RACE2050 - Responsible innovation Agenda for

Competitive European transport industries up to 2050

D5.1 – Current Transport Demand and Global Transport Outlook.

(D5.1 here presented is the result of - content neutral - merge of D51. and D5.2 as listed in the DoW)

Dissemination level:

Public

Contents

1. Executive summary

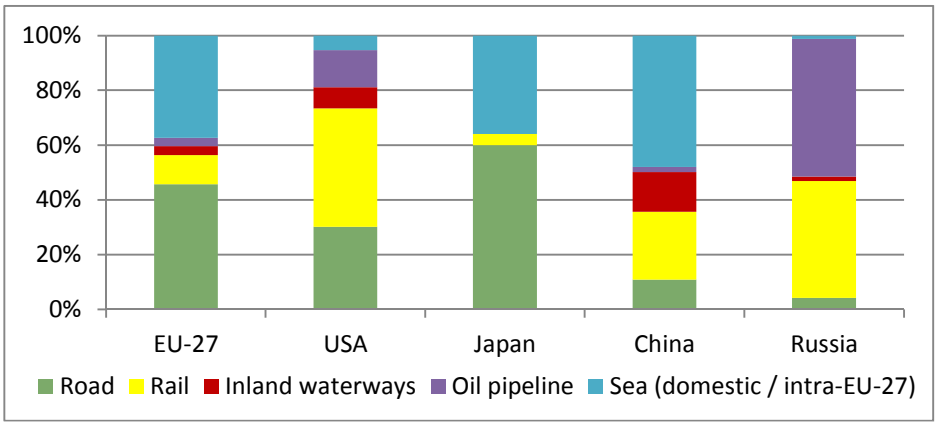
This document builds on current and prospective information on people and freight mobility patterns, Economic, Demographic, Energy, Environmental and Geopolitical issues to frame the "Driving Forces" that will shape the future development of demand for transportation and the "Demand Challenges" those changes will impose on transportation systems into 2030 and beyond. A snap shot for current demand for transportation at a worldwide level is given and a review of transportation future worldwide requirements - based on existing literature and published foresighted studies and scenarios – enables the identification of future competitive agendas requiring appropriate answers from the European transport industry to ensure its future competitiveness.

European and global demand for transportation are assessed in terms of:

- Current passengers and trade freight flows;
- Modal choices and market shares;
- Driving forces and demand challenges entailing the future evolution of transportation;
- Geopolitical issues;
- Review of foresight visions for the future demand of transportation systems.

This document is composed by 5 main chapters: besides an introduction and this executive summary Chapter 3 addresses current freight and passenger transportation demand. A detailed modal split analysis is carried out for major world regions, and a high level quantification of current demand for transport services is carried out at a global and regional level.

Research shows that modal split for freight and passengers varies significantly by region, being largely influenced by geography and economic factors.

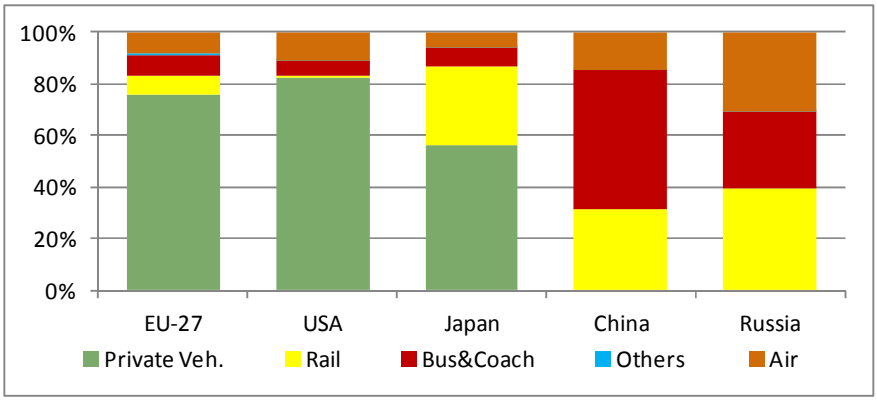


Freight modal split in 2009: Intercontinental Comparisons (all modes, tkm) (DGET-EC 2009)

In terms of global freight travel, road is currently the most used mode (in volume terms) with 10,500 billion ton.kilometers (tkm), closely followed by seaborne transportation, with almost 9,750 billion tkm and rail, with 97% of its' 9,300 tkm produced in 7 regional networks alone: Russia, USA, China, India, Europe, Canada and Brazil. Aviation is responsible for just over 0.2 billion tkm (less than 1% of global transportation flows in volume) but, nonetheless, represents a most relevant

share of international trade in value, with almost half of USAs' and a third of European external trade being flown in/out.

Regarding passenger transport, private car dominates modal shares in developed countries, while rail and bus are relatively more important in developing countries, although as increasing wealth and disposable income spreads across emerging economies, motorization rates are climbing fast.



Passenger modal split[1] in 2010: Intercontinental Comparisons (all modes, pkm; several sources)

Some discrepancies on passenger transport statistics arise from manifest lack of or incomplete data for several geographies, as is the case for private car transportation in China, India or Russia, or for public road transport in India. The next table highlights some road transport infrastructure and fleet statistics for most relevant regions.

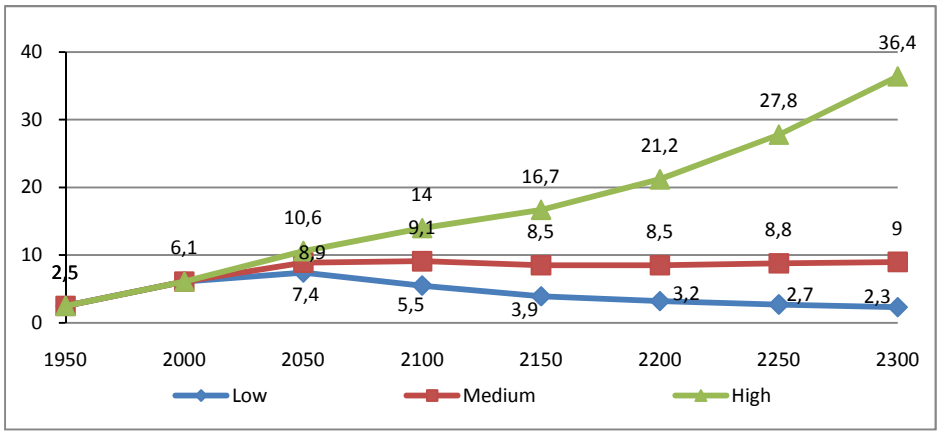
	EU-27	USA	Japan	China	Russia	India	Brasil
Road network (paved) [x 1000 km]	5000	4400	968	3056	776	2433	202
Motorway network [x 1000 km]	68.2	94.3	7.6	65.1	30	70.9	9
Commercial freight vehicles [million]	34.1	11.0	6.2	13.7	5.4	6.4	8.7
Passenger Car Stock [million]	238.8	234	69.2	40.3	32.6	17.2	37.2
Private car [billion pkm]	4920	6826	712	46	-	-	-
Motorization [cars/1000p.]	477	763	542	30	228	15	195
Bus&Coach [billion pkm]	510.1	470.4	87	1502	147.7	582	27.4
Bus& Coach fleet [x1000]	819	846	227	1696	900	1532	723

Road Transport statistics

Chapter 4 focuses on the "Driving Forces" and key factors influencing transport demand evolution and the relationships between changes in these factors and expected repercussions on transport, tackling subjects such as:

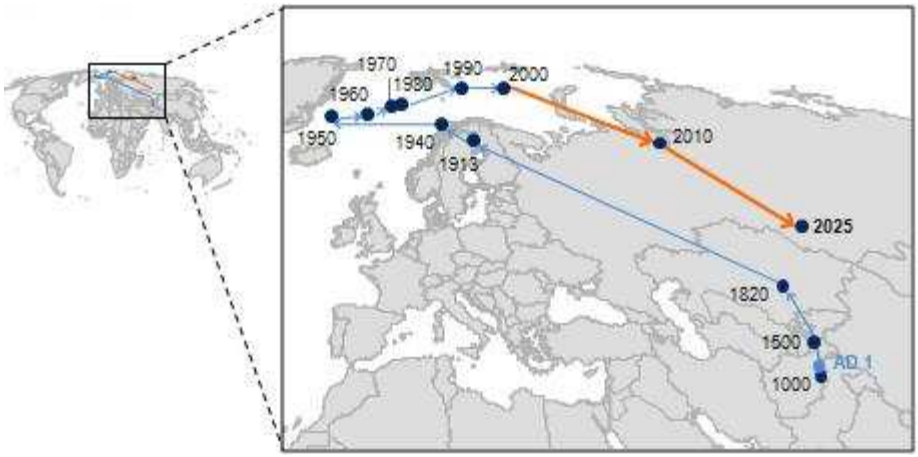
[1] Data for private car use in China and Russia is not available; Japan data is related to 2009.

- Demographics and society, as the world population is expected to increase to around 9 billion persons by 2050 with several developments in terms of changing demographics and society, lifestyle and mobility behaviours, migration and growing urbanization.



Global population development 1950-2000 and projections to 2300 (UN 2004)

- Economic issues: GDP and GDP per capita progression and evolution in disposable income leading to increased and differentiated regional patterns of demand for passengers and freight transport. Trade and globalization and developments in regional economies;



Evolution of the earth's economic centre of gravity (from A.D.1 to 2025) (Dobbs, et al. 2012)

- Energy consumption and resources;
- Environment, addressing the unprecedented pressures mankind is imposing on the natural environment and the transportation sector in particularly.
- Infrastructure, as a driver for transport demand and economic development;
- Tourism role in the global transportation arena;
- Safety and Security issues in transportation.

Chapter 5 addresses geopolitical issues such as effects on the demand side of geopolitical changes such as rapid industrialization of emerging economies, global competition for energy, raw materials and natural resources, competing economic models, and divergent industrial and environmental regulations.

This chapter intends to identify the political and socioeconomic developments occurring in countries where the European transport industry has established its business presence in order to understand how these events may affect European industry products and services in the medium and long-terms, covering the following topics:

- Trade and international division of labour: trade barriers, global trade and global Value Chains and multilateral liberalization of trade;
- Business prospects in emerging nations: research capabilities and intellectual property protection; manufacturing competitiveness and unlocking emerging markets potential.

Chapter 6 deals with the demand challenges that current trends will impose on future transportation systems, namely the advent of an ageing society, the urbanization growth, increasing congestion and infrastructural future needs, future energy challenges as dependency and scarcity, and tourism challenges and opportunities.

This document ends with Chapter 7 which addresses several foresight visions of the future transportation demand for passengers and freight. The following table resumes the main findings from our research on future expectations for transportation demand for current(!) modes of transport.

		2030	2050
Aviation	Pax	160 - 220	240 - 360
	Freight	237 - 253	-
Waterbourne	Pax	-	-
	Freight	146 - 188	227 - 370
Rail	Pax	-	219 - 286
	Freight	-	180 - 240
Road	Private Car		
	Bus&Coach	-	More than Double
	Freight		

Expected evolution of transport demand by mode by different sources (index 100 = 2010)

2. Introduction

The main objectives of Work Package 5, under Race 2050 project, are to provide an in-depth understanding of the demand-side driving forces influencing the EU transport industry's competiveness and a foresight of its evolution up to 2030 and beyond. WP5 identifies crucial challenges and opportunities, in terms of passenger and freight future mobility requirements that may represent opportunities for the European transport industry, and provide further inputs to European research policies in the coming years. Therefore, this document assesses:

- The present European and global demand for transportation and patterns of socio-economic development in regional terms, intra- and-extra-EU, modal choices and market shares;
- Factors structuring world demand for transport equipment, infrastructure and supporting systems up to 2030 and beyond.
- Effects on the demand side arising from geopolitical changes such as rapid industrialization of emerging economies, global competition for energy, raw materials and natural resources, competing economic models, and divergent industrial and environmental regulations.

Transport is an inseparable part of any society and an important driver of its development. It strongly impacts on the economy as it facilitates international trade, tourism and social development. It plays a vital role connecting people, places and businesses as it gives access to markets and resources, and support to new labour opportunities and specialization, wealth creation and distribution, leveraging an increasingly integrated and competitive world economy. Hardly any economic activity, even if not directly related with transportation, does not hold on transport to support their daily activities.

Transport systems also consume significant amounts of resources, such as energy and land space – as almost all cities use 20-30% of its land with transport facilities - and impose other costs to society as congestion, noise and polluting emissions, and safety and security challenges, which are imperative to deal with if we want to secure future economic growth, sustainability and society general wellbeing.

Transportation is essential to European economy, playing an important role on the economic growth and job creation. According to the White Paper on Transport, it directly employs around 10 million people and accounts for about 5% of the GDP in EU. In 2005, transport services accounted for 6.9% of the persons employed and for 7.1% of the added value in non-financial business economy, according to (Eurostat 2009). In turn, transport equipment industry contributed with a share of 2.5% to the number of persons employed in EU-27's non-financial business economy, employing 3.2 million persons in 2005 and generating an added value of EUR 182 billion.

3. Current Transportation Demand

This chapter gives a broad quantitative perspective of current demand for major transportation systems, with the purpose of providing a tangible framework for subsequent analyses on future demand for transportation equipments and services at a global level.

3.1. Current Freight Demand

Trade

Trade as the act of buying and selling goods and services both in domestic and international (import, export) markets, has been a key factor for rapid economic growth and regional development in an increasingly globalized world economy.

In 1990, Europe was responsible for almost half of the world's exports mainly due to intra-European flows, followed by North America and Japan. However, almost twenty years later, the patterns of global trade have shifted significantly as shown in Figure 1 and Figure 2.

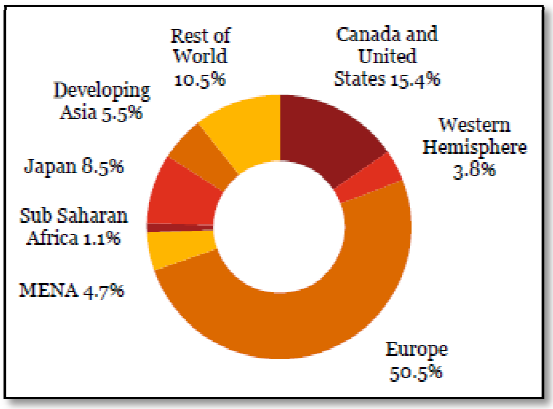


Figure 1- 1990 distribution of world merchandise exports by exporting country/region – USD base (Hope and Selfin 2011)

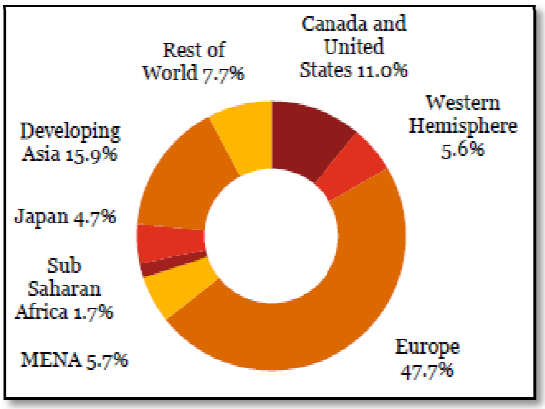


Figure 2- 2009 distribution of world merchandise exports by exporting country/region – USD base (Hope and Selfin 2011)

By 2009, the emerging economies and developing Asia had gained significant shares in world merchandise exports, especially due to the shift of global manufacturing markets to lower labour cost countries such as China and South Eastern Asian countries, which offer cheap labour and good trade links to provide Western markets with cheap consumer goods. Nowadays developing Asia market share on world trades equals North America and Japan jointly shares, when in 1990 was only a fourth of it.

Meanwhile, China became a global production cluster having the United States as its main customer. According to Hope and Selfin (2011), these two countries became the largest bilateral trade pair in amount of air and sea trade (US$ 290,960m), followed by China-Japan (US$ 207,677m). The United States features most in the Top 25 of bilateral trade pairs, mainly due to its propensity to import goods and to the large size of its economy. China appears in the second position with seven of the top 25 trade pairs.

In 2011, the cumulative effects of the multiple economic shocks provoked by the earthquake, tsunami and nuclear incident that hit Japan, the European Union sovereign debt crises, the flooding in Thailand and the turmoil in North African countries, led to a significant slowdown in the world's trade and economic activity: the volume of world merchandise trade growth fell to 5% from 13.8% and GDP growth fell to 2.4 % from 3.8 %, in 2010 (see Figure 3).

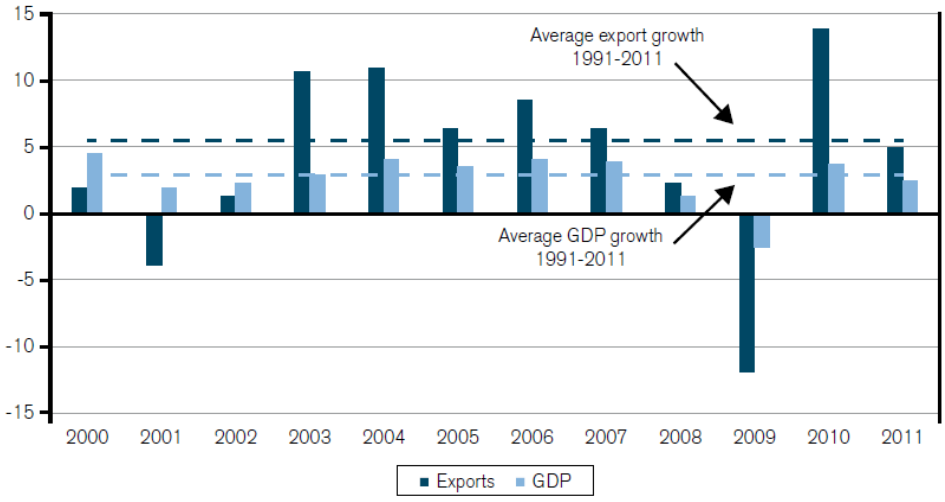


Figure 3- Growth in volume of world merchandise trade and GDP, 2000-11 (annual % change) (WTO 2012b)

Developed economies exceeded expectations with an export growth of 4.7% in 2011 volumes of merchandise trade – mainly driven by the strong increase (7.2%) in the United States export volumes – while developing economies including the Commonwealth of Independent States did worse than estimated, with an increase of only 5.4% (see Table 1), nevertheless having grown faster than the world average, and including a high proportion of manufactured goods as well as fuels and mining products.

According to the WTO (2012a), Asia's exports of manufactured goods increased by 15% between 2010 and 2011 and the exports of fuels and mining products increased by 30%; exports of fuels and mining products from the Middle East, the Commonwealth of Independent States (CIS) and Africa increased by 46%, 37% and 15% respectively in 2011. The developed countries have also increased their share in world manufacturing added value over this period. Europe had a 15% increase in exports of manufactured goods during 2011. The merchandise trade increased 5% in volume and 20% in value from 2010 to 2011. This 5.0% growth was below the pre-crisis average of 6.0% (1990–2008), and was even below the average of the last 20 years, including the period of the trade collapse (5.4%).

	GDP			Exports			Imports		
	2009	2010	2011	2009	2010	2011	2009	2010	2011
World	-2.6	3.8	2.4	-12.0	13.8	5.0	-12.9	13.7	4.9
North America	-3.6	3.2	1.9	-14.8	14.9	6.2	-16.6	15.7	4.7
United States	-3.5	3.0	1.7	-14.0	15.4	7.2	-16.4	14.8	3.7
South and Central America[a]	-0.3	6.1	4.5	-8.1	5.6	5.3	-16.5	22.9	10.4
Europe	-4.1	2.2	1.7	-14.1	10.9	5.0	-14.1	9.7	2.4
European Union (27)	-4.3	2.1	1.5	-14.5	11.5	5.2	-14.1	9.5	2.0
Commonwealth of Independent States (CIS)	-6.9	4.7	4.6	-4.8	6.0	1.8	-28.0	18.6	16.7
Africa	2.2	4.6	2.3	-3.7	3.0	-8.3	-5.1	7.3	5.0
Middle East	1.0	4.5	4.9	-4.6	6.5	5.4	-7.7	7.5	5.3
Asia	-0.1	6.4	3.5	-11.4	22.7	6.6	-7.7	18.2	6.4
China	9.2	10.4	9.2	-10.5	28.4	9.3	2.9	22.1	9.7
Japan	-6.3	4.0	-0.5	-24.9	27.5	-0.5	-12.2	10.1	1.9
India	6.8	10.1	7.8	-6.0	22.0	16.1	3.6	22.7	6.6
Newly industrialized economies (4)[b]	-0.6	8.0	4.2	-5.7	20.9	6.0	-11.4	17.9	2.0
Memo: Developed economies	-4.1	2.9	1.5	-15.1	13.0	4.7	-14.4	10.9	2.8
Memo: Developing and CIS	2.2	7.2	5.7	-7.4	14.9	5.4	-10.5	18.1	7.9

a) Includes the Caribbean.
b) Hong Kong, China; Republic of Korea; Singapore; and Chinese Taipei.

Table 1 - GDP and merchandise trade by region, 2009-11 (annual percentage change) (WTO 2012b)

From the total world exporters/importers by 2011, the following table features the top five:

Exporters			Importers		
Country	**Value (US$)**	**%**	**Country**	**Value (US$)**	**%**
China	1.90 trillion	10.4	United States	2.27 trillion	12.3
United States	1.48 trillion	8.1	China	1.74 trillion	9.5
Germany	1,47 trillion	8.1	Germany	1.25 trillion	6.8
Japan	823 billion	4.5	Japan	854 billion	4.6
Netherlands	660 billion	3.6	France	715 billion	4.0

Table 2 - World Top 5 leading exporters/importers by value and relative share (WTO 2012b)

The Top Ten merchandise traders accounted to 51% of world's total merchandise trade with the United States as the world's single biggest trader in merchandise (see Figure 4), with imports and exports totalling US$ 3,746 billion in 2011. USAs' trade deficit in this period amounted to US$ 785 billion, 5.2% of its GDP (WTO 2012a).

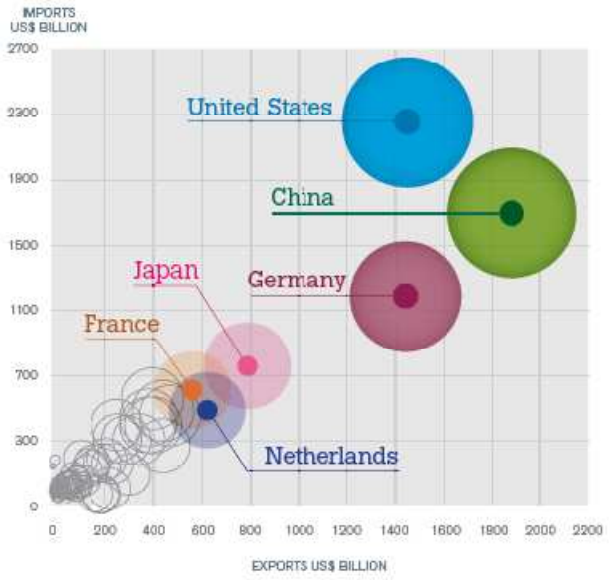


Figure 4- Leading economies of merchandise trade, 2011 (WTO 2012a)

Being the US the largest world economy it is also relevant to understand the relative importance of its trade partners.

US imports			US exports		
From	Amount	% of overall US imports	To	Amount	% of overall US exports
China	$ 417.3 billion	18.4%	Canada	$ 280.7 billion	19%
Mexico	$ 265.3 billion	11.7%	Mexico	$ 197.5 billion	13.3%
Japan	$ 132.4 billion	5.9%	China	$ 103.9 billion	7.0%
Germany	$ 100.4 billion	4.4%	Japan	$ 66.2 billion	4.5%
South Korea	$ 58.6 billion	2.6%	UK	$ 55.9 billion	3.8%
UK	$ 52.1 billion	2.3%	Germany	$ 48.8 billion	3.3%
Total Top 6	$ 1026.1 billion	45.3%	Total Top 6	$ 753 billion	50.9%

Table 3 - America imports and exports in value and % of share, 2011 (WTO 2012a)

As shown in Table 3, China's exports to America amounted to $417.3 billion or 18.4% of overall US imports and Mexico's exports to America amounted to $265.3 billion or 11.7% of overall US imports. America's exports to Canada amounted to $280.7 billion or 19% of overall US exports and America's exports to Mexico amounted to $197.5 billion or 13.3% of overall US exports.

USA shipped $1.55 trillion worth of goods around the globe, led by the top 5 items: Machines, engines (13.9%); Electronic equipment (10.5%); Oil (8.9%); Vehicles (8.6%) and Aircraft and spacecraft (6.7%) and bought $2.263 trillion worth of imported products led by: Oil (20.5%); Machines, engines (13%); Electronic equipment (12.5%); Vehicles excluding railway/tram (9.1%) and Medical and technical equipment (3%).

Ignoring trade between European Union member countries and treating the EU as a single entity, Europe emerges as the most important contender in global trade. Using this canon, the top exporters ranking in 2011 results as presented in Table 4.

Exporters		
Country/Region	**Value (US$)**	**%**
European Union	2.13 trillion	14.9
China	1.90 trillion	13.3
United States	1.47 trillion	10.3
Japan	815 billion	5.7
Republic of Korea	557 billion	3.9

Importers		
Country/Region	**Value (US$)**	**%**
European Union	2.34 billion	16.2
United States	2.25 billion	15.6
China	1.73 billion	12.0
Japan	852 billion	5.9
Republic of Korea	520 billion	3.6

Table 4 - World Top 5 leading exporters/importers by value and % of share (EU as a single entity) (WTO 2012b)

The main EU-27 trade partners are China, USA, Russia, Japan and Switzerland, as Table 5 illustrates.

EU imports		
From	**Value (million €)**	**% of overall EU imports**
China	289,927	16.2
Russia	213,257	11.9
USA	205,794	11.5
Switzerland	104,544	5.8
Norway	100,437	5.6
Japan	63,813	3.6
Total top 6	977,772	54.6

EU exports		
To	**Value (million €)**	**% of overall EU exports**
USA	291,901	17.3
China	143,876	8.5
Switzerland	133,342	7.9
Russia	123,266	7.3
Turkey	75,200	4.5
Japan	55,460	3.3
Total top 6	823,074	48.8

Table 5- EU27 imports and exports in value and % of share, 2011 (EC 2012a)

The major export markets for European products are the USA with 291,901 million € or 17.3% of overall EU exports, while EU exports to China and to Switzerland amounted to 143,876 million € (8.5%) and 133,342 million € (7.9%), respectively. In relation to the EU-27 imports, China accounts to 16.2% of the overall EU imports, Russia with 11.9% and USA with 11.5%. The top 6 of the EU imports main partners constitutes 54.6% of the overall EU imports.

China imports		
From	**Value (million USD)**	**% of overall EU exports**
European Union	211,200	12.2
Japan	194,600	11.1
ASEAN	192,800	11.0
Republic of Korea	162,700	9.3
USA	122,200	7.1
Hong Kong, China	15,500	0.9
Total top 6	899,000	51.6

China exports		
To	**Value (million USD)**	**% of overall EU imports**
European Union	356,000	18.8
USA	324,500	17.1
Hong Kong, China	268,000	14.1
ASEAN	170,100	8.9
Japan	148,300	7.8
Republic of Korea	82,900	4.4
Total top 6	1349,800	71.1

Table 6- China imports and exports in value and % of share, 2011 (NBSC 2012a)

As can be seen in Table 6, China closes the top three leading trade contenders in world trade. The main Chinese trading partners are the European Union, the USA and Japan, as well as, Hong Kong, ASEAN and Republic of Korea. The European Union is China main exporter (in value) with 211,200 million USD in 2011, followed by Japan with 194,900 million USD and ASEAN with 192,800 million. In relation to the imports, the European Union is the region that most imports from China,

18.8% of China overall imports or 356,000 million USD, followed by the USA with 17.1% and Hong Kong with 14.1%.

The total value of China imports and exports in 2011reached 3,642.1 billion US dollars, up by 22.5% over the previous year. China shipped $1.898 trillion worth of goods around the globe, led by the top 5 items: Electronic equipment (23.5%); Machines, engines (18.6%); Knit or crochet clothing (4.2%); Clothing (not knit or crochet) (3.3%) and Medical and technical equipment (3.2%); and bought $1.743 trillion worth of imported products led by: Electronic equipment (20.1%); Oil (15.8%); Machines, engines (11.4%); Ores, slag (8.6%) and Medical and technical equipment (5.7%).

In relation to other relevant trade between regions in 2011, in value, 24% of Central and South America exports were sent to North America, 54% of CIS products were exported to Europe, 53% of the Middle East exports were sent to Asia and 36% of African products were sent to Europe; 50% of total world exports were from North America and Europe.

Finally, in what concerns trade within regions, North America, Europe and Asia hold the higher levels of intraregional trade. 71% of European countries exports remained within European boundaries in 2011, while a total of 53% of Asian trade exported to Asian countries and nearly 48% of North America's exports leaving to members of the North American Free Trade Agreement (US, Canada and Mexico).

Modal Split

Modal split for freight transport varies significantly by region and O/D pair, being largely determined by geographic and economic factors, as well as resources availability. However there is a common trend towards more use of land transport (where feasible) and, especially in EU-27, of road transport at the expense of rail and water transport. Despite the large efforts against road transport use and the regular release of several environmental policies towards the reduction of road market share and changes to less polluting means of transport, road transport still domains.

Figure 5 reflects the geographical differences in which transport systems operate, comparing modal split for freight transport in EU-27 in 2009 with that in the USA, Japan, China and Russia. While within the European Union and in Japan road and coastal shipping account for the great majority of tonnes-kilometres[2] (tkm), rail dominates in the United States and pipeline transport and rail in Russia. In relation to maritime transport, China has more than half of its freight volume transported by coastal shipping. It is also of note that China carries some 24% of the world's railway transport volume on only 6% of the world's railways length/extension (NBSC 2012).

[2] A measure of freight transport production – a tonne of merchandize travelling one kilometre.

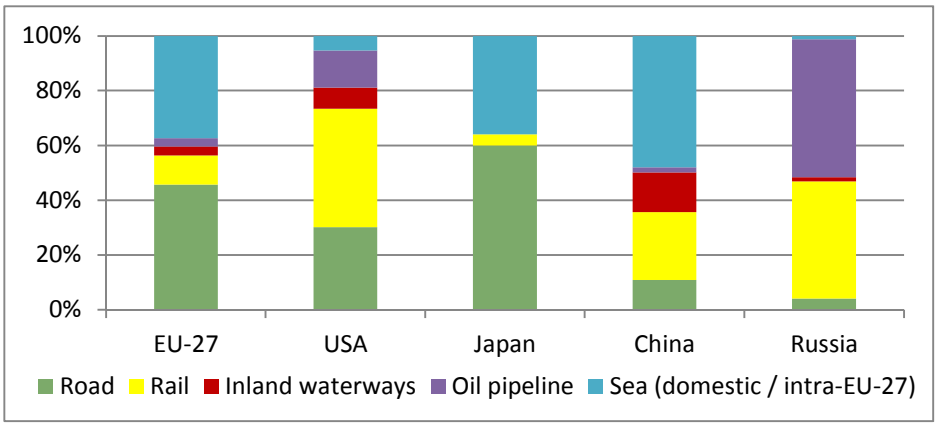


Figure 5- Freight modal split in 2009: Intercontinental Comparisons [all modes, tkm] (DGET-EC 2009)

In EU-27, freight transport volumes in 2010 was around 3,711 billion tkm, an increase of 4% compared to 2009, but still below 2008 levels (-7%). As shown in Figure 6, road transport in 2010 accounted for over 45% of the total inland transport travel, while maritime transport represented more than 38% and railway transport accounted for almost 11% of total tkm.

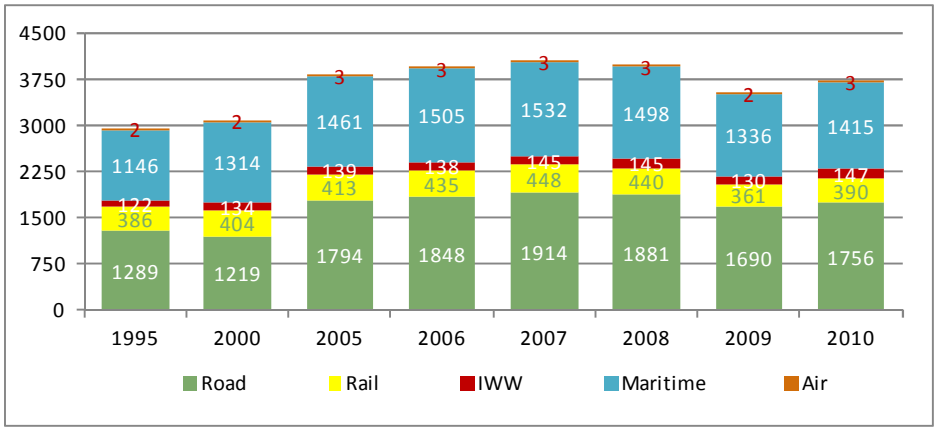


Figure 6- EU-27 Freight transport volume [billion tkm] (EEA 2013)

Since 2005, goods volumes transported have remained practically stable. However, because of the economic crisis, movements fell around 11% between 2008 and 2009. During the 2005-2010 period, volumes transported by road in Europe were around four times those transported by rail. According to EEA (2013) this can be explained by the higher ability of road transport in taking advantage on the dismantling of trade barriers than rail transport, as international rail connections are still slowed down by border-crossings and network technical and operational discrepancies, leaving road transport often as the fastest and most reliable form of transport available, with its greater flexibility regarding pickup and delivery points. Moreover, the average travel of goods carried by road is about 110 km, a distance which rail or inland waterways can hardly compete with, in particular if road transport is needed at the extreme legs of the freight consignment.

As shown in Figure 7, while road has a lower cost function for short distances, its cost function climbs faster than rail and maritime cost functions, thus becoming more profitable to use rail transport than road transport for distances between 500-750 km (D1) and maritime transport becomes more advantageous for distances higher than 1500 km (D2).

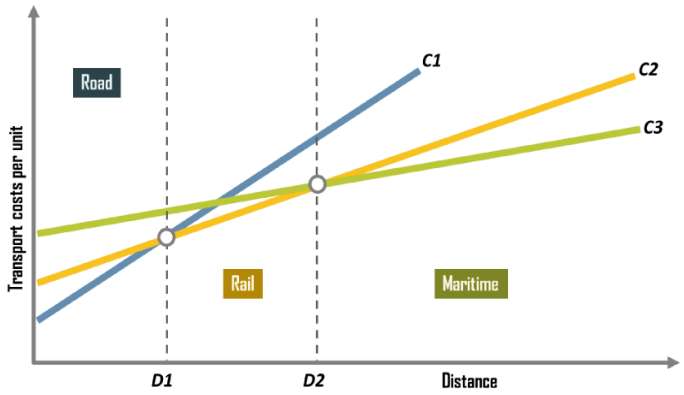


Figure 7 - Distance, Modal Choice and Transport Costs (Rodrigue 2013)

3.1.1. Air Cargo

Over the past 40 years, worldwide air transport activity has been characterized by strong growth rates led mainly by advanced economies, such as the United States and Western Europe and, more recently, by the Asian market (in the last two decades). Products transported by air are typically those with higher value/weight unit.

In 2011, over 22 million tonnes of cargo - US$2.9 trillion worth - were airlifted, pilling up 202.4 billion tkm down from its 2010 record of 204.2 billion tkm[3] (Airbus 2012, Boeing 2012). Although it represents only 1% of global trade movements in weight, air cargo represents a most significant share international trade movements by value - up to 40% of EU and 55% of USA exports are flown out, and 28% and 33% of imports by value, for EU and USA respectively are flown in (OECD 2011). About 72% of European air Exports go to North America and Asia Pacific regions, with increasing importance for the later one, and 83% of flown imports are also from these regions.

According to Airbus “semiconductor / high technology and telecommunications industries are the largest users of air freight in terms of the value of transported goods [...] closely followed by "valuables" and pharmaceuticals. In terms of weight, the fresh foods industry is the largest contributor to the air freight industry.” The international express share of total world air cargo tkm in 2011 was 13.8%, as integrators/express carriers hold more than 40% of the freighters fleet. Still, lower hold passenger airplane capacity is responsible for almost 55% of available worldwide capacity, and this figure is expected to remain relatively unchanged in the future (Boeing 2012).

The recent economic crisis starting in 2008Q3 and the increasing cost of jet fuel resulted in the world aviation cargo market going through a difficult period, with severe demand reductions in some parts of the world, only now showing some signs of recovery, with China emerging as one of the most important and fastest growing air transport market.

In 2012, Asia-Pacific airlines (the largest players in the air cargo market) reported a 5.5% decline in demand and cut capacity by 2.4%. As the world’s major manufacturing centre, the region suffered

[3] You can refer to Figure 73 to have an ilustration of historical evolution of air cargo since the 1970’s.

from the slowdown in demand from Western markets; European and North American carriers also saw falls in freight demand, of 2.9% and 0.5% respectively. European carriers increased its capacity by 0.3% and North American carriers managed to reduce capacity by 2.0%; Latin American airlines saw freight demand decline by 1.2%, but capacity grew 4.9% over the year; African and Middle Eastern airlines freight demand grew 7.1% and 14.7% respectively, both improvements on 2011 when the Middle East expanded 8.2% and Africa declined by 2.1% (ICAO 2012).

Asia & Pacific

Traffic originating or ending in the Asia-Pacific region in 2011 accounted for more than 60% of all global air traffic in terms of tkm, and intra-Asia air cargo market represented 14.7% of the world's air cargo traffic in tonnage and about 7.4% in tkm. Traffic to, from and within People's Republic of China (PRC) represented by its own 26% of the global air traffic market (Boeing 2012).

In relation to regional market flows, traffic from India to China has grown at 35% per year over the last decade. The value of goods transported from China to India has been multiplied by 15 over the last decade and now represents 18% of the value of all goods exported by China.

South Asia

The South Asia market represents approximately 4.8% of the world's air cargo traffic in tonnage and 4.9% in tkm. Europe is the leading regional air trade partner with South Asia, accounting for 29% of total trade with the region; Asia and Middle East are the second and third largest trade partners of South Asia.

South Asia imports from Europe especially capital equipment (especially for garment and textile manufacture), industrial pumps, telecommunication equipment, power generating machinery, and electrical machinery.

Europe and Central Asia

The intra-Europe air cargo market comprises approximately 3.3% of the world's air cargo tonnage, but only 0.8% of tkm (because of distances involved). In terms of value of products transported, Airbus (2012) indicates that nearly 25% of all air cargo value is originated in Europe.

The total number of tkm flown in Europe in 2011 was 7% above the pre-crisis high in 2007 and 23 % higher than the low in 2009, dropping from 75 billion tkm to 64 billion tkm between 2007 and 2009, and reaching 82 billion tkm in 2011 (Airbus 2012). In average terms, air cargo traffic growth rate between 2001 and 2011 was 3.7% (which compares to 8.3% on maritime containerized traffic, for the same period), as fuel prices roughly tripled between 2004 and 2012 (Boeing 2012).

Europe market has Asia as its main trading partner. Europe–Asia market comprises in 2011 approximately 20.6% of the world's air cargo traffic in tkm and 10.4% in tonnage. In Europe-to-Asia direction, the top five commodity categories account for 66.5% of all air cargo traffic and the flow consists primarily of manufactured goods, while the Asia-to-Europe flow is primarily consumer goods.

The Europe-North America market is its second largest trading relation accounting for approximately 6.9% of world air cargo tonnage and 8.9% of the world's tkm.

CIS

In 2011, the CIS domestic air cargo comprised about 635.000 tonnes (98.7% of them from Russia). The Artic regions, Siberia, the Russian Far East and Europe are the larger markets of CIS region. As an example, total the CIS air trade with Europe was 262,000 tonnes in 2011, with about 206,000 tonnes (79%) imported from Europe.

Latin America

The United States is Latin America's most important trading partner, accounting for 99% of North America's air exports to Latin America and 99% of North America's imports from Latin America in 2011. The Latin America–North America market, which represents 2.6% of the world's air cargo traffic measured in tkm and 3.0% measured in tonnes, grew 1.1% in 2011, following a growth of 17.1% in 2010. The Latin America–Europe market, which represents approximately 3.2% of the world's air cargo traffic in terms of tkm and 1.8% in trade tonnage, grew 9.2% in 2010 and 3.8% in 2011 (Boeing 2012).

North America

According to Boeing (2012) "air cargo moving to, from, and within the United States and Canada accounts for 9.1% of the world's air cargo traffic in terms of tkm and 14.0% in terms of pure tonnage". Being a mature market, it shows flat or even decreasing growth rates during the last decade, dominated by express services with over 60% of Revenue Tonne Kilometres[4] (RTK).

US domestic traffic represented, in 2011, only 33% of all US carriers' cargo traffic. This figure compares with 45% observed in 2003.

[4] Another way to measure freight transportation.

Africa

As Boeing (2012) mentions, historically, South Africa has been the largest source of air cargo traffic in Africa, but today more and more capacity is focused on East and West Africa, which are now increasing their role in the air cargo market.

Today, traffic between Africa and Europe represents almost 60% of all traffic to, from and within Africa, owing to its proximity and long-standing historical and investment relations between these two regions.

The high growth in traffic relations between Africa and India, and also between Africa and Latin America may also present the opportunity for a new traffic flow between Latin America and India through the continent of Africa. The most recent civil aviation agreement between Turkey and Latin America will boost the importance of Central Africa as it will provide the increase in the supply of services both to Latin America and to Central Asia and the Middle East.

3.1.2. Waterborne

With over 80% of world cargo (in volume) transported by sea, maritime transport remains the backbone of international trade (ITF 2012a), as shipping is the major responsible for bulk transport of raw materials as crude oil and other petroleum products, coal, iron ore, grains and manufactured products (increasingly containerized). Global trade has permitted an enormous variety of resources to be widely accessible, with major trade patterns supported by the main shipping routes as those listed below (IMO 2011):

- coal from Australia, Southern Africa and North America to Europe and the Far East;
- grain from North and South America to Asia, Africa and the Far East;
- iron ore from South America and Australia to Europe and the Far East;
- oil from the Middle East, West Africa, South America and the Caribbean to Europe, North America and Asia;
- containerized goods from the People‘s Republic of China, Japan and South-east Asia to the consumer markets of the western world.

As Figure 8 illustrates, the biggest share of seaborne trade, in metric tonnes, refers to dry cargo, followed by crude oil and petroleum products and gas (including LNG, LPG, naphtha, gasoline, jet fuel, kerosene, light oil, heavy fuel oil and others). Dry cargo seaborne trade has grown 2.5 times in volume between 1991 and 2011, at an average annual rate of 4,8%, carrying almost 8,750 million metric tonnes of freight in 2011, while the annual averaged growth during the same period for crude oil trade was 1.4% and for petroleum products and gas was 4.2%.

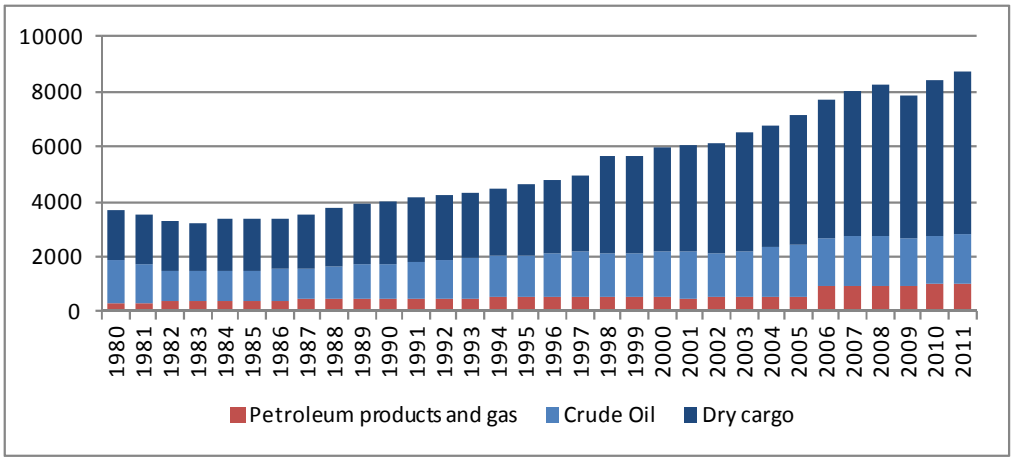


Figure 8 – Seaborne trade loaded by types of cargo [million metric tonnes] (source: UNCTADstat)

World container port throughput volumes rose six fold over the last twenty years from around 85 million TEU[5] to 531.4 million TEU. After the global economic crisis, the world container port throughput suffered a brief stumble in 2009, recovering in 2010, with an increase of 13.3% (UNCTAD 2011) which provides evidence on the current trend for ever increasing containerization of cargos in seaborne transportation.

The world's 20 leading container ports list includes 14 ports from developing economies, all of which are in Asia and 6 ports from developed countries, 3 of which are located in Europe and 3 in North America, therefore it is not surprising that the busiest trade routes remain between these three global economic strongholds. The country with the largest share of container throughput is China, with nine ports in the top 20 (see Table 7). In 2010, the port of Shanghai for the first time took the title of the world's busiest container port from Singapore, with a throughput of 29.2 million TEUs.

The top 20 container ports combined accounted for approximately 47.9% of world container throughput in 2010, which is up from 47.1% in 2009 but down from the figure of 48.1% reached in 2008 before the global financial crisis.

[5] A unit of cargo capacity often used to describe the capacity of container ships and container terminals. 1 TEU (Twenty-foot equivalent unit) stands for a 20-foot-long (6.1 m) intermodal ISO container. 40-foot (12.2 m) or 45-foot (13.7m) containers are usually designated as 2 TEU.

Rank	Port, Country	Volume 2010 (Million-TEUs)	Rank	Port, Country	Volume 2010 (Million-TEUs)
1	Shanghai, China	29.07	11	Tianjin, China	10.08
2	Singapore, Singapore	28.43	12	Kaohsiung, Taiwan, China	9.18
3	Hong Kong, China	23.70	13	Port Kelang, Malaysia	8.87
4	Shenzhen, China	22.51	14	Antwerp, Belgium	8.47
5	Busan, South Korea	14.18	15	Hamburg, Germany	7.91
6	Ningbo-Zhoushan, China	13.14	16	Los Angeles, U.S.A.	7.83
7	Guangzhou Harbor, China	12.55	17	Keihin Ports, Japan	7.48
8	Qingdao, China	12.01	18	Tanjung Pelepas, Malaysia	6.47
9	Jebel Ali, Dubai, United Arab Emirates	11.60	19	Xiamen, China	5.82
10	Rotterdam, Netherlands	11.14	20	Dalian, China	5.24

Table 7 - World's 20 leading container ports (World Shipping Council 2013)

As shown in Table 8, in 2011, Asia (except China) leads world container traffic, with a 31.1% share, or 175 million TEUs; followed by China, with 29.1% (164 million TEUs) and Northern Europe, with 11% (62 million TEUs). Asia (including China) accounts for over 60% of the world's container port traffic, followed by Europe (including the Mediterranean), with 18.2%. Latin America and the Caribbean handled 41.3 million twenty-foot equivalent units (TEUs), up 11.1% over 2010 (Salas 2012).

	2010	2011	Per cent Change	2010 Share	2011 Share
North America (excl. Mexico)	44,010	45,000	2.2	8.5%	8.0%
Northern Europe	57,325	62,000	8.2	11.1%	11.0%
Mediterranean	42,411	46,650	10.0	8.2%	8.3%
China	147,585	164,000	11.1	28.5%	29.1%
Asia (excl. China)	161,199	175,855	9.1	31.1%	31.2%
Latin America and the Caribbean	37,205	413,170	11.1	7.2%	7.3%
Other regions	25,734	27,140	5.5	5.0%	4.8%
World Total	517,845	563,779	8.9	100%	100%

Table 8 - Share of World regions in World Container Port Throughput [thousands of TEUs] (Salas 2012)

Inland waterways

Inland water transport (rivers and canals) represents an important alternative to other inland transport modes as it is an environmentally friendly mean of transporting goods. All around the world a great importance is being given to this mean of transport, especially in Asia and most recently in South America.

As can be seen in Table 9, China is by far the biggest player in what concerns freight transport by inland waterways (in tkm), followed by the United States and the EU-27. The countries and regions presented in Table 9 are responsible for almost all the world freight transport by inland waterways.

	2008	2009
China	1.741.170	1.803.267
United States	380.994	357.685
EU-27	145.300	129.800
Brazil		55.426
Russian Federation	63.705	52.686
Canada	22.800	16.400
India		4.364
Serbia, Republic of	1.369	872
Switzerland	128	100
Croatia	79	58

Table 9- Freight transport in inland waterways [in million tkm][6] (OECD s.d., EC, EU transport in figures 2012c)

China leading position can be explained by the fact that Asia is generously endowed with navigable inland waterways which represent 290,000 km in length playing a vital role in the economic development of remote rural areas and in the welfare of their inhabitants, who are usually among the lowest of low-income groups in the region. China's position also reflects the effectiveness of the Chinese IWT policy strategy in order to "stimulate the share of inland waterways traffic and to improve the interface between inland waterways and other transport modes especially sea-ports and rail" (NEA n.d.)

With an inland waterway system comprising more than 5,600 navigable rivers and a total navigable length higher than 120,000 km, and 200 inland ports, China alone has the most highly developed inland waterways transport subsector in Asia, contributing approximately for 70% of Asia freight volume per year, with China's longest river, the Yangtze, playing a core role in government efforts to develop the country's interior (see Figure 9).

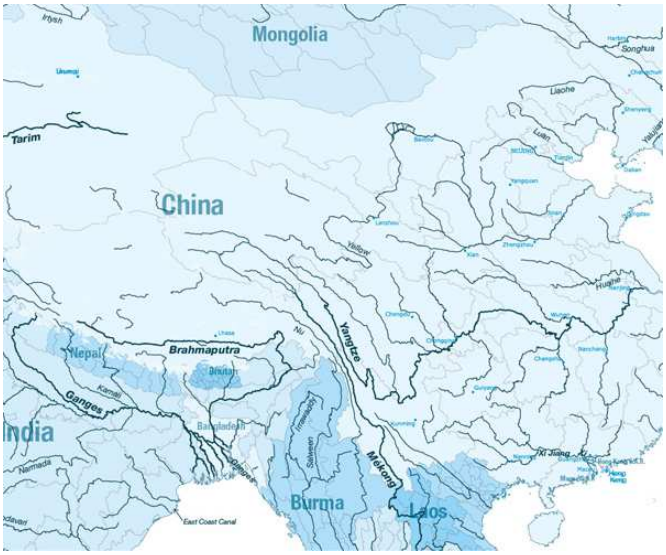


Figure 9- China inland waterways (CCNR 2012)

[6] Brazil data is related to 2010.

In what concerns EU, inland waterway transport plays also an important role in goods transportation. With 20 out of the 27 EU Member States having inland waterways, 12 of which interconnected, EU have more than 37,000 km of waterways connecting hundreds of cities and industrial regions (see Figure 10).

Figure 10- Europe inland waterways (AIWI 2010)

In 2010, inland waterways share in the total transport system (in % of total tkm) was the highest in the Netherlands (33%), followed by Romania (27.2%), Bulgaria (21.2%) and Belgium (18%) (OECD s.d.). These shares are likely to grow in the future, particularly in view of Europe-wide policies aimed at promoting its further use. In this respect, the European Commission, through its action programme entitled “NAIADES”, aims at promoting and strengthening the competitive position of inland waterway transport in the context of a liberalised transport market, by enhancing its integration into multi-modal supply chains (UNCTAD 2011).

Figure 11- North America inland waterways (AIWI 2010)

Inland waterways in the United States include over 40,000 km of navigable waters located mainly in the eastern half of the country (Figure 11); much of the commercially important waterways of the United States consist on the Mississippi River and its connecting waterways. In the West Coast, the Columbia, Sacramento and San Joaquin Rivers are the only major navigable rivers. However, lack

of investment and maintenance for aging infrastructure and dredging shortfalls have been identified as the main threats to present waterway viability in the United States and consequently to guarantee the future of this waterway network.

Brazil is also endowed with numerous waterways systems as the Solimão-Amazonas or the Paraguai-Paraná-Tiete, amongst several others (see Figure 12). Brazil is currently betting on IWW to develop its logistics infrastructure - the implementation of its national strategy for IWW (Plano Hidroviário Estratégico), is expected to raise the modal split of water transport (IWW and coastal shipping) from 13% in 2005 to 29% in 2025.

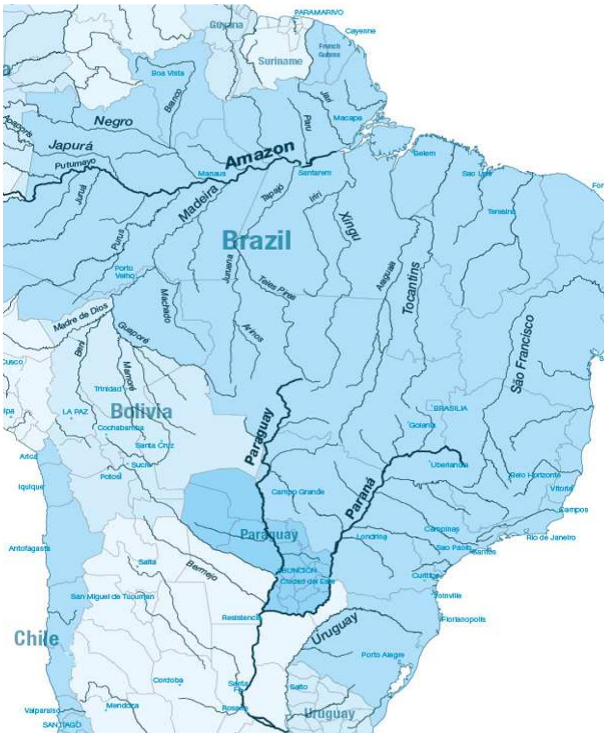


Figure 12- Brazil inland waterways (CCNR 2012)

India, on the other hand, has neglected its inland waterway system (see Figure 13) for many years, not providing the necessary funds for its improvement. Inadequate infrastructural facilities such as terminals for loading and unloading, connectivity with road/ rail, navigational aids, issues regarding depth and width required for movement of vessels for round the year operation, and even shortage of vessels are the main constraints facing the inland waterways sector in India. A special agency for waterway transport (Inland Waterway Authority of India) was created several years ago in order to improve the waterways system and as result freight transportation by IWW has been steadily increasing, climbing up to 4,364 billion tkm in 2009-10 from the level of 1,630 billion tkm in 2003-04 (IWAI 2010).

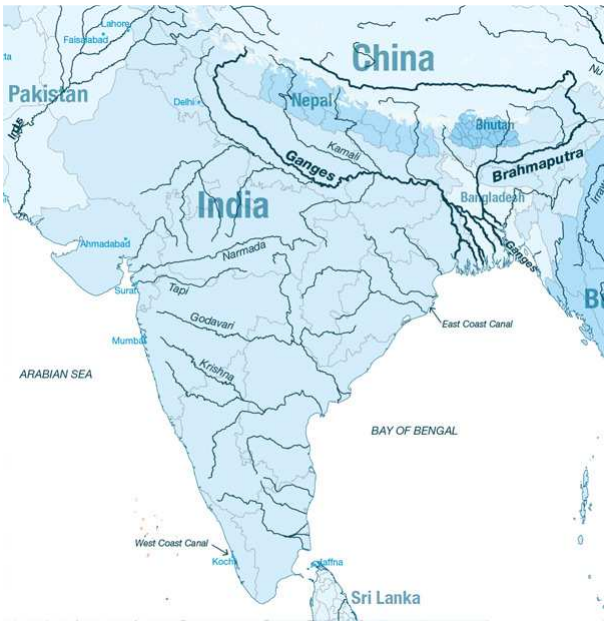


Figure 13- India inland waterways (CCNR 2012)

Comparing the length of some navigable inland waterways in an international scope (Figure 14), China with over 120,000 km of navigable length and the Russian Federation with an annual volume of freight carried by IWT of 155 million tons distributed by 100,000 km of navigable length, have the longest networks of navigable inland waterways.

The use of the Yangtze - the largest navigable river in China and the third largest river in the world - alone is increasing at 40% per annum. This situation highlights the relevance given to this mode of transport in recent years and the efficiency of China's Inland Transport Development Strategy, as industry moves west and raw materials to feed it are being shipped via the waterway.

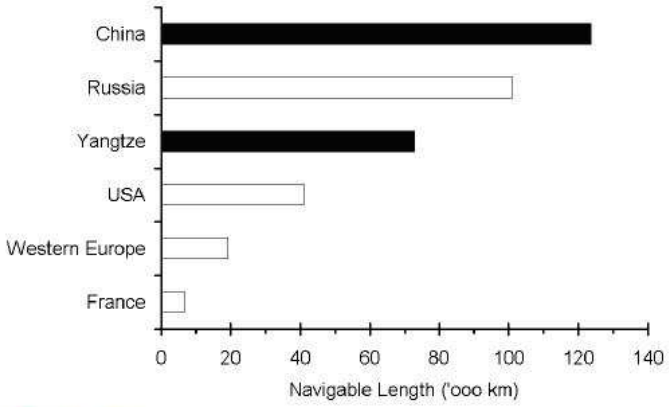


Figure 14- International comparison of navigable inland waterways (UNCTAD 2011)

3.1.3. Road

After the recent economic crisis, recovery in road freight has been slow and volumes remain below pre-2008 levels. Nevertheless, road transport continues to be the most used mode mainly in what refers to freight transport – a little over two thirds of goods carried by road were related to the transportation of goods on national road networks. According to several sources (Barrientos and Soria 2013, ITF 2013, Mckinsey & Co. 2010, CNT 2009), the total volume of goods transported by road in 2009 was around 10,500 billion tkm, with the top ten regions responsible for over 95% of world road freight flows:

Rank	Country	million tkm	Cumulative % world share
1	China	3,718,882	36%
2	EU	1,891,603	54%
3	United States	1,889,923	72%
4	India	755,250	79%
5	Brazil	485,625	83%
6	CIS	339,946	87%
7	Japan	334,667	90%
8	Mexico	211,600	92%
9	Australia	189,847	94%
10	Turkey	176,455	95%

Table 10 – Goods transported by road in 2009 [million tkm] (Barrientos and Soria 2013)[7]

China's road freight flows, with almost 3,720 billion tkm, represents over one third of world total flows, followed by EU-27 and USA, both with almost 1,900 million tkm of goods transported by road (see Figure 15). The remaining BRICS follows at some distance.

Figure 15- Goods transported by road around the world [million tkm], adapted from (Barrientos and Soria 2013)

In relation to the EU-27 area, road freight volumes crawled in 2010, with volumes remaining 14% below pre-crisis levels. EU's road freight volumes in 2010 were estimated at 1,658 billion tkm with Western Europe accounting for the largest share, with a total of 1,229 billion tkm, while Eastern Europe reached only 429 billion tkm. In terms of tonnage, European freight transport recorded a

[7] Available data for road freight volumes ranges from 2008 to 2010.

small increase between 2011 and 2010. The major product groups were mining and quarrying products (29% of the total), other nonmetallic mineral products (14%), food, beverages and tobacco (11%) and agricultural products (8%). In terms of tkm, the major product groups were food, beverages and tobacco (16% of the total), agricultural products (10%), other nonmetallic mineral products (9%), chemicals (8%) and metal products (7%) (de Angelis and Roubanis 2012).

	EU-27	USA	Japan	China	Russia	India	Brasil
Road network (paved)	5000	4400	968	3056	776	2433	202
Motorway network	68.2	94.3	7.6	65.1	30	70.9	9
Commercial freight vehicles [million]	34.1	11.0	6.2	13.7	5.4	6.4	8.7

Table 11 - Road transport infrastructure and freight vehicle stock [x1000km] (EC 2012)

Currently, road transport carries on average more than 80% in inland freight volume and more than 90% of goods in value (IRU 2011). Table 12 highlights some statistics on road transportation for major economies, namely the distribution of world's paved road network and commercial freight vehicle's fleet.

Road infrastructure grew 12 million lane.km (11 million paved) or more than 35% in the past decade, with China and India accounting for more than half of paved lane.km additions. During this period, paved lanes share of total network increased from 53% to 60% of a total worldwide road network length of 43 million km. Chinese paved network has grown 3 times during this period (to approximately 70% of USA total network length) and Chinese capital investments on paved roadways are likely to continue. India, on its part, added nearly 1 million km of paved roadway to its domestic network.

3.1.4. Rail

World rail infrastructure is almost 1,000,000 km rail track long and, since 2000, roughly 66,000 rail track km were removed (physically removed or serviced removed), while China, India and other ASEAN countries added 11,000 km of rail track, with China alone accounting for 7,000 km, 2,000 km of those for high speed rail services (HSR), which were expected to grow to 8,300 km by 2012 (Dulac 2013). This network carried almost 9,300 billion tkm in 2010 (UIC 2010).

Three countries/regions – CIS, USA and China - dominate the world's ranking of freight flows by rail, each one holding close to 26% of global rail flows, with India at a distant fourth place. The top 10 regions of the world, presented at Table 12, are responsible by 98% of the total world rail freight flows.

The total length of Russian railway lines is second only to the United States, as rail transportation was a key aspect of soviet trade infrastructure which still stands today, while in the United States rail freight gain increased predominance only after the 1980s', following the deregulation of American rail industry by the *Staggers Rail Act* legislative initiative. China owns the third largest rail line infrastructure, showing the highest density of operations - TKM+PK by km in the world, followed at a considerable distance by India.

Rank	Country	million tkm	Cumulative % world share
1	CIS	2,532,867	27%
2	United States	2,468,738	53%
3	China	2,451,185	79%
4	India	600,548	86%
5	EU	328,803	89%
6	Canada	322,741	92%
7	Brazil	267,700	95%
8	South Africa	113,342	97%
9	Mexico	71,136	97%
10	Australia	64,172	98%

Table 12 – Goods transported by rail in 2010 [million tkm] (Barrientos and Soria 2013)[8]

Rail transport in Europe has been declining in recent decades, especially in what concerns freight flows. Rail's share in the freight land transport market has dropped from 32.6 % in 1970 (EU-15) to just 16.7 % in 2006. In absolute terms, based on the amount of goods carried and distances travelled, rail freight transport activity (EU-15) declined between 1970 and 2006 by about 1 % annually (EC 2008).

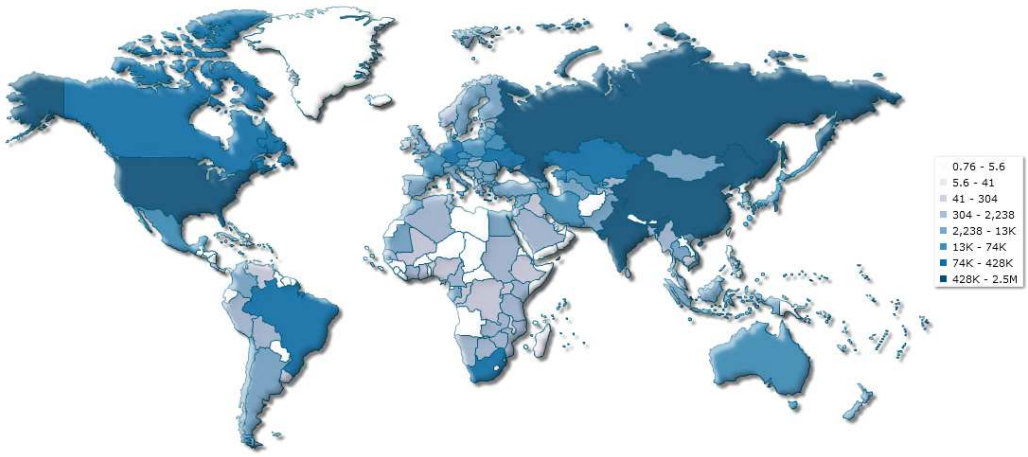


Figure 16- Goods transported by rail in 2010 around the world [million tkm] (Barrientos and Soria 2013)

Significant structural changes, caused in a large extent by initiatives taken at EU level to, for instance, the open up of rail markets to greater competition and the increase of technical harmonisation, rail freight volumes have stopped falling and the decline in rail's market share for freight has slowed down. Any licensed EU railway company with the necessary safety certification can offer national and international rail freight services throughout the EU.

In 2010, rail freight volumes in the European Union were estimated to be 16% below the 2008 peak level. The drop of freight rail transport for the period 2008–2009 has been visible in all EU Member States (except Estonia) and Norway which reported a slight improvement in freight transport, 0.1% and 1.2%, respectively. Despite EU rail freight volume reduction, in 2010 the global rail freight sector grew by 7.2% to reach 9,843 billion TKMs, or $161,797 million in value terms, a 7.7%

[8] Available data for road freight volumes ranges from 2006 to 2009.

increase over the previous year. This can be explained by the strong recovery of the United States, which accounted for 43.2% of the global rail freight sector value.

Russian rail transport accounts for a considerable share of external trade freight between the Russian Federation and China. During 2010, the volume of rail freight between the countries increased by 33% to reach 53 million tons. The vast majority (94%) of cargo comprises Russian oil, timber, chemicals and mineral fertilizer exports, but there are also increased volumes of imports of Chinese machinery and technical goods. Railways have been developing the main freight routes between the Russian Federation and China through large investments in rail infrastructure in the regions of Siberia and the Russian Federation's Far East (UNCTAD 2011).

3.2.Current Passenger Demand

Modal split

Setting comparisons between passenger transport modal shares across different countries is a challenging task but helps highlight several common trends and some particularities between different markets. Passenger transport continues to be dominated by car, particularly in developed countries, with private car holding a huge share of total passenger-kilometres (pkm), while public transport still dominates in emerging economies, although private car use is gaining increased market share at a fast rate. Air passenger transport share continues to increase strongly and is linked to a rapidly growing tourism industry and also an increase in international business travels. New business models - like low cost airlines - have also contributed to this growth. Rail passenger services have considerable higher demand in some Asian markets being comparatively negligible in North America.

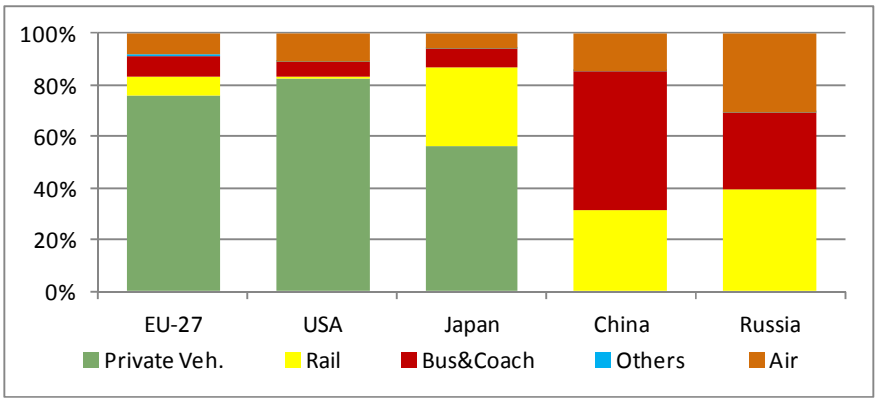


Figure 17- Passenger modal split[9] in 2010: Intercontinental Comparisons [all modes, pkm] (Several sources)

There was an increase of 17% on EU-27 passenger transport volumes between 1995 and 2005, as shown in Figure 18. During this 20-years period, the volumes of all transportation modes increased in absolute terms while the total volume of public transport modes was more or less constant.

[9] Data for private car use in China and Russia is not available; Japan data is related to 2009.

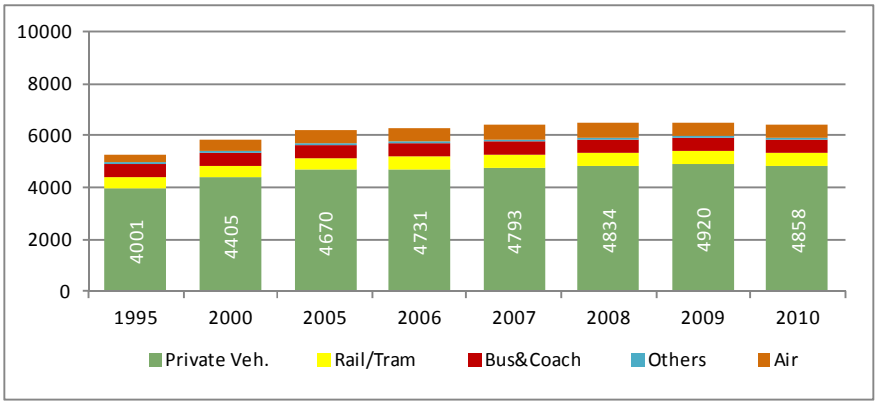


Figure 18- Modal split in the EU-27 between 1995-2010 [billion pkm] (EC 2012)

In 2010, the crisis effects led to a reduction of passenger transport figures. Although car transport represented the larger share of passenger transport in 2010, only air and rail transport were able to marginally increased their market share in relation to the previous year, +0.2% and +0.1%, respectively.

Air transport has seen a slight increase in modal split during this period and this is a trend expected to continue well into the future. The growing share of air traffic is linked to a growing tourism industry and also to increased international business travel as a result of growing globalization.

High-speed rail has brought some stamina to passenger rail transport sector, harvesting increased competition with air transport. High-speed rail lines are developing quickly but prices and total time travel are decisive factors in modal split ratios, as high speed rail can only compete in cases where (door-to-door) travel times are close to those of aviation and prices are also competitive[10] (van Essen, et al. 2009).

In the USA, passenger travel grew 95% between 1970 and 1995. This growth cannot be explained simply by the growth in the U.S. population, which rose by only 28% during the mentioned period. Rather, changes in the labour force, income, the make-up of metropolitan areas and other factors increased travel (M. Sedor 1997). Ten years later, passenger transport volume continued to grow, to decline only with the subprime crisis of 2008.

[10] The Madrid-Barcelona case is one example that investments in high speed rail have a tremendous impact on the number of passengers who travel by rail and consequently, at the rail-share. Rail-share in this corridor increased from 10% in 2004 to 60% after Madrid-Barcelona HSR corridor entered into force. The air connection between Madrid and Barcelona was the busiest regular route in Europe, ahead of the one between São Paulo and Rio de Janeiro (CNA 2011). However, since the high speed line between Madrid and Barcelona entered into service, in 2008, the air traffic flow in this route decreased by 50%. Available evidences shows that is mainly when travel time is below 3.5h that people switch from airplaine to HSR trains (Harland 2011).

	1995	2000	2005	2010
	p.km - share	p.km - share	p.km - share	Pkm - share
Air	346 - 7%	457 - 8%	527 - 8%	524 - 8%
Private veh.	4 001 - 75%	4 405 - 75%	4 670 - 75%	4 858 - 76%
Bus&Coach	497 - 9%	516 - 9%	524 - 8%	510 - 8%
Rail	421 - 8%	448 - 8%	460 - 7%	494 - 8%
Others	44 - 1%	42 - 1%	40 - 1%	38 - 1%

Table 13 - Modal share between 1995-2010 in the EU-27 [billion pkm] (EC 2012)

With a network of 4.4 million kilometers of paved highways, highly developed by global standards, USA passenger transportation is dominated by passenger vehicles (including cars, trucks, and motorcycles), which account for 83% of passenger-km traveled (7% higher than in Europe). The remaining 17% was handled by mainly by airplanes and Buses&Coaches, with trains chosen by less than 1% of the market (Figure 19).

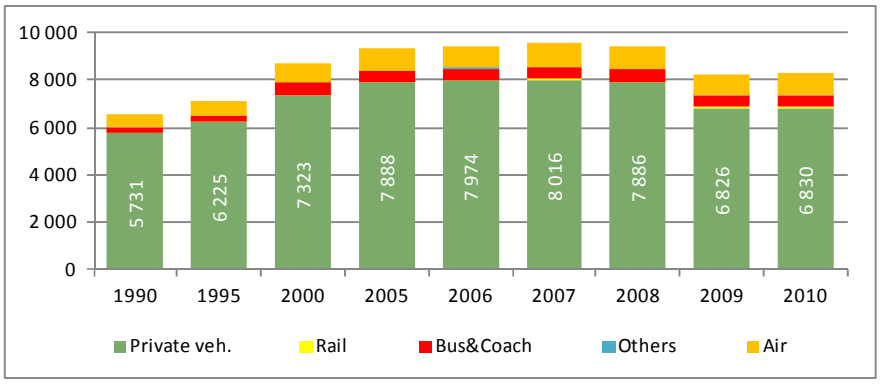


Figure 19- Modal split in the USA between 1990-2010 [billion pkm] (BTS-US DOT 2013b)

Despite some volume changes between modes in the 1995-2010 period, passenger transport shares in the USA remains quite stable for different modes over the years, as can be seen in Table 14. Yet, air has been steadily gaining market share over this period, while other public modes activity also illustrate some more recent vivacity albeit starting from a very low base, as is the case of rail and others (maritime, etc). The small share of rail passengers in US transport system, as illustrated in Table 14, stands out when compared to other geographies (see Table 13, Table 15 and Table 16).

	1990	1995	2000	2005	2010
	p.km - share	p.km - share	p.km - share	p.km - share	Pkm - share
Air	556.6 - 9%	650.0 - 9%	829.8 - 10%	939.5 - 10%	908.9 - 11%
Private veh.	5 731.2 - 88%	6 225.1 - 87%	7 323.4 - 84%	7 887.7 - 85%	6 830.3 - 83%
Bus&Coach	195.4 - 3.0%	219.0 - 3.1%	505.2 - 5.8%	448.8 - 4.8%	470.4 - 5.7%
Rail	39.9 - 0.6%	39.5 - 0.6%	46.6 - 0.5%	47.4 - 0.5%	54.3 - 0.7%
Others	1.4 - 0.0%	1.8 - 0.0%	2.4 - 0.0%	3.1 - 0.0%	4.1 - 0.0%

Table 14 - Modal share between 1990-2010 in USA [billion pkm] (BTS-US DOT 2013a)

In China, public passenger transport volumes have experienced major growth and expansion during the last 3 decades, with an increase of 2,200 billion pkm between 1990 and 2010 (a fivefold increase), as shown in Figure 20. Rail transport which in 1980 had more than 60% of passenger transport modal share saw its share halved in two decades. In turn, road transport has been increasing its modal share, accounting in 2010 for more than 54% of the total passenger-km transport volume. It's worth noting that Road passenger turnover (pkm) statistics available for

China comprises commercial services only (scheduled passenger services, taxis, buses and other commercial services), ignoring private cars[11] (IRU 2009), with the following market shares (pkm):

- Scheduled passenger transport lines: 74.8%;
- Taxi 5.7%;
- Urban public transport vehicles (buses): 32.3%, and
- Other commercial passenger transport: 11.1%.

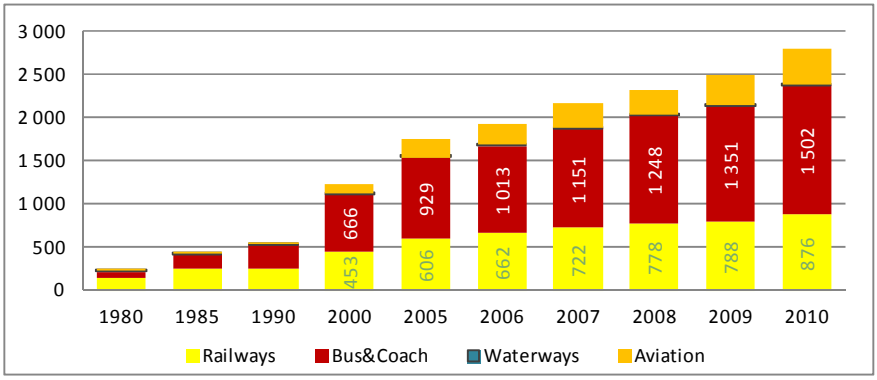


Figure 20- Modal split in China between 1980-2010 [billion pkm] (NBSC 2012)

Despite declining to only 31% of China's total passenger-km volume (disregarding private vehicles, see above) in recent years, China's rail passenger traffic volume is one of the highest in the world (second only to India) and the recent opening of new high speed rail lines is likely to strengthen this position, although the increasing challenge of aviation which has also been steadily gaining market share in this fast growing market.

	1990	1995	2000	2005	2010
	p.km - share	p.km - share	p.km - share	p.km - share	p.km - share
Aviation	23.0 - 4%	68.1 - 8%	97.1 - 8%	204.5 - 12%	403.9 - 14%
Road (public)	262.0 - 47%	460.3 - 51%	665.7 - 54%	929.2 - 53%	1 502.1 - 54%
Railways	261.3 - 46%	354.6 - 39%	453.3 - 37%	606.2 - 35%	876.2 - 31%
Waterways	16.5 - 3%	17.2 - 2%	10.1 - 1%	6.8 - 0%	7.2 - 0%

Table 15 - Modal share between 1990-2010 in China [billion pkm] (NBSC 2012)

The rapid increase of motor vehicle use throughout China is a result of its highway and road systems fast expansion –the Chinese highway system comprised, in 2008, 3.7 million km of highways (up to 3.98 million km in 2010), with over 3 million km paved and 65,100 km of Expressways, while the number of registered passenger cars in China has grown threefold between 2004 and 2009 (CAGR of 25%), from 15.33 million to almost 46 million in 2009 (CSP-NBSC 2011).

In 2004, around 10% of the Chinese car fleet was constituted by taxis – each traveling 90,000 km to 115,000 km yearly - placing the Chinese averaged yearly car mileage at about 24,000 to 27,000 km, quite higher than in developed countries (Huo, et al. 2007). These figures put average private car

[11] As opposed to statistics available on stats.oecd.org on inland passenger transport, which swap over results between private and commercial vehicle use.

annual mileage at around 17,000 km and chinese private car travel volumes in 2004 at around 235 billion vehicle.kilometers, slightly above 2005 Aviation figures, suggesting[12] a 15% market share for passenger car turnover (pkm - including taxis), growing to 20% in 2010, which is still quite distant from developed economies.

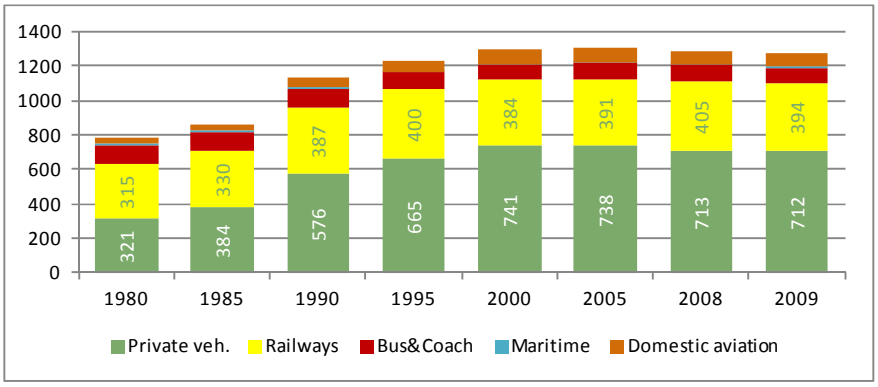


Figure 21- Modal split in Japan between 1980-2009 (SRTI - MIC 2013)

In what concerns Japan, between 1980 and 1990 there was a relevant shift from public and inflexible modes (railways and buses) to individual travel (see Figure 21). Road transport gained a significant share especially after 1990, leaving rail transport behind, with a percentage of passenger transport share of more than 60% of all passenger-km volume. This trend is especially related to income level growth and to demographic growth (Rodrigue 2013).

Since then, no major changes have been observed in Japan's passenger transport volume and mode shares, as can be seen in Table 16. In 2009, the total volume of passenger transport was 1,438 billion passenger-kilometres (down 2.0% from 2008).

	1990	1995	2000	2005	2009
	p.km - share	p.km - share	p.km - share	p.km - share	Pkm - share
Air	52 000 - 5%	65 000 - 5%	80 000 - 6%	83 000 - 6%	75 000 - 6%
Private veh.	576 000 - 51%	665 000 - 54%	741 000 - 57%	738 000 - 57%	712 000 - 56%
Bus&Coach	110 000 - 10%	97 000 - 8%	87 000 - 7%	88 000 - 7%	87 000 - 7%
Rail	387 000 - 34%	400 000 - 32%	384 000 - 30%	391 000 - 30%	394 000 - 31%
Maritime	6 300 - 1%	5 600 - 0%	4 300 - 0%	4 000 - 0%	3 100 - 0%

Table 16 - Modal share between 1990-2009 in Japan [million pkm] (SRTI - MIC 2013)

As seen before for freight, Rail is also a major producer of pkm in Russia, although its share has been steadily declining throughout the years. Road collective services (Bus&Coach) data also reveal a similar pattern, while the spotlight goes on aviation, whose relative performance has outpaced consistently other mode's, climbing from 11% in 2000 to 30% in 2010. Available data for passenger transport in Russia is liquid of private car travel.

[12] Considering a conservative assumption of single car occupancy, for both taxis (excluding driver) and private cars.

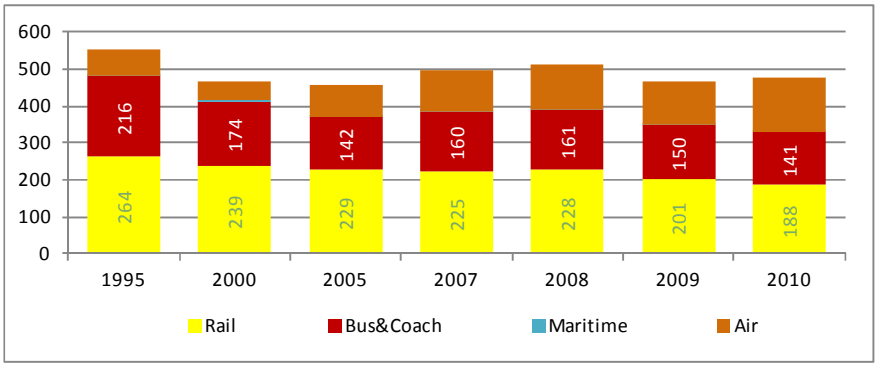


Figure 22- Modal split in Russia between 1995-2010 (FSSS 2012)

	1995	2000	2005	2010
	p.km - share	p.km - share	p.km - share	p.km - share
railway	263.5 - 48%	239.1 - 51%	229.1 - 50%	188 - 39%
road (public)	215.7 - 39%	173.9 - 37%	142.4 - 31%	140.7 - 30%
maritime	1.4 - 0%	1.1 - 0%	0.99 - 0%	0.86 - 0%
air	71.7 - 13%	54 - 12%	85.8 - 19%	147.1 - 31%

Table 17 - Modal share between 1995-2010 in Russia [in million pkm] (FSSS 2012)

Unfortunately, modal split data for other relevant regional markets like India or Brazil is not available due to lack of data, as recent statistical reports jointly produced by the BRICS illustrates[13].

3.2.1. Air

Between 1999 and 2008, global scheduled air travel, measured in pkm, grew on average by 4.8% per year. Fast growth is expected to continue over the next decades, particularly in non-OECD economies. Fuel costs, income and population growth are key drivers, while “open skies” and deregulation in Asian regions will be a further growth factor. Many countries may experience higher levels of air travel at lower levels of per-capita income than has historically been the case in OECD countries.

In 2011, according to the International Civil Aviation Organization (ICAO), approximately 2.7 billion passengers travelled by air. Passenger demand rose by 5.9% compared to 2010, in line with long-term growth trends. As shown in Table 18, international traffic grew by 7.4%, with a strong demand in business and leisure travel, particularly in emerging markets.

[13] See (CSP-NBSC 2011)

Passenger Traffic (pkm)	International		Domestic		Total		ASKs	LFs
Region	Traffic Growth	Market Share	Traffic Growth	Market Share	Traffic Growth	Market Share	Capacity Growth	Load Factors
Africa	4.6%	3.7%	5.4%	0.8%	4.7%	2.6%	6.1%	66.7%
Asia/Pacific	4.3%	24.8%	9.0%	31.4%	6.3%	27.4%	5.8%	75.8%
Europe	9.5%	40.5%	4.5%	9.2%	8.9%	28.5%	9.7%	75.9%
Middle East	11.9%	11.6%	11.6%	1.7%	11.9%	7.8%	13.4%	73.2%
North America	4.3%	15.5%	2.3%	51.3%	2.9%	29.1%	3.1%	83.5%
Latin America and Caribbean	9.0%	3.8%	6.0%	5.7%	7.5%	4.6%	2.2%	78.5%
World	7.4%	100%	4.9%	100%	6.4%	100%	6.5%	77.5%

Table 18 - 2011 Regional market share, passenger traffic, capacity growth and load factors (%) (ICAO 2012b)

According to Figure 23, USA domestic market was just recently (2010) the largest in the world with 19% of the global passenger traffic flows, followed by Europe with 13% and the Chinese domestic market with 7%. The main inter-regional flow takes place between North America-Europe with 8.7% of the global passenger aviation flows, followed by Europe-Middle East and Europe-Africa links with 2.9% and 2.8%, respectively.

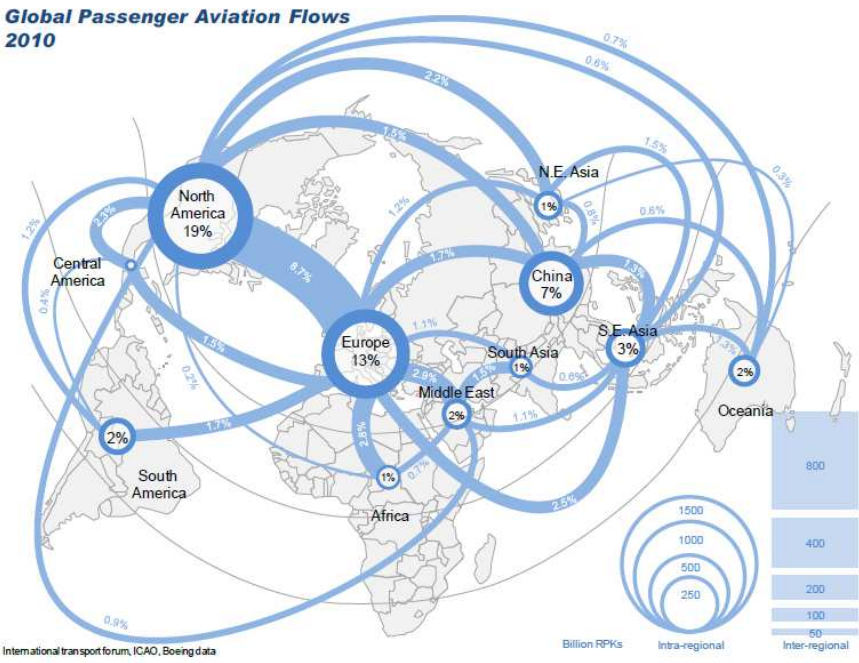


Figure 23- Regional passenger flows in 2010 (ITF 2012b)

In global terms, domestic traffic grew by 4.9% over 2010 leverage by an estimated 10% increase in demand for domestic air travel in China. Growth in domestic markets, however, was significantly lower than that registered in 2010. The relatively lower growth rates registered in North America, Europe and Africa were offset by the robust growth rates of Latin America, Asia/Pacific and Middle East airlines. Between 2006 and 2011, domestic passenger demand grew from 1.37 billion passengers to 1.77 billion, an AAGR of 5.3%, especially due to the expansion in the Indian and Chinese domestic markets (IATA 2013).

In 2012, Domestic markets grew by 3.9% over 2011. This growth was mainly driven by strong demand for domestic air travel in the Asia/Pacific, Latin America/Caribbean and the Middle East regions with China (9.5%) and Brazil (8.6%) as the strongest performers. US traffic expanded by 0.7% in 2012 (down from 1.5% in 2011), and capacity grew by just half of that at 0.3%. The slowdown reflects the maturity and subdued economic growth of the US market which accounts for about half of all domestic travel (as intra-European flights are considered as international flights). The European domestic market (flights constrained to European countries boundaries) declined in 2012, due to financial issues for some carriers and a deteriorating national and regional economic environment.

International passenger demand rose from 760 million passengers in 2006 to 980 million in 2011, at an annual average rate (AAGR) of 5.1% (IATA 2013). The highest growth for international traffic was registered by the airlines of the Middle East followed by Europe, which benefitted from the ability of low cost carriers (LCCs) to expand their point-to-point markets. The lowest growth figures, registered in both North America and Asia/Pacific, still represent a significant increase in absolute numbers. Meanwhile, the negative economic growth in Japan continued to keep on low air travel growth in the Asia/Pacific region.

According to ICAO (2012a), international traffic grew more than 6.0% in 2012, the same rate as the previous year. The strongest growth came from emerging markets, particularly the Middle East (17.3%), Latin America (11.7%) and Africa (7.4%). African carriers registered growth almost twice higher than their 2011 results, at 7.4% compared to 4.3% (see Table 19).

Passenger Traffic (pkm)	International		Domestic		Total		ASKs	LFs
Region	Traffic Growth	Market Share	Traffic Growth	Market Share	Traffic Growth	Market Share	Capacity growth	Load Factor
Africa	7.4%	3%	2.3%	1%	6.7%	2%	5.2%	68%
Asia and Pacific	5.5%	27%	8.8%	35%	6.9%	30%	5.9%	77%
Europe	5.6%	39%	-0.7%	8%	4.9%	27%	2.5%	79%
Latin America and Caribbean	11.7%	4%	5.3%	7%	8.4%	5%	6.1%	75%
Middle East	17.3%	13%	7.9%	1%	16.8%	8%	11.6%	79%
North America	1.3%	14%	1.2%	49%	1.2%	27%	0.7%	83%
World	6.5%	100%	3.9%	100%	5.5%	99%	4.0%	77%

Table 19 – 2012 Regional passenger traffic and capacity growth, market shares and load factors (ICAO 2012a)

In relation to Asia/Pacific region, international traffic saw a passenger growth of 5.5% in 2012 which was stronger than the 4.3% growth observed in 2011, when figures were affected by the Japanese tsunami. The 2012 performance was in line with the global average and contributed about a fifth of the total industry growth.

European airlines' passenger traffic expanded 5.6% in 2012, sharply down on the 9.5% growth of 2011, mainly due to financial issues for some carriers and a deteriorating national and regional economic environment and because around a quarter of European airline international traffic growth came from airlines outside of the Eurozone (Turkey being a major contributor). Despite slow economic growth in some regions and the implementation of austerity policies (mainly in southern

European countries) 2.9 billion people (more than 5% in relation to 2011) used air transport in Europe, during 2012.

Despite the decent performance of Canadian carriers, the North American market registered the lowest growth rate of all international markets (IATA 2013). In global terms, capacity grew more slowly than demand (4.0%) supporting a near record level international load factor of 78.9%.

3.2.2. Waterborne

Major waterborne passenger traffics are confined to ferry services on specific maritime liaisons like those in the Baltic Sea, the English Channel, or connecting islands like in Greece or Spain, and some inland navigation (like urban-commuting ferry services in Lisbon, New York, Bangkok or Hong Kong). Ferries forms part of the public transport systems of many waterside cities and islands, allowing direct transit between points at a capital cost much lower than bridges or tunnels.

The number of passengers-kilometres produced in EU-27 waterways has been steadily decreasing since the 1990s', as Figure 24 illustrates. This sustained fall in European maritime transport of passengers in recent years has mainly been caused by decreased transport to or from ports in a number of the largest maritime transport countries, such as Italy, Greece, the UK and France (EC 2013).

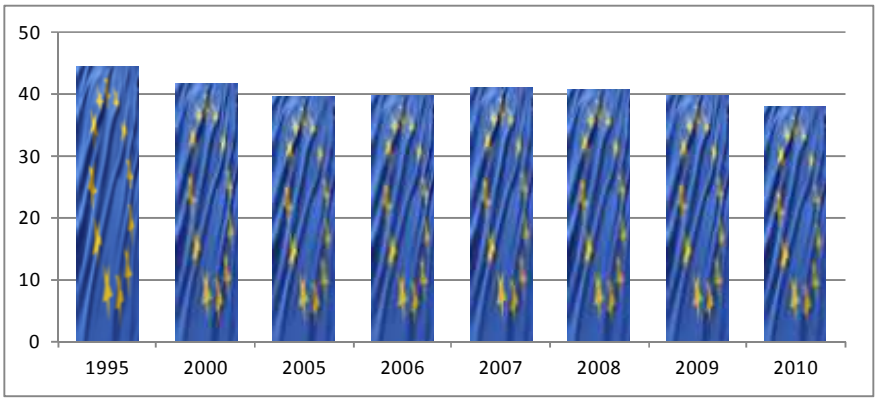


Figure 24 - EU-27 passengers transported by waterways [billion pkm] (EC 2012)

In 2011, the highest numbers of passengers embarking or disembarking in maritime ports (excluding cruises) were recorded in Italy (82 million passengers, -7% compared with 2010), Greece (79 million, -8%), Denmark (42 million, -1%), Sweden (30 million, 0%), Germany (29 million, +2%) and the United Kingdom (28 million, -3%) (EC 2012), as shown in Figure 25. Italy, Greece, Denmark, Sweden and Germany together accounts for just over two-thirds of the total number of passengers handled. Compared with 2010, the number of passengers decreased by 3.5% in 2011 (EC 2013).

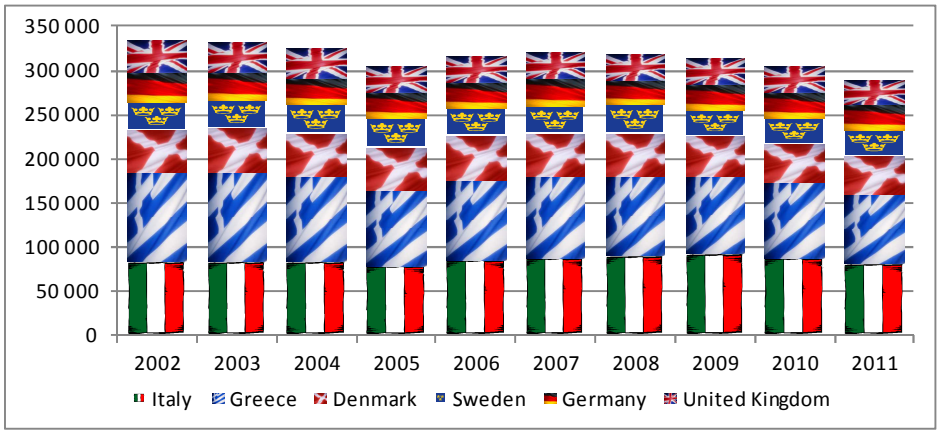


Figure 25- Passengers embarked and disembarked at 6 major European Countries (EC 2012)

In relation to other geographies, Chinese's passenger volumes transported by waterways have generally been declining since the 1990s', reaching under 6 billion pkm in 2008 (see Figure 26) to stabilize near 7 billion pkm in recent years. This evolution comes as a consequence of new railways and highways constructions which have diminish the overall utility of Chinese waterways for passenger travel. Still, passenger boats are particularly popular in some mountainous regions, such as Western Hubei and Chongqing (the Three Gorges area), where railways are few and road access to many towns is inconvenient (NBSC 2012).

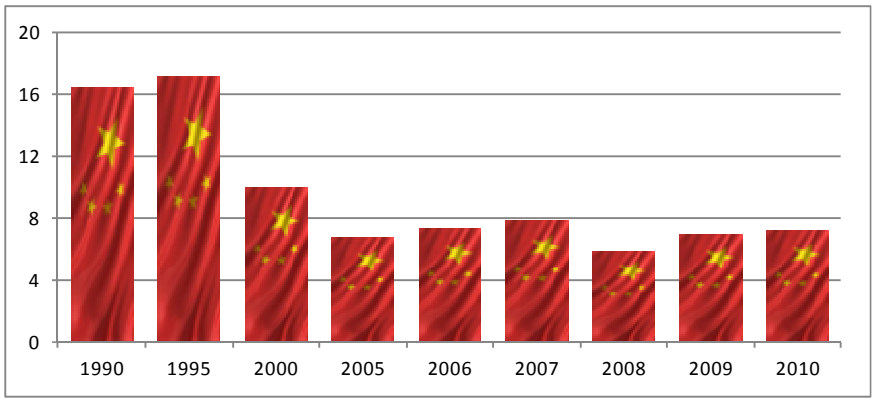


Figure 26- China's passengers transported by waterways [billion pkm] (NBSC 2012)

Although the number of US passengers transported by waterways over the years is considerably smaller comparing to the majority of other countries, the share of passengers transported by waterways has been increasing (Figure 27) contradicting the world tendency. Transit agencies operating the public transit ferry systems served over 576 million passenger-km in 2009, using a fleet of 143 ferryboats. These ferry services continue to serve an increasing number of passengers since mid-1990s' (U.S.DoT 2011).

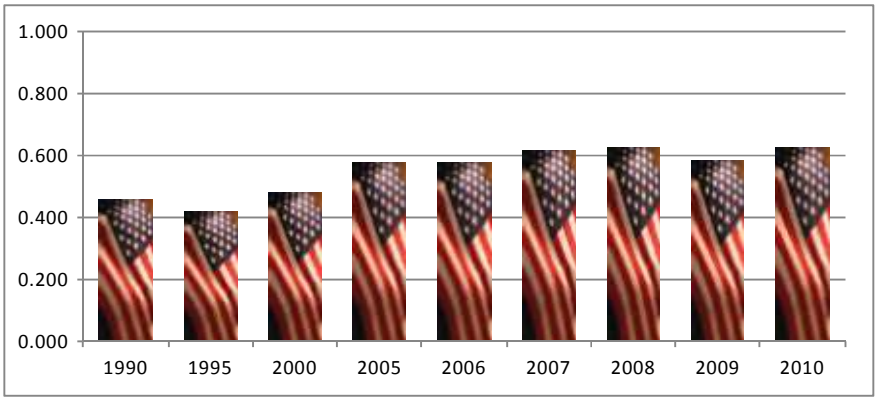


Figure 27- Evolution of US passengers transported by waterways [billion pkm] (BTS-US DOT 2013a)

Cruising has become a major player of the tourism industry, with millions of passengers each year. With larger capacity ships and ship diversification, more local ports, more destinations and new on-board/on-shore activities that match demands of consumers, the worldwide passengers carried by cruise have been increasing annually. In 2012, the worldwide passengers carried reached 20.3 million, from under 4 million in 1990 (Figure 28).

North America, with almost 11 million passengers taking 4,222 cruises for a record 71.8 million passenger nights in 2011 (U.S.DoT 2012), is the largest cruise market, with over 60% of nowadays cruises established in America, while 27% are European based and the remaining 13% travels in other parts of the world. Still, the number of passengers in Europe is increasing more rapidly than in North America, while market growth and improving infrastructures increasingly places Asia as the next potential market for the cruise industry (Koncept Analytics 2013).

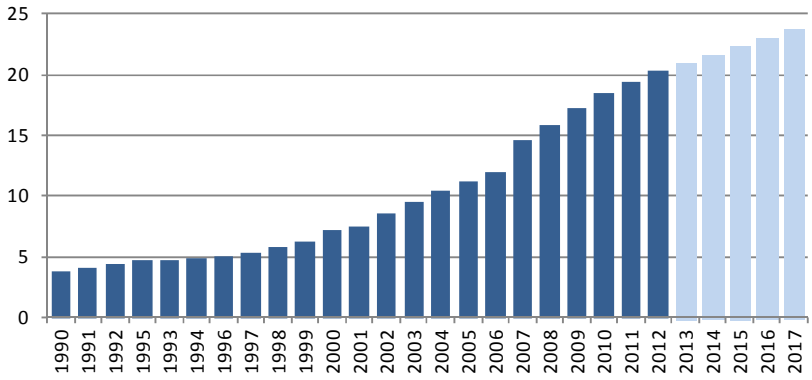


Figure 28- Worldwide passengers carried by cruiseships [million] (2013 to 2017 estimates) (Cruise s.d.)

With higher outputs year after year for over two decades, still today's long distance passenger travel in Europe fulfils a marginal leisure purpose only, if one considers that cruise passengers represents only 3% of the total number of passengers in EU-27 ports (data for in 2011) (EC 2013).

Cruise (s.d.) estimates that, Europe's share is expected to rise 1% between 2013 and 2017 while North America's share is expected to decrease almost 2% during that period.

3.2.3. Road

Passenger transportation in develop countries is dominated by private vehicles, as private transport is generally perceived as faster, more flexible and comfortable than public transport. Historically, the transport and land use policies from many developed countries have pursued the accommodation for ever increasing demand for private transport, although current practices increasingly promote the use of more sustainable modes, a trend that might be picked up earlier in the developing by emerging economies.

Private vehicles comprise light-duty vehicles (LDV - cars and light trucks) and two-wheelers. Data presented in Table 20 gives a global view on vehicle stocks on major regions, highlighting the high motorization rates in the most developed economies, like the USA, EU-27 or Japan, as opposed to other emerging economies.

	EU-27	USA	Japan	China	Russia	India	Brasil
Car Stock [million]	238.8	234	69.2	40.3	32.6	17.2	37.2
Motorization [cars/1000p.]	477	763	542	30	228	15	195

Table 20 – 2010 Vehicle stock (EC 2012, Denatran 2013, TRW - MRTH 2012)

The global LDV fleet has grown over 2.5 times from just over 300 million LDV in 1975 to over 800 million in 2010. While in the 70's around 85% of the world fleet was found in OECD countries, this figure has fallen to 70% nowadays, as fleet growth rates declines in developed countries and intensifies in developing economies - a pattern that is expected to intensify in the future (ITF 2012b), due to the "s-shaped" relations between income and car ownership, with levels of car ownership and use growing strongly at first and then decreasing and eventually levelling off at higher levels of income, while other determinants of driving also led in the same direction, as the age structure of population.

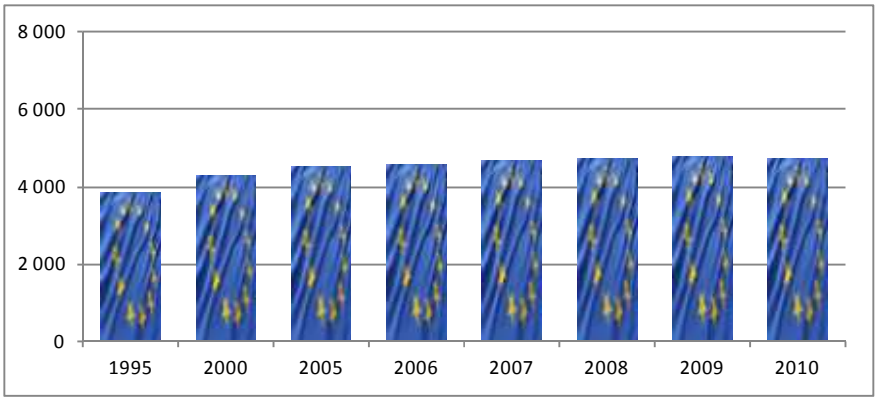


Figure 29 – EU-27 private passenger transport between 1995-2010 [billion pkm] (EC 2012)

Historical data on private car use evolution places the highest demand levels in the world in USA, with over 7,000 billion pkm produced annually by 2005-08. This illustrates USA's higher propensity for private car use, as UE27 population is two thirds higher than USA's, but its per capita pkm production is only 40% of USA's private passenger transport (Figure 29). Most recent

result for US reveals a strong correction on transport production although, based on light duty vehicles transport only, dropping USA figures to slightly over 6,000 billion pkm, in 2009 and 2010 (Figure 30).

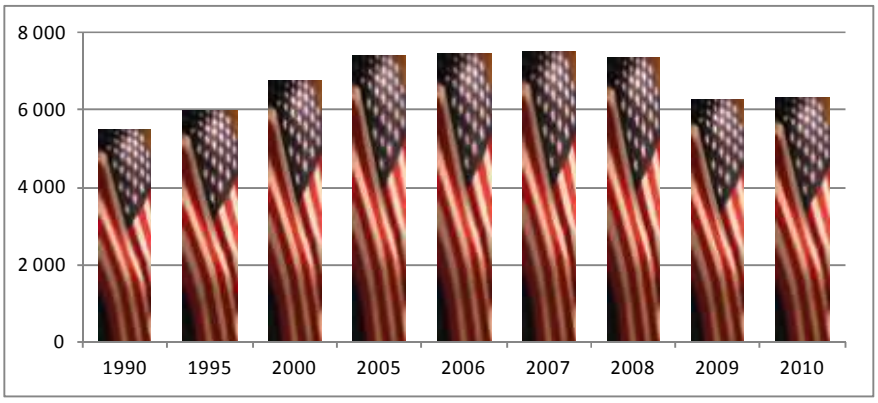


Figure 30 – USA private passenger transport between 1990-2010[14] [billion pkm] (BTS-US DOT 2013b)

Data for Japan, on the other side, illustrates a developed economy with a much leaner propensity for private car use, despite recent market developments referred previously, as Japanese 127 million population only produces around 800 billion pkm yearly, less than one third of USA's per capita figures. Figure 31 illustrates a 5.5% fall in Japanese private passenger transport between 2000 and 2008.

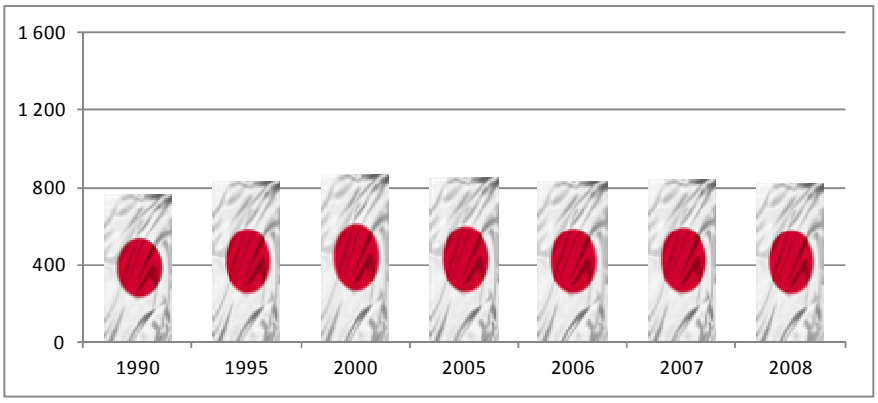


Figure 31 – Japanese private passenger transport between 1990-2008 [billion pkm] (BTS-US DOT 2013b)

The overall global figure for motorization rate in 2009 was 123.8, according to the WB (2013), which raises huge potential for future car acquisitions in emerging economies, although future levels of ownership and use are highly uncertain and directly linked to future energy prices, transport policies and infrastructural developments, technical and lifestyle changes. If historical development patterns are to apply to emerging economies, it will raise some significant sustainability issues.

[14] Data for USA includes: Light duty vehicle, short wheel base; light duty vehicle, long wheel base; truck, single unit 2-axle 6-tire or more and truck combination; the sources notes stresses out that data for 1960-99 are not exactly comparable to data for 2000 onwards.

Buses and coaches can help reduce congestion and pollution, as in averaged terms one coach can replace 30 cars. Its use in more developed countries is linked to either lower income stratus or better mobility planning, as focused transport policies and spatial structures can promote its increased use, especially in urban environments.

Bus&Coach	EU-27	USA	Japan	China	Russia	India	Brasil
billion pkm	510.1	470.4	87	1502	147.7	582	27.4
fleet [x1000]	819	846	227	1696	900	1532	723

Table 21 – 2010 Bus&Coach vehicle stock and transport production[15]

Table 21 presents current fleets and demand use for public road services in major regional markets. Data for developed economies as EU-27, USA and Japan places Bus&Coach demand at roughly one tenth of private car figures, as China and India stand out as the major users of these services. It's worthy of note that Indian pkm only considers SRTU (State Road Transport Undertakings) production, lacking pure commercial services data, and that available data for Brazil only considers interstate and international traffics, highlighting the difficulties on retrieving this kind of information, which is not always available.

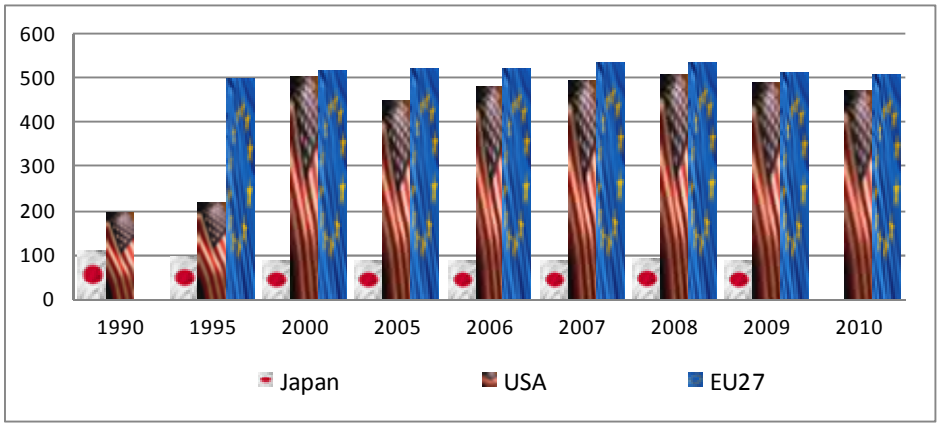


Figure 32 – Bus&Coach passenger transport between 1990-2010 in developed regions [billion pkm]

The steady evolution on Bus&Coach ridership in developed countries is illustrated in the above chart. The evolution of American statistics between 1999 and 2000 raises some question marks we are not able to answer, that are probably linked to data retrieving and processing. Data for Japan also shows that current traffic is somewhat lesser than in the 1990s, from over 100 billion pkm to 87 billion pkm in 2009[16].

Regarding available information on developing countries, available data on Chinese and Russian demand for public road transport shows opposite developments from a similar starting point in the 1990s, with China road sector showing greater dynamism, while Russia public road sector has been

[15] Data from several sources, including EC, USDOT, ANTT (Br), ARSTU (In), Statistics Japan and Russian Federation State Statistics Services.

[16] Available series for Japanese pkm go only until 2009. Available information from another document places them at 71 billion pkm in 2010, but as this value appears solely and not in a series, it's not clear if they match correctly.

losing ground to aviation and probably to private cars also, although there is no statistical data to support this last statement, since the collapse of the Soviet Union.

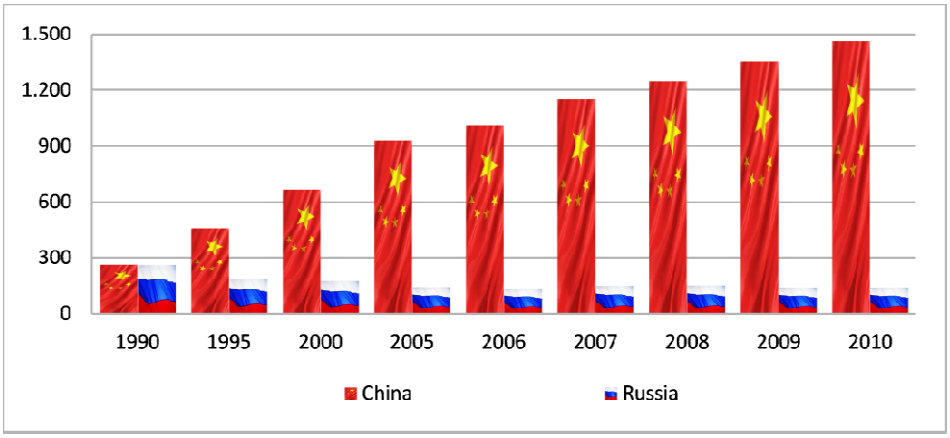


Figure 33 – China and Russia Bus&Coach passenger transport [billion pkm] (NBSC 2012, FSSS 2012)

3.2.4. Rail

Rail passenger transport in 2010 was over 2,750 billion pkm (UIC 2010). Rail passenger transport rankings are dominated by Asian countries, with India, China and Japan on the top three spots, followed by EU-27, other Europe and Russia. The evolution of rail passenger demand is quite dissimilar in different regional markets.

Country	pkm [x10^6]
India	903,465
China (Pop. Rep. of)	791,158
Japan	393,470
EU27	386,191
Other Europe	225,666
Russian Fed. *	139,028
Africa	62,324
Ukraine	50,240
Egypt	40,837
Korea (Rep. of)	33,027
South Africa	13,865
USA	9,518

Table 22 – Passenger transported by rail in 2010 [million pkm] (UIC 2010)[17] and (SRTI - MIC 2013)

Rail is a commonly used mode of long-distance transportation in India, as the rail network traverses the length and breadth of the country, covering a total length of 64,460 kilometres (MR-GI 2011) – the fourth largest in the world. Demand for rail passenger services have increased tenfold over the last decade in India (OECD s.d.). Available information until 2000 placed road transport production fourfold higher than rail (Chaudhury 2005), but more recent information on road demand is available only for State Road Transport Undertakings, as referred to previously.

[17] Africa figures include Egypt and South Africa; values for Japan were retrieved at stat.go.jp (http://www.stat.go.jp/english/data/handbook/pdf/c09cont.pdf) since available figures from UICs were quite different.

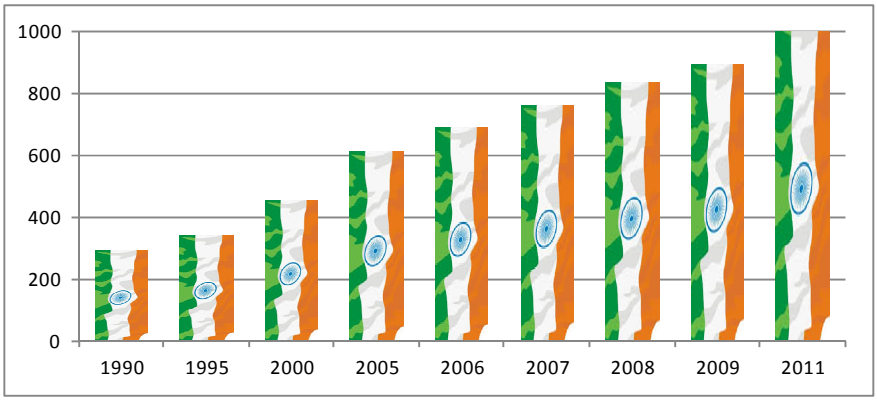


Figure 34 – India rail passenger transport[18] 2000 - 2010 [billion pkm] (OECD s.d., Chaudhury 2005)

Regarding China, we can safely say that rail has lost the leading role it once played on passenger mobility, (before the 1980s – see Figure 20). Nevertheless, the historical evolution of pkm in China Railways has also been quite impressive, although it looks like its growth is levelling off over the last years, as Figure 35 illustrates.

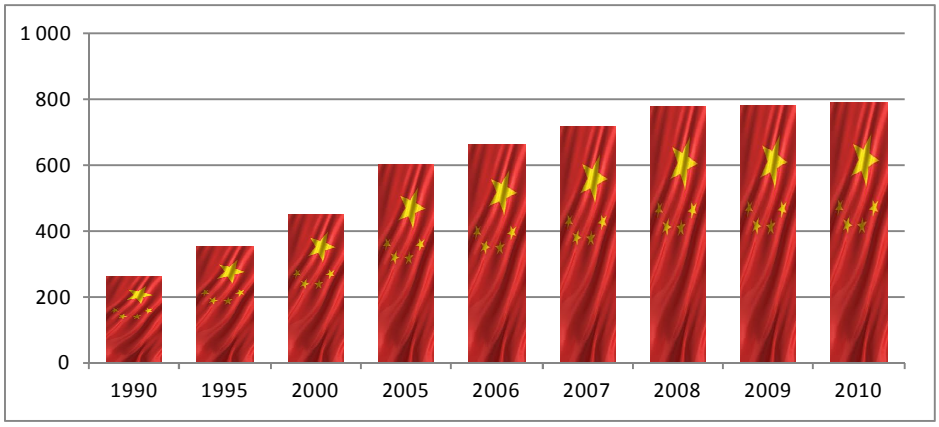


Figure 35 – China railways passenger transport between 1990-2010 [billion pkm] (OECD s.d.)

Rail passenger transport volume in the EU-27 reached a low in 1994, after which average growth was 1.0% per year. Growth was particularly strong in the last three years for which data are available, passenger transport increased by an average of 2.3% per year between 2003 and 2006 (Figure 36).

[18] There is a discrepancy between UIC and OECD data, since they give the same figure for 2009 and 2010.

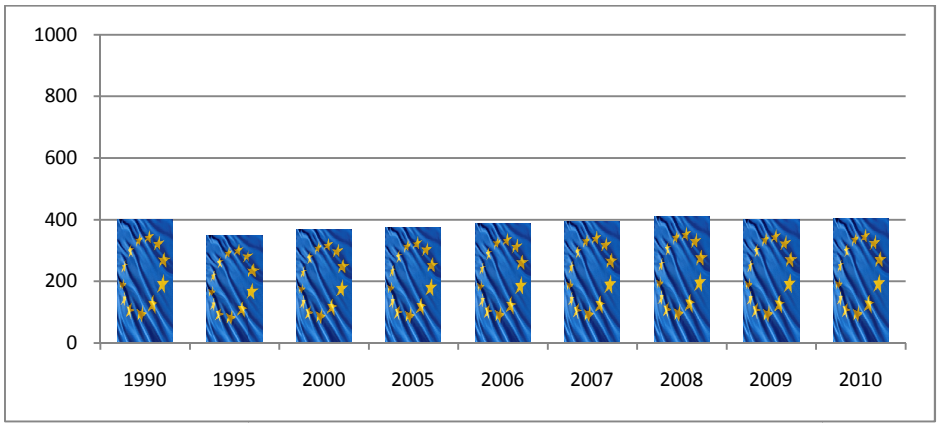


Figure 36- EU-27 railways passenger transport between 1990-2010 [billion pkm] (EC, EU transport in figures 2012c)

Rail passenger transport felt the full impact of the economic crisis later than other sectors. It was more visible in 2009 and continued to be felt in 2010. In the EU, passengers-kilometres stagnated in 2010 (+0.2%) after falling 2% in 2009. According to ITF (2012b), more than two thirds of all rail travel (national and international combined) was accounted for by the four largest EU Member States with France and Germany together accounting for more than two fifths of the EU's passenger rail travel. The number of international passenger-kilometres travelled by French passengers (in 2009) was more than twice the level for Germany which in turn recorded a figure that was 2.5 times as high as that in the United Kingdom in 2010.

Regarding Russia, available rail passenger-kilometres data showed a drop by 8% in 2010, in line with historical evolution since the 1990s', when transport production doubled nowadays figures. Overall fall since the soviet times is around 50%.

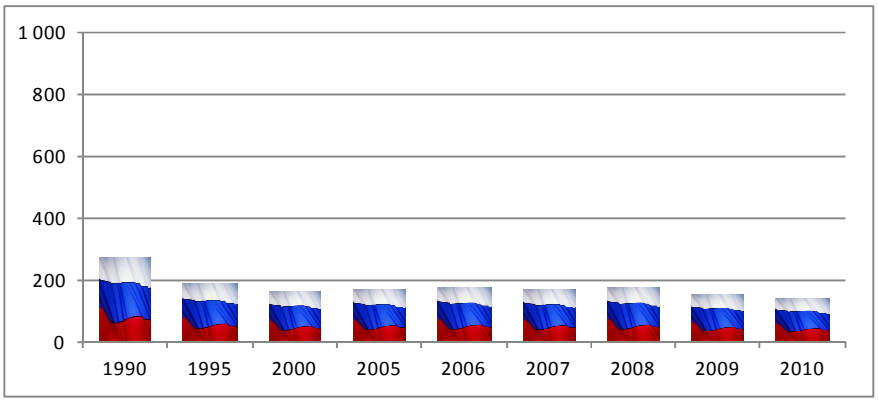


Figure 37- Evolution of passenger rail transport in Russia between 1990-2010 [billion pkm] (OECD s.d., UIC 2010)

Japan rail passenger statistics definitely illustrates a more mature and stable market, where supply and demand have met an equilibrium stage some time ago.

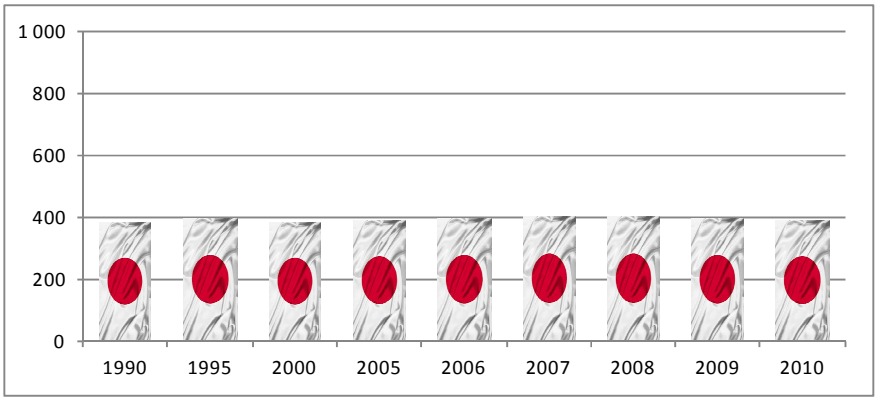


Figure 38- Evolution of passenger rail transport in Japan between 1990-2010 [billion pkm] (OECD s.d., SRTI - MIC 2013)

4. Driving forces

Transport is usually described as a “derived demand” in the sense that demand for transport is almost always determined by broader aspects of economic or personal activity. Freight must be moved from production point to markets, and passengers travel to work or to shop or for leisure: rarely is the trip itself the object of the transport, except maybe for tourism or sporting events. Transport thus has been understood to arise from other drivers rather than being a principal actor. The most influential driving forces for future transportation demand patterns are highlighted and referenced in the this chapter.

4.1. Demographics and society

Demographic and socio-economic developments include a variety of driving forces influencing and changing the demand for mobility. Mobility is an intrinsic need of human beings a derived demand of the activity system. As societies have developed, trip purposes have become diverse and travelled distances longer. The existence and further development of infrastructures and services are important induction factors, shortening distances between places and improving travellers’ comfort.

Beyond individual mobility needs, the population size, density, structure and expected growth rates are important parameters that help to explain trip generation, mode choices and infrastructure use. Population growth and changing lifestyles creates a need for versatile, individual mobility solutions and can lead to the creation of new infrastructures as a response to the expansion of city borders. Population density is also an important driver for the creation of sustainable public transport systems since it also brings along an adequate demand for centralized transport services and ensures a higher capacity use of the public transport vehicles.

Extended life expectancy leads also to an increased demand for mobility. In developing countries the working population will increase and with it the need for commuting and business trips. In developed countries, it is expected that more elderly in the future will travel more than previous generations of elderly did, generating a higher transport demand for daily passenger transport with special mobility needs. In this case, future transport systems and services will play an essential role in supporting a more independent and healthy ageing population.

4.1.1. Population

4.1.1.1. Population development

The world population is growing, although with very significant regional differences. The European Environment Agency (EEA) has published a study including past and future trends for the global population, demographic development and structures (EEA 2011a). The past developments and future projections are for the time periods 1800-2150 and 1960-2100. According to the EEA study (EEA 2011b) the global population has been steadily growing during the past decades with some regional differences. While population growth has stabilized in Europe and in the USA, it still has a positive trend in most of the developing economies such as India or countries in Africa and Latin America (EEA 2011b).

The United Nations has developed three long term scenarios for the world population which go until 2300 (see Figure 39).

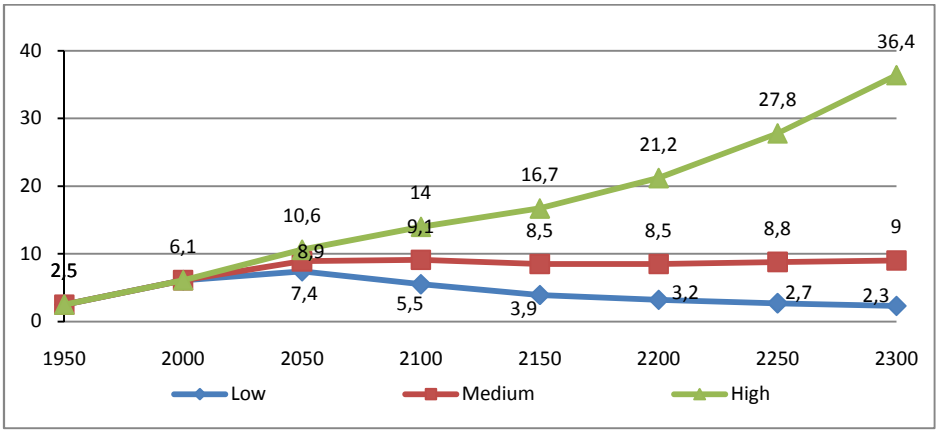


Figure 39- Global population development 1950-2000 and projections to 2300 [billion] (UN 2004)

In the medium scenario the world population will not change greatly after 2050, whereas the high scenario shows a drastic increase in global population and the low scenario would lead to a global population of only 2.3 billion until 2300 (UN 2004). The UN report highlights the importance of fertility and life expectancy for the population development. Until 2050 fertility will have the largest influence on increasing populations, but in the long term the increasing life expectancy will become the most important factor for population growth (UN 2004).

UN's projections (2004) for the distribution of global population support the previously mentioned analysis from the European Environmental Agency and show the shares of the global population until 2300. The largest shares will be also according to the UN in Asia and Africa, Latin America having the third biggest share. The proportionally largest increase will take place in Africa and the greatest decrease in Europe (see Figure 40).

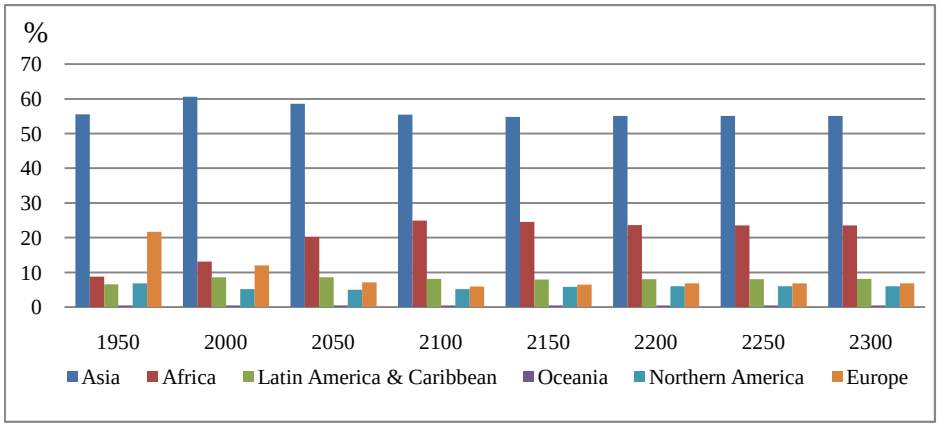


Figure 40- Distribution of world's population 1950-200 and projections to 2300 (UN 2004)

4.1.1.2. Demographic change

Besides the globally increasing population and regional disparities in the growth one of the main trends relating to demographics is ageing. Several institutions have dealt with this issue, such as the

United Nations, the European Environment Agency, the European Commission, Eurostat and the National Intelligence Council (NIC). They have all published studies concerning the changing age structures.

Even though the trend for ageing society is currently the strongest in Europe and in Northern America, the median age is expected to increase on all continents (UN 2004). According to this paper the rising median age does not only have to do with increasing shares of elderly populations (see Figure 41), but also with decreasing share of younger age groups due to decreasing fertility rates.

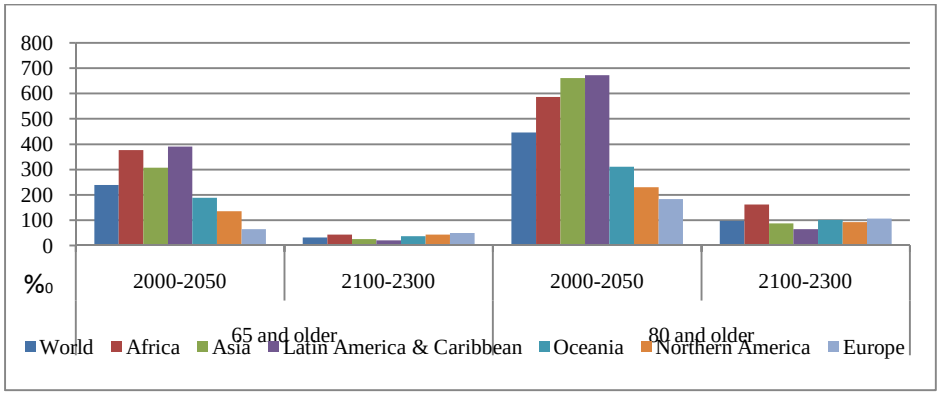


Figure 41- Share of the advanced age groups +65 and +80 during 2000-2050 and 2100-2300 (UN 2004)

The proportional growth of the elderly populations will be the biggest in the developing countries and emerging markets, whereas the trend will slow down in Northern America and in Europe (UN 2004).

With their habits from lifelong active mobility behaviour the willingness of this group to change daily transport modes might be limited. According to a study conducted in Germany the elderly rather pay an increasing price for mobility than change their mobility behaviour, however seniors with lower financial resources might have to adapt and reduce the use of mobility services if the public transport tariffs aren't lowered (Zentrum für Alternskulturen 2009). An adjusted tariff system for seniors would keep the public transport services available and is an effective way to stimulate the use of public transport modes (Arentze, et al. 2008).

Population Changes in Developed Western Countries

Some studies (Moriarty and Honnery 2008, Rudinger, Donaghy and Poppelreuter 2004) analyse the expected stagnating and ageing populations in Europe and in North America. The stagnation in industrialized countries takes place due to decreasing child birth rates and increasing life expectancy leading to proportionally larger populations in Asia, Africa and Latin America (Moriarty and Honnery 2008).

Between 2000 and 2060 increasing life expectancy, decreasing fertility rates and a proportional reduction in the age groups below 30 years is expected in Europe and in North America (Moriarty and Honnery 2008), leading to ageing populations. Older adults are the fastest growing segment of the population in Europe and North America and by 2030 every fourth citizen will be aged 65 or

older (Feng, Hubacek and Guan 2009, Rosenbloom and Ståhl 2003). According to another European Union study the population over 65 years will increase its share in the EU from 17% in 2009 to 30% in 2060 (EU 2005).

A closer look on the national level populations shows disparities, even within Europe. A study covering six Central and Eastern European countries looked at the demographic development during 2000-2010. Stagnation or declining populations were identified in Germany, Hungary and Croatia (EU 2011). A slight population growth was shown in Belgium, the Netherlands and Austria, but in the long term demographic ageing is becoming an issue in all these countries. During the research period the average age of the inhabitants increased between 4% and 12% (EU 2011).

Population Changes in Asia

Asia's 50 countries and territories, and its population of around 4.3 billion - accounting for 60% of the world total - will witness the most rapid demographic change in the world (Zhongwei Zhao 2013)[19].

In the 1950s, the Asian population as a whole was still in the early stages of demographic transition; fertility and mortality were both higher than the world average, with a total fertility rate of 5.8 children per woman and a life expectancy of 43 years. In 2013, the total fertility rate has fallen to 2.2 children per woman and life expectancy has reached 70 years.

Great demographic diversity still exists. Asian populations have experienced remarkable demographic changes, but the process, magnitude and consequence of these changes have varied significantly. When examined by region, East Asia has led the change over the past six decades — the lowest fertility and mortality rates in the world have been recorded in some East Asian populations in recent years. Southeast Asia is now slightly behind East Asia; the region's total fertility rate has fallen from 6.1 to 2.1 children per woman and life expectancy has risen from 42 to 71 years over 1960-2013.

In contrast, fertility and mortality changes have been much smaller in the five Central Asian "-kstan" countries. Their total fertility rate has declined from 4.6 to 2.5 children per woman and life expectancy has increased by only 13 years (from 55 to 68 years). Demographic changes in West and South Asia have been far more notable than those in Central Asia but have been less dramatic in comparison with East and Southeast Asia.

Marked variations in fertility and mortality have helped to form different age structures and other demographic characteristics in these populations, which have had very different impacts on Asia's recent socioeconomic development. For the same reason, these countries and areas will also face very different demographic challenges in the near future. On the basis of these considerations and

[19] Zhongwei Zhao is a professor at the Australian Demographic and Social Research Institute, College of Arts and Social Sciences, the Australian National University.

their current fertility and mortality levels, Asian populations can be divided broadly into three major groups, although there are some exceptions.

The first group consists of most East Asian populations and several countries in other parts of Asia. These populations completed their demographic transition some time ago. Their recent and current fertility levels are lower or much lower than 1.8 children per woman, and life expectancy tends to be higher than 74 years. Their recent population changes have opened the 'demographic window' to economic development, and most of these countries have experienced rapid economic growth in recent decades. Because of their very low fertility rates and remarkable reductions in mortality, these countries have witnessed and will continue to witness rapid ageing. Many of them have experienced or will soon experience a notable decline in the working-age population, or even a decline in the national population. The conventionally defined old-age dependency ratio will further increase in most of these countries. If their far-below-replacement fertility levels are not reversed soon, the age structure of these populations will become even more top-heavy or biased towards old people.

By 2050 Asia will add another billion to its already huge population of 4.3 billion. Demographers reckon that this will be a very good result, not because Asia's population will become so large but because the population projection for 2050 is several billion lower than it would have been without the spread of control over human fertility that has occurred over the past four decades.

With 1.4 billion and 1.2 billion people respectively, China and India currently account for 37% of the world's population. Thirty years later, they are expected to account for roughly the same share of world population. But the overall numbers hide the fundamental changes that will have occurred by then. The bulk of population growth in Asia over the next three and a half decades will be in South Asia, a result not of high birth rates but of the large number of people in the childbearing ages, itself the product of past higher levels of fertility.

The falls in birth rates across Asia mean that today there is a concentration of population in most Asian countries in the working ages. Economists call this feature of population transition in Asia the demographic dividend because it provides the opportunity for more productive investment of capital and for a stronger focus on developing the human capital of the next generation of workers, both essential features of economic development. Economies like Japan and the Asian tiger economies of Korea and Taiwan benefited from the demographic dividend during their earlier periods of high economic growth. Capturing the demographic dividend is now a major objective in the progress of development in countries such as Malaysia, Thailand, Indonesia and China. The economies of South Asia and elsewhere also need to ensure that they capitalise on this source of growth potential.

The second group of countries, which is spread right across Asia and includes countries such as Turkey, Indonesia and Oman, has largely completed its demographic transition, but fertility levels are either slightly higher than replacement or have only reached this level recently. Their life expectancy is generally within the range of 70 to 75 years. Largely for this reason, the proportion of old people is still growing relatively slowly in these countries. Most of these populations will have low or declining dependency ratios over the next few decades, which, together with favorable

development policies and adequate investment, could bring about the kind of rapid economic growth that have been seen in many group-one countries. Creating enough jobs will be a major challenge over the next 20–30 years.

The third group of countries is largely from South, Southeast and West Asia. Most of these countries are still in the late stages of demographic transition. Their fertility rates are still notably higher than replacement level and life expectancy is generally lower — in some cases much lower — than 70 years. Rapid population growth will continue to be a major challenge for them, and some will see their current population more than double by the middle of the century. This will lead to increased population density, a high dependency ratio and strong demand for employment — and these factors will put great pressure on socioeconomic development. In some of the group-two and group-three countries, the high population density, increasing demand for jobs and low standards of living will also produce a strong 'push' which could lead to increased international migration.

In the next 20–30 years, fertility and mortality changes are likely to be relatively slow and steady in most Asian populations, although they may decline rapidly in some group-three countries. This is because after falling to a low level, mortality rates are very unlikely to bounce back dramatically unless the country is struck by catastrophic infectious disease, natural disaster or war. Similarly, in low-fertility populations, small fluctuations or a moderate increase in fertility may take place, but a drastic surge or reduction in fertility seems unlikely in the near future.

The certainty about Asia's future demographic changes also stems from the impact of population momentum. Because of this, a number of major demographic trends in Asia have already been determined by the size and structure of the current population. While unexpected events or radical interventions can still alter Asia's demographic future, the demographic backdrop has been largely set up for the next 20–30 years. The socioeconomic impacts and policy implications of this backdrop need to be considered carefully in planning for fulfillment of future demand for mobility and transportation (Zhongwei Zhao 2013). They also provide reach food for thought for European strategists at transport and other mobility providing industries who either are interested in containment or further expansion of their business presence at different regions of Asian continent.

Population Changes in MENA Countries

For hundreds of years, MENA's population oscillated around 30 million, reaching 60 million at the beginning of the 20th century. In the second half of 20th century, MENA region witnessed an explosive population growth – population increased from around 100 million in 1950 to around 380 million, 50 years later (Roudi 2011). This was the world highest population growth rate recorded in the past century: MENA region reached a peak of population growth (3%) around 1980, while the world as a whole reached its pick (2%) around two decades earlier; in 2007, MENA was growing at about 2% a year almost twice than the world average (Assaad and Roudi-Fahimi 2007). Nowadays, MENA region contains about 6% of world's population, partially the same as EU population. Together, Egypt, Morocco, Iran, Algeria and Sudan account for more than 70% of the region's population.

The significant decline in child mortality – infant mortality dropped from 200 deaths per 1,000 live births in the early 1950s to fewer than 50 deaths at the turn of the 21st century – allied with the decline of MENA's fertility rate – fertility declined from 7 children per woman around 1960 to 3.6 children in 2001 –, led first to an increase in the proportion of children under 15 and then to an increase in the proportion of people between 15 and 24 years. These young populations represent a tremendous opportunity, both as market and as labour force. According to Ahmed, Guillaume e Furceri (2012), over the past decade, "the labour force in MENA has grown at an average annual rate of 2.7%, faster than in any other region of the world, excluding Africa. And it will continue to outpace most other regions. The number of labour force entrants remains daunting – approximately 10.7 million new entrants are expected to join the labour force in the coming decade, compared with 10.2 million in the previous decade. However, youth labour force growth is expected to gradually decelerate over the next decade, easing labour market supply." Today, with half of its population under age 25, MENA has the second youngest population among world regions, after sub-Saharan Africa. The average life expectancy at birth is about 65 years – close to the world average (67.2 years).

According to Roudi (2011), "in a number of (MENA) countries, each generation of young people enters childbearing years in greater numbers than the previous generation, so as a whole they will produce a larger number of births" so, despite the decline in fertility rates, MENA's population is expected to continue to grow for several decades. The population ages and dependency ration could rise as a greater proportion of the population reaches retirement age.

More than half the working-age population of the MENA region are neither employed nor in school. MENA's youth unemployment rate (25%) – in Tunisia reaches up to about 30% - and economic dependency are the highest in the world mainly because of its young age structure and the low level of female labour force participation.

By 2025, overall share of youth in MENA's population is expected to decline to 17% although the number of 15-to-24-year-olds is still expected to increase by more than 7 million for the whole region. The growth in the youth population will be especially prominent in Iraq, Yemen, and the Palestinian Territories – where current levels of fertility are the highest in the region. By 2035, youth population is expected to reach a peak at 100 million and decline slowly thereafter.

Since 1950, MENA's population growth rate quadruple and it's expected to surpass 700 million by 2050, exceeding the population of Europe in that year. This continuing growth is complicating the region's capacity to adapt to social change, economic strains, and sometimes wrenching political transformations (Kent e Farzaneh 2007). With population growth, elderly population will also grow and with it the demands for health care and financial security, however they will remain a small share of the total population, especially compared with Europe, where one-third of the population will be age 60 or older by 2050.

Population Changes in Latin America

The Latin America (LA) population has been growing at declining rates. Population in Latin America increased 3.5 times over the last half-century—from 161 million in 1950 to 547 million in 2005—and is projected to increase an additional 40% over the next 45 years, to reach 763 million in 2050 (Cotlear 2011). However, according to Un-Habitat (2012), after a rapid population growth by the mid of the last century, LA region have been experiencing profound demographic changes, most notably a reduction in population growth rates (from an annual rate of 2.7% in 1950–1955 to 1.15% in 2011, a rate similar to the one observed at the global level) and an increasing upward shift in age structures. In the most populous countries of the region, the population growth ratio reduction has been from 6.1 to just 1.7 in Brazil and from 6.7 to just 2.0 in Mexico (Leeson 2011) and can be explained by the decline of the fertility - result of profound social changes as changing values and attitudes as well as behavior to family formation and childbearing.

Even so, due to decreasing mortality which ensures more and more people were surviving to older ages, population increased from 60 million (in the 1960s) to nearly 588 million in 2010, comprising 8.5% of the world's total population. This population high share is concentrated mainly in two countries, Brazil and Mexico, totaling more than half of LA's population (33% and 18.5%, respectively). The majority of LA countries still had populations below 10 million but there are now 11 countries with populations between 10 and 50 million and 2 with more than 50 million – Brazil and Mexico.

With an increase of life expectancy at birth from 47 years in the mid-20th century to 74 years in 2011 and with the decline in mortality and fertility, the number of older people and their share of population increased from 8% in the mid-20th to 11% (data from World databank). This kind of population structure is expected to be even pronounced in the future.

By 2050, LA will be the developing region with the smallest proportional growth expected. Stabilized at 800 million – 8% of the projected global population, this slight population growth will be largely due to fertility declines in several of its largest countries such as Brazil and Mexico. However, the number of countries with more than 50 million inhabitants will double – Colombia and Argentina will join to Brazil and Mexico (United Nations 2009).

In relation to the number of the working-age population (aged 15–59) it is estimated to keep growing steadily until around 2030, after which it would start to decline under the low and medium variants, but the growth would continue under the high variant. The total number of working-age people is estimated at between 365 million and 474 million in 2050 (Cotlear 2011).

Between 2000 and 2050, the proportion of persons aged over 65 will triple, by which time one in every five persons in Latin America will belong to that age group. By 2050, 22.5% of Brazil's population and 22.1% of Mexico's population will be aged 65 years and over. Cotlear (2011) wrote "the magnitude of the older population is expected to match that of the youth population for the first time in history around 2040. By 2050, the older population is expected to outnumber the youth

population by 30%". The total demographic dependency will reach a pick in 2050, increasing from 53% in 2010 to 62% in Brazil and from 48% in 2010 to 62% in Mexico.

4.1.1.3. Changing society, lifestyle and mobility behaviour

Society has changed fundamentally over the last decades affecting demand for transportation. The size and spatial distribution of households changes the demand for living space and settlement patterns. Due to smaller household size more complex mobility is needed to establish and maintain social contacts as well as to conduct other activities which then again increase the demand for transportation (Brög, Barta and Erl 2005).

The household structure has changed in Europe as the average household size has dropped by 10-15% during the past 15-20 years (EU 2005). In 1995 the average household in Europe had 2.5 persons, but since then there has been a trend towards single households. The share of single households is expected to grow from 30% to 36% during 2000-2015 (Brög, Barta and Erl 2005). Future perspectives for Germany also show an increasing amount of single households by 2030. The increase is predicted to be up to 8% depending on the underlying future scenario (Institut für Mobilitätsforschung 2010).

Changing lifestyles can also be seen on other continents. The trend is especially strong in China where the increasing income levels lead to growing household consumption and better availability of goods and services including transportation (Feng, Hubacek and Guan 2009). According to this source there will however be clear regional differences in the development of lifestyles. The income and lifestyle disparities between urban and rural areas are growing and the urban lifestyles with increasing expenditures change towards the western European lifestyles (Feng, Hubacek and Guan 2009).

Two studies carried out in Germany and another one conducted by the European Commission identified some key aspects for the changing lifestyles and values affecting mobility (Lanzendorf and Gather 2005, EU 2005). Key words used to describe the change were individualisation and flexibility (Hunsicker, et al. 2008, EU 2005). Demand for individual mobility services is expected to increase due to changing, flexible and spontaneous lifestyles.

People want to choose freely where they live, work and spend their leisure time regardless of longer distances or the increasing need for more complex, individual mobility services. Leisure activities are gaining on importance and the everyday life becomes more irregular and quickly changing (Brög, Barta and Erl 2005, EU 2005). The individual mobility needs are strengthened by the liberalisation of working hours and conditions, making commuting less regular (Lanzendorf and Gather 2005).

The private car enables fulfilling individual needs and routes, which suits the previously mentioned lifestyle changes towards individualisation and the need for flexible mobility. According to Hunsicker, et al. (2008) the rising fuel costs and emissions will however improve the attractiveness of the public transport. Especially in the urban areas multi-modal transport solutions with emphasis on the public transport will become more important (Hunsicker, et al. 2008).

Still unknown is the effect of upcoming forms of virtual mobility, which will together with the knowledge society and service economy open new opportunities for the virtualization of work. Together with the changing lifestyles and technological developments the working life is also changing. Home office and virtual conferences can be suitable, efficient options depending on the job characters, tasks and the position of the employee (de Graaff and Rietveld 2007).

Public transport services focusing only on traditional schedules will become less adequate and need to be adapted to the changing lifestyles. Demand responsive transport services could be a solution for a more flexible public transport (EU 2005). Inflexible transport services which aren't offering appropriate alternatives lead to increasing use of the private car to secure individual travelling (EU 2005).

The changing lifestyles include internationality and lead also to growing international travelling due to social connections, leisure time preferences or family members with different nationalities (Brög, Barta and Erl 2005).

4.1.2. Migration

Migration is also a strong influencing factor for population growth particularly in the developed countries. Migrants tend to be younger and generally active workforce with higher fertility rates compared with the natives (Brög, Barta and Erl 2005). The migration flows show a trend from rural to urban areas and the migrants also settle down in urban or suburban environments (UNEP 2012).

Migration has led and leads to population growth and evens out the stagnating child births in developed countries. Migration's role is becoming more important due to demographic ageing and the stagnation of the working age populations (Brög, Barta and Erl 2005, EU 2009). Out of the yearly population growth of ca. 0.25% in the EU, migration counted for 0.20% (EU 2005). A prognosis for Germany also recognised the importance of migration and expects an annual migration flow of approximately 100,000 people until 2050 (Fraunhofer 2011). Another study from Germany predicts even a higher migration flow between 100,000 and 200,000 persons per year, depending on the future's scenario for 2030 (Institut für Mobilitätsforschung 2010).

Migration also has an influence on the demand for mobility, especially when it comes to public transport services (Brög, Barta and Erl 2005, EU 2005) After arriving to a country immigrants are more often using the public transport services compared with the local population. A demand for multilingual information services will also increase with the development of a multicultural society (Brög, Barta and Erl 2005, EU 2005), which is seen as a trend for the future, for example in the Netherlands (Harms, et al. 2011).

There will also be relevant transportation effects arising as economic and cultural links to other regions and countries are intensified by the migrants, especially to their countries of origin, leading to growing international people travel and goods transport (EU 2009).

4.1.3. Urbanisation patterns

According to the United Nations Environment Programme (UNEP 2012) almost all population growth will take place in cities in developing countries while this trend is slowing down in the industrialized countries. The majority of Europeans are already living in cities and the regional differences in urban development have evened out since a high level of urbanisation throughout Europe has been reached (EEA 2011b). Due to urbanization in emerging economies the global urban population is expected to increase with more than 3 billion by 2050.

Urbanisation patterns influence travel behaviour and modal choice, especially when considering population's lifestyle. Land scarcity and urban congestion will continue to influence urban planning strategies and lead to higher demographic densities and mixed land use developments. To tackle the land use and accessibility issues relating to urbanisation, the use of multimodal transport services and active modes should be promoted.

Urban sprawl is closely linked to socio-economic trends: the spreading of housing and commercial services outside the cities where they are mainly accessed by private transportation, driven by the high private car ownership which is a result of affordable automobiles, low fuel prices, increased individual mobility needs and inadequate public transport services (EC 2011). However the movement of people from city centres towards suburbs without strict planning is an old phenomenon. As long as there have been cities the more fortunate ones have moved to areas with lower population densities and more nature or at least acquired a holiday home outside the cities. This development could be seen already in the ancient Rome where the ones in possession of horses and carriages escaped the cities to the hills or sea for relaxation (Bruegmann 2008).

Cities with compact and centralised housing areas and labour markets are a result of the history as well as geographic and cultural factors. From the transport perspective compact and densely populated areas are a requirement for improved public transport services, which then again leads to an increased use of public transport (EEA 2011b). The public transport can however only be profitable and the capacity of the transport services adequately used when the population or passenger density is high enough (Gori, Nigro and Petrelli 2012). The high level of transport services and infrastructures hasn't only improved the access in urban areas but also the connections to suburbs and other locations in the agglomeration, which have led to increasing urban sprawl. The gaps between urban and rural areas have sharpened and are causing contradicting mobility needs (EEA 2011b, EU 2009).

According to Buehlerand and Pucher (2012), Germany is one example for frequent use of public transport services as Germans are five times as likely as Americans to make a trip by public transport. There are several differences between these two opposite examples on travel attitude countries. German legislation encourages dense, mixed-use urban development. The increasing appeal of public transport in Germany for persons with easy access to a car may be explained by the rising cost of driving as well as improved public transport service. Compared with the USA, German households with more cars than drivers made 20 times more trips by public transport in 2008/2009 (5.7% versus 0.3%). On the other hand, in the USA, governments have failed to restrict car use in cities, raise the cost of driving, and improve land-use policies, subsidizing roadways, car

use, and parking which have inhibited the use of public transport and puts the United States as the country with the highest motorization rate in the world: 828 vehicles per 1,000 inhabitants facing 509 vehicles for Germany and 473 vehicles for EU-27.

Public transport ridership in Germany has increased significantly in urban and rural areas as well as in small and large metropolitan regions. The growth was the biggest in densely populated areas. Compared with Germany, public transport use in the USA is more concentrated during the peak hours, being dominated by commuter travels from the suburbs to city centres.

Settlement patterns are influenced by lifestyle changes as well as urbanisation, as influencing factors such as income, transport infrastructure and regional economic situations are changing. In the last decades many countries' infrastructural development has been influenced by auto mobilization, enabling the combination of individual housing preferences with job opportunities (EC 2011). Sub- and peri-urbanization and increasing distances between housing areas and work places leads to commuting and to new kind of issues like irregular traffic flows due to peak hours and otherwise low capacity use of public transport vehicles, also in Europe. These issues could partly be solved with flexible working hours, home office and online services (Gori, Nigro and Petrelli 2012).

A combination of urban planning, good public transport services and improved infrastructure for active modes is needed to reduce the land area used for transport infrastructure and to make the land use more efficient (EC 2011). A reduced need of travel and of private transportation could be achieved through urban planning, which then again would reduce congestion in urban areas and emissions caused by the transport sector (Gori, Nigro and Petrelli 2012, EC 2011).

4.2.Economic Issues

4.2.1. GDP and GDP per Capita

At worldwide level, an increase in Gross domestic product (GDP)[20] and in personnel income translates an increase of people's propensity to travel further, faster and more comfortably, as it affects the level of consumer purchasing power, the propensity to undertake leisure travel and to valuing more quality and comfort while travelling. Car ownership and usage is also likely to increase along with wealth, therefore increasing the propensity for the use of private cars in short / medium distance trips.

UKs' Department for Transport (2012) found that when available income increases, the opportunity cost of travel becomes higher - the individual can be earning more money or enjoying more leisure instead of travelling. With higher purchasing power, individuals could decide how much time they want to spend on a trip and which mode to take. People's "value of time" - a key parameter on transportation demand modelling - is particularly influenced by GDP variations.

[20] GDP is the market value of all the finished goods and services produced within a country's borders in a specific time period; usually calculated on an annual basis.

GDP per capita growth normally leads to individuals having more disposable income, more choice options and a consequently increase in general demand for goods and services (that are increasingly sourced globally), provoking increased use of transport for the production, distribution and consumption of goods and services.

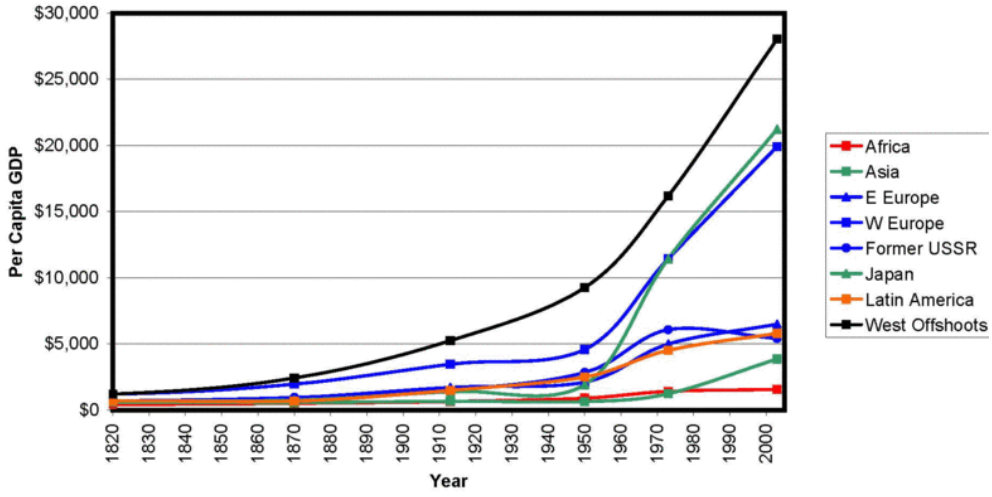


Figure 42- Per Capita GDP by World Region between 1820-2000 in International Dollars (Maddison 2007)

GDP evolution

The twenty-first century multi-polar world is no longer dominated by the EU, the US and Japan. Asia and Africa, which over the last decade came to the fore, include some of the world most competitive and sophisticated economies, as well as many emerging ones which either already have become global players or are in process of doing so.

From 2000 to 2010, the world's economic centre of gravity has shifted further than at any time (see Figure 43), moving eastwards after years moving west due to the profound productivity gains and mass urbanization that came during the British and America Industrial Revolutions (Dobbs, et al. 2012).

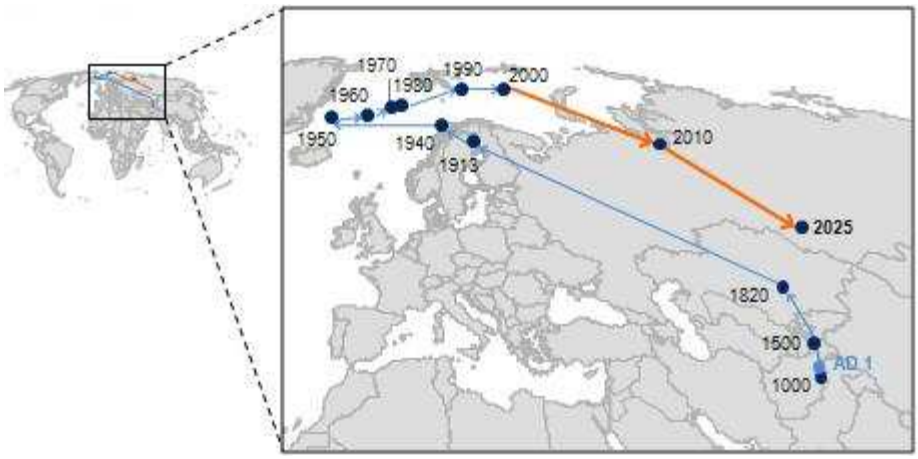


Figure 43- Evolution of the earth's economic centre of gravity (from A.D.1 to 2025) (Dobbs, et al. 2012)

This eastward movement has been mainly explained by a number of rapidly growing mid-to-large sized metropolitan areas in Asia – their productivity growth is elevating millions of poor to the ranks of the consumer class. China by itself has 242 cities – 236 of them are middleweights – in the City 600, a group constituted by 600 cities which is predicted to generate 65% of world economic growth by 2025. India is another Asian country where the increasing size and power of their cities will be translated into rising incomes and consequently, a rapid growth demand for many goods and services.

OECD projections also place the highest economic growth expectations in the Asia/Pacific region; China and India will lead the way, with many other economies also growing strongly. Among the developed country regions, North America's GDP could be 50% higher and Europe's 40% higher by 2030 than today's values (OECD 2012a). Figure 44 illustrates the GDP per capita historical evolution on major regions in the world.

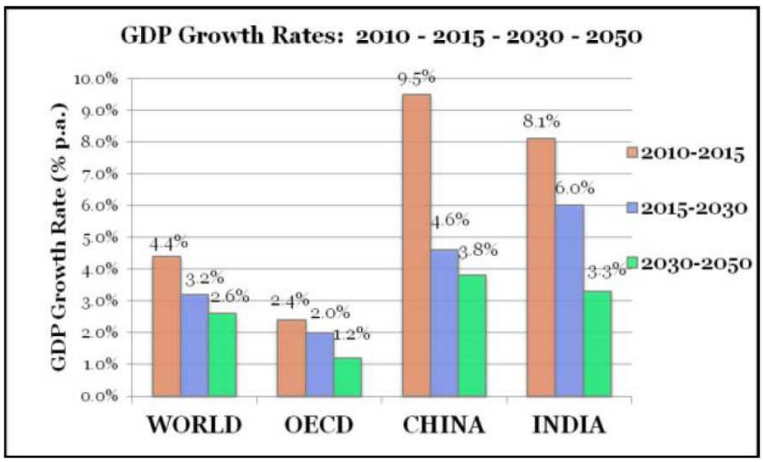


Figure 44- GDP growth rates 2010-2050 (OECD 2012a)

However, differentiated patterns of global economic growth, already emerging before the recent financial crisis, are expected to continue. Despite having a GDP growth higher than average GDP per capita growth, the largest developing economies and levels in the developing economies will still be much lower in 2030 than in the high-income group – the current income gap is just too large to bridge fully over this period.

By 2050, China, the US and India are likely to be by far the three largest economies in the world (Table 23). As well as the rise in China and India already noted, another notable development projected is that Mexico and Indonesia could rise to be amongst the top 10 largest economies - ranking 7th and 8th respectively by 2050 in terms of GDP at PPPs. In turn, the UK is expected to drop from 9th to 11th place by 2050 given that it is a relatively mature and advanced economy, although it holds its place relatively well against other advanced economies, in part due to relatively favourable demographics by EU standards (PwC 2013).

	2011		2030		2050	
PPP rank	**Country**	**GDP at PPP (2011 US$bn)**	**Country**	**Projected GDP at PPP (2011 US$bn)**	**Country**	**Projected GDP at PPP (2011 US$bn)**
1	US	15,094	**China**	30,634	**China**	53,856
2	**China**	11,347	US	23,376	US	37,998
3	India	4,531	India	13,716	India	34,704
4	Japan	4,381	Japan	5,842	**Brazil**	8,825
5	Germany	3,221	Russia	5,308	Japan	8,065
6	Russia	3,031	**Brazil**	4,685	Russia	8,013
7	**Brazil**	2,305	Germany	4,118	**Mexico**	7,409
8	France	2,303	**Mexico**	3,662	**Indonesia**	6,346
9	**UK**	2,287	**UK**	3,499	Germany	5,822
10	Italy	1,979	France	3,427	France	5,714

Table 23 - Actual and projected top 20 economies ranked based on GDP in PPP terms (PwC 2013)

According to United Nations (2010), structural change is commonly associated with modifications in the relative importance of different sectors over time, measured by their share of output or employment and refers to long-term and persistent shifts in the sector composition of economic systems.

The rise of new economic powers has generally been driven by the rapid structural transformation of their economies, featured by the shift from primary production, such as mining and agriculture to manufacturing; and in manufacturing from natural-resource-based to more sophisticated, skill- and technology-intensive activities. Continued and massive FDI flows transformed emerging economies from production sweatshops and technology takers into innovation motors and technology path breakers. By so doing they have also changed division of labour within the global R&D sector.

4.2.2. Household disposable income

Gross household income[21] determines the mode of transport used to travel to and from work or school, that is to say, modal choice is a variable of considerable interest, since it is likely to be highly affected by income levels.

Low income groups travel further using cheaper, more effortful modes (walk and bicycle) than the higher income groups, although for cycling the difference is only marginal. Thus, it can be seen that walking as a mode of transport is more highly favoured by individuals from low income households. On the other hand, high income groups travel further by car, motorcycle and bus than the low income group. Schafer and Victor (2000) found that as households become wealthier their vehicle ownership tends to increases, but at a declining rate.

[21] According to OECD, household disposable income is the sum of household final consumption expenditure and savings (minus the change in net equity of households in pension funds).

It may also be assumed that as household income increases, so does travellers' value of time. The quicker and more time efficient option of taking a trip by car may therefore become more attractive. Although car ownership and usage is not solely driven by income, it is nevertheless a high predictor (EEA 2008).

In what concerns to scholar travels, the cost of transport can be a significant factor in determining the mode of transport children use when travelling to school. In high income families, children are likely to be driven by parents to and from school, instead of walking or bicycle to school, especially because high income families generally have more than one car per family and are therefore more likely to use a car for this purpose.

According to Dobbs, et al. (2012), "as incomes improve, the shape of the income distribution within the consuming classes will change". In what concerns to middle income segments (with an annual income above $20,000 at PPP), in the Emerging 440 [22] the share of households will rise from 35% of all households to more than 55%. However, this income growth is not only limited to middle income segments. Cities in emerging markets will account for 60% of new high income households – with an annual income of more than $70,000 at PPP – in 2025. As shown in Figure 45, China alone will account for 19% of those households, India 6%, Russia and Brazil 4% each and Mexico 3%. These 5 countries will be responsible for 43 million of the total number of households in emerging economies, 56 million; and Emerging 440 cities will represent 77% of such households.

In China and India, the most populated countries in the world, the majority of household does not have yet a car; however, these countries are reaching the stage of development where a rapid take off in car ownership and in mobility in general may be expected.

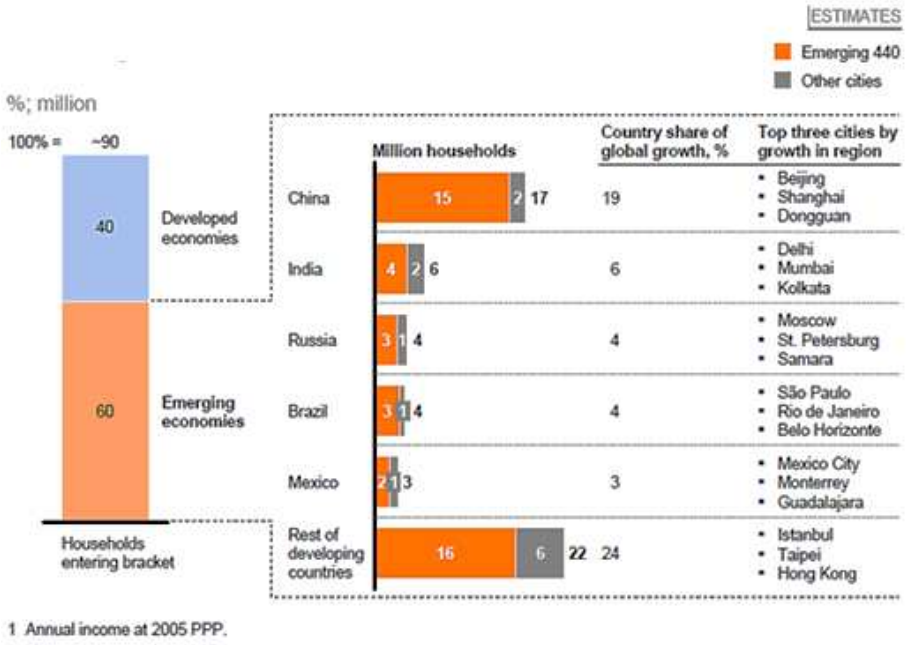


Figure 45- Growth in urban households with income above $70,000 between 2010-25 (Dobbs, et al. 2012)

[22] Emerging market cities in the «City 600» - the top 600 cities by their contribution to global GDP growth 2010–25.

Dargay (2007) wrote that household vehicle ownership rates increase with employment and incomes but are less likely to decline if employment and incomes are reduced. Additionally, Karlaftis and Golias (2002) found that a household's purchase of its first vehicle is primarily dependent on socioeconomic factors (employment and income), but the purchase of additional vehicles depends primarily on local travel conditions. If walking and cycling conditions are poor and driving is faster and cheaper than transit, households tend to own more automobiles.

4.2.3. Globalization

Apart from deeper global integration of cultures and politics since mid-last century, the world has witnessed a continued internationalization and globalization of the world's economy with a deeper dispersion of supply chains, capitals and labour markets, for which the development of international transport has been a key driving force, leveraging international trade activity, as "Globalization means geographical dispersion of production and strong reliance on trade" (OECD 2009). As transportation and communication costs decreases and production facilities and capital are shifted without restraint to locations around the globe where products can be produced more competitively, the world demand for trade can continue to increase, while changing patterns of world trade influence both transport flows and mode choices[23].

On its World Trade Report, WTO (2008) emphasizes technological innovation, political change and economic policy choices as the main forces driving global integration:

- Technological innovation: improvements like containerization in the shipping industry, the development of the jet engine in aviation and the revolution in information and communication technologies drove costs of trade downwards while increasing the speed of transportation and communications;
- Political developments reshaping the geopolitical and economical arena, like the fall of the Berlin Wall and the collapse of the Soviet Union, or China economic reforms;
- Economic policies favouring deregulation and the reduction or elimination of restrictions on international trade, foreign investment and financial transactions; promoting enlarged economic integration and regional cooperation, supported by trade liberalization agreements at bilateral and regional levels.

Technological innovations in transport and ICT made possible to share technology and coordinate production worldwide, manufacture products in distant locations from market and make trade in products possible where it had not been previously, with huge variations in the types of trips that make up international freight in terms of their frequency, complexity, distance travelled and vehicle types used.

[23] A good example is rail transport between Europe and Asia. Trans-Siberian Railway is estimated to account for approximately 3-4% of containerised freight flows between Europe and China in 2005 (and road freight was estimated to represent less than 1% of these), but rail market share is expected to grow significantly in the future, as more industries move Westwards in China (further away from major seaports), and infrastructure and logistics services improve on this corridor.

Several evolutions in the transport sector have had a relevant role in the current globalization, as the next boxes illustrates.

Aviation role on globalization

The impacts of the aviation sector have been profound on globalization. “Air markets have been liberalised, the networks that airline companies operate have changed (often to hub-and-spoke networks), many new (often low-cost) companies have entered the market, and many (low-cost and other) airline companies have gone out of business or merged (most of the remaining airlines have already united into three major alliances)” (OECD 2009).

Air transport costs (measured in terms of revenue per Ton-kilometre) have dropped over 90% since the 1950s, as Figure 46 illustrates. The CAGR over the period 1955-72 was - 8.1% (WTO 2008).

The increasing proliferation of Open Sky agreements between regional partners is driving aviation costs further down and increasing the share of aviation in international trade. For instance, Aviation is responsible for carrying half of United States exports outside North America, and for a third of imports, in value terms (WTO 2008), while for EU-27, almost a quarter of Exports was shipped by air, against a share of 16% in the opposite direction.

In what concerns passenger air transport, globalisation also entailed greater factor mobility, with an increase in both temporary and permanent migration, business trips and tourism through the use of air transport.

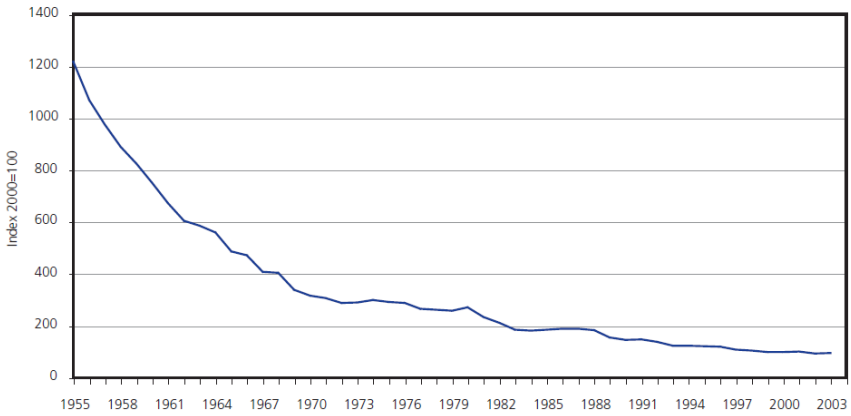


Figure 46- Worldwide air revenue per ton.km
Source: Figure from World Trade Report 2008 – Trade in a Globalizing World (citing Hummels (2007))

Maritime transport role on globalization

Increasing globalisation has also led to a strong increase of maritime shipping. In fact, the maritime industry has transformed its technologies – like containerization, reducing operational handling times (load/unload) and promoting greater ports efficiency and multi-modality – or adhering to open registry shipping, restricting regulatory burdens and manning costs.

In a globalized world, mode choice (especially for containerized cargo movement) involves balancing trade-offs between time, cost, and reliability of delivery to facilitate trade among global corporations and nations. According to Corbett and Winebrake (2008), “Low cost modes may be

less preferred than faster modes if the cargo is very time sensitive; however, slower, lower cost modes often carry much more cargo and, with proper planning, these modes can reliably deliver larger quantities to meet just-in-time inventory needs".

According to OECD (2009), globalisation helped facilitate the greater division of labour, and exploit comparative advantage more completely. In the longer term, globalisation also stimulated technology and labour transfers, and allowed the dynamism that accompanies entrepreneurial activities to motivate the development of new technologies and processes that lead to global welfare improvements. Globalization also creates a demand for goods and services that makes improved infrastructure and more efficient transport systems a precondition for economic development.

The promotion of competitive transport markets combined with appropriate provision of infrastructure and continued international cooperation and openness are vital to the seamless progress of the global economy. The failure to comply with any of the above aspects will surely penalize future global economic prospects.

On the aftermath of the severe financial and sovereign debt crises that hit global economies, with particular severity on developed countries, it is questionable if pre-crisis globalization patterns will prevail, due to the fragile sustainability of some of its aspects, like the extreme trade imbalances and the historical current account deficits in western economies or the availability of cheap credit.

Recent evidences seems to point out to an evolution on trade patterns between major regional markets, with the decrease of imports from Asia-Pacific by western economies and the increase of their exports, as massive trade gaps starts narrowing, or the current concerns on increased protectionism pressures and the evolution of trade liberalization talks.

The expected rise of oil prices (and transportation cost) and the evolution in relative costs of production - wages, capital costs and energy prices – might lead increasingly in the direction of shorter supply chains, as numerous business cases already seems to pointing out, with direct implications in the transportation patterns market. It is feasible that future global developments patterns become less trade-intensive than previously. The future of global economy seems to stand between more modest and steady growth patterns or higher growths with irregular and severe disruptions, and its evolution is subject to some uncertainty.

4.2.4. Changes in China's Economy

2013 can be a memorial year which will mark an interesting turning point in China's economic evolution. It may be the year that China's services sector officially eclipses manufacturing industry. According to national statistics (cited by Economist 2013/02/analects-blog), which include transport, wholesaling, retailing, hotels, catering, finance, and real estate (among others) accounted for 44.6 of China's GDP in 2012. That is less than one point behind the industry's output whose share in the GDP was 45.3%. And services are growing faster than material production. The surge in services may reflect the ongoing rebalancing in Chinese demand away from exports towards consumption. This surge may also help to promote this rebalancing. Because service tend to be labour-intensive, their expansion should encourage faster job creation, higher wages, leading to higher levels of households discretionary spending.

However, before heralding the dawn of China's post-industrial future, one should observe that despite its growth, the role of services in the China's GDP still falls short of global norms. Service-based economic wealth production may play a more prominent role than it did in 2005, when its share fell eight points short of China's peers. But China's material economy has also moved on since then. If the service production followed the same path as the industry growth, its share in the China's GDP would be around 55-60% now.

Service prices have also been rising faster than those of industrial outputs. Measured at constant 2005 prices, services still represent a smaller GDP share as compared to its peers (India and Brazil). But the increasing value of services does not change the fact that more will be spent on them in the times ahead, which should encourage greater investments and imports to meet the soaring demand. Therefore, this development should be closely watched and utilised by the European transport industry which wants to sell its equipment, products and services to Chinese customers with booming discretionary incomes.

4.2.5. Changes in Other Asian Economies

Asian countries economies showed a strong and sustained increase – with lesser extend for South Asia – in what concerns to investment as a share of GDP comparing to other world countries/regions (see Figure 47). However a large portion of this GDP is due to these countries investment in infrastructure, property and manufacturing and not consumption.

Among Asian economies, Japan represents the first mover in the industrialization process followed by newly industrialized economies as Korea, Taiwan, Hong Kong and Singapore. The majority of these countries changed their industrial structure, moving from low-skilled production to a more sophisticated one (Memedovic and Apadre 2009). Having showed less dynamic and structural change relatively to newly industrialized economies in East Asia, South Asia verified an slightly increase of the share of manufacturing and mining from 14% in 1970 to a peak of 22% in the 1990s. This growth was mainly a reflection about what was happening in India by the time – traditional industries showed a downward trend to the advantage of chemicals and non-metallic mineral products; most recently, India's growth has been driven by a fast-growing service sector.

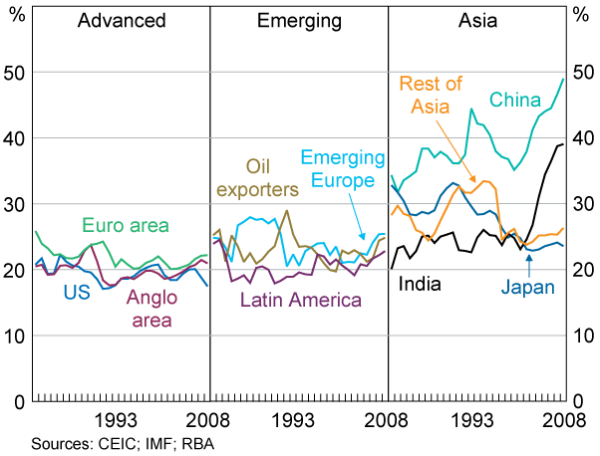


Figure 47- Investment as a proportion of GDP (% of GDP) (Cassidy and Orsmond 2009)

According to Rungfapaisarn (2012) , the “traditional model” for Asian countries (especially Japan and China) was to export goods to the West by buying US treasuries and European assets. However, since the 1998 crisis, Asian investments have being shifted from the West to Asia. Asian nations are no longer investing exclusively in the United States or Europe, instead, are looking for investment opportunities in Asia developing countries, that is to say, predominantly South and Southeast countries.

Orsmond (2011) wrote “the rapid pace of investment growth in emerging Asia has reinforced large increases in the region's investment to GDP ratio. Aggregate investment has increased from around 26% of nominal GDP in the early 1980s to 37% of GDP in recent years”.

After the Asian financial crisis in 1998, the investment to GDP ratio in the majority of Asian countries fell back while that in China continued to rise strongly. At almost 50% of GDP, the investment to GDP ratio in China has reached historically high levels. In India, the investment ratio has also increased strongly of late, rising by 15 percentage points of GDP in just the last decade. However, at around 40% of GDP, India's investment to GDP ratio is still far below that in China. In contrast, the investment ratio in Japan has been a lower share of GDP and has declined over time (Orsmond 2011).

Memedovic and Apadre (2009) found out that in Asia “Until 2000, an unabated process of tertiarisation was visible, with the value-added share of services rising from 40 to 59%, mainly to the detriment of agriculture, which fell from 22 to 6%. The current decade is characterized by different trends: the share of industry rose from 34 to 38%, as a result of the growth in “mining and utilities” and manufacturing, and even agriculture recouped a small part of its previous losses, reaching a share of over 7% in 2008.”

In the period 1980-2000, the Taiwanese industrial structure was “dominated by the rise of consumption electronics, at the expense of most traditional industries” (Memedovic and Apadre 2009). In relation to Japan and Republic of Korea, during the same period, their economy has progressively intensified its specialisation in machinery, electronics, telecommunications and transport equipment, at the expense of all traditional productions. In turn, the industrial structure of Singapore’s economy has concentrated in few key activities as chemical and petrochemical products, electrical machinery and communication equipment.

4.2.6. Changes in MENA countries’ Economies

Middle East and North African (MENA) countries are an aggregation of a geographically connected but highly heterogeneous region. The Worldbank (2013) considers the heterogeneity of the region drawn on two distinct dimensions (see Table 24):

- Oil trade with import versus export, and
- Availability of resources including labour import.

	Oil importers	Developing oil exporters	Oil exporters GCC
	Developing countries		Developed countries
Resource poor	Djibouti, Egypt, Jordan, Lebanon, Morocco, Tunisia, West Bank and Gaza		
Resource rich[4]		Algeria, Iran, Iraq, Syria, Yemen	
Resource rich[4] labour importing[5]		Libya	Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arabian Emirates

Table 24 - MENA countries according to World Bank classification[24]

A closer look to the GDP on country level shows highest GDP growth in the last decades in oil exporting countries, such as Qatar, Oman and also Iraq, which belongs to the developing oil exporters. They differ concerning their economic development in certain time periods; Qatar managed the last years of crisis and even increased its GDP growth rate up to 15.5% per year between 2005 and 2011 while the UAE could hardly reach 2% (see Figure 48).

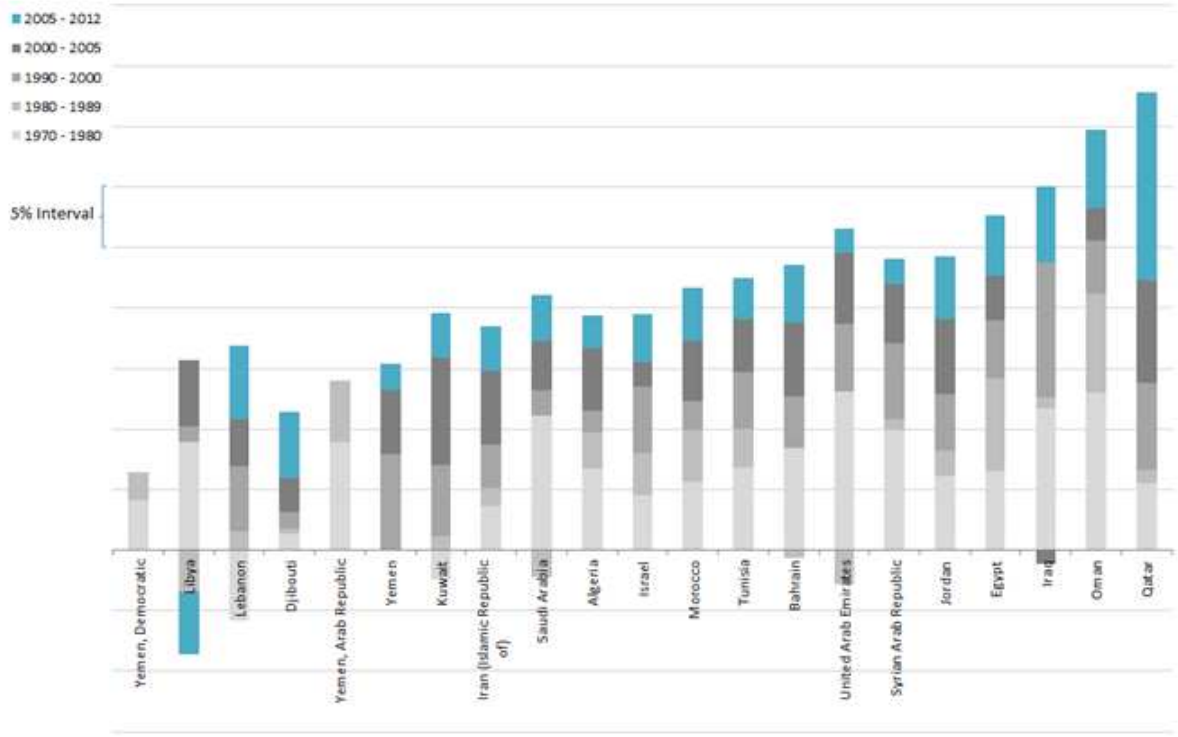


Figure 48- GDP of MENA countries by period (UNCTAD 2013)

Most countries in the MENA region have undergone a transformation in the last decades while processes and results differ due to the described different socio-economic structure. Economic transformation in South, Central and East Asia as well as in Europe, the Pacific region, Latin America and Sub-Saharan Africa is characterized as industrialization and/or tertiarization – a shift from agriculture to industry and from industry to services. Not so in MENA countries where economic transformation seems to be mainly industrialization. Services haven't increased their

[24] GCCC – Gulf Cooperation Council Countries

share for the last three decades. Instead industry was growing but not on the same level as the service sector in most other regions of the world. Industry growth rates were below 20% on average compared to more than 40% of service growth in Europe or Central Asia.

On the other hand the agricultural sector in MENA countries lost almost 40% of its share (see Figure 49). Thus economic transformation since the 1980th was a shift from agriculture to industry and a small increase of manufacturing in the MENA region while in the rest of the world the losses in the agricultural sector were accompanied by an increasing service sector – although with huge differences of branches and added value between national economies. Exploitation of natural resources was the main driver for this special kind of transformation in the MENA region (World Bank 2013).

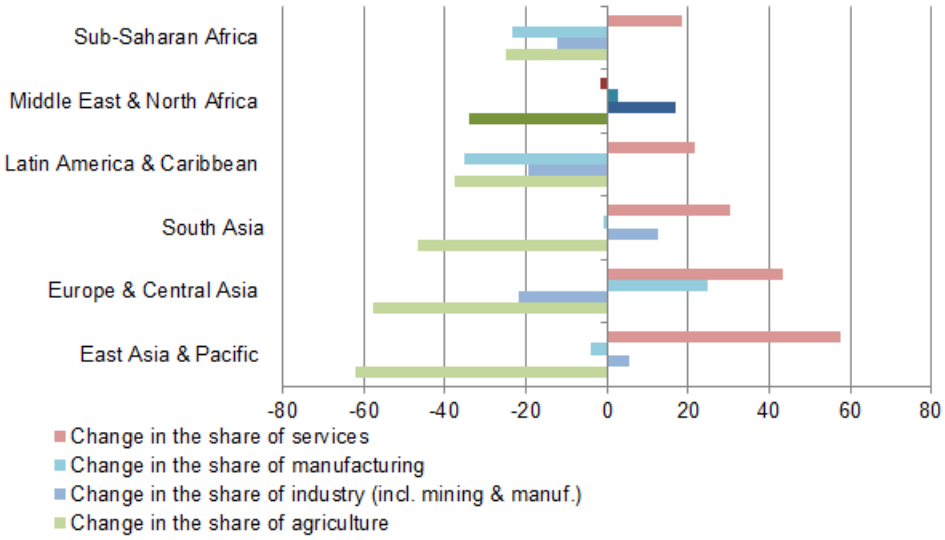


Figure 49- Changes in the composition of GDT in selected world regions 1980-83 and 2007-2010 (World Bank 2013)

Beside the economic differences of the MENA region there are also political ones leading to different paths of political development. In the last few years the region has experienced political transformation with conflicts and riots namely in Tunisia, Libya, Egypt and Yemen. These developments have led to political change and a transformation process as summarized under the notion of the 'Arab Spring' – a development which is still continuing[25] while Syria has to suffer from a civil war. Beside those concise incidents also other countries of the region have experienced rioting so far without the long lasting effects of fundamental, political or socio-economic change; among those countries are –Algeria, Iraq, Oman and Saudi Arabia, while in Morocco political adjustments were provoked by the protests. The worse socio-economic situation has been the source of the change as also reflected in the above described problems of economy and labour market affecting the social situation.

[25] As it seems to be the case, with due reservations, of June 2013s' turbulence in Turkey, since Turkey is not a dictatorship nor is its military on the fray.

Unemployment, youth unemployment, high income disparities – partially based on structural problems of mismatch between education and economic development – lead to the social riots. Behind this missing economic adaption on changing environment and the unsuccessful transformation are the root of the problems motivating society to fight for change. The causes of the problems are structural and fundamental characteristics of the affected countries. Other countries in the region experience wealth and high incomes as they are able to compensate a lack of education or transformation towards a high-technology or knowledge intensive economy with natural resources especially oil and gas which enables them to gain immigrant workforce. Nevertheless oil exporting countries reflect and discuss options for a post fossil era; projects like Masdar City or huge solar plants are planned in the region aiming for economic transformation – although as a very first step.

The political riots and struggle for social, political and economic change in Arab Spring countries are also motivated by a wish for transformation. Up to now the direction and character of this transformation isn't clear. Beside a wish for modernisation also religious trends are strengthened. Protests, violence and confusion concerning political power affected the economic situation. As a consequence tourism, foreign direct investment and trade decreased which exacerbated the situation (UNCTAD 2013).

As MENA countries are important oil exporters the political and socio-economic situation and development are highly relevant for Europe, not only for the transportation system but for the whole economy and society. Europe is depending on oil at affordable prices – as is the rest of the world. In the last decades oil price volatility due to increasing demand, but also due to political instability and price policies affected European economy and citizens. The coincidence of the financial and economic crisis with the political crisis and transition process in MENA countries in the last years affected world economy substantially.

Some of the described internal factors of socio-economic and political trends will result in future challenges for the MENA region. Especially trends which are linked with development of social disparities, economic transformation problems and the educational-labour market gap will challenge policy and the need to adapt economy to changing frame conditions. The relevant trends and drivers for the future transformation in the MENA region can be summarized as following:

- Unemployment, especially in young age groups;
- Low education level;
- Knowledge and labour market gap between large group of unskilled/less skilled people in need of a job and need of economy for skilled workforce;
- Development of oil price and resources;
- Energy system transformation → potential for solar energy.

4.2.7. Changes in Latin America's Economies

After benefited from an early industrialization process in the 1930s and experienced sustained growth until the beginning of the 1980s, Latin America (LA) countries began to suffer a long-term slow economic growth associated with a de-industrialization process. In these countries, growth was

mainly concentrated in the services sector while the share of agriculture in output was declining or remaining stable (Memedovic and Apadre 2009).

The relatively strong growth performance during the 1950s and 1960s laid on an import-substituting industrialization strategy[26], which because of its limitations, encouraged some LA countries in a parallel fashion, export diversification and regional integration (United Nations 2010). With a premature trade liberalization that led to strong declines in industrial output in the 1970s, the lack of foreign financing and the stabilization policies in the aftermath of the debt crisis of the early 1980s, both trade and financial reforms were necessary (see Figure 50). These reforms turned exports into the engine of growth in most LA countries however the export growth was not built on dynamic industrialization but in a continued reliance on exports of primary products / raw materials or on assembling manufacturing processes. This volatile growth and the recurrent financial crisis which provoked a deficient long-term investment for dynamic structural change, led to a decrease in the share of manufacturing and mining in total output during 1970-2003; only mechanical and electrical industries and transport equipment have continued to expand.

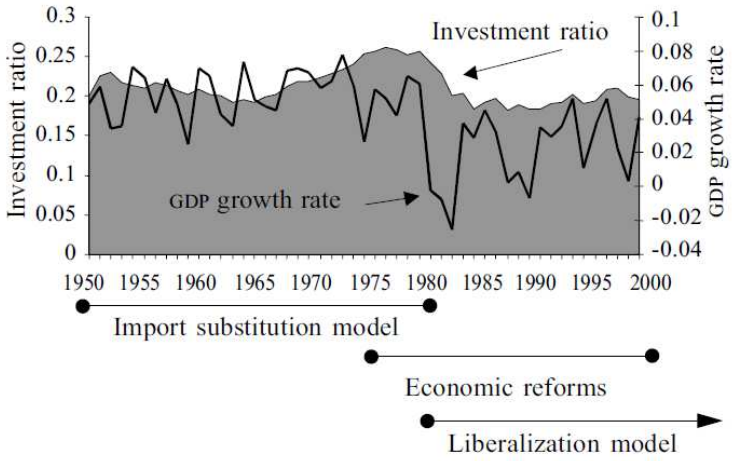


Figure 50- Latin America: GDP growth and the investment ratio, 1950-2000 (Moguillansky 2002)

With the economic changes in the mid-1980s and in the early 1990s that opened up the region's economies to trade and international financial flows and integrated them into the globalizing world economy, the investment growth in Latin America during the 1990s was unstable and the investment rate was low as the GDP share comparing with high-growth developing countries. By this time, "the region's trade and investment ties with Japan were already well developed, but links with China and other developing countries in Asia were still incipient" (ECLAC 2012).

This changed rapidly afterwards. The turn of the millennium has seen a major shift in Latin America's growth model, from the so-called import substitution model towards a model characterized by liberalized trade, finance and capital markets and by a reduced role for the State in

[26] The import-substituting industrialization strategy goal was to create industries capable of producing substitutes for expensive imports while simultaneously promoting industrial growth and the expansion of internal economies.; it is a development concept, which was converted particularly in and the 60's 50's in south Asia, Africa and Latin America (Source: http://www.economypoint.org/i/import-substituting-industrialization.html)

production, finance and the overall direction of the economy (Moguillansky 2002). According to ECLAC (2012), with rising trade demand, especially from China – trade with China more than triple during the 2000s – the average annual GDP growth rate increased to almost 5% during the 2003-2008 period, and public debt in the region shrank considerably.

FitchRatings (2012) wrote “LA has generally benefited from China’s economy rise through increased bilateral trade, foreign direct investment (FDI) and commodity-backed loans”. The fast rebound of Asian imports after 2009 has supported Latin America’s own economic recovery from the recent global economic crisis.

After nearly a decade of continuous expansion, interrupted only in 2009, GDP growth in Latin America will slow from 4.4% in 2011 to 3.2% in 2012 and 4.0% in 2013 (ECLAC 2012). This GDP slowdown is largely related to LA dependency of the Chinese trade. This dependency makes the region more exposed to the China potential growth slowdown, which affects LA exports demand levels and commodity prices. LA dependency from China requires improving infrastructure and education, increasing labour market flexibility and greater competition in domestic markets to guarantee a sustainable and competitive growth of the region. Thus, the outlook remains relatively positive, but is exposed to global uncertainty and volatility.

4.3. Energy

Global economy, industry, transportation networks, households and ultimately the well-being of the majority of world population are clearly dependent upon energy. Energy is a basic demand in our modern world, provided through global supply chains (using ships, trains, ducts, trucks, or electricity networks) that practically span the world reaching almost every place on Earth.

Energy consumption has almost doubled between 1973 and 2010 from approximately 4,600 Mtoe (Million tonnes of oil equivalent) in 1973 to ca. 8,600 Mtoe in 2010. In the OECD countries the final energy consumption has increased in the same time from 2,800 Mtoe to 3,600 Mtoe - in 2010 around 42% of all the energy was consumed by the OECD countries (IEA 2012)

The transportation sector is currently the second largest sector in energy consumption (second only to the industrial sector), responsible for consuming 30% of the world's energy production. The global transport sector was consuming more than 60% of the oil in 2010, as most energy for transportation is based on fossil fuels, and particularly fossil oil (97.6%). Of all the energy that goes into transportation, road transport can account for around 80%.

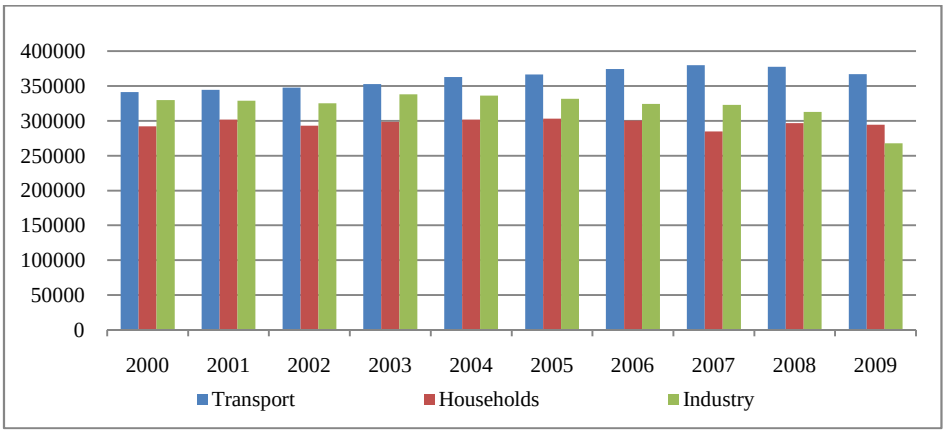


Figure 51- Annual end energy use according to sector in 1000 tons of oil equivalent EU-27 (Eurostat 2012)

Transport holds the largest share of energy use in Europe (see Figure 51) and the total energy consumption is expected to grow the most in the transport sector, where demand is projected to increase by 28% between 2005 and 2030, reflecting the global economic growth and rising living standards (IEA 2011).

4.3.1. Energy sources

In 2010 the main energy sources in the OECD countries and globally were oil and natural gas. Biofuels and waste made out 12.7% of the global energy use, but only 4.9% of the OECD countries (see Figure 52).

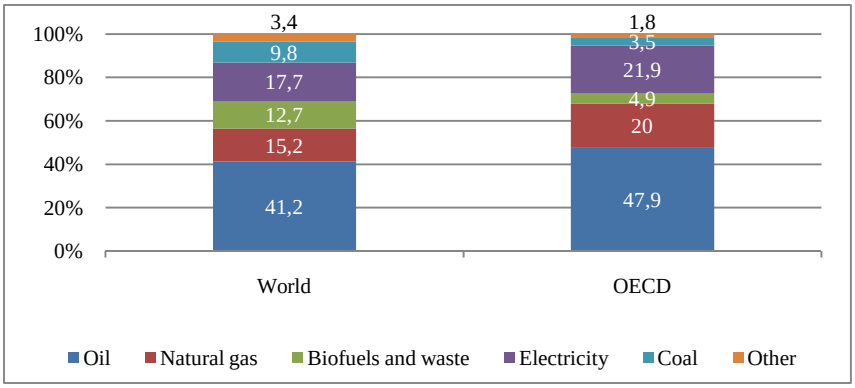


Figure 52- Energy sources globally and in the OECD countries in 2010 (IEA 2012)
(Other: solar, wind, geothermal, Electricity: nuclear, water, thermal and fossil)

In the OECD countries oil had a share of 48% in 2010 and natural gas 20%. Globally the corresponding numbers were 41% and 15% (IEA 2012). It is assumed that the share of natural gas as an energy source will be increasing in the future and the proportion of oil decreasing (UNEP 2012). Biofuels and waste as well as coal have larger global shares as energy sources compared with the OECD countries, whereas the share of electricity as an energy source is larger in the OECD countries (IEA 2012) .

The global share of renewable energy sources such as solar, wind and geothermy has increased from 1.6% in 1973 to 3.4% in 2010, but the share is still minor. The share of electricity as an energy source has increased with almost 10% and it also includes renewable sources such as hydro power

and biomass. The use of biofuels and waste as energy source has had a rising trend as well (IEA 2012).

4.3.2. Liquid Oil World Consumption

Since transportation is almost solely dependent on liquid fossil oil, it would serve us well to observe recent trends in liquid fossil oil prices.

The price of oil reached its highest value ever in 2008, mainly because of the demand of emerging economies and developing countries for transportation and transportation fuels. Even before 2008, energy use for transportation in non-OECD countries increased by 4.1% and 6.4% in 2007 and 2008, but the economic crisis in 2008 put a halt to the growth and inhibited the sector's activity.

The economic recession, aided by high oil prices, affected the OECD countries profoundly, and has caused a decline of 1.6% of energy use for transportation by 2008, and a similar decline of 1.8% by 2009. Only in 2010 can we find signs of recovery, as evidenced by a 0.7% growth.

Despite the overarching and dramatic consequences of the economic crisis, it is expected that as the economy recovers, developing nations will resume their path of fast-paced growth and will raise vast needs for transportation and transportation fuels. Transportation related energy demand in the OECD states, however, is expected to grow more slowly, especially in light of the regulations and policy measures that some OECD countries have implemented, which are supposed to improve vehicles' fuel efficiency. This is the main reason that OECD transportation energy use will only rise by 0.3% a year according to the projection provided by the (EIA 2011).

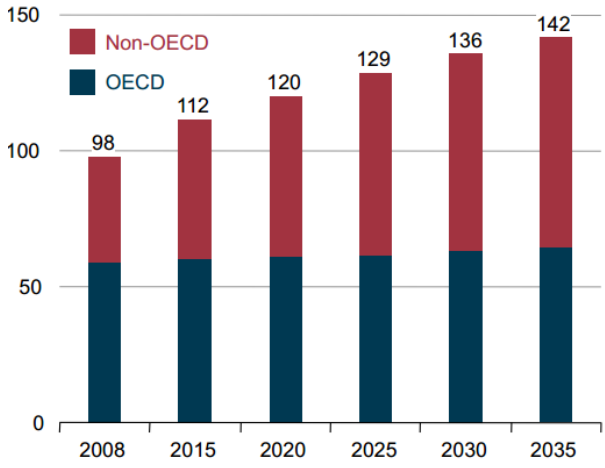


Figure 53- World transportation delivered energy consumption between 2008-2035 [in quadrillion Btu] (EIA 2011)

4.3.3. Unconventional Energy Resources

A few of the most promising unconventional energy resources include oil sands, biofuels, extra-heavy oil and coal liquefaction. According to projections by EIA (2011) these resources are expected to grow by an average of 4.6% each year until 2035, both in OPEC and non-OPEC countries. These resources will attain special favour if the prices of oil become too high for a

sustained period of time, or should geopolitical circumstances (wars, embargos, etc.) prevent the transportation of oil from areas in conflict.

World production of unconventional liquid fuels is expected to increase from nearly 4 million barrels a day in 2008 to 13.1 million barrels a day in 2035, which should account for 12% of total world liquid fuel supply. Of this amount, the largest component is expected to come from the Canadian oil sands (4.8 million barrels a day), and a lesser amount from U.S. and Brazilian biofuels and Venezuelan extra-heavy oil. We will therefore look more deeply into these energy resources and their anticipated production in the future.

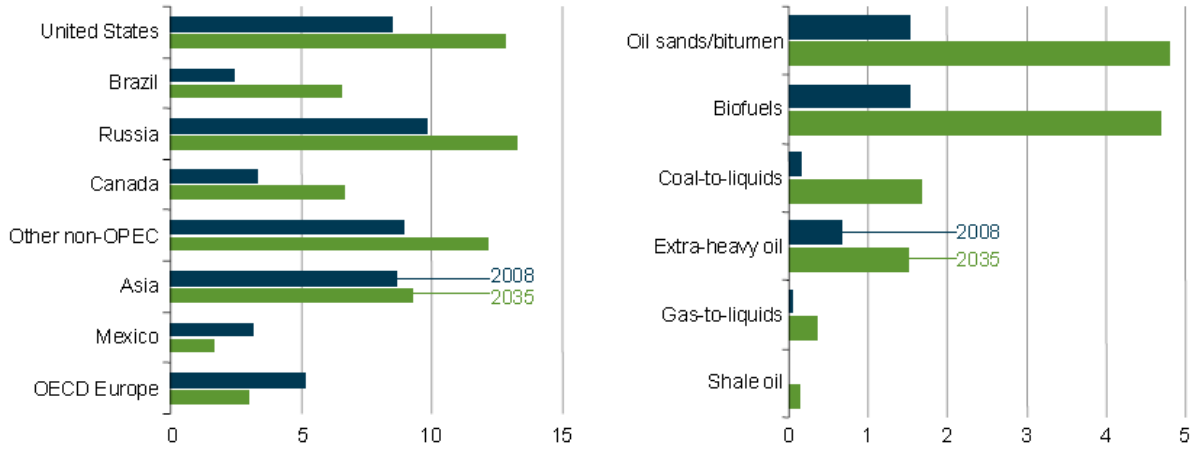


Figure 54- Present (2008) and future (2035) of non-OPEC liquid fuel production by region and country (left graph), and unconventional liquid fuel production (right graph) (EIA 2011, 27)

Oil Sands

Oil sands are composed of sand and sandstone particles, mixed with water and bitumen, which is a highly dense and viscous form of petroleum. The largest bitumen deposits by far are found in Canada (70.8% of the world's deposits). However, it is extremely difficult to determine just how much oil can be produced from these deposits, and estimates vary widely. Published compilations by OPEC, for example, exclude it entirely, while the Energy Resources Conservation Board considers that Canada has approximately 172.7 billion barrels of “established oil reserves” (WEC 2010).

While novel technologies enable the extraction and refinement of oil from oil sands, the exact extent by which oil would be produced from oil sands *en masse* is still uncertain, especially seeing as the production and refinement process releases as much as 14% more greenhouse gas emissions to the environment (Biello 2013). Should Canada opt for full production and refinement of the oil from oil sands, it would become the largest source for unconventional liquid fuel by 2035.

Biofuels

Biofuels have the potential to replace some of the fossil fuels. Biodiesel in particular is produced from different kinds of sources (Singh and Singh 2009), which include vegetable oil originally produced for human dietary consumption (such as rapeseed, soybean and sunflower oil), non-edible vegetable oil (such as the one produced from algae (Ahmad, et al. 2011)), waste or recycled oil and

oil produced from animal waste (chicken fat, fish oil, etc). Currently, over 95% of biodiesel is produced from edible oils. Since biodiesel can be produced from all the above sources, it is a 'safer' alternative to the limited amount of fossil fuels that exist on the Earth today. In addition, biodiesel is easily biodegradable, enjoys minimal toxicity and exhibits a significantly lesser amount of toxic emissions, and can replace ordinary diesel fuel in internal combustion engines (Cetinkaya, et al. 2005).

Biodiesel is currently in use in the USA, as well as many European countries. A recent study from 2006 examined the potential of 226 countries to create biodiesel in an affordable and even profitable manner. The results reveal an upper limit worldwide volume potential of 51 billion litres from 119 countries, 47 billion of which could be produced profitably even today (Johnston and Holloway 2006) (according to factors that include production volume, estimated price, corruption in the country, travel safety, and GDP). The five states indicated as the top potential producers are Malaysia, Indonesia, Argentina, the USA and Brazil, followed by the Netherlands, Germany, Philippines, Belgium, and Spain. A massive amount of biodiesel is being produced each day (more than 400,000 barrels per day by 2011 (EIA 2013)), with 44% being produced by the EU-27 states, 13% by Asia & Oceania (with Thailand being top producer in that category, standing at 10,000 barrels per day), and North, Central and South Americas together standing at 41% of world production. The entire Middle East, in comparison, produced only 100 barrels in 2011 – an extremely minor fraction of world production.

It is expected that acceptance of Kyoto protocol and similar clean development strategies will lead to more biodiesel production worldwide, and to a larger consumer market. According to (Atabani, et al. (2012) the total bio-fuel demand in EU will reach 30.3 million tons by 2020 assisted by the EU mandate that 10% of all liquid fuels consist of biofuels by 2020 (U.S.Congress 2007). Similar programs and mandates exist in the US, Canada, and China (Hertel, Tyner and Birur 2010).

While the prospects of biodiesel are promising, it would seem that this type of fuel will only reach significant success if it won't compete with agricultural lands that are used to produce food for human consumption. Its success also hinges upon the price of conventional liquid fuel. In the case oil price rises up steeply, EIA (2011) predicts that 6.2 million barrels of biofuel per day will be produced worldwide, with 3.3 million barrels in the US, 1.9 million in Brazil, and only 0.3 and 0.1 million barrels in China and India, respectively. This amount is cut by half in a different scenario, under the assumption that conventional oil price will actually go down instead of rising up.

Coal Liquefaction

Coal liquefaction processes are being used to produce liquid fuels, using coal as substrate for the chemical reactions involved. Usually the process involves conversion of coal into gas or liquid by the utilization of certain solvents and catalysts. The reactions require specific high-pressure and high-temperature surroundings, and thus can only happen in dedicated plants.

Recent advances in coal liquefaction technologies have enabled its production in developing countries like China, which is anticipated to become the main liquefied coal producer in 2035, with production levels ranging between 0.2 million barrels per day and 2.1 million barrels per day. In

either case, China is expected to produce approximately half the world total of liquefied coal in 2035, with only the US as a serious contender (0.5 – 1.6 million barrels per day) (EIA 2011).

Extra-Heavy Oil

Extra-heavy oil is the common name for different types of highly viscous crude oils, much like the ones produced from oil sands. The current largest reserves of extra-heavy oil can be found near the Orinoco river in Venezuela. It is estimated that the Venezuela reservoir contains around 270 billion barrels of oil (EIA 2011).

Despite this fortune in oil, projects in the area are suffering from poor maintenance and lack of investment. As a result, the scenarios developed by EIA (2011) forecast that Venezuela will only be able to produce 1.4, 1.6 or 3.6 million barrels per day by 2035, in a baseline scenario, high oil price scenario and low oil price scenario.

4.4.Environment

World populations' environmental awareness has already a most relevant significance in the definition of future transport strategies and policies, as the world faces unprecedented pressures from the natural environment.

4.4.1. Greenhouse gases and climate change

Climate change is a global phenomenon caused by excessive greenhouse gas (GHG) emissions. It has a negative impact on the environment, economy and society and leads to extreme weather conditions and affects the land use negatively (Zachmann, et al. 2012). Besides indirect effects of global warming the extreme weather conditions, precipitation and changing temperatures have direct negative impacts and can cause damage on the transport infrastructures.

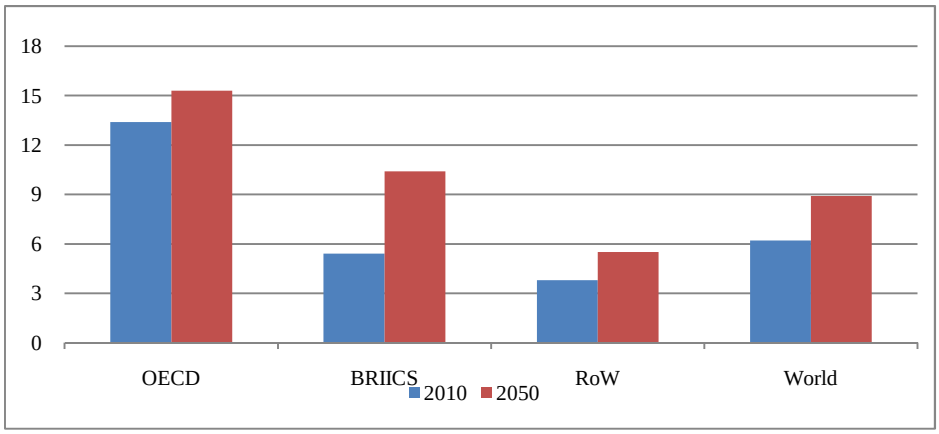


Figure 55- Average, per capita GHG emissions [CO_2 tonnes] (OECD 2011)

CO2 from energy and industry sectors is and will continue being the dominating greenhouse gas globally, followed by methan gas, nitrous oxides and fluoroform emissions (HFC, PFC). The share

of BRIICS[27] countries of the emissions is the largest and will become even more dominating by 2050 whereas the OECD countries cause the second largest share of the global emissions (OECD 2011), as Figure 55 illustrates. The per capita GHG emissions are however higher in the OECD countries than in the BRIICS countries or in rest of the world (RoW), but the trend in the emerging economies is going towards the OECD per capita emissions (OECD 2011).

Currently the transport sector has the highest CO2 emissions' growth of all sectors, being responsible for 23% of energy-related CO2 emissions. By 2030 the emissions are expected to grow with approximately 40% (EEA 2011b).

In the future, major CO2 emissions reductions in transport can be achieved through more efficient vehicles, a shift towards electricity and biofuels and progressive adoption of natural gas followed by a transition to biogas. The shift from private modes to public and active modes also supports the targets for declining emissions.

The EU is aware of the negative impacts of the GHG emissions on the climate and has set goals for a significant emissions' reduction by 2050 (EC 2011). The goal for the reduction in the transport sector is 60% compared with the 1990 levels and the total reduction target for the energy sector is 80-100% (Zachmann, et al. 2012). To reach the reduction targets a decreasing fossil fuel consumption, drastic increase in the use of renewables as well as significant technical improvements are needed. Clean energy and new transport technologies alone won't be enough to reach a zero emission society, but are necessary in order to keep the current service level with low emissions (Zachmann, et al. 2012).

4.4.2. Air pollution

Transportation is one of the main sources for air pollution globally. Air pollution has a negative impact on the local air quality and human health and is caused by the traditional fuel burning engines (Vergragt and Brown 2007). The pollution is mainly in the form of particulate matter and chemicals such as nitrogen compounds and is especially a problem in metropolitan and urban areas (UNEP 2012). The emissions of sulphur dioxides have been significantly reduced due to legislative measures and technological changes (UNEP 2012).

Technical solutions such as unleaded petrol and catalytic converters have reduced the per litre of fuel air pollutions drastically, but as the global car ownership is prognosed to triple by 2030 and the occupancy rate of the vehicles is expected to further decrease, the pollution savings are compensated by this growing amount of private motorized vehicles (Moriarty and Honnery 2008). An efficient solution for tackling the local air pollutions would be the use of electric vehicles, but they have other issues such as a demand for rare elements for the battery manufacturing and the insufficient global production of carbon neutral electricity (Moriarty and Honnery 2008). Still this would only solve the problem of air pollution locally but not in general. A reduced use of private motorized vehicles through public and active modes as well as attractive local destinations would be the best way to reduce the transportation related emissions (Vergragt and Brown 2007).

[27] BRIICS = Brazil, Russia, India, Indonesia and South Africa (OECD 2011)

Additionally high capacity occupation of the public transport vehicles is important for sustainable transportation.

4.4.3. Noise emissions

Traffic noise has become a significant issue in urban areas worldwide. The international threshold values for noise levels affecting housing areas are defined by the World Health Organisation and are aiming for reduced disturbance and negative health effects caused by loud noise (WHO 1999). According to the WHO (1999). the guideline values during daytime for outdoors in settlement areas are 50 dB for moderate annoyance and 55 dB for serious annoyance. 65dB is the threshold for serious health impacts. During night time the limit for sleep disturbance is 45 dB and the guidelines for noise levels indoors are 35 dB daytime and 30 dB at night (WHO 1999).

Noise emissions are major issues in Europe affecting health, sleep and concentration, traffic being the most significant noise source. Around 20% of the people are regularly exposed to road traffic noise levels between 55 and 65 dB, which exceeds the recommended threshold value for serious disturbance (van Blokland und de Graaff 2012). 10% of the population in Europe is exposed to noise levels over 65 dB which can in the long term cause serious health problems (van Blokland und de Graaff 2012). Besides health effects traffic noise is also economically relevant due to the costs for the health care systems and possible decreasing real estate or rent values.

4.5.Infrastructure

The role of infrastructure as a driving force for mobility and demand generation can be evaluated from a threefold standpoint.

- The transport industry, as with other business sectors, relies on developed and well-functioning infrastructures, both to access raw material and for the shipping of final products, as well as for the access of the workforce. Appropriate transport infrastructures are among the basic requirement for the competitiveness of any economy (see Figure 56), as the World Economic Forum underlines once is time to prepare its competitiveness annual report: “Extensive and efficient infrastructure is critical for ensuring the effective functioning of the economy, as it is an important factor determining the location of economic activity and the kinds of activities or sectors that can develop in a particular instance. Well-developed infrastructure reduces the effect of distance between regions, integrating the national markets and connect them at low cost to markets in other countries and regions. In addition, the quality and extensiveness of infrastructure networks significantly impact economic growth and reduce income inequalities and poverty in a variety of ways.” (WEF 2011b, 23);

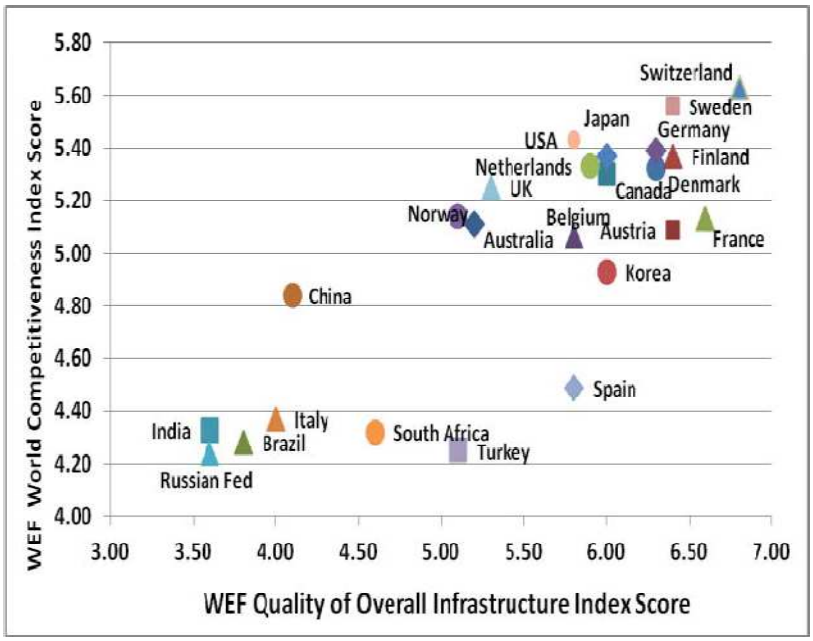


Figure 56- Infrastructure as competitiveness factor according to OECD (OECD 2012a, 53)

- Infrastructure can unleash under-developed transport requests in different modes. To give an example, Cairns und Newson (2006) presented the analogy of the growing supply of aviation infrastructure to road building: “New roads are created to accommodate increasing traffic demand. As new road space becomes available, extra traffic is generated and [in the medium-run] congestion worsens. There is a potential for the same phenomenon to occur with air traffic, whereby the demand for air travel grows in line with growth in supply. A self-enforcing cycle is hereby created, where developments outside of the aviation sector induce changes within it, allowing for further changes in the outside sectors.” (EEA 2008, 37).
- Highly developed transport infrastructures catalyse demand for devices and services required to make those systems work. To give an example, there are hints that the European and Chinese massive investment in railway infrastructure, especially high speed trains, first support the industry creating a huge demand of rolling stock, signalling and control systems; secondly, this entails a spill-over effect supporting the rail manufacturing market, developing the railway industry’s high-tech contents, and eventually placing it in leading positions in the international market (Worldwatch 2010).

There is a feedback loop between the relatively passive idea of a derived transport demand and the impact that the uses and construction of the transport assets have on present and future economic and social possibilities. Much of the development and operation of the transport sector in the 20th century was based on transport as response-driven, without recognizing the return part of the loop (Thompson 2010, 7).

As Thompson, among others, wrote, it is a well-known secret that infrastructures can also induce mobility: once a new (or cheaper) transportation system is implemented, this can lead to new demand which was previously not realized or even not envisioned. Speaking of urban traffic (although any sort of transport field can be considered in a similar way), Litman (2012) wrote: “Traffic engineers often compare traffic to a fluid, assuming that a certain volume must flow

through the road system. But urban traffic may be more comparable to a gas that expands to fill available space. Road improvements that reduce travel costs attract trips from other routes, times and modes, and encourage longer and more frequent travel".

Thus, infrastructure is not a silent onlooker built in order to cope with given volumes of traffic – it is actually *q.e.d.* a driving force for mobility and demand generators.

4.6. Tourism

Tourism has always been an important feature of society as well as of the economy, with considerable impact on the transport industry. By definition, tourism is intrinsically linked to the transport realm, and transport facilities influence tourism flows. Naturally, the impact can be the reverse, where touristic demand can distress the transport volumes and industry.

Transport facilities have a dominant role in the tourism industry, not just in terms of ability to put people in movement, but also in terms of customers' experience and satisfaction. Bad management of tourism mobility can affect the whole tourism industry, and harm its development. On the contrary, flourishing tourism can facilitate economies of scale in the transport industry and guarantee its expansion. We should add that, increasingly often the travel experience itself, e.g. without any particular destination, is becoming a relevant part of the tourism industry: a cruise holiday or a four-day tour on a historical train is a touristic attraction *per se*.

A better synchronization of tourism and other industrial branches is taking its first steps in Europe. The EU Lisbon treaty addressed the issues of competitiveness, cooperation and integrated policies for tourism. The EU Madrid 2010 meeting on tourism considered the above points, recommending development of the concept of "sustainable, responsible and high-quality tourism" within the EU, as well as the consolidation of the "image and profile of Europe as a collection of sustainable and high-quality destinations" (EC 2010a, 12).

The need for more stringent cooperation between tourism and other sectors is claimed as necessary by stakeholders, European (EC 2010a) and international agencies (OECD 2012b), while complaints about siloed approaches to the tourist industry have been addressed (WEF 2011a). In this regard, transport seems to be the main target for such coordination, also considering that "in 2010, approximately 33% of all recorded complaints by tourists were in the area of transport and, of these, 57% concerned air passenger rights." (RPA 2012, 34).

While the political agenda is strongly aware of the need for better cooperation between tourism and other sectors, there is little evidence of actions devoted to this task. Just for example, although the relevance of sustainable tourism is gaining momentum, often there are no perceivable indications of actions taken to meet this market request with a sustainable transport system, constraining a promising market for both the fields (WEF 2011a).

Current trends

According to the World Tourism Organization, in 2012 there were 1.2 billion international arrivals (including intra-EU). "An analysis of the latest available data to 2010 shows that in OECD member countries, tourism directly contributes, on average, 4.2% of GDP and 5.4% of employment". For EU countries, those numbers rise to 4.4% for the GDP and 5.7% for employment (OECD 2012b).

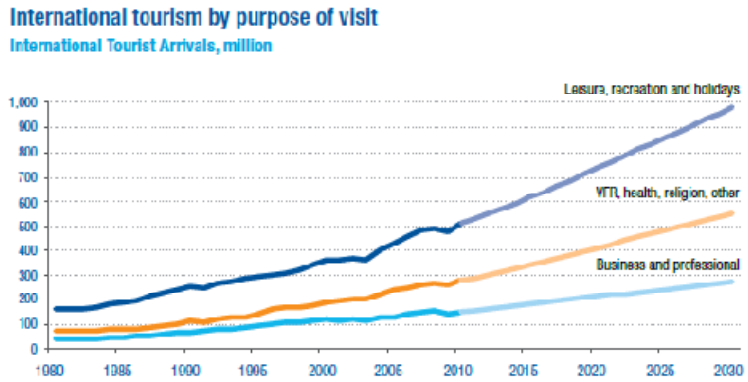


Figure 57- International tourism by purpose of visit: historical trends and expectation for 2030 (UNWTO 2011, 29)

Europe has a lion's share of *international arrivals*, totalling a noteworthy 200 million international arrivals in 1980, reaching about 500 million in 2010 (UNWTO 2011). Of those 500 million, about 65% were arrivals from other EU-27 countries, 25% from non-EU European countries, and 10% from outside of Europe (see Figure 57 and Figure 58)[28]. The Schengen agreement hugely simplified visa and passport requirements for all EU countries, smoothing tourist flows (UNWTO 2000).

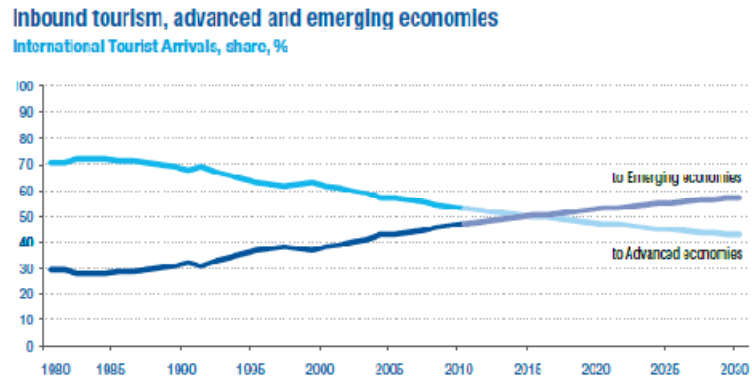


Figure 58- Inbound tourism: historical trends and expectation for 2030 (UNWTO 2011, 13)

European variety and charm have an indubitable appeal when it is time to choose a holiday. However, the share of total international arrivals in Europe gradually declined from 64% in 1980 to 51% in 2010. So, despite its growth, the EU tourist sector is growing less than other tourist markets,

[28] Naturally, once we consider international arrivals towards EU-27 countries generated from EU-27 countries themselves, the above figure changes dramatically. In such a situation, when intra EU-27 international arrivals are counted as "domestic", Europe as UE-27 should total about the 28% of international arrivals in 2010, compared to 22% of Asia & Pacific, and roughly 16% of the Americas (UNWTO 2011, 16).

and it presents considerable differences among its countries (France, Spain and Italy here have an unrivalled role).

Both long term patterns and new trends can be observed on tourism related demand for transport. The largest part of EU tourism travel is most likely to be made by car, which represents more than 70% of total tourist movements (ECT-CET). The role of motor-vehicles is therefore still dominant in this sector, as in the past decades. Naturally, air transport is the main mode for international and intra EU-27 tourism which normally involves medium and long distance journeys. The appearance of low cost airlines has altered the market of intra-EU tourism, opening new markets and new extended seasons for tourism (ECORYS 2009).

The coach sector, which had its heyday in the previous decades, is under attack, but it is also experiencing a new array of offers and a second youth within national and intra-EU markets. Incidentally, this testifies to a growing demand for medium and long distance mobility. The demand for rail transport in the tourism arena is weaker than decades ago, although there are expectations for the role of high-speed trains. In some parts of Europe – especially in Eastern Europe - the "ordinary" train system has been claimed as inadequate to cope with the demand. The cruise industry is booming, to the point where a main challenge, inside and outside the EU, is a shortage of equipped ports for docking.

4.7. Safety

In this chapter we concentrate on road safety, which is the most problematic part in transport safety as most fatalities occur in road accidents.

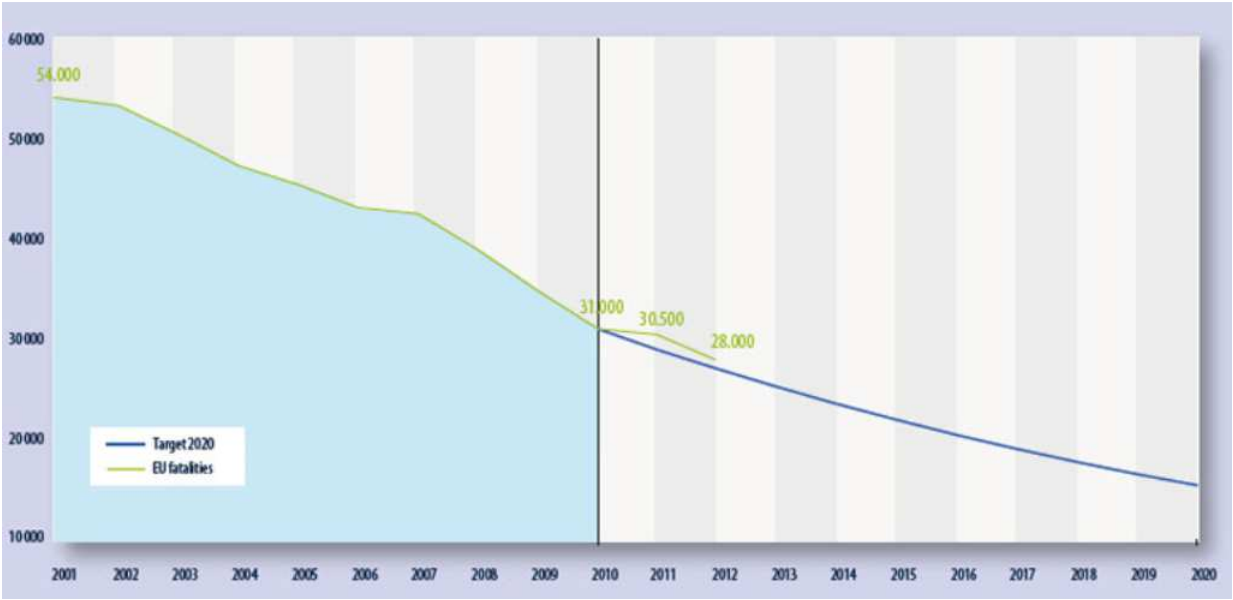


Figure 59- Road fatalities in the EU since 2001 and decrease target till 2020 (EC 2010b)

In 2011, more than 35,000 people died on the roads of the European Union, i.e. the and at least 1,500,000 were injured. The cost for society is huge: approximately 130 billion € in 2009. Hence, the strong demand of increased safety stems from serious societal as well as economic concerns. Road safety is currently the most serious concern in transportation, as air, sea and even rail

transportation systems are much safer. In fact, bringing the road transportation to similar safety levels to the other transportation systems would be a great achievement.

The EC defined several important policy objectives with regards to road safety for the period 2011 – 2020: Improved education, increased enforcement of road rules (including vehicle technologies to assist enforcement), safer road infrastructures, safer vehicles, promoting the use of modern technology for safety and protecting vulnerable road users. The EC document points out that reducing the environmental impact (defined as a major priority by the EC), may lead to characteristics radically different from traditional vehicles, with likely impacts on safety, and therefore a coordinated approach is essential. A significant contribution to road safety is expected from cooperative systems which enable vehicles to interact with the infrastructure and other surrounding vehicles (EC 2010c).

According to an R&D technology roadmap for future road vehicles published by the European Thematic Network FURORE (2009) several novel technologies will enable enhanced active safety in road vehicles by 2020, such as image enhancement (night vision), image recognition, vehicle-vehicle warning systems, and break/steer-by-wire. Therefore in the short term research and development needs include (among others) better and cheaper sensor/actuator technologies, as well as methods and protocols for information networking and for human-machine interfaces. For the medium term research needs include the introduction of affordable partially-autonomous vehicles with a high degree of on-board intelligence. In the long term the demand will be a transition to *fully-autonomous* vehicles (see below).

Responding to the EU strategy for an Innovation Union, The European Road Transport Research Advisory Council (ERTRAC) created several research and innovation roadmaps, including a road safety roadmap. ERTRAC's "Safe Road Transport" roadmap covers all enabling research activities needed to improve road safety, considering the vehicle, the infrastructure and the behaviour of road users. All types of safety (cooperative-preventive-active, passive and post-crash) have been considered. The ambitious goal defined by ERTRAC was 60% reduction of fatalities and severe injuries by year 2030 compared to 2010.

ERTRAC identified several critical enablers for high safety, such as the integration of human factors in road infrastructure engineering ("self-explaining and forgiving roads"), advanced driver support and automated driving systems utilizing advanced cooperative/V2X systems, intelligent vehicle dynamics, and integrated passive/active safety means, to name a few (ERTRAC 2013).

Substantial reduction of accidents would strongly affect the demand, not only because of better personal safety of users but also due to important benefits to traffic reliability, since accidents are one of the main causes of traffic abnormalities and congestions.

The following figure presents the roadmap for increased safety of vulnerable road users (VRUs) from the R&D phase till market introduction, as envisaged by ERTRAC.

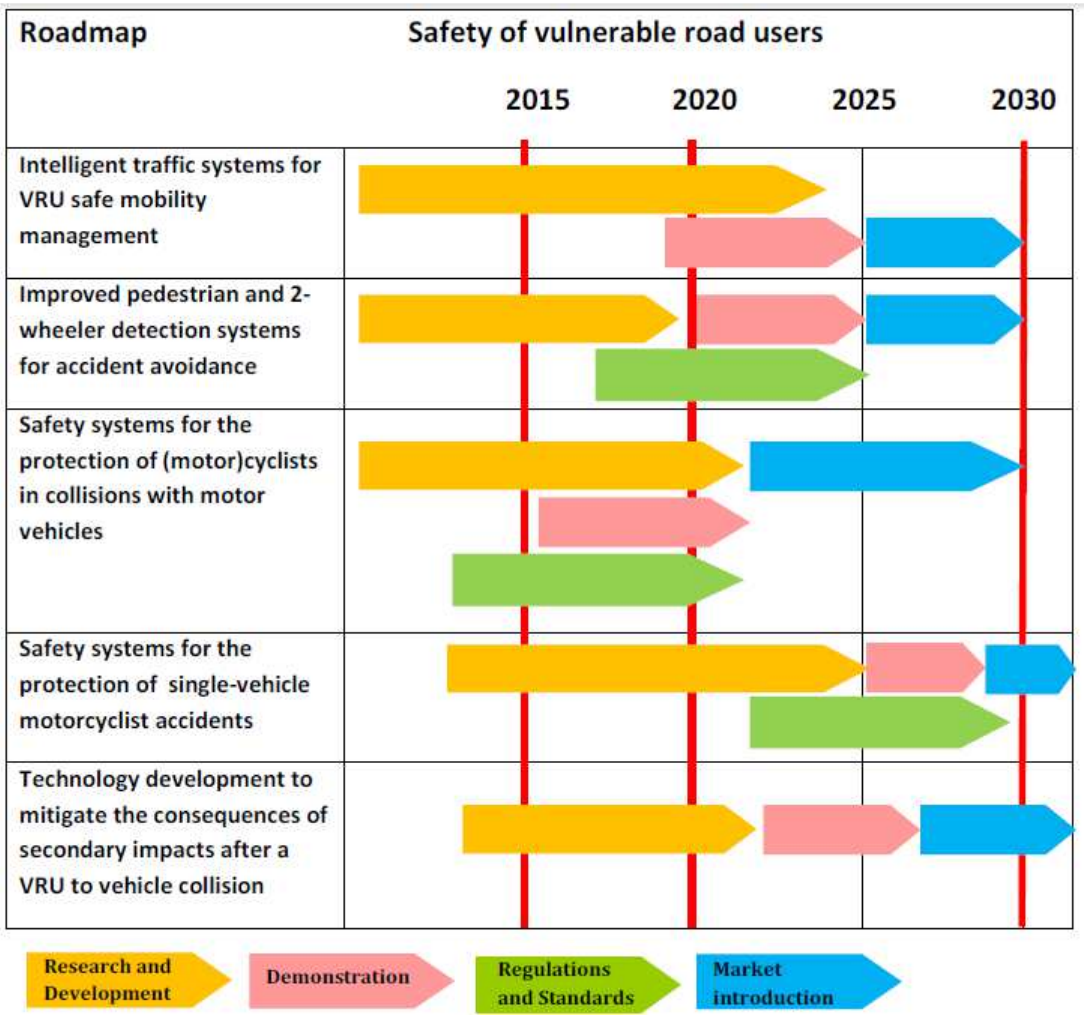


Figure 60- Roadmap for safety of vulnerable road users (VRUs) until 2030 (ERTRAC 2011)

Environmental and energy considerations drive the demand for the introduction of new electric vehicles and new, smaller and lighter vehicles. These will have important impacts on safety. On one hand these vehicles will require new safety considerations, but on the other hand they will also offer new opportunities, for example using the available high electric power to control the traction torque at each wheel, or the replacement of mechanical shafts by electric power transmission (ERTRAC 2011).

Present crashworthiness requirements set limits to weight reductions, so the challenge will be how to achieve environmental friendliness (e.g by weight reduction and alternatives to internal combustion engines) together with high level of safety. One potential solution can be offered by advanced strong and lightweight materials (with high strength to density ratio), such as nano composites. Another direction is increasing safety by more automated driving, which in turn could ease the weight-demanding crashworthiness requirements in the future.

The following figure presents the ERRAC roadmap for safety of new vehicles, from the R&D phase till market introduction.

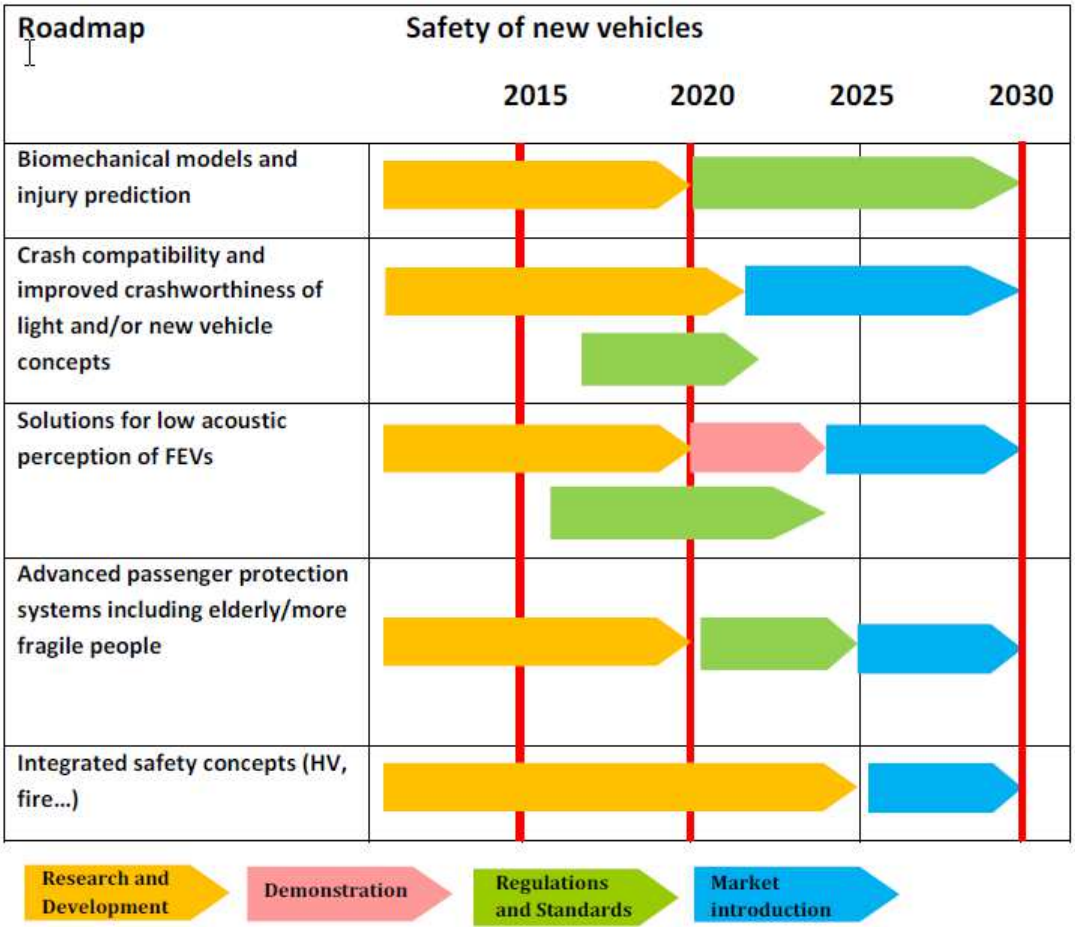


Figure 61- Roadmap for safety of new vehicles until 2030 (ERTRAC 2011)

Since the vast majority of road accidents are caused by human errors, increasing safety means introducing advanced driver support systems, leading to more automated functions (e.g automatic steering and/or braking), and ultimately to fully autonomous driving. So far the market penetration of available advanced driver support systems has been rather slow, mainly because of high costs.

Even before fully autonomous "driverless cars", higher level of automated driving will require new regulatory frameworks. Technology enablers for fully automated driving already exist, but there is a need for more reliable and extended environment perception and situation understanding. ERTRAC estimates that within the time-frame of its present roadmap, full automation will be limited to specific contexts (e.g., platooning or dedicated lanes) where the main role of the driver will be monitoring. A key issue in the near term is handling transitions between automatic and manual control modes.

The demand for improved road safety has urged the US National Highway Traffic Safety Administration (NHTSA) to focus attention on self-driving vehicles, ultimately aiming at not just "driverless cars" but “crash-less” cars. KPMG points out that historically vehicle safety has focused on crash-worthiness, but in the future "self-driving crash-less vehicles" could be much lighter and their cabins could be redesigned to support activities other than driving and crash survival – with profound implications for the car manufacturers (CAR 2012).

The following figure exhibits the ERRAC roadmap for advanced driver support systems, till 2030.

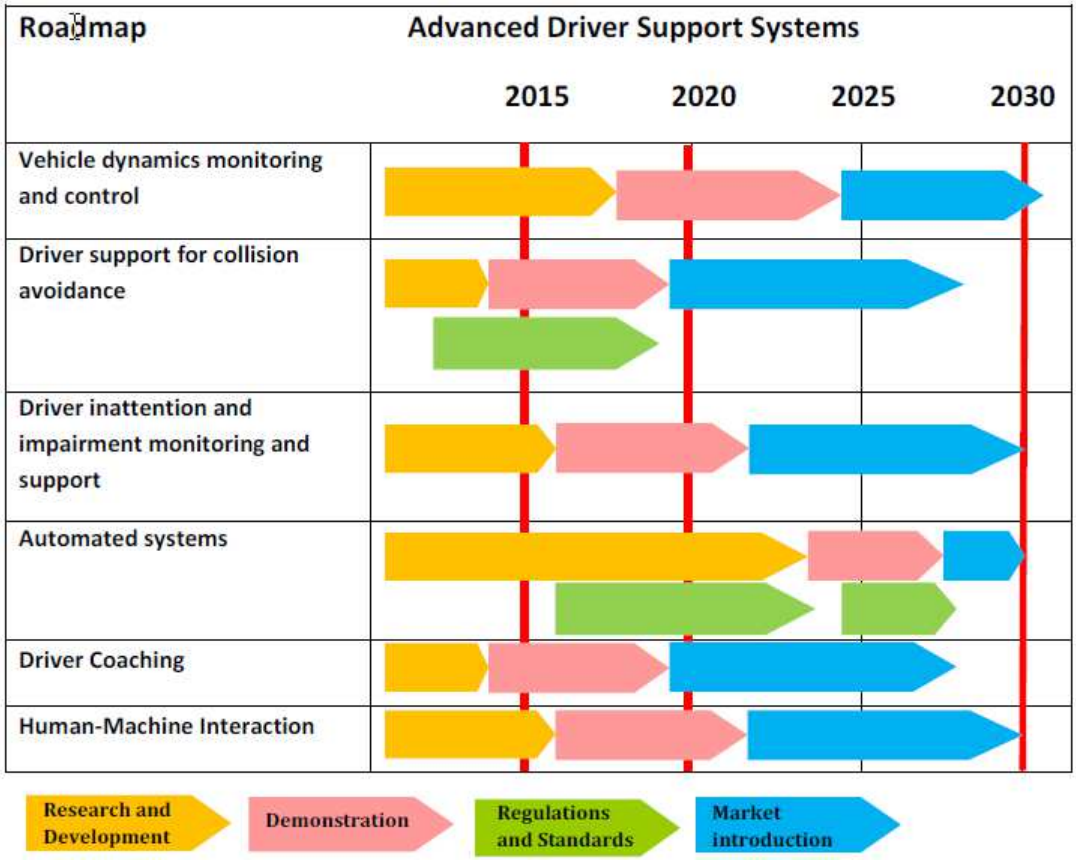


Figure 62- Roadmap for Advanced Driver Support Systems until 2030 (ERTRAC 2011)

4.8.Security

Transport systems that operate effectively and efficiently are a key driving force supporting economic well-being and growth. However, the effective operation of transport systems depend among others on the level of security which are provided to users.

Security is a broad concept. The Merriam Webster online dictionary defines security as: "The quality or state of being secure: as ***a*****:** freedom from danger**:** safety, ***b*****:** freedom from fear or anxiety, ***c*****:** freedom from the prospect of being laid off (job *security*)" (Merriam Webster 2013).

In the European Commission staff working document on Transport Security we find the following definition of security:

"Security in a transport context seeks to prevent acts of unlawful interference against passengers, freight or the transport infrastructure. Security should give users confidence that they can use transport. Transport – and thus transport security - has also an important international dimension: in order to ensure security within the EU it may be necessary for transport security to be performed outside the EU before a journey to the EU commences." (EC 2012d).

The role of security in transportation is problematic. The same EC working document also states that "For much of the transport sector security is not a positive selling feature that attracts customers

or passengers. Consequently, security can be perceived by some transport operators to be a negative cost, or even something that is not their responsibility to provide, taking into account that the return and effectiveness of investments in security is difficult to measure."

The September 11th, 2001 attack on the world trade centre in New York City was a colossal event that changed transport security dramatically. President Bush signed a new law called Aviation and Transportation Security Act (ASTA) two months later. The US Transportation Security Administration (TSA) was formed as a result, and several important changes were introduced in the civil aviation security procedures. These changes include the federalisation of passenger security screening and the requirement to begin screening all checked baggage.

The implementation of new security procedures restored the confidence of passengers but their impact on the demand for transportation was unclear. Passengers did have more confidence in the aviation system, but they now have to suffer longer lines and increased discomfort. One study found that as a result of the new baggage screening procedures passenger's volume was reduced by 6% in all flights in the USA after the 9/11 event (Blalock, Kadiyali and Simon 2007).

The perception of safety and security is a very important factor in travellers' decisions to visit certain places. Undesirable incidents, such as terror attacks, will have a negative impact on passenger's actions. Such incidents may change the perceived travel risks (Mansfeld 2006). Risk perceptions of travellers may also be affected by news and word-of –mouth information regarding terrorism and other security issues.

It appears that the impact of security on the usage of transportation systems is somewhat complex. Several issues are involved, such as the generation of risk perceptions by passengers, perceptions that may be affected by the risks involved in usage of the transport mode itself, as well as the perceived risk pertaining to the destination of the travel.

Another determinant of transportation demand is the security regulation. We saw earlier that the new regulation in the USA following the 9/11 attack caused a certain reduction in passengers volume of 6% after the new regulation took effect. Although transport security is a necessity heavy security regulation may cause a certain decrease in the overall demand for transport in a specific mode such as air travel. A certain portion of passengers may switch from one mode of transportation to another.

In the roadmap to a Single European Transport Area white paper (EC 2011) secure transport is specifically mentioned. In this paper there is an emphasis on the need for common approach and a single set of rules in the EU that are essential for high level security, also called "One Stop Security". The paper calls for improved screening methods respecting human rights and developing a "Check point of the future". The term "End-to-end" security, which is mentioned in the paper, relates to increasing the level of security within the supply chain without interfering with the free flow of trade. According to the authors, the effect of "One Stop Security" in terms of eliminating redundant standards and procedures is a major 'value added' of European security policy.

Regarding air cargo, the Commission intends to bring forward legislative means in relation to cargo originating from outside the EU, following a risk based approach and requiring improved data

quality of advance information about shipments. With regards to the security of land transport, the Commission has developed an EU Chemical, Biological, Radioactivity and Nuclear (CBRN) Action Plan123, which introduces an all-hazard approach to reduce the threat of and damage from CBRN incidents, including acts of terrorism.

An important relatively new security issue is ensuring that transport is resilient to cyber-attacks. Transport is particularly dependent on computerized management systems, and therefore is vulnerable to cyber-attacks. Moreover, incorporation of new information and communication technologies in vehicles and their growing connectivity also pose new threats and vulnerabilities.

This issue is briefly addressed in the EC staff working document on Transport Security (EC 2012d). The authors of this document warn that, for example, with the eventual deployment of e-freight or e-maritime systems a cyber-attack could close down one or several maritime or air ports for days with a substantial damage to the economy.

The US Department of Transportation (DoT) regards the Cyber threats as a major risk in transportation, mainly because of the increasing dependence on information systems and networks. According to the DoT, there is a need for culture/ecosystem of cyber security, similar to the existing culture of like fire safety (Dinning 2011).

5. Geopolitical Issues

Socio-economic and political developments which either already have occurred or are expected to occur in extra-European markets where the European transport industry has established or may establish its business presence (through manufacturing and assembling operations, market service and sourcing activities, etc.) are of vital importance to assess how these happenings may affect demand for the products and services as compared to the local and foreign competitors, and the overall growth potential for the next 40 years.

Geopolitical developments impose constraints, enablers, catalysts and external shocks, whose direct and indirect impacts may affect the sustainability of the European transport industry's competitiveness in the medium-and-long-terms, as these events shape and re-mould consumption structures and business environments in the present and prospective extra-European markets, affecting demand for transport equipment and service, licensing, know-how, franchising and in-and off-shoring of manufacturing, raw materials, energy and component production.

In addition to evolution in technology developments, urban and industrial growth which are prime drivers of transport demand, a recent World Bank's study identified several factors which concurrently or in concert with other parameters may influence transport demand and, consequently, transport growth:

- Population growth at the different emerging and developed continents, and particularly, demographics of working age groups, urbanisation, health conditions, and education, households' incomes and purchasing power, social values (particularly those related to eco-sustainability), family structures and female participation in labour markets;
- Projections on shares of industrial manufacturing in emerging nations GDP versus other sectors (services);
- Outlook for democratic geo-political developments, and adoption of higher social and environmental standards by emerging countries' laws and regulations related to environment and domestic industries);
- Preponderance of multilateral and bilateral agreements and memberships in global organisations (such as WTO) and other trading pacts reducing costs of international trade and distribution;
- Projections on growth dynamics in bilateral trade between Euro-North America and Euro-Latin America, Euro-Mena countries and Euro-Asia trade and also in multilateral south-south, north-north and south-north exchange flows.

Although not mentioned by the World Bank's study, the role of eco-sustainability of industrial and/or business activities must also be considered because industry's socio-environmental responsibility for products and services is increasingly required from both the European and the global market players.

Complementing the above, WEF (2012) has specified several auxiliary parameters whose impacts may affect demand for foreign direct investments (FDI) in infrastructure, assembling and production facilities and manufacturing of parts, components, sub-systems and/ or entire modules:

- Easiness of access to domestic and international markets;

- Efficiency of customs administration;
- Transparency of border administration;
- Availability of high quality transport and logistics services;
- Availability of high-standard ICT;
- Physical security.

These developments will affect consumer numbers and behaviours in the emerging and developed economies, and particularly:

- Rise in middle class over the next two decades in developing world, and evolution in demand structure driven by needs for mobility, accessibility and social cohesion;
- Changes in consumer preferences towards greener products and services and more environmentally responsible methods of production, transportation, distribution and supply, and an overall more ecologically sustainable lifestyle and expenditure patterns;
- New opportunities that the above trends may generate for the European transport industry, and needs to incorporate these developments in the sector's investments, manufacturing, marketing and branding strategies;
- Growth in demand for energy and emergence of new suppliers of gas, oil and agro-products and these parties' impacts on global availability of bio-and-fossil fuels over the next 40 years;

Also relevant are the impacts that transformation of the emerging countries' political systems may have on global economic developments and business prospects for the European transport industry, namely:

- Expectations of geo-political upheavals in Africa, Middle East, China and Russia that may affect availability of energy and other strategic resources but also unlock new growth opportunities;
- How these developments may create new disequilibria and crises which together may tilt the current geo-political balance and affect economic prospects for European transport industry;
- Evolution in major developing economies' (China, Brazil, Mexico, South Africa and Russia) manufacturing skills, exports, technologic and commercial innovations, consumer expenditures and business sophistication, and how these elements may affect these countries' FDIs, and through this, the competitiveness of European transport industry in foreign settings.

5.1.Trade and International Division of Labour

5.1.1. Political and Administrative Trade Barriers

The quality of administrative management may both impede and facilitate the international trade and demand for rolling stock, sea-going vessels and motorised vehicles in addition to passenger and goods transfer. The EC (2001) highlights several administrative and regulatory barriers that still stifle trade and volumes of international exchange. Duties, tariffs, taxes and other administrative hurdles increase production costs and reduce supply efficiency. Therefore, the cross-border collaboration and international trade agreements are needed to reduce the exchange barriers and make the international business less costly. Trade hindrances are usually connected to protectionism

which basically is a political problem, whose occurrence and intensity tend to increase during the periods of economic downturns.

However, according to the recent WTO's official announcement[29], a trade world today is imbued by other hurdles than tariff-barriers. Proliferation of geographically disaggregated production systems and global value–chains caused by that more and more items are processed at multiple locations, and thus could be called "Made in the World". With the same products manufactured across the globe, the national tariffs and customs increasingly make no sense. Under these circumstances, a tariff on an import is a bullet fired by a country at its own export of products, services and/or intermediary components. This explains a wide-spread autonomous and volitional tariff reduction by many national governments.

Instead, regulatory discrepancies on safety, quality standards, and environmental and human health consequences become more preponderant and constitute much larger principal challenges for international and global industrial suppliers. Also, differences in standards, in technical regulations, in certification procedures, in service legislation, in prudential rules and many others can have major impacts on export sales of individual companies and entire industries.

As regulations of transport safety, taxation levels and infrastructure investments are nationally determined, they pose considerable challenges to cross-border exchanges and off-shoring of manufacturing and sourcing operations. Therefore international agreements and multilateral accords became increasingly important for dealing with national regulatory discrepancies. Again, the Asian countries have been very efficient at creating bilateral and multilateral Free Trade Agreements (FTA). Since developments of supply chains and production networks in Asia has been driven by businesses, the key driver of regional intra-Asian integration through the FTSs was to reduce the cost of trading through improved quantity and quality of infrastructure, logistics and institutions which together underpin the competitiveness. As tariffs are generally not a significant barrier anymore, at least for the large global traders, these agreements have increasingly focused on non-tariff trade facilitation, both at and behind national borders but also across the entire Asia and with important commercial partners from other continents.

Access to international markets is contingent on evolution in international division of labour which again is connected to economic growth and demand for transfer of people, goods and capital. Thus, a broader and deeper division of labour may produce cheaper and more competitive products, prosperity and higher living standards. It may generate new types of comparative advantage, but also re-shape the existing trade patterns and financial exchanges. Liberalisation of trade and services generate new demand for transport, and affects its structure and investment needs. The WTO publication of data series on global trade evolution from 1948 to 2010 indicates that Europe is the largest world trade operator, but with clearly visible declining trend. Europe's share in the world goods trade reached 37.8% in 2010 against Asia's 31.6% whose participation took a steep upturn from 20% in 1993. The share of the US has clearly declined to 13.2% after reaching 18% peak in

[29] Derived from the speech that Pascal Lamy, the chairman of WTO has delivered during the international conference on "The Future of the World Trading System: Asian Perspectives" held in Geneva on March 11th and 12th 2013.

1993. Russia was not included in this calculation. However, the previous WTO assessments estimated Russia's share at roughly 5%.

Although the WTO's estimates that the volumes of world merchandise export would in 2011 increase by 5.8% while the overall GDP by 2.5%, did not materialise for Europe, still the developing countries' export shipments rose by 8.5% while GDP by 5.9%. Thus, according to WTO calculations, commercial integration between the members of OECD and the extra-European countries happens through much stronger export growth, particularly from Asian nations to Europe, increasing thereby the Asia's position in world trade.

Thus, Asia is a living example of how trade can contribute to economic development. Trade share in Asia' GDP has grown more than four times, from 13% in 1960 to 70% in 2007. An Asian Development Bank study (ADB 2011) suggests that by 2050, Asia can account for more than a half of global GDP, trade and investment, and enjoy widespread affluence, with its per capita income rising six-fold and reaching the global average similar to the current European levels.

As a consequence, the emerging Asian countries make their voices heard at international forums such as the World Trade Organisation and United Nations. They no longer wish to be "quote/unquote" takers of the WTO rulebook, but also makers of global collaboration rules. Emergence of BRICS countries as large contributors to global economic exchange and trade cooperation in the twenty first century became a fundamental feature of the new geopolitical reality. This was essentially the reason for formation of G-20 group of countries which are big participants in global economic activity and thus became powerful shapers of economic governance structures (Lamy 2013).

The current European recession has sharply decreased the trade between the European Community and the rest of the world. As the economic outlook for the EU remains quite uncertain, the prolongation of the current economic woes may re-shape the trade links between the old and the new partners even further, and by so doing, also the direction and the content of global commerce, including the middle-and-long-terms exchanges of transport equipment and service.

The report from the WTO shows that this exactly is occurring manifested by the growth of the so called south-south trade. In 2010, the south-to-south exports made up 23% of the world trade as compared to just 13% in 2000. This evolution indicates that developing countries constitute now the largest market for other developing countries with some key export/import players coming from China, South Korea, but also UAE, Turkey, Iraq and many others. In fact, whereas 60% of the world trade in 2010 was north-north, only a third is likely to remain that in time ahead. Projections say that the share of north-south and south-south exchanges in global trade will rise to one third for each of them. Although the above trend is quite apparent, still the contribution of different developing regions to the South-South trade is highly skewed. Asian countries make up more than 80% of this trade segment, while the shares of Africa and Latin America remain just 6% and 10%, respectively.

Another and quite interesting aspect of the south-south and south-north trade concerns the foreign direct investments and external exchanges between the BRICS countries which are rather small. Despite the political rhetoric around the BRICS partnership, the alliance faces serious challenges

about whether its members have enough in common to function effectively as a counterweight to the West. This could be due to widely divergent economies, disparate political foreign policy aims and different political systems. India, Brazil and South Africa have strong democratic traditions, while Russia and China are autocratic. According to a report released on March 24th, 2013 (UNCTAD 2013) by the United Nations Conference on Trade and Development (UNCTAD), the BRICS countries hardly invest in one another rather preferring their neighbours and the developed world's major economies for outgoing capital placements.

Just 2.5% of foreign investments by BRICS countries goes to other BRICS partners, the report said, while more than 40% of their foreign direct investments goes to the US, the EU and Japan. Africa, home to the world' fastest-growing economies, drew less than 5% of total investments from BRICS nations. France and the United States still have the highest rates of foreign direct investments in Africa. Despite China's reputation for heavy investment in Africa Malaysia has actually invested US Dollar 2 billion more in Africa than China did.

China is in many ways a major competitor of its fellow BRICS member, South Africa. South African manufacturers, retail chains, cell phone service providers, mining operations and tourism companies have bet heavily on African economic growth, and in some ways go head-to-head against Chinese companies at the continent (UNCTAD 2013).

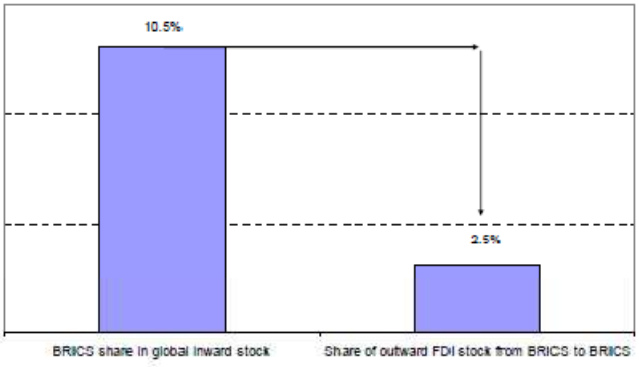


Figure 63- Share of Intra-BRICS FDI Stock in Global FDI stock, 2011 (%) Source: UNCTAD FDI/TNC database

Asia's rapid economic growth owes much to the development of supply webs and production networks, often known as "Factory Asia". A 2011 joint study by the WTO and IDE-JETRO highlighted a degree of complementarity among Asian countries, which are both a cause and a consequence of deepened economic intra-Asia interdependency. This is reflected in an increasing share of intra-regional trade, growing from about 20% in 1960 to over 50% of Asia merchandise trade in 2011. This success owes much to services, including transport, communications and a broad business offerings apparatus which became key components of supply chains' efficiency. The same could be said about relatively low tariffs on industrial products and little escalation in tariffs structure. European FDIs have also played a big role in expansion of trade in ready-made and intermediate goods in Asia.

Today, nearly 60% of the volume of world merchandise trade is in components and intermediate goods. In Asia the figure is closed to two-thirds. The period of increased inter-regional trade has mirrored an expansion of Asia's in world merchandise trade, growing from around 13% in 1960 to

over 30% in 2011. In other words, the Asia's regional trade integration provided backbone for its production networks and efficient transfer webs which contributed to emergence of global value-added chains.

5.1.2. Global Trade and Global Value Chains

The above brings to the fore new models for organization of global manufacturing and logistics channels. In addition to large Asian players who dominate trade direction and multinational supply channels, new trends in how goods and services are produced and exchanged cause that both western governments and business people need to take a notice and align their policies and strategies with the increasing ubiquitous "Made in the World" tendency.

The term "Made in the World" means that increasingly, countries are trading intermediaries, not final products[30]. This implies that the concept "Made in Country X" becomes obsolete. The old mercantilist phrase that exports are good but imports are bad for a given country's economy becomes irrelevant when one looks at the world trade statistics indicating that in 2013 almost 60% of trade in goods consists of intermediaries, and the average import content of exports is around 40%. As a consequence, future innovation and technology developments will increasingly have owners in several countries.

The proliferation of "Made in the World" techniques would also have some surprising consequences:

- They will not allow that generation and containment of innovative knowledge or technical breakthroughs is preserved within one national industry or country,
- Protection of intellectual property rights may be more challenging for a group of international inventors working together on several technology and/or development projects and,
- Training and retaining people capable of joint know-how creation, diffusion of new discoveries and turning knowledge advancement into new business applications will be more difficult for European businesses and governments.

The growth in Non-Tariff-Measures (NTMs) over the past decade spurted greater regulatory convergence that is taking precedence over the old-style protectionist safeguards. The 2012 edition of the World Trade Report (WTO 2012b), has examined the evolving landscape of Non-Tariff-Measures. One of the most important findings was that the nature of Non-Tariff-Measures has evolved. The traditional protectionism-motivated quotas and other trade rationalisation instruments have increasingly given way to precaution-oriented emphasis on health, safety, environment quality and how the technical and operational parameters may affect social welfare or induce harm. The above marks a considerable shift in regulatory focus: Tariffs protect producers, while Non-Tariffs Measures invariably protect customers and consumers. Although these considerations are entirely

30 According to 2012 World Trade Report (p.23), the top merchandise exporters in 2011 were China (valued in US$ 1.90 trillion, or 10.4% of world exports) the United States (US$ 1.48 trillion, 8.1%), Germany (US$ 1.47 trillion, 8.1%), Japan (US$823 billion, 4.5%), and Netherlands (US$ 600 billion, 3.6%).
The leading importers were the United States (US$2.27 trillion, 12.3 of world imports), China 1.74 trillion, 9.5%), Germany (US$1.2 trillion, 6.8%), Japan US$ 854 billion, 4.6%), and France (US$ 7.15 billion, 4%).

legitimate, still the nature of the measures used to pursue public policy objectives, and the way how these are enforced can, however, induce quite varying effects on trade, in both positive and negative sense.

As already demonstrated by some national governments, the public good concerns could be used as a proxy for obstructing trade in certain goods and services or for shut out certain products from national markets out of desire for political or economic concessions.

Another instrument that transforms the global trade and demand for internationally produced wares, items, and services are the preferential trade agreements (PTAs). Although PTAs have already been used for quite some time in bilateral negotiations, still their role in opening the national markets for toll-free exchanges and customs unions on a (quid pro quo) reciprocity basis is growing. By so doing it also increases the shares of imported final and intermittent wares and services for many countries' demand fulfilment.

5.1.3. Multilateral Liberalization of World Trade

The proliferation of FTAs and bilateral liberalisation originated from domestic reforms making it easier for goods and services to be bought and sold across national borders. Establishment of customs free zones and tariff-free trilateral agreements put foundation for development of regional trade. According to WTO calculations, around 65% of the global trade liberalization between 1983 and 2003 happened through unilateral cutting of import-export taxes and customs duties (tariffs). After 2004, these agreements paved the road towards more comprehensive multilateral accords.

Unilateralism prompted efforts to consolidate the intra-continental and intra-regional FTAs into broader regional pacts, such as the Regional Comprehensive Economic Partnership (RCEP) taking shape between the ASEAN[31] and the six additional countries. Since the latter involves much broader collaboration than just free trade in goods and services, it also marks out a new course towards much broader multilateral trade practice[32]. The recent drive towards multilateralism is particularly supported by Asian countries where trade liberalization is considered as catalyst

[31] ASEAN stands for Association of Southeastern Asian Nations and is a geo-political and economic organization of ten Asian countries located in Southeastern Asia which was formed in 1967 by Indonesia, Malaysia, the Philippines, Singapore and Thailand. Since then the membership has expanded to include Brunei, Burma (Myanmar), Cambodia, Laos, and Vietnam. In 2007 ASEN celebrated 30 years of diplomatic relationships with the US and stated its aim to complete its free trade agreement with China, Japan, South Korea, India, Australia and New Zealand by 2013, in line with the establishment of the ASEAN Economic Community through Regional Comprehensive Economic Partnership by 2015.

[32] At the turn of 21st century, the ASEAN collaboration was extended to regional protection of natural environment. The ASEA members started to discuss environmental agreements which materialized in signing of the ASEA Agreement on Trans-boundary Haze Pollution in 2002 as an attempt to reduce haze pollution in Southeast Asia. Unfortunately it was unsuccessful due to the outbreak in 2005 of Malaysian haze and in the 2006 of Southeast Asia Haze. Other environmental treaties that ASEAN concluded included the Cebu Declaration on East Asian Energy Security and the ASEAN wildlife Enforcement Network in 2005, the Asia-Pacific Partnership on Clean Development and Climate, both of which are responses to the potential effect of climate change. Through the Bali Concord II in 2003 ASEAN has subscribed to the notion of democratic peace, which means that all member countries believe that democratization process will contribute to regional pace. Also non-democratic members have agreed that peace through democratization was a goal that all members should aspire to.

enhancing Asia's participation in global economic exchange, and reinforcing Asia's "Made in the World" value-creation.

First, the idea of "open regionalism" originated in the Asia-Pacific Economic Cooperation's (APEC) context in 1996, as an option to extend the benefits of ASEAN FTAs accords to non-members on a non-discriminatory basis. Second, the majority of Asian FTAs, including the RCEP members, constitute inter-regional agreements, which outreached to members located in the other parts of Pacific Ocean, but also in Europe. By so doing they extended the number of international forums such Asia-Pacific European Cooperation (APEC) and the Asia-Europe Meeting (ASEM)[33].

The spreading pattern of multilateralism is especially pronounced in the light of the recent announcement about starting negotiations related to striking free trade treaty between the EU and the US, between Japan and the EU, and also by the membership expansion in the Trans-Pacific Partnership, a free trade deal to be stroke between the US and ten other Asian and Latin American countries.

The Doha Round Trade Talks

The Doha Development Agenda is the latest cycle of negotiations under the umbrella of the World Trade Organisation, the Geneva-based arbiter of global trade. Its aim is to cut the import taxes (tariffs) on everything from wheat to cars and services traded among its 155 members[34]. It also means restricting use of subsidies for farmers and fishermen; lowering taxes and regulatory barriers that affect cross-border trade in transportation, banking and consulting, and intellectual property rights on pharmaceutical products and intellectual works (innovations and technical and technology breakthroughs). The Doha round is based on an idea of single undertaking, which means that, in effect "*nothing is agreed before everything is agreed*".

Negotiators are trying to agree on new trade rules for huge number of items, including outputs of automotive and aerospace industries. The Doha talks came close to striking a deal and concluding the Doha agreement during a high-level meeting in Geneva in July 2008. But after 10 days of talks, the negotiations broke down again over a dispute between the US and India about rules governing trade in agricultural goods. Since then the meetings at WTO headquarters in Geneva made precious little progress. So, when and what kind of progress could be expected that could boost the European exports of cars, trucks, civil aircrafts and automotive parts, sub-systems and production modules?

Each round of multilateral trade talks over the last 70 years has taken longer than the one that preceded it. So, the sluggish process of the Doha round is not unprecedented. Actually the latest

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[33] The Asia-Europe Meeting (ASEM) is an informal process of dialogue and cooperation bringing together the EU 27 member states, 2 non-EU European countries, European Commission with 20 Asian countries and the ASEAN secretariat. The ASEM dialogue addresses political, economic and cultural issues, with an objective to strengthen cooperation between the European and the Asian regions. ASEM Asian Members are coordinated by Laos and Pakistan, while the European ones by the European Commission.

[34] The Doha round negotiators represent each of the WTO 155 members, most but not all of which are countries (the EU Hong Kong have their own delegations). Developing nations represent about two-thirds of the members, but economic heavyweights including the EU, the USA and India and China tend to dominate the talks.

Doha round has reached its 11 year birthday in November 2012, and so far there is no agreement in sight. This underscores the importance of bilateral, trilateral and regional agreements on free exchanges of specific articles, equipment and service which, although not yet global in scope may slowly reduce the impediments hindering free trade.

5.1.4. Shifts between Industries and Impacts on Transportation

One crucial factor influencing international trade in the middle-to-long-terms are industrial shifts triggered by adoption of new technologies, and manufacturing and/or organisational breakthroughs. Changes in technologies may also affect the international division of labour, and together, these two factors may displace the affected industries from competitive positions in a given country, region, or continent, or production of given systems and/or items. Also, changes in the global supply chains especially those related to distant sourcing of raw materials may modify the international competitive arenas, and the roles the different sectors and/or industrial clusters play. This applies to all manufacturing and service provision sectors.

Over the last twenty years many production sites were relocated from the US and the EU to overseas industrial centres while European service provision expanded to extra-European territories. These off-shoring trends have often been driven by abundance of cheap workforce and/or lucrative taxation schemes offered by the host countries to foreign investors. Needless to say this off-shoring played havoc with some European industries, represented mainly by textiles and ship-building, which lost in competition with foreign-made. Another reason for industry relocations and FDIs in foreign setting was to be closer to consumer markets with large unsaturated growth potentials.

However, the reverse is also taking shape in recent days. With the US labour costs sharply cut during the 2008-2012 economic crises, and with steep rise in manufacturing and shipping costs from Asia, increasingly more American companies repatriate their businesses home and invest in domestic manufacturing base to serve foreign markets with export sales. This tendency was also enforced by high risks of natural catastrophes that ravaged production facilities in Japan and Thailand, and also by an easy access to excellent domestic centres of technology and design development in manufacturers' home backyards or regional surroundings.

The statistics related to the scope of these reversals are not yet available, but an indirect evidence could be deduced from the 20% fall in commercial containership sailings between China and the US' eastern and western coast harbours and 3% drop in import volumes from China in the US' fourth 2011/2012 quarter-to-quarter external trade (Journal of Commerce, March 14th, 2013).

5.2.Business Prospects in Emerging Nations

Business leaders from across Europe often look at developing countries for new market potentials and growth prospects. High economic growth (as compared to advanced economies), rising young population and financially empowered middle class signal arrival of many new consumers with grossly unmet material needs and sizable spending freedom. Some may argue that over the next 50

years, the strongest growth opportunities shall still prevail in China, Russia, UAE and other BRICS nations[35].

However, several parallel trends indicate that many new opportunities are already opening in Africa (e.g., The Microsoft's 2012 Projection of Technologic Transformation in Africa). With more than one billion people, Africa is a home to 16 of the world's 30 fastest growing economies. Yet, a poor image of the continent's potentials shaped by its lingering poverty legacy and corruption at government and corporate levels stymied inflow of western capital and know-how, delaying Africa's economic advancement. But with rapidly improving business infrastructure, booming stock markets and burgeoning demographics, Africa may become a magnet for investors, manufacturers and suppliers of consumer and technology products[36].

Facilitated by the last decade's boom in mineral extraction, manufactured exports and infrastructure built by Chinese, many African countries developed close business Sino-ties. As a result, new supply chains and new financial exchanges were established between Africa and Asia. This new trade opening has richly rewarded all business parties putting several African nations on a steep growth trajectory. Despite the fact that the quality of transport and ICT infrastructures is still unsatisfactory in Africa as compared to Asia, yet the African-Chinese collaboration has shown that many structural blocks could be removed and pathways cleared, thus producing considerable unilateral gains that could also be utilised by European transport industry.

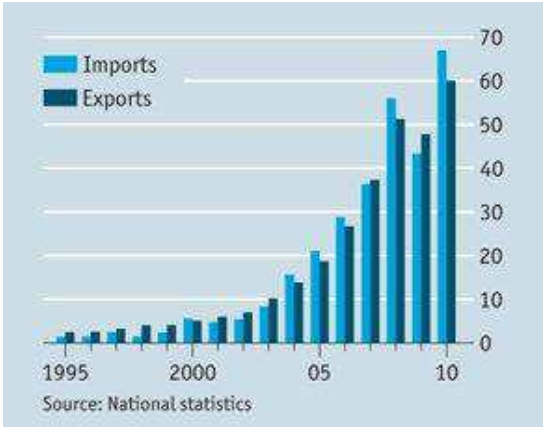

Figure 64- China's trade with Africa [Billions] (The Economist 2013)

[35] According to World Trade Report 2012 (p.23), the exports from Middle East surged 37% in dollar terms to USS 1.23 trillion (or 6.9% of the world total) as a result of rising oil prices. In contrast to this, import only increase by 16% to USS6.65 million (30%). Export of the Commonwealth of Independent States (CIS) jumped 34% to USS 788 billion, supported by rising energy prices. Imports also increased by 30% to USS 540 billion. Shares of the CIS exports and imports in world trade were 4.4% and 3.0%, respectively. Finally, Asia's exports were up by 18% in 2011 to USS 5.53 trillion (3.1% in the world total), while imports advanced by 23 % to USS 5.57 trillion (30.9%).

[36] Africa's 2011 exports in Dollar terms were up 17% (USS 597 billion) and reached 3.4% of the world total while imports rose by 18% to USS 555 billion (3.1.%) (World Trade Report, 2012, p.23).

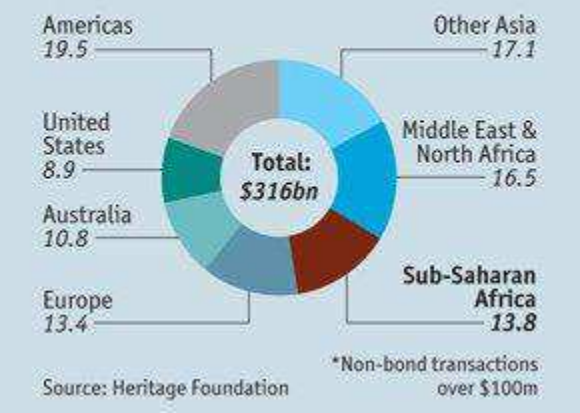

Figure 65- Share of Chinese Outward Investment in Sub-Saharan Africa, 2005-2010, % (The Economist 2013)

In addition to China, three other BRICS countries, South Africa, India and the Russian Federation have grown in ranks among the top investing countries in Africa as regards the foreign direct investment stock and flows (Figure 51).

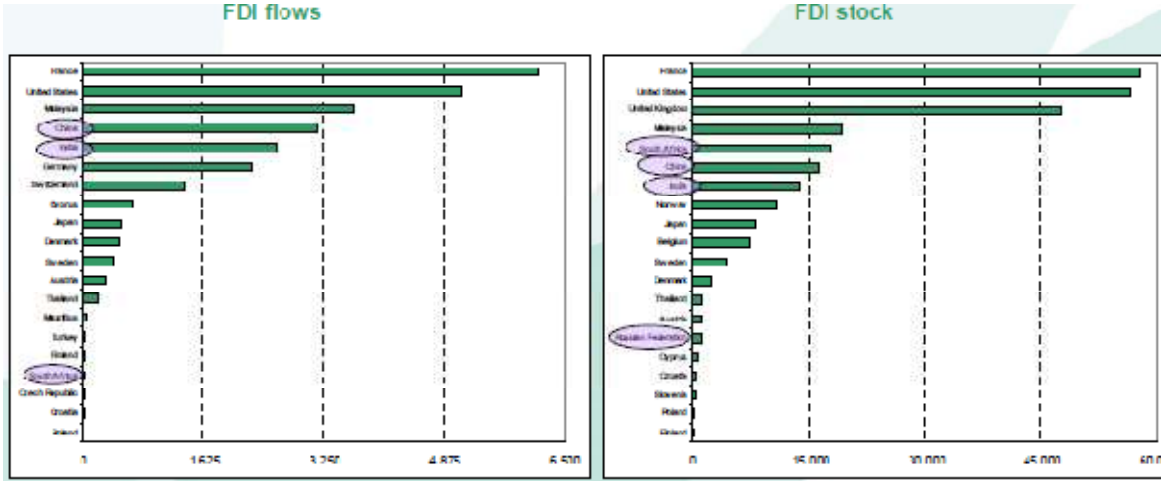

Figure 66- Top 20 Investors in Africa, 2011 [Millions of USS Dollars] (UNCTAD, FDI/INC Database)

China is the largest investor among the BRICS countries, with a total of nearly US Dollar 425billion in FDI stock worldwide. However, its outward FID stock to other BRICS countries accounts for only 2.2% of the total. South Africa and Russian Federation have been important targets of outward FDI from China. Recently, Russian transnational Corporations (TNCs) have found their way to the BRICS countries, increasing their stock to US Dollar 1.1 billion. In contrast to TNCs from other BRICS countries, the main aim of the Russian TNCs is not simply to secure the supply of raw materials to their home country, but also to expand their control over the value chains of their own natural resources, to build sustainable competitive advantages versus other firms, and to strengthen their market presence in key developing countries. For example, Rosneft formed joint-venture with CNPC (China) to develop oil extraction projects in the Russian Federation and downstream operations in China.

5.2.1. Emerging Markets' Research Capabilities and Intellectual Property Protection

Since the beginning of the 1990s when Asia, and particularly China, became the world's manufacturing hub of low-to-middle-range technology products and capitalised on high export volumes, many companies in these countries have realised that in order to raise returns on investments they need to increase the technology content of products and services. Consequently, both the national governments and business communities, particularly in China and India, recognised that in order to increase the value-added of export and service offerings, considerable investments in higher education, and R&D capabilities and infrastructure are needed.

Availability of well-educated and intellectually potent people preconditions good quality of research and stimulates innovation-driven breakthroughs. As the number of young and highly qualified workers in emerging countries increases quickly, their technical and intellectual skills are also better utilised bringing them closer to knowledge-based economies. Between 2004 and 2011 the student population in BRICS countries grew by more than 7% p.a., while student enrolment in Germany increased by 2% yearly only. Availability of researchers and engineers across Asia, Africa and Arab countries is growing too. Over the period 2004-2007, the number of Chinese engineering graduates doubled from 1 to 2 million, while in Iran and Saudi Arabia the number of people with technical and technology educational backgrounds grew three-and-five folds, respectively. Arguably, as universities in some emerging nations still strive with inadequate teaching standards and low level of knowledge production, the quality of tertiary education and scientific training in these countries still remains a concern. But, as educational investments grow quickly, the quality of academic performance is bound to improve soon.

Not surprisingly, from 2007 to 2012, China became the world's most prominent R&D hub which has lifted its share of global R&D expenditures to 14.2% of the worldwide R&D spending. For comparison, during the same time the shares of R&D investments of European countries dipped by 1.8% (Battelle 2011).

Growing R&D competence and the relative cost-effectiveness of Chinese and Indian scientific offerings attracted considerable foreign demand for contract research and technology developments. Since 1981, domestic research has at least trebled among the BRICS nations. Growth has been stellar in China, where domestic research output has grown 10-fold since 1997 and is 30% greater than that of the UK. "Home-grown" research is also expanding rapidly at in emerging research powers such as Brazil, India, South Korea and Eastern Europe (quoted from Financial Times of March 22nd, 2013).

This trend made China and India net exporters of R&D services to the EU. Between 2005 and 2010, the value of EU 27 imports of Chinese R&D services quadruplet from € 211 million to almost one billion. During the same time the R&D imports from India grew from € 507 to 734 million. As a result, the external trade surplus in EU 27 R&D services turned in 2012 into a €659 million deficit for India, and a €454 million shortfall for China (Roland Berger 2012).

According to Roland Berger Consultants, the global R&D expenditures grew within 2007-2012 from 1,058 billion to 1,403 billion USS (Roland Berger 2012) and contributed to establishment of

emerging markets' research and innovation hubs. While China's and India's R&D investments grew over this period by 0.9 and 4.7% p.c. respectively, those in Europe and the US retreated by 1.8% and 3.2%. Japans' share of research investment has also slid by 2. 3%. During the same period China and India doubled their R&/D spending from USS 100 to 200 billion (China) and from USS 21 to 41 billion (India). As a result, these countries accounted in 2012 for almost 20% of global R&D spending.

Admittedly, the 2008-2010 recessions depressed the 2012 R&D allocations of some developing nations. Yet, research endowments will grow again after the developing economies re-gained higher growth rates. However, already now some companies from China, India and Brazil allocate considerably higher percentage of their revenues to R&D purposes than national statistics indicate. Consequently, five companies from China, India and Brazil were present at the Forbes 2012 list of twenty most innovative companies in the world and, and considered as the biggest global technology developers and innovation achievers[37]. In 2011, 44 out of 1,000 world biggest technology companies (in terms of R&D spending) had headquarters in emerging countries. Chinese and Hong Kong companies topped the amount of capital spent on research investments while Brazilian and Indian firms followed at second place.

The legal protection of intellectual property is an indicator of a country's evolution towards higher "information society" preconditioning stable influx of foreign investments in technology development and/or technology-driven manufacturing industries. According to the World Economic Forum, China, Saudi Arabia, Malaysia and South Africa quite successfully affirm the intellectual property rights of foreign investors. Unfortunately India and Indonesia still score relatively low on intellectual property protection.

5.2.2. Manufacturing Competitiveness of Emerging Countries

Manufacturers and service providers from developing nations increasingly surprise their western counterparts with daunting competitiveness of their products and services. A slightly crude explanation for this phenomenon may be that competition between the more developed countries suppliers typically consists in allowing customers to choose between the different features of basically similar products rather than in expansion of products' functionalities and/or application areas. Price differentials are often driven by design, materials used and other outer features. Many European manufacturers are quite proficient at adding non-essential features to basic wares in order to differentiate them from the rivals' models, increase margins or convince customers to buy the latest releases.

The customers in emerging nations are usually less affluent than their European brethrens. This means that the local manufacturers, in addition to price, usually compete on real utility and quality of core performance. Cost/value competition is much more demanding when customers' valuation of product's design represents only a tiny portion of its functionality.

[37] www.forbes.com/innovative-companies/list/

Seeking to emulate this practice, many European manufacturers have realized that stripping their products down to the engineering core will not work either. The reason is that the European price for the basic functionalities will neither match the local competitors' costs of production nor the scope of value-added required by local markets. This indicates that competitive environment in emerging markets is structured by idiosyncratic perceptions of quality and utility, meaning that in order to launch, anchor, and/or retain the products and services in emerging markets' sales outlets, European exporters and suppliers have to employ their manufacturing, technology and marketing prowess to devise new articles and equipment that are specifically designed and engineered for the emerging consumers' requirements and purchasing power.

If the scope of value-added does not meet these anticipations, the European companies will lose in competition with locally produced items or imports from other developing locations. Thus, the European business and industry players may need to utilise the emerging countries' R&D capabilities to better assess and/or more correctly decipher the local expectations in order to tailor their transport offerings to domestic tastes.

Proliferation of innovation hubs in Asia and the growth in Asian R&D sectors heralds a change in the way how the products and services are designed, developed and brought to the market by technologically and economically savvy manufacturers and branding specialists. They also reveal that domestic demand is often met by quite sophisticated locally crafted products, and that the nature of competitive rivalry between the developing and the developed countries does not consist in direct imports of western wares, equipment or services by retailers and whole buyers from emerging countries. Higher involvement of R&D services in the developing countries' manufacturing and engineering systems contributed to arrival of new class of highly competitive products, crafted especially for functionality expectations of the low-and-medium-range customer segments.

These inventions, often called "*frugal products*" represent consumer goods that are created, designed and manufactured by applications of low-and/or medium-end production technologies, but whose technical performance still exceeds the world's average quality standards. Manufacturers of frugal products which target less affluent but quickly growing consumer numbers have between 2005 and 2010 achieved a respectable 6% of CAGR on domestic business investments. As the demand for higher goods quality and single-and/or limited functionality production machines is expected to soar in the emerging markets, these industries can easily earn GACR as high as 10% and even 11% over the next five years[38].

And the unwelcome surprise is that these relatively simple but highly functional items, articles and gadgets may create their own market niches among the advanced economies' customers without necessarily reducing sales of higher priced and more sophisticated wares. This "reverse" shift in international innovation heralds a new era in global trade environment where the competitive

[38] CAGR stands for Compound Annual Growth Rate which is a theoretical measure of economic returns. It measures an average growth rate over a period of several years by using a geometric average of annual growth rates: CAGR = (ending value - staring value) $^{1/\text{number of years}}$ -1.

rivalry between the western and the developing suppliers is sharpened by the availability of relatively simple but highly functional offerings exported to advanced economies.

5.2.3. Unlocking the Emerging Markets' Potentials

Favourable regulations and market friendly policy plus availability of well-educated scientists, engineers and skilful workforce are frequently cited as preconditions for high-edge R&D-driven productivity in material and service provision at extra-European latitudes. However the ability to understand a given country's working culture, political and economic systems, consumer preferences and buying behaviours are even more important.

The mindsets of scientists, engineers and workers from emerging countries differ from their European counterparts. Comparative statistics can reveal the gaps in purchasing power, the pay scales and the levels of income discretion separating consumers from developed and emerging economies. But they won't capture the content of future market tendencies, neither the cultural understanding of consumer sensitivities, preferences for product content, and modes of product creation, launching, and branding in foreign settings. And while the characteristics of basic consumer preferences may be easy to detect, such as proclivity for economising rather than advanced design, visual styling vs. practical application and basic engineering vs. highly complex manufacturing technology, still people with western cultural mind-sets might have problems with spotting and perceiving the idiosyncrasies of remote markets. This may particularly apply to design, manufacturing and marketing of highly functional products tailored to users in low-and-medium-income categories spread across vast geographical territories.

Discrepancies in demand patterns are further reinforced by the sheer geographic distances separating the different demographic and ethnic customers in emerging markets, which became too large to be managed from single regional headquarters. According to recent survey (December 2012) conducted by The Economist among 207 senior executives at large western multinational companies each with global revenues exceeding USS 1 billion, the western firms are changing the way they organise themselves in Asia[39]. In the past, many western firms used to oversee the entire Asia Pacific from one continent-wide management centre. As the region became too large and too complex, the western started carving up the Asia Pacific business area into several smaller and more manageable blocks. The countries that are most likely to be extracted from Asia's highly complex market structures and managed as stand-alone entities due to visibly discernible business idiosyncrasies are China, India and Japan (The Economist 2013).

[39] "Investing in an Accelerating Asia? Insights from Asia' Business Leaders on Their Outlook for 2013" Issued by The Economist's Corporate Network.

6. Demand Challenges

In this chapter the author visits the challenges that current demand trends will impose on future transportation systems.

6.1.Ageing

The changing age structure affects the mobility patterns in several countries. Seniors are becoming more mobile than in the past and the per capita amount of yearly trips of the elderly has almost doubled between the 1970s and the beginning of the 21th century, e.g. in Finland, Sweden, France or Canada (Rudinger, Donaghy and Poppelreuter 2004, Kotavaara, Antikainen and Rusanen 2011, Dejoux, et al. 2010). The expected increasing demand for mobility by 2020 is partly caused by the growing group of more mobile seniors over 65 years (Rudinger, Donaghy and Poppelreuter 2004) .

The main reasons for increasing mobility of the elderly are better health conditions and a more active lifestyle compared to previous generations, which is also enforced by increasing average incomes, at least for some groups.

Several studies (Rosenbloom and Ståhl 2003, EU 2009, Rudinger, Donaghy and Poppelreuter 2004, Zentrum für Alternskulturen 2009, Alsnih and Hensher 2003) provide evidence for the trend towards an active and healthier future generation of elderly. The future seniors want to keep their mobile lifestyle and the ability to travel is essential for an independent life. The improved health together with increasing travelling options and language skills also lead to growing demand for international travelling (EU 2009).

The effects are not only of quantitative nature reflected in an increasing amount of senior travellers, but also qualitative. The need for accessible and affordable public transports will also increase in the future. A barrier-free access to public transport is important for many of the elderly, since it allows seniors with a reduced mobility, without a car or driving licence to independently visit friends and family and to take part in recreational, social and cultural activities (EU 2007, Rudinger, Donaghy and Poppelreuter 2004). Especially the share of older women using the public transport services will grow as well as the share of elderly women with a driving licence (Rudinger, Donaghy and Poppelreuter 2004). Not to underestimate is the growing demand for assisted mobility which will accompany the increasing life expectancy.

6.2. Urbanisation growth

According to Roland Berger (s.d.), by 2030, 4.9 billion people (about 59% of world's population) will live in cities, compared to the 3.5 billion people today (50% of world's population). In 2030, developed countries share of urban population will increase by 5.7% to 81% while developing urban population share will increase by 9.9% to 55%. Urban population growth will be mainly due to non-OECD countries with over 90% of the increase in urbanization taking place in developing countries.

Already now the cities in developing countries are very large: 36% of the cities have a urban population of 1-5 million and around 12% a population over 10 million (UNEP 2012). More than

70% of China's and 50% of India's population will be living in urban areas by 2050 and around 30 new cities in China and 26 in India are likely between 2007-2050. The urbanization has global and local environmental impacts, for example in the form of greenhouse gases and resource use, as more and more steel and energy is required to build them. The cities should be built in a sustainable way from the beginning, since the structures are difficult and slow to change once the buildings and infrastructure exist (UNEP 2012). An urban region does have potential for reduced energy demand and natural resources due to its concentrated form as long as it is effectively governed. Several European examples are good benchmarks when it comes to sustainability issues and creating low-carbon and resource-efficient urban environments (EEA 2011b).

As largest part of the world's population lives in cities and towns, physical distance between consumer settlements and production centres is growing. This worldwide phenomenon is happening overall, but is most pronounced in Asia, Latin America and Africa. Hence, it also heightens demand for transport equipment and service in the far away and/or emerging locations. Sheer population growth may translate into higher employment, and a higher employment may contribute to higher GDP rise. Higher GDP may foster international trade and demand for transport equipment and service. Thus, the increase in mega-cities on developing continents may create large demand for mobility and transport means, unlocking an opportunity for the European transport providers. This may particularly be relevant for countries in West and West-southern and South Asia such as Iran, Iraq, Pakistan, India, Vietnam, Burma, Cambodia and Thailand.

This lead to a new kind of issues with irregular traffic flows due to peak hours and otherwise low capacity use of public transport vehicles. These issues could partly be solved with flexible working hours, home office and online services. Another issue arising in this context is the true cost of transportation. Currently the transport sector is not covering for the negative environmental and social impacts caused by transportation (see also EEA (2011b)). Even maintaining the infrastructure needs subsidies; as mentioned above this system and structures are based on cheap mobility, therefore a change of the financial basis would be fundamental.

Another issue arising in this context is the true cost of transportation. Currently the transport sector is not covering for the negative environmental and social impacts caused by transportation (EEA 2011b). Even maintaining the transport infrastructures needs subsidies; as mentioned above this system and structures are based on cheap mobility and therefore a change of the financial basis would be necessary.

6.3. Congestion

Road Congestion is particularly prevalent in bigger agglomerations and their access routes. As more and more people live within cities and motorization rates increase at a global level, the pressures on existing infrastructures are burdensome and affect all, imposing delays to citizens and businesses alike. Incentives to the expansion of road supply usually results in more congestion, as improved travel costs call for latent demand that otherwise would not take place – aka the vicious circle of congestion.

The urban share of population continues to increase and the number of so-called mega-Cities is rising, particularly in less-motorized emerging economies. Of the 15 largest conurbations identified

by United Nations, only four are located in highly industrialized countries: Tokyo, New York, Los Angeles, and Osaka-Kobe-Kyoto. The overwhelming majority of mega-cities are located in developing countries, like São Paulo (18.8 million inhabitants in 2007), Delhi (15.9 million), and Manila (11.1 million), where vehicle ownership is growing geometrically without corresponding land use planning and sustainable transportation planning strategies.

Estimates range between 60 to over 100 megacities (with populations over 10 million) by 2050 globally (with China alone hosting 50) (World Energy Council 2011), with significant implications in terms of mobility and congestion Some mega recurrent congestions today in cities like São Paulo, BR which saw a record breaking 562 km of queues on its network in a Friday afternoon in June 2012, or Beijing, CHIN where the local Traffic Management Bureau announced over 90% of roads saturated or super –saturated in the morning and evening peak-hours, give us a glimpse of what the future may hold for these conurbations. Strategies to relieve congestion rely mostly on policies and regulatory mechanisms addressing pricing, intelligent transportation systems and vehicle technology, parking supply, car-pooling, HOV lanes or ownership restrictions. Congestion places increasing stress upon public services to provide convenient, affordable and safe transport supply to masses, creating a window of opportunity to providers and operators of mass transit systems worldwide.

The EU estimates that in 2011 road congestion cost €200 billion in Europe, approximately 2% of GDP. According to Eurocontrol, European airspace traffic congestion cost to air-space users in 2006 was around €6 billion, and is estimated to be €50 billion in 2020 and over €90 Billion in 2025, if meanwhile nothing changes in the supply side.

In the US, the Texan Transport Institute claims that road congestion in the United States cost raised from $24 billion dollars in 1982 to $121 billion dollars in 2011 (just in 498 urban areas) corresponding to almost 1% of US GDP (TTI 2012). According to another source, freight bottlenecks and other forms of congestion cost about $200 billion, or 1.6% of US GDP a year, with an upward trend as the logistic system try to cope with ever increasing growth of freight transport demand: *"In Chicago, the nation's biggest rail centre, congestion is so bad that it takes a freight train longer to get through the city limits than it does to get to Los Angeles"* (BAF Ed Fund 2011).

Congestion is a major challenge of transport. Congestion occurs as a consequence of transport demand equalling or exceeding system capacity. It generates extra costs to economy in terms of delays, time and resources waste, and increased fuel consumptions and pollution. As transport networks and nodes (e.g. maritime ports and airports) run near capacity and more users enter the system, delays increase in a disproportional way, eventually leading to gridlocks. This phenomenon is common to all modes of transport running over-capacity, as Table 25 illustrates, using the TRB level of service concept.

Mode	Europe		US	
Inter-urban roads	Mainly Randstad and Ruhr areas and urban access	C ↘	Highway intersections and around agglomerations	B ↘
Urban roads	Severe congestion in some cities, no general problem	C ↘	Steadily increasing but not perceived as major problem	D ↘
Rail	Only at port hinterland lines; technical standards	B →	Considerable lag in grade-separated facilities in major lines	D ↘
Aviation	Problems in major hubs (London, Paris); airspace	C ↘	Constant investments and still recovery from 9/11	B ↗
Waterborne transport	Only port hinterland trans-port (Rotterdam)	B →	Port capacity and conges-tion on hinterland routes	D ↘

Legend: A (= congestion-free) to E (totally congested): Current situation. ↘↘ (fastly declining quality) to ↗↗ (clearly improving conditions): expected future transport system quality

Table 25 - Direct comparison between EU and USA Congestion - Summary of findings (COMPETE 2006)

Air traffic congestion is a growing concern worldwide. ATFCM[40], provided by the National Aviation System in USA and civil aerospace authorities in Europe are amongst the major sources for delays at most congested U.S. and European Airports. Air traffic capacity is still dictated by 1950s' ground to air radar- and radio- technologies, and airport slots rules which are not consistent with efficient and open markets. Ongoing research programmes as SESAR in Europe, under the Single European Sky (SES) initiative, or FAAs' Next Gen initiative in the USA, are addressing these issues, following a path to replace current air traffic management systems by merging them into a global interconnected network, supported on satellite navigation and advanced digital communication technologies. According to the Association of European Airlines (AEA), fully-implementation of "Single European Sky will lead to a significant increase in operational efficiency, reducing aviation's carbon emissions by 16m tonnes of CO2 per year and eliminating unnecessary fuel burn worth €3.7bn at today's prices" (AEA 2012).

In Europe, rail congestion is an issue mainly for freight operators at Sea port hinterlands and crossing some metropolitan areas, due to operating rules that prioritise passenger traffics, and slot availability. As the high speed network evolves, former corridors are becoming freight dedicated, and integrated multinational network management offices are being implemented in order to promote and streamline rail freight flows across the continent. Europe must still overcome a burdensome set of regulatory and technical discrepancies amongst different national networks, which seriously holds back system capacity.

The quest for congestion-free transportation systems is not practicable or economically viable, as ultimately congestion reflects system demand and is evidence of social and economic vitality, but lack of proper system capacity planning and mobility related policies addressing demand management, given future demand pressures on current infrastructures, poses huge threats on future regional efficiency and competitiveness, imposing incalculable costs on businesses, workers, and quality of life of future generations.

[40] Air Traffic Flow and Capacity Management

6.4.Energy

Energy use connected to fossil fuel production is amongst the most important environmental challenges worldwide.

The global energy consumption is expected to rise by 53% between 2008 and 2035. The growth is expected to be the biggest in the emerging markets (with half the increase attributed to China and India) where a long-term economic boost will take place and where essential economic partners and competitors for the OECD countries as well as resource users will emerge (IEA 2011, OECD 2008). By 2030, the energy consumption in Brazil, Russia, India and China is assumed to grow with 72% compared with the base year 2005 (OECD 2008). It is therefore clear why the EIA (2011) has claimed that "understanding the development of transportation energy is the most important factor in assessing future trends in demand for liquid fuels".

Transportation energy use is expected to grow by nearly 2% each year in the upcoming two decades (Atabani, et al. 2012) thus constituting a large part of the overall energy consumption rise.

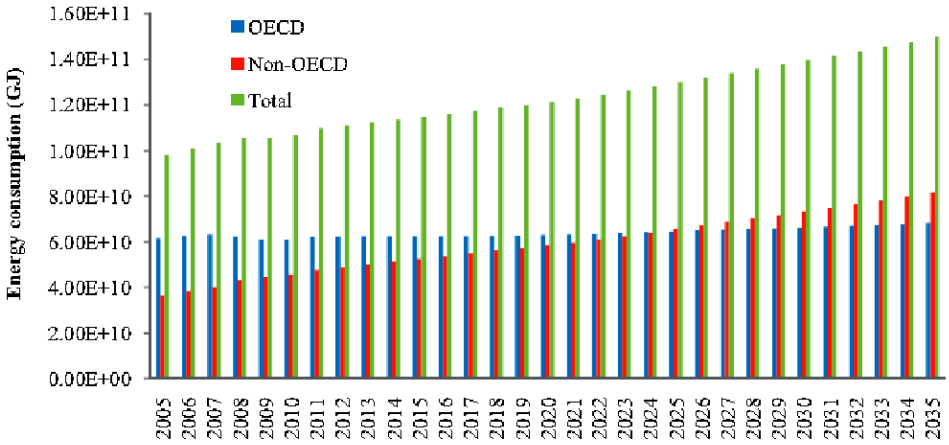

Figure 67- Transportation sector energy consumption between 2005-2035 (Atabani, et al. 2012)

Due to increasing mobility demand the consumption of petroleum and diesel is expected to keep on increasing drastically until 2035, which is also reflecting the global economic growth and rising living standards. The increase in the consumption of diesel and petrol will proportionally be the largest in the developing and emerging economies, but also in developed countries the trend for fuel consumption will still be rising (IEA 2011).

Versatile challenges arise as the energy demand increases and a higher energy supply and production is required. The growing trend for energy and fuel demand is also followed by increasing energy prices, which however won't reduce the demand for energy. Especially the price for fossil fuels is going to rise significantly, whereas the renewable energy can become more affordable due to technological development and more established solutions for energy production (IEA 2011).

Although liquid fossil fuels are, in principal, found in limited quantities in the Earth, they are expected to go on and supply nearly 80% of the world energy use in 2035 (EIA 2011). This forecast

has its roots in the fact that the oil proved reserves so far have only became larger despite many prophecies of doom depicting “the end of oil” (BP 2010).

It is obvious that rising energy demand and prices will affect transportation; although this will depend on the availability of alternatives to fossil fuel. When it comes to using alternative, renewable energy resources there are also infrastructural limitations globally (UNEP 2012). The current energy infrastructure for producing and distributing fossil energy has created a lock-in effect for decades and for example in China new fossil fuel energy plants are still being built (UNEP 2012).

6.4.1. Energy dependency

Concerning the competitiveness of the economy one of the main challenges is the energy dependency of Europe. Global reserves for natural resources are unevenly distributed and there are several highly developed economies without significant domestic energy sources but with high energy demand (Wuppertal 2009). The EU is strongly depending on imported energy and for example in 2010 around 85% of the crude oil and more than 60% of natural gas were imported. The dependency rate for natural gas has increased with 14% and for crude oil with 10% during 2000-2010 (Eurostat 2012).

The aim of the EU is to reduce the dependency through improved European energy supplies and reduced consumption of fossil fuels. The production of renewable energy can be supported and increased, but the domestic fossil fuel sources are limited. Due to limited sources only a drastic reduction in the fossil energy use could lead to a reduced dependency on imported oil and gas in Europe (Zachmann, et al. 2012). The energy dependency and the use of fossil resources could be reduced through the use of alternative energy sources and decentralized energy production.

The scarcity of natural resources together with uneven distribution of energy sources will influence the international trade and investment patterns in the energy sector. The state of the natural resources affects the economic development and the energy prices (UNEP 2012), which then again influences the transport sector’s competitiveness.

6.4.2. Scarcity of resources

Another global challenge is the increasing demand for finite natural resources. People tend to use the most easily found and produced quantities of resources first, leaving the more difficult ones for later production. This makes the non-renewable resources harder to access and they will become scarce over time. As the demand grows and a resource becomes scarce, its price will rise and consequently, the maintenance and operation of transport services will became more expensive. The major challenge here is on the innovation and technology side, finding new solutions to keep mobility as easy and affordable as possible in the future.

The demand for natural resources is growing, which leads to increasing global extraction. The majority of the reservoirs for energy, metals and other minerals lay outside OECD countries and the extracted resources need to be imported. The amount of extracted fossil energy carriers, metals and

non-metallic minerals increased by 35% between 1980 and 2002 and between 2002 and 2020 the extraction is expected to almost double (OECD 2008).

The Wuppertal Institute for Climate, Environment and Energy (2009) states that the maximum extraction levels for several resources have already been reached or will be reached in the near future, which will lead to decreasing extraction and difficulties in the availability of certain natural resources as well as to rising energy prices. There are varying information and opinions on the peak of different fuels and metals; for example the peak for oil is predicted to be between 2006 and 2026 and the peak for the extraction of lead has already passed (Wuppertal 2009). The lack of oil can to some extent be replaced with natural gas, but it is also a finite resource. Especially the transport sector will face rising fuel prices and negative economic impacts, if the oil dependency can't be reduced on time (Wuppertal 2009).

The scarcity of fossil resources could stimulate the shift to renewable energy sources in Europe. However the decreasing extraction of natural resources won't be the only reason for supply shortages; financial and political crisis will also contribute to them (EEA 2011b).

Also different metals and other elements, which are critical for the production of high-end products, are becoming scarce and will influence the lifestyles in Europe and in other industrialized countries. The access to necessary elements for innovative transport technologies such as electric vehicles and batteries will become limited (Wuppertal 2009). There are geographical areas for example in China with very high concentrations of such resources, which also affects the competitiveness of Europe and strengthens the role of China and other similar regions.

Besides mobile resources also land is a resource which is linked to transportation issues. As described in the previous urbanisation chapter the past trends of land use in Europe are mainly caused by urbanization, expansion of residential areas and other artificial surfaces such as transport infrastructure (EC 2011). A considerable amount of land in the urban areas is needed for transportation. Majority of the cities uses 20-30% of its land for transport facilities and infrastructures. The urbanisation and their infrastructure have lead to fragmentation of land, inefficient land use and to negative developments such as urban sprawl, soil erosion, biodiversity loss and floods (EC 2011).

6.4.3. Future energy comsumption

Renewable fuels are considered to be the fastest growing source of energy consumption, but they are not expected to capture more than 14% of the share of total world energy consumption by 2035, with nuclear energy sources accounting for another 7% share (EIA 2011).

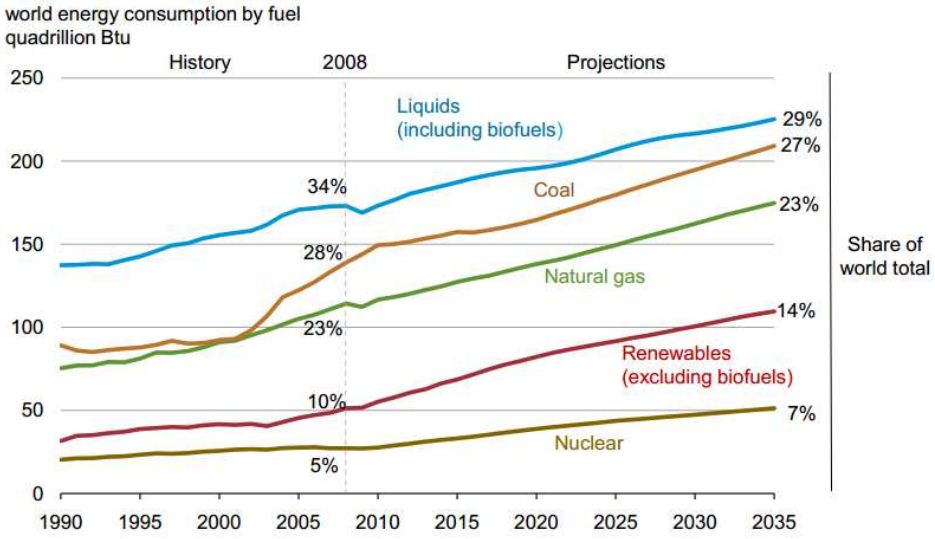

Figure 68- Share of world total energy consumption by fuel between 1990-2035 (EIA 2011)

Future forecasts, however, need to be tampered with the realization that the price of fossil oil suffers from severe fluctuations, and the trend of dramatic changes in price is not expected to change anytime soon. As an example, while the price for a single barrel of oil at the end of 2010 reached 82$, by April 2011 the price went up to more than 112$ a barrel (Sellfox 2011). The prices of oil depend largely on transport systems and regional supply security, which are particularly difficult to forecast.

In a similar vein, while nuclear energy trends seemed more obvious in the past, the recent tsunami in Japan which caused severe damage to the reactors at Fukushima Daiichi might have profound consequences on the development of nuclear power in other countries. Last but not least, should renewable energy producing technologies achieve a vast leap forward, their share is then likely to grow much larger than currently anticipated.

Energy-efficiency is also a relevant issue for the future energy sector. The emerging and developing economies can learn from the experiences made with energy-efficiency in the industrialized countries (UNEP 2012). A more energy and resource efficient society can be reached through existing know-how and technological solutions as well as through the integration of energy related issues into the political decision making. There needs to be policies supporting and promoting energy efficiency measures as well as innovations leading to improved energy solutions (UNEP 2012).

6.5. Infrastructure

The quality of infrastructure in trade partner countries is decisive for the long-term transport development. Infrastructure bottlenecks and lack of intermodal interoperability may stifle fulfilment of transport demand and/or reduce trade effectiveness. Further, the lack of good logistics facilities and poor information systems may also compromise the human and cargo mobility, and global economic integration.

Also, since the quality of traffic management and the scope of transport' s environmental impacts also depend on quality of infrastructure, large-scale construction of new infrastructure networks and/or upgrades of the existing ones may be required for unlocking growth potentials in international trade. In this context, both the public and the private investors may contribute, although cooperation between these two needs to be carefully managed. One of the potentials for European transport industry may lie exactly in contributing to transport infrastructure development in emerging countries, and thereby, boost the long-term demand for primary and derived mobility.

Trans-vision research points out that "Most of the EU's future transport infrastructure is already in place, or is at least in the planning stage. Road networks, rail networks, airports, ports have been constructed over a long period in history, and this infrastructure will also in the future provide the backbone for transport services." (Transvisions 2009, 48)

With this in mind, generally speaking, we can claim that the EU has rich and dense networks of transport infrastructure, which can compete or divide the workload of moving passengers and goods. The European Union has one of the densest road and railway networks per 1000 km^2: EU-27 rail density is 51km/1000 km^2 (US 16km/1000 km^2; JP 73km/1000 km^2), and road density is 978km/1000 km^2 (US 650km/1000 km^2; JP 3320km/1000 km^2). Even though Europe has higher levels of public transport usage compared, for instance, with the USA, in 2009, 72.7% of domestic and intra-EU-27 passenger trips (pkm) were made by private car. On the freight side, road is still the most prevalent mode, with 45.6% of tonnes-kilometres transported, but sea accounted for 37.3% and rail for 10.5% of the domestic and intra-EU-27 market (Eurostat). And about rail, EU is, when compared to Russia, NAFTA, China and India, definitely a small fish in term of volumes, both on Pkm and Tkm (Thompson 2010, 23).

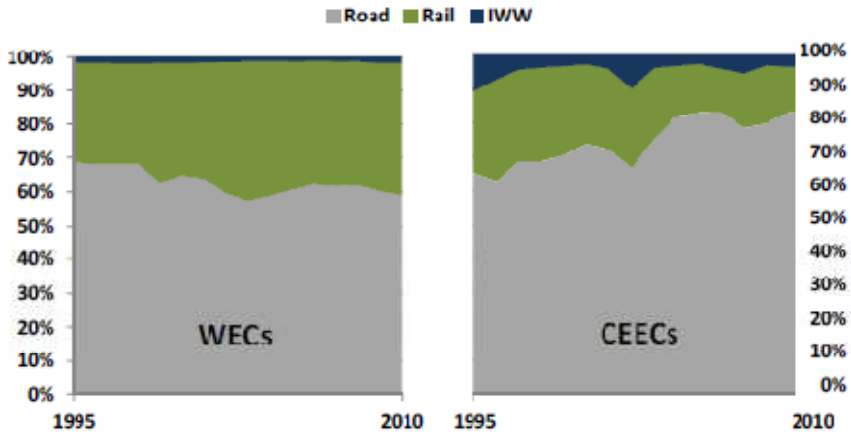

Figure 69- Distribution of infrastructure investment in WECs and CEECs (WECs as Western European Countries and CEECs as Central and Eastern European Countries) (ITF 2012c, 6)

On the contrary, USA freight market is dominated by rail transportation, and rail is gaining momentum in emerging countries too. Massive investments are currently under implementation not only in BRIC and next-11 countries, but also more generally in African countries, as an answer to the need to match the growing trade of local natural resources. We are thus facing a double-face state-of-the-art, in which we can underline a slowdown of infrastructural investment in mature economies and, on the opposite, a booming condition in emerging economies.

About the first, in the past two decades, there was a lower level of spending in Japan, which was also manifest in the USA, but less significant in the EU. Keeping the focus on the EU, the overall picture is a constant key attention devoted to road facilities, and a somewhat growing attention to the rail sector, mainly (if not completely) as a consequence of the high speed train programs. In this vein, the train sector is receiving a bigger share of infrastructural investment than its share of freight and passenger mobility (see Figure 69).

Western European countries (WEC) had a solid focus on road (about 68% of the total investments in inland transport infrastructures in the past 20 years) with minor decreases to that sub-field in the past five years. Central and Eastern European countries (CEEC) have experienced a counter-trend, moving from 66% in 1995 to 79% in 2008 devoted to roads (ITF 2012c, 2). Rail investments have grown in WECs from 29.5 in 1995 to 34.5 in 2008, but in CEECs those decreased from 23.3% in 1995 to 14.5 in 2005, although they finally rebounded to 17.9 in 2008 (see Figure 70 and Figure 71).

Regarding emerging economies, we are facing the end of a first wave of Chinese investment in the national High speed train network, and at the horizon a “second” China is not visible. However, India, South America, Africa and next-11 countries are definitely in desperate need of infrastructures (see Figure 70).

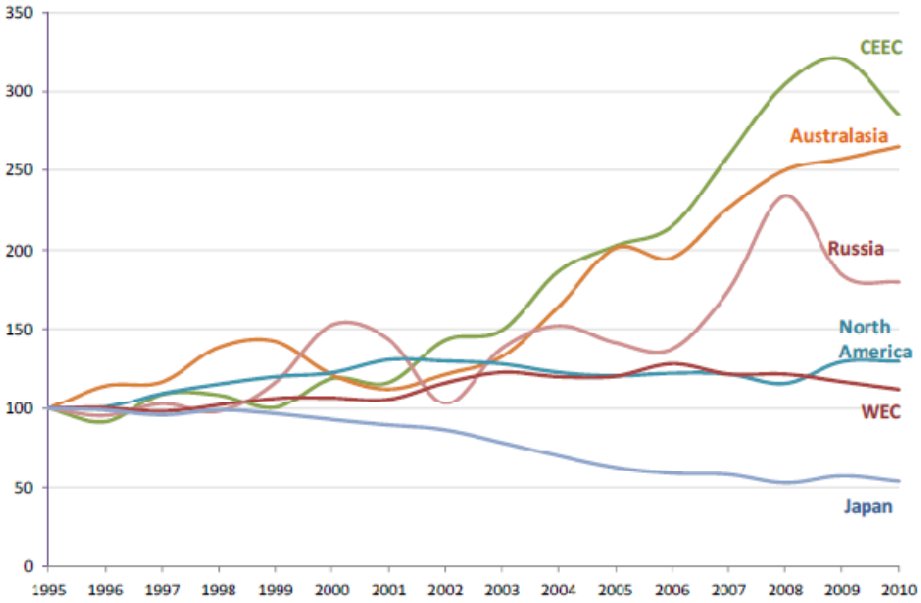

Figure 70- Volume of investment in inland infrastructure between 1995-2010 [index 100= 1995] (ITF 2012c, 5)

Some countries use transport infrastructure as “stimulus packages to benefit employment-intensive infrastructure projects, but many of these will have run their course or will be withdrawn in the not too distant future.” (OECD 2012a, 55)

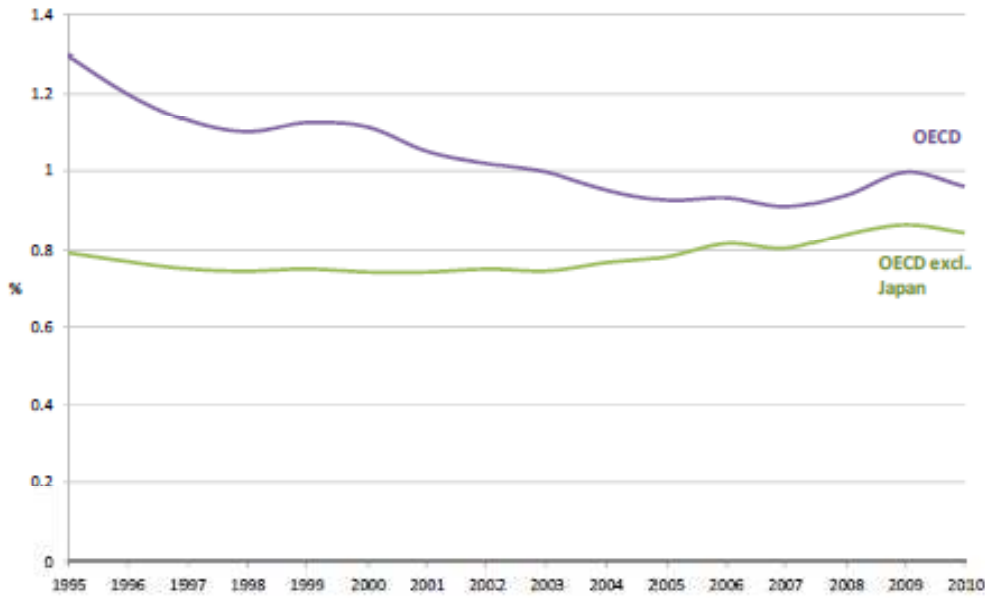

Figure 71- Investment in inland transport infrastructure between 1995-2010 [%GDP] (ITF 2012c, 4)

Trends

Generally speaking, the past 30 years' trends suggest that international freight and passenger traffic grows faster than the growing GDP. In this vein, the OECD forecasts that air passenger traffic could easily double in 15 years, air freight could treble in 20 years and port handling of maritime containers worldwide could quadruple by 2030 (OECD 2012a, 16). The same estimations of double/treble volumes by 2030 for the other transport modes have also been made. Assuming this is so, infrastructure will face an enormous pressure and if no improvements are made, the saturation of transport infrastructure is granted (see Table 26).

Global	Annual average investment		Aggregate investment		
Infrastructure facilities	2009-2015	2015-2030	2009-2015	2015-2030	2009-2030
Airports' capital expenditure	70	120	400	1 800	2 200
Port infrastructure facilities' capital expenditure	33	40	200	630	830
Rail "new construction" (including maintenance)	130	270	920	4 060	5 000
Oil and gas – transport and distribution	155	155	930	2 325	3 255

Table 26 - Annual and aggregate investment needs between 2009-2030 [$US billions] (OECD 2012a, 56)

This will have heavy social and economic effects, forcing the public authorities and the private sector to take action, even if they are reluctant. Additionally, new transport devices and technologies will require appropriate infrastructure, just as the containerisation of maritime traffic did. Therefore the infrastructure field should experience one of these three development paths.

- Improve the use of the existing infrastructure
- Create new infrastructure
- A mix of the above.

The EU's research and actions about infrastructure are largely addressing the problem of better management of existing infrastructure. The case of European airspace shows how there is a lot of room for significant improvement: the lack of harmonisation of intra-EU-27 airspace operational rules carries additional costs for the suppliers, delays, and under-utilization of the existing infrastructures. The EU-27 railway domestic networks experience similar problems. There are currently several obstacles in the way of such coordination policies (ITS and CER 2009). The bigger transport volumes foreseen for the future could become the compelling factor to overcome the political hesitations, or to force the doubting actors involved to take action.

In addition, the coordination among different transport modes could lead to better service for customers and to enhancing the use of existing services. There are huge expectations about the decisive role of ICT in improving the use of transport devices (expectations which, sometimes, have the tone of a messianic redemption). Whatever the degree ICT will (further) be embedded in transport facilities, it is expected that the infrastructural network will benefit in terms of broader uses (OECD 2012a, 54).

Recent debate by stakeholders´ has also pointed out the unsatisfactory level of integration among the transport modes and the management of their infrastructures. In other words, while the customer (demanding passenger movement or freight transport) is aiming at a rapid and seamless journey, the current infrastructure and service are not well prepared to match this request. Additionally, we see a weak point in policy trends: so far the debate is addressing either *i)* the problem of medium and long-range trips, or *ii)* the urban level of mobility. While the micro and mega levels are only partially considered, the regional and national policies, with remarkable exceptions, do not sufficiently address the meso-level (Transvisions 2009, 11).

In its research about infrastructure trends up to 2030, OECD claims that the investment needed for airports, ports, rail, and oil and gas "could amount to over USD 11 trillion over 2009-2030 (OECD 2012a, 17). The creation of new transport infrastructure is one of most outstanding policies in many emerging economies, which have devoted political attention, conspicuous resources and strong emphasis to that field.

This can lead to new framework conditions for the EU transport industry, well beyond the market of infrastructure construction. Just as British railway engineers in the 1800s blanketed the world (and carried not just their expertise but also market opportunities for their domestic industry), nowadays "in Africa, for example, thousands of Chinese workers are building roads and railways to connect the vast resources of the interior to ports and pipelines, and – eventually – out for export back to China. In parts of Asia too, Chinese companies are active, in some cases bringing together Chinese financing and contractors to complete end-to-end projects in places like Indonesia." (KPMG 2010, 38).

The cost of borrowing increased and availability of funds for infrastructure investment is reduced, with many projects postponed or restructured, due to lack of credit (ITF 2009 a). Revenues from existing infrastructure are also shrinking due to lower use. Thus it becomes necessary to improve funding and financing arrangements in many developed countries, given their current deficit and debt levels and other expected demands on budget resources (OECD 2012a, 3). This situation leads

to increasingly engaging the private sector in infrastructure development by way of privatization or public-private partnerships (PPP).

In the debate the solution is envisioned as larger private-sector investment, although these co-funded actions need better framework conditions ("PPPs are often successful but there have also been some significant failures.") (OECD 2012a, 20). According to ITF (2009), transport projects can be designed to increase their attractiveness to private investors through the insurance of bigger and more reliable flows of revenue as well as broader public banking of projects revenues. This attractiveness could be ensured by "limiting competition among transport facilities, or increasing tolls, or reducing project-specific risk by pooling projects, or remunerating investment on the basis of delivery of capacity rather than on the basis of traffic volumes" and through taxes receipts reduction.

6.6.Tourism

All the scenarios on tourism development in the next 20/30 years foresee a growth of the sector, and therefore a growth of the related mobility. Even in the worst case scenario, UNWTO claims there will be a 20% growth between 2010 and 2030. In the rosiest scenario, international arrivals will double by 2030. Some megatrends studies, which are analysed here, claim that the tourism industry:

- in the long term presents a two-century growth trend;
- is short-term volatile;
- has quick fails and recoveries, mainly according to economic cycles and security issues;
- has doubled between 1980 and 1995 and then again between 1995 and 2010 (despite the oil crisis, terrorist attacks, pandemics etc.)
- is depicted as an urbanized middle-class phenomena: therefore considering an expected increase in urbanized middle-classes in emerging economies, this should lead to more tourism.

Expected challenges and opportunities

- Social and professional changes will affect the travel and tourism market, leading to shorter but more frequent holidays, placing stronger constraints on the travel time budget, and therefore increasing the share of aviation transport (ECT-CET 2006). Additionally, time-constraints lead to easy-to-purchase all-inclusive deals, having a cascade effect on the tourism industry and, naturally, on the transport suppliers, leading to a more consolidated vertical integration. The tourism industry is still massively fragmented, although the past two decades have witnessed merging trends, correlated also to ICT development. Again, this is already influencing the transport suppliers and carriers.
- The tourism industry is also facing, as in the past, a great variety of customers, which reflects new and old social fragmentation and trends. Many of these social trends are discussed under lifestyle changes, although we should here outline an increased gap between time-rich and money-rich customers (ECT-CET 2006). While the first present a shortage of financial resources, the latter have a shortage of time, thus creating *de facto* two markets for the travel and tourism industry. Those different demands raise problems for the transport suppliers, which have to feed two alternative clienteles.

- Some weak signals comes from the so-called post-tourism trends (becoming evident especially in high-quality tourism); here tourists ask for “genuine” and “not-staged” experiences (Urry 2002) and transport carriers have to be able to understand this growing demand. In this vein, some worldwide known tourist destinations base their charm on the lack of car access as well as on a shortage of transport facilities. Like Cinque Terre in Italy and Mont Saint-Michel in France, those destinations are paradoxically popular and highly visited due to their (transport) partial isolation. These examples display the contradiction between the need for well-served and developed infrastructure and the request for remoteness by tourist demand.
- Finally, Europe is witnessing a booming second-house purchase, with a North-South flow, especially by high-end incomes and pensioners. This trend has a number of reasons: i) (relatively) accessible real-estate markets, ii) low-cost journeys, and iii) a layer of population with solid pension income and plenty of time (DG-Internal 2010). Ignoring here wild-cards (like the Icelandic volcano eruption), some studies have pointed out how those conditions could be put under pressure in the next decades, particularly as pensioners face budget limits in the future, and as aviation costs could have unexpected twists.

According to those forecasts, in 2030, Europe should have about 750 million international arrivals (50% growth from 2010), but its share of the worldwide tourist market will drop to from 51% in 2010 to 41% in 2030, perpetuating a decline in its role as experienced in the past 50 years (UNWTO 2011). Additionally, in twenty years’ time, North-East Asia will be the most visited sub-region (at least in terms of international arrivals). As the growth of European tourism as envisioned for 2030 and beyond lying below the world average can be seen as a problem, it is also as an opportunity to bet on high-quality tourism, as aimed for by EU policy-makers in the past decade. As stated, high-quality tourism is openly envisioned by EU documents: this policy can lead to (wealthy) high-end targets, pushing the tourism industry to innovation, and to an environmentally sustainable/social accepted/economically vibrant tourist offer by the EU (ECORYS 2009). At the same time, elite tourism can also open political problems, regarding its internal contradictions about access to common natural and cultural resources.

This does not mean that the European tourist industry has no worries: quite the opposite. Europe will remain a big playground for globetrotters, and to some extent, its variety in language, style and offers is a good selling point, especially if we consider that a multiplicity of experiences is a driving force of travelling. However, this difference among EU countries leads also to a broad variety of legal regulations as well as visa barriers. The strongest barrier remains the EU-27 countries’ lack of coordination in national tourism policies to improve Europe as a whole destination (ECORYS 2009).

7. Future demand for Transport

Projections for future demand for transportation in large time frames, like 20 and 40 years, are available from several sources – international organizations and business companies – as these entities try to assess potential developments in energy consumption, emissions, congestion or business prospects (e.g. Airbus or Boeing) in order to endorse the best strategies to tackle the challenges ahead and shape a sustainable and efficient transport system to future generations.

These projections are usually spread across several scenarios exploring different trends and rates of economic growth and global trade development, demographic evolution and technological changes. More often than not, projections for future travel comes as inputs to model other variables future evolution as referred above but, on the present case, we are looking after these projections aiming to illustrate what the future global demand for passenger and freight transport by Sea, Air and Land - Road and Rail in such large time frames may look like.

7.1. Aviation demand

Passengers

OECD (2009) presents on its own words a "very rough view" of what passenger travel volumes might look in the future. Based on different assumptions on the evolution of global GDP and on how aviation demand responds to different GDP scenarios, ITF proposes four possible evolution scenarios for air travel demand (see Figure 76), estimating it is likely to triple over the next forty years, with projections for 2050 ranging between 12,000 and 18,000 billion pkm (passenger kilometres), from slightly over 5,000 billion pkm today (see Figure 72).

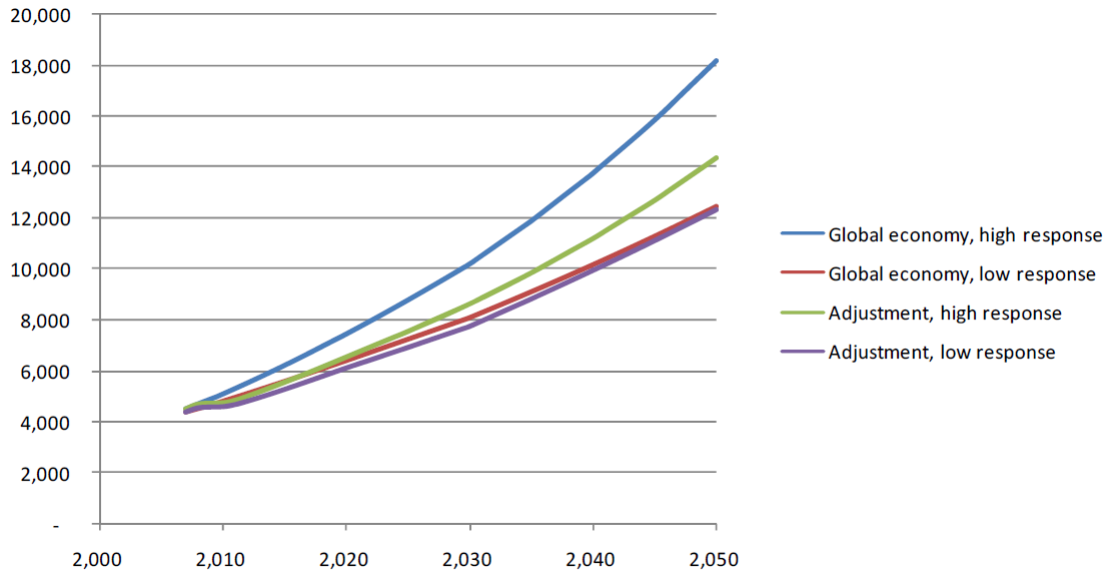

Figure 72- Global aviation volumes in four scenarios [billion pkm] (OECD 2009)

According to these scenarios, projections for air travel demand in twenty years' time stand between 8,000 and 11,000 billion pkm, entailing an average annual growth rate from 2011 to 2031 ranging between 2.4% and 4.0%.

Most OEMs periodically publish their views on future prospects for air travel and fleet development for the next twenty years, publicising quite more optimistic forecasts than the previous one (with Boeing's even more optimistic Airbus). The following analyses rely on the latest edition of Airbus' Global Market Outlook (Airbus 2012).

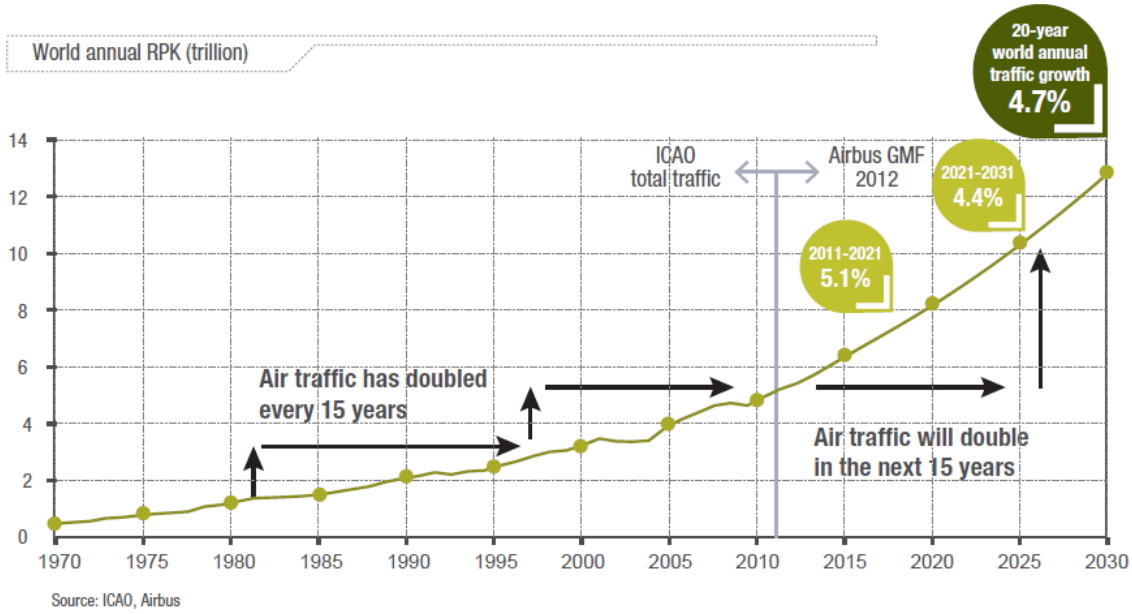

Figure 73- World annual pkm forecasts (Airbus 2012)

Driven by global economic activity - GDP growth, global trade, disposable income, unemployment, etc - the price of travel[41] and developing competition from other modes, passenger air travel is expected to grow at an average annual rate of 4.7% globally (5% on Boeing forecasts), doubling-up in the next 15 years (replicating past evidences – see Figure 77), from just above 5,000 billion pkm in 2011 to 12,800 billion pkm in 2031.

As emerging economies are expected to drive long term economic growth, they will hold the biggest share in future demand growth for air travel, with traffic amongst them expected to grow 6.6% yearly.

The largest flows during the next twenty years are forecasted by Airbus to occur in domestic markets of China PR (with a huge growth potential), North America and Western Europe (Figure 78). The transatlantic route connecting North America and Europe is expected to remain the largest interregional flow, although the market share of advanced – advanced origin – destinations' traffic flows is expected to drop from current 45% to 32%, as emerging – emerging traffic flows will climb from 27% to 38%.

[41] To which it computes an elasticity of -0.6, i.e. a 10% increase in the price of travel yields a 6% drop in demand.

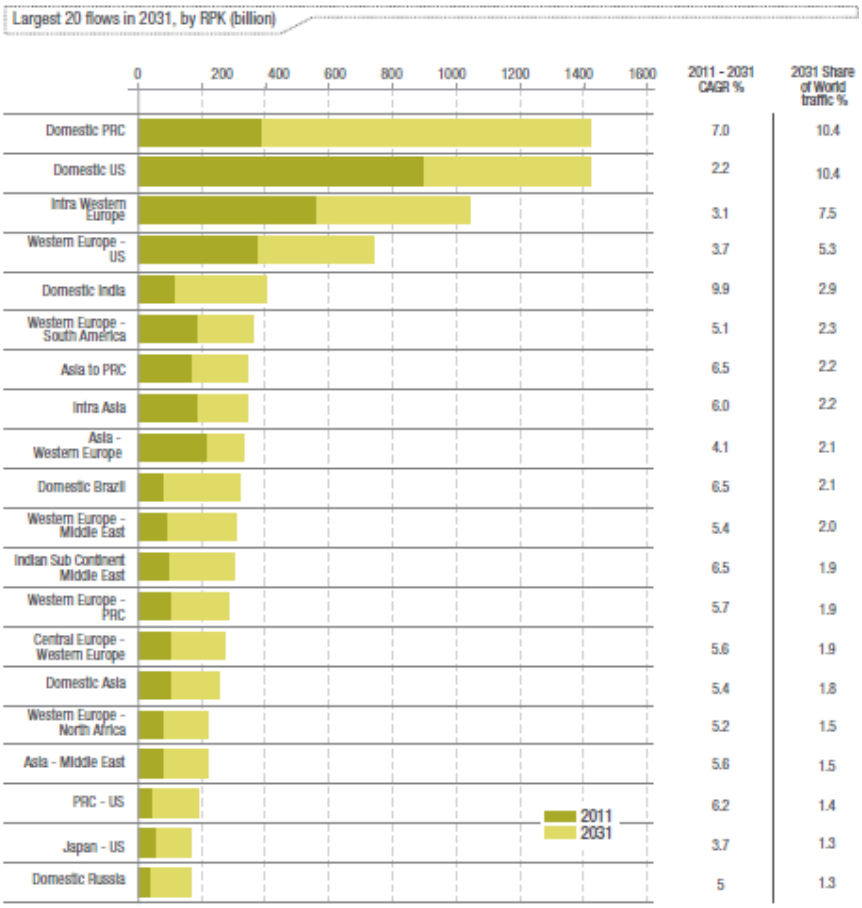

Figure 74- Largest passenger flows in 2011 and 2031 (Airbus 2012)

As result of these developments, Asia Pacific region will hold almost half of top twenty airports in terms of international long haul PKM processed; with Europe and North America equally sharing the other half (see Figure 75).

Figure 75- Top Twenty Airports in 2031 (Airbus 2012)

One of the most important drivers of air freight growth is Foreign Direct Investments Flows. The USA and Europe have historically been the drivers of FDI but nowadays more and more FDI flows are sourcing from emerging economies as China, other Asian countries and the Middle East, which bear the largest growth in outward FDI flows in recent years, as the nature of FDI also develops

from more extractive industries to technological industries and scattered manufacturing, leading to increased transportation demand for components and subsystems between manufacturing facilities.

Globalization patterns that have fuelled past growth - with raising fragmentation and dispersion of supply chains - are meanwhile being questioned by changing relative costs of production - wages, capital costs and energy prices - which might affect trade and transport patterns, with increasing number of business cases pointing out in the direction of shorter supply chains, with direct implications in the air cargo market.

Traffic has grown 5.2% per year since 1980 (Boeing 2012), and is now expected to double by 2031, growing at an average annual rate of 4.9% (Airbus) to 5.3% (Boeing). As in passenger's traffic, the highest growth rates will take place in and between emerging economies.

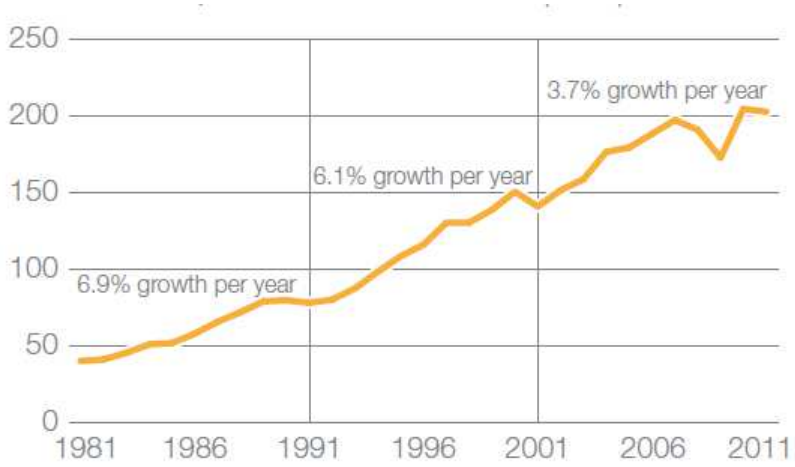

Figure 76 - Actual Traffic [revenue tkm] (Boeing 2012)

These factors are changing the structure of the market (see Figure 77), with intra-Asia flows expected to grow at almost 7% annually, as China overall air trade is expected to grow 8% annually, India domestic travel will show a 8.5% average growth rate, and South Asian air trades with Europe and North America are expected to grow at an annual average rate of 5.8%. North America domestic air freight flows shall grow at 2.3% per year and Intra-European traffic is forecasted to grow at 2.4% annually, while traffics between North America and Europe are expected to grow at 3.5% annually until 2031 (Boeing 2012).

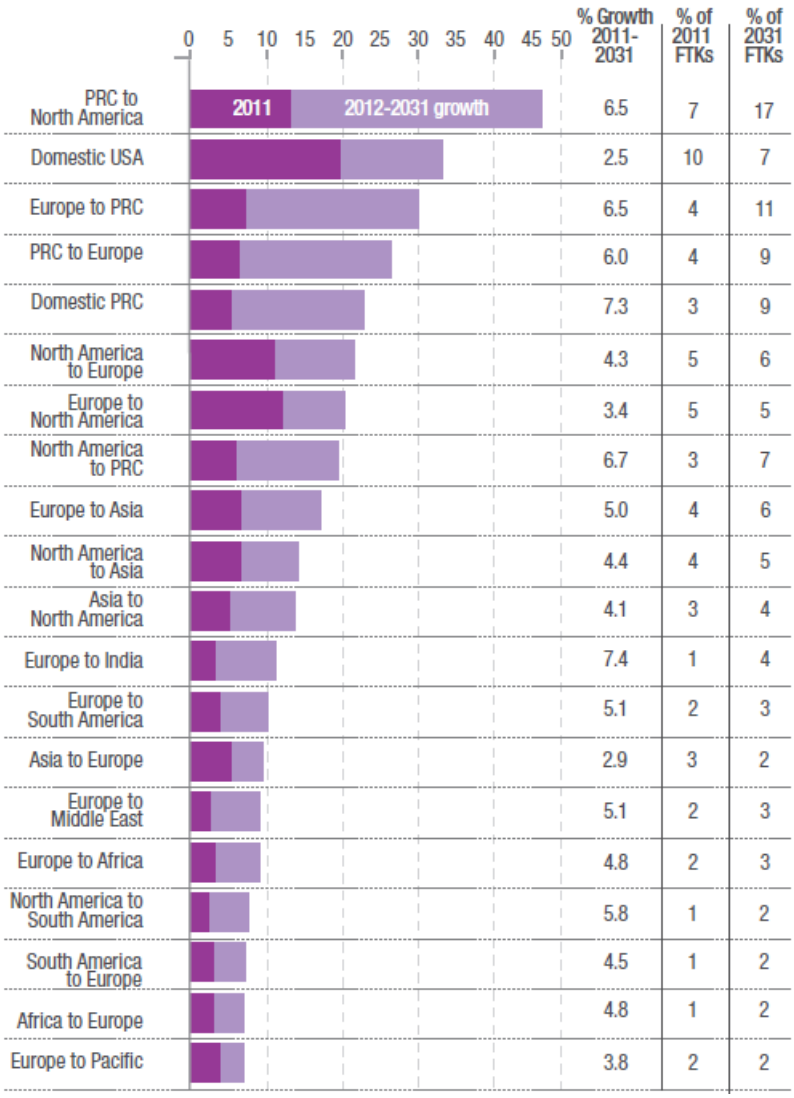

Figure 77 - Largest freight flows in 2011 and 2031 (Airbus 2012)

7.2.Maritime transport

Maritime transport, also referred to as shipping, is tightly linked to international commodity trade and economic activity. Economic mass and trade flows are growing and being redistributed over the world and global sea trade volumes have already surpassed pre-crisis figures as Figure 8 illustrates, displaying a healthy 3.6% average annual growth from 1983 to 2011, and reaching almost 8,750 million tonnes loaded.

IMO (2009) in its second report on future emissions from international shipping presents their projections for future shipping demand by 2020 and 2050, by vessel type and SRES scenarios.

IMO bases its projections model on assumptions of global development put forward by the Intergovernmental Panel on Climate Change (IPCC) on its Special Report on emissions Scenarios

(SRES) storylines[42]. These scenarios oscillate between two dimensions: Globalization vs. Regionalization and Environmental values vs. Economic Values. The report identifies three key driver variables that influence ship emissions up to 2050 as (1) Economy, (2) Transport efficiency and (3) Energy, with values for each variable generated using an open Delphi Process.

Shipping transport demand was modelled (in tonne-miles per year), under the economy driver, based on expectations for economic growth and historical correlations between global GDP growth and demand for sea transport, considering current fleet characteristics[43].

2050	A1B	A1F	A1T	A2	B1	B2
Ocean-going shipping	320	320	320	240	220	180
Coastwise shipping	320	320	320	270	220	220
Container	1230	1230	1230	960	850	690
Average, all ships	540	540	540	421	372	302

Table 27- Tonne.mile (index 100 = 2007) for 2050 from correlation with GDP (table 7.2 from (IMO 2009))

According to this information, future demand for sea transportation could increase 2007 figures by 3 to 5.4 times to 2050, with Container Shipping holding the greatest growth potential – 6.9 to 12.3 times, while Ocean Going Shipping (intercontinental trade) growth potential is projected to reach between 1.8 and 3.2 times 2007 figures and coastwise shipping (regional, short sea shipping) between 2.2 and 3.2 times (Table 27).

But this report goes on stating this approach cannot account for other trends that might influence future demand for Sea transport, as it will also depend on developments in trade / changing trade patterns, location of manufacturing sites, consumption of raw materials and possible new sea routes, as a study about the Japanese maritime industry targets for 2050 produced by the Ocean Policy Research Foundation (OPRF 2008) - a Japanese non-governmental organization for shipbuilding advancement - considers.

In this last study, demand for sea transport is projected towards 2050, based on IPCC A1B Scenario, using also (as IMO's) a correlation with GDP for containerized traffic but addressing other cargo as dry bulk, crude oil, LNG and petroleum production with different parameters evolution such as population or primary energy use. It additionally anticipates and considers future changes in transport patterns and modal shift *e.g.* the widening of the Panama Canal, the commissioning of new pipelines, the modernization of the Siberian Railroad or the development of the Artic sea route, amongst several others. This results in estimates of future tonne-miles travelled by shipping vessels that are somewhat half the ones computed by the method put forward by IMO.

[42] For a summary of each scenarios storyline please refer to Nakicenovic, N., Alcamo, J., Davis, G. and Vries, B.D. 2000. *Special Report on Emissions Scenarios*. Cambridge University Press: Cambridge, UK, or (IMO 2009)

[43] Gains of efficiency due to fleet improvements like technical developments or changes in ship size are only considered afterwards in the analysis, so this analysis can be directly translated into a sea transport tonnes demand index.

2050	A1B	A1F	A1T	A2	B1	B2
Ocean-going shipping	170	170	170	140	150	130
Coastwise shipping	170	170	170	160	150	150
Container	570	570	570	330	380	360
Average, all ships	266	266	266	188	205	187

Table 28- Tonne.mile (index 100 = 2007) for 2050 building on OPRF study (table 7.3 from (IMO 2009))

Acknowledging on the uncertainties regarding each of the approaches, IMO researchers chose to use in their emission computations for the central scenario[44] an average of both, as illustrated in Table 29.

2020	A1B	A1F	A1T	A2	B1	B2
Ocean-going shipping	131	131	131	121	120	114
Coastwise shipping	131	132	131	126	120	120
Container	194	193	195	176	173	165
Average, all ships	146	146	146	135	133	127
2050	**A1B**	**A1F**	**A1T**	**A2**	**B1**	**B2**
Ocean-going shipping	245	245	245	190	185	155
Coastwise shipping	245	250	245	215	185	185
Container	900	875	905	645	615	525
Average, all ships	402	397	403	302	288	247

Table 29- Final tonne.mile (index 100 = 2007) for 2020 and 2050 for emission computations (table 7.4 from (IMO 2009))

Given these last results, and considering an adjustment factor of 1.089[45] to reference these figures from 2007 to 2011 sea trade flows and using a geometrical interpolation between given years, demand for future sea transportation between 2020 and 2050 is projected to fall into the following ranges:

	2020	2030	2040	2050
Ocean-going shipping	105 - 120	116 - 148	129 - 183	142 - 225
Coastwise shipping	110 - 121	127 - 143	147 - 168	170 - 197
Container	152 - 179	223 - 299	328 - 498	482 - 831
Average, all ships	117 - 134	146 - 188	182 - 264	227 - 370

Table 30- Future Sea freight demand range (index 100 = 2007) from 2020 to 2050 (based on Table 29)

The recent "Maritime Outlook towards 2030" by Lloyd's Register (2013), in its central view scenario (*Status Quo*), increases global seaborne trade from today's under 9,000 million tonnes to over 21,000 million tonnes by 2030 (Figure 78). Although Lloyd's Register (2013) highlights the probable evolution of future freight trade (tonnes) and sea-trade routes for major commodities (in terms of origins and destinations), it skips over quantitative observations on future freight travel (tonne.miles). If sea trading routes were to remain stable in this scenario, this expected increase would place the future demand index at around 240 (index 100= 2011), therefore reaching this value at least a decade earlier than expected in the previous projection.

[44] They additionally considered two extreme upper and lower bond scenarios, for each IPCC scenario, large enough to accommodate both views from IMO's GDP correlation and OPRF study.

[45] Derived from UNCTADstat tonnes figures for world seaborne trade.

Figure 78- Major seaborne trade routes in 2010 and 2030 [million tonnes] (figure 17 in (Lloyd's Register 2013))

Yet, Lloyd's Register (2013) prognoses that, as sourcing and consumption location for major commodities (Iron ore, coal, crude and petroleum products, grains) and manufactured products evolves over time, "global seaborne trade will be dominated by Intra-Far East, between Oceania and Far East, Far East and Latin America, and Far East and the Middle East" and that "we will also see the strongest growth within these trade routes with Asia taking centre stage in the global seaborne trade". These changes will probably alter sea transportation average distances, but the implication of these developments in terms of ton.mile production is not plainly addressed in the document.

New shipbuilding deliveries are expected to remain at current levels in twenty years' time, and China and emerging economies (like Brazil, Vietnam, India and Philippines) will be in the forefront of the industry, as South Korea and Japan will lose market share (from 34% to 22% and from 21% to 9-10%, respectively).

In what concerns passenger seaborne transportation, there was no success finding out sources dealing with this subject on the time frames we are looking at. Passenger water transportation serves mainly as part of the public transport systems of many waterside cities and islands, as it allows direct transit between short to medium distance points at a much lower capital cost than bridges or tunnels. Statistics on operation shows divergent realities, with recent demand for this mode increasing in the United States but declining across Europe and China.

Forecast for future evolution of cruising travel demand are available on the short term by Cruise (s.d.), and points to 3.1% yearly increases in passengers carried from 2014 to 2017 in European, North American/Caribbean and emerging markets (see Figure 28). But one must acknowledge that cruise passengers represented only 3% of the total number of passengers in EU-27 ports in 2011, so cruise shipping has a relative small importance in seaborne passenger production of transport.

7.3. Road transportation

Dulac (2013) analyses infrastructural developments in road and rail - and inherent cost estimates – needed to support projected land travel through 2050, based on International Energy Agency (IAE) mobility model (momo). His study broadly considers two evolution scenarios for global

development taken from ETP[46] 2012 – 2DS and 4DS, related to achieving emission targets of 2°c or 4°c increase in average global atmospheric temperatures by 2050, respectively, with 6DS describing a "*business as usual*" – or nothing changes - development (with infrastructural needs roughly similar to 4DS):

- 4DS trajectory unfolds with existing and upcoming policies, including a tightening of fuel economy standards and a slow uptake of advanced vehicle technologies (hybrid, plug in hybrid-electric and battery electric, etc), with transport energy consumption expected to increase by 40% by 2050. Light duty vehicle travel[47] increases nearly 2.5 times in 2050, and total road activity is expected to more than double to 43,000 billion TU.km[48] in this scenario;
- 2DS development is supported on improved vehicle and fuel developments, that lower GHG emissions, improved share of most efficient modes and avoid/shift strategies e.g. virtual mobility and policies promoting innovative solutions as car-pooling, car sharing, BRT systems and HSR, with the objective of cutting transport fuel use and CO_2 emissions significantly by 2050. Total road activity in this scenario is expected to nearly 25% smaller tham in 4DS.

Between 2000 and 2010, road and rail total travel (passengers and freight) grew some 40% or 15,000 billion TU.km and, under 2DS scenario, is projected to climb up additional 35,000 billion pkm and 15,000 billion ton.km until 2050, less 10,000 billion TU.km than if 4DS projections are considered. 90% of anticipated growth is expected to occur in non-OECD countries, with a 75/25 ratio favouring road over rail.

In 4DS scenario road activity - function of car ownership (strongly correlated to income growth) and fuel price - is expected to more than double to 43,000 billion vkm in 2050, as road infrastructure shall grow by 60% (14 million km until 2030 and 11 million afterwards), with China and India responsible for half the expected additions.

Chinese Infrastructure Occupancy Levels (IOL) is expected to grow by 2.5 times to 2050, to over 0.7 million vkm per paved lane.km (roughly 1,900 AADT[49] *per lane*), as Chinese vkm are expected to surpass USAs' by 2025 and double them by 2050, and its vehicle fleet multiplies USA's fleet by 4. India IOL, with half the vehicle ownership of China, will grow 6.5 times to 0.8 million vkm per paved lane.km (2 200 AADT *per lane*) - 1.5 times current USAs' IOL level (1,500 AADT *per lane*). Latin America will keep its struggle to raise capacity, expecting a slight decrease in IOL from over 1.1 million vkm per paved lane.km today to 1 million vkm per paved lane.km by 2050 (2,700 AADT *per lane*) – the largest average occupancy of all. Average global IOL in 2010 was around 0.45 million vkm per paved lane.km (1,200 AADT *per lane*).

The global passenger light duty vehicle (PLDV) stock is expected to more than double to 2050. In terms of parking needs, this translates for an additional demand for almost 50,000 km^2 of parking space (from present 30,000 km^2, 40% of which in China and India.

[46] IEA Energy Technology Perspectives - Pathways to a Clean Energy System, 690 pages, 2012

[47] Usually measured in vehicle.kilometres (vkm).

[48] TU.km stands here for Traffic Units, as the sum of pkm and tkm.

[49] AADT – annual average daily traffic.

The 2DS scenario expects less 9,000 billion vkm (road activity) in 2050, compared to 4DS scenario, and road paved infrastructure will only grow 14.8 million km in the period, 60% of them in China and India. Infrastructure occupancy levels (IOL), as compared to levels estimated for 4DS scenario, will be less 20% in China, less 15% in India and less 5% in LAC, Africa and Middle East countries. The PLDV fleet is only expected to double in this scenario, which means less 500 million passenger vehicles and further parking space needs will reduce accordingly to additional 23,000 km^2 (8,000 km^2 in China and India) while North America shall witness a decrease in parking space of around 6,000 km^2.

Another recent report on "Global Transportation Scenarios for 2050" by the World Energy Council (2011) places current light duty vehicle global fleet in circulation in 802 million vehicles, with over 70% of the global fleet based in developed OECD countries (see Table 31).

OECD EU	228
USA	211
Japan	58
Russia	29
Other Asia	26
Brazil	24
non-OECD EU	18
Canada	17
Africa	15
Middle East	15
Mexico	15
Oceania	15
China	14
Argentina	8
India	7
Chile	3
others	100
total	802

Table 31- Personal light duty vehicle fleet - based on (WEC 2011) and WorldBank

On this report, the future evolution of light duty vehicles (LDV) in circulation to 2050 is framed on to two distinct transport development scenarios – Freeway, where pure market prevails, or Tollway, describing a more regulated world with intervening governments (see Table 33). Under these projections, global LDV fleet is expected to grow between 2.2 and 2.6 times, according to the development scenario considered, to a value between 1766 and 2086 million LDV. According to Sousanis (2011), this figure surpassed 1 billion already by 2010.

Region	2005 Fleet	2050 Fleet	
		Tollway	Freeway
OECD	572	778	807
non-OECD	230	987	1279
Total	802	1766	2086

Table 32- Personal light duty vehicle fleet by 2050 [millions] - based on (WEC 2011)[50]

[50] As referred in 3.2., the number of Chinese registered passenger cars increased threefold to 46 million by 2009.

A particular attention is given on Dulac's report to Bus Rapid Transit (BRT) networks. This kind of public road transportation system has grown to 2,200 trunk km in 2011 – more than half on non-OECD countries – and additional 1,200 km are planned or proposed until 2025, although not completely certain. In the 4DS scenario this network is expected to raise only to 2,800 km which means these systems, maintaining present ridership levels, will be responsible for less than 0.5% of total bus travel in 2050 (roughly 40 billion pass.km). These figures are rather different in the 2DS scenario, as promotion of this kind of mobility solutions will push over 24,000 trunk km to existing 2,200 km, and travel levels might reach 700 billion pkm (5% of total bus travel).

From what is stated above, one can derive that global demand for BUS services in 2050 is expected to be between 8,000 billion pkm (4DS) and 14,000 billion pkm (2DS). According to data available on passenger transport in ITF[51], demand for bus and coaches in OECD countries and some European former communist countries was 1,630 billion pkm in 2008. However, this number doesn't include Africa, LATAM, China, India or Southeast Asia. Data for India pointed to 2,330 billion pkm in 2000-01 and is expected to develop to 5,608 in 2030 (S. K. Singh 2006). Available data for intercity transport demand in China places current demand levels at 1,460 in 2010 to nearly 3,200 in 2030 (Ma, et al. 2012), while data for Latin America places BUS transport production at 20 billion vkm and 341 billion pkm which roughly places current demand levels clearly above 5,750 billion pass.km.

7.4. Rail transportation

Global rail travel is expected to grow to nearly 23,000 billion TU.km annually by 2050, from today's 12,000 billion TU.km. While significant roadway additions are needed to accommodate passengers and freight demand growth, considerable fewer shall be needed if the railway is to be the mode chosen, since only 335,000 additional track.km (30% current network) are deemed necessary to fulfil this demand, 10% of which are already underway in several HSR undertakings, 25% are due in China and India, and 56% in OECD North America, OECD Europe, Russia and LATAM.

Despite the recent rush in Chinese HSR network development (see chapter 3.1.4), the global rail network is not expected to grow rapidly in the near future, as only additional 7,500 km are expected by 2025, and another additional, but highly uncertain, 14,000 km are proposed beyond 2015 – namely in Iran, Turkey, Morocco, Brazil, Argentina and USA. Considering present 16,000 km plus 7,500 km under construction and additional 14,000 km planned or proposed until 2025 places future HSR network length in 37,000 km by 2025.

According to Dulac (2013), the total global HSR network length expected by 2030 in the 4DS scenario is 44,000 km, with 60% of its growth expected in China and almost everything else in France and Spain, with only minor increments expected thereafter. No HSR tracks are considered for North America and most non-OECD regions (including Africa, ASEAN and CIS) in this scenario. HRS stands for only 4% of global rail network in 2030 and 3% in 2050, while 2025s' 1,000 billion HSR pkm stands for one fifth of global rail travel projected

[51] http://stats.oecd.org/Index.aspx?QueryId=23180

In the 2DS scenario rail travel in 2050 shall surpass 30,000 billion TU.km, pilling additional 200,000 track.km requirements to 4DS scenario expectations, while rail occupancy is expected to be 10% higher. HSR is believed to reach 4,000 billion pkm (35% of global rail 11,400 billion pass.km), requiring additional 90,000 km of HSR tracks (if current intensity levels on HSR services remains unchanged) which, large as it can be, is however in line with total HSR planning announcements (official or conceptual) so far.

According to Thompson (2010) on its "Vision for railways in 2050", both global passenger and freight travel by rail are expected to more than double by 2050, with global production of pkm growing 2.6 times and ton.km 2.2 times. Although Rail has been growing its travel activity over the last decades, it has also been showing an almost uniform loss of market share to other modes, with the exception of freight movements in the USA, following the rail freight deregulation act (the Staggers Act).

Almost 90% of current rail traffic in the world (passengers and freight) can be found in only six networks – North America (mainly freight), China, India, Russia, Japan (mainly passengers) and Eu-25, and this fact shouldn't change significantly in the projection horizon.

Rail traffic projections by Thomson assumes that the current worldwide recession will end with return to economic growth and hold considerable growth expectations for rail travel (to over 26,500 billion TU.km annually in 2050), which are consistent with the enormous rail investments under way – US$200 billion by 2020 in China, a separate heavy haul system for India, TEN-T in Europe, Russia or USA (where investments in HSR have potential to multiply by 3 or more current pass.km) and future expected improvements in railway energy efficiency – expansion of electric traction and innovations in signalling, automation, enhanced communications, GPS systems use and regulatory policies.

As shown in Table 33, in terms of passenger traffic, India and China are responsible for over half the production of rail pkm in the world, followed in importance by Europe and Japan.

country	year /	pass.km x 10^9	Percent world total	CAGR 2010-2050	2050 10^9 pass.km	% growth 2010 - 2050
India	2007	770	30.9%	3.1%	1 877	237.2
China	2005	583	23.4%	3.2%	2 071	252.4
EU 15	2005	327	13.1%	1.2%	543	60.5
Japan	2007	310	12.4%	1.5%	504	82.1
Russia	2005	172	6.9%	2.1%	466	132.4
EU 10	2005	45	1.8%	2.1%	174	130.2
N. America	2005	12	0.5%	1.1%	82	57.7
All Other	*most recent*	276	11.1%	2.1%	786	185.1
World Total	-	**2 495**	**100%**	**2.4%**	**6 505**	**160.7**

Table 33- Passenger traffic activity rankings [Pkm 10^9], based on (Thompson 2010)

China is expected to sustain the largest growth in passenger rail travel between 2010 and 2050, with demand growing over 2.5 times in this period, which shall establish the Chinese domestic passenger rail market as the largest in the world by 2050 with a 32% market share – 2,071 billion pkm annually, followed by India with 1,087 billion pkm annually and EU25 with 717 billion pkm in

2050. This last figure is quite short of the ERRAC vision for passenger rail traffic in Europe by 2050 – 1,650 billion pkm and an increase in modal share from 7.6% to 15.3% (ERRAC 2012).

The world's railways carry about 3.5 times as many net tonne.km as passenger.km[52], with freight movements by rail being strongly influenced by geography, as it requires large expanses as in Russia, USA and India to be a viable mode.

country	year /	ton.km x 10^9	Percent world total	CAGR 2010-2050	2050 10^9 ton.km	% growth 2010 - 2050
N. America	2005	2 997	33.9%	1.7%	5 514	93.2
China	2005	1 935	21.9%	3.3%	6 472	261.1
Russia	2005	1 858	21.0%	2.3%	3 618	145.9
India	2007	481	5.4%	3.3%	1 524	271.7
EU 15	2005	244	2.8%	1.0%	393	46.5
EU 10	2005	143	1.6%	2.6%	457	181.9
Japan	2007	23	0.3%	1.2%	280	62.9
All Other	*most recent*	1 165	13.2%	2.0%	1 800	54.5
World Total	-	**8 845**	**100%**	**2.1%**	**20 059**	**126.8**

Table 34- Freight traffic activity rankings [ton.km 10^9], based on (Thompson 2010)

As stated by Thompson (2010) North America, with approximately 3,000 billion ton.km in 2005, is home to almost 34% of present global rail ton.km, followed at some distance by China and Russia with less 1,000 billion Ton.km yearly; India lags behind in fourth with only a quarter of Chinese rail freight activity, followed by European network(s) (see Table 34).

As China Government continues to invest in its infrastructure to stimulate its economy, namely with its "Great Western Development Strategy", Chinese rail will expectedly overtake North America and become the largest producer of rail freight transportation by 2050, with 6,472 against North Americans' 5,512 annual billion ton.km, thanks to a averaged annualized growth rate of 3.3% during the next 40 years, a performance only exceeded by India, which is projected to grow over 2.7 times until 2050 to reach an annual figure of 1,524 billion ton.km. European rail freight is projected to grow 2.2 times to over 850 billion ton.km produced in 2050, in line with projections by other sources as Freightvision (2010) optimistic views, with scenarios 3 (supporting similar ton.km growth to rail and road) and 4 (strong rail growth and no growth in road) framing a 785 – 942 billion ton.km interval. Even so, other projection sources places this figure quite higher, as Transvisions (2009) pointing at 1,222 billion ton.km and ERRAC (2012) doubling it to just under 1,600 billion ton.km in 2050.

7.5.Main findings

In view of the above, the next table synthesizes the main findings of the bibliographic research carried out specifically for this chapter.

[52] Which in turn requires twice the energy consumption of a ton.km to travel the same distance, in very rough terms, as passengers travel faster, and energy consumption growths in a quadratic rate to speed.

		2030	2050
Aviation	Pax	160 - 220	240 - 360
	Freight	237 - 253	-
Waterbourne	Pax	-	-
	Freight	146 - 188	227 - 370
Rail	Pax	-	219 - 286
	Freight	-	180 - 240
Road	Private Car	-	More than Double
	Bus&Coach		
	Freight		

Table 35 – Expected evolution of transport demand by mode by different sources (index 100 = 2010)

These values represent a high level view on what current foresight studies indicate for future transportation demand growth. This range of figures set out clearly that current expectations for demand growth are of a very significant increase over the next 3 to 4 decades.

8. RACE2050 basics

Project acronym	RACE2050
Project title	Responsible innovation Agenda for Competitive European transport industries up to 2050
Call identifier	FP7-TPT-2012-RTD-1 [Prospects for transport evolution: challenges for the competitiveness of the European transport sector in the long term]
Grant Agreement no.	314753
Starting date	01/09/2012
End date	28/02/2015
Funding Scheme	Coordination and support action

RACE2050 consortium partners are:

Partner acronym	Partner name	Logo
TUB	TU Berlin, Zentrum Technik und Gesellschaft, Berlin, Germany	
RCAB	Ritchey Consulting AB, Stockholm, Sweden	
ZHAW	Zurcher Hochschule für Angewandte Wissenschaften, Zurich, Switzerland	
ICTAF	Interdisciplinary Center for Technological Analysis and Forecasting, Tel Aviv, Israel	
TOI	Transportokonomist Institutt, Oslo, Norway	
VTM	VTM Consultores em Engenharia e Planeamento Lda, Lisbon, Portugal	

9. Deliverable basics

Deliverable no.	D.XX
Document name	RACE2050D5.1FINAL
Deliverable name	Current transport demand and global transport outlook
Work Package	WP5
Nature	Report
Dissemination	Public
Editor	Miguel Sena e Silva
Contributors	Miguel Sena e Silva, Mónica Oliveira, Nuno Soares Ribeiro, Massimo Moraglio, Johanna Ludvigsen, Andreas Christ, Tiina-Maria Seppänen, Merja Hoppe, Aharon Hauptman, Yoel Raban and Roey Tzezana.
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11. List of tables

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