangistau areas – the main oil-extracting region of Kazakhstan along Dina Nurpeisova's route – Makat – Beyneu – Mangyshlak. Along the corridor there are the switchyards of Makat and Atyrau where terminals for processing of large-capacity containers are placed. Prospects of growth of transportations along a railway route of the Western corridor are directly connected with economic development of the region and transport opportunities of the sea trade port of Aktau.
- **The CENTRAL corridor** crosses Kazakhstan from the South on the northwest and passes through industrial hubs of Kyzylorda, Aktyubinsk, Ural, Karachaganak and Iletsk (territory of the Russian Federation) along a route Saryagash – Arys – Kandagach – Semiglaviy Mar. Along the corridor there are the switchyards of Arys, Kandagach, Iletsk – 1, Aktyubinsk. Container terminals are available at the stations of Aktyubinsk, Zhilayevo, Tyura-Tam, Kyzylorda.

The corridors of the Trans-Asian railway line passing across the territory of the Republic of Kazakhstan allow reducing considerably the distance of transportations in the message Asia – Europe.

Another corridor crossing the territory of the Republic of Kazakhstan is corridor "**the NORTH – the SOUTH",** with considerable potential in development of a cargo transportation the international transport. The new railway line of Uzen – Kyzylkaya – Bereket – Etrek – Gorgan provide an alternative to the existing more extended railway direction of Beyneu – Dashoguz – Turkmenabad – Sarakhs – Feriman becoming the main direction of east branch of International transport corridor "The North — the South". The missing branch Bereket – Etrek is planned to be in operation in December 2014. The new line allows reducing two-day travel time in comparison with the existing route. Coordinated policy on development of transport connections, including simplification of crossing of borders, promoting expansion of mutual trade along the corridor will allow to provide a strong transport links between the countries of Europe, CIS, the Persian Gulf and the Southern Asia.

Fig. A - 2: Integration of Kazakhstan into the international corridors



Source: Ministry of Investments and Development Republic of Kazakhstan

The TRACECA program (transport corridor of Europe-Caucasus-Asia) accepted at conference in Brussels in May, 1993 is conceived to create an alternative transport corridor connecting Western and Eastern Europe through the Caucasus and the Caspian Sea with Central Asia and China. The seaport of Aktau is the main link in Kazakhstan and the first link towards the countries of Asia.

KTZ is carrying out an active work to develop the international transport corridors trough the active cooperation with the international transport organisations, such as OSJD, EurAsEC, KSTP, UIC, UN ESCAP. OSJD in 1996 defined 13 main railway transport corridors, of which five involve the Republic of Kazakhstan (OSJD N° 1, 2, 5, 8, 10) A "Memorandums of cooperation in technical, operational and commercial development of railway corridors" provide the implementation of cooperation on monitoring cargo and passenger streams, the realisation of complex measures for improvement of transportations, the exchange of information about a condition of infrastructure of the corridors, the establishment of competitive conditions to implement passengers and freights transportations along the corridor.

Fig. A - 3: Main OSJD rail corridors between Europe and Asia

Source: OSJD

The railway administration of Kazakhstan is the leading performer on the Comprehensive plan of development of a corridor of OSZJD N° 2 (Moscow – Kazan – Sverdlovsk (Yekaterinburg) – Kurgan – Petropavlovsk – Astana – Dostyk – Alashankou – Urumqi – Zhengzhou – Xuzhou – Lianyungang. Branches: 2a. Dyoma – Kartala – Aksu – Astana, 2b. Zhengzhou – Hengyang – Jiulong, 2c. Xuzhou – Shanghai, 2d. Hengyang – Liuzhou – Nanning – Hanoi).

Region's priorities

Formation of Transport Logistic Centre network

KTZ has planned a large investment to form an extensive network of transport logistic centres (TLC), inside and outside of its borders. A TLC is a centre in a defined area within which all activities relating to transport, logistics and the distribution of goods - both for national and international transit, are carried out on a commercial basis. A TLC must be equipped with all facilities to carry out the mentioned operations. A TLC is served by several transport modes (road, rail, sea, air). The construction of the TLC network in Kazakhstan has just started.

The development of the TLC network provides the creation of regional hubs in the major cities of the country. Deployed market analysis showed that the TLCs to be developed in priority in Kazakhstan are those in Shymkent, Astana, Aktau, Kostanay, Pavlodar and Semey. In July 2014 the TLC construction in Astana and Shymkent was launched.

Building a terminal in Lianyungang port (China)

Development of external terminal network will promote the integration of Kazakhstan into a global transport-logistic network by means of strong presence in key points of formation and settlement of cargo flow, promotion of Kazakhstani export to the global markets and attraction of additional transit cargo flows. The first similar foreign project is a creation of terminal infrastructure in Lianyungang port (PRC) that is implemented together with Chinese partners within the framework of Agreement on cooperation and interaction between KTZ and Public Government of Lianyungang. The main goal of building this logistic terminal is a consolidation of cargo flows in/out of Eastern and South-East Asia (one of the most perspective directions of Kazakhstan trade development), significant improvement of work with customers and organisation of through traffic both to Central Asia countries, Russia and Europe, and backwards through the transkazakhstani routes, and provision of export potential of the country to the markets of South-East Asia countries.

Extension of Aktau sea port in northern direction

The extension of Aktau sea port, development of own dry cargo fleet and way out to the open sea through Iranian ports are strategic task of Kazakhstani government. Aktau port is a main segment of the multimodal hub being under formation. The development of Aktau sea port is oriented on solving the most important problems on extension of new perspective routes, decrease of the cost and traffic duration, and provision of system implementation of tasks in transport area. Currently there is a project being implemented on the extension of Aktau international sea port in the northern direction with building three dry bulk terminals having a capacity of 2.5 mln tons and capable to handle different freight including containers. With the purpose of effective development and management of Aktau port a professional manager of infrastructure facilities represented by the world port and terminal operator DP World was attracted to the project.

KTZ together with DP World have set a general line of transport interaction with Aktau seaport (“Western Gates of Kazakhstan”) and its connection to SEZ “Khorgos-Eastern Gates” project in the organisation of global supplies and integration of KTZ infrastructure service into the global trade and transport chain.

Also in order to increase the export potential in western direction through Caspian coast it is supposed to build a ferry complex in Kurlyk port which will be able to serve a number of ferry boats necessary to handle the cargo flow of railway cars and auto trailers.

Building of “dry” port on the territory of SEZ “Khorgos-Eastern gates”

The building of dry port and infrastructure of logistic zone SEZ “Khorgos-Eastern gates” started in July 2014. A number of multimodal and transport infrastructure and performance of the following functions will be provided in the Dry port:

- Implementation of warehousing and supporting transport activities (storage, sorting, secondary package for transit freight and for the goods of industrial zone);
- Work in the regime of multimodal traffic connected by railway and road services.

International center of border-cross cooperation "Khorgos"

One of the largest Kazakhstani-Chinese projects, oriented on simplifying trade with China, and mainly on the development of both countries' transit potential which encourages practical realisation of the project of transcontinental corridor Western Europe-Western China, is a creation of International centre of cross-border cooperation "Khorgos". On March 31, 2014 the first cargo flow was launched in a test run mode. The estimated cargo flow will make 1 mln tons per year by 2018.

Establishment of Consolidated transport-logistic company (CTLC)

A key project for KTZ is a project of creation of Consolidated transport-logistic company (CTLC) on the base of railway administrations which will be an operator of container traffic and terminal handling on the territory of Common Economic Space. JSC "CTLC" was registered on November 13, 2014 in appropriate state bodies of Russian Federation. The CTLC activity is intended to provide the development of transport-logistic infrastructure of member-countries, according to common principles of price policy, mutual use of rolling stock park, introduction of common technology and standards of transport-logistic services on the territory of Eurasian economic space. This will allow to create a transport platform for the development of integration processes in other economics fields of Common economic space countries, implementation of large projects and first of all discovery of the Customs Union's transit potential by China-Europe route.

Organisation of container trains

The Government of the Republic of Kazakhstan is implementing a project "Kazakhstan-New Silk Way" which supposes maximum use of transit potential of Kazakhstan and which is considered as a priority and important step of country formation as a transport-logistic hub of the region. At present time KTZ has arranged regular container trains in the direction China-Europe with the use of rent container flatcars through interstate border-cross point Dostyk-Alashankou by the routes: Chongqing (China) – Dostyk – Duysburg (Germany), Chengdu (China) – Dostyk – Lodz (Poland), Wuhan (China) – Dostyk – Pardubice (Czech Republic), Zhengzhou (China) – Dostyk – Hamburg (Germany), Wuhan (China) – Dostyk – Lodz (Poland), Wuhan (China) – Dostyk – Hamburg (Germany).

Human Resources Policy

The aim of KTZ human resource (HR) policy is a creation of high-performance and team-oriented staff of qualified workers.

The principles of HR Policy:

- Attitude to the staff as to the long-term investments, main corporate-wide resource;
- Respect of the workers (employees) rights for the safe labor conditions and worth salary provisions and social payments;
- Selection and placement of staff according to their professional and personal qualities;
- Continuity of knowledge, experience and traditions, emphasis on development and education of the employees;
- Continuity of solutions taken within the implementation of HR Policy;
- Social responsibility and social partnership;
- Social justice and transparency while distribution of social benefits and guarantees.

The system of corporate education cover the whole range of training, re-training, qualification upgrade and academic education of the employees both at the external education providers and at the educational organisations of railway transport.

Training of the operating personnel

In order to improve the technical expertise and skills of Company workers in accordance with plan of production program on the base of training centers, there is a professional training arranged for the workers by professionals of the railway field. The training should be passed by the operating staff of KTZ branches and subsidiaries. The training should be related to the work of rolling stock and railway objects, to the maintenance of boiler inspection and elevating construction objects, and to the track repair.

Provision of education grants to the employees studying within master's and PhD programs

With the purpose of professional and intellectual development KTZ workers are given education grants under Master's and PhD programs annually. In order to attract young and perspective specialist to the Company the students of educational organisations are awarded education grant within "Track line" (Magistral) program.

Upgrade qualifications of the employees

Within upgrade qualification of the staff a number of training events are held in order to make KTZ specialists satisfy the requirements of national legislation (compulsory education), Sole shareholder; study of innovations in Kazakhstani legislation, experience of foreign countries in railway area; general increase of professional qualification upgrade. According to the results of efficiency estimation of employees' education average outcome is 86.9%, i.e. the education objective is gained to the full extent.

Training of young specialists

Supporting the course of modernisation of national educational system KTZ is carrying out the work on training middle ranking specialists by dual educational system of colleges' students. In this regard in 2012 KTZ, Ministry of education and science signed Multilateral agreement on cooperation within the framework of dual educational system maintenance.

Within the framework of dual education a practical part of colleges' students is being held on the basis of KTZ Center of transport technologies on a contract basis. According to the practical course results the students get a certificate of completion for further employment at KTZ undertakings.

In order to provide the field with qualified specialists KTZ acquired major share of stock of JSC "Kazakh academy of transport and communication named after M.Tynyshpayev" (hereafter referred to as KazATK).

Being a shareholder of KazATK, the largest specialized higher educational institute of railway filed, KTZ is taking an active part in its activity:

- approval and updating working academic programs,
- attracting the KTZ top-management to the reading of thematic lectures for KazATK students,
- organisation of all kinds of training courses for students,
- approval of topics of students' diploma works,
- modernisation of material and technical bases and academic-laboratory facilities.

Within the framework of KazATK infrastructure modernisation the Company is carrying out the reinforcement of material and technical basis of Academy. In order to provide KazATK with academic-laboratory facilities there is a work being held on supplying models and academic implements by foreign partners: Alstom, Siemens AG, Bombardier, General Electric etc.

REPUBLIC OF KOREA

Infrastructure of the region

The Korean government has developed a national rail network following the first phase of the Rail Network Establishment Plan extending from 2006 to 2015. The plan's objective is to build a national transportation network with a focus on rail lines, expanded by the construction of high-speed lines and the extension of existing conventional lines. Currently, the total length of the Korean railway lines reaches 3 588km. This length includes the high-speed lines, conventional lines and inter-city lines. Many major cities are also operating an urban metro system.

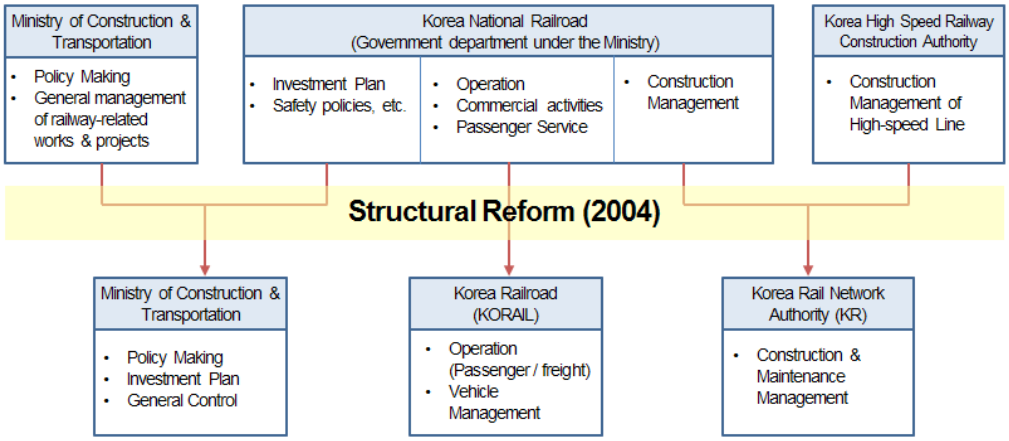
The second phase of the rail network plan was launched in 2011 and will extend to 2020. An objective of the second phase is to connect the whole country in such a way that it would take a passenger only 90 minutes to traverse the nation. The term given to this objective of the plan is a One-Day Life Zone. Strategies of this phase of the plan include connecting major cities by the KTX network, constructing a rapid inter-city rail network between metropolitan cities, establishing an eco-friendly freight & logistics network and fostering a user-friendly railway environment.

Major contents of the plan include the construction of two additional high-speed lines – besides the already-finished Gyeongbu high speed line, the very first high speed rail line in Korea. The first phase of the Honam high speed line, which connects major cities in the southwestern part of Korea, is planned to be opened in April, 2015. Construction of Phase 2of the Honam line will be completed by 2017 – the same year the Seoul Metropolitan Area high speed line will begin operations.

Furthermore, there are a number of railway infrastructure projects that are both on-going or are in the planning stages to improve existing lines and related facilities. By speeding up, double-tracking and electrification of existing conventional lines, passenger convenience and safety will be greatly stimulated. The percentage of electrified lines in operation reaches 60.3%, while the percentage of double-track lines in operation reaches 49.5%. The Korean government is planning to increase both by 85% and 79% respectively by the year 2020. Furthermore, through constant upgrading of railway-related facilities, improvement rates will be raised by 80%, with the main focus on obtaining speed competitiveness and environmentally-friendly sustainability.

To promote a user-friendly environment regarding the railway infrastructure, Korea is now actively trying to develop complex stations, which will provide passengers with convenient transferring capabilities and pathways to other transport systems, as well as diverse commercial facilities, such as shopping centres, accommodations or cultural centres. Those complex stations will be a new centre of each region. In addition to this, assisting the physically impaired with facilities like elevators are supplemented in many stations to promote passenger convenience. High-end safety or counter-disaster facilities are also being installed to prevent railway-related accidents.

Fig. A - 4: Structural Reform of the Railway Industry in Korea



A huge structural reform of the Korean railway industry took place in 2004, which has formed the present picture of role allocation among railway-related authorities. The key purpose of this reform was to separate the construction from the operations of railway management. This separation formed two, distinct organisations: Korea Rail Network Authority (KRNA or, simply KR) and Korea Railroad (KORAIL).

Prior to 2004, the Korea National Railroad, as a government department under the Ministry of Construction & Transportation, was mainly responsible for the overall processes of railway management under the guidance of the Ministry. The economic crisis in the late 1990s and the subsequent IMF intervention triggered the need for a smaller government influence in domestic matters, leading to a debate on privatizing the government's authority in the railway industry. Despite this, the Korean government insisted on maintaining the railway industry, in order to keep secure the public's interests in a key part of the nation's infrastructure. As a compromise, the parties involved agreed to the separation of construction and operations of the department.

The Ministry of Construction & Transport (the current Ministry of Land, Transport & Infrastructure) established the overall strategy for the Korean railway industry development; it controls investment plans and owns the infrastructure. KR, as a quasi-government authority, orders and manages railway construction projects. KORAIL, as a government-owned company, conducts commercial activities, including operation of passenger/freight railways, passenger services in stations and on trains, development of travel packages, and vehicle management.

After the separation, the Korean government started to review action plans for the second phase of the reformation, which would introduce competitive systems in the area of operations. The objective was to improve management efficiency of the sole operator, KORAIL, through market competition among various operators. Still, maintaining the public's acceptance of a national traffic system after the separation was a major issue.

As a result of a number of debates and studies, it was decided that the direction of the competitive system was to be modeled after the German system, in which subsections of operations are divided between the government-controlled holding company and its subsidiaries. While the main lines will be operated completely by the public operators, competition with private operators will also be partially introduced to some branch lines. In this regard, in 2014, KORAIL established its subsidiary to operate a high-speed line (the KTX line) starting from Suseo station, which is currently under construction. Detailed action plans for the establishment of other subsidiaries, and partial competition with private sectors, will begin after further reviews.

Rail transport policy

The issues occurred on railway transport are:

- Lack of railway investment causes many missing-links upon railway network. For instance, last 5 years, Korea government assigned budget to highway (46.9%), railway (23.8%), urban railway (8.0%) respectively;
- Railway network should be complete for connecting east and west regions;
- Lack of speed competitiveness at regional railway except for high-speed against highway system. Regular railway speeds (km/h) are relatively low as Kyungbu (85), Jeola (77), Joongang (64), Janghang (66) compared to highway (km/h) as Kyungbu (92), Joongbu (93), West-sea (97);
- Railway systems required high operational cost deter from extra railway investment hence new railway systems with less cost for construction and operation are needed;
- Another issue of urban railway policy is to accessibility because the railway stations located at outside of CBD causes lack of accessibility and were not attractive to passengers. Therefore railway passenger volume was not increased respect to expected demand.

The policies for the future railway systems are: 1) the slogan, “one-nation, one-city”, requires connecting national key regions based on 2020 National railway plan of high-speed railway, X-shape (shortest path for major key regions), and □-shape (connecting coastal region), 2) For enhancing railway ridership, 30minutes commuting transport by investment of urban high-speed railway as well as improvement of accessibility and transfer convenience, 3) Low-carbon and green growth transit and freight transport system needs further development of railway oriented transport network system, 4) Developing new vehicles and operation systems for elderly and disabled people will be crucial for upcoming urban society.

Regional priorities

Forecast of freight and passenger flows on rail transport

The future freight demand is classified by container and non-container mode. As seen on Table, rail freight demand will be approximately 20milion-ton and 36milion-ton for container and non-container respectively in 2040. The average ratio of freight demand on rail transport increase 1.95% for container and 0.85 % for non-container. The total size of rail freight will be reached by 56milion-ton in 2040.

Prediction of freight flow on rail transport (thousand ton/year)

Year	2015	2020	2025	2030	2035	2040
Container	13 571	15 860	17 647	18 253	20 069	20 266
Non-con.	29 244	30 953	32 742	33 946	34 987	36 210
Total	42 815	46 814	50 389	53 199	55 056	56 476

Reference: Korea Transport Database, 2012

The passenger demand on rail transport in 2015 is 11 712 (thousand trips/day) for both regular railway (including urban railway modes) and high-speed railway. The mode share of rail transport is approximately 13.5% in 2015, which will be slightly increased as 13.8%. The passenger trips will be increased by 2025, then decrease steadily by 2040 due to gradual decline of population.

Prediction of freight and passenger flow on rail transport (trips/day, thousand)

Year	2015	2020	2025	2030	2035	2040
Rail & urban	11 540	11 775	11 889	11 818	11 602	11 342
High-speed	172	182	185	184	182	177
Total	11 712	11 957	12 074	12 002	11 784	11 311

Reference: Korea Transport Database, 2012

MONGOLIA

Strategy principles

- Update policy for basic reserves, property and assets, as well as the activities of the organisation, to implement corporate power;
- Updating the plan, the policy of increasing revenue, profit, business, pick up investment to widen the field of activity of the organisation;
- To support the independent activity of the branches and units, to establish subsidiaries and to compose them possible, the conditions to develop themselves;
- Introduce to market services, energy products, technology, communication, information, mechanical maintenance, car production, iron products, furniture production, wooden structure, manufacture of concrete, building maintenance assembly, vehicles and to use their advantages;
- Introduced science and technology research and research of new methods and tools, to hire scientists and specialists working in this sphere, include to the market turnover their knowledge and intellectual creature, to develop the innovation system of the organisation;
- To activate the foreign policy and cooperation, to join in social and political groups, to ensure the market active participation, to carry any sale by auction principle, the purchases by open bidding method, and to use financial effective means;
- To participate in market competition of travel, food production and service, processing of raw materials, leathery, cashmere, vegetables, farming, intensive cattle-breeding, landscape, horticulture, environment remediation, health, education, culture, media, insurance, finance, banking and anew open country features service, production according to Mongolian economy and market environment;
- To compose legal framework for possible to fully implement company governance, to go on stock market, bond and to conduct business activities.

Infrastructure of the region

Extend and increase capacity of Arrival and departure track of the stations and create remote control stations

- Extended departure and arrival track of the Zamiin-Uud 1, Sainshand, Ulaanbaatar 1, 2 stations, and increased their capacity 20-30 per cent;
- In 2013 between the stations of Sainshand-Agisumbet created new crossing point with remote control and microprocessor electric centralisation according to the European standardisation;

- In 2014 we are creating 3 new crossing points with remote control and microprocessor electric centralisation;
- To increase capacity of border stations we are started to build in Zamiin Uud station the United Control centre for electrical centralisation;
- Planning to resolve curves and slopes of the track, which are decreasing speed of the trains.

Upgrade of current railway lines and railway facilities and new projected railway lines and facilities

- To improve technical condition of the current line Ulaanbaatar railway each year carry out major repair of the mainline in not less than 50 km;
- Gradually upgrading lines, bridges and structures;
- From station Zamiin Uud to Chinese border built second mainline with a length of 3.5 km;
- Built 3.5 km second line between Ulaanbaatar 2–Tolgoit stations to increase passenger transport capacity of Ulaanbaatar city;
- Planned to build Logistic centre and terminal of combined transport in Zamiin Uud station to increase competitiveness and efficient of the Zamiin Uud port.

Cooperation agreement between Ministry of Transport of Mongolia and "RZD" JSC of Russia to develop Ulaanbaatar Railway JSC

- Planning to electrify 1110 km of mainline in direction Sukhbaatar–Ulaanbaatar–Zamiin Uud;
- Planning to build second mainline in parallel with the current line;
- Implement BogdKhan Railway project and build 170 km of railway line through to new airport.

Development of international transport corridors

In December of 2013 Ministry of Road and Transportation, Government of Mongolia organized First Conference named "North Corridor" which participated Railway companies, authorities, Ministries of Mongolia, Russia and China. The main goal of the conference is develop and increase transport of the railway through to the 3 countries.

In September of 2014 Ministry of Road and Transport of Mongolia and Russian Railways JSC signed Strategy cooperation agreement to develop and upgrade Ulaanbaatar Railway. According to this agreement parties agreed to build second mainline of Ulaanbaatar railway, electrify mainline, increase transport capacity to transport in an one year 100 mln of freight, increase transit transport in 2015 into 6 mln tones, and in 2020 increase transit transport to 20 mln tones, extend Salkhit-Erdenet line to west side of the country to border of Russian Federation and open new railway exit to Russia to transport Russian mining products to China through territory of Mongolia and operate port Radjin of the North Korea.

Ulaanbaatar Railway is also the member of Organization for co-operation between railways and included the 1st corridor of OSJD where Ulaanbaatar Railway carries container and transit transportation.

Ulaanbaatar Railway's mainline in the north side connecting with Trans-Siberian railway and in a south side connecting with Chinese Railway. To transport freights from Europe to East Asia the Ulaanbaatar Railway is the shortest route and shorter than 1135 km Zabaikalskii-Manchurian route and 1600 km shorter than Middle Asian-Silk road route.

Trans-Siberian railway network

Ulaanbaatar Railway currently operates 25% of the total transport capacity of Sukhbaatar-Naushki Mongolian-Russian border stations.

Trans-Asian Railway

In 2001 Trans Asian Railway divided into 4 corridors and Mongolia included into North corridor of TAR. The mainline from Skhbaatar to Zamiin Uud includes into north corridor and requires to develop transit transportation in this corridor.

Development of Rail Transport and Transport Policy in the Region

In order to create a logistic service market, in 14th of May 2008 Government of Mongolia approved the national program "Transit Mongolia". The main goal of the program is to use advantage of the geographical location to support and develop transit transport and logistics. According to this program Government of Mongolia supports the creation of Zamiin Uud's combined transport terminal and Logistic center. According to the calculation developed by 'Tera international' company which developed feasibility study, in 2018 the total freight turnover will increase 80% and accumulation of the freight will decrease 50% in Zamiin Uud port. This logistic center will produce over 6 mln tones of freight for year.

Key Elements

Key Objectives to ensure security at rail transport facilities

To ensure security at rail transport facilities Ulaanbaatar railway planning to implement internal control which based on risk of security then implement the quality management and ensure International standardisation ISO-9000.

Key areas of rail transport research

The research work which developed and developing in railway fields:

- Technical development program of Ulaanbaatar Railway until 2020;
- Research on Implementation of European standardisation in Railway;
- Cost estimates of key activities of Ulaanbaatar Railway JSC;
- Diagnosis depreciation of wagon wheel pairs;
- Improve the capacity of transport and logistic.

Key areas of international cooperation and enhancing the competitiveness of rail transport

- Implement projects and programs to improve infrastructure and transporting capacity of Ulaanbaatar Railway and share experience with other countries;
- Cooperate with organization for co-operation between railways;
- Cooperate with International union of railways.

Key areas of human Resource development in rail transport

15161 workers are currently employed in Ulaanbaatar Railway, and 60% of theme works in railway operation fields. 213 workers are in management position, 1379 are specialists or officers, 1497 engineers and technical, 824 clerical workers and 11248 professional workers.

Future Strategy for the human resource development is:

- Implement HR policy and planning,
- Contest for the selection of HR,
- Determine the requirements of HR and training,
- Discipline and labour relations,
- Evaluate the performance of workers.

Regional priorities

Development of heavy traffic

Export and domestic transport of mining products increased rapidly in last years. For this reason It requires to develop heavy haul transport in Mongolia. Today the technical capacity of infrastructure and rolling stocks not satisfies the general requirements of heavy haul. According to the State Policy on Railway fields, approved by Great Khural of Mongolian Parliament from 24th of June 2010, in order to transport heavy haul train Ulaanbaatar Railway requires to increase pressure on one axle and upgrade locomotives with high capacity.

Renewal of rolling stock

- Locomotives
  - > Ulaanbaatar Railway has 161 locomotives. From 2010 Ulaanbaatar Railway purchased 31 mainline locomotives of 2TE116UM, 4 locomotives of 2TE116UD, 11 shunting locomotives of TEM18DM. From 2003 Ulaanbaatar Railway started
- Freight wagon/cars
  - > Ulaanbaatar Railway has 2792 freight cars. Last few years UBTZ did not upgraded freight cars, but in 2007 and in 2010 purchased from Russian Federation 350 and 200 used freight cars.
- Passenger coaches
  - > In 2014 it has been purchased 15 brand new passenger coaches from Russian Federation and currently total number of passenger coaches is 301. 51 per cent of these coaches is over 28 years. In the future, it requires to upgrade new coaches which is satisfying modern requirements.

Develop the railway equipment manufacturing industry

Ulaanbaatar Railway sent wheel pairs to Russian Federation for repair. To repair wheel pairs in Mongolia, it is being developed a project of build a repair factory. This project requires investment for 21.9 billion tugriks in 2014-2015. According to estimates of the project, the breakeven point is set at 5.4 years.

Forecast of freight and passenger flows on rail transport

Ulaanbaatar Railway develops Technical modernisation development program until 2020 and consulting company developed forecast for freight and passenger stream of Ulaanbaatar Railway.

- Freight transportation forecast for 2020 with 3 options

Types of transportation	2020		
	1st option	2nd option	3rd option
Total	31.3	44.9	73.7
Domestic transport	13.7	13.7	21.4
International transport	17.6	31.2	52.3
export	11.8	23.8	39.1
import	2.7	3.2	3.2
transit	3.1	4.2	10.0

- Passenger transportation forecast for 2020 with 3 options

	Areas	2020		
		1st option	2nd option	3rd option
1	**Sukhbaatar - Yuruu**	4	4	4
2	**Yuruu - Darkhan**	4	4	4
3	**Darkhan - Salhit**	7	7	7
4	**Salkhit - Zuunkharaa**	6	6	6
5	**Zuunkharaa - Mandal**	6	6	6
6	**Mandal - Tolgoit**	6	6	6
7	**Tolgoit - Ulaanbaatar**	18	18	18
8	**Ulaanbaatar - Amgalan**	12	12	12
9	**Amgalan - Khonkhor**	6	6	6
10	**Khonkhor - Bagakhangai**	6	6	6
11	**Bagakhangai - Choir**	6	6	6
12	**Choir - Airag**	6	6	6
13	**Airag - Sainshand**	6	6	6
14	**Sainshand – Zamiin Uud**	4	4	4
15	**Darkhan – Shariin Gol**	2	2	2
16	**Salkhit - Erdenet**	2	2	2
17	**Baganuur - Bagakhangai**	1	1	1
18	**Bor Undur - Airag**	1	1	1
19	**Zuunbayan - Sainshand**	2	2	2
20	**Dalanzadgad - Zuunbayan**	-	1	1
21	**Murun - Erdenet**	-	1	1
22	**Kiziil- Murun**	-	-	0
23	**Ereentsav - Bayantumen**	0	0	0

RUSSIAN FEDERATION

Development of Railway Transport and Transport Policy in the Region

The Russian railway market was reformed by *a comprehensive Railway Structural Reform* Programme developed in cooperation with the government and published in 2001 (Decree No. 384). The Reform Programme sets out strategic priorities for the rail industry up to 2010 and beyond with the aim of improving the efficiency and profitability of rail services in Russia, encouraging competition and private investment. Infrastructure is not affected by reform activities and remains in government ownership under the control of Russian Railways. Actually Russian Railway (RZD)[37] is a State-owned joint-stock company that operates under monopoly conditions within the railway freight sector in addition to managing the entire Russian railway network. The passenger transport of medium and long distance is operated by Federal Passenger Company FPC JSC[38], joint-stock company whose share capital is entirely held by RR, while 26 suburban companies established with the involvement of the region operate regional transport. Currently the reform program is delayed by some technical constraints, in particular the capacity constraints of a congested rail network, which require no further liberalisation in the rail market. Investments in the improvement of the railway network are assigned to "network contract" between the state and RR. The tariff system does not respond to market logic but to the overall objectives of general economic policy. In the last decade the fees charged in the freight sector have not followed the general trend of prices in the Russian Federation with the aim of supporting some key industrial sectors.

Phase I Preparation (2001-2002 and completed with a one-year delay in 2003):

- Ministry of Railways is renamed the Federal Railway Transport Agency (FTRA);
- FTRA retains regulatory powers over railway transport, including the implementation of industry reform, the preparation of normative and legal acts and the licensing of federal railway activities;
- The Open Joint-Stock Company Russian Railways (JSC RR) is created as the corporate successor to the Ministry of Railways in September 2003 by Decree No. 585;
- Russian Railways assumes all assets and operations of the former Ministry of Railways.

Phase II Asset unbundling along functional lines (2003-2005):

- Formation of multiple subsidiaries for:
  - passenger services;
  - non-core businesses;
  - selected freight services such as intermodal and refrigerator transportation;
- Phasing out cross-subsidies from profitable freight operations to passenger services;
- Russian Railways retains its monopoly on infrastructure, locomotives and most freight business and continues to be the main owner and provider of locomotives and rail cars in Russia.

Phase III Increased Competition (2006-2011 and beyond):

- Increased competition from private rail operators through partial privatisation of Russian Railways and/or some of its enterprises;

37. http://eng.rzd.ru/
38. JSC Federal Passenger Company was founded in 2009 and is based in Moscow, Russian Federation. It also has various branch offices in the Russian Federation. The company operates as subsidiary of Open Joint Stock Company Russian Railways. http://moscow-paris.ru/fpk_en.html

- Initial Public Offerings (IPOs) and/or privatisation of local passenger, repair & construction, and research & development subsidiaries;
- Sell operating licenses for selected passenger services to independent operators.

Country infrastructure

The Transport Strategy of the Russian Federation until 2030 (version approved by Order No. 1032-r of the Government of the Russian Federation dated 11 June 2014) envisages measures to develop railway infrastructure in two phases with the first phase lasting until 2020 and the second phase running from 2021 to 2030.

The plans for the first phase provide:

- expanding the operating domain of heavy trains by 13 200 km;
- organising closed loop routes in connection with the widespread use of special rolling stock;
- developing alternative shipment routes;
- closing low-density lines and stations or identifying sources for their funding;
- organising the operation of double-decker coach cars on the routes;
- building new railway lines to create the infrastructure conditions needed for the integrated development of new areas and deposits.

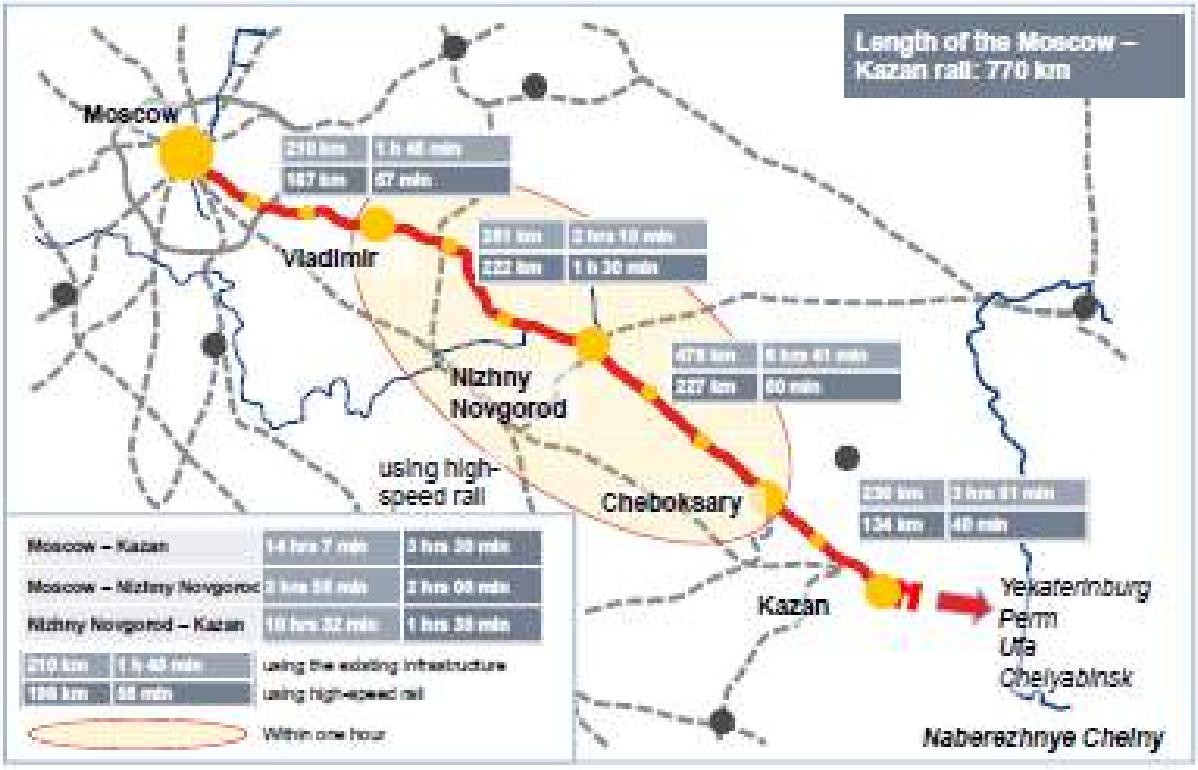
Fig. A - 5: Russian Railways infrastructure development according to the Strategy for Developing Rail Transport in the Russian Federation up to 2030

Source: Russian Railways Website

The elimination of gaps and bottlenecks in the transport network requires the total construction of 5 190 km of additional main lines, automatic block signalling equipment on 1 740 km, the electrification of 1 350 km of lines as well as the gradual modernisation of the infrastructure of the main congested passenger routes of the Russian railway network in order to organise the regular transport of passenger trains with length of 22–24 cars.

Construction is to start on the Moscow–Nizhny Novgorod–Kazan section (803 km) of the 1 563-km Moscow–Nizhny Novgorod–Kazan–Yekaterinburg High-Speed Line (HSL-2) in order to increase the capacity and speed parameters of transport infrastructure.

Fig. A - 6: Moscow – Kazan High-Speed Rail Work Map



Source: Russian Railways (Engineering Surveys and Designing of The Moscow — Kazan Section of The Moscow — Kazan – Yekaterinburg High Speed Rail Line - Information Memorandum)

The following measures are envisaged to develop the transport systems of major urban communities:

- implementing the master concept for the development of the Moscow railway hub;
- the design of a master concept for the development of the railway hubs of such major cities of the Russian Federation as St Petersburg, Yekaterinburg and others;
- the use of existing surface railways and expanding their functions as one of the most efficient types of transport in the “city-suburb” zone. The launch of passenger transport on the Moscow Circular Railway.

Plans for the second phase provide:

- extending building new railway lines;
- building railway dry ports (Baltiysky, Tamansky, Primorsky);

- building the complete bypass of the Moscow hub;
- developing railway lines on approaches to the St Petersburg hub, the North Caucasus, ports of the Primorye Region, the Far East, and the Moscow railway hub as well as departing tracks from West Siberia and the Urals;
- building additional mainlines to expand the land coverage of the railway network;
- extending electrification of 7 820 km of lines;
- building routes for long trains (2 630 km of additional mainlines);
- the construction of the new Moscow–St Petersburg High-Speed Line (HSL-1) (659 km);
- the completion of construction of the 1 563-km Moscow–Nizhny Novgorod–Kazan–Yekaterinburg High-Speed Line (HSL-2) on the Kazan–Yekaterinburg section (760 km) and branches to Perm and Ufa;
- building the Kazan–Samara high-speed line (560 km) which branches from the Moscow–Nizhny Novgorod–Kazan–Yekaterinburg HSL-2;
- building the new Moscow–Rostov–Adler high-speed line (1 470.6 km);
- conducting a range of measures to increase the route speed of container trains on average throughout the network to 800 km/day, including to 1 700 km/day as part of the "Trans-Siberian in 7 Days" project.

In addition, the Transport Strategy envisages the implementation of a number of major investment projects as:

- the integrated development of transport hubs in Murmansk, Novorossiysk, Vostochny–Nakhodka (Primorye Region), and Yekaterinburg;
- the construction of the dry cargo area of the Taman sea port;
- the construction of the Sviyazhsk interregional multimodal logistics centre (Republic of Tatarstan);
- the construction of transport infrastructure to establish the integrated transport and logistics system of Moscow and Moscow Region, including the establishment of the Dmitrovsk interregional multimodal logistics centre;
- the development of the Rostov Universal Port multimodal transport and logistics hub;
- the Moscow–Nizhny Novgorod–Kazan–Yekaterinburg High-Speed Line (HSL), the Moscow–St Petersburg HSL-1, the Kazan–Samara HSL, and the Moscow–Rostov–Adler HSL;
- ensuring approaches to the ports Primorsk, Vyborg, Vysotsk, Ust-Luga and Murmansk and increasing the capacity of the routes: Konosha–Labytnangi, Dmitrov–Sonkovo–Mga, Novorossiysk, Temryuk, Taman and Olya, including bypasses of the Krasnodar and Saratov railway hubs, Nakhodka, Vladivostok, Sovetskaya Gavan, Vanino and the development of the Baikal–Amur Mainline and the Trans-Siberian Railway;
- the construction of the Northern Latitudinal Railway;
- the development of the railway networks of the Urals, West Siberia and the Central region;
- rapid transport on the routes: Moscow–Kursk, Moscow–Yaroslavl, Moscow–Krasnoye (with a further extension to Minsk and Berlin), Moscow–Suzemka, Omsk–Novosibirsk, Samara–Saransk, Samara–Saratov, Samara–Penza, Saratov–Volgograd, Yekaterinburg–Chelyabinsk, Novosibirsk–Barnaul, Novosibirsk–Novokuznetsk, Novosibirsk–Kemerovo and Khabarovsk–Vladivostok.

Key Elements

Safety

Main objectives to ensure safety at railway transport facilities concerns:

- improving the main provisions of the government policy and regulatory framework for ensuring safety at railway transport infrastructure facilities and their implementation;
- developing a range of measures to implement the provisions of the government policy and priority areas for ensuring the safety of the Russian transport system in railway transport;
- developing methodology and practical methods to address the objectives to ensure safety at railway transport facilities;
- identifying the safety threats at railway transport facilities;
- categorising and assessing the vulnerability of railway transport facilities;
- developing a system of safety requirements for railway transport infrastructure facilities taking into account the category and vulnerability of facilities;
- developing a system of obligations for business entities for mobilisation preparation on railway transport as well as military and special railway shipments (including financing mechanisms);
- developing and implementing a system of measures to improve the comprehensive protection of infrastructure facilities and creating a list of objective criteria to merge railway transport facilities into a group in order to reduce costs on ensuring their safety through type design and standardisation;
- developing and adapting the latest safety technologies, software and hardware, including passive and active means of protection for critical and hazardous railway transport infrastructure facilities;
- establishing an automated system to monitor the safety condition and management of critical and hazardous infrastructure facilities;
- improving the material, technical, information, communication, scientific, engineering and personnel support for safety;
- training specialists in ensuring transport safety;
- conducting automated control and supervision in transport safety;
- establishing, modernising and maintaining databases to assess the vulnerability of the categorised facilities;
- developing and implementing plans to ensure the transport safety of the categorised facilities;
- certifying the categorised facilities;
- monitoring the condition of transport safety on railway transport, including establishing and operating a transport safety control centre;
- operating, technical support and modernising of the unified public information system for ensuring transport safety on railway transport;
- equipping (modernising) railway transport facilities with protective equipment.

Scientific Research

The main areas of scientific research on railway transport are:

- developing a set of technical regulations containing requirements on safety and environmental protection for technical regulation facilities on railway transport;
- developing a regulatory and methodological framework for calculating the parameters of operational availability, durability, safety and service life with regards to rolling stock and railway transport infrastructure;
- developing new technical requirements for commercially supplied products and a regulatory framework for interaction with suppliers based on quality management principles.

The following measures are envisaged to ensure the development of railway transport infrastructure:

- developing a mathematical model for the development of railway transport infrastructure;
- establishing a regulatory framework for the content and operation of railway transport infrastructure;
- developing integrated solutions for the reconstruction of railway transport infrastructure for the passage of trains with axle loads up to 30 tonne-forces on the operating domains of heavy trains;
- using low-maintenance designs for railway transport infrastructure, railway automation and communications equipment and the power supply system;
- reducing unit costs on the maintenance of railway transport infrastructure by 25–30 per cent;
- increasing the operating time of railway transport infrastructure by 30–40 per cent.

The targeted parameters of the train traffic control and safety system envisage:

- traffic control on the basis of satellite technology and the automated identification of rolling stock;
- establishing automated control centres and expanding the functions of centralised traffic control (rapid and high-speed lines);
- introducing computer control systems at stations in conjunction with a digital radio channel;
- introducing train traffic interval regulation systems without traffic signals using satellite navigation and a digital radio channel;
- introducing integrated computer systems at marshalling stations, including automated locomotive control;
- introducing integrated diagnostics devices along route borders;
- establishing special centres to receive and process information from satellites about the condition of infrastructure for the main routes (monitoring the main routes on sections with passenger transport);
- ensuring the control systems and safety systems comply with international standards.

In order to support high-speed traffic, a technical maintenance system is to be established for rapid and high-speed infrastructure and rolling stock.

The targeted parameters for introducing transport logistics envisage:

- transitioning from information to information and control technologies on all sections of the main routes;
- introducing new technologies for the processing of shipment documents at border crossings and seaports;
- introducing an automated accounting system for operational work;
- introducing optimised automated transport control systems based on the process-related production and economic model for operating activities.

The manufacturing of new generation rolling stock will be established in the period prior to 2030. The following is envisaged for this purpose:

- developing technical requirements for new types of rolling stock with minimal expenses on the operational life cycle;
- creating a regulatory, methodological and statistical framework to control the life cycle of technical equipment;
- increasing traffic speed;
- improving interaction in the wheel–rail system.

Developing International Activities

Improving the competitiveness of railway transport and developing international activities are among the most important strategic objectives.

The following is envisaged in the period prior to 2030:

- developing international transport corridors passing through Russian territory;
- transport support for the foreign economic relations of the Russian Federation, including the comprehensive development of the infrastructure of Russian seaports and approaches thereto;
- establishing transport logistics centres abroad with an extension of railway lines with track gauge of 1 520 mm to the territory of European nations and the Korean Peninsula;
- expanding cooperation with major international transport companies and implementing joint projects with such companies aimed at developing various segments of the transport business (freight and passenger transport, local infrastructure projects, management logistics, the establishment of modern rolling stock, etc.);
- involvement in international organisations in order to harmonise transport legislation, improve passenger and freight transport technologies, and establish a unified legal space for international transportation;
- developing partnerships with 1520 space nations aimed at producing a joint strategy for the development of the railway network, reducing the transport load on the economy of these countries, developing the advantages of the technological unification of railway transport, jointly operating rolling stock on railway lines with track gauge of 1 520 mm, developing and introducing progressive technologies, etc.;
- involvement in the infrastructure projects of foreign nations, including railway construction and the sale of the competitive technologies of Russian railways and domestic transport engineering products;
- purchasing modern foreign equipment and the subsequent localisation of licensed technologies under the condition they have advantages over their Russian analogues;

- participation in the capital of foreign transport companies in order to improve the competitiveness of railway services on the international transport;
- market and establish mutually beneficial conditions for intensified cooperation with foreign partners;
- expanding international cooperation in the training and development of personnel, basic and applied research as well as experimental and design projects.

International transport corridors

The following principles ensure the effective development of international transport corridors, including the return on capital investment:

- the balanced development of individual sections of international transport corridors, including the compatibility of technical standards and the absence of bottlenecks that restrict traffic capacity (taking into account local transport operations);
- pursuing a coordinated tariff policy and ensuring a substantiated reduction in transport expenses;
- concentrating resources on the most efficient routes while eliminating the possibility of destructive competition between separate international transport corridors for similar freight;
- the priority-based use of existing transport infrastructure;
- improving the level of transport services by developing the transport, logistics and information infrastructure of shipments along the route of international transport corridors.

The following areas must be developed to improve the competitiveness of Russian railways in the system of international transport corridors:

- introducing modern technologies for the organisation of intermodal shipments, in particular container block trains;
- improving the operation of transit freight and passenger transport on the basis of international treaties;
- introducing systems and devices to improve transport safety and transport process technologies in order to reduce the time required to deliver freight and ensure their safekeeping;
- increasing the throughput and carrying capacity of Russian mainlines in compliance with the main international transport routes;
- eliminating bottlenecks on existing railway infrastructure and introducing automated transport process control systems that improve the speed and quality of shipments;
- increasing the capacity and improving the technical equipment of customs checkpoints;
- harmonising Russian regulatory legal acts regarding transport with international laws and acts;
- improving customs declaration technologies and procedures as well as establishing special customs regimes for transit freight;
- developing and introducing unified shipping documentation forms for railway transport according to international standards;
- computerising shipments on international transport corridors, including information support for shippers and the introduction of electronic document management and electronic signature;

- intensifying marketing activities and developing an agency network;
- establishing a network of information and logistics centres and developing the infrastructure of intermodal shipments;
- improving the tariff policy in foreign trade shipments in order to enhance its flexibility and establish "through tariff rates";
- developing and introducing modern high-performance rolling stock on the Russian railways network, in particular container flatcars with increased capacity;
- cooperating actively with foreign railways and transport companies on the development of shipments on the routes of individual international transport corridors, including through the establishment of joint ventures;
- being involved in the work of the Organisation for Cooperation of Railways (OSJD), the Inland Transport Committee (ITC) of the United Nations Economic Commission for Europe (UNECE), the UN Economic and Social Commission for Asia and the Pacific (UNESCAP), the International Union of Railways (UIC), and the Transport Policy Council under the Integration Committee of the Eurasian Economic Community (EurAsEC);
- developing partnerships with 1520 space countries.

The quality of transport services and the safekeeping of the transported freight have improved significantly along the Trans-Siberian Railway in recent years. Freight customs declarations procedures have been simplified and a number of other measures have been implemented to ease the border crossing procedure. A simplified procedure has been introduced for the declaration of freight transported in containers, which has reduced the downtime of containers at the border from three to five days to a few hours. The information technologies employed provide full monitoring over the movement of train cars and containers in real time.

Express container trains will be able to deliver freight all the way across Russia from the Pacific Ocean to its western borders in eleven days, i.e. at a speed of more than 1 000 km per day. This technology will not only make it possible to significantly reduce freight delivery time but also to deliver specific consignments regularly and strictly according to schedule.

The trading volumes that South Korea, Japan as well as northern and north-eastern regions of China have with European countries are the most promising for the East–West route. Cooperation with Kazakhstan may become productive in terms of attracting trade volumes between the western regions of China and European nations using a branch of the East–West corridor through Kartaly–Astana–Dostyk. The development of transit shipments along the East–West corridor largely depends on the implementation of the project to restore the Trans-Korean Railway with access to the Trans-Siberian Railway. This project will make it possible to ensure a direct railway link between European nations and South Korea and significantly enhance the appeal of railway transport for South Korean container cargo by eliminating the sea distance (Pusan–Vladivostok).

A natural extension of the Trans-Siberian Railway is International Transport Corridor No. 2, which connects Russia with European nations. The high-speed line Moscow–Smolensk–Krasnoye is to be established as part of International Transport Corridor No. 2 (using the maximum option) in order to expand transport ties with these countries, create more appealing conditions for passengers, improve comfort and safety of passenger transport and reduce travel time. The implementation of the project is possible by establishing an international consortium.

The potential volume of container freight in European–Asian trade that can be shifted from the sea-based route to Russia's transport routes, in particular along the East–West corridor, is currently estimated at 250 000–450 000 TUE[39].

Equally important is the development of the North–South international transport corridor, which serves as an alternative to the sea-based route connecting Europe, Persian Gulf countries and the Indian Ocean. The competitiveness of the North–South international transport corridor has diminished due to dual cargo handling in the Caspian Sea. In this regard, the establishment of a direct railway line along the western branch of the corridor has become a relevant issue. Developing the western branch of the corridor requires establishing a direct railway route in Iran. The railway companies of three countries (Russia, Azerbaijan and Iran) in May 2005 signed an Agreement on the implementation of a project to build and operate the new railway line Qazvin–Rasht–Astara (Iran)–Astara (Azerbaijan). With the construction of this line, the western branch of the North–South international transport corridor will become the shortest railway route between the ports of Baltic Sea and the Persian Gulf and will eventually ensure a direct railway line with Pakistan and India.

Despite the increase in transit volumes, there are a number of remaining systemic problems that need to be resolved as quickly as possible. Such problems include:

- the unpreparedness of most transport companies to provide high-quality "through" services and a "through" tariff;
- technological and customs problems related to the organisation of transit container flows;
- the unwillingness of shippers to change the well-established logistics transport schemes involving sea transport;
- the absence of an effective system of government support for the development of transit;
- the establishment of alternative intermodal routes using the railway transport of other countries that can provide active competition to Russian transit routes.

To expand the feasibility of integration and ensure the balanced development of the individual links of the international transport chain, the most effective solution for railway transport organisations is to join the management of major seaports, ferries, ground terminals and railway transport facilities on the territory of other nations.

Human resources

The main measures in the development of human resources are:

- providing railway transport (at all levels) with professionally trained workers of mass professions as well as experts and executives focused on long-term labour relations and professional career development in the railway transport sector;
- training multi-skilled experts and developing a high level of skills among railway transport personnel in order to work under conditions of a unified transport system, active interaction between different types of transport, logistics complexes, unified process chains, and high quality standards;
- facilitating the establishment of corporate personnel management systems focused on motivated and efficient work by employees, improving the quality and productivity of such work, and active involvement in the technical modernisation and innovative development of railway transport.

39. Measurement unit equal to the amount held by a standard 20-foot container.

Regional priorities

Freight and passenger traffic on railway transport forecast

The Transport Strategy of the Russian Federation until 2030 predicts a significant increase in freight turnover on Russian railways in the long term: up to 2 680 billion tonne-kilometres by 2020 (+22% versus 2013 level) and up to 3 020.6 billion tonne-kilometres by 2030 (+37.5% versus 2013 level). In addition, a major increase is expected in the volume of freight shipments on railway routes that primarily deliver freight to the country's sea ports.

Given the existing potential of the railway freight base in the Far East region as well as the intensification of Russia's trade and economic relations with Asian-Pacific nations and the development of sales markets for Russian goods in Asian countries, certain changes are expected to take place in the future to the structure of freight shipments with an increase in the volume of freight shipped to the east.

The most dynamic development will be seen with container shipments. The accelerated growth in container shipments is due to:

- the development of logistics services in Russia;
- the development of warehouse and terminal infrastructure in the Russian Federation;
- the complexity of logistics chains, which makes container shipments more efficient compared with other types of transport.

Passenger turnover on the railway network of Russian Railways is projected to be 156.2 billion passenger-km by 2020 and 176.6 billion passenger-km by 2030 (up +12.8% and +27.5% versus the 2013 level, respectively). Plans exist to develop rapid long-distance passenger transport and rapid suburban transport as well as to establish high-speed.

VIETNAM

Strategy principles

- The strategy on railway development must be in accordance with the overall strategy on transport development and the strategy on socio-economic development of the country from now till 2020 and the Vision till 2050.
- The railway transport - which is an important part in socio-economic infrastructure framework the primary transport model for high volume of freight in long or middle distance; transports passengers in long distance, intercity and public transport at big cities; plays key role in passenger transport on North - South axis, and freight on West - East axis, as well as outstanding advances on public transport - requires prioritized investment for development.
- Encourage economic sectors and bring into full play every source to invest in developing infrastructure structure, transport facilities and executing transport business in accordance with the master plan and the State's centralized management and operation on national railway.
- Develop railway industry in accordance with nationwide orientation for industry development. The State issues policies which encourage other industry of the country to participate in railway industrial production process, especially in auxiliary manufacturing sector.

Infrastructure of the region

Development of railway transport requires suitable implementation, exploiting effectively the existing railway lines, as well as to research on investment and construction of new, modern lines, closely connecting to big sea ports of each region and other transport means of transport; to promote advantages for the highest effectiveness of the country's development. The State concentrates the investment on development of the national railway infrastructure, as well as attaches great importance to the maintenance works of the existing infrastructure to ensure the effective, throughout, orderly and safe operation.

National railways network

Up to 2020

- Existing Railway Network: Giving priority to upgrading and modernizing the existing North - South railway line with a view to reaching a uniform load of 4.2 T/m and meeting the transport demand till 2030 with an average speed of 80-90km/h as for passenger trains and 50-60km/h as for freight trains; increasing transport capacity/quality and upgrading the existing railway lines such as Yen Vien - Lao Cai, Gia Lam - Hai Phong, Yen Vien - Dong Dang, Ha Noi - Thai Nguyen, and Ha Noi - Lang Son. Focusing on investing, upgrading, and improving railway stations; implementing projects to ensure railway transport safety, with special attention to investment in intersections at grade between railway and road where the traffic flow is high.
- Newly Constructed Railway Lines: Studying alternatives to construct new electrified, 1435mm-gauge, double-track, medium high-speed railway on the North - South axis; putting the entire Yen Vien - Pha Lai - Ha Long - Cai Lan railway line into operation. Studying alternatives to construct new lines including Lao Cai - Ha Noi, Ha Noi - Hai Phong and Ha Noi - Dong Dang, Bien Hoa - Vung Tau, Sai Gon - Can Tho; railway connecting to Hai Phong Seaport - Lach Huyen; railway connecting Tay Nguyen provinces to seaports; Trans-Asia Railway such as Vung Ang - Cha Lo (Mu Gia) railway connecting to Laos railway at Tha Khet, Di An - Loc Ninh railway connecting to Cambodia railway.

2020 – 2030

- Effectively operating the existing railways.
- Preparing neccessary conditions to gradually construct the new electrified, 1435mm-gauge, double-track, medium high-speed railway on the North - South axis, with priority given to constructing sections where transport demand is high, especially the area connecting to Hanoi and Ho Chi Minh Cities such as Hanoi - Vinh, Sai Gon - Nha Trang.
- Studying and constructing railways connecting to big seaports, industrial parks, and tourist attractions, etc., of which priority will be given to such railways as Lao Cai - Ha Noi, Ha Noi - Hai Phong, Ha Noi - Dong Dang, Bien Hoa - Vung Tau, Ho Chi Minh City - Can Tho, Hai Phong - Lach Huyen, Trans-Asia Railway, etc., and some railway sections in Hanoi railway junction and Ho Chi Minh City according to the plan and fund availability.

Vision up to 2050

- Attempting to complete 1435mm-gauge double-track, medium high-speed railway on the North - South axis, modernizing the existing railway network in order to mainly meet the local freight and passenger transport demand.
- Constructing Tay Nguyen railway lines, Trans-Asia Railway, and railways connecting to big industrial parks and seaports.

Urban Railway Network

Up to 2020

- Actively implementing urban railway projects in Hanoi and Ho Chi Minh Cities.

2020 - 2030

- Further constructing and putting the urban railway projects in Hanoi and Ho Chi Minh Cities into operation.

Vision till 2050

- Completing urban railway network in Hanoi and Ho Chi Minh Cities, investing in developing urban railway network in other big cities according to the approved plans.

Development of international transport corridors/Boosting the efficiency of rail border passes

2020-2030

- It is provided the gradual construction of missing lines under Trans-Asia Railway such as Vung Ang - Cha Lo (Mu Gia) railway connecting to Laos railway at Tha Khet, Di An - Loc Ninh railway connecting to Cambodia railway.

Development of Rail Transport and Transport Policy in the Region

- Encouraging every economic sector to participate in transport business and services.
- Establishing fare and charge system as macro regulators, orienting the proper railway transport development.
- Developing railway transport and supporting services with high quality, quickness, safety, convenience, and saved social costs. Strongly developing multi-mode transport and logistics services in freight transport.
- Strengthening management and inspection of the quality of vehicles and transport services, especially passengers transport. Developing organisations and associations to protect customers' interests.

Key Elements

Key areas of rail transport research

- Establishing policies to encourage the research and application of new scientific and technological breakthroughs in training, transport operation, construction and maintenance of infrastructure, industries and services, paying special attention to apply Information Technology to plan operation organisation.
- Establishing policies to encourage the cooperation in research and transfer of advanced technologies in railway industry from foreign countries, especially medium high-speed railway.
- Environmental safety
  - > Controlling, preventing and restricting environmental pollution due to railway transport operations, especially waste treatment. Improving the effectiveness of energy consumption, quickly developing public transport in urban areas.

- Increasing the adaptability to climate change and rising sea level of railway infrastructure system.
- Speeding up the application of technology and energy-saving vehicles. Use of clean energy, renewable energy and other alternative energies in railway transport activities.

- Railway safety
  - Promptly complete the railway right-of-way project.
  - Speeding up the investment in improving and upgrading infrastructure system, ensuring right-of-way, tackling hot spots on the railway, etc., in order to control traffic accidents and reducing the number of annual railway accidents.

Key areas of international cooperation and enhancing the competitiveness of rail transport

- Enhancing international cooperation, especially with countries whose railway industry develops at the high level, acquiring experience during railway development, collaborating in training human resources to acquire and transfer modern and advanced technologies to meet the domestic development demand in the short term and expand our market to regional countries and worldwide countries in the long term.
- Human resource development in rail transport/ HR policies, including training, retraining and skills development programmes:
  - Making proper investment plan on training and development of human resources. Establishing policies to encourage and attract excellent experts to railway transport field, especially medium high-speed railways;
  - Increasing investment in facilities, renewing training program and expanding training form;

Regional Priorities

- Development of rapid and high-speed railway traffic.
- Development of heavy traffic.
- Renewal/Manufacturing of rolling stock, railway equipment manufacturing industry.

Up to 2020

- Focusing on development of products such as manufacturing modern and convenient passenger/freight cars for domestic use and export; manufacturing spare parts/ accessories; assembling modern locomotives.

2020-2030

- Investing in modern production line for locomotive establishments, manufacturing cars and advanced spare parts. Railway industry must play a key role, associating with nationwide industrial establishments to assemble, manufacture, overhaul and repair locomotives and cars at various levels to meet the operation demand.

Up to 2050

- Developing locomotive establishments, manufacturing modern cars and spare parts. Assemble and manufacture of rolling stocks for domestic use and export.
- Creating a logistics services market by the promotion of connection to big seaports of each region and other transport means of transport.

- Technical regulation policy/Technical requirements to infrastructure and rolling stock: studying, supplementing, formulating, and amending laws and legal documents, standards, technical regulations, procedures, regulations, norms on unit costs, etc., to complete the relevant legal system and supporting the call for domestic and foreign investors in the national railway network.
- Forecast of freight and passenger flows on rail transport:

	2020		2030		After 2030	
	Volume	**Transport Volume**	**Volume**	**Transport Volume**	**Volume**	**Transport Volume**
Passenger (%)	2.24	3.89	3.88	12.38	8.37	14.43
Freight (%)	3.95	6.84	5.08	8.80	5.20	9.18

ANNEX B
COUNTRY PROFILES

GEOGRAPHY AND DEMOGRAPHICS

ARMENIA

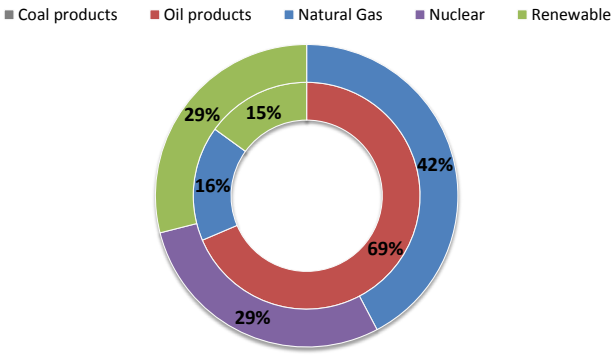
Area m^2 (Land and Water)	29 743
Land boundaries	1 570
Population (2013)	2 976 566
Population growth rate (1990-2013)	-0.8%
Urban population (2013)	1 874 492
Rate of urbanization (1990-2013)	-1.1%
GINI index (2012)	30.3

ECONOMICS

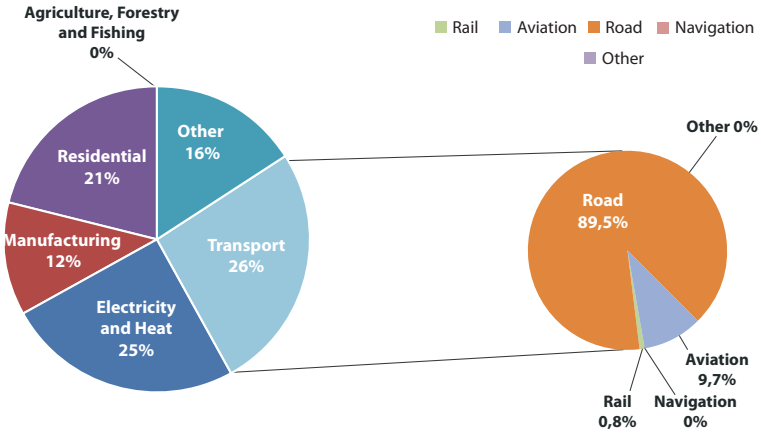
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	4.1	2.1	2.8	4.9	5.9	6.9	2.3%
GDP per capita (constant 2005 USD)	1 146	666	896	1 625	1 997	2 310	3.1%
Value added by sector (% of GDP)							
Agriculture	17%	42%	26%	21%	19%	22%	
Industry	52%	32%	39%	45%	37%	31%	
Services	31%	26%	35%	34%	44%	47%	
Imports (constant 2005 USD billions)	4.0	1.1	1.2	2.1	2.4	2.3	-2.3%
Exports (constant 2005 USD billions)	3.1	0.4	0.6	1.4	1.2	1.8	-2.3%

ENERGY AND CO_2 EMISSIONS

ARMENIA NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

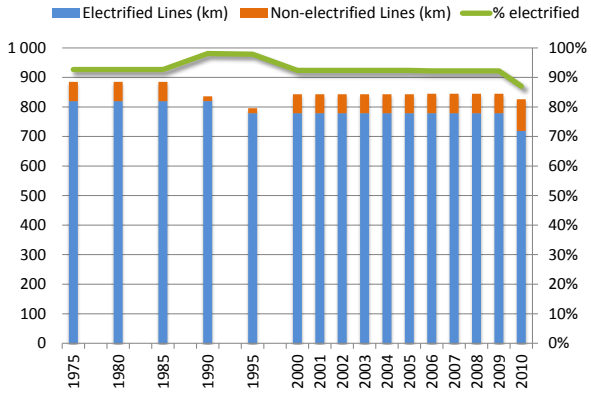


ARMENIA TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

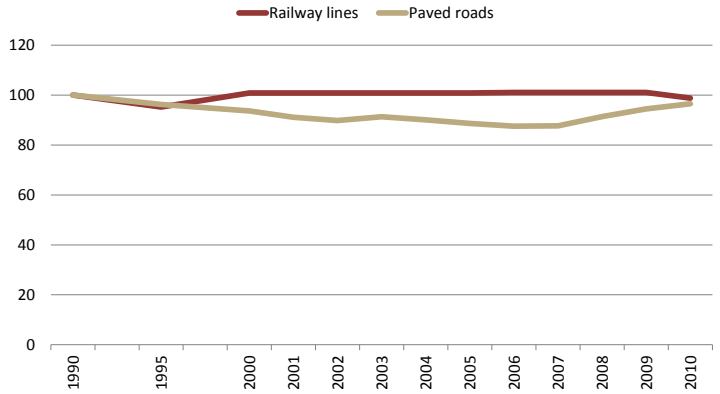


INFRASTRUCTURE

Armenia Railway Lines



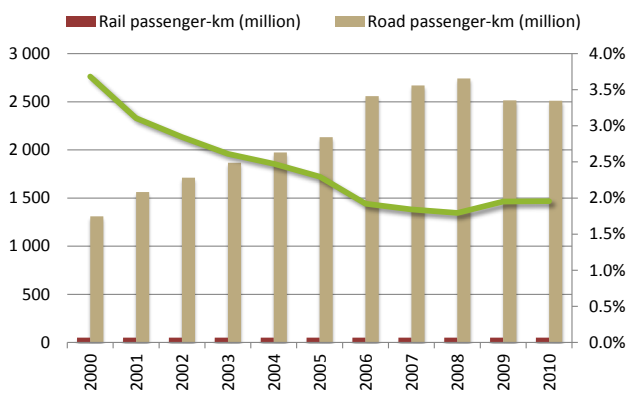
Armenia Infrastructure kms, rail and road (1990=100)



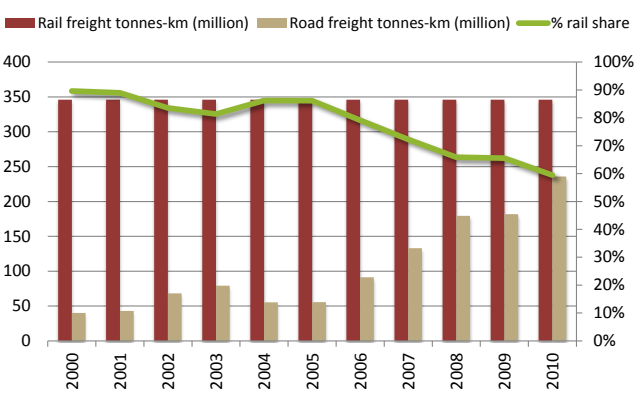
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Armenia	Rail passenger 0.0%	Road passenger 6.7%	Rail freight 0.0%	Road Freight 19.4%

Armenia Passenger Activity



Armenia Freight Activity



GEOGRAPHY AND DEMOGRAPHICS

AUSTRALIA

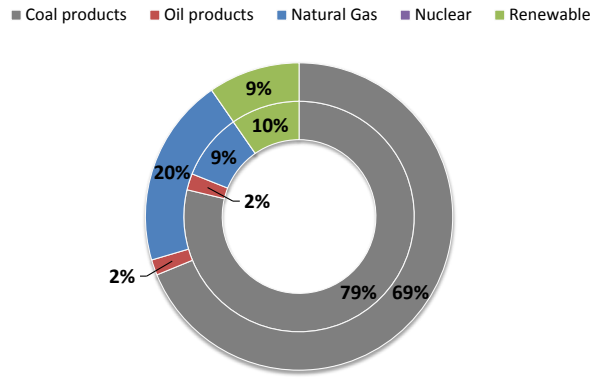
Area m^2 (Land and Water)	7 741 220
Land boundaries	0
Population (2013)	23 130 900
Population growth rate (1990-2013)	1.3%
Urban population (2013)	20 621 891
Rate of urbanization (1990-2013)	1.5%
GINI index (2003)	34.01

ECONOMICS

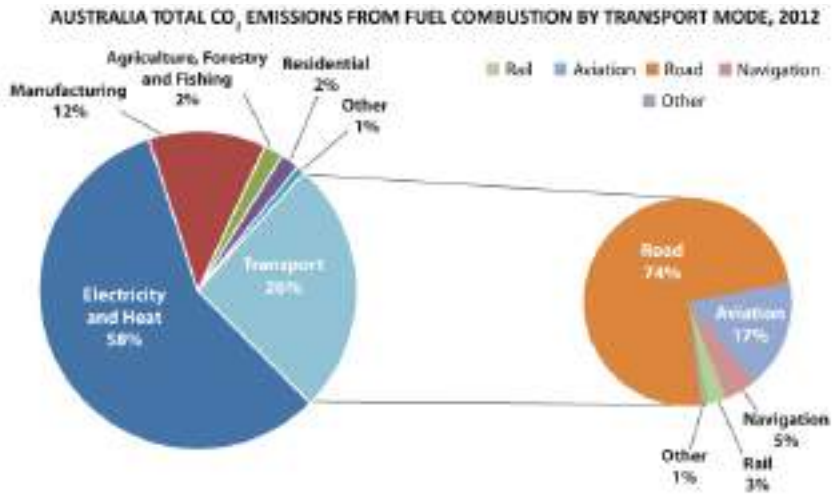
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	427.3	480.2	591.0	693.3	797.0	867.2	3.1%
GDP per capita (constant 2005 USD)	25 037	26 572	30 856	33 996	36 175	37 489	1.8%
Value added by sector (% of GDP)							
Agriculture	5%	3%	3%	3%	2%	2%	
Industry	31%	29%	27%	27%	27%	27%	
Services	64%	68%	70%	70%	71%	71%	
Imports (constant 2005 USD billions)	51.8	67.2	99.7	144.1	201.2	249.2	7.1%
Exports (constant 2005 USD billions)	52.1	78.0	111.3	125.3	147.8	166.1	5.2%

ENERGY AND CO_2 EMISSIONS

AUSTRALIA NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

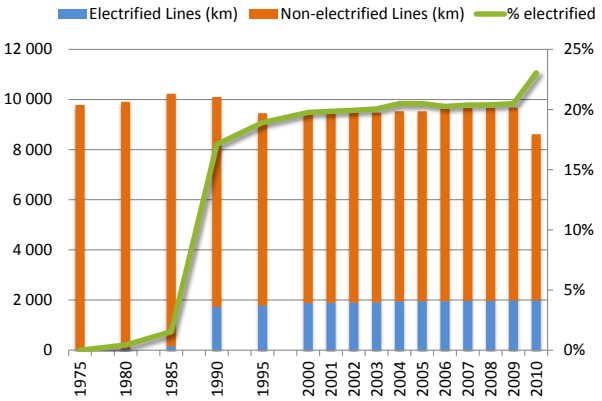


AUSTRALIA TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

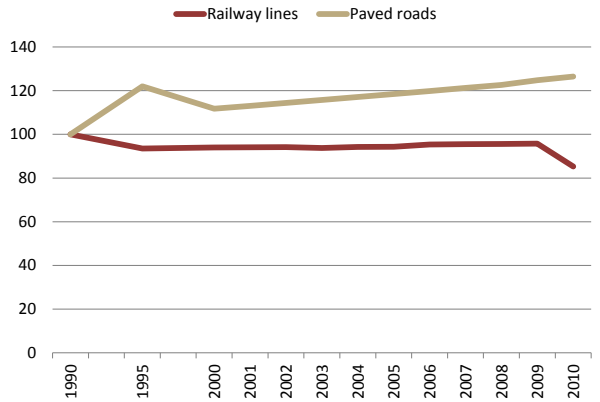


INFRASTRUCTURE

Australia Railway Lines



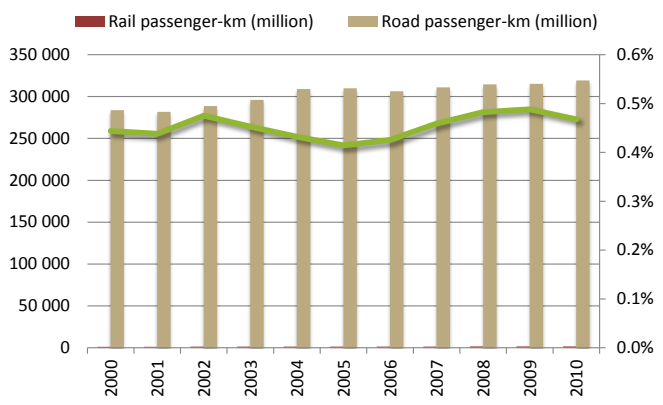
Australia Infrastructure kms, rail and road (1990=100)



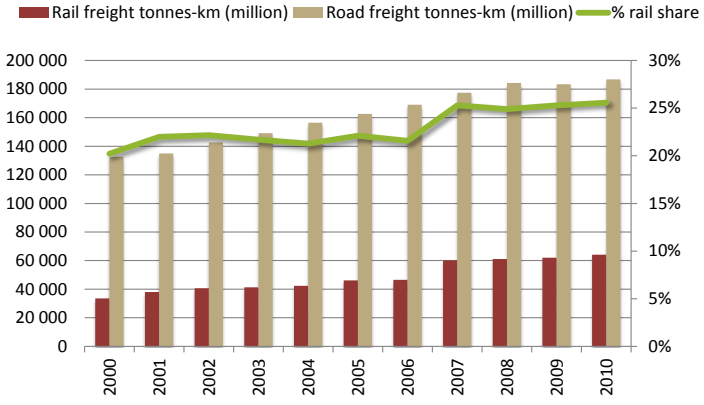
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Australia	Rail passenger 1.7%	Road passenger 1.2%	Rail freight 6.7%	Road Freight 3.5%

Australia Passenger Activity



Australia Freight Activity



AZERBAIJAN

GEOGRAPHY AND DEMOGRAPHICS

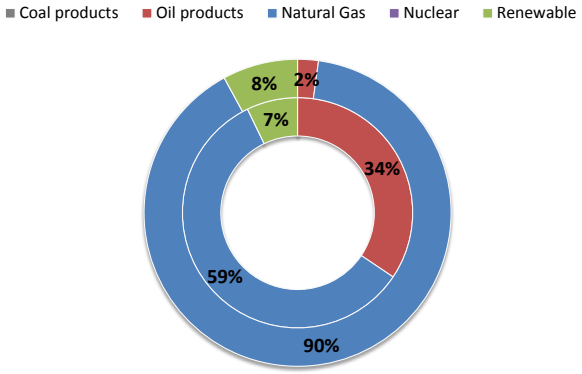
Area m2 (Land and Water)	86 600
Land boundaries	2 468
Population (2013)	9 416 598
Population growth rate (1990-2013)	1.2%
Urban population (2013)	5 094 380
Rate of urbanization (1990-2013)	1.2%
GINI index (2008)	30.03

ECONOMICS

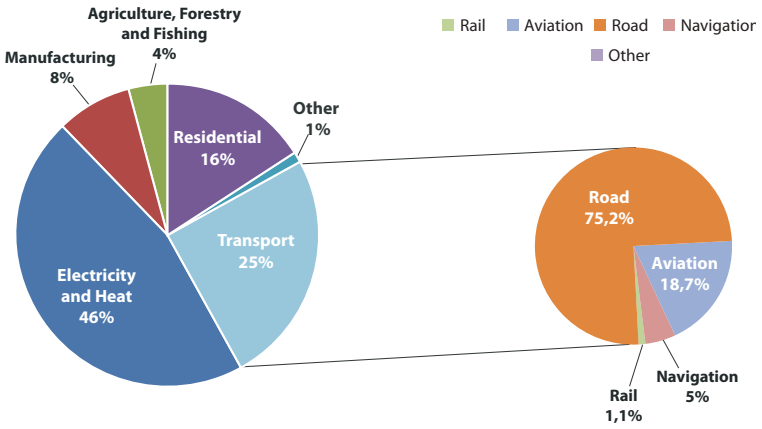
	1990	1995	2000	2005	2010	2013	1995-2013
GDP (constant 2005 USD billions)	11.9	5.0	7.0	13.2	28.3	30.6	10.6%
GDP per capita (constant 2005 USD)	1 669	651	874	1 578	3 127	3 253	9.4%
Value added by sector (% of GDP)							
Agriculture	29%	27%	17%	10%	6%	6%	
Industry	33%	34%	45%	64%	64%	62%	
Services	38%	39%	38%	27%	30%	32%	
Imports (constant 2005 USD billions)	-	1.1	2.2	7.0	9.8	14.9	15.3%
Exports (constant 2005 USD billions)	-	1.4	3.5	8.3	23.9	25.7	17.4%

ENERGY AND CO_2 EMISSIONS

AZERBAIJAN NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

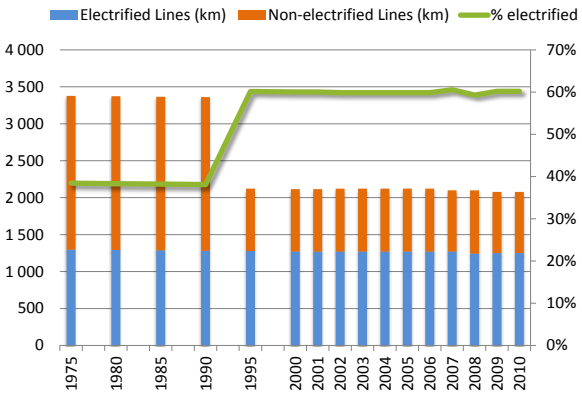


AZERBAIJAN TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

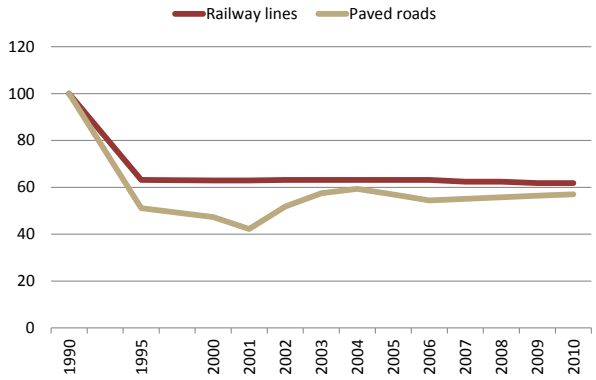


INFRASTRUCTURE

Azerbaijan Railway Lines



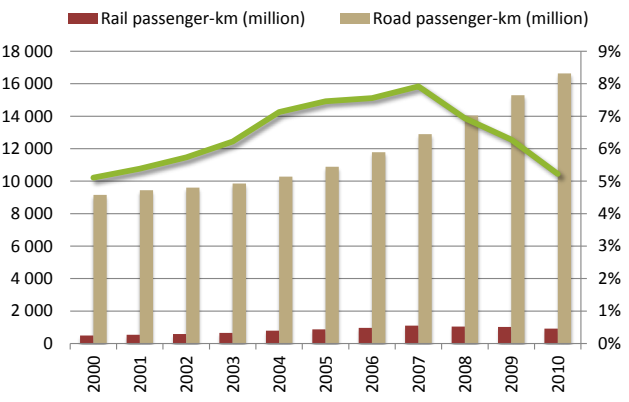
Azerbaijan Infrastructure kms, rail and road (1990=100)



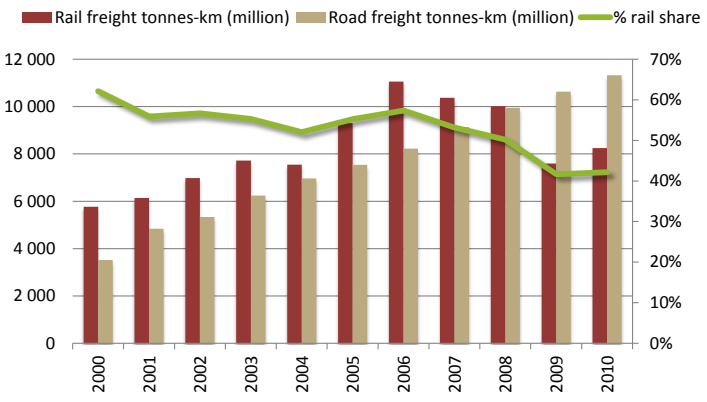
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Azerbaijan	Rail passenger 6.4%	Road passenger 6.2%	Rail freight 3.6%	Road Freight 12.4%

Azerbaijan Passenger Activity



Azerbaijan Freight Activity



BANGLADESH

GEOGRAPHY AND DEMOGRAPHICS

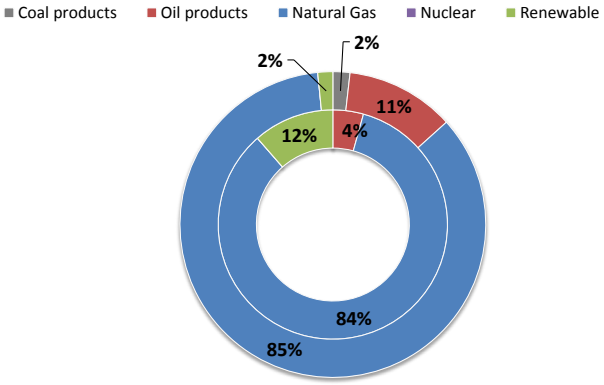
Area m^2 (Land and Water)	143 998
Land boundaries	4 413
Population (2013)	156 594 962
Population growth rate (1990-2013)	1.7%
Urban population (2013)	51 289 548
Rate of urbanization (1990-2013)	3.9%
GINI index (2012)	32.12

ECONOMICS

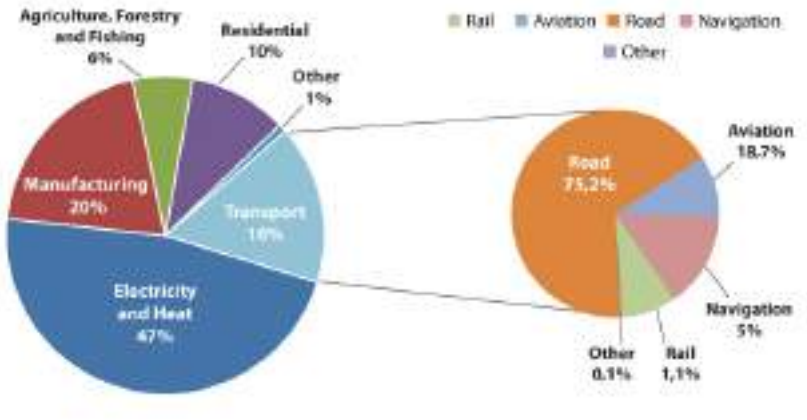
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	29.0	35.9	46.3	60.3	80.9	97.3	5.4%
GDP per capita (constant 2005 USD)	270	299	350	421	535	621	3.7%
Value added by sector (% of GDP)							
Agriculture	30%	26%	26%	20%	18%	16%	
Industry	21%	25%	25%	27%	26%	28%	
Services	48%	49%	49%	53%	56%	56%	
Imports (constant 2005 USD billions)	5.1	7.5	9.9	13.9	18.3	26.5	7.4%
Exports (constant 2005 USD billions)	2.1	3.9	6.4	10.0	15.4	22.9	11.0%

ENERGY AND CO_2 EMISSIONS

BANGLADESH NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

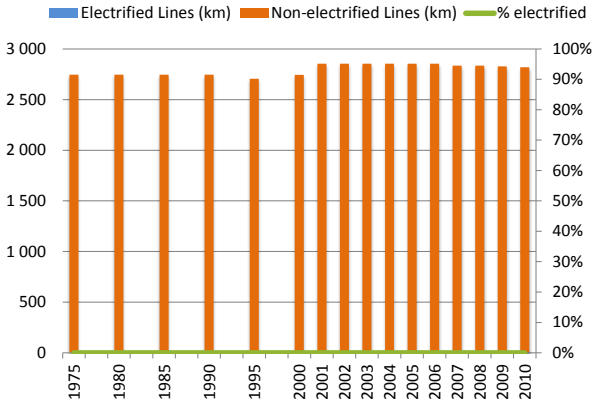


BANGLADESH TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

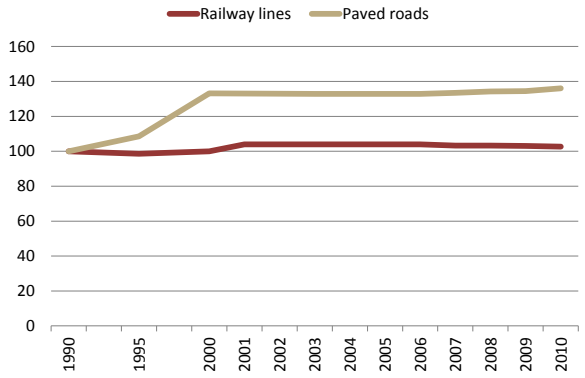


INFRASTRUCTURE

Bangladesh Railway Lines



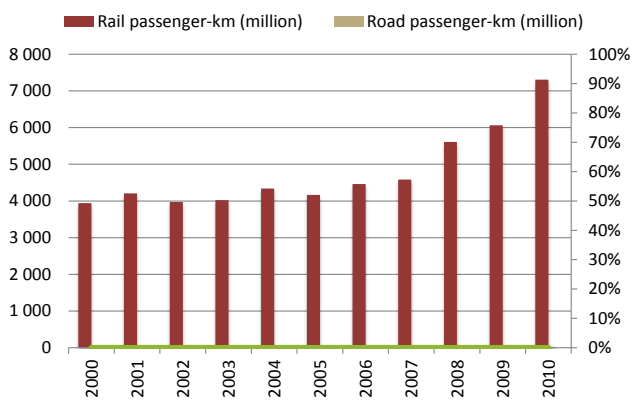
Bangladesh Infrastructure kms, rail and road (1990=100)



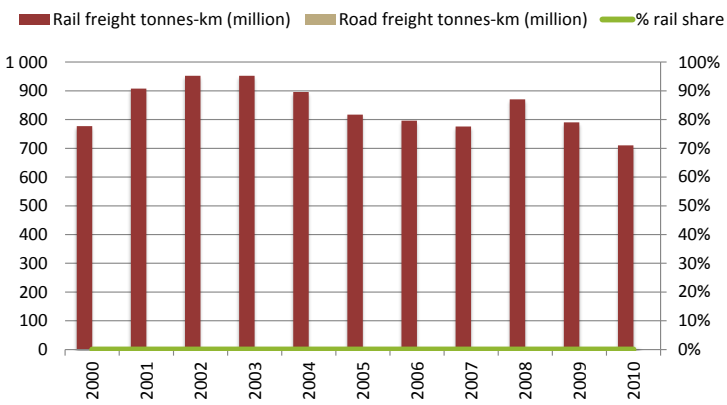
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Bangladesh	Rail passenger	6.4%	Road passenger	-	Rail freight	-0.9%	Road Freight	-

Bangladesh Passenger Activity



Bangladesh Freight Activity



CAMBODIA

GEOGRAPHY AND DEMOGRAPHICS

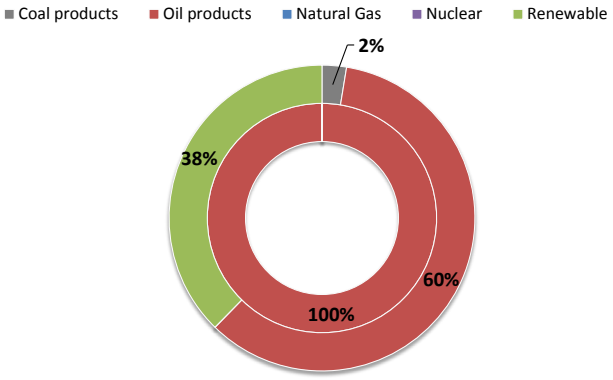
Area m2 (Land and Water)	181 035
Land boundaries	2 530
Population (2013)	15 135 169
Population growth rate (1990-2013)	2.3%
Urban population (2013)	3 075 315
Rate of urbanization (1990-2013)	3.5%
GINI index (2011)	31.82

ECONOMICS

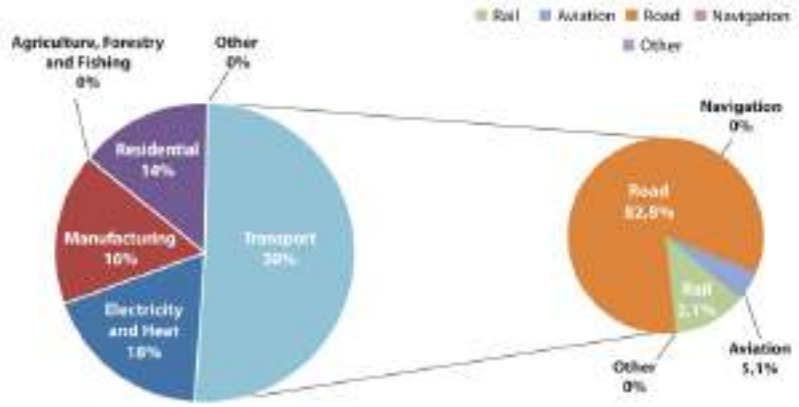
	1990	1995	2000	2005	2010	2013	1995-2013
GDP (constant 2005 USD billions)	-	2.8	4.0	6.3	8.7	10.7	7.7%
GDP per capita (constant 2005 USD)	-	263	329	471	605	709	5.7%
Value added by sector (% of GDP)							
Agriculture	-	50%	38%	32%	36%	34%	
Industry	-	15%	23%	26%	23%	26%	
Services	-	36%	39%	41%	41%	41%	
Imports (constant 2005 USD billions)	-	1.3	2.3	4.6	7.7	7.4	10.2%
Exports (constant 2005 USD billions)	-	0.9	1.8	4.0	6.7	7.3	12.5%

ENERGY AND CO_2 EMISSIONS

CAMBODIA NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

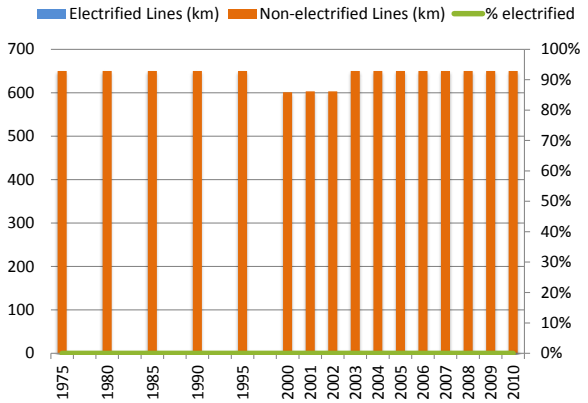


CAMBODIA TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

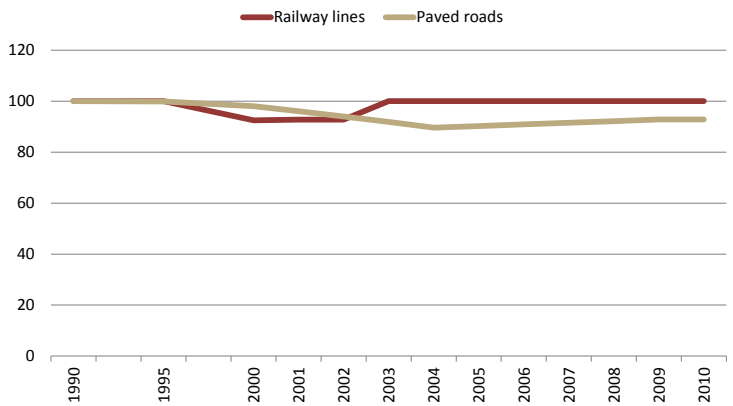


INFRASTRUCTURE

Cambodia Railway Lines



Cambodia Infrastructure kms, rail and road (1990=100)

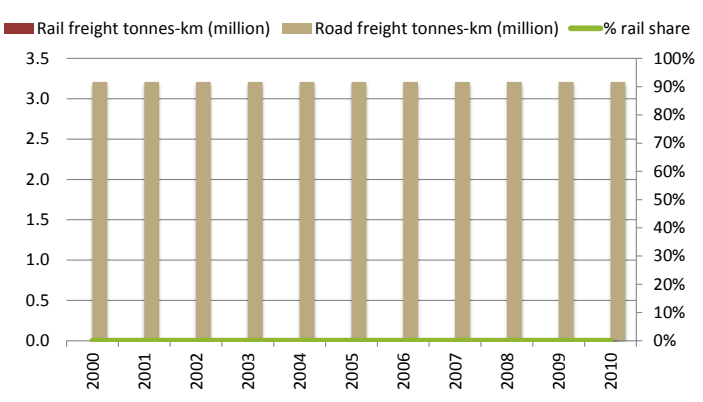


TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Cambodia	Rail passenger -	Road passenger 0.0%	Rail freight -	Road Freight 0.0%

Cambodia Passenger Activity

Cambodia Freight Activity



CHINA

GEOGRAPHY AND DEMOGRAPHICS

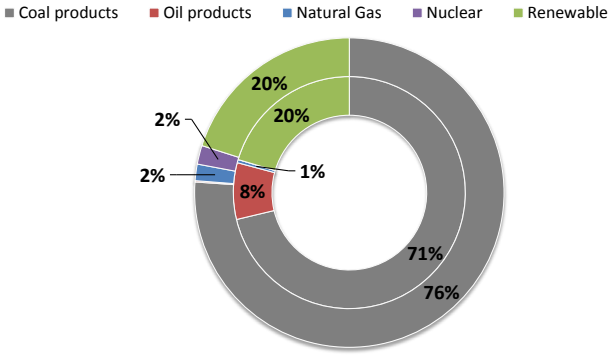
Area m^2 (Land and Water)	9 596 960
Land boundaries	22 457
Population (2013)	1 357 380 000
Population growth rate (1990-2013)	0.8%
Urban population (2013)	721 691 798
Rate of urbanization (1990-2013)	3.9%
GINI index (2011)	37.01

ECONOMICS

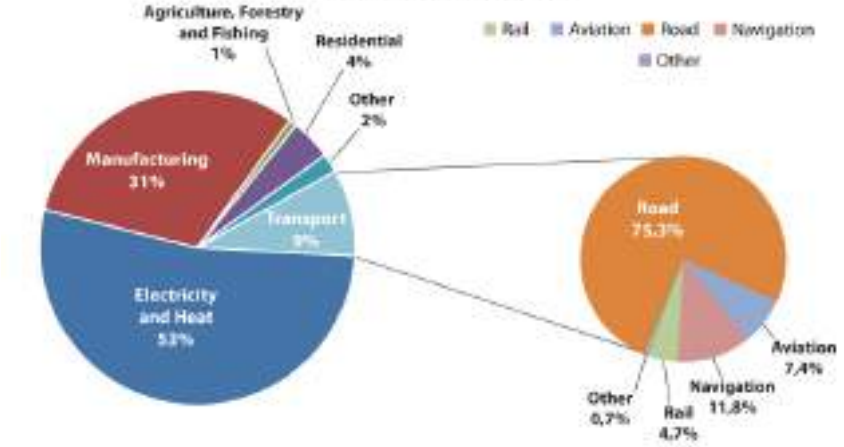
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	525.3	936.6	1 417.0	2 256.9	3 839.3	4 864.0	10.2%
GDP per capita (constant 2005 USD)	463	777	1 122	1 731	2 870	3 583	9.3%
Value added by sector (% of GDP)							
Agriculture	27%	20%	15%	12%	10%	10%	
Industry	41%	47%	46%	47%	47%	44%	
Services	32%	33%	39%	41%	43%	46%	
Imports (constant 2005 USD billions)	56.8	158.4	310.5	712.3	1 262.4	1 693.6	15.9%
Exports (constant 2005 USD billions)	64.6	150.4	358.7	836.9	1 584.6	2 033.4	16.2%

ENERGY AND CO_2 EMISSIONS

CHINA NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

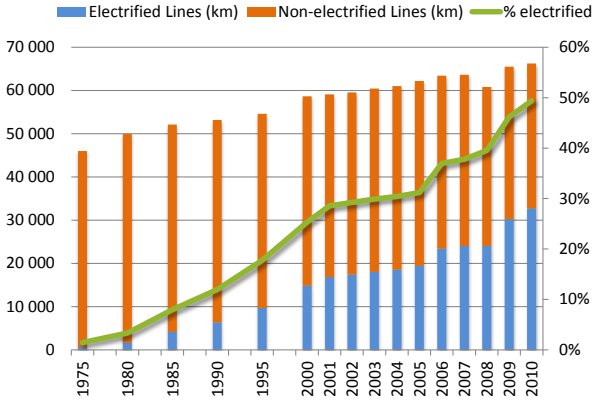


PEOPLE'S REPUBLIC OF CHINA TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

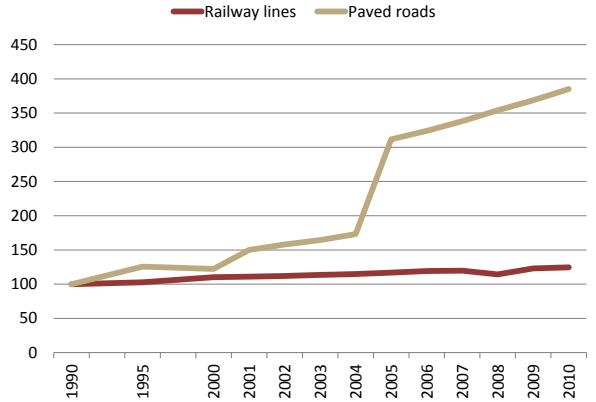


INFRASTRUCTURE

China Railway Lines



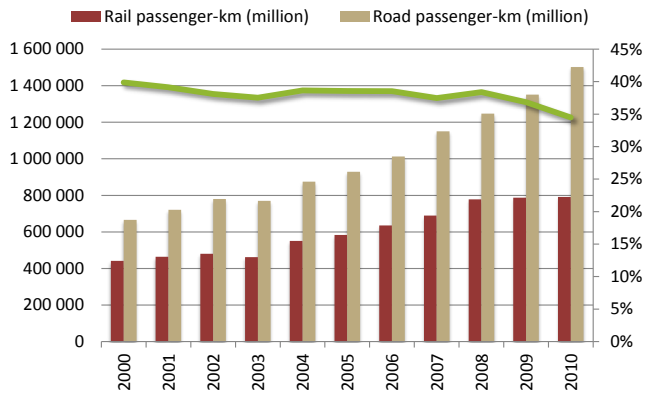
China Infrastructure kms, rail and road (1990=100)



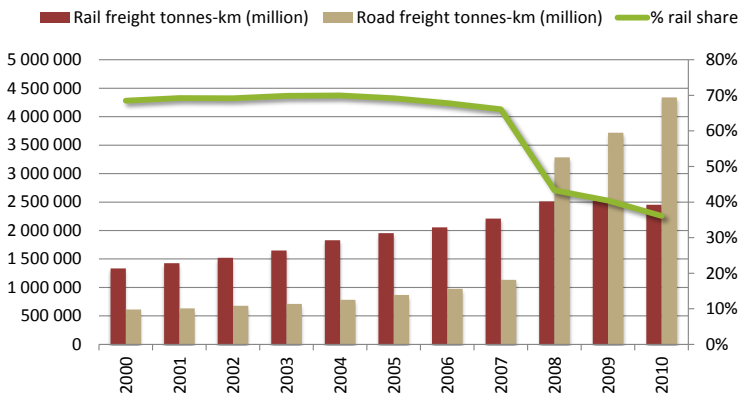
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - China	Rail passenger 6.0%	Road passenger 8.5%	Rail freight 6.3%	Road Freight 21.6%

China Passenger Activity



China Freight Activity



GEOGRAPHY AND DEMOGRAPHICS

CHINESE TAIPEI

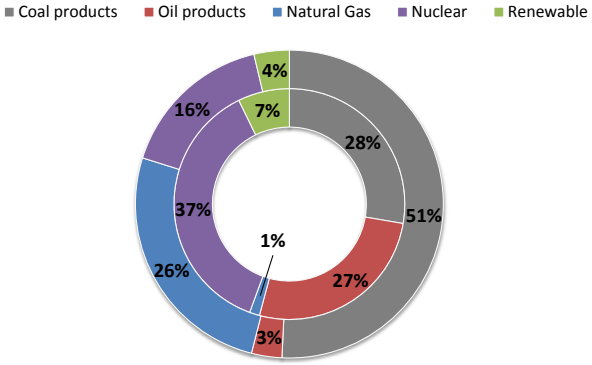
Area m^2 (Land and Water)	36 193
Land boundaries	0
Population (2012)	23 234 940
Population growth rate (2000-2012)	0.4%
Urban population (2013)	-
Rate of urbanization (1990-2013)	-
GINI index (2010)	34.20

ECONOMICS

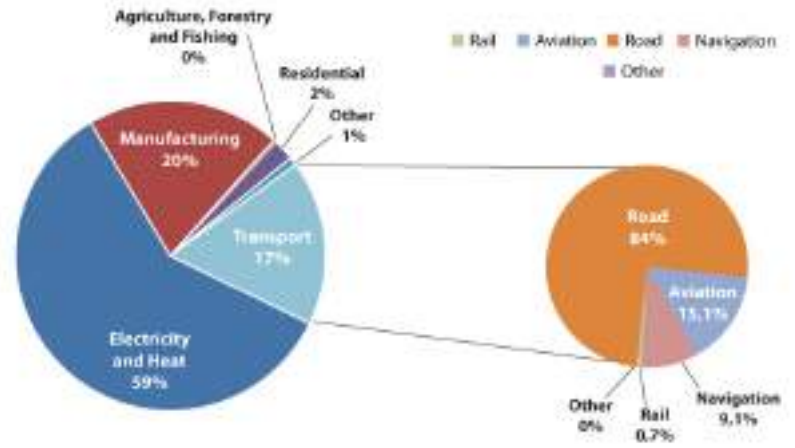
	1990	1995	2000	2005	2010	2013	2000-2010
GDP (current USD billions)	165.0	274.8	326.2	364.8	428.2	489.2	2.8%
GDP per capita (curren USD)	8 086	12 865	14 641	16 023	18 488	20 930	2.4%
Value added by sector (% of GDP)							
Agriculture	-	-	-	2%	2%	2%	
Industry	-	-	-	27%	30%	31%	
Services	-	-	-	71%	68%	67%	
Imports (constant 2005 USD billions)	-	-	140.0	165.0	251.0	-	6.0%
Exports (constant 2005 USD billions)	-	-	148.4	170.1	274.1	-	6.3%

ENERGY AND CO_2 EMISSIONS

CHINESE TAIPEI NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

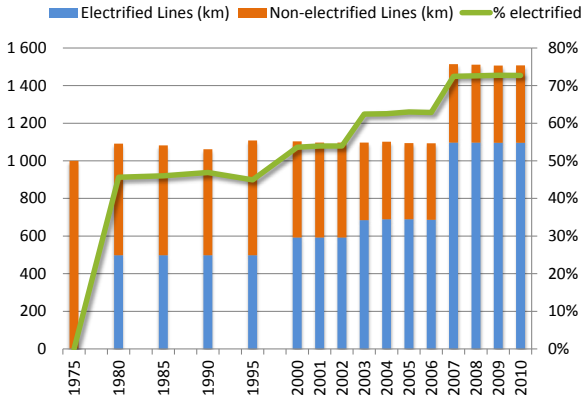


CHINESE TAIPEI TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

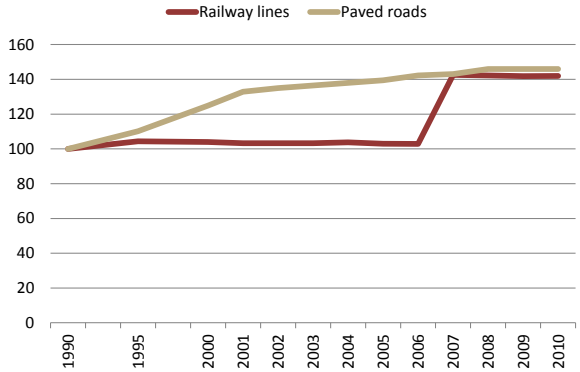


INFRASTRUCTURE

Chinese Taipei Railway Lines



Chinese Taipei Infrastructure kms, rail and road (1990=100)

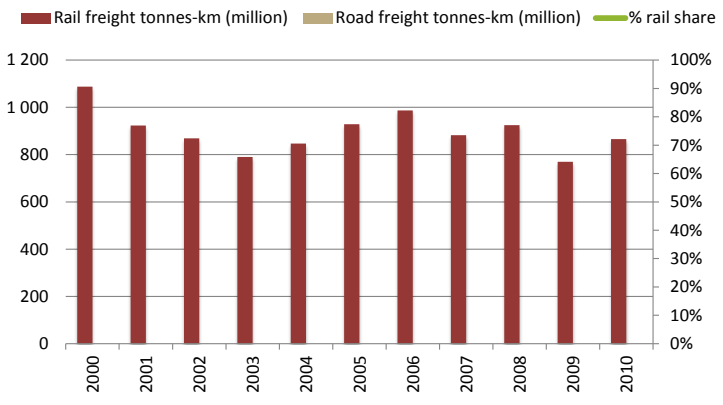


TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Chinese Taipei	Rail passenger	4.5%	Road passenger	-	Rail freight	-2.3%	Road Freight	-

Chinese Taipei Passenger Activity

Chinese Taipei Freight Activity



GEOGRAPHY AND DEMOGRAPHICS

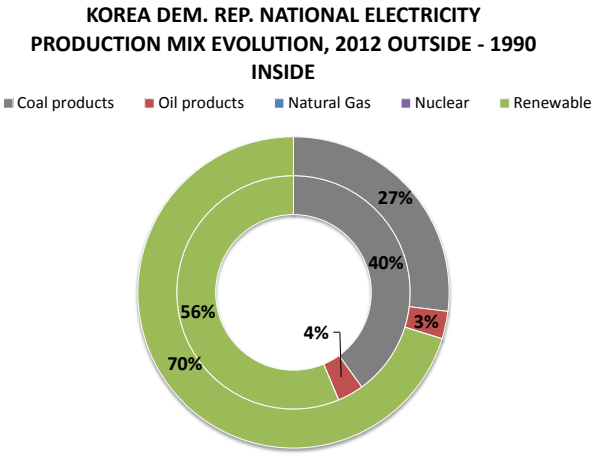
Area m2 (Land and Water)	120 538
Land boundaries	1 607
Population (2013)	24 895 480
Population growth rate (1990-2013)	0.9%
Urban population (2013)	15 078 943
Rate of urbanization (1990-2013)	1.1%
GINI index	-

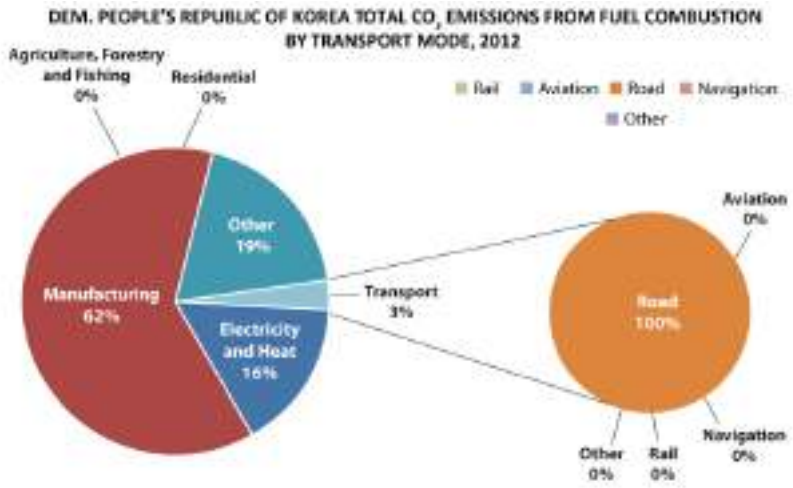
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

ECONOMICS

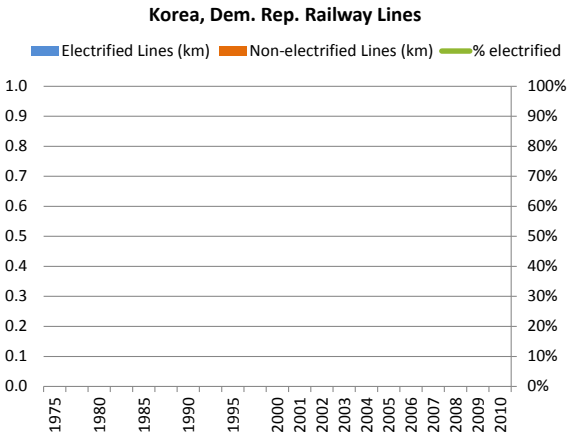
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	-	-	-	-	-	-	-
GDP per capita (constant 2005 USD)	-	-	-	-	-	-	-
Value added by sector (% of GDP)							
Agriculture	-	-	-	-	-	-	
Industry	-	-	-	-	-	-	
Services	-	-	-	-	-	-	
Imports (constant 2005 USD billions)	-	-	-	-	-	-	-
Exports (constant 2005 USD billions)	-	-	-	-	-	-	-

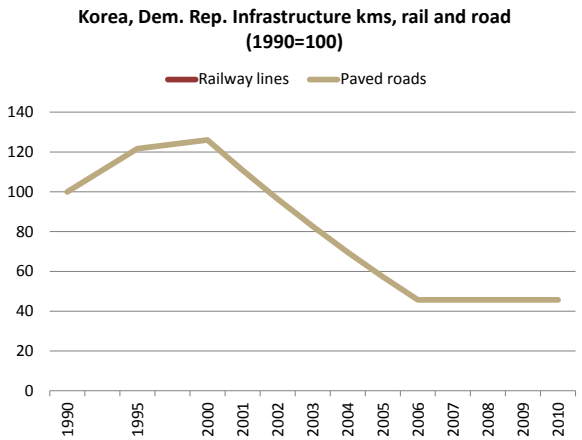
ENERGY AND CO_2 EMISSIONS





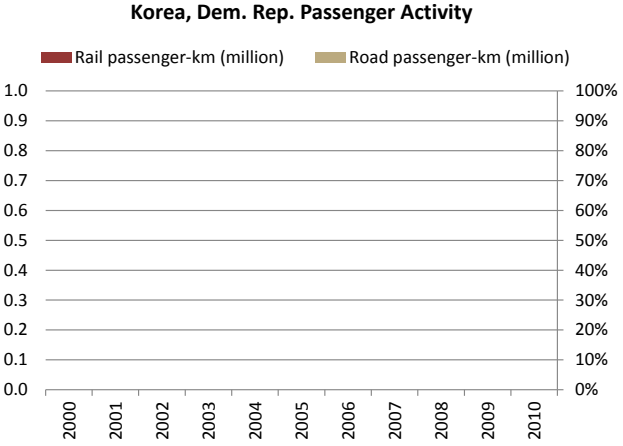
INFRASTRUCTURE

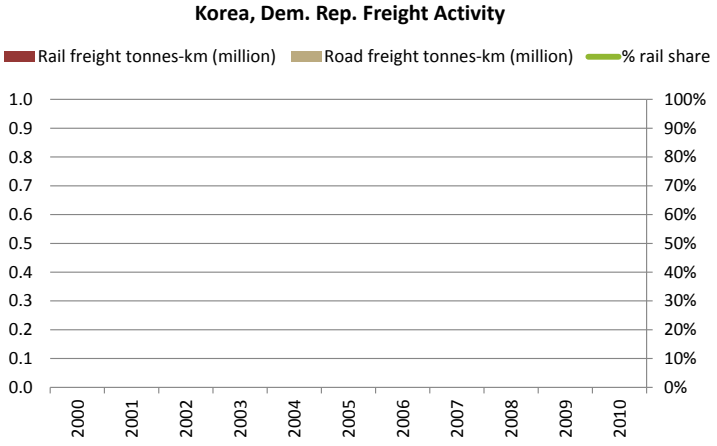




TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Korea, Dem. Rep.	Rail passenger	-	Road passenger	-	Rail freight	-	Road Freight	-





GEORGIA

GEOGRAPHY AND DEMOGRAPHICS

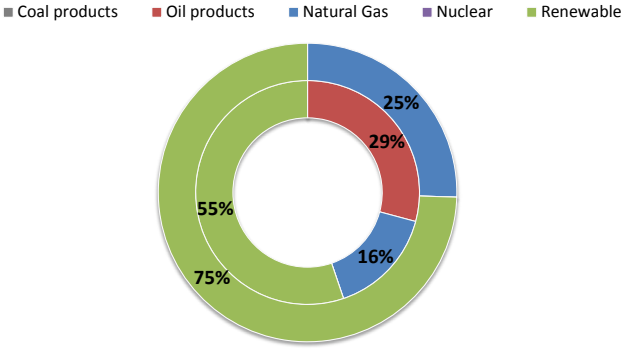
Area m2 (Land and Water)	69 700
Land boundaries	1 814
Population (2013)	4 476 900
Population growth rate (1990-2013)	-0.3%
Urban population (2013)	2 386 591
Rate of urbanization (1990-2013)	-0.4%
GINI index (2012)	41.35

ECONOMICS

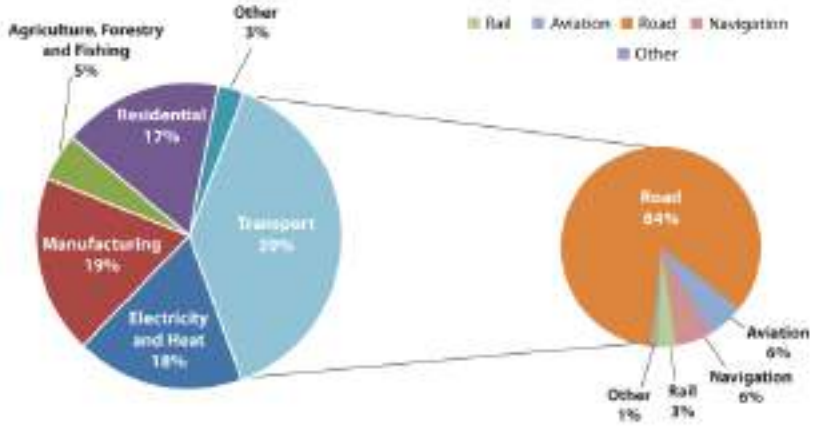
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	12.0	3.4	4.5	6.4	8.2	9.7	-0.9%
GDP per capita (constant 2005 USD)	2 499	716	1 019	1 470	1 851	2 165	-0.6%
Value added by sector (% of GDP)							
Agriculture	32%	52%	22%	17%	8%	9%	
Industry	33%	16%	22%	27%	22%	24%	
Services	35%	32%	56%	56%	69%	67%	
Imports (constant 2005 USD billions)	-	-	-	3.3	-	-	-
Exports (constant 2005 USD billions)	-	-	-	2.2	-	-	-

ENERGY AND CO_2 EMISSIONS

GEORGIA NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

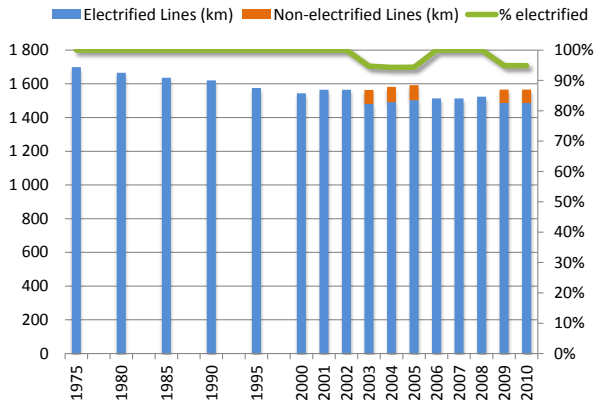


GEORGIA TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

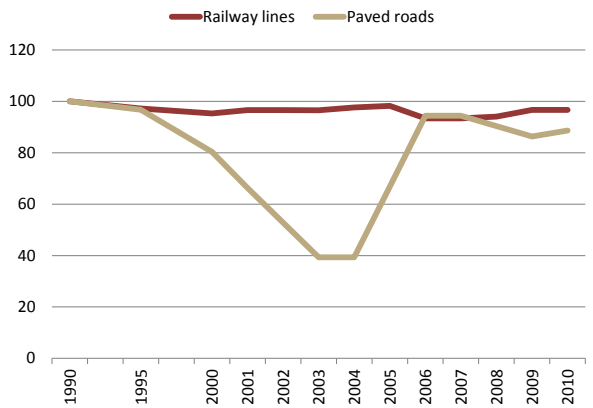


INFRASTRUCTURE

Georgia Railway Lines



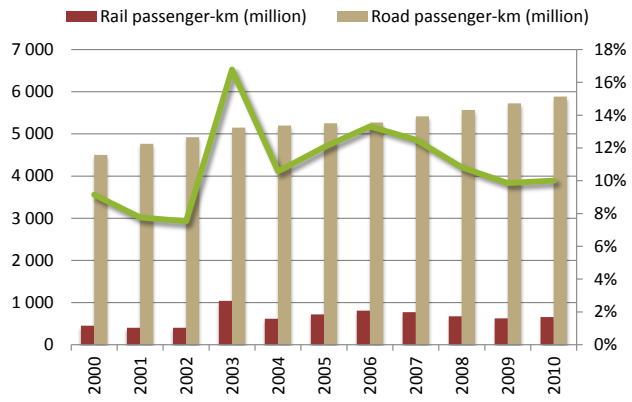
Georgia Infrastructure kms, rail and road (1990=100)



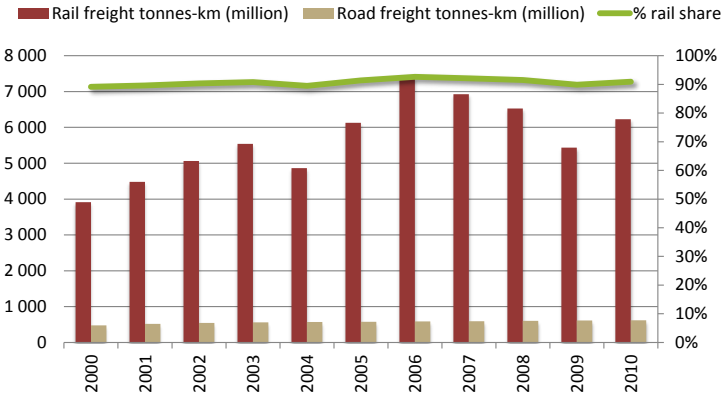
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Georgia	Rail passenger	3.8%	Road passenger	2.7%	Rail freight	4.8%	Road Freight	2.7%

Georgia Passenger Activity



Georgia Freight Activity



INDIA

GEOGRAPHY AND DEMOGRAPHICS

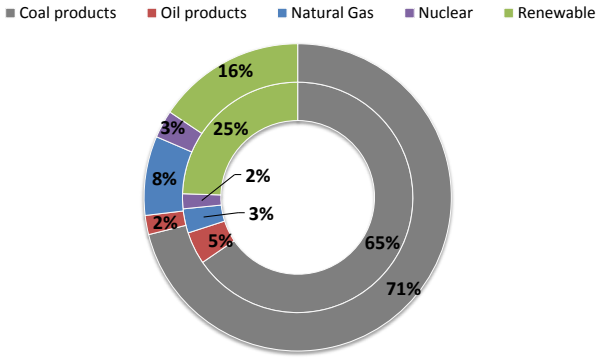
Area m^2 (Land and Water)	3 287 263
Land boundaries	13 888
Population (2013)	1 252 139 596
Population growth rate (1990-2013)	1.6%
Urban population (2013)	400 609 542
Rate of urbanization (1990-2013)	2.6%
GINI index (2012)	33.6

ECONOMICS

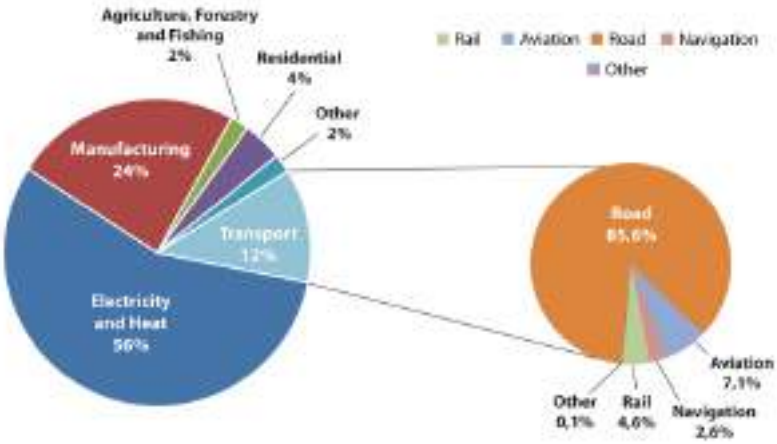
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	350.2	448.7	602.7	834.2	1 243.7	1 458.7	6.4%
GDP per capita (constant 2005 USD)	403	469	578	740	1 032	1 165	4.7%
Value added by sector (% of GDP)							
Agriculture	29%	26%	23%	19%	18%	18%	
Industry	26%	27%	26%	28%	27%	25%	
Services	44%	46%	51%	53%	55%	57%	
Imports (constant 2005 USD billions)	25.5	57.8	86.4	183.7	341.5	429.2	13.1%
Exports (constant 2005 USD billions)	22.6	44.0	72.5	160.8	267.9	352.5	12.7%

ENERGY AND CO_2 EMISSIONS

INDIA NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

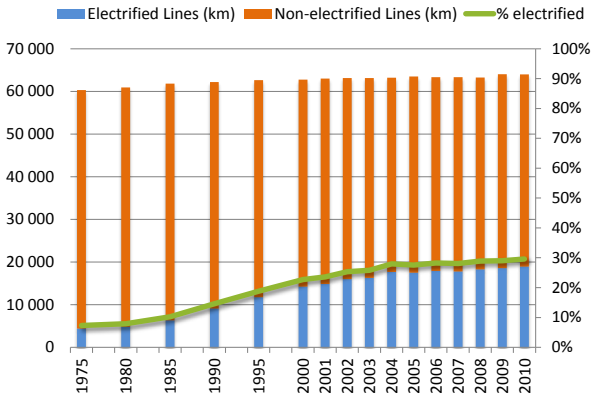


INDIA TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

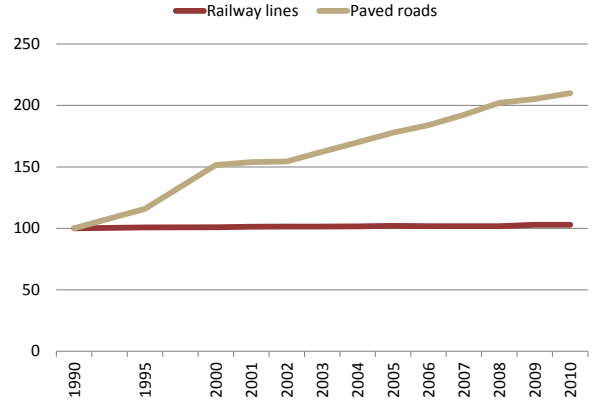


INFRASTRUCTURE

India Railway Lines



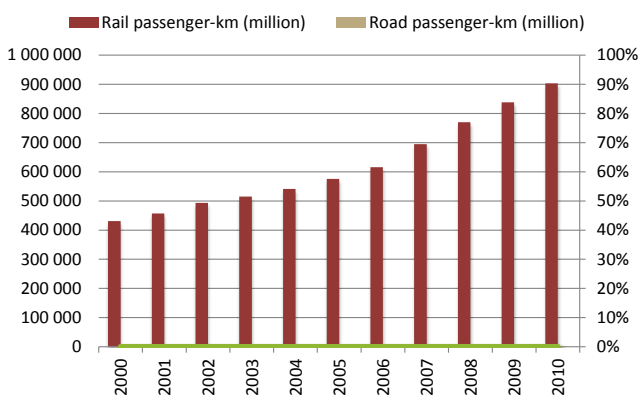
India Infrastructure kms, rail and road (1990=100)



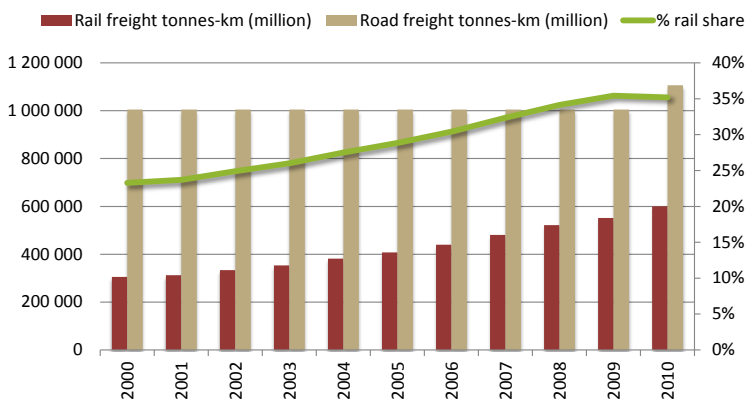
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - India	Rail passenger	7.7%	Road passenger	-	Rail freight	7.0%	Road Freight	1.0%

India Passenger Activity



India Freight Activity



INDONESIA

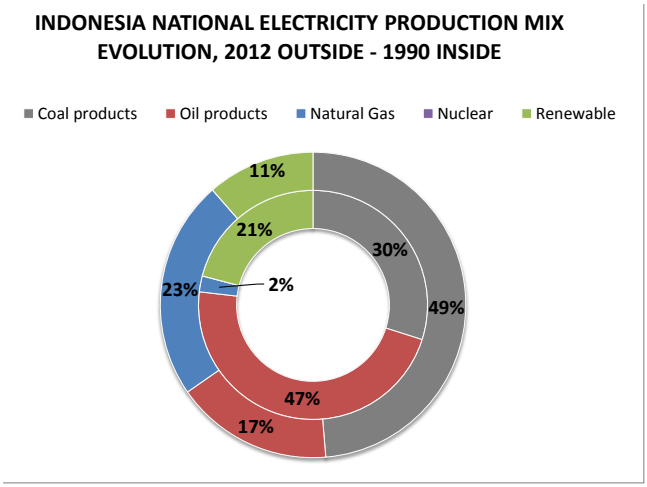
GEOGRAPHY AND DEMOGRAPHICS

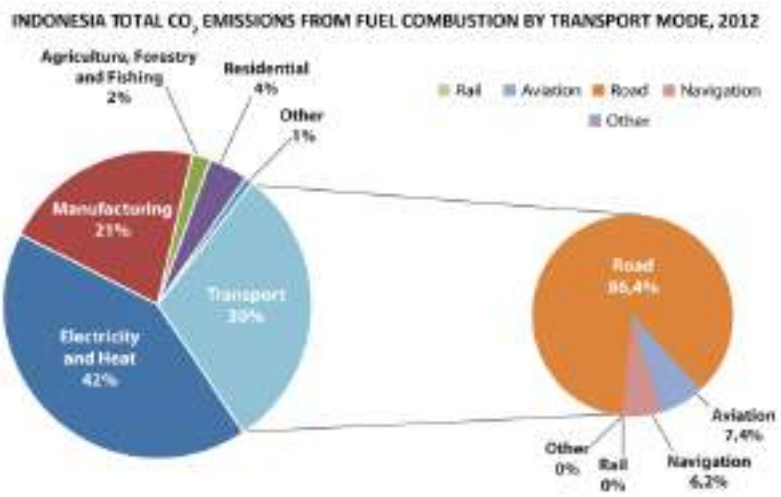
Area m^2 (Land and Water)	1 904 569
Land boundaries	2 958
Population (2013)	249 865 631
Population growth rate (1990-2013)	1.5%
Urban population (2013)	130 559 790
Rate of urbanization (1990-2013)	3.9%
GINI index (2011)	38.14

ECONOMICS

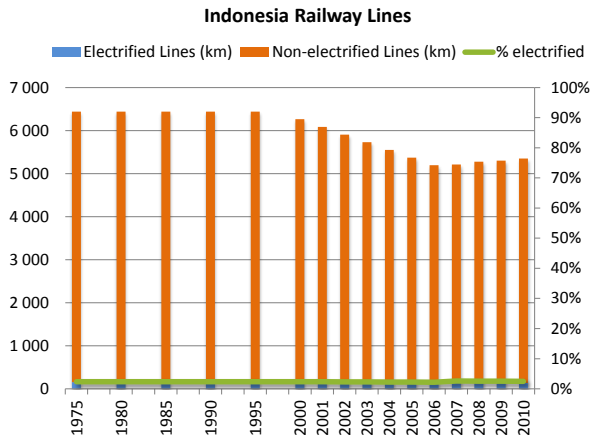
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	150.1	219.2	226.9	285.9	377.9	452.3	4.9%
GDP per capita (constant 2005 USD)	840	1 129	1 086	1 273	1 570	1 810	3.4%
Value added by sector (% of GDP)							
Agriculture	19%	17%	16%	13%	15%	14%	
Industry	39%	42%	46%	47%	47%	46%	
Services	41%	41%	38%	40%	38%	40%	
Imports (constant 2005 USD billions)	34.2	65.3	56.6	85.5	111.2	136.0	6.2%
Exports (constant 2005 USD billions)	37.0	62.8	69.9	97.4	131.9	161.0	6.6%

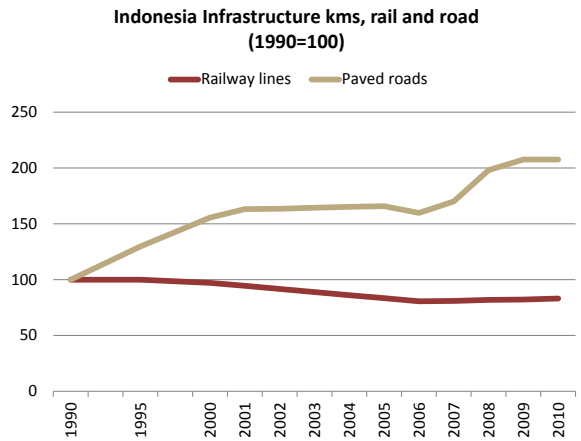
ENERGY AND CO_2 EMISSIONS





INFRASTRUCTURE





TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Indonesia	Rail passenger	5.5%	Road passenger	-	Rail freight	0.9%	Road Freight	-

JAPAN

GEOGRAPHY AND DEMOGRAPHICS

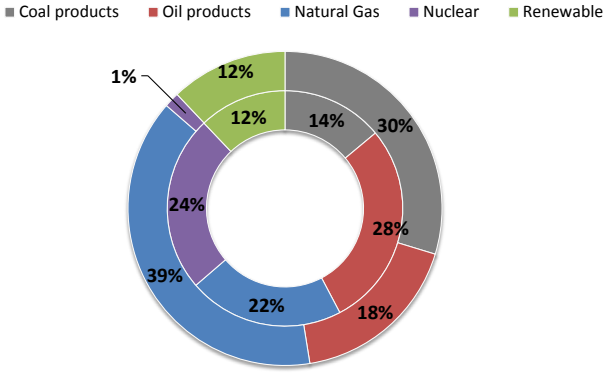
Area m2 (Land and Water)	377 915
Land boundaries	0
Population (2013)	127 338 621
Population growth rate (1990-2013)	0.1%
Urban population (2013)	117 776 764
Rate of urbanization (1990-2013)	0.9%
GINI index (2008)	32.11

ECONOMICS

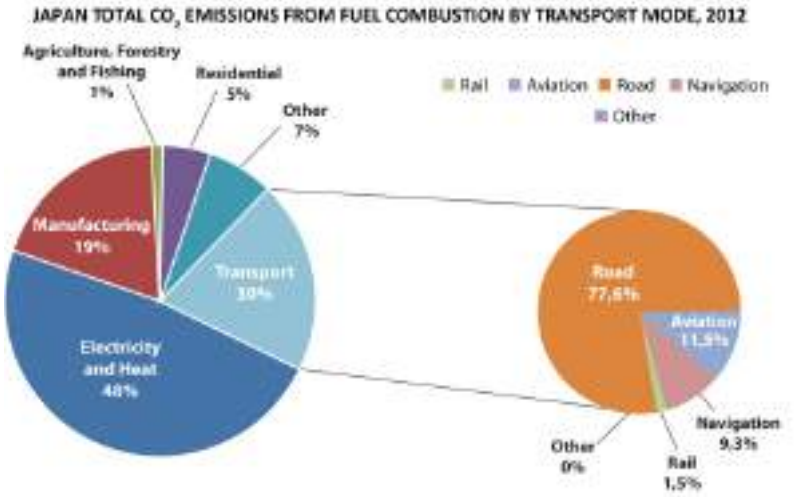
	1990	1995	2000	2005	2010	2012	1990-2012
GDP (constant 2005 USD billions)	3 851.1	4 132.2	4 308.1	4 571.9	4 648.5	4 708.6	0.9%
GDP per capita (constant 2005 USD)	31 174	32 942	33 957	35 781	36 473	36 912	0.8%
Value added by sector (% of GDP)							
Agriculture	2%	2%	2%	1%	1%	1%	
Industry	38%	33%	31%	28%	28%	26%	
Services	60%	65%	67%	71%	71%	73%	
Imports (constant 2005 USD billions)	346.9	403.7	498.4	590.0	592.8	660.9	3.0%
Exports (constant 2005 USD billions)	314.4	375.1	491.7	654.4	747.6	743.6	4.0%

ENERGY AND CO_2 EMISSIONS

JAPAN NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

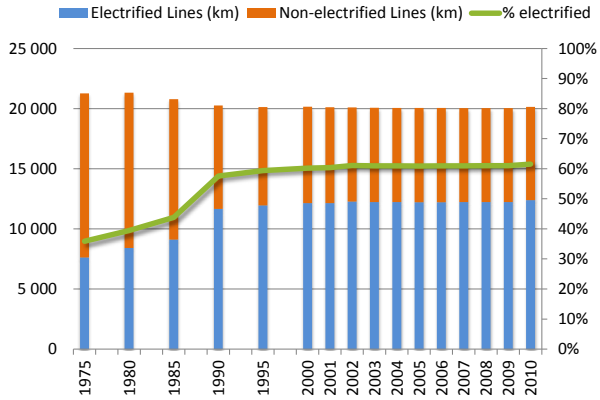


JAPAN TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

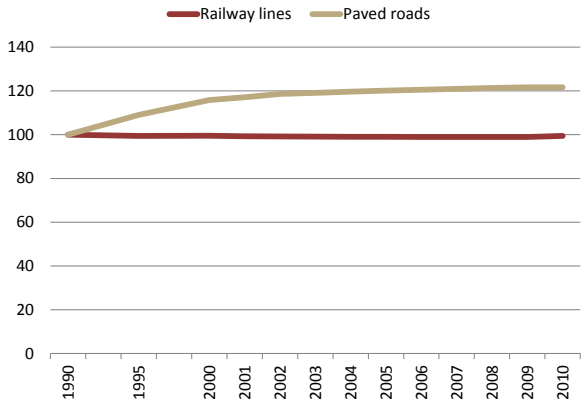


INFRASTRUCTURE

Japan Railway Lines



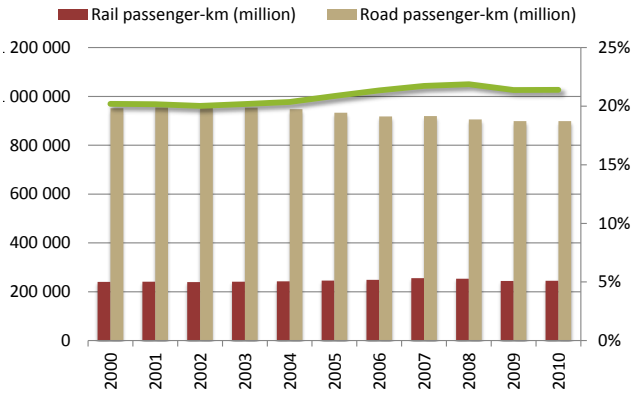
Japan Infrastructure kms, rail and road (1990=100)



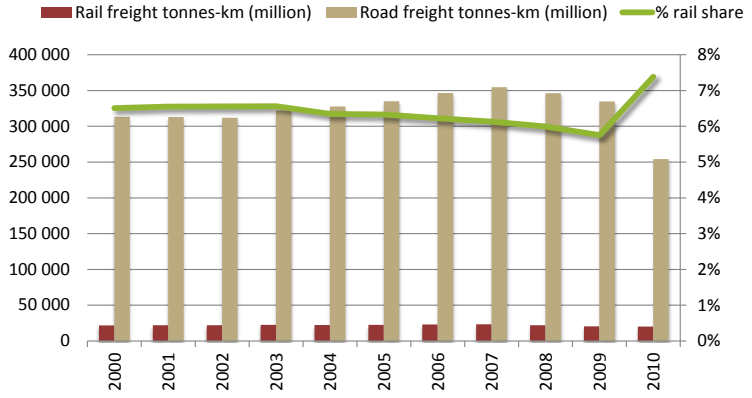
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Japan	Rail passenger	0.2%	Road passenger	-0.6%	Rail freight	-0.7%	Road Freight	-2.1%

Japan Passenger Activity



Japan Freight Activity



KAZAKHSTAN

GEOGRAPHY AND DEMOGRAPHICS

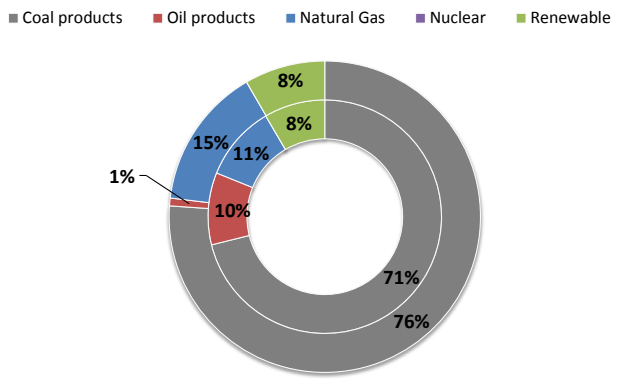
Area m2 (Land and Water)	2 724 900
Land boundaries	13 364
Population (2013)	17 037 508
Population growth rate (1990-2013)	0.2%
Urban population (2013)	9 091 385
Rate of urbanization (1990-2013)	-0.1%
GINI index (2010)	28.56

ECONOMICS

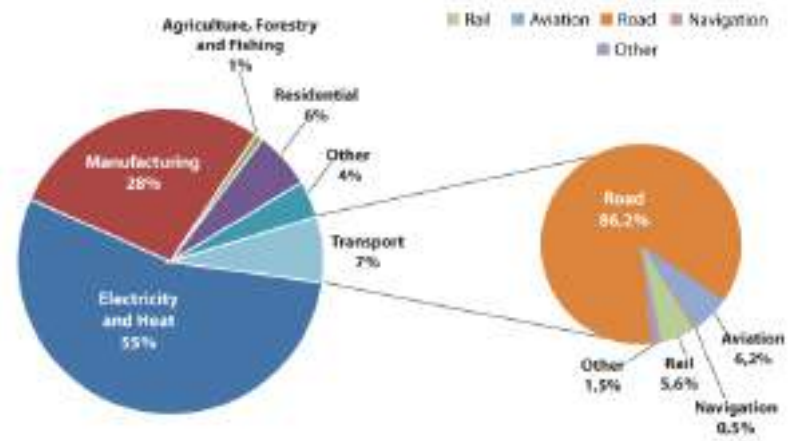
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	50.2	30.8	34.9	57.1	77.2	92.4	2.7%
GDP per capita (constant 2005 USD)	3 073	1 951	2 344	3 771	4 733	5 425	2.5%
Value added by sector (% of GDP)							
Agriculture	-	13%	9%	7%	5%	5%	
Industry	-	31%	40%	40%	43%	37%	
Services	-	56%	51%	53%	52%	58%	
Imports (constant 2005 USD billions)	78.1	24.3	21.0	25.5	27.8	36.5	-3.3%
Exports (constant 2005 USD billions)	24.2	17.0	22.0	30.4	32.4	34.0	1.5%

ENERGY AND CO_2 EMISSIONS

KAZAKHSTAN NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

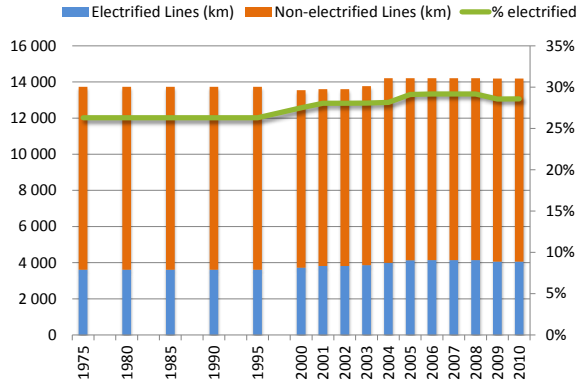


KAZAKHSTAN TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

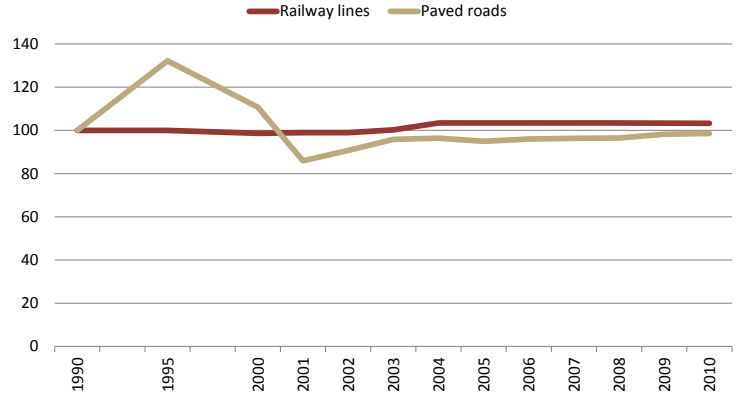


INFRASTRUCTURE

Kazakhstan Railway Lines



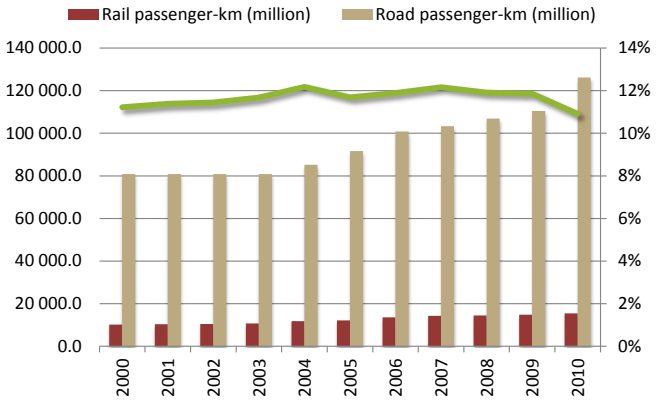
Kazakhstan Infrastructure kms, rail and road (1990=100)



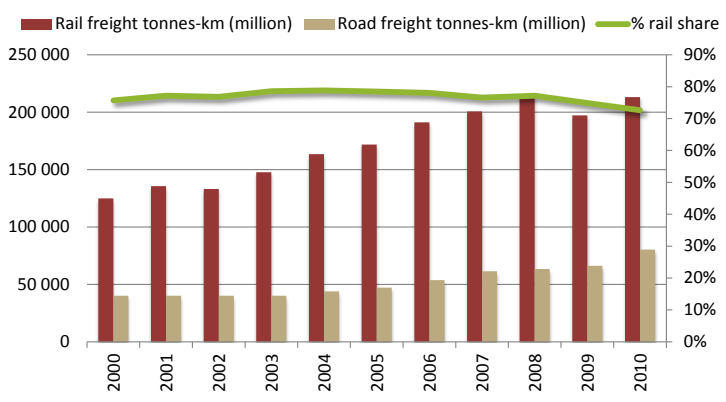
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Kazakhstan	Rail passenger 4.2%	Road passenger 4.6%	Rail freight 5.5%	Road Freight 7.2%

Kazakhstan Passenger Activity



Kazakhstan Freight Activity



GEOGRAPHY AND DEMOGRAPHICS

KYRGYZSTAN

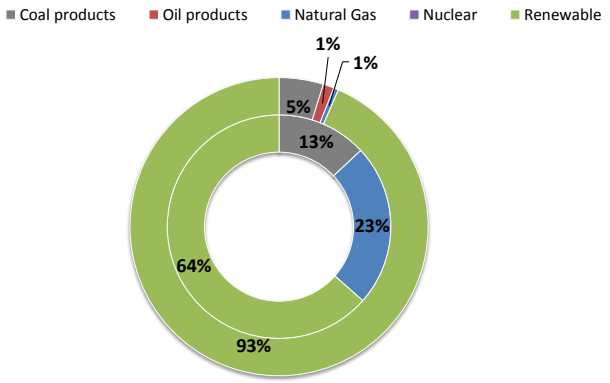
Area m2 (Land and Water)	199 951
Land boundaries	4 573
Population (2013)	5 719 500
Population growth rate (1990-2013)	1.2%
Urban population (2013)	2 029 450
Rate of urbanization (1990-2013)	0.9%
GINI index (2011)	33.39

ECONOMICS

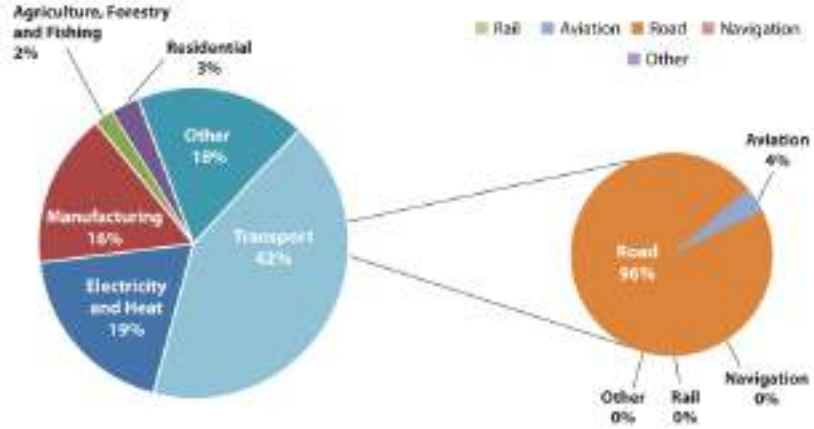
	1990	1995	2000	2005	2010	2013	1995-2013
GDP (constant 2005 USD billions)	3.1	1.6	2.0	2.5	3.1	3.6	4.7%
GDP per capita (constant 2005 USD)	699	341	417	476	561	625	3.4%
Value added by sector (% of GDP)							
Agriculture	34%	44%	37%	32%	19%	18%	
Industry	35%	20%	31%	22%	29%	27%	
Services	31%	37%	32%	46%	51%	56%	
Imports (constant 2005 USD billions)	-	1.2	1.0	1.4	1.9	2.6	4.4%
Exports (constant 2005 USD billions)	-	0.7	0.9	0.9	1.2	1.4	3.6%

ENERGY AND CO_2 EMISSIONS

KYRGYZSTAN NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

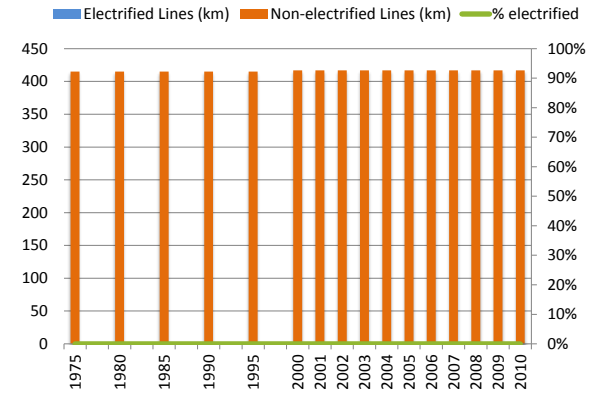


KYRGYZSTAN TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

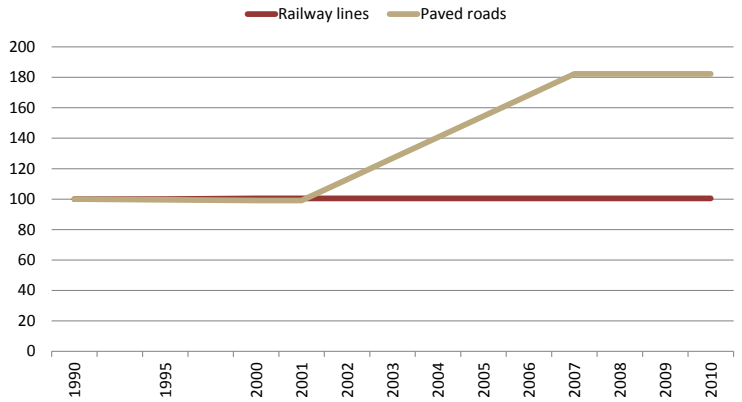


INFRASTRUCTURE

Kyrgyz Republic Railway Lines



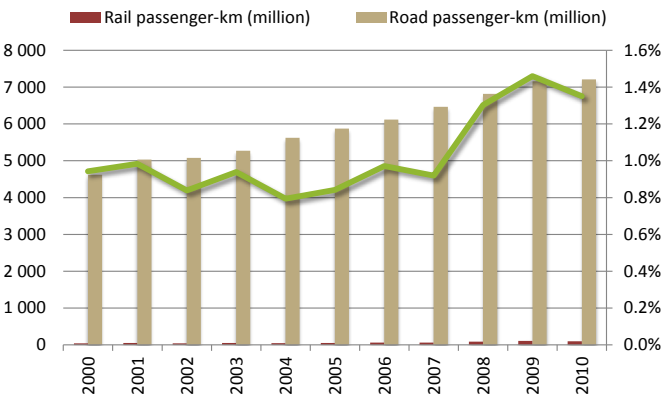
Kyrgyz Republic Infrastructure kms, rail and road (1990=100)



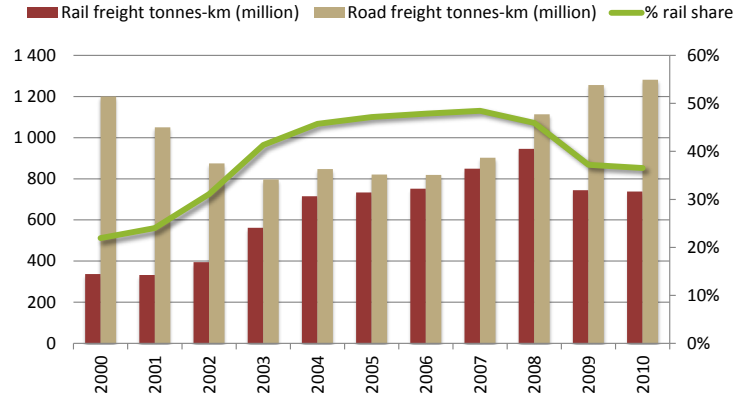
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Kyrgyz Republic	Rail passenger	8.4%	Road passenger	4.5%	Rail freight	8.1%	Road Freight	0.7%

Kyrgyz Republic Passenger Activity



Kyrgyz Republic Freight Activity



MALAYSIA

GEOGRAPHY AND DEMOGRAPHICS

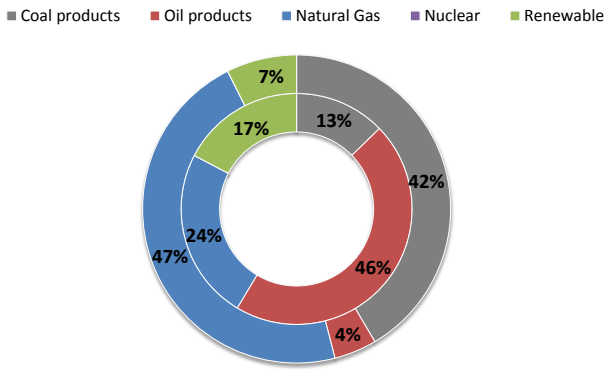
Area m^2 (Land and Water)	329 847
Land boundaries	2 742
Population (2013)	29 716 965
Population growth rate (1990-2013)	2.2%
Urban population (2013)	21 777 781
Rate of urbanization (1990-2013)	3.9%
GINI index (2009)	46.21

ECONOMICS

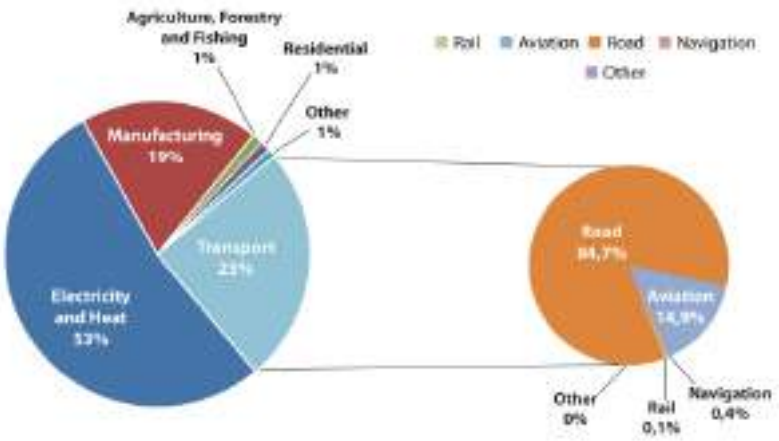
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	57.3	90.1	113.9	143.5	178.7	207.9	5.8%
GDP per capita (constant 2005 USD)	3 147	4 348	4 862	5 554	6 319	6 998	3.5%
Value added by sector (% of GDP)							
Agriculture	15%	13%	9%	8%	10%	9%	
Industry	42%	41%	48%	46%	41%	41%	
Services	43%	46%	43%	45%	48%	50%	
Imports (constant 2005 USD billions)	33.3	79.3	98.4	130.6	154.5	171.5	7.4%
Exports (constant 2005 USD billions)	38.9	82.1	124.8	162.0	180.5	186.2	7.0%

ENERGY AND CO_2 EMISSIONS

MALAYSIA NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

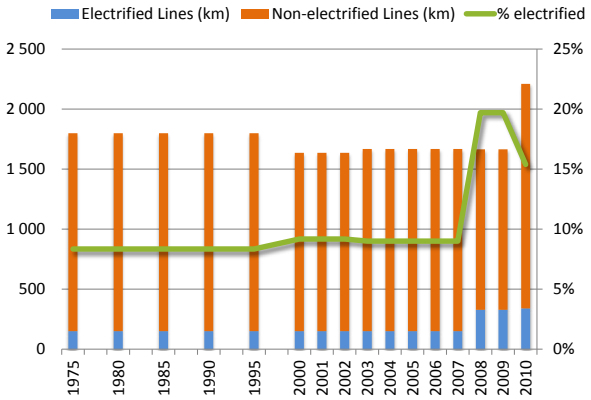


MALAYSIA TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

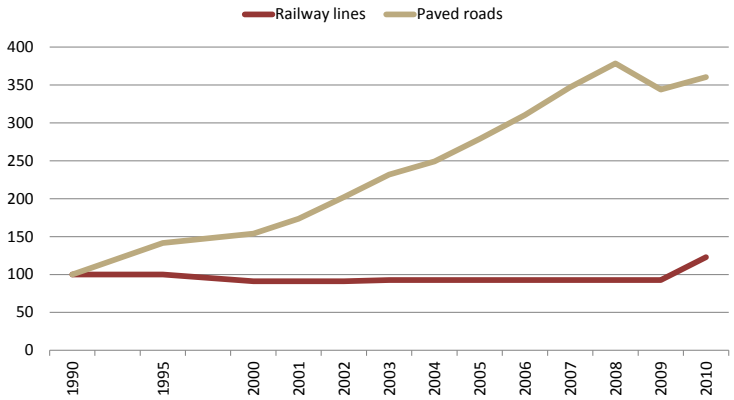


INFRASTRUCTURE

Malaysia Railway Lines



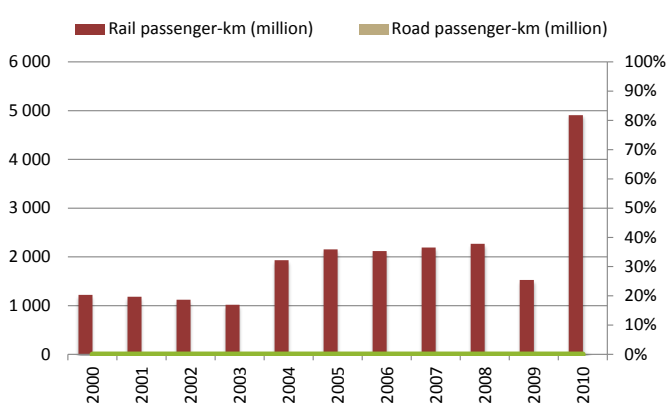
Malaysia Infrastructure kms, rail and road (1990=100)



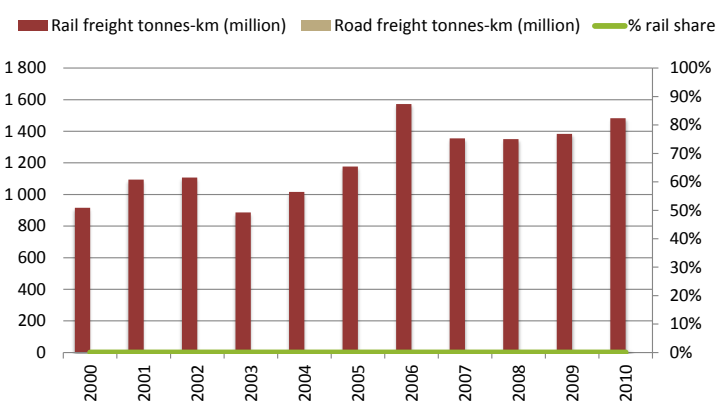
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Malaysia	Rail passenger	14.9%	Road passenger	-	Rail freight	4.9%	Road Freight	-

Malaysia Passenger Activity



Malaysia Freight Activity



MONGOLIA

GEOGRAPHY AND DEMOGRAPHICS

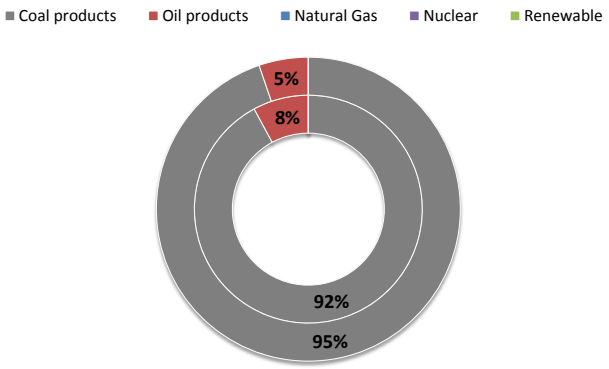
Area m2 (Land and Water)	1 564 116
Land boundaries	8 082
Population (2013)	2 839 073
Population growth rate (1990-2013)	1.1%
Urban population (2013)	1 997 742
Rate of urbanization (1990-2013)	2.1%
GINI index (2008)	36.52

ECONOMICS

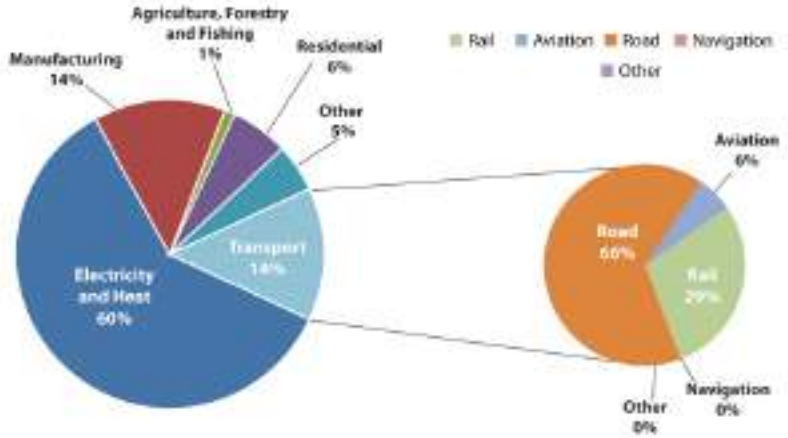
	1990	1995	2000	2005	2010	2013	2005-2013
GDP (constant 2005 USD billions)	1.8	1.6	1.8	2.5	3.5	5.1	9.2%
GDP per capita (constant 2005 USD)	846	701	769	999	1 273	1 796	7.6%
Value added by sector (% of GDP)							
Agriculture	13%	34%	31%	22%	16%	16%	
Industry	42%	35%	25%	36%	38%	33%	
Services	45%	31%	44%	42%	46%	50%	
Imports (constant 2005 USD billions)	-	-	-	1.6	3.2	6.0	17.9%
Exports (constant 2005 USD billions)	-	-	-	1.5	2.4	3.3	10.7%

ENERGY AND CO_2 EMISSIONS

MONGOLIA NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

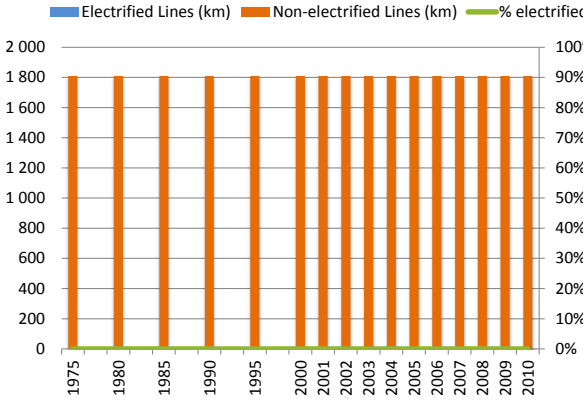


MONGOLIA TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

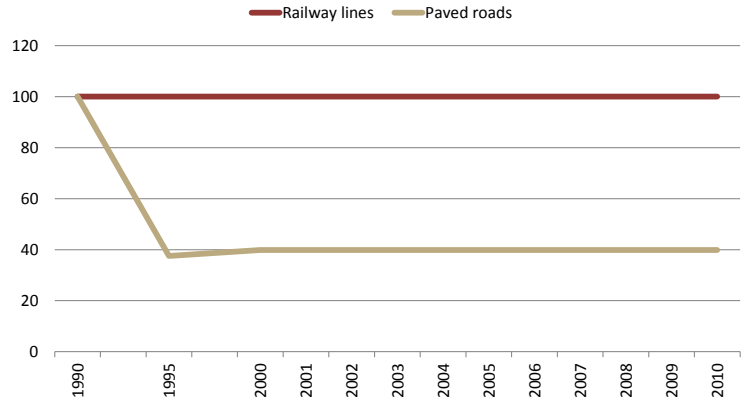


INFRASTRUCTURE

Mongolia Railway Lines



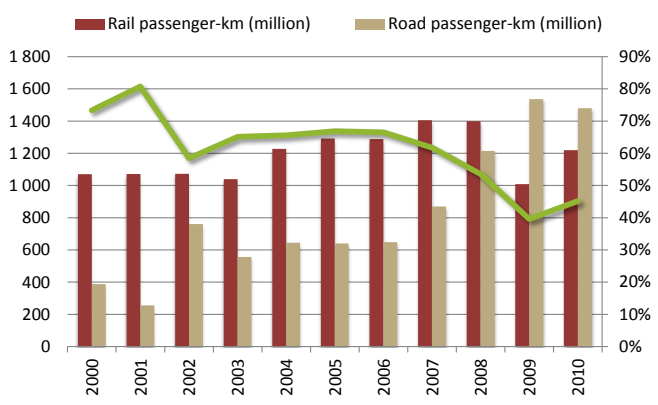
Mongolia Infrastructure kms, rail and road (1990=100)



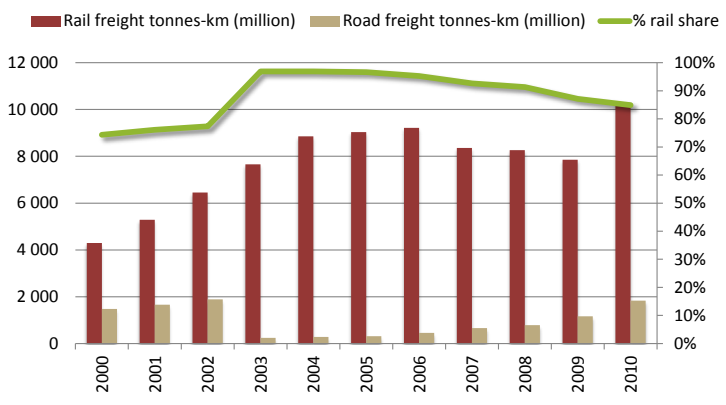
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Mongolia	Rail passenger	1.3%	Road passenger	14.3%	Rail freight	9.1%	Road Freight	2.2%

Mongolia Passenger Activity



Mongolia Freight Activity



MYANMAR

GEOGRAPHY AND DEMOGRAPHICS

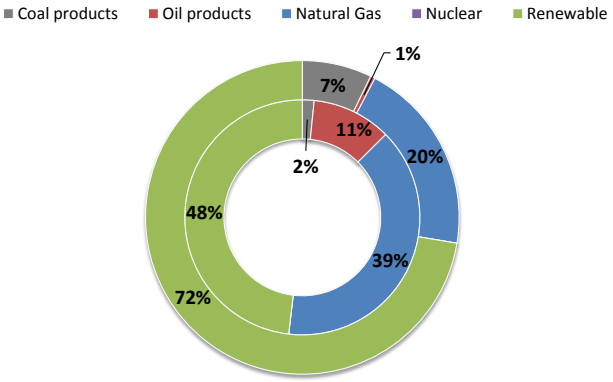
Area m2 (Land and Water)	676 578
Land boundaries	6 522
Population (2013)	53 259 018
Population growth rate (1990-2013)	1.0%
Urban population (2013)	17 579 204
Rate of urbanization (1990-2013)	2.3%
GINI index	-

ECONOMICS

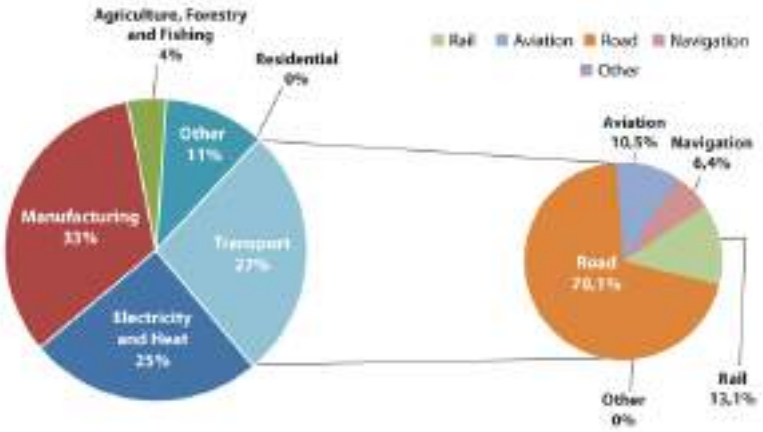
	1990	1995	2000	2005	2010	2013	CAGR
GDP (constant 2005 USD billions)	-	-	-	-	-	-	-
GDP per capita (constant 2005 USD)	-	-	-	-	-	-	-
Value added by sector (% of GDP)							
Agriculture	57%	60%	57%	-	-	-	
Industry	11%	10%	10%	-	-	-	
Services	32%	30%	33%	-	-	-	
Imports (constant 2005 USD billions)	-	-	-	-	-	-	-
Exports (constant 2005 USD billions)	-	-	-	-	-	-	-

ENERGY AND CO_2 EMISSIONS

MYANMAR NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

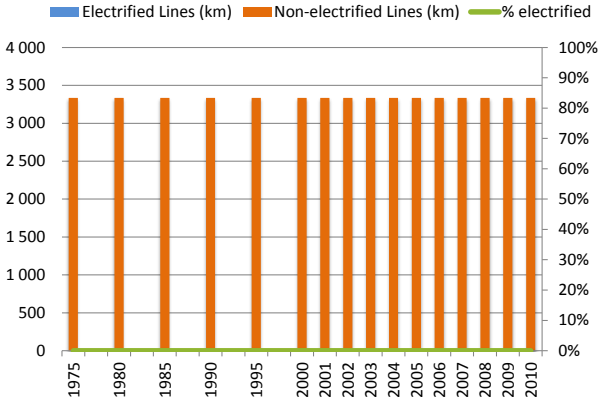


MYANMAR TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

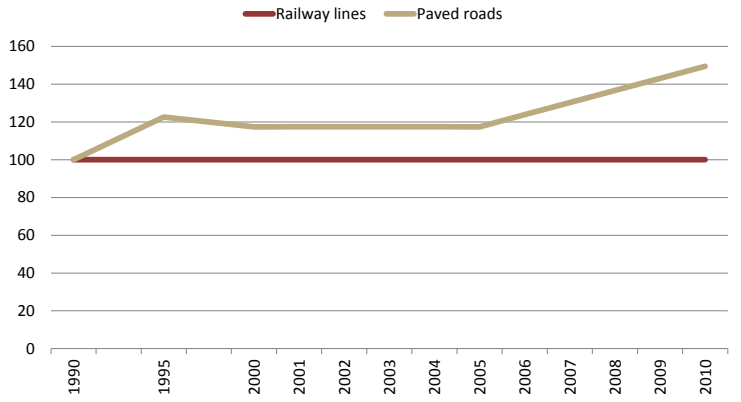


INFRASTRUCTURE

Myanmar Railway Lines



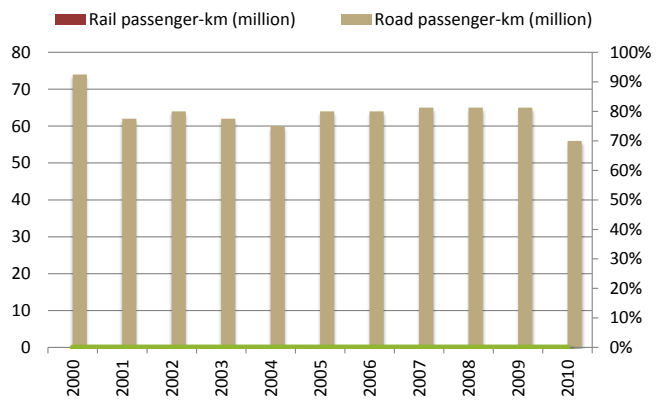
Myanmar Infrastructure kms, rail and road (1990=100)



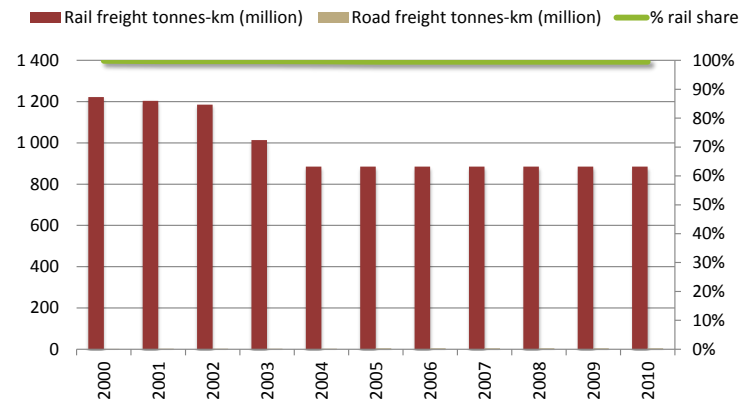
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Myanmar	Rail passenger	-	Road passenger	-2.7%	Rail freight	-3.2%	Road Freight	7.2%

Myanmar Passenger Activity



Myanmar Freight Activity



NEPAL

GEOGRAPHY AND DEMOGRAPHICS

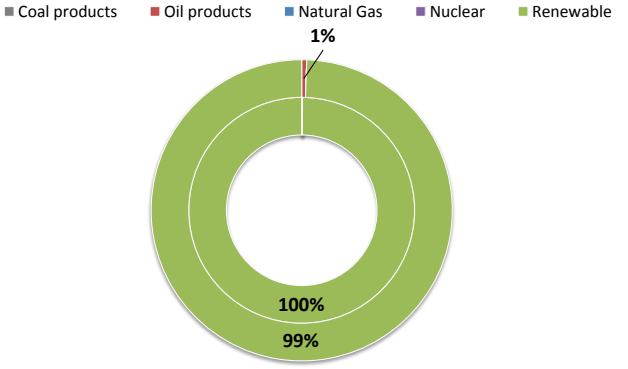
Area m2 (Land and Water)	147 181
Land boundaries	3 159
Population (2013)	27 797 457
Population growth rate (1990-2013)	1.9%
Urban population (2013)	4 969 351
Rate of urbanization (1990-2013)	5.0%
GINI index (2010)	32.82

ECONOMICS

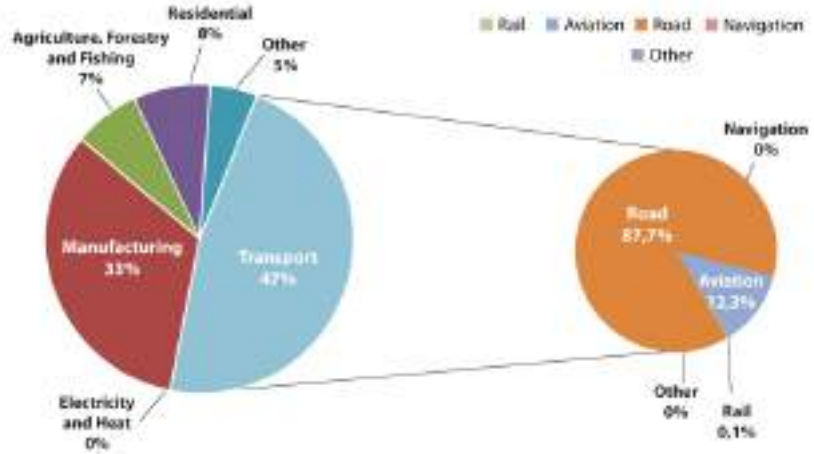
	1990	1995	2000	2005	2010	2013	2000-2013
GDP (constant 2005 USD billions)	4.2	5.4	6.9	8.1	10.1	11.4	4.4%
GDP per capita (constant 2005 USD)	233	264	297	321	376	409	2.5%
Value added by sector (% of GDP)							
Agriculture	52%	42%	41%	36%	37%	35%	
Industry	16%	23%	22%	18%	16%	16%	
Services	32%	35%	37%	46%	48%	49%	
Imports (constant 2005 USD billions)	-	-	2.4	2.4	4.1	4.6	5.5%
Exports (constant 2005 USD billions)	-	-	1.5	1.2	1.1	1.2	-1.8%

ENERGY AND CO_2 EMISSIONS

NEPAL NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

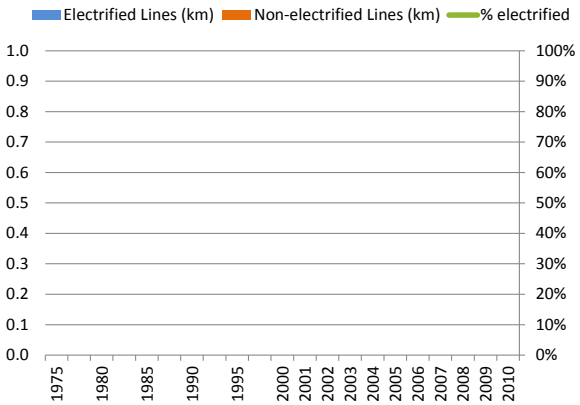


NEPAL TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

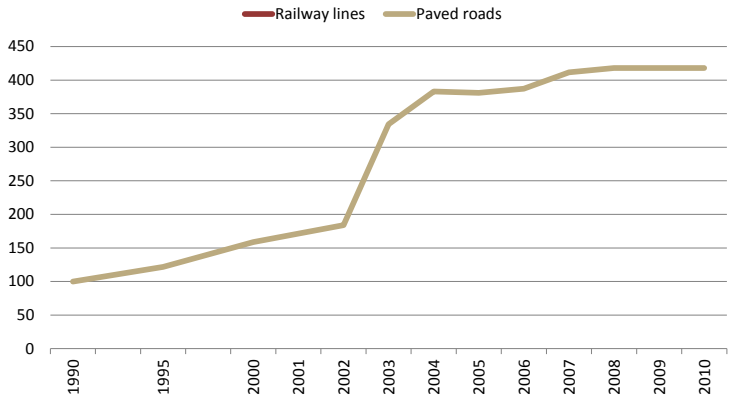


INFRASTRUCTURE

Nepal Railway Lines



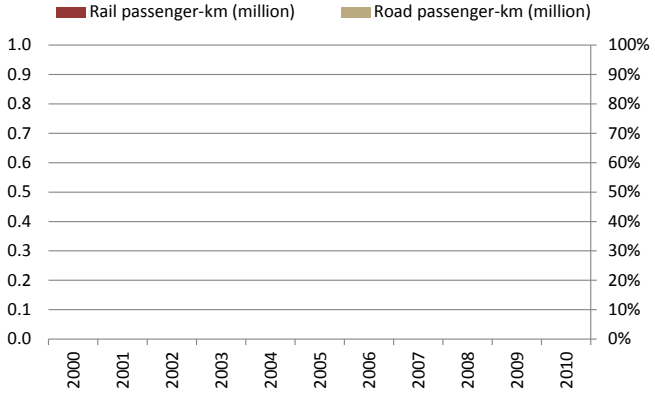
Nepal Infrastructure kms, rail and road (1990=100)



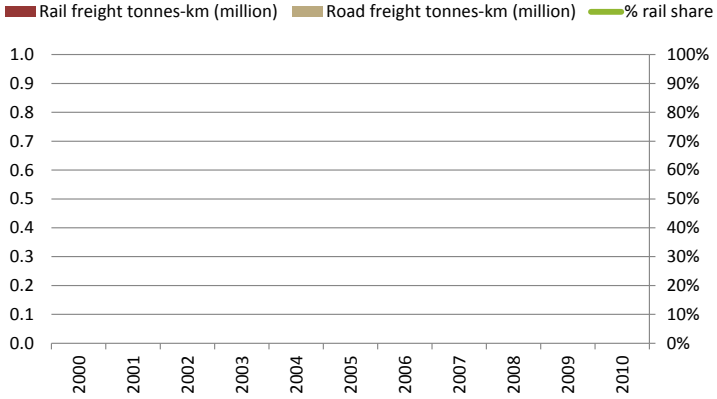
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Nepal	Rail passenger -	Road passenger -	Rail freight -	Road Freight -

Nepal Passenger Activity



Nepal Freight Activity



NEW ZEALAND

GEOGRAPHY AND DEMOGRAPHICS

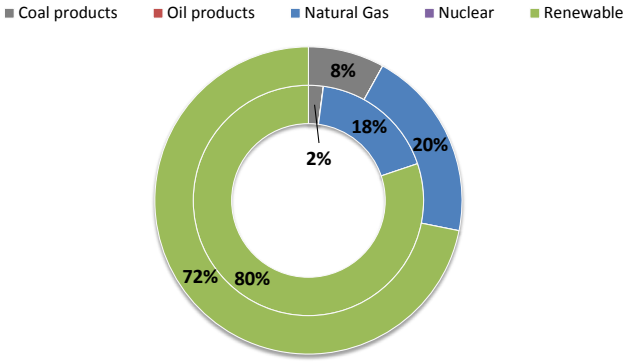
Area m2 (Land and Water)	267 710
Land boundaries	0
Population (2013)	4 470 800
Population growth rate (1990-2013)	1.3%
Urban population (2013)	3 854 858
Rate of urbanization (1990-2013)	1.4%
GINI index	-

ECONOMICS

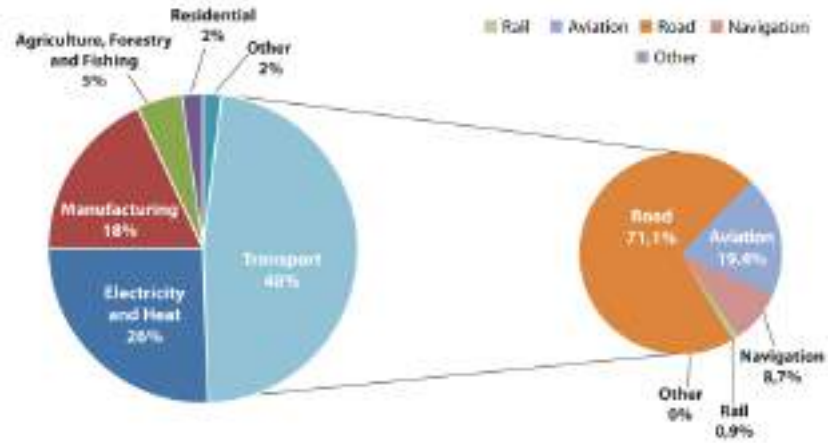
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	69.3	80.7	94.0	113.8	121.2	130.3	2.8%
GDP per capita (constant 2005 USD)	20 810	21 960	24 362	27 526	27 742	29 146	1.5%
Value added by sector (% of GDP)							
Agriculture	7%	7%	8%	5%	7%	-	
Industry	29%	28%	25%	26%	24%	-	
Services	65%	65%	66%	69%	69%	-	
Imports (constant 2005 USD billions)	13.7	18.6	22.7	34.1	36.3	42.2	5.0%
Exports (constant 2005 USD billions)	15.9	21.6	27.7	32.4	36.4	38.5	3.9%

ENERGY AND CO_2 EMISSIONS

NEW ZEALAND NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

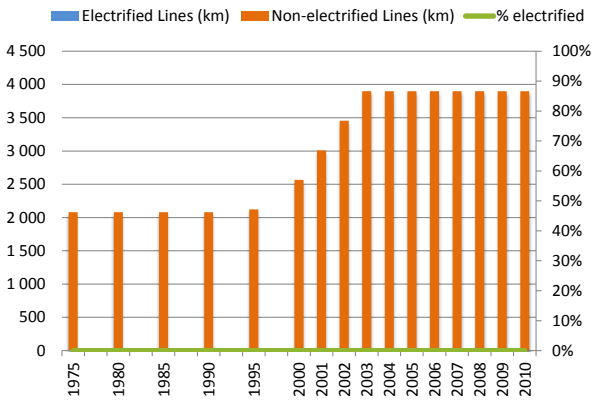


NEW ZELAND TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

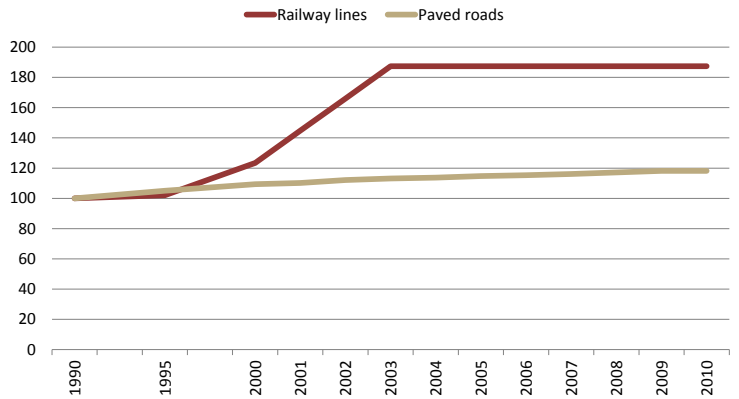


INFRASTRUCTURE

New Zealand Railway Lines



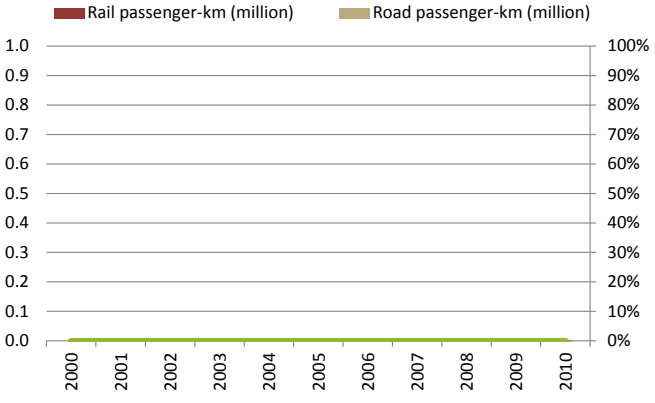
New Zealand Infrastructure kms, rail and road (1990=100)



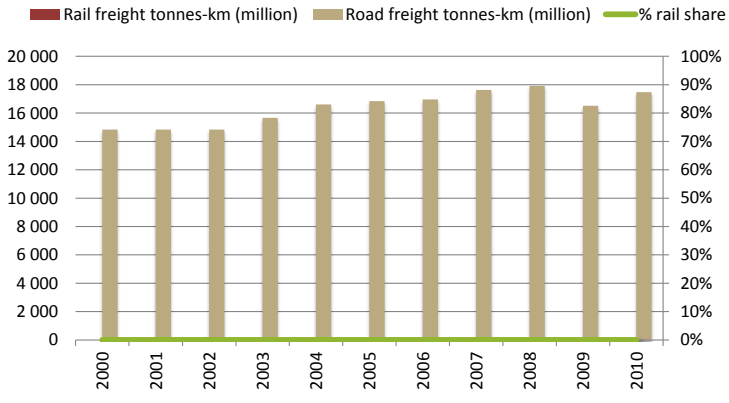
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - New Zealand	Rail passenger	-	Road passenger	-	Rail freight	-	Road Freight	-1.7%

New Zealand Passenger Activity



New Zealand Freight Activity



PAKISTAN

GEOGRAPHY AND DEMOGRAPHICS

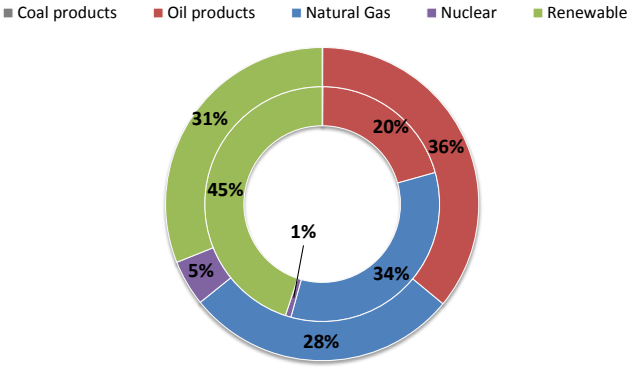
Area m^2 (Land and Water)	796 905
Land boundaries	7 257
Population (2013)	182 142 594
Population growth rate (1990-2013)	2.2%
Urban population (2013)	68 959 186
Rate of urbanization (1990-2013)	3.1%
GINI index (2011)	29.63

ECONOMICS

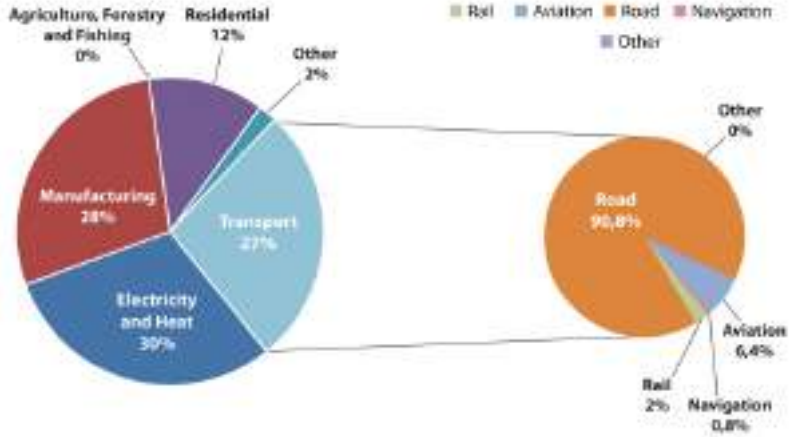
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	58.3	73.1	85.8	109.5	129.5	143.8	4.0%
GDP per capita (constant 2005 USD)	525	577	597	693	748	790	1.8%
Value added by sector (% of GDP)							
Agriculture	26%	26%	26%	21%	24%	25%	
Industry	25%	24%	23%	27%	21%	21%	
Services	49%	50%	51%	51%	55%	54%	
Imports (constant 2005 USD billions)	11.6	14.9	14.2	21.4	22.7	22.3	2.9%
Exports (constant 2005 USD billions)	6.5	9.9	10.1	17.2	20.5	20.2	5.1%

ENERGY AND CO_2 EMISSIONS

PAKISTAN NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

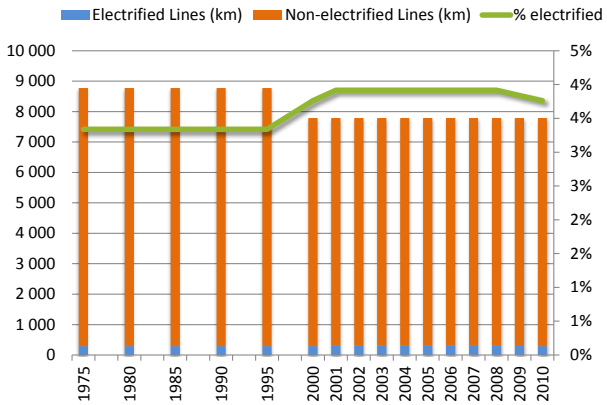


PAKISTAN TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

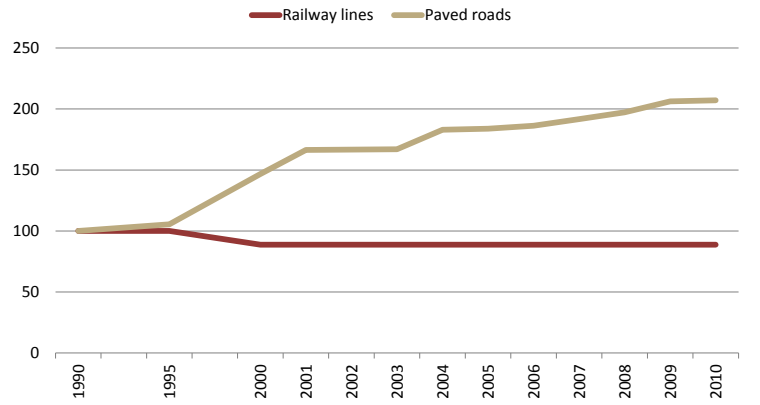


INFRASTRUCTURE

Pakistan Railway Lines



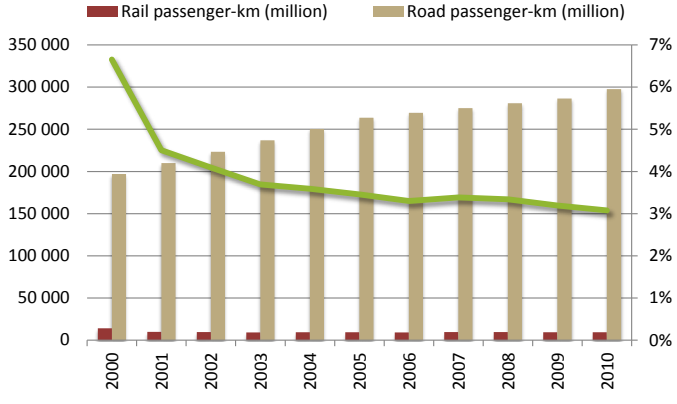
Pakistan Infrastructure kms, rail and road (1990=100)



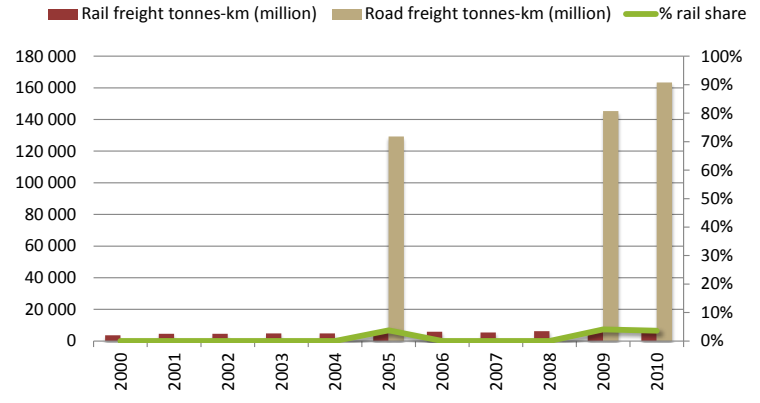
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Pakistan	Rail passenger	-3.9%	Road passenger	4.2%	Rail freight	5.5%	Road Freight	-

Pakistan Passenger Activity



Pakistan Freight Activity



GEOGRAPHY AND DEMOGRAPHICS

PHILIPPINES

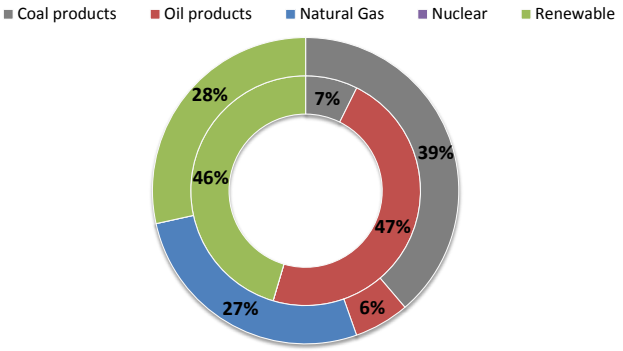
Area m^2 (Land and Water)	300 000
Land boundaries	0
Population (2013)	98 393 574
Population growth rate (1990-2013)	2.0%
Urban population (2013)	43 916 004
Rate of urbanization (1990-2013)	1.7%
GINI index (2012)	43.03

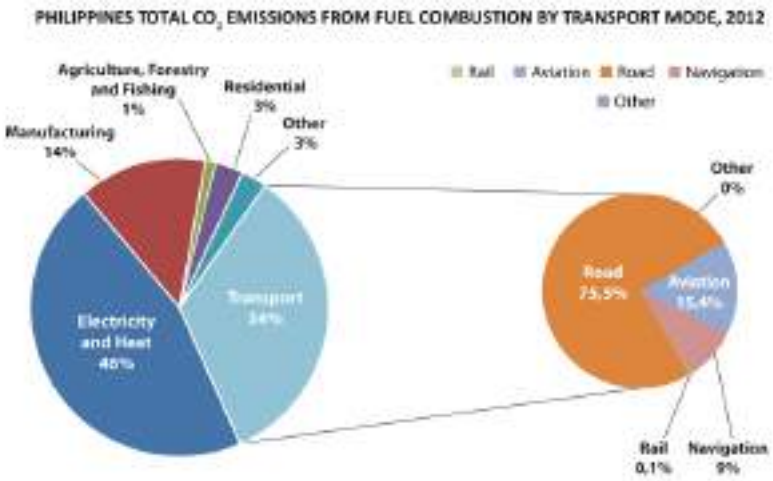
ECONOMICS

	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	62.1	69.1	82.4	103.1	131.1	155.6	4.1%
GDP per capita (constant 2005 USD)	1 002	993	1 061	1 201	1 403	1 581	2.0%
Value added by sector (% of GDP)							
Agriculture	22%	22%	14%	13%	12%	11%	
Industry	34%	32%	34%	34%	33%	31%	
Services	44%	46%	52%	54%	55%	58%	
Imports (constant 2005 USD billions)	20.8	33.1	42.5	53.3	64.2	70.6	5.5%
Exports (constant 2005 USD billions)	18.7	29.6	39.5	47.6	62.0	64.9	5.6%

ENERGY AND CO_2 EMISSIONS

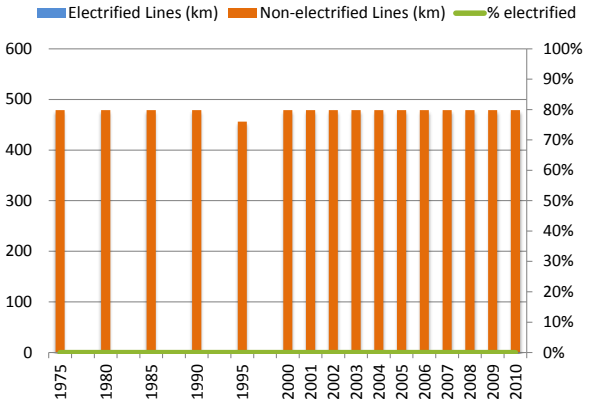
PHILIPPINES NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE



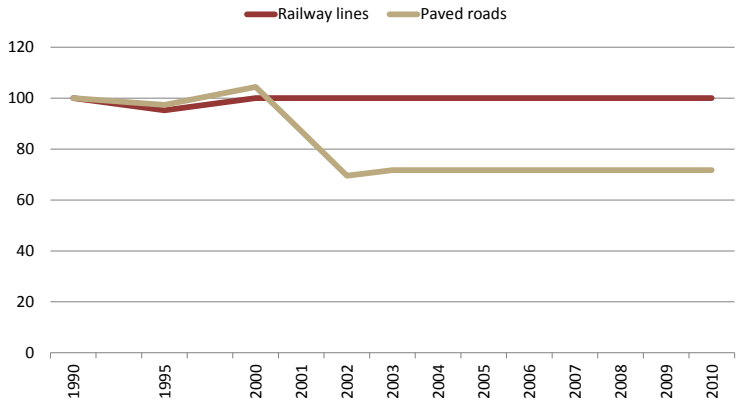


INFRASTRUCTURE

Philippines Railway Lines



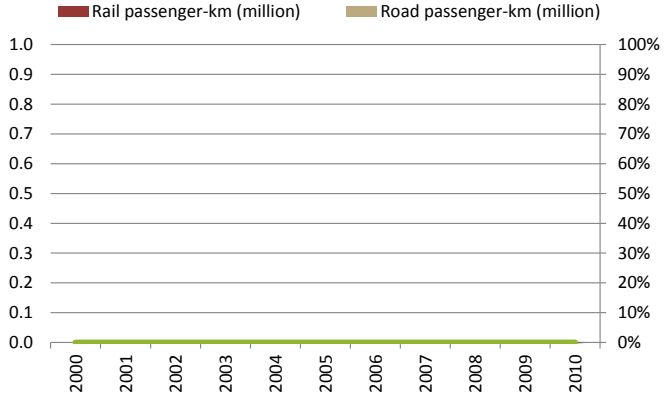
Philippines Infrastructure kms, rail and road (1990=100)



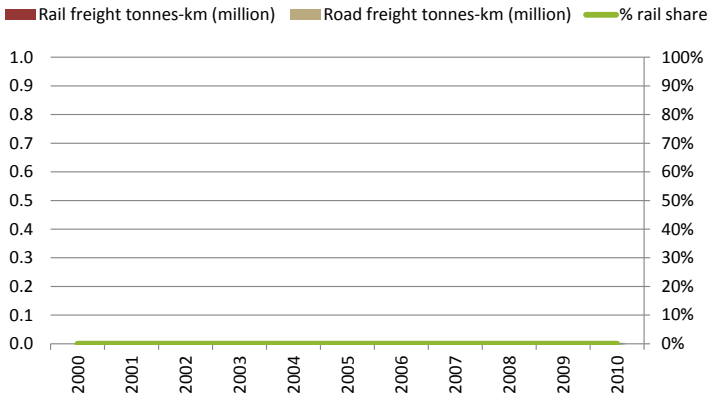
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Philippines	Rail passenger -	Road passenger -	Rail freightì -	Road Freight -

Philippines Passenger Activity



Philippines Freight Activity



REPUBLIC OF KOREA

GEOGRAPHY AND DEMOGRAPHICS

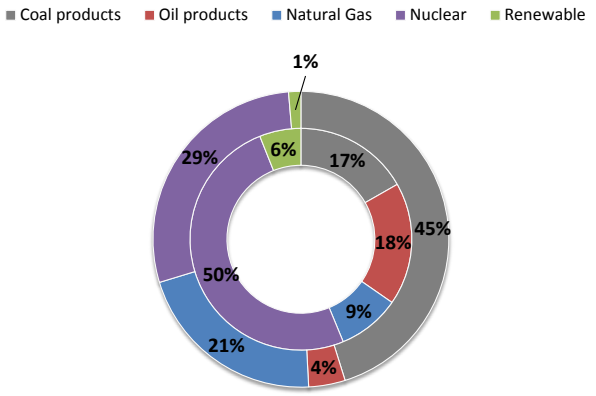
Area m^2 (Land and Water)	99 720
Land boundaries	237
Population (2013)	50 219 669
Population growth rate (1990-2013)	0.7%
Urban population (2013)	41 305 176
Rate of urbanization (1990-2013)	1.2%
GINI index	-

ECONOMICS

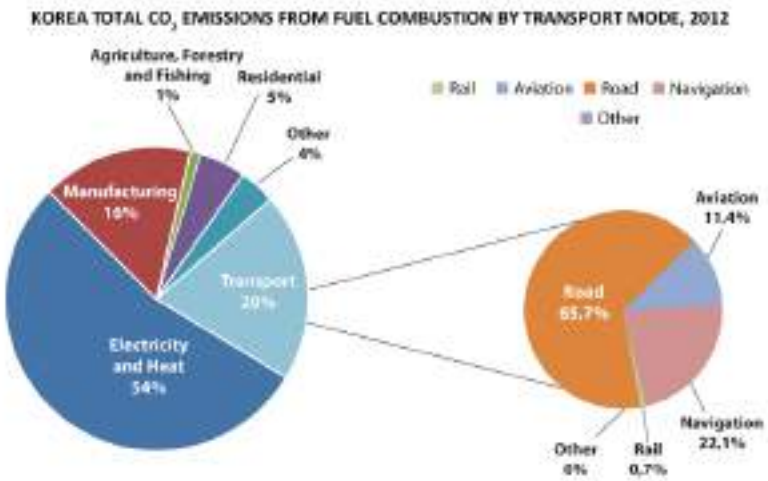
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	378.5	553.3	712.8	898.1	1 098.7	1 199.9	5.1%
GDP per capita (constant 2005 USD)	8 829	12 271	15 162	18 657	22 236	23 893	4.4%
Value added by sector (% of GDP)							
Agriculture	8%	6%	4%	3%	2%	2%	
Industry	38%	38%	38%	37%	38%	39%	
Services	54%	56%	58%	59%	59%	59%	
Imports (constant 2005 USD billions)	74.2	146.6	208.0	308.7	436.9	519.8	8.8%
Exports (constant 2005 USD billions)	47.6	96.3	202.1	330.6	504.1	635.9	11.9%

ENERGY AND CO_2 EMISSIONS

KOREA REP. ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

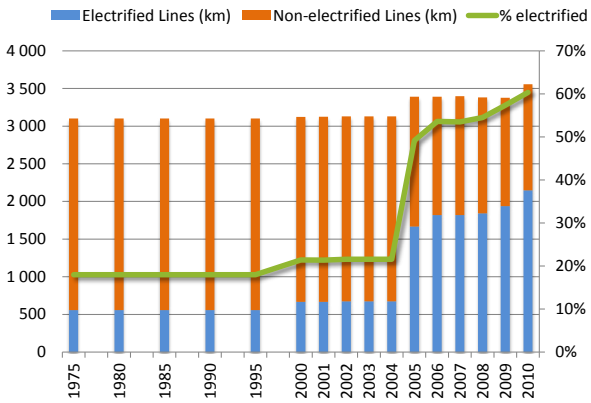


KOREA TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

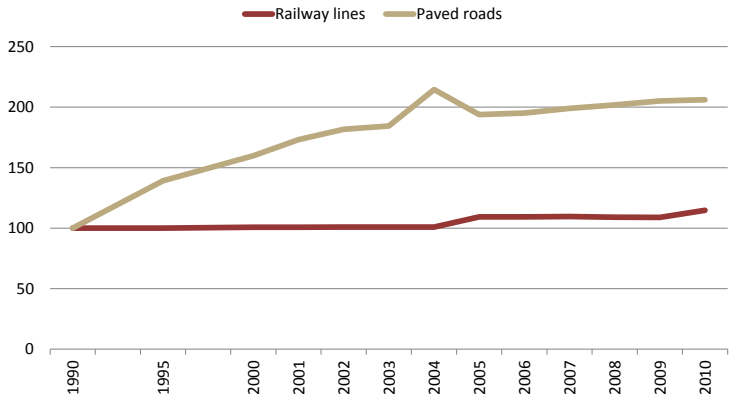


INFRASTRUCTURE

Korea, Rep. Railway Lines



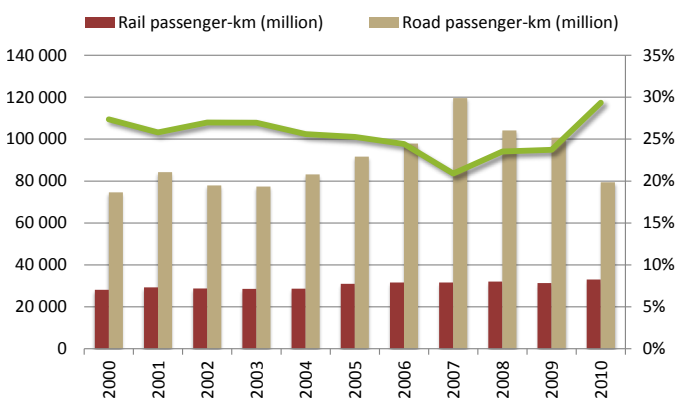
Korea, Rep. Infrastructure kms, rail and road (1990=100)



TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Korea, Rep.	Rail passenger 1.6%	Road passenger 0.6%	Rail freight -1.2%	Road Freight 1.0%

Korea, Rep. Passenger Activity



Korea, Rep. Freight Activity

RUSSIAN FEDERATION

GEOGRAPHY AND DEMOGRAPHICS

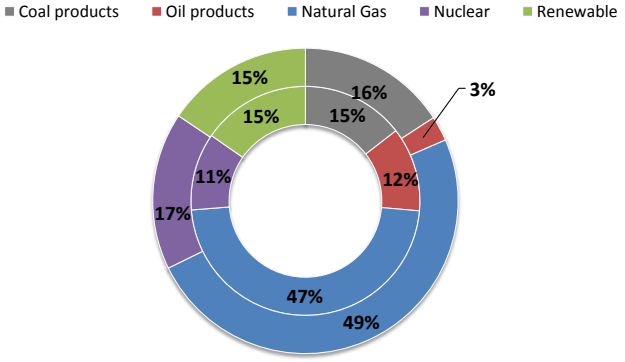
Area m^2 (Land and Water)	17 098 240
Land boundaries	22 407
Population (2013)	143 499 861
Population growth rate (1990-2013)	-0.1%
Urban population (2013)	105 976 082
Rate of urbanization (1990-2013)	-0.1%
GINI index (2009)	39.69

ECONOMICS

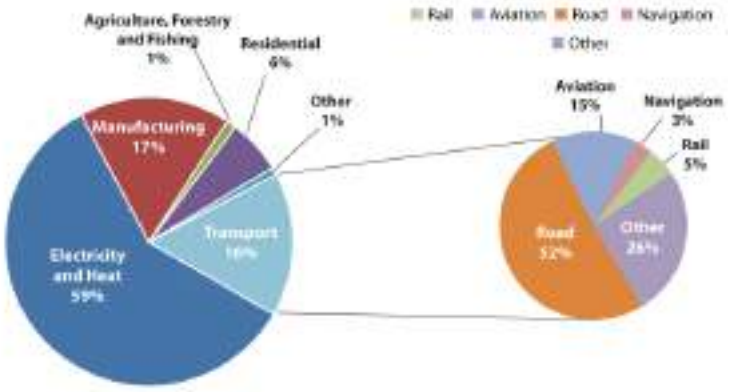
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	843.0	523.7	567.4	764.0	909.2	993.5	0.7%
GDP per capita (constant 2005 USD)	5 685	3 535	3 870	5 338	6 386	6 923	0.9%
Value added by sector (% of GDP)							
Agriculture	17%	7%	6%	5%	4%	4%	
Industry	48%	37%	38%	38%	35%	36%	
Services	35%	56%	56%	57%	61%	60%	
Imports (constant 2005 USD billions)	190.9	77.6	71.6	164.3	252.9	343.2	2.6%
Exports (constant 2005 USD billions)	212.9	136.3	174.5	269.0	314.7	333.5	2.0%

ENERGY AND CO_2 EMISSIONS

RUSSIAN FEDERATION NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

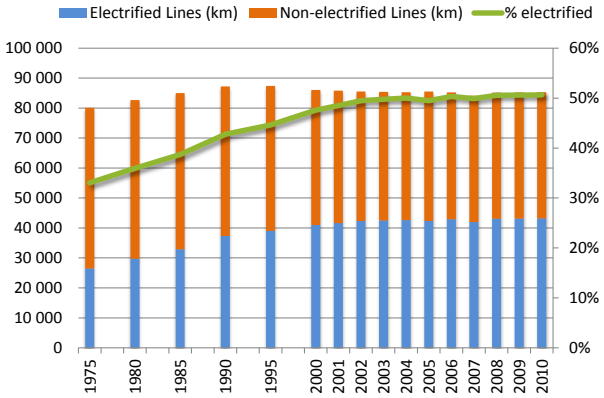


RUSSIAN FEDERATION TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

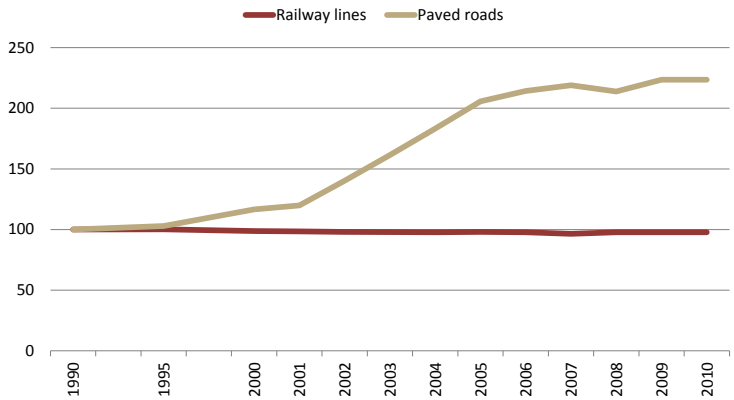


INFRASTRUCTURE

Russian Federation Railway Lines



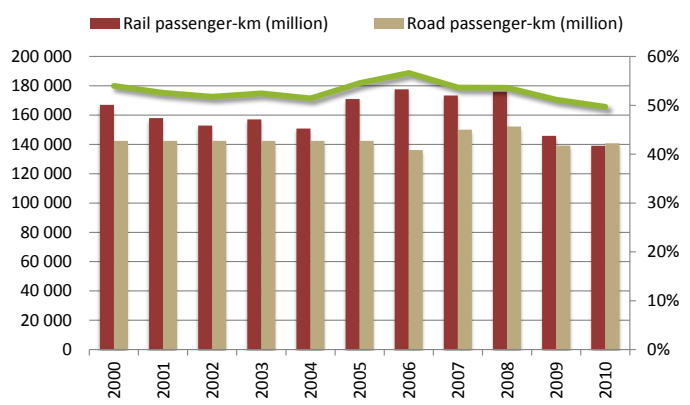
Russian Federation Infrastructure kms, rail and road (1990=100)



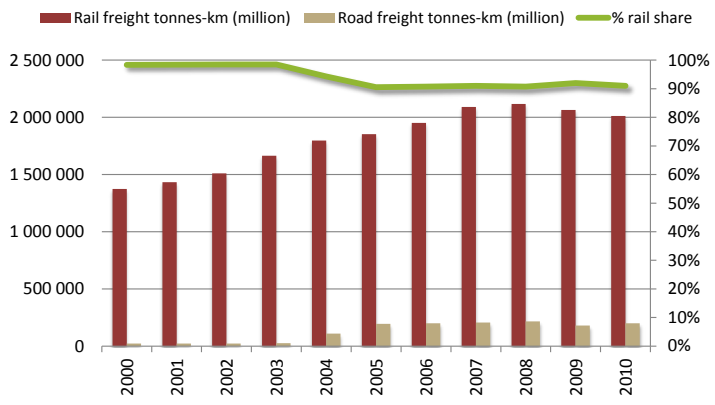
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Russian Federation	Rail passenger	-1.8%	Road passenger	-0.1%	Rail freight	3.9%	Road Freight	23.9%

Russian Federation Passenger Activity



Russian Federation Freight Activity



SRI LANKA

GEOGRAPHY AND DEMOGRAPHICS

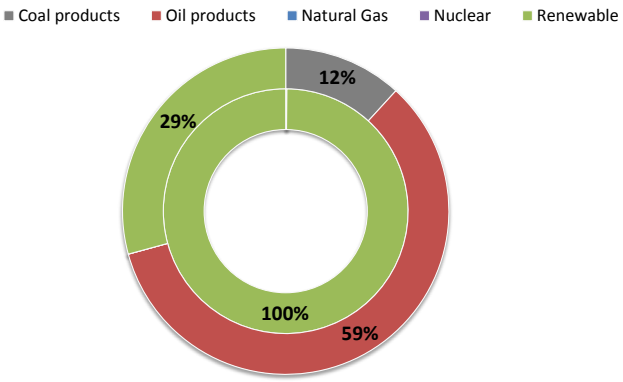
Area m^2 (Land and Water)	65 610
Land boundaries	0
Population (2013)	20 483 000
Population growth rate (1990-2013)	0.8%
Urban population (2013)	3 748 389
Rate of urbanization (1990-2013)	0.7%
GINI index (2010)	36.4

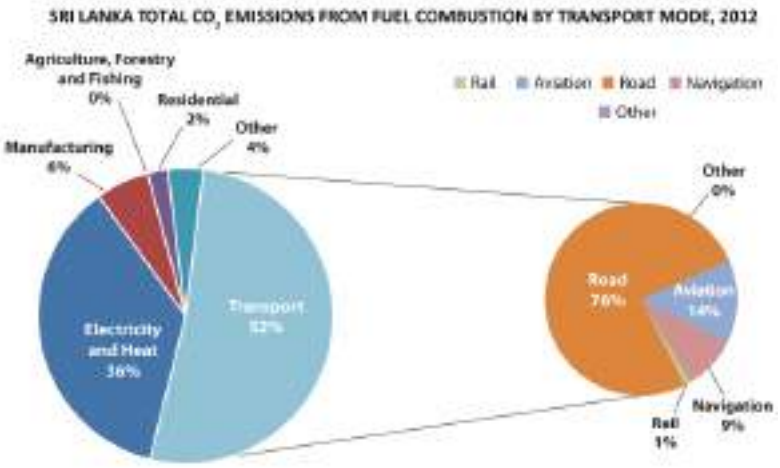
ECONOMICS

	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	12.1	15.7	20.1	24.4	33.3	41.1	5.5%
GDP per capita (constant 2005 USD)	710	866	1 052	1 242	1 610	2 004	4.6%
Value added by sector (% of GDP)							
Agriculture	26%	23%	20%	12%	13%	11%	
Industry	26%	27%	27%	30%	29%	32%	
Services	48%	50%	53%	58%	58%	57%	
Imports (constant 2005 USD billions)	3.4	5.2	8.0	10.1	11.8	14.2	6.5%
Exports (constant 2005 USD billions)	3.1	4.6	6.6	7.9	8.4	9.9	5.2%

ENERGY AND CO_2 EMISSIONS

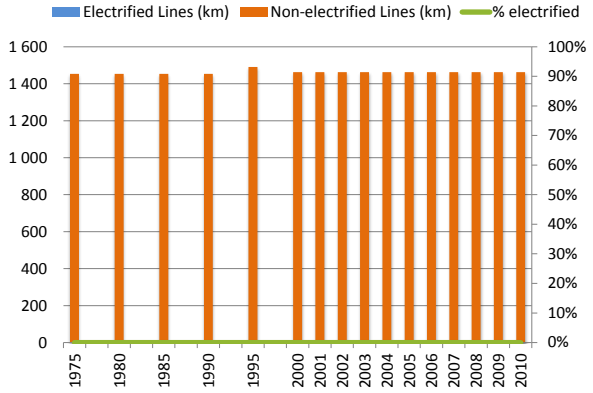
SRI LANKA NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE



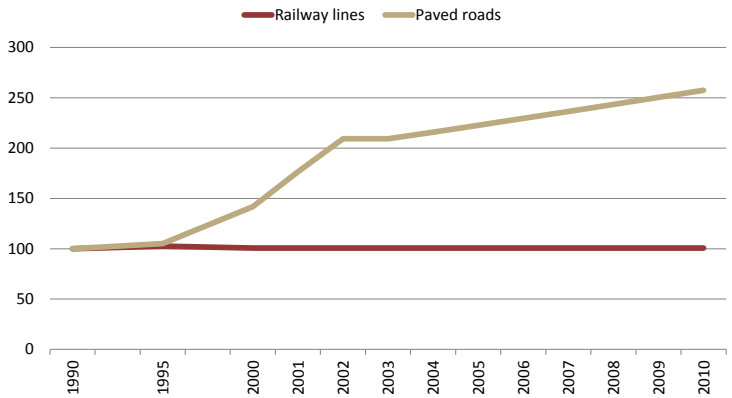


INFRASTRUCTURE

Sri Lanka Railway Lines



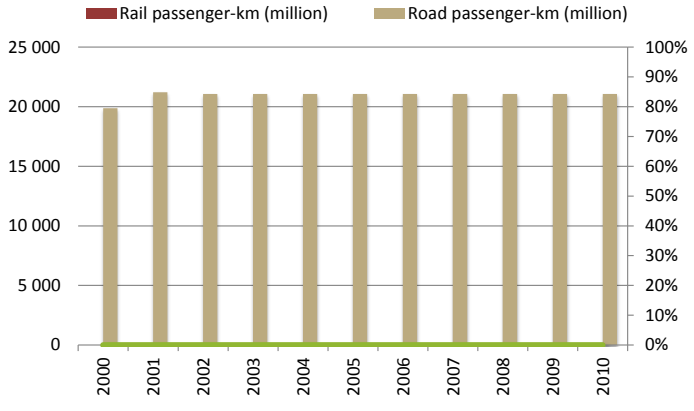
Sri Lanka Infrastructure kms, rail and road (1990=100)



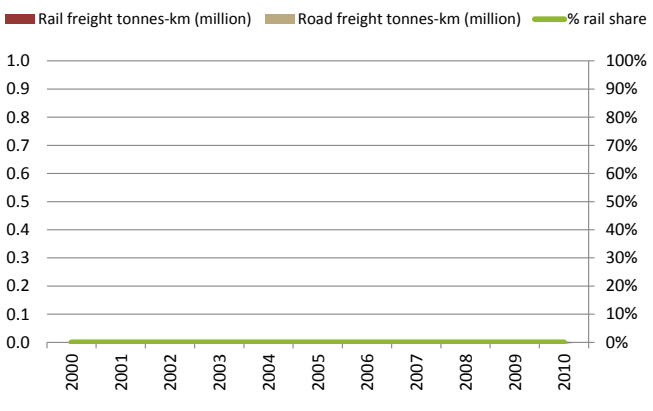
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Sri Lanka	Rail passenger	-	Road passenger	0.6%	Rail freight	-	Road Freight	-

Sri Lanka Passenger Activity



Sri Lanka Freight Activity



TAJIKISTAN

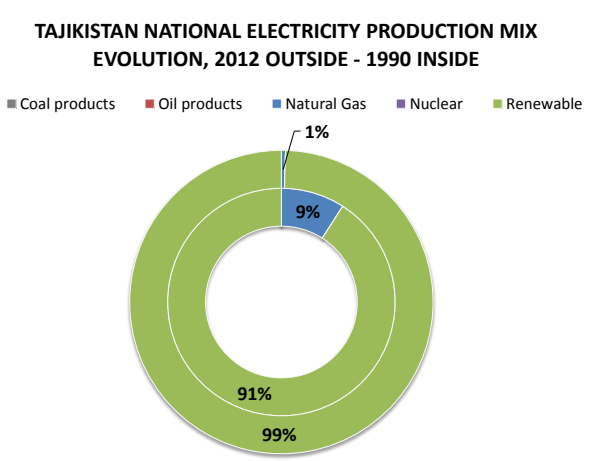
GEOGRAPHY AND DEMOGRAPHICS

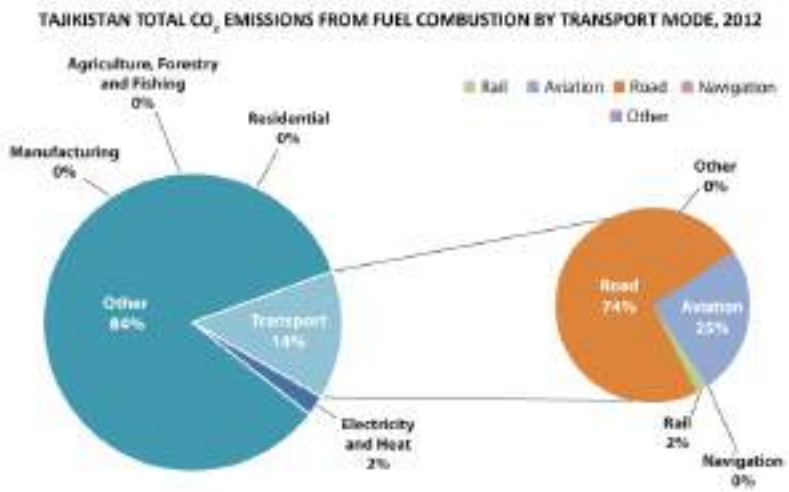
Area m^2 (Land and Water)	143 100
Land boundaries	4 130
Population (2013)	8 207 834
Population growth rate (1990-2013)	1.9%
Urban population (2013)	2 185 007
Rate of urbanization (1990-2013)	1.2%
GINI index (2009)	30.77

ECONOMICS

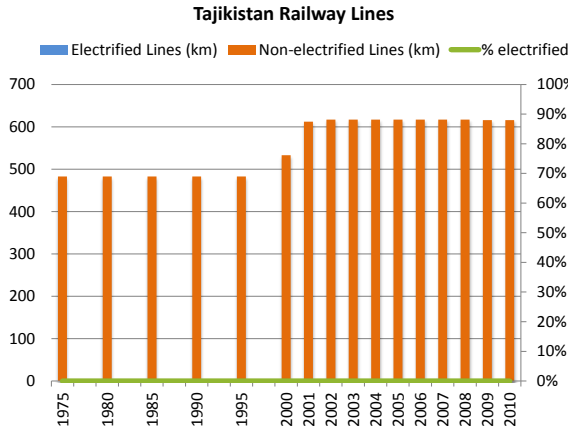
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	3.8	1.4	1.4	2.3	3.2	3.9	0.2%
GDP per capita (constant 2005 USD)	719	250	234	340	417	481	-1.7%
Value added by sector (% of GDP)							
Agriculture	33%	38%	27%	24%	22%	27%	
Industry	38%	39%	39%	31%	28%	22%	
Services	29%	22%	34%	45%	50%	51%	
Imports (constant 2005 USD billions)	1.2	0.7	0.7	1.2	1.6	1.9	2.1%
Exports (constant 2005 USD billions)	0.7	0.4	0.4	0.6	0.8	1.0	1.3%

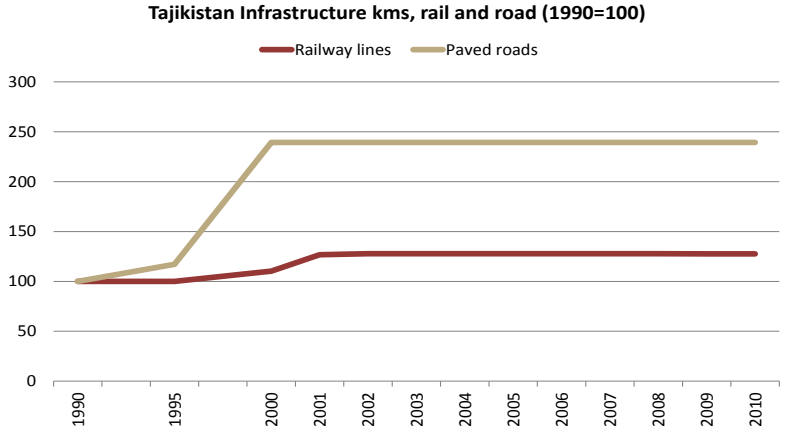
ENERGY AND CO_2 EMISSIONS





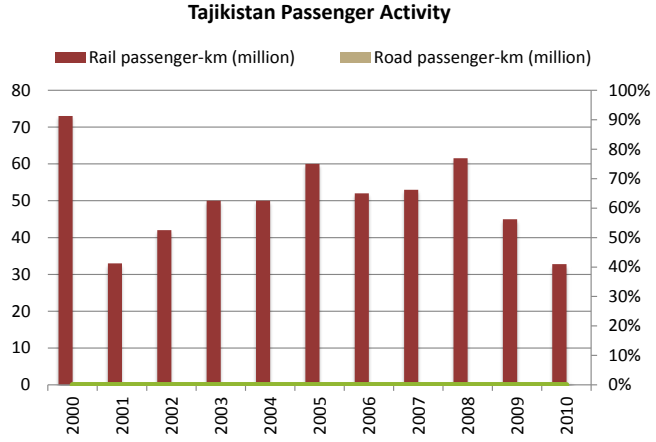
INFRASTRUCTURE

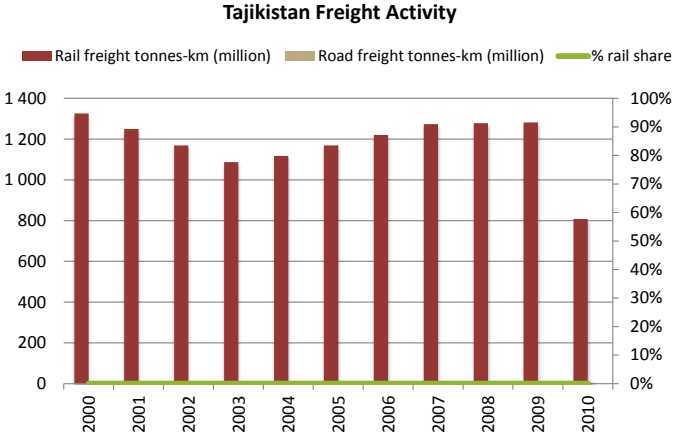




TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Tajikistan	Rail passenger -7.7%	Road passenger -	Rail freight -4.8%	Road Freight -





THAILAND

GEOGRAPHY AND DEMOGRAPHICS

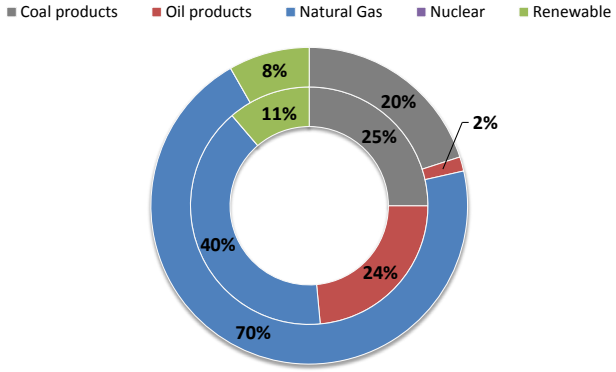
Area m^2 (Land and Water)	513 120
Land boundaries	5 673
Population (2013)	67 010 502
Population growth rate (1990-2013)	0.7%
Urban population (2013)	32 126 845
Rate of urbanization (1990-2013)	2.9%
GINI index (2010)	39.38

ECONOMICS

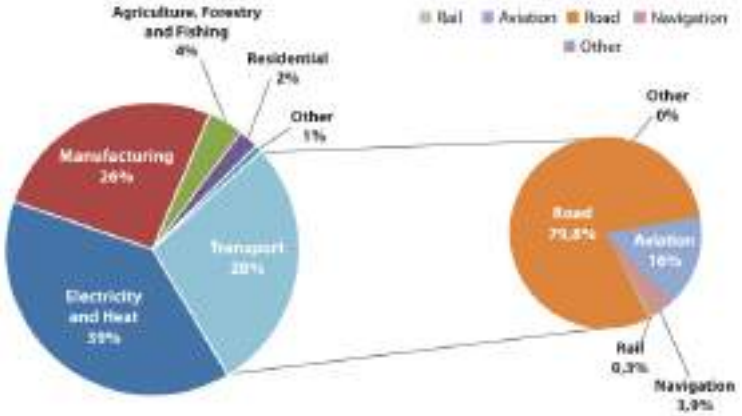
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	88.9	134.5	137.5	176.4	210.1	230.4	4.2%
GDP per capita (constant 2005 USD)	1 572	2 280	2 206	2 690	3 164	3 438	3.5%
Value added by sector (% of GDP)							
Agriculture	12%	10%	9%	10%	12%	12%	
Industry	37%	41%	42%	44%	45%	43%	
Services	50%	50%	49%	46%	43%	45%	
Imports (constant 2005 USD billions)	49.3	94.3	91.5	131.7	147.6	182.5	5.9%
Exports (constant 2005 USD billions)	36.0	70.4	98.9	129.7	161.0	189.4	7.5%

ENERGY AND CO_2 EMISSIONS

THAILAND NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

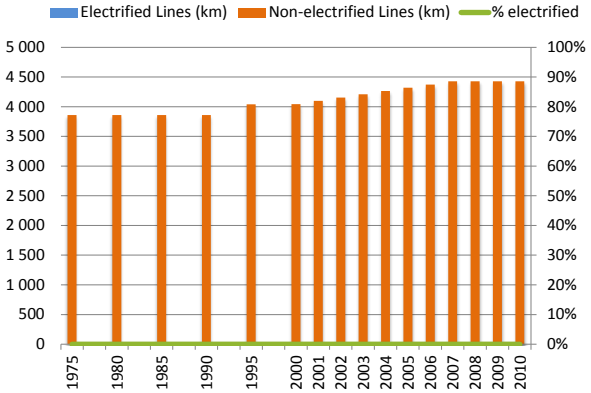


THAILAND TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

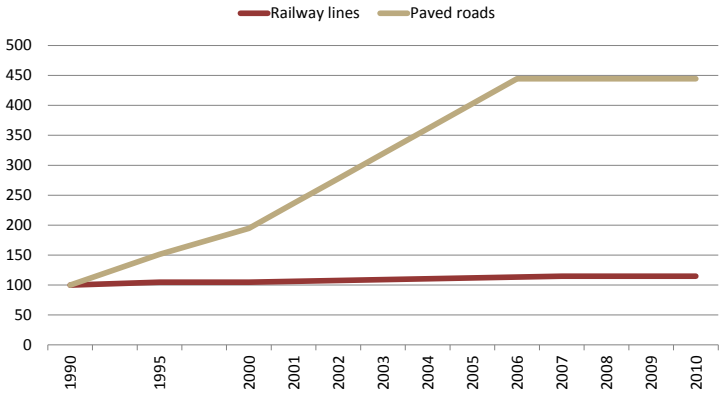


INFRASTRUCTURE

Thailand Railway Lines



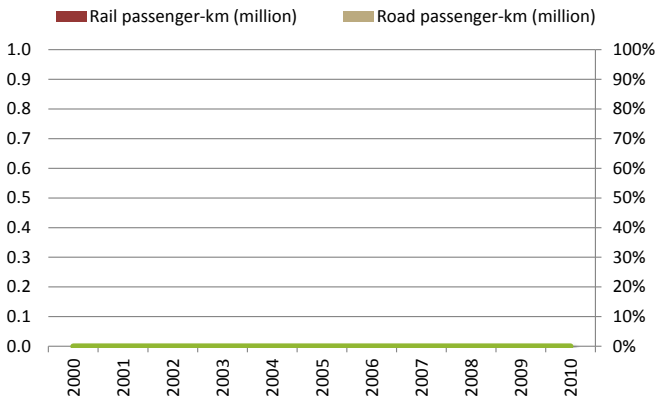
Thailand Infrastructure kms, rail and road (1990=100)



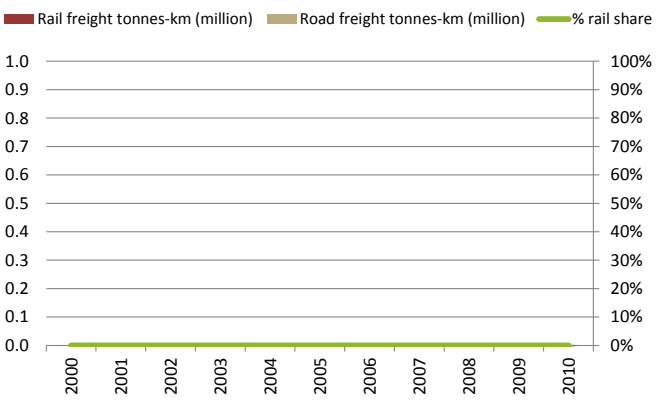
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Thailand	Rail passenger	-	Road passenger	-	Rail freight	-	Road Freight	-

Thailand Passenger Activity



Thailand Freight Activity



TURKMENISTAN

GEOGRAPHY AND DEMOGRAPHICS

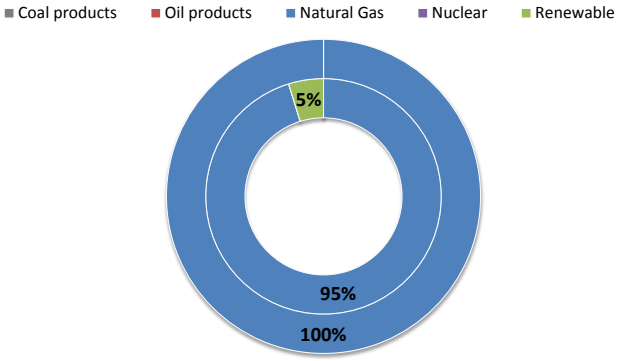
Area m2 (Land and Water)	488 100
Land boundaries	4 158
Population (2013)	5 240 072
Population growth rate (1990-2013)	1.6%
Urban population (2013)	2 585 976
Rate of urbanization (1990-2013)	2.0%
GINI index (1998)	40.77

ECONOMICS

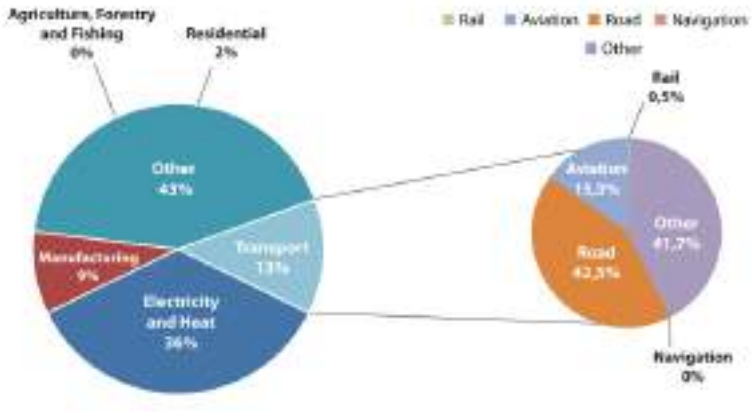
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	8.0	5.1	6.3	8.1	13.3	18.6	3.7%
GDP per capita (constant 2005 USD)	2 192	1 213	1 404	1 707	2 632	3 557	2.1%
Value added by sector (% of GDP)							
Agriculture	32%	17%	24%	19%	15%	-	
Industry	30%	63%	44%	38%	48%	-	
Services	38%	20%	31%	44%	37%	-	
Imports (constant 2005 USD billions)	-	2.1	2.4	3.9	-	-	-
Exports (constant 2005 USD billions)	-	2.1	2.8	5.3	-	-	-

ENERGY AND CO_2 EMISSIONS

TURKMENISTAN NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

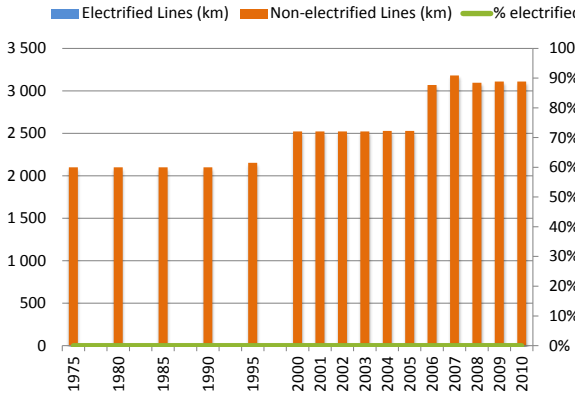


TURKMENISTAN TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

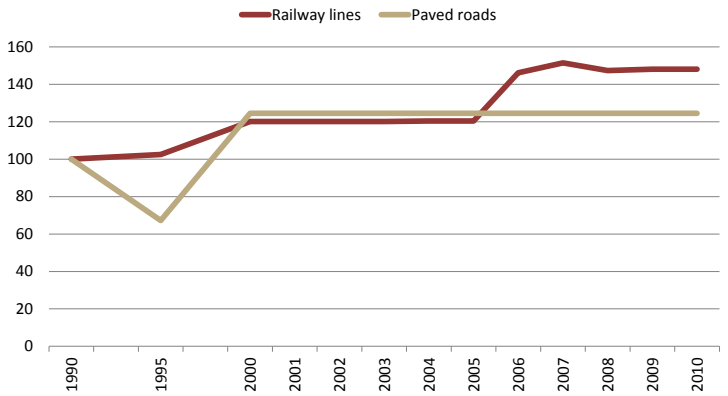


INFRASTRUCTURE

Turkmenistan Railway Lines



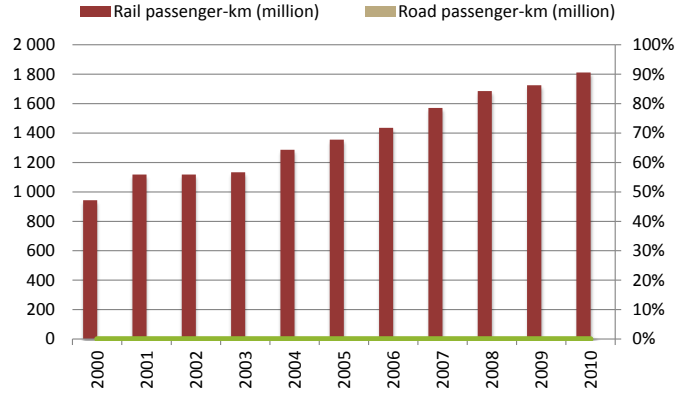
Turkmenistan Infrastructure kms, rail and road (1990=100)



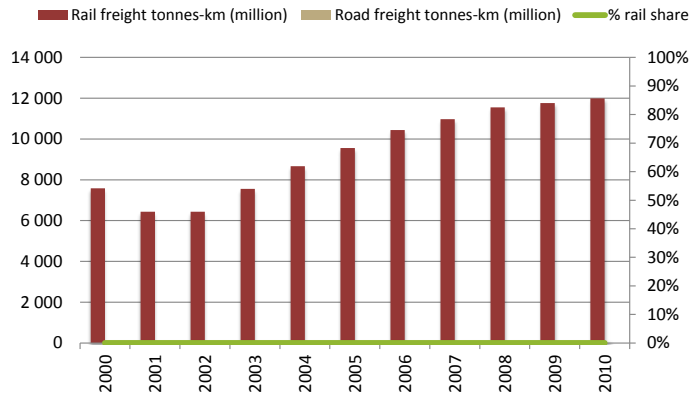
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Turkmenistan	Rail passenger	6.7%	Road passenger	-	Rail freight	4.7%	Road Freight	-

Turkmenistan Passenger Activity



Turkmenistan Freight Activity



UZBEKISTAN

GEOGRAPHY AND DEMOGRAPHICS

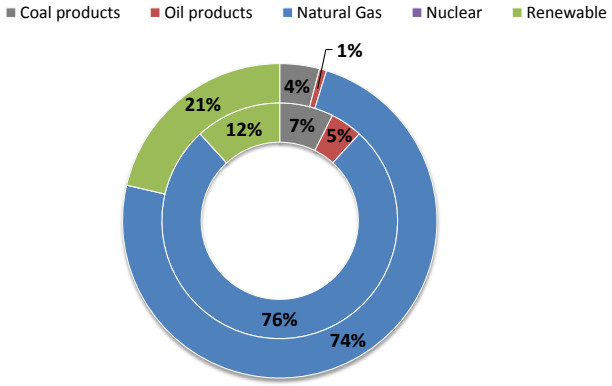
Area m2 (Land and Water)	447 400
Land boundaries	6 893
Population (2013)	30 241 100
Population growth rate (1990-2013)	1.7%
Urban population (2013)	10 952 419
Rate of urbanization (1990-2013)	1.2%
GINI index (2003)	35.19

ECONOMICS

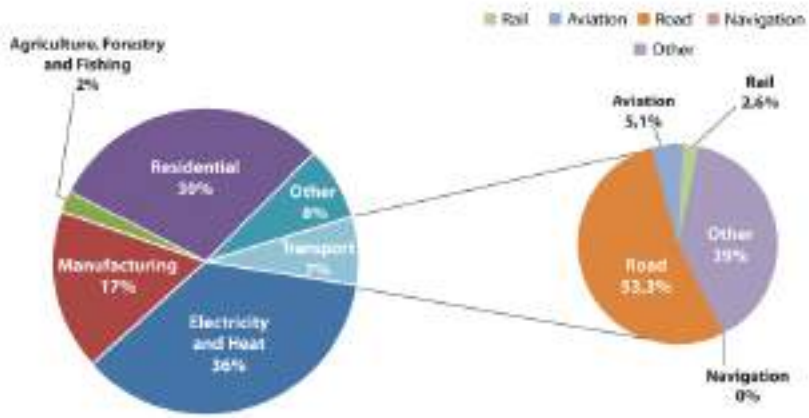
	1990	1995	2000	2005	2010	2013	1995-2013
GDP (constant 2005 USD billions)	11.2	9.1	11.0	14.3	21.5	27.2	6.3%
GDP per capita (constant 2005 USD)	547	399	446	547	752	899	4.6%
Value added by sector (% of GDP)							
Agriculture	33%	32%	34%	28%	19%	19%	
Industry	33%	28%	23%	23%	33%	26%	
Services	34%	40%	43%	49%	48%	55%	
Imports (constant 2005 USD billions)	-	3.7	3.0	4.1	11.2	18.0	9.1%
Exports (constant 2005 USD billions)	-	3.7	3.4	5.4	12.5	15.7	8.3%

ENERGY AND CO_2 EMISSIONS

UZBEKISTAN NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

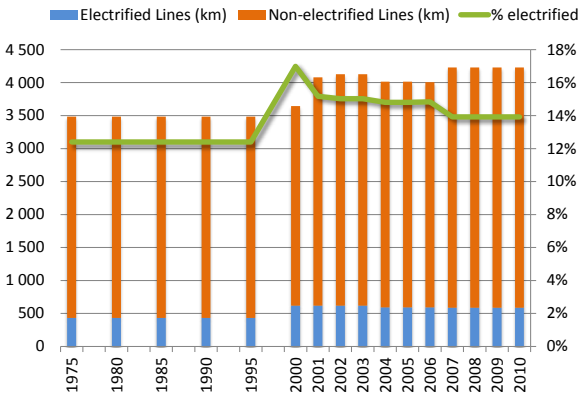


UZBEKISTAN TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

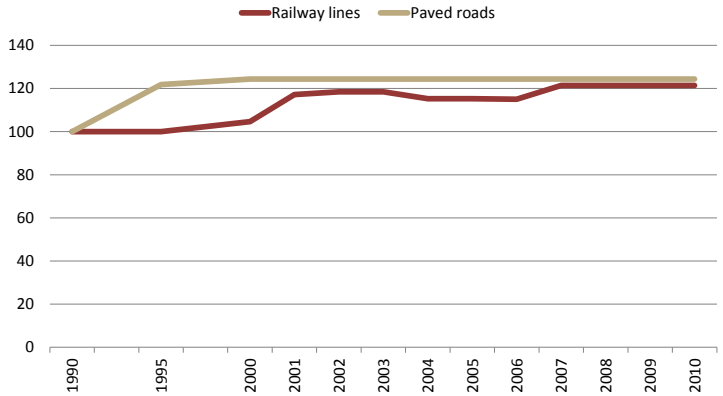


INFRASTRUCTURE

Uzbekistan Railway Lines



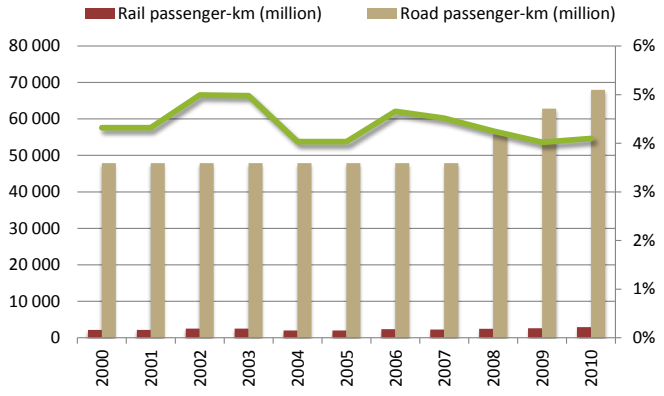
Uzbekistan Infrastructure kms, rail and road (1990=100)



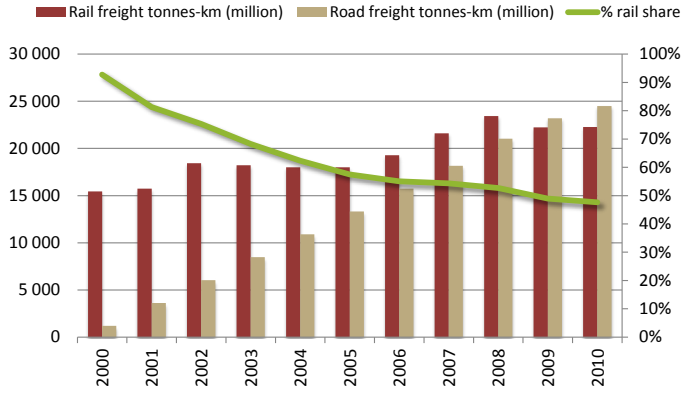
TRANSPORT ACTIVITY AND MODAL SPLIT

CAGR 2000-2010 - Uzbekistan	Rail passenger	3.0%	Road passenger	3.6%	Rail freight	3.7%	Road Freight	35.2%

Uzbekistan Passenger Activity



Uzbekistan Freight Activity



VIET NAM

GEOGRAPHY AND DEMOGRAPHICS

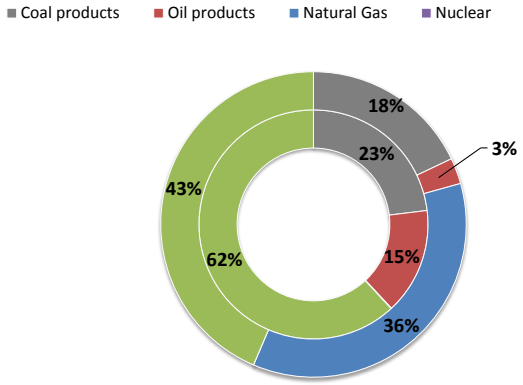
Area m^2 (Land and Water)	331 210
Land boundaries	4 616
Population (2013)	89 708 900
Population growth rate (1990-2013)	1.3%
Urban population (2013)	28 984 049
Rate of urbanization (1990-2013)	3.4%
GINI index (2012)	35.62

ECONOMICS

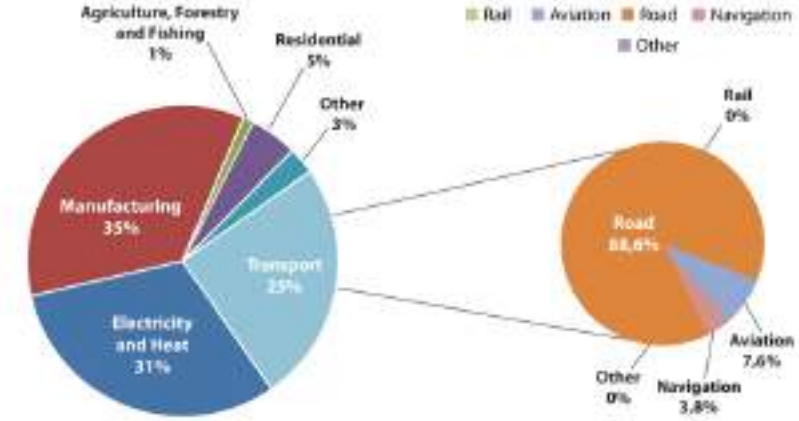
	1990	1995	2000	2005	2010	2013	1990-2013
GDP (constant 2005 USD billions)	19.9	29.5	41.3	57.6	78.3	92.3	6.9%
GDP per capita (constant 2005 USD)	301	410	532	699	900	1 029	5.5%
Value added by sector (% of GDP)							
Agriculture	39%	27%	23%	19%	19%	18%	
Industry	23%	29%	34%	38%	38%	38%	
Services	39%	44%	43%	43%	43%	43%	
Imports (constant 2005 USD billions)	3.4	8.1	16.8	38.6	63.7	84.9	15.1%
Exports (constant 2005 USD billions)	2.6	6.3	16.0	36.7	53.8	80.8	16.2%

ENERGY AND CO_2 EMISSIONS

VIET NAM NATIONAL ELECTRICITY PRODUCTION MIX EVOLUTION, 2012 OUTSIDE - 1990 INSIDE

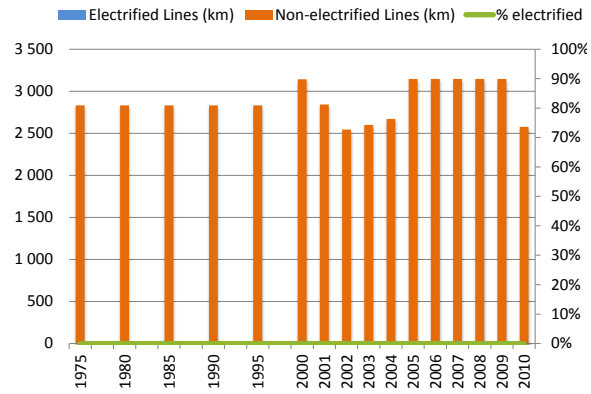


VIET NAM TOTAL CO_2 EMISSIONS FROM FUEL COMBUSTION BY TRANSPORT MODE, 2012

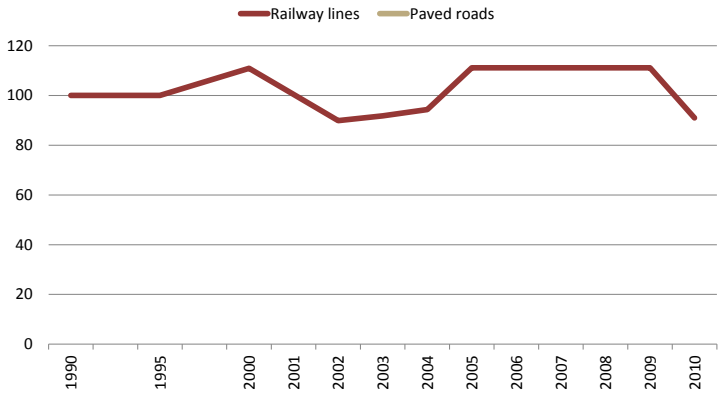


INFRASTRUCTURE

Viet Nam Railway Lines



Viet Nam Infrastructure kms, rail and road (1990=100)

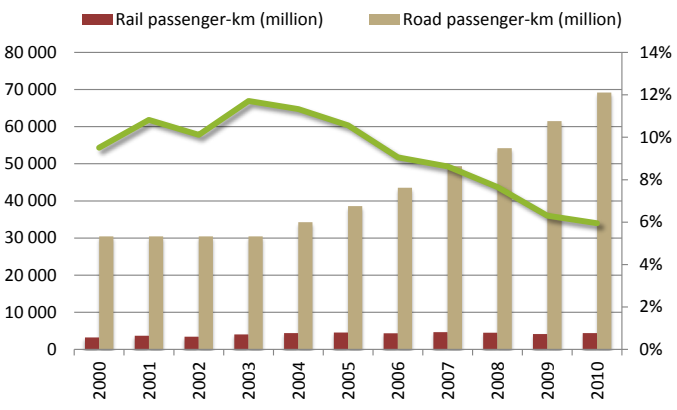


TRANSPORT ACTIVITY AND MODAL SPLIT

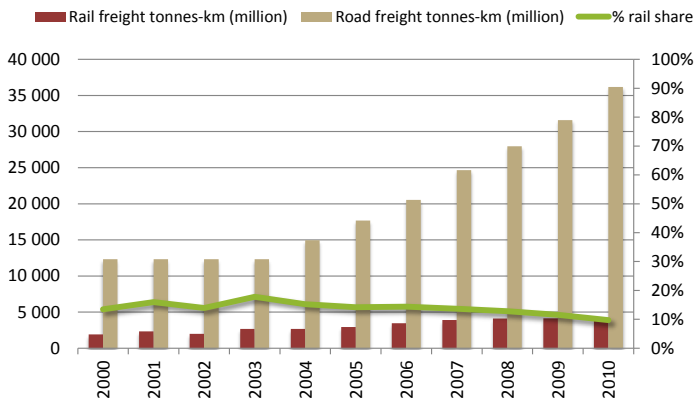
CAGR 2000-2010 - Viet Nam

Rail passenger	3.2%	Road passenger	8.6%	Rail freight	7.3%	Road Freight	11.4%

Viet Nam Passenger Activity



Viet Nam Freight Activity



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