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Transport for Sustainable Development

The case of inland transport

DRAFT

February 2015

INTERNATIONAL UNION
OF RAILWAYS

International
Road Transport
Union

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List of Acronyms

Acronym	Definition
ACG	European Agreement on Main International Railway Lines
ADB	Asian Development Bank
ADN	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
AEGPL	European Association of Liquid Petroleum Gases
AGC	European Agreement on Main International Railway Lines
AGN	European Agreement on Main Inland Waterways of International Importance
AGR	European Agreement on Main International Traffic Arteries
AGTC	European Agreement on Important International Combined Transport Lines and Related Installations

Acronym	Definition
ASEAN	Association of South East Asian Nations
ATP	The Agreement on the International Carriage of Perishable Foodstuffs and on the Special Equipment to be Used for such Carriage
AU	African Union
AUC	African Union Commission
CDIAC	Carbon Dioxide Information Analysis Centre
CDM	Clean Development Mechanism
CECI	Committee on Economic Competition and Innovation
CEFACT	The United Nations Centre for Trade Facilitation and Electronic Business
CEVNI	European Code for Inland Waterways
CNG	Compressed Natural Gas
COSIPLAN	South American Council of Infrastructure and Planning
CTU code	Code of Practice for Packing of Cargo Transport Units
DESA	The United Nations Department of Economic and Social Affairs
DGSA	Dangerous goods safety advisors
EATL	Euro-Asian Transport Links
ECA	United Nations Economic Commission for Africa
ECE	United Nations Economic Commission for Europe
ECLAC	United Nations Economic Commission for Latin America and the Caribbean
ECO	Economic Cooperation Organization
ECOSOC	United Nations Economic and Social Council
EDIFACT	United Nations Electronic Data Interchange for Administration, Commerce and Transport
EEA	European Environmental Agency
EIA	United States of America Energy Information Administration
EIGA	European Industrial Gases Association
ERA	European Railway Agency
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
ESCWA	United Nations Economic and Social Commission for Western Asia
ETS	Emissions Trading Scheme
EU	European Union
ForFITS	For Future Inland Transport Systems
GCC	Gulf Cooperation Council

Acronym	Definition
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GPL	Liquid Petroleum Gases
GPST	Global Partnership for Sustainable Transport
HDI	Human Development Index
HICP	Harmonized Index of Consumer Prices
ICAO	International Civil Aviation Organization
IDEP	UNECA African Institute for Economic Development and Planning
IEA	International Energy Agency
IIRSA	The Initiative for the Integration of Regional Infrastructure in South America
ILO	International Labour Organization
IMDG Code	International Maritime Dangerous Goods Code
IMF	International Monetary Fund
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
IRTAD	The International Traffic Safety Data and Analysis Group
IRU	International Road Transport Union
ISPS	International Ship and Port Facility Security
ITC	UNECE Inland Transport Committee
ITF	International Transport Federation
ITSAM	Integrated Transport System in the Arab Mashreq
IWGLTS	International Working Group on Land Transport Security
IWT	Inland waterway transport
LAIA	Latin American Integration Association
LANDSEC	EU Experts Advisory Group on Land Transport Security
LAS	League of Arab States
LDC	Least developed countries
LLDC	Land-locked developing countries
LPI	World Banks's Logistics Performance Index
MDG	Millennium Development Goals
MERCOSUR	Common Market of the South
MFAG	Medical First Aid Guide for Use in Accidents involving Dangerous Goods
NHTSA	United States of America, the Department of Transportation, National

Acronym	Definition
	Highway Traffic Safety Administration
OECD	Organization for Economic Cooperation and Development
OTIF	Intergovernmental Organization for International Carriage by Rail
PEP	The Pan-European Programme on Transport, Health and Environment
PIDA	Programme for Infrastructure Development in Africa
RAI	Rural Access Index
RCP	Representative Concentration Pathways
RICAM	International Network of Mesoamerican Highways
RID	Regulations concerning the International Carriage of Dangerous Goods by Rail
RSSB	Rail Safety and Standards Board
SADC	Southern African Developing Community
SAFE	Framework of Standards to Secure and Facilitate Global Trade
SC.1	UNECE Working Party Road Transport
SC.2	UNECE Working Party on Rail Transport
SDG	Sustainable Development Goals
SEFA	European Association of Steel Drum Manufacturers
SIECA	Secretariat for Central American Economic Integration
SIGNI	Technical requirements for the construction of inland navigation vessels, Signs and Signals on Inland Waterways
SOLAS	International Convention for the Safety of Life at Sea
SPECA	Special Programme for the Economies of Central Asia
SRES	Special Report on Emissions Scenarios
SSATP	Sub-Saharan African Transport Policy Programme
TAH	Trans-African Highways
TAPA	Transport Asset Protection Association
TBCPWG	Transport Infrastructure and Border Crossing Facilitation Project Working Group
TEM	Trans European Motorways project
TEN-T	Trans-European Transport Network project
TER	Trans European Railways project
TFEU	Treaty on the Functioning of the European Union
TIR	Customs Convention on the International Transport of Goods under Cover of TIR Carnets
TOD	Transit-Oriented Development

Acronym	Definition
TOE	Tons of Oil Equivalent
C-TPAT	Customs Trade Partnership Against Terrorism
TSA	United States of America Transportation Security Administration
UIC	International Union of Railways
UIRR	International Union of Combined Road/Rail Transport Companies
UITP	International Association of Public Transport
UNASUR	Union of South American Nations
UNCED	United Nations Conference on Environment and Development
UNCTAD	United Nations Conference on Trade and Development
UNDA	United Nations Development Account
UNDP	United Nations Development Program
UNDPI	United Nations Department of Public Information
UNECA	United Nations Economic Commission for Africa
UNECE	United Nations Economic Commission for Europe
UNECLAC	United Nations Economic Commission for Latin America and the Caribbean
UNEP	United Nations Environment Program
UNESCAP	United Nations Economic and Social Commission for the Asian and the Pacific
UNESCWA	United Nations Economic and Social Commission for Western Africa
UNLK	UN Layout Key for Trade Documents
UNTDED	UN Trade Data Elements Directory
WCED	World Commission on Environment and Development
WCO	World Customs Organization
WHO	World Health Organization
WP.1	UNECE Working Party on the Transport of Perishable Foodstuffs
WP.11	UNECE Working Party on the Transport of Perishable Foodstuffs
WP.29	UNECE World Forum for Harmonization of Vehicle Regulations
WTO	World Trade Organization

Executive Summary

Transport is essential for the economic and social development of all countries as well as for supporting regional and global cooperation and economies. Historically, the development of a countries transport sector has been an indicator for its economic welfare and success. Adequate, efficient, and effective inland transport systems are important for access to markets, employment, education and basic services critical to poverty alleviation; at the same time, transportation is a major driving force behind a growing world demand for energy and it has a significant environmental footprint.

Transport sustainability is controlled by socio-economic, demographic and environmental megatrends, i.e. major shifts in economic, social and environmental conditions that can impact people at all levels and transform societies. The present economic growth, which has been associated with a 'reversed' geographical fragmentation of production, has created particular transport patterns such as increasing transport volumes mostly in the non-OECD regions. At the same time, the significant changes in global population size, age structure, household size and urbanization expected for the 21st century may have substantial implications for inland transport, in terms of transport patterns, energy use and Greenhouse Gas (GHG) emissions. These will be further complicated by the mounting effects of climate change and variability on the transport infrastructure and services.

As a crosscutting sector, transport will play an important role in efforts towards achievement of post-2015 sustainable development goals. As such, inland transport systems must be enablers of sustainable development, not obstacles in its path. Therefore, integrated approaches to policy making should be promoted, including policies/planning for land use, infrastructure development, public transport systems and goods delivery networks, with a view to providing affordable, efficient, safe and secure transportation, increasing energy efficiency, and reducing pollution and congestion effects. In this study, the impact of transport on social, economic and environmental sustainability of development worldwide is assessed through insight into the current status across the five dimensions of sustainable transport – access (to mobility of individuals and for societies), affordability (of transport for individuals and society), safety, security and environmental impact (of transport and on transport).

Accessibility - In transport, accessibility refers to the peoples' ability to reach goods, services, activities and destinations from a given location, using the available transportation system. Many factors affect accessibility, including the transport needs and abilities of individuals, the quality of the transport options, the connectivity of the various links and modes, the land use patterns, and the quality/costs of alternative solutions. Transport accessibility has large impacts on both the economy and human development, as improved accessibility to transport can facilitate the achievement of many economic, social and environmental objectives. Rural accessibility is a challenge in all regions; nearly one billion people worldwide still lack adequate access to road networks, living more than two kilometres from an all-weather road. Fast urbanization, increasing congestion and insufficient access to public transportation in many areas call for a redesigning of urban mobility conditions, with emphasis towards facilitating infrastructure for more

environmentally friendly modes like walking and cycling, and vulnerable groups such as children, persons with reduced mobility and the growing global elderly population.

International transport links are the most important facilitator of global trade and a prerequisite for economic development. Participation in global supply chains is essential for attracting foreign investment and enterprises as well as human capital. In many areas it is hampered by underdeveloped international transport links which undermine national and regional competitiveness. Foreign trade is especially important for small, land-locked and sea-locked economies, which are also dependent on hinterland and/or sea connections and border crossings. Emerging land- and sea-locked economies require particular attention, as their geography constrains trade and economic development. Inefficient border crossings reduce the efficiency of global trade, and are a particular challenge in parts of South-eastern Europe, the Caucasus, the Central and East Asia, countries of the ESCWA region and Africa.

Affordability - Transport costs money and, thus, transport accessibility is controlled by the costs (and returns) of the passenger and freight transport services as well as by the sustainability of the investments associated with the up-grading and/or the planning and construction of transportation infrastructure. Transport affordability refers to the financial ability of people and societies to access adequate transport services without compromising their ability to purchase other basic goods and services, such as food, housing, education and health. It can be assessed under several perspectives, e.g. the level of private motorization, the costs of owning, driving and parking private vehicles as well as the quality and cost of alternative transport modes such as public transport and cycling. High income inequalities are an issue present in all regions, and low income groups, which spend a high proportion of their income on transport, are especially dependant on the availability of affordable public transport. At the same time, in the present global economic climate, national and local government capacities to offer affordable public transport are diminished by a lack of availability of public funds.

All available trends and projections relating to passenger and freight volumes suggest a strong future growth particularly in the non-OECD (Organization for Economic Cooperation and Development) regions (see Chapter 2). The expected growth in freight and passenger transport will require the planning and construction of new transportation infrastructure as well as the establishment of sustainable funding mechanisms for the transport sector. Efficient, safe and environmentally sustainable transport infrastructure is expensive and, despite recent improvements, transport networks in many regions still suffer from the under-investment of the previous decades. At the same time, infrastructure development is generally planned and financed within national budgets and under macro-economic constraints, being in competition with other needs such as education, health, housing or security. The 2008 financial crisis and its aftermath have increased pressures on national budgets and reduced public funding for transport infrastructure development, increasing the importance of private sector funding flows (as well as hybrid financing through public private partnerships), and warranting more rigorous project feasibility assessment.

Safety -Transport related injuries are a major social, economic, development and public health problem. Developing countries and economies in transition bear the majority of this burden so

that inland transport accidents are a development issue that disproportionately affects the poor in low and middle-income countries. Globally, well over a million people are killed annually in road traffic accidents causing, in addition, to human loss and suffering, billions of dollars of associated costs which, in some countries, amount to 1-3 % of the GDP. Underreporting and insufficient global harmonization of statistics is an obstacle to improved insight into transport safety challenges, the first step in efforts to develop solutions.

Road safety depends on driver behaviour, infrastructure quality and vehicle safety, and improvements can be achieved only by considering all these contributing factors and through adequate legislation modelled to respond to local circumstances. In order to break the cycle of increased casualties, road safety and vehicle safety legislation, standards, management and programmes need to be strengthened, with special attention to vulnerable road users (motorcycles, bicycles, pedestrians). The main precursors to railway accidents remain level crossing incidents along with high worldwide trespassing rates on railway infrastructure leading to fatalities. Certain parts of Africa and Asia are suffering from a high rate of accidents on internal waterways involving commuters, often resulting for vessel overloading, poor construction and a lack of appropriate safety measures and their enforcement. Safety in transport of dangerous goods is a special focus area and deserves more attention as it presents severe risks for the population in general, property and the environment.

Security -The notion of transport security encompasses acts ranging from ordinary infliction of damage and everyday delinquency to highly orchestrated acts of terrorism directed towards transport systems and facilitating infrastructure, and passenger and freight vehicles. Due to their open areas, inland transport systems are relatively unprotected from security threats in comparison with ports and airports. Transport related crime rates are high in many parts of the world, while analytical and statistical data on the phenomena needs to be strengthened in many others. A high volume of cross-border transport related crime in certain regions calls for a strengthening of international cooperation and coordination of responsive actions.

Transport systems stakeholders, from the public and private sector, must, in cooperation with state security services, work to establish national, regional and international frameworks that can ensure security of persons, infrastructure and freight, having in mind that the economic cost of transport crime must not be overlooked and that security systems in place should not interfere with the efficiency of operations and the movement of persons and freight within and across transport modes. In taking actions to guarantee such collective security, the stakeholders involved must safeguard personal freedoms of individuals.

Environmental impact - Transport can affect or be affected by the environment in many ways and at different spatio-temporal scales. Inland transport requires infrastructure, the construction of which could involve extensive land-use and, consequently, potential loss of natural habitat. Transport also requires energy. Unfortunately many of the most popular transport modes, despite energy efficiency improvements, depend on increasing amounts of non-renewable energy sources, which contribute to the emission of greenhouse gases that severely affect the environment at the global level. Air pollutants from transport (nitrogen oxides, particles, carbon monoxide and hydrocarbons) reduce air quality and can have damaging (local) impacts on human health and

ecosystems. Moreover, transport produces noise, which can also have significant implications for human health, particularly in urban agglomerations, and ecosystem services. Keeping vehicles environmentally friendly throughout their lifetime and adjusting to a more environmentally acceptable transport modal split are key challenges today across the world.

Transport is not only a major contributor to the observed carbon emission growth and, thus, a probable contributor to climate change, but it is also a 'victim' of the effects climate change and extreme weather events which can have a range of diverse impacts on transport infrastructure and services. These impacts will vary significantly by mode, climate change factor, and will depend on the local or regional circumstances and vulnerabilities, including those associated with the natural environment, as well as a broad range of socio-economic factors.

The way forward

Sustainable transport is safe, high-quality, and accessible to all, ecologically sound, economically viable, and a positive contributor to local, national and international sustainable development. Specific goals for sustainable transport may include: improved service quality and quality of access to goods and services, decreased inland transport related accident and crime rates, improved air quality, noise reduction, improved water quality, protection of natural habitat and open space, historic preservation, reduced carbon emissions, increased social equity, economic development, and a satisfying quality of life, as well as local goals consistent with the overall objective.

Economic, social and environmental sustainability can only be achieved through an integrated inland transport system. When water, road and rail transport work together, the comparative advantage of each mode can be exploited optimally. Integration of transport systems is a complex task with many dimensions. The optimal modal split of freight and passenger transport depends on countries geographic, demographic, economic and historic conditions. Cooperation across transport modes, regions and borders as well as between public and private operators is needed.

Creating an efficient integrated transport network requires international collaboration. United Nations Regional Economic and Social Commissions provide intergovernmental cooperation platforms and address the sustainability of transport, across its five key areas – accessibility, affordability, safety, security, environmental impact - through a variety of legal instruments, analytical work and technical assistance, as well as through governance structures, i.e. Working Parties. By the beginning of 2015 a total of 1,701 national signatures were placed, by countries from six continents, on the 56 UN Legal Instruments on Transport serviced by the UNECE. Continued and strengthened international cooperation through the UN platform will be an important step in securing a future transport sector that strongly contributes to the attainment of sustainable development goals.

1. Sustainable development and Transport

Sustainable development has been hindered by a widely-held notion that development can be primarily defined as economic growth; this has been the framework used for many years by developed countries to achieve their current levels of wealth and it seems that major developing economies are set to follow a similar course. The problem with such an approach is that (a) economic growth does not necessarily guarantee social equity and (b) natural resources are exhaustible, both in terms of quality (e.g. environmental pollution) and supply (e.g. oil/gas reserves) (Drexhage and Murphy, 2010).

1.1 Sustainable development

The World Commission on Environment and Development (WCED) report 'Our Common Future' *(*1987) provides the 'classic' definition of sustainable development[1] as '*…the development which meets the needs of the present without compromising the ability of future generations to meet their own needs*' (WCED, 1987). Acceptance of the report by the United Nations General Assembly gave the term political salience and, in 1992, leaders set out the principles of sustainable development at the UN Conference on Environment and Development (UNCED) in Rio de Janeiro (Brazil), also referred to as the *Rio Summit* or the *Earth Summit*.

Sustainable development is a fluid concept (see e.g. DESA, 2013). Nevertheless, despite ongoing discussions on its exact meaning, certain fundamental principles have emerged in the past decades (Drexhage and Murphy, 2010): (i) a commitment that decisions should consider equity and fairness and account for the rights of future generations; (ii) there should be a long-term view that emphasizes the precautionary principle, i.e. "*where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation*"[2] and (iii) sustainable development involves understanding and acting on the complex interconnections between its three pillars, i.e. the economy, society and the environment.

Acting on the complex interconnections between the economy, society and the environment should not take place as a balancing act; instead, there is an apparent need for convergence between the three pillars of sustainable development, i.e. the economic development, social

[1] The framework for sustainable development evolved between early seventies and early nineties in many international conferences and initiatives. The 1972 UN Conference on the Human Environment (Stockholm, Sweden) led to the establishment of the UN Environment Programme (UNEP) and numerous national environmental protection agencies. Stockholm's recommendations were further considered in the 1980 World Conservation Strategy (e.g. Talbot, 1980), a collaboration between the International Union for the Conservation of Nature (IUCN), the World Wildlife Fund (WWF), and UNEP, which aimed at prioritising conservation issues and defining key policy options. In 1983, United Nations convened the World Commission on Environment and Development (WCED), comprised of representatives from developed and developing countries and chaired by the Norwegian Prime Minister Gro Harlem Brundtland, to address growing concerns over the *'accelerating deterioration of the human environment and natural resources and the consequences of that deterioration for economic and social development*'; in 1987, the Commission produced its landmark report '*Our Common Future',* also known as 'the Brundtland report', see http://www.un-documents.net/our-common-future.pdf.

[2] Principle 15 of the Rio Declaration on Environment and Development (Annex I), of The United Nations Conference on Environment and Development (Rio de Janeiro, 1992) http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm.

equity and environmental health/sustainability; moreover, sustainable development should aim at inter- and intra-generational distributional justice, i.e. should aim at the well-being of both the current and future generations of the whole global population.

Presently, all three sustainable development pillars (economic, social and environmental) face great challenges; more than 1 billion people are still living in extreme poverty, income inequality within and amongst many countries has been rising and unsustainable consumption/production patterns have resulted in increasing environmental degradation and dwindling natural resources (DESA, 2013).

1.2 Sustainable transport

Transport is essential for the economic and social development of all countries as well as for supporting regional and global cooperation and economies. Historically, the development of a countries transport sector has been an indicator for its economic welfare and success. The direct value added by the transport sector to global GDP is about 3-5 per cent, and transport typically provides 5-8 per cent of average national total paid employment.

Between 1950 and 1990, the number of motorized vehicles in the world grew by roughly nine times, from about 75 million to 675 million. During the same period, the world population doubled, from about 2.55 billion to near 5.25 billion. The United Nations Department of Economic and Social Affairs (DESA) estimates that the global population will increase by more than 2.5 billion during the next 35 years reaching over 9.5 billion inhabitants in 2050. Population growth, coupled with continuing globalization and trade liberalization, is expected to accelerate demand for transportation of both people and goods. The ever increasing movement of people and goods has resulted in transport becoming instrumental to many economic and social functions and, thus, one of the controls of sustainable development.

Principles of development (increasing well-being and equity) as well as sustainability (preserving natural and man-made capital) should be inherent in sustainable transport policies and manifested in transport trends (Gudmundsson and Höjer, 1996). Adequate, efficient, and effective transport systems are important for access to markets, employment, education and basic services critical to poverty alleviation; at the same time, transportation is expected to be a major driving force behind a growing world demand for energy and it has a significant environmental footprint. Therefore, integrated approaches to policy making should be promoted, including policies/planning for land use, infrastructure development, public transport systems and goods delivery networks, with a view to providing affordable, efficient and safe transportation, increasing energy efficiency, and reducing pollution and congestion effects[3].

In recent extensive consultations with decision makers[4], different International Organisations and industry associations have highlighted some of the current challenges associated with sustainable transport. DESA highlighted the contribution of sustainable transport towards

[3] See also: http://sustainabledevelopment.un.org/index.php?menu=238

[4] Consultation for Decision-Makers on Implementing Sustainable Transport New York City, USA, September 26th 2013 attended by 67 participants from all regions. Organized by UN DESA, Ford Foundation, FIA Foundation and UN-Habitat. See also http://sustainabledevelopment.un.org/index.php?menu=1569.

economic growth, integration of the economy (rural-urban linkages), environmental protection, social equity, health and road safety and promoted integrated approaches and system development. The International Energy Agency (IEA) has provided an evaluation of future energy requirements under different development scenarios, on the basis of a mobility model. It found that a lot of action will be required by the transport sector in order to remain within the +2 degrees ^{0}C temperature increase scenario, including a so called 'avoid, shift and improve' approach[5]. The United Nation Economic Commission for Europe (UNECE) has suggested that transport is instrumental for poverty eradication, as studies have shown that transport may explain about 70 % of the variability in global living standards. According to UNECE, there are 5 key dimensions of sustainable transport: (i) access – integrating countries in a broader market to eradicate poverty; (ii) affordability; (iii) safety, (vi) security and (v) environmental aspects.

The United Nations Environment Programme (UNEP) has suggested that there are 5 key areas of intervention, involving: (i) road safety –infrastructure; (ii) public transportation - mass transit; (iii) air quality - link to health issues; (iv) fuel consumption - link to energy and (v) new technologies. The World Bank has focussed on the significance of improving accessibility to transport services in rural areas, which will offer greater potential for economic growth, market access/consolidation, opening up of small businesses and employment and, thus, for poverty alleviation. The UN-Habitat stressed the importance of urban mobility and linking cities and urban areas in the 21st century, considering a mixed-use environment approach by integrating land-use and non-motorizing infrastructure. The United Nations Economic Commission for Latin America and the Caribbean (ECLAC) analysed the role of transport sector in the progress towards the Millennium Development Goals (MDG), highlighting the high impact of the sector's performance for achieving most MDGs. It highlighted the fundamental role of the public transport policies in reducing the increasing externalities of economic growth and in making sure that saving and benefits from better transport services effectively contribute to reducing social and economic inequality which remains a major challenge in the ECLAC region (UNECLAC, 2012).

The International Road Transportation Union (IRU) has suggested that buses/coaches and taxis should be placed at the centre of the transport policy-making debate, in order to double their use and achieve sustainable mobility for all. The Asian Development Bank (ADB) has predicted that increasing demand for private motorisation in South East Asia will exacerbate traffic congestion and air pollution, contribute to climate change and reduce road safety in this region; ADB discussed its 'Sustainable Transport Initiative', which involves the establishment of a Multilateral Development Bank working group on sustainable transport, initiation of innovative sustainable transport projects and capacity building for sustainable transport. Finally, UNECE has developed a new initiative to support member States' efforts to promote sustainable housing and land management, in order to achieve green, inclusive, compact and resilient cities which are regarded as a prerequisite to sustainable transport in the urban environment[6].

[5] See also http://www.unep.org/transport/about.asp

[6] See http://sustainabledevelopment.un.org/index.php?page=view&type=1006&menu=1510&nr=2603

1.3 Assessment of sustainable development

Each transportation system is unique, with its complexity derived from the pluralism of its hardware (infrastructure and vehicles) and of the people and organizations involved. The complexity is multiplied by the existence/roles of the different transport modes, the various regulatory and legislative bodies, service providers, builders, financing systems, technologies, land-use patterns, and, most importantly, human behaviour. Therefore, no single measurement of sustainable development allows evaluation of the current state and progress of the sustainability of transport.

Transport sustainability is linked to many factors (e.g. DESA, 2013) making it necessary to establish a set of indicators to determine the current situation and trends. It is theoretically optimal to define these indicators on the basis of the capital approach, i.e. of the sustainability of the total capital base of global society (UNECE, 2012). This capital base can be defined as consisting of 3 types of capital [7], frequently referred to as the 'triple bottom line' of transport sustainability (Richardson, 2005):

- Social capital, which refers to "the institutions, relationships and norms that shape the quality and quantity of a society's social interactions" (World Bank, 2011). Transport connects people and provides access to basic social services; it is therefore a necessary condition for social sustainability.
- Economic capital refers to (tangible and intangible) financial capital. Transport provides access, connects people and business and is therefore essential for economic sustainability.
- Environmental capital refers to the natural capital, including stocks of natural resources, land and ecosystems. Transportation affects environmental capital negatively through pollution, Greenhouse Gas-GHG emissions, energy use, waste generation and loss of natural habitat. Mitigation of these impacts is crucial for transport sustainability.

The economic, social and environmental pillars of sustainability are closely linked and a clear policy distinction between these pillars is neither possible nor beneficial. In fact, the close linkage between all aspects of sustainability and efficiency, once understood and acknowledged, encourages private sector to set sustainability goals in order to meet external demands coming from a growing number of concerned stakeholders[8]. Evaluation of the current state and future challenges involving the sustainability of transport should be made on the basis of trends/projections in transport accessibility, affordability, safety and security, environmental impacts, as well as the presence/promotion of integrated transport (e.g. intermodality).

Transport accessibility can be measured against e.g. infrastructure density and quality. At the same time, international transport links play an important role in the economic development of regions. The flow/volume of international freight transport and the border-crossing efficiency can

[7] Typically five to six types of capital are used: financial capital, produced capital, natural capital, human capital and social capital. In the present report, these types have been aggregated into the three pillars of sustainable development: social, economic and environmental (see also UNECE, 2012).

[8] Wilmsmeier G. and al, "Efficiency — key ingredient towards sustainable supply chains", ELCAC FAL Buletin No. 331, Number 3 / 2014.

provide an assessment of the performance of the transport system with respect to international accessibility. Mobility is an important factor for social and economic inclusion. Access to the most basic goods and services requires mobility; an affordable transport system is thus a prerequisite to social and economic development. Individual affordability can be evaluated by e.g. the share of transport expenditure relative to the total household income/consumption and/or the development of transport pricing. Transport systems should be also affordable for societies; therefore public expenditure and its sustainability as well as alternative funding options should be also evaluated.

Transport accidents (fatalities or injuries) lead to substantial social and economic losses for families and society. In order to evaluate transport safety, the current situation, trends and controlling factors (e.g. speeding and drink-driving) of transport accidents should be assessed. Finally, transportation affects the environment negatively through the consumption of non-renewable fuels, Carbon emissions, noise and ecosystem degradation. At the same time, transport infrastructure and services are impacted by the environmental conditions and their variability.

Table 1.1 summarises the relation between the 3 pillars of sustainable development, the key issues and particular performance indicators. The upcoming chapters that focus on individual dimensions of sustainable transport, as defined above, contain overviews of indicators listed in table 1.1, i.e. the current regional and global situations across those dimensions, the challenges facing policy makers in the transport industry and selected best practices contributing to achieving more sustainable inland transport of passengers and freight.

Table 1.1 Transport for sustainable development: transport themes, 3 pillars of sustainable development and general and specific performance indicators

	Access	Affordability	Safety	Security	Environment
Impact on capital	***Economic capital***: Access to markets and employment ***Social capital***: Access to basic social services	***Economic capital:*** Affordable access to employment and education opportunities. Long-term economically sustainable investments ***Social capital:*** Affordable access to basic social services.	***Social capital***: Safe transport for individuals and increase of human and cultural capital safety ***Economic capital:*** Safe transport to avoid costs of traffic accidents	***Social capital***: Secure transport for individuals and increase of human and cultural capital security ***Economic capital:*** Secure transport to avoid losses in infrastructure, goods and human capital	***Natural capital:*** Transport that is sustainable with respect to energy use, emissions and land use to maintain the natural capital of the world
Indicators	***Indicator 1:*** Infrastructure density ***Indicator 2:*** Infrastructure quality ***Indicator 3:*** International transport ***Indicator 4:*** Burden of border crossing	***Indicator 1:*** Household transport spending ***Indicator 2:*** Price of transport ***Indicator 3:*** Transport Public investment ***Indicator 4:*** Transport Private investment	***Indicator 1:*** Road fatalities ***Indicator 2:*** Seat-belt use, impaired driving and speeding ***Indicator 3:*** Active level crossings	***Indicator 1:*** Terror threats ***Indicator 2:*** Criminal activities	***Indicator 1:*** Transport Energy consumption i ***Indicator 2:*** Emission of greenhouse gases and local pollutants ***Indicator 3:*** Local pollutants from transport ***Indicator 4:*** Noise from transport
Sustainability targets	*-Infrastructure density linked to social development performance* *Minimize population share without access to all-season transport road/rail* *Strategic international links especially for landlocked countries* *Efficient border crossings*	*Affordable for all incomes* *Long-term investment plans* *Thorough pre-investment analysis*	*Minimize road fatalities and injuries* *Minimize rail and IWT fatalities and injuries* *Minimize accidents involving dangerous goods*	*Prevent terrorist threat/attacks* *Prevent criminal activities*	*Reduce dependency on non-renewable energy sources* *Minimize greenhouse gas and pollutant emissions* *Minimize noise from transport* *Minimize waste from transport and improve recycling*

2. General trends controlling transport growth and demand

Transport sustainability is controlled by socio-economic, demographic and environmental megatrends, i.e. major shifts in economic, social and environmental conditions that can impact people at all levels and transform societies. In recent decades, large sections of the global society have benefited from market access and the dissemination of knowledge and technology, but others still remain marginalized. Stronger trade and investment links have augmented global interdependence, but also increased the contagion risks from a financial crisis. Disparate population and economic growth dynamics have resulted in greater income inequalities, whereas environmental degradation has worsened due to non-sustainable production and consumption patterns. At the same time, long term climatic changes and extreme weather events (SREX, 2012; IPCC, 2013) can result in large transport infrastructure damages and costs (UNECE, 2013), induce health problems and precipitate food shortages that affect disproportionally the poorest sections of the global society and undermine efforts to achieve sustainable development (DESA, 2013).

This chapter will provide an overview of global and regional economic development, social and demographic and environmental trends, and describe their implications for the future development of the inland transport sector in accordance with principles and requirements for achieving sustainable development of society.

2.1 Economic development

2.1.1 Global trends

Globalization emerged in the 19th century, when technological progress in the transportation sector drove a sustained trade expansion of about 4 % annually throughout the century (DESA, 2013). The latest globalisation boom has been, however, qualitatively different, as underlying global production patterns have fundamentally changed through the rise of transnational corporations and globalised transport chains. Assembly-oriented export production, mostly concentrated in the industrialising East Asian economies, has introduced a 'reversed' geographical fragmentation of production, creating at the same time further requirements for efficient global transport networks.

It is interesting to note that, in the past decades, trade has grown at much faster rates than those of the World Product-WP (United Nations, 2010). There is, however, a structural regional diversity in trade growth. Growth in production of manufactured goods has been mostly limited in Asia, whereas in Africa and, to a lesser extent, in Latin America trade growth has been dominated by increases in commodity exports and/or imports of manufactured and capital goods (Erten and Ocampo, 2012). At the same time, foreign direct investment (FDI) has been growing faster than the world trade, reaching $ 1.5 trillion in 2011 (UNCTAD, 2012). Trade flows have recovered from their 2008-2009 collapse (Fig. 2.1), but growth is projected to remain slower than that prevailing before the 2008-2009 crisis, at least for some years (United Nations, 2013).

In recent years, economic growth has been consistently higher in the low- and middle-income economies than in the developed countries (Figs. 2.2 and 2.3). Nevertheless, average per capita growth may hide increasing income inequalities (Dervis, 2012) that undermine prospects for sustainable development (Berg and Ostry, 2011), threaten economic stability (Stiglitz, 2012),

impact on transportation patterns (e.g. Lau, 2011) and, ultimately, affect the sustainability of the transport sector.

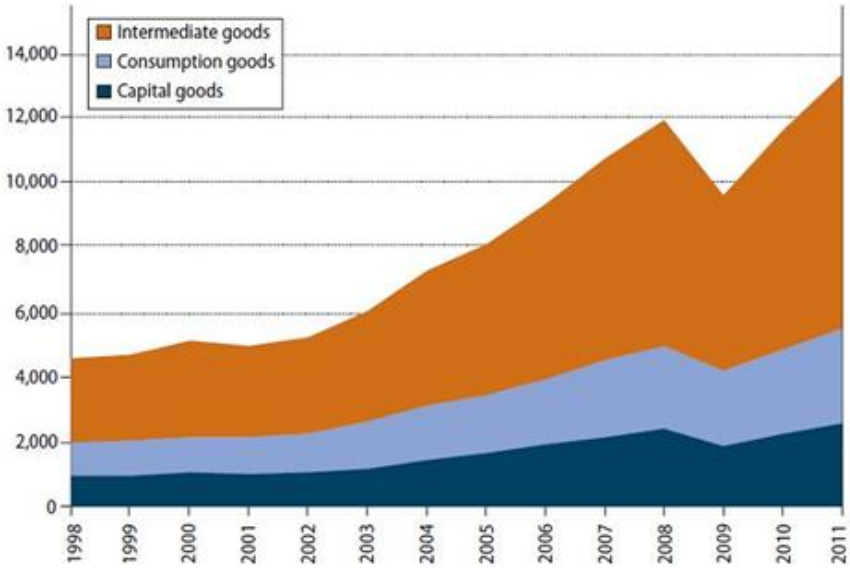


Fig. 2.1 Trends (in billions of United States dollars) in non-fuel exports in the 1998-2011 period (DESA, 2013)

In addition, the outsourcing/offshoring of jobs requiring mid-level skills that have been facilitated by changes in global production patterns and improved transport sector efficiency can affect considerably labour markets (Abel and Deitz, 2012). At the same time, continued growth in emerging economies can be a growth engine for the world economy, providing also opportunities for other developing countries; nevertheless, the gravity shift to China and India (the major drivers of this process) can also change the character of end markets and pose new challenges for economic development. Globalisation may also increase the cyclical interdependence of national economies making them more vulnerable to external shocks. Changes in consumer demand in end-markets are likely to be transmitted in real time to producers, with large implications for economic growth, employment and the transport sector (Cattaneo et al., 2010; Keane, 2012).

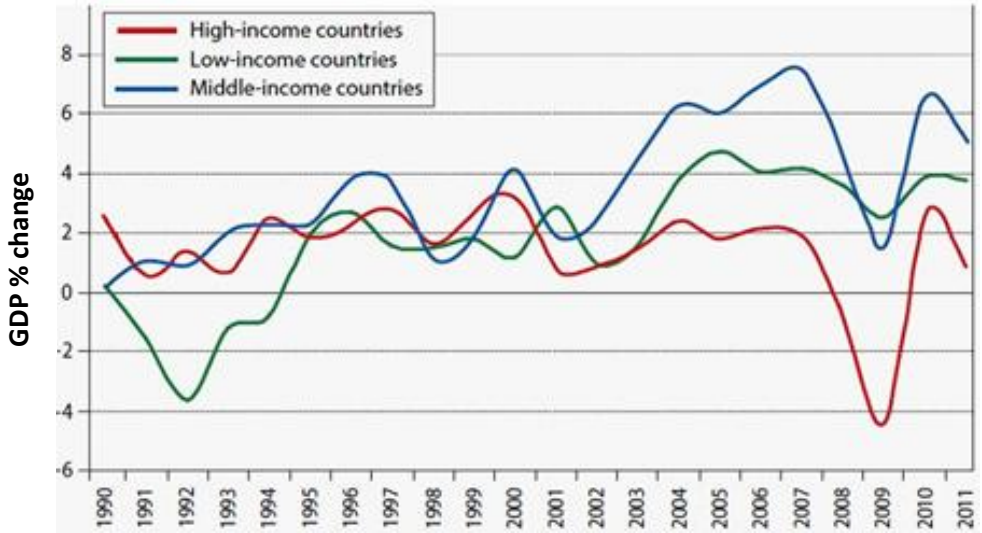


Fig. 2.2 Trends in annual GDP growth in high-, low- and middle-income countries (DESA, 2013).

Passenger and freight flow trends as well as transport infrastructure development are controlled by economic growth and its spatial distribution, as well as demographics and environmental policies. It is expected that transport volumes are likely to grow strongly in non-OECD regions, although there are certain challenges that may affect their growth, such as the availability of sustainable funding mechanisms for the development of sustainable capacities (ITF, 2013).

2.1.2. Regional trends

Western European and Nordic countries, Canada, Mexico and the United States of America have had an annual low/moderate economic growth (1–2 % on average) in the years after 2005. In comparison, economic growth has been higher in Eastern Europe, Asia, most African countries and certain Latin American countries (Fig. 2.3), forcing a narrowing of the gap between the per capita income of poorest and richest countries. For example, the 2005 per capita income in Tajikistan was 92 times lower than that of the United States of America, but by 2011 this difference had been reduced to about 40 times (UNECE, 2012).

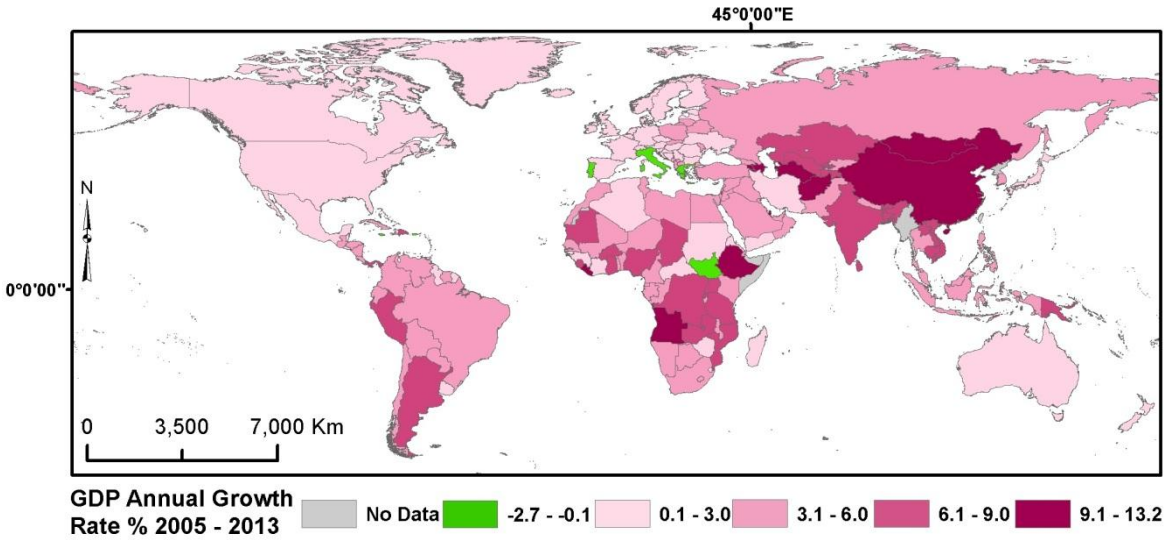


Fig. 2.3 Average annual GDP growth rate at constant 2005 prices for the period 2005–2013 Source: the World Bank.

This section contains a brief overview of GDP, and the evolution of unemployment and rail and road freight transport volume in member states of the five UN regional economic (and social) commissions. Table A2 in the annex to this report provides a more detailed correlation analysis of these and other statistics relevant to sustainable transport.

ECA region (excluding ESCWA member states)

Africa has benefited from unprecedented growth while a large part of its population remained trapped in economic poverty, facing rampant unemployment and inequality. The continent has averaged 5 % annual growth over the last decade, with some countries returning more than 7 %. Leading the growth were Equatorial Guinea, Liberia, Angola and Chad, with 10% average annual growth between 2002 and 2012, while the most lagging country during that period was Zimbabwe, losing over a fifth of the value of its economy. Underpinning this growth were relatively high commodity prices, increased domestic demand (due especially to increased private investment in

infrastructure and energy) and improved economic governance and management (UNECA and AU, 2014).

In most ECA member states, according to International Labour Organization (ILO) estimates, unemployment has been steady during the past decade, regardless of the actual rate. In 2012, thirty-nine African countries had unemployment rates at below 10%, while only 6 were below 5%, South Africa has suffered a consistently high unemployment at 25% during much of the past decade, while Algeria showed most progress in the area, cutting unemployment from 29.8% in 2000 to 9.8% in 2012. The global unemployment rate in the continent was estimated at 6.0 per cent in 2013, and unemployment numbers are set to rise from 202 million in 2013 to 205 million in 2014 (UNECA, 2014).

Most of Africa's railway lines and roads are in bad condition and need huge investments, while the proportion of paved roads on the continent today is five times less than those in developed countries. As a result, transport costs alone are 63% higher in Africa than in developed countries, hampering its competitiveness in the international and local markets (UNDPI, 2014). Algeria is the only country from the ECA region with available road freight transport statistics[9], while data on rail freight transport is available for only a dozen or so countries[10]. In most of the countries for which data is available, there is a clear dip in rail freight transport volume between 2008 and 2010, as in the ECE case, as a result of the economic crisis.

ECE Region

In the ECE region, growth and development in recent years has been diverse. Although the GDP of all Member States was seriously affected by the 2008-2009 financial crisis, the long-lasting economic growth and unemployment repercussions have been concentrated only in some of the Member States (Fig. 2.4). In 1995, more than one quarter of the ECE Member States (for which data are available) had double digit unemployment rates. This number peaked in 1999, when nearly half of these countries had an unemployment rate above 10 %.

Following the rapid economic growth of the beginning of the 21st century, only 7 of the ECE Member States had double-digit unemployment rates in 2007. The 2008-2009 global financial crises resulted in a return to the 1995 levels, with about one third of the ECE Member States exhibiting unemployment rates of more than 10 %. In 2009, only 9 of the 47 ECE States for which data was been available had unemployment rates below 6 %, with the unemployment rate in Norway being 3.2 %. The Former Yugoslav Republic of Macedonia showed the highest unemployment rate (32.2 %), followed by Bosnia-Herzegovina (24.1 %). In Estonia, Latvia and Lithuania unemployment rates more than doubled in 2008–2009 whereas, over the same period, unemployment in the United States of America increased from 5.8 % in 2008 to 9.3 % in 2009 (see also UNECE, 2012).

In the following years (2009-2012), only 13 of the 43 ECE States (for which data have been available) achieved unemployment rates below 6 %. The southern European countries showed devastating increases in their unemployment rates: Spain had its unemployment rate soar from 18

[9] http://data.worldbank.org/indicator/IS.ROD.GOOD.MT.K6
[10] http://data.worldbank.org/indicator/IS.RRS.GOOD.MT.K6

%to 25%, Greece from 9.5 % to 24.3%, Portugal from 10.6 % to 15.9 %, and Cyprus from 5.4 % to 11.9 %.

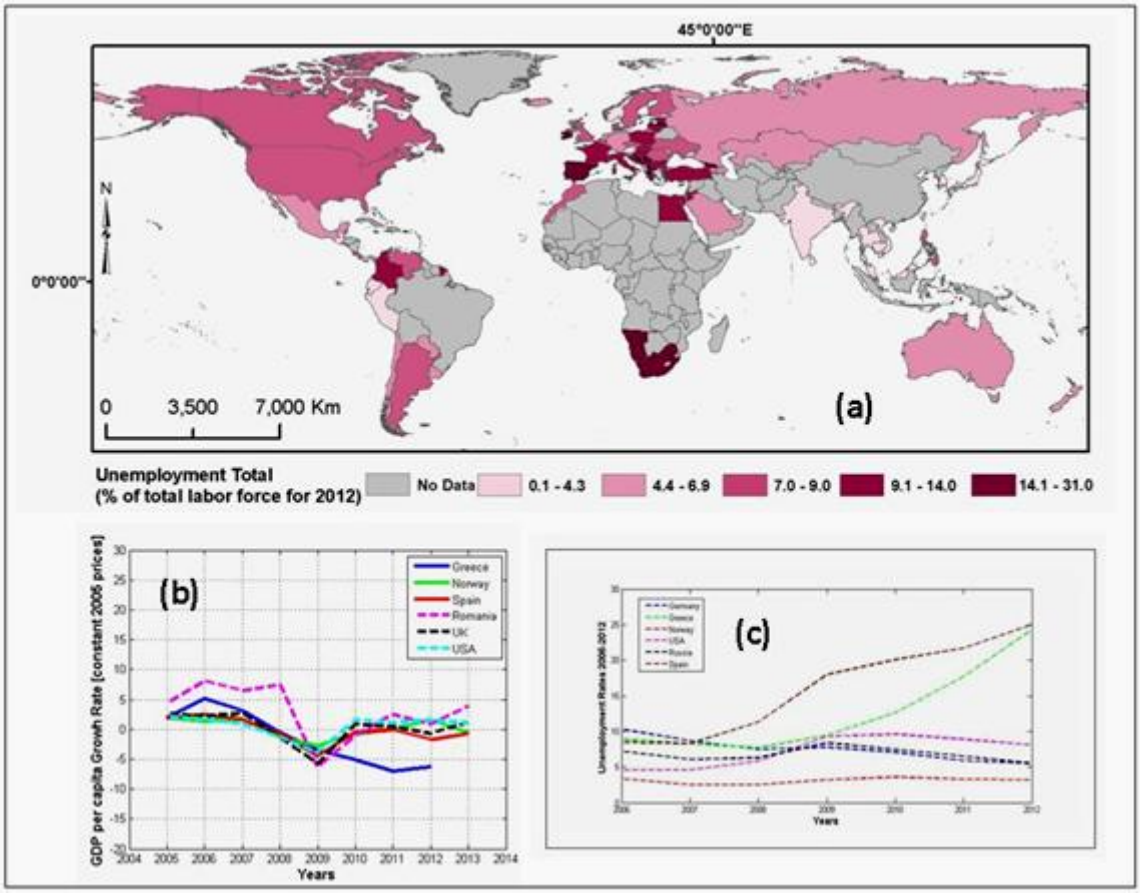


Fig. 2.4 (a) Unemployment rates for 2012 (Data source: World Bank). (b) Economic growth rates (at constant 2005 prices) in selected UNECE Member States (Source: UNECE). (c) Unemployment rates for the month May (2006-2013) in selected UNECE States.

In comparison, the unemployment rate in Germany has been steadily decreasing from 7.8 % in 2009 to about 5.5% in 2012, making Germany the country with the eighth lowest unemployment rate in the ECE region (after Norway, Switzerland, Austria, Luxemburg, Kazakhstan, the Netherlands and Azerbaijan). This (along with Fig. 2.4) shows that there is a large diversity in the unemployment rates of the ECE region.

Inland freight transport increased considerably in the ECE region between 2000 and 2007, with eastern and south-eastern European Member States showing increasing demand for freight transport (UNECE, 2012). Following a sharp decline in 2009 due to the 2008-2009 crisis, inland transport freight recovered and continued its increasing trends. With regard to the relationship between economic growth and inland transport, the available data indicate that since 2000 there has been a relative 'decoupling' (Fig. 2.5); this may reflect control by other factors such as demographics, income distribution, the global distribution of industrial production and the patterns of transportation, most of which have gone through major changes in recent years (see also Chapter 8.1.1).

Fig. 2.5 Inland freight transport excluding inland waterways transport (blue line), and nominal GDP growth (red line) trends. The volume of goods transported by railway (http://data.worldbank.org/indicator/IS.RRS.GOOD.MT.K6) and road vehicles (http://data.worldbank.org/indicator/IS.ROD.GOOD.MT.K6) in metric tons multiplied by km travelled.

ECLAC region (excluding ECE and ESCAP member states)

The 2008-2009 economic crises strongly affected the ECLAC region, with 20 regional countries experiencing recession in 2009. While the majority bounced back in 2010 and 2011, eight countries were still in recession in 2010, including Haiti, which did not find itself in economic downturn due to the global crisis, but as a result of the devastating 2010 Earthquake. Never the less, average GDP growth rates for the previous decade are in the positive for regional countries, with Panama (7.43%) and the Dominican Republic (5.46%) leading the way in Central America, Peru (6.23%), Columbia (4.53%) and Argentina (4.35%), after its recovery from the early 2000s national recession, showing strong growth in South America, while Trinidad and Tobago (4.89%) and Cuba (5.22%) growth stood out in the Caribbean region[11].

Following an initial surge, economic growth in Latin America and the Caribbean has been slowing since 2011, and the data available for the first six months of 2014 indicate that the region will not match the growth rate of 2.5% recorded in 2013. A regional growth rate of 2.2% is forecast for 2014 (UNECLAC, 2014a[12]).

Despite the periods of sustainable growth for a number of countries in the first decade of the 2000s, the overall growth performance of the ECLAC region in the past thirty years has not been so encouraging. The region performed poorly in the three decades between 1980 and 2012, at least from the perspective of much of the Latin American and Caribbean population. The average annual gain in per capita GDP during these 32 years has been less than 2% for 91.7% of the population, and less than 1% for 32.0%. For a large number of countries economic growth was insufficient to produce convergence with the per capita GDP of developed countries. Very importantly, income distribution in the region continues to be highly unequal. In Latin America,

[11] http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG
[12] http://www.cepal.org/publicaciones/xml/1/53391/EconomicSurvey2014.pdf

the richest 10% of the population capture 32% of total income, while the poorest 40% receives only 15%. Inequality levels are lower in the Caribbean.

Growth in Latin America and the Caribbean in the past three decades shows the heavy influence of external conditions. Long periods of limited access to external financial resources, crises in large economies in the region and beyond, and negative turns of events in export markets leading to terms-of-trade deterioration, have almost always slowed growth and, in certain instances, have led output to fall outright. Although the region showed significant resilience during the global financial crisis, thanks to its capacity to implement countercyclical policies and rapidly regain access to international financial markets, external variability continued to slow down its growth (UNECLAC, 2013).

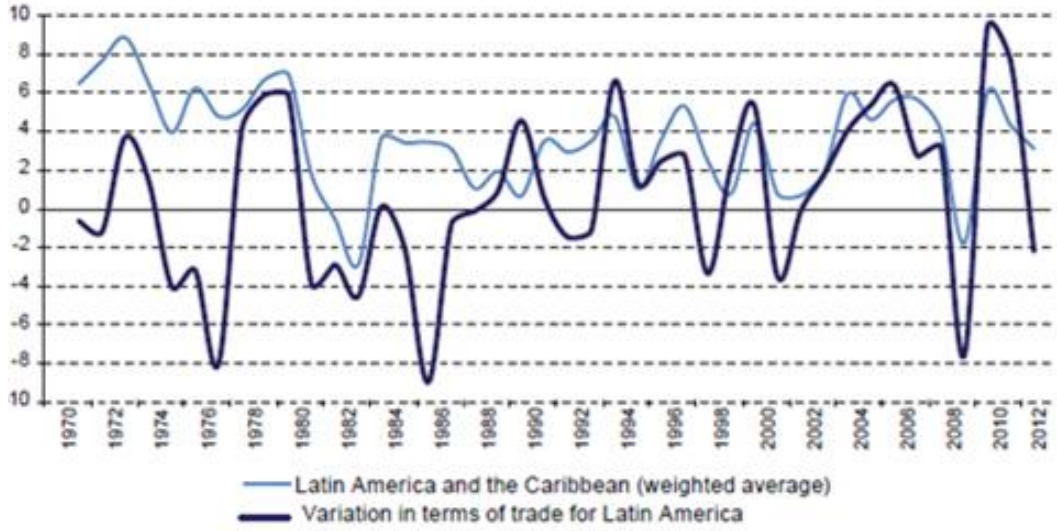


Fig. 2.6 Latin America and the Caribbean: GDP growth and terms of trade, 1970-2012 (percentage) (source: UNECLAC, 2013*)*

A number of countries in the region are experiencing high unemployment rates, with Guyana having the highest levels during the past decade, surpassing 20%. Six other South American and Caribbean countries have maintained unemployment levels higher than 10% over the same period. Argentina has bounced back from an unemployment rate high of 18.3% in 2001 to 7.2% in 2012. Panama, Trinidad and Tobago, Venezuela and Belize have significantly reduced unemployment levels when compared to 2002, while eight regional countries currently have unemployment rates lower than 5% of the total labour force[13].

Intraregional trade statistics indicate that in 2010 34.6% of volume (metric tons) was moved by road transport, 1.3% by rail, while river and lake transport accounted for 1% of the total annual trade volume. In terms of value, road transport accounted for 41.8%, rail 0.7% and river and lake transport for 0.42% of the total value of traded goods. Maritime transport is by far the most dominant mode, representing more than 60% of the volume and almost 50% of the value of traded goods. Available data indicates that in most countries the volumes of rail and road freight transport have been increasing in the past decade. Since 2002 levels, Brazil, Chile and Mexico have increased rail freight volumes by 43%, 22% and 21% respectively, while Argentina has experienced

[13] http://data.worldbank.org/indicator/SL.UEM.TOTL.ZS

a slight decline of 4% in 2009 compared to 2008 levels, but has since been increasing rail freight transport volumes. In Colombia freight transport volumes were increasing until 2009 but have since dropped.

ESCAP region (excluding ECE member states)

Countries in the Asia and the Pacific region face a challenging task of sustaining growth and productive and decent employment in a complex and uncertain global economic situation. Prolonged recession in the developed world and slowdown in major emerging market economies further hampered export prospects (ESCAP, 2014a). The economic crisis induced a slowdown in growth in most countries in the ESCAP region including India and China, where growth rates in 2008 dropped by 5% compared to the precious year, while Japan, Thailand, Iran and a number of pacific island states experienced recession in 2008-2009.

The average growth rate of the developing economies of Asia and the Pacific is forecast to rise moderately in 2014 to 5.8% from 5.6% in 2013. In line with the diversity of the region, economic growth momentum in 2014 will likely be varied across sub-regions. In South and South-West Asia, the forecast is for a significant increase in growth, to 4.7% from 3.9% in 2013. Pacific island developing economies are also forecast to record a notable increase in growth, to 4.9% from 4% in 2013, while East and North-East Asia is forecast to post stable growth in 2014 and growth in South-East Asia is projected to record 4.6% (ESCAP, 2014b).

The average regional unemployment rate between 2002 and 2012 was 5%. Much like in the ECA region, according to ILO estimates[14] unemployment has been stable in the past decade in ESCAP member states, with 18 states recording average annual unemployment below 5% between 2002 and 2012. On the other hand, the Islamic Republic of Iran and the Maldives have consistently been exposed to unemployment rates greater than 10% during the same period. Indonesia and the Philippines have by 2012 succeeded in reducing their record unemployment registered during the decade by 41%, reaching levels of 6.6% and 7% respectively.

Available statistics show that volume of road and rail freight transport has experienced growth at the ESCAP regional level since the early 2000s. While a number of countries, Bangladesh (-9%), Thailand (-27%), Japan (-9%) and the Republic of Korea (-8) registered freight volume declines in rail transport during the period, highest increases in rail freight volume transport for the 2002-2012 period were reported by Malaysia (239%), Mongolia (166%), Vietnam (108%) and India (105%). China's rapid expansion of road infrastructure was followed in step by high inter-annual increases in road freight transport volumes, totalling more than 738% in 2011 compared to 2001 levels, reaching 5,137,474 million-ton kilometres transported goods. Significant volume increases were registered in Australia (47%) and Vietnam (193%), while Japan was hard hit by effects of the economic crisis in this area (or possibly as a result of the aftermath of the devastating tsunami of 2010 as well) with road freight transport volumes in 2010 reduced by 25% compared to 2009 levels (Wilmsmeier, G. and Guidry, L, 2013).

[14] http://data.worldbank.org/indicator/SL.UEM.TOTL.ZS

ESCWA region

The strong growth in the 2002-2012 decade in the gulf region was driven by Kuwait, Jordan and Saudi Arabia, all registering an average of above 5% for the period, while similar data for the period is registered in Egypt, Tunisia and Morocco with 4.5% average growth rates. Qatar had the highest average GDP growth rate in the region during this period with an average annual growth of 12.83%, however since peaking at 26.17% in 2006 the growth rate has decreased to 2.56% in 2012. Although the global financial crisis affected ESCWA member countries and resulted in various degrees of decline in GDP growth rates between 2008 and 2011, due to high oil prices, growth in the region during the period was above the global average.

Table 2.1 GDP growth – global and ESCWA averages 2008-2011[15]

	2008	**2009**	**2010**	**2011**
ESCWA	6.4	2.0	4.5	4.7
World	1.6	-2.0	3.6	3.1

Economic growth in the ESCWA region slowed down in 2013 compared to 2012, owing mainly to the moderate oil revenue growth of major oil-exporting countries, namely Gulf Cooperation Council states (GCC). In 2013, the average growth rate in GDP in real terms was estimated to be 3.0 per cent for the Arab region, compared to 7.7 per cent in 2012. This fluctuation, also observed in 2011, is for the most part the result of highly fluctuating economic performance statistics in post-conflict Libya. The average regional GDP growth rate without the influence of the Libyan economy stood at 4.1 per cent in 2012 and 3.2 per cent in 2013. The crisis in the Syrian Arab Republic continues to have negative spill over effects on neighbouring countries, particularly with regards to subdued cross-border economic activities, including trade, investment and tourism (ESCWA, 2014).

Only four countries in the ESCWA region, Saudi Arabia, United Arab Emirates, Kuwait and Qatar have kept unemployment rates consistently lower than 6%, with Qatar maintaining an average of 0.69% unemployment over the 2002-2012 period. On the other hand, a number of countries have struggled with high unemployment during the same period, seven of which had an average rate of over 10%, with Iraq and Yemen being the hardest hit with average rates of 18.62% and 15.66% during the period. There doesn't seem to be any correlation in regional unemployment with the global economic crisis of 2008-2009, as the majority of countries demonstrate stable unemployment rates, regardless if they are low, moderate or high.

Road transport in Arab countries accounts for more than 80% of the total transportation of passengers and freight. There are very limited statistics describing the volume of road freight transport in the region, and are to an extent available only for Tunisia and Morocco. Railway transport systems are available in a limited number of Arab countries, especially in Egypt, Iraq, Saudi Arabia, the Sudan and the Syrian Arab (ESCWA, 2009). According to available statistics, the rail freight transport volume has since 2006 decreased in Egypt and Iraq by close to 60%, and by 33% in Jordan. Elsewhere it has remained stagnant during the period, with a notable increase in freight volume reported only in Saudi Arabia (36%)[16].

[15] http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG
[16] http://data.worldbank.org/indicator/IS.RRS.GOOD.MT.K6

2.2 Social and demographic trends

Significant changes in global population size, age structure, household size and urbanization are expected for the 21st century (Cohen, 2003); such changes could have substantial implications for inland transport, in terms of transport patterns, energy use and Greenhouse Gas (GHG) emissions (see also Chapters 2.3 and 7). An assessment of the implications of demographic changes on the basis of an energy–economic growth model that accounts for demographic dynamics (O' Neill et al., 2010) has shown for the 21st century (a) an increase of the population trend that will probably peter out after 2050 and (b) significant regional differences (Fig. 2.7).

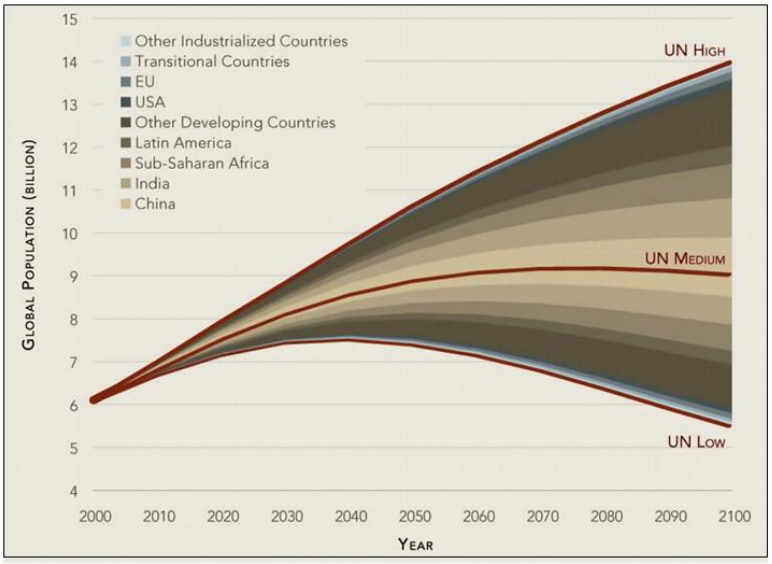


Fig. 2.7 Global (solid lines) and regional (coloured bands) population size projections for the 21st century (O'Neill et al., 2010)

Population aging, which presently takes place in many regions (Fig. 2.8), is likely to increase in the future decades due to reductions in new births and the lengthening of life expectancy, particularly in China, Western Europe, Canada and Latin America. In comparison certain parts of Africa and central Asia are likely to experience opposing trends. The number of people per household is also projected to decline in many areas due to living arrangement shifts towards nuclear families.

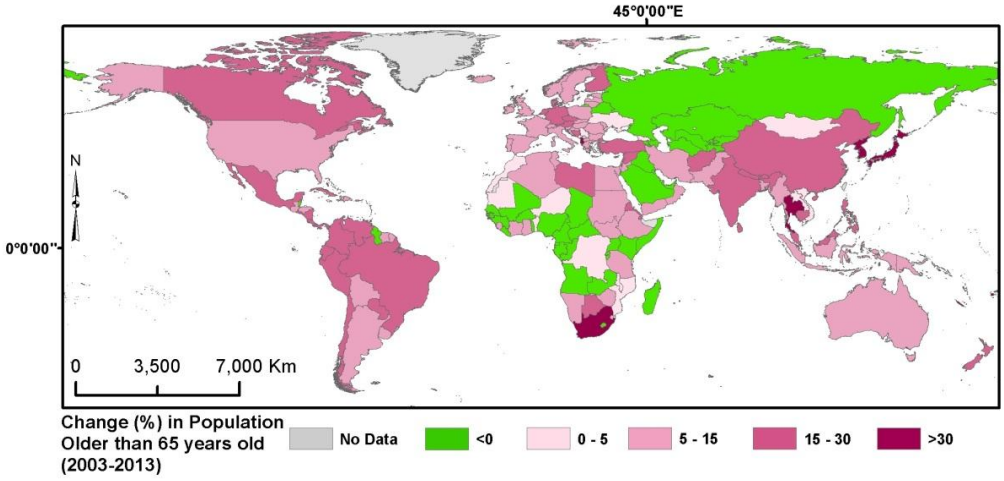


Fig. 2.8 Changes (%) in population older than 65 years old during the period 2003-2013

It appears that several regions have entered critical phases of demographic evolution. In Western European countries populations have come have been aging since the beginning of the 21st century, driven by low fertility/birth rates over the previous 3 decades. The effects of this ageing are likely to increase over time, if fertility remains at low levels and there will be no offsets from immigration or rising life expectancy (Lutz et al., 2003). In other parts of the world (e.g. East Asia, Latin America), population ageing (and, possibly, population decreases) are also projected to occur if the current trends (Fig. 2.8) are to continue. Urbanization has also altered (and will continue to alter) the global demography in an unprecedented manner. These trends are likely to affect very significantly inland transport and its sustainability.

Global population may grow by more than 2 billion by 2050, with the growth concentrated in urban areas (Fig. 2.9). Urbanization, a direct effect of modernization and industrialization, allows individuals and corporations to take advantage of the opportunities offered by proximity, diversity, and market place competition, altering, at the same time, the socio-economic and environmental character of the growing cities and surrounding areas. Since the beginning of the 21st century, the number of people living in urban centres has grown over the number of people living in rural areas and this trend is expected to hold well in the future decades, with the urban populations being projected to constitute more than 65 % of the total population by 2050.

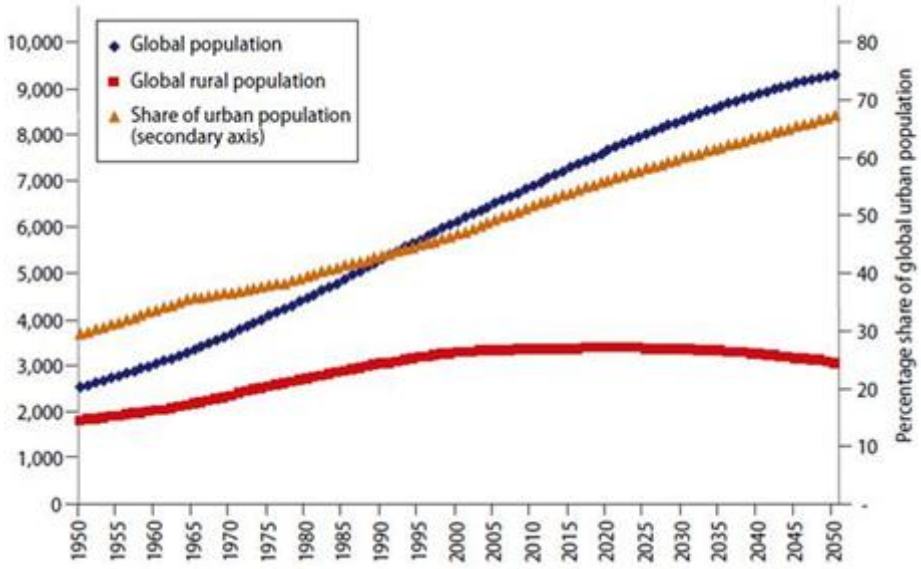


Fig. 2.9 Urbanisation trends and projections, 1950-2050 (DESA, 2013)

There is considerable regional diversity in the patterns, level and pace of urbanization. For example, Latin America and the Caribbean regions are highly urbanized, whereas least developed countries (LDC) and land-locked developing countries (LLDC) are still predominantly agricultural, although they will also probably experience accelerating urbanization in the coming decades (DESA, 2013). On average, nearly 80 % of the population in developed regions resides in urban centres, whereas the average share of urban populations in parts of Asia and Africa is less than 50% (Grübler and Buettner, 2013).

As stated before, currently the urban population in Latin America is larger, in percentage terms, than the world average. The urban population, as a proportion of the total, in the region rose dramatically between 1950 and 1995, as a result of the import substitution policy and the absence

of reform in the countryside. This trend continued until the end of the twentieth century, by which time Latin America had overtaken the most developed regions in terms of urban population. Today, with about 80% of its population residing in cities (Fig 2.10), Latin America has the most urbanized population of any region in the developing world (UNECLAC, 2014b)

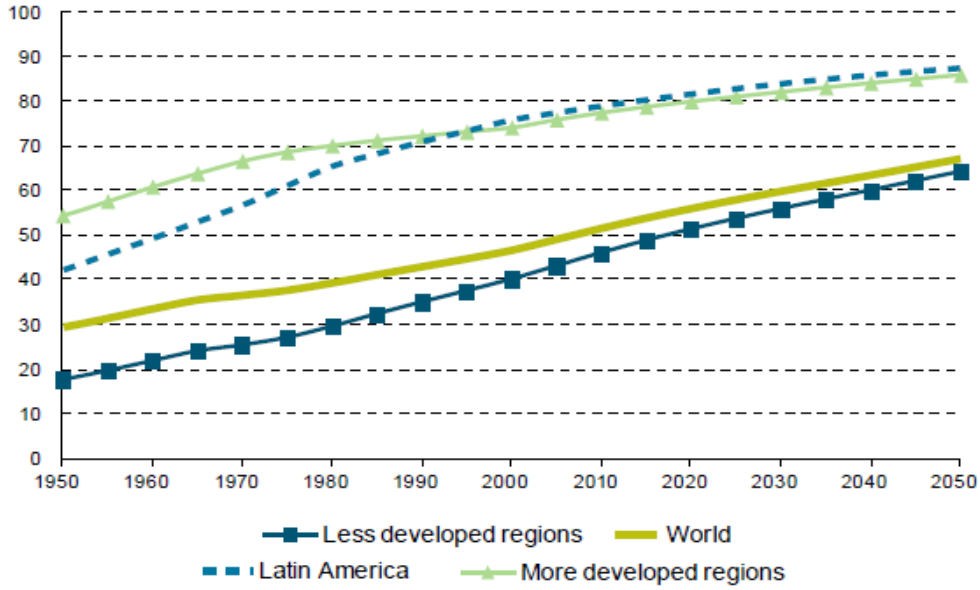


Fig. 2.10 World, Latin America and developed and developing regions: urban population estimates and projections, 1950-2050 (UNECLAC, 2014b)

It should be also noted that, since the middle of the last century, there has been a move in developed countries towards sub-urbanization and counter-urbanization, which has been accommodated by a more adequate transportation infrastructure. Sub-urbanization began in earnest in the 1950s in the United States of America, following the construction of the interstate highway system and private vehicles being more affordable for middle class families. In the 1990s, another trend emerged ('ex-urbanization'), when higher income urban dwellers started to move out of the inner cities and suburbs to high-end housing in the countryside. In addition to these changes there have been also changes in the education levels, the income levels/inequality as well as changes in the geo-spatial distribution of the populations due to e.g. population movement towards the coastal areas. All these trends have been influencing transport needs and patterns, and related energy use and Greenhouse Gas -GHG emission patterns (e.g. Dodson and Sipe, 2006).

2.3 Environmental trends and implications for inland transport

The transport sector is instrumental to many economic and social functions. At the same time, transport infrastructure/services have a significant environmental footprint at different spatio-temporal scales. Transport can even affect the global climate through its substantial emissions (see below) as well as be affected by the Climate Variability and Change-(CV & C) (see also Chapter 7).

Global Climate Variability and Change is controlled by the planet's heat inflows and outflows and its storage dynamics in the various constituents of the Earth System. There is now sufficient evidence to suggest a long-term, increasing temperature trend, with the global average air temperature having increased by about 0.8 ^{o}C since the 1850s and the upper 75 m of the ocean increasing by 0.11 °C per decade over the last 40 years (IPCC, 2013). Atmospheric temperature

increases of between 1.0 and 3.7 ^{o}C have been projected for the 2100, depending on the scenario. Precipitation has been also changing, but in a more complex manner, with some regions becoming wetter and others dryer; such trends are predicted to remain steady or even increase in pace in the future (IPCC, 2013). One of the most damaging side-effects of the temperature increases is rising mean sea levels, due to ocean thermal expansion, the melting of the Greenland and Antarctic ice sheets and the glacier and ice caps, the glacio-isostatic adjustment (GIA) and changes in the terrestrial water storage. (Hanna et al., 2013). Since the 1860s, sea levels have risen by about 0.2 m, with satellite information showing a progressive increase rate (to up to 3.1 mm/yr^{-1}) since the 1990s (Church and White, 2011).

Changes in the average climate conditions can also lead to fluctuations in the frequency, intensity, spatial coverage, duration, and timing of extreme weather and climate events, which can, in turn, modify the distributions of future climatic conditions. Extreme events (e.g. storms and storm surges, floods and droughts and heat waves), as well as changes in the patterns of particular climatic systems such as the monsoons (SREX, 2012), can have more severe impacts on transport than changes in the mean variables when concentrated in smaller areas over a limited period. One of the clearest trends appears to be the increasing frequency and intensity of heavy downpours. Climate models project the continuation of this trend; for example, the 1 in 20 year (heaviest) downpours of N. America have been projected to occur every 4 to 15 years by 2100, depending on location (Karl et al.,2009). River floods appear also to present a very significant hazard and there is evidence to suggest increases in the frequency and intensity of heat waves, i.e. of extended periods of abnormally hot weather, as well as of severe droughts in some regions (EEA 2012; UNECE, 2013).

The above changes may severely impact transport infrastructure, hubs and services. Coastal flooding will have significant impacts on coastal transport infrastructure, by rendering it unusable for the duration of the event and significantly damaging terminals, intermodal facilities, freight villages, cargo, storage areas and energy infrastructure (Brown et al., 2014) and, thus, disrupting intermodal supply chains and transport connectivity for longer periods. Ports, which form key-nodes in international transport networks linking international supply-chains, will be particularly effected, due mostly to the long life nature of their key infrastructure, their exposed coastal and/or estuarine location, and their dependence on trade, shipping and inland transport that are also vulnerable to climate change (Becker et al., 2013).

Precipitation changes may result in changes to the way water courses move that are likely to affect roadways, railways, and rail and coach terminals. There can be direct damages during the event, necessitating emergency responses as well as effects on the structural integrity and maintenance of roads, rail lines, bridges, tunnels, drainage systems, telecommunication and traffic management systems. Increases in heavy precipitation events and floods will cause more accidents due to vehicle, road and rail track damage and poor visibility as well as delays and traffic disruptions. Inland waterways can suffer navigation suspensions, silting, changes in river morphology and damages of banks and flood protection systems. Extreme winds can damage coastal and estuarine railways, destroy agricultural crops and stress industrial facilities and, thus, indirectly affect the transport industry, damage road and railway infrastructure (through e.g. wind-generated debris) and strain road and rail operations. Heat waves may also have substantial

impacts on transport infrastructure and services, by stressing water supplies and food storage and energy systems, damaging roads, deforming rail tracks and damaging track foundations as well as by causing lengthy delays through speed restrictions (UNECE, 2013).

One of the major causes of the observed climatic changes is considered to be the increasing atmospheric concentrations of Greenhouse Gases-GHGs, e.g. water vapour, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), which absorb heat reflected back from the Earth's surface and, thus, increase the Earth's heat storage (IPCC, 2013). Since the industrial revolution, atmospheric concentrations of the GHGs have been steadily increasing, being now higher than they have been for some million years. For example, the CO_2 concentration surpassed the 400 ppm (parts per million) milestone for the first time since, probably, the mid-Pliocene Warm Period (MPWP), 3.3 to 3.0 million years BP-Before Present (IPCC, 2013) in early May 2013. Climatic changes can be amplified by reinforcing feedbacks, i.e. climate change-driven processes that can induce further global warming. For example, previously inert carbon reservoirs (e.g. the tropical peatlands and the vast CH_4 stores of the Arctic permafrost) can be mobilized by increasing temperatures and release more CO_2 and/or CH_4 into the atmosphere. The rapid reduction in the spatial coverage of Arctic Ocean ice, particularly during summer, may also affect the climate, as sea ice reflects most of the incoming sun radiation back into the atmosphere in contrast to the sea water; an ice-free Arctic Ocean will absorb more sun radiation, reinforce global warming and increase 'tipping' risks (Lenton et al., 2008; SREX, 2012; IPCC, 2013; Lenton, 2013).

The transport sector is one of the major contributors of the CO_2 emissions as well as a major energy consumer. Therefore, in order to assess transport sector sustainability, it is necessary to assess its trends and projections concerning Carbon emissions and energy use.

2.3.1 Global and regional trends in Carbon emissions

The expansion of global trade due to changes (including fragmentation) in production patterns has resulted in increases in the global CO_2 emissions, with the transport sector being a significant source of such emissions; the international trading of goods generates emissions that are 50 % higher, on average, than those generated by locally-traded goods (United Nations, 2013). It is expected that the expansion of and changes in the consumption patterns in emerging economies will exacerbate the already very significant environmental challenges that have been originally imposed by unsustainable consumption patterns in the developed countries (DESA, 2013).

Presently, the CO_2 transport emissions show a significant spatial variability. The highest emissions are found in the United States of America, the Russian Federation, China, Japan and Brazil, with Western Europe, Australia and India also associated with high transport emissions (Fig. 11(a)). In comparison, Africa and the central Asia are characterized by low transport-generated emissions. The fastest growing CO_2 emissions are found in China, certain African countries, Eastern Europe, India and in the western Latin America (Fig. 11(b)). In the ECE region, CO_2 transport related emissions increased by 23 % in the period 1990-2008, but with a large variability; in several member States emissions have more than doubled, whereas in others emissions have decreased as, for example, in Germany (UNECE, 2012).

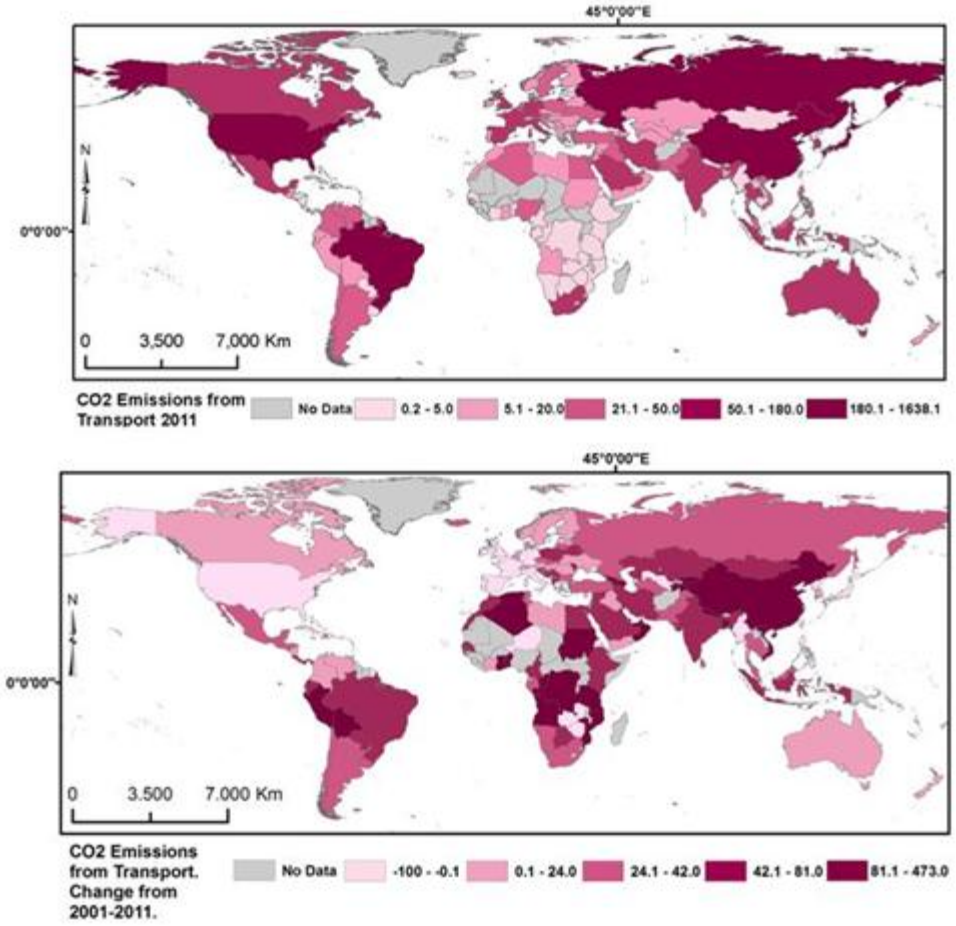


Fig. 2.11 (a) CO2 emissions (in million metric tonnes) from transport (2011) and (b) Changes in the CO2 emissions in the period 2001-2011 (see also ANNEX Table A.1). The information relates to emissions from the combustion of fuel for all transport activity, regardless of the mode (except for international marine bunkers and international aviation). It includes domestic aviation and navigation, road, rail and pipeline transport, and corresponds to IPCC Source/Sink Category 1 A 3.

Analysis of the historical data suggests that population growth has been one of the significant drivers of Carbon emission growth over the past several decades, with urbanization, aging, and changes in household size being also important controls. With regard to future projections, a recent modelling study (O'Neill et al., 2010) has suggested that changes in population composition can have a significant influence on Carbon emissions in particular regions, notwithstanding the effects of population size changes. It has been suggested that aging, which can influence labour supply and productivity, may reduce long-term emissions by up to 20%, particularly in industrialized countries, whereas urbanization may increase emissions by more than 25%, particularly in developing regions. Nevertheless, there are other studies suggesting that urban living, being generally more energy and transport-efficient, may actually result in Carbon emission decreases (Dodman, 2009; Clark, 2013).

Neill et al. (2010) have also found that if the population was to follow the low path rather than the medium in the Special Report on Emissions Scenarios (SRES) B2 scenario (Fig. 2.10), emissions might significantly decrease with global reductions of 1.4 GtC/y in 2050 and 5.1 GtC/y in 2100 being projected. However, if population growth was to follow the high projection rather than the medium, global emissions would increase by 1.7 GtC/year in 2050 and 7.3 GtC/year in 2100.

Regionally, the most substantial changes are projected to be in the developing countries, although the contribution from the industrialized countries will also be substantial; a positive change in the US population growth will have a pronounced effect on Carbon emissions, despite its small contribution to global population growth, due to the relatively high per capita emissions implied in the B2 scenario. For the IPCC SRES A2 scenario, projections at the global level are even larger in absolute terms (Fig. 2.12).

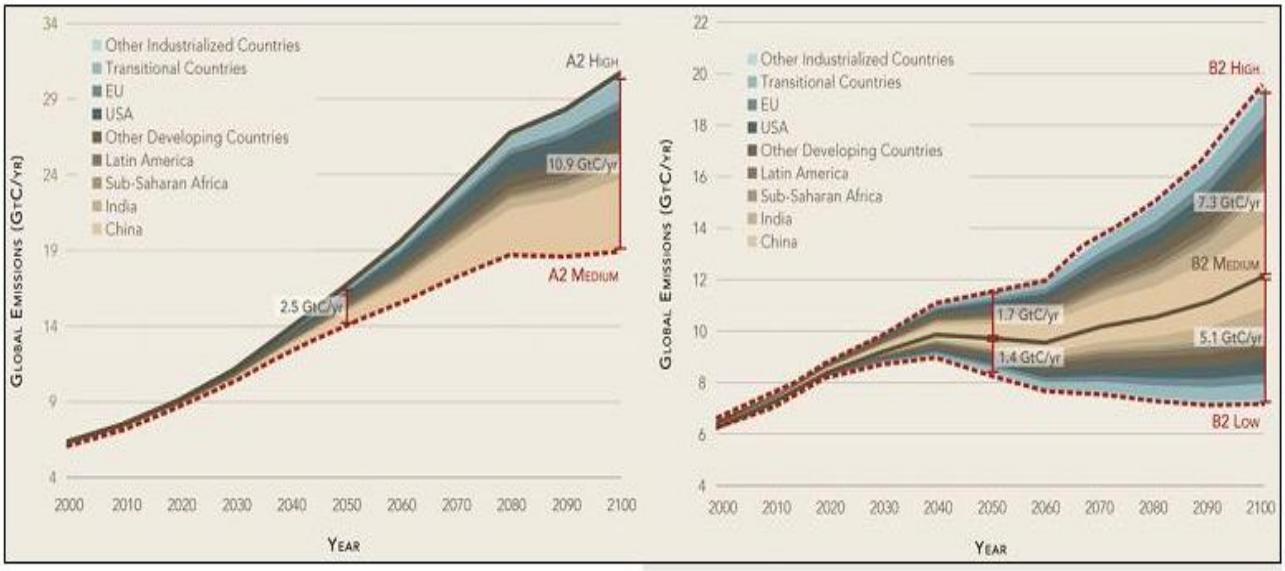


Fig. 2.12 Projected global totals (lines) and regional differences (colour bands) for CO2 emissions (in GtC per year). Individual coloured bands indicate the contribution of each region to the difference between global scenarios. Solid lines shows emissions in the baseline scenario, and dashed lines show emissions in variants with alternative demographic assumptions. All scenarios include the effects of changes in population composition by household age, size, and urbanisation. Economic and technological assumptions are based on the IPCC A2 (left) and B2 (right) scenarios (O'Neill et al., 2010).

2.3.2. Global and regional trends in energy consumption

The transportation sector is a very substantial end-use energy consumer, accounting for about 26 % of the total world delivered energy consumption and 55 % of the total liquid fuel consumption in 2010 (EIA, 2013). In the period 2001-2011, energy use has been increasing in most countries, although there have been some exceptions. A comparison between the development of energy use and (nominal) GDP (Fig. 2.13) shows that energy use has had a slower growth than the nominal GDP growth, with some regions showing an actual decrease of energy consumption (a full 'decoupling' between energy consumption and economic growth) during this period.

Energy consumption is projected to increase substantially in the following decades (EIA, 2013). The development of energy use will control the sustainability of the transportation sector. Oil prices were projected to be consistently high in the next decades[17], in response to dwindling oil resources and a strong increase in demand for transportation fuels, particularly in the emerging

[17] Nevertheless, oil consumption as reflected by oil prices can be also volatile, depending on the economic cycle and geo-political circumstances. For example, the crude oil price (per barrel) in mid-January 2015 was 50% lower than the January 2014 price: http://www.nasdaq.com/markets/crude-oil.aspx?timeframe=1y

non-OECD[18] economies (Fig. 2.14). In these economies, income growth and demand for personal mobility (private motorization) together with rapid urbanization, is likely to induce a strong growth in transportation energy use, especially if contrary to past projections the price of oil remains low.

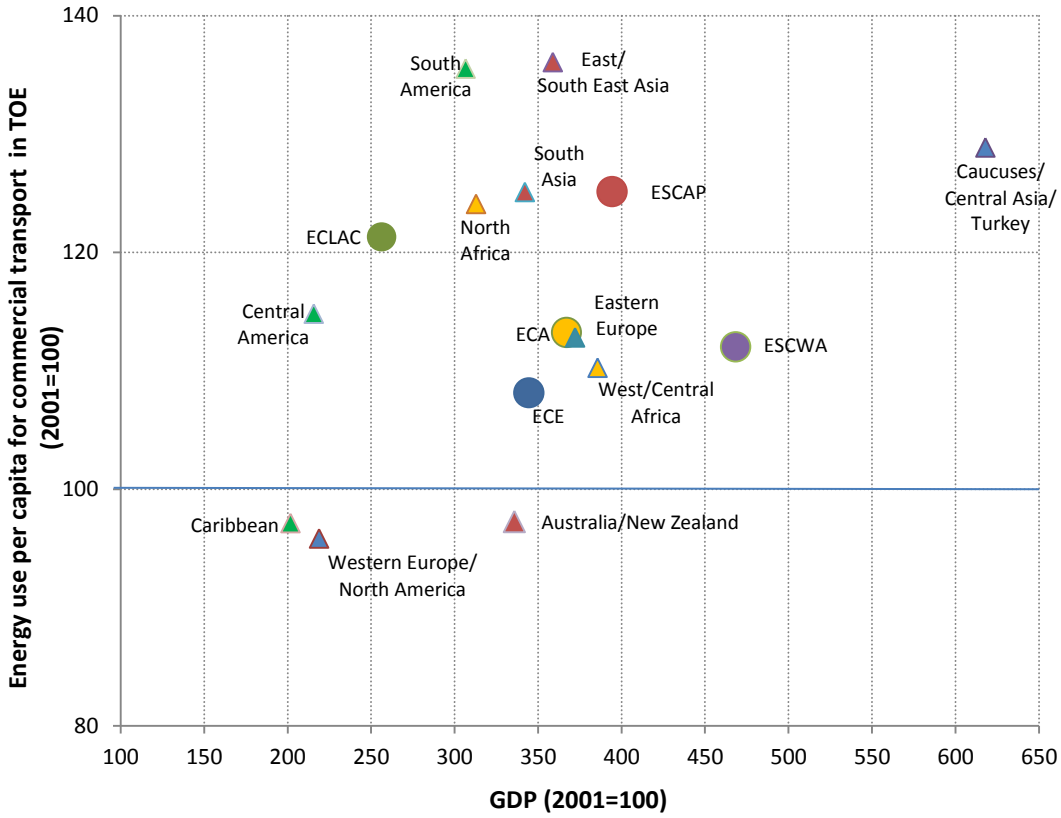


Fig. 2.13 Development of the energy use per capita (in TOE-Tonnes of Oil Equivalent) for commercial transport in the period 2001-2011 for different regions. It refers to primary energy use, before transformation to end-use fuels (indigenous production plus imports and stock use, minus exports and fuels supplied to ships and aircraft engaged in international transport). GDP at purchaser's prices (current US dollars), converted from domestic currencies using single year official exchange rates and calculated without making deductions for depreciation of fabricated assets or for depletion/degradation of natural resources (http://data.worldbank.org/indicator/NY.GDP.MKTP.CD).

According to recent projections (EIA, 2013), non-OECD transportation energy use will grow by 2.2 % annually in the period 2010-2040. China will lead the projected global growth in the demand for transportation fuels, as is projected to more than tripling its consumption from 8 in 2010 to 26 quadrillion Btu[19] in 2040, an energy consumption that will be similar to that of the United States of America (EIA, 2013). The projected growth in energy demand in the sector will require increased uptake of renewable energy based fuels and innovative solutions for their competitive application.

A recent study (Gujba et al., 2013) on the life cycle impacts and costs of the passenger transport sector in Nigeria for 2003–2030 has found that, under a Business As Usual-BAU scenario, the life-

[18] OECD member countries as of September 1, 2012, are the United States, Canada, Mexico, Austria, Belgium, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, Japan, South Korea, Australia, and New Zealand.

[19] One quadrillion (1×10^{15}) Btu (British thermal units) is equivalent to about 180,136,000 boe (barrels of oil equivalent)

cycle environmental impacts will double despite a projected 35% increase in fuel/vehicle efficiency; at the same time, fuel costs at the sectorial level will increase threefold, from US$ 3.4 billion/yr in 2003 to US$ 9.7 billion/yr in 2030. Increasing the use of public transport (buses) could reduce environmental impacts by 15–20% and fuel costs by 25–30 % relatively to the BAU scenario, whereas high economic growth with increased car ownership/private motorization and decline of public transport would increase environmental impacts and fuel costs by 16 and 26 %, respectively.

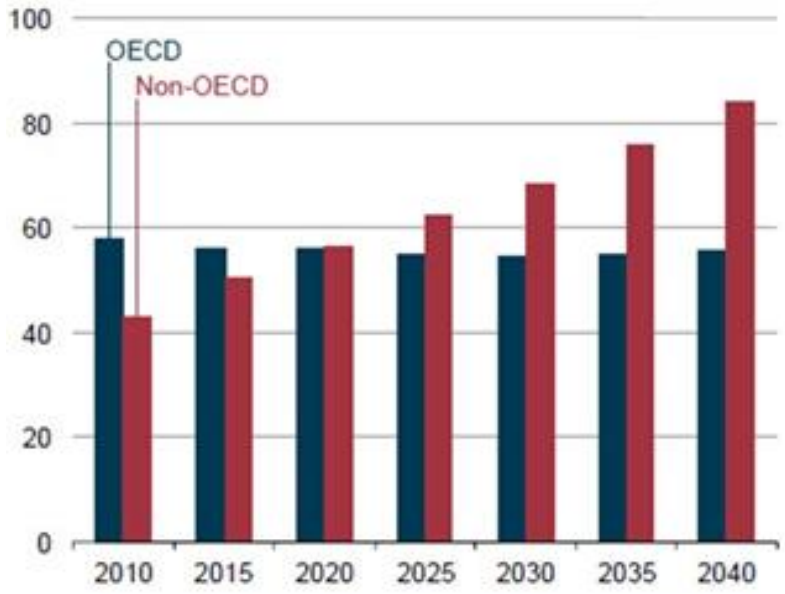


Fig. 2.14 Projected trends in the transportation energy consumption (in quadrillion Btu) in OECD and non-OECD countries, for the period 2010-2040 (EIA, 2013).

High oil prices together with the 2008-2009 financial crisis had a more profound impact on the OECD economies than on the non-OECD economies. Energy use for transportation in the OECD countries declined by 2 % in 2008, followed by a further decrease of 3.1 % in 2009, before recovering in 2010 (about 0.8 % growth). Slower economic and population growths are likely to drive a slow growth in OECD transportation energy demand in the short- to mid-term future. In addition, demand for transportation fuels in OECD countries will be constrained by policies aiming at strong energy efficiency improvements in the transportation sector. Recent studies suggest that in the period 2010-2040, transportation energy use in the OECD countries will decline by an average of 0.1 % annually, whereas, at the global level, transportation energy use is projected to increase by 1.1 % annually, driven by the high transportation growth projected for the non-OECD countries; in these countries, transportation energy use will increase by about 2.3 % per year (EIA, 2013).

In the ECE region, liquid fuel consumption per capita in the transport sector increased by 12 % in the period 1993-2008. Consumption peaked in 2007, when per capita consumption was 0.965 TOE. In 2008, Luxembourg and the United States were the highest per capita consumers while Tajikistan the lowest (UNECE, 2012).

In the ECLAC region the transport sector's energy demand represented 27%, 31% and 35%, in 1990, 2000 and 2010 respectively, of total supply (simple non-weighted averages) and was the largest single energy consumer in many cases. Its relative weight in the energy matrix is a function, on the

one hand, of the configuration of the transport sector's own energy demand, level of activity, modes of transport used, the size of the vehicle fleet, etc., and, on the other hand, the relative weight of other sectors, especially the electricity-generating and industrial sectors, which are equally large energy consumers in some countries (Kreuzer, F.M. and Wilmsmeier, G., 2014).

The Latin American countries can be divided into three groups: (a) low-consumption countries, which display varying patterns but in which, with the exception of the Dominican Republic , the transport sector has increased its level of energy consumption significantly; (b) intermediate-consumption countries (consumption levels between 2,000 and 20,000 ktoe in 2010), in which consumption levels also increased, but less sharply (Chile, Colombia, Ecuador , Guatemala, Peru and the Bolivarian Republic of Venezuela); and (c) high-consumption countries, in which the sector's energy use rose steeply (Brazil and Mexico) (Kreuzer, F.M. and Wilmsmeier, G., 2014). The absolute and relative intensities of energy use by the transport sector in the Latin American countries are determined by the exogenous factors of levels of economic activity, income levels and population growth and by the sector-specific factors of the distribution of modes of transport and their efficiency in a broad sense, which includes the technologies embedded in the equipment that is used, the level of use (load factors), the condition of the railway system and others. Key issues in Latin America and the Caribbean are the rapid expansion of the vehicle fleet, particularly vehicles used for personal transportation at a time when the roadway network has not kept pace with that expansion has turned mobility into a challenge and a high-priority issue in terms of comfort, transit times and air pollution for the governments of many cities, especially in Latin America. Another evident trend in Latin America is that the use of diesel fuel by automobiles has been on the rise, chiefly because the price of diesel is usually lower than gasoline and because the use of sport utility vehicles is increasing as well and most of these vehicles use diesel-fuelled engines.

The total gasoline and diesel oil consumption in road transport in 2012 in the ESCWA region reached about 391 million tons of oil equivalents. Although national proportions vary, the transport sector accounts for 30% of total regional fuel consumption. The transport sector fuel use is as high as 50% of total consumption in Iraq, while at the lower end it is 19% in the United Arab Emirates and in Oman. The transport sector in the ESCWA region relies on oil and oil products as its primary source of energy. Hence, oil and oil based products supplied 98.4% of energy consumed in the transport sector in 2011[20]. Natural gas use in the transport sector represents a small fraction, 1.6 percent (2011) of the total energy mix. The total greenhouse gas emissions associated to the transport sector account for 22 per cent of the total CO2 emitted; 85 per cent of which is attributed to in-land transportation[21].

2.4. Challenges

In the near to mid-term future, the transportation sector will face significant challenges. Continuation of the current trends in the economic growth, which has been consistently higher in

[20] http://www.iea.org/statistics/statisticssearch/report/?country=Oman&product=balances&year=2011
[21] Environment 2007 – International Conference on Integrated Sustainable Energy Resources in the Arid Regions, 28 January to 1 February 2007, Abu Dhabi.

developing countries than in the developed world, is likely to influence transportation patterns, particularly if such trends would couple with increases in the developing countries' consumption volumes and patterns. Nevertheless, increasing income inequalities might also affect demand/consumption and, thus, the transportation sector. In addition, changes in the global population size, age structure, household size, as well as the increasing urbanization could have significant impacts on inland transport, as they are also likely to influence transportation patterns and volumes. For example, road (highway) travel in the European countries is expected to grow slowly due to changes in the population age structure: as the average age increases, the number of licensed drivers and the average amount of highway travel per capita will probably decline in areas with already high motorization levels. At the same time, the fast-paced economic growth and socio-demographic changes in the developing countries are likely to increase uncertainties in the long-term development of the transportation sector, due to a greater flexibility in capital investment and the associated infrastructure/services development.

In the next decades, the nexus between transportation, energy and Carbon emissions will continue to pose challenges to the transport sector. Transportation energy demand is projected to increase in the next decades, due to the increasing private motorization of the non-OECD countries and the increasing freight transport in both developing and developed economies (EIA, 2013). At the same time, improvements in energy efficiency are likely to control future energy transportation demand in the OECD economies. Adaptation of more stringent fuel economy standards (e.g. EC, 2012a) will probably curb growth in transportation energy use in the developed economies, as will specially-targeted financial instruments. For example, many European countries have introduced increased fuel consumption taxes on motor vehicles to encourage fuel conservation. Although such taxes vary widely, diesel fuel is generally treated more favourably as it is generally 20-30 % more efficient than petrol in equivalent vehicles (see also Chapter 7).

With regard to energy use and income, there appear to be differential effects of energy use on individuals/households with different income levels; this also increases further social inequality. It seems that income inequality is also an obstacle to the uptake of new technology (e.g. electric vehicles), and can therefore be an obstacle to sustainable energy use (Andrich et al., 2013).

It has been suggested that global oil supplies will only meet demand until global oil production peaks; this could cause a global energy gap to develop, which will have to be bridged by unconventional and renewable energy sources (e.g. Salameh, 2003) and/or reduced demand. With regard to transportation, there is a scope for continued research and development to improve further car energy efficiency. A recent study (Daly and Ó Gallachóir, 2012) has modelled future car stock and policy and measures related to Ireland's transport energy demand in the period to 2030. Modelled policies/measures involved deployment targets for electric and compressed natural gas vehicles, European Union (EU) regulation for the improvement of vehicle efficiency and implementation of national bio-fuel obligations as well as encouraging modal shifting and reduced travel demand. The results indicated a possible improvement of 32 % in car stock efficiency and a 22% reduction in private car CO_2 emissions relative to 2009 levels, and a 7.8 % renewable energy share of road and rail transport.

It must be noted that decarbonisation targets have been already set in some areas. For example, the EU Roadmap 2050 specifies an 80% GHG emissions reduction target by 2050. Simulation of alternative EU decarbonisation pathways under technological limitations and climate policy delays (Capros et al., 2014) has shown that (a) the EU emissions reduction target is feasible within currently known technological options and at low cost (lower than 1 % of GDP in the period 2015–2050) and (b) delay on emission reduction action until 2030 will have significant adverse effects on energy system costs.

Decoupling between Carbon emissions and the associated transport activity is urgently required, which could be driven by e.g. alternative transportation options in urban areas. However, there is still a key uncertainty which is associated with the effectiveness of future policies to shape transportation demand – the effectiveness of policies promoting novel energy efficiency technologies and their timely uptake, the introduction of alternative-fuel vehicles and more efficient land-use planning. Finally, the sustainability of the transportation sector will also depend on its ability to adapt to the projected climatic changes and its resilience to climatic extremes (UNECE, 2013).

It must be noted that climate change and energy security are two of the key global policy issues of our time. At the same time, although the transportation sector is a very substantial energy consumer, currently accounting for about 55 % of the total liquid fuel consumption (EIA, 2013), it is also the sector from which it has been hardest to cut emissions. It appears that in order to make substantial progress in the future, action will be required at all levels of governance, from international to local. This is a difficult exercise, as transport governance is already very challenging due also to the varying structures in both formal governance and in the transport mode management across countries and regions (Mardsen and Rye, 2010).

3. Accessibility

In transport, accessibility refers to the peoples' ability to reach goods, services, activities and destinations from a given location, using the available transportation system. Many factors affect accessibility, including the transport needs and abilities of individuals, the quality of the transport options, the connectivity of the various links and modes, the land use patterns, and the quality/costs of alternative solutions (Litman, 2012). Transport accessibility has large impacts on both the economy and human development, as improved accessibility to transport can facilitate the achievement of many economic, social and environmental objectives.

This chapter will provide an overview of indicators relevant for transport accessibility assessment from the global, regional and national perspectives, defining current accessibility to transport for individuals and households, as well as for accessing international markets. The indicators help to identify and define challenges standing in the way of securing transport accessibility, a selection of which are presented in the second part of the chapter along with examples of best practices implemented towards overcoming regional and national challenges.

3.1 Transport accessibility: Individuals and households

In inland transport, individual/household accessibility can be assessed on the basis of several indicators, including the transportation infrastructure density, the integration of transport and land-use system, the level of the urban development and the individual travel requirements, choices and habits (e.g. Morris et al., 1979). There is no single way to evaluate accessibility, as different planning choices require different methods to account for different scales, modes and user perspectives. For example, neighbourhood transport planning requires 'walkability' analysis, while regional transport planning requires a thorough analysis of private car, bus/coach and rail travel options. In addition, the evaluation of accessibility depends also on income; accessibility should be evaluated differently for lower-income populations and for wealthier/business travellers.

National accessibility ⇨ High Mobility ⇨ Access to education, food, health and employment ⇨ **Social inclusion, individual economic development and reduced inequality**	
Key challenges	➢ Rural accessibility is a challenge in all regions; ➢ Fast urbanization worldwide calls for redesigning urban mobility conditions; ➢ Insufficient access to public transport in many urban areas; ➢ Walking and cycling is often rendered impossible or not safe due to lack of appropriate sidewalks and cycling lanes; ➢ Transport infrastructure quality is unsatisfactory in several countries of the world; ➢ Persons with reduced mobility require appropriate infrastructure; ➢ Congestion is an increasing challenge in urban and sub-urban areas.
Role of the United Nations	➢ Provide intergovernmental platforms for sharing of best practices, e.g. Inland Transport Committee (ITC), the PEP; ➢ Promote legal instruments for multilateral harmonization of classification of transport infrastructure for road, rail, inland motorway and intermodal transport, such as AGR, ACG, AGTC, AGN; ➢ Provide statistical and analytical information that assists governments in recognizing and handling national accessibility of transport; ➢ Assist in the promotion of public transport and capacity building.

3.1.1 Accessibility factors

Most of the social and economic functions of society require transport and, thus, accessible transport is a precondition for social and economic sustainability. Improvement of local transport infrastructure in e.g. rural areas can increase social inclusion of rural populations as well as their competitiveness and economic development.

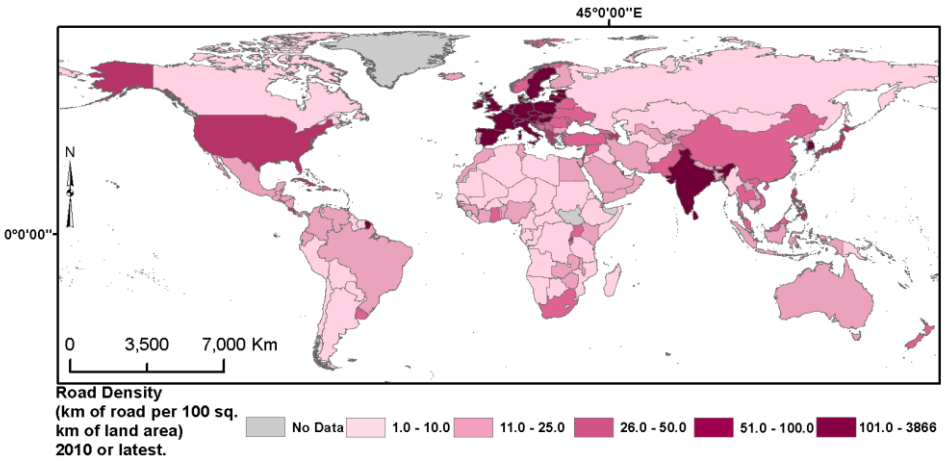


Fig. 3.1 Road density (in road km/100 km^2) in 2010 (or latest)

Assessments of national transport accessibility are complex exercises, as accessibility depends not only on the economic but also on geographic and demographic characteristics. Nevertheless, the infrastructure density of the transport network (Fig. 3.1), although a simple indicator, can still provide a first assessment of national transport accessibility. It is, however, important to recognize the limitations of this indicator. Construction of more roads and rail lines may improve network density, but may not necessarily provide the optimal accessibility solution. For example, traffic congestion in urban areas can lead to low transport accessibility, despite the large density of roads and the other transport infrastructure.

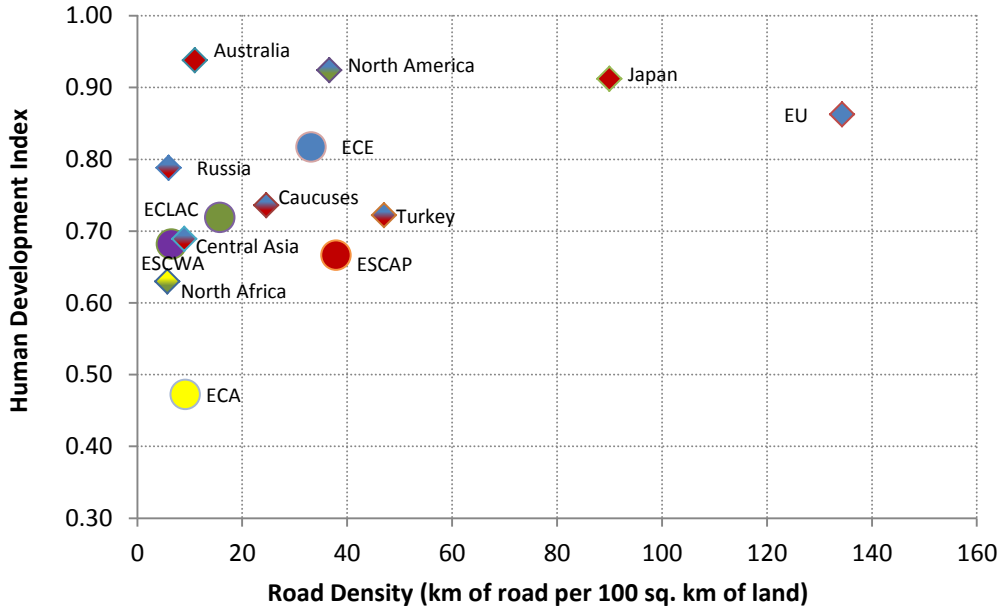


Fig. 3.2 Road density versus the Human Development Index (HDI) for different regions. Road Density (km of road per 100 sq. km of land area) is for 2010 or the most recent year available.

On a global scale, the highest density of roads (in road km/100 km^2) is found in developed countries, with certain industrializing countries (e.g. China) catching up fast. Nevertheless, the data show that road density might reflect also the area and population of the country[22], its physiography and demography (see e.g. the relatively low road density in Canada, Australia, Norway and Finland and the Russian Federation), as well as various other factors related to social and economic development. It is interesting to note that although an increasing trend of road density with the Human Development Index (HDI)[23] might be discerned at the national level (Fig. 3.2[24]), there is not, however, a strong correlation. Several countries exhibiting high HDIs are associated with relatively low road densities, suggesting a strong influence by other factors, e.g. the physiography and demography (e.g. USA, Canada, Russia).

With regard to the national road quality, first assessments can be made on the basis of the proportion of the paved road network relative to the total (Fig. 3.3). Again a similar pattern is observed, with the countries of N. America and Europe being those with the highest proportions of paved roads. There are, however, some notable exceptions, as certain Asian and African countries also exhibit large paved road percentages, whereas Sweden, on the other hand, is characterised by a relatively small proportion of hard-surfaced roads. It is important to note that as the road type/quality is mostly determined by needs and costs, many regions are made accessible through non-paved roads which can be constructed at a considerably lower cost than hard-surface roads.

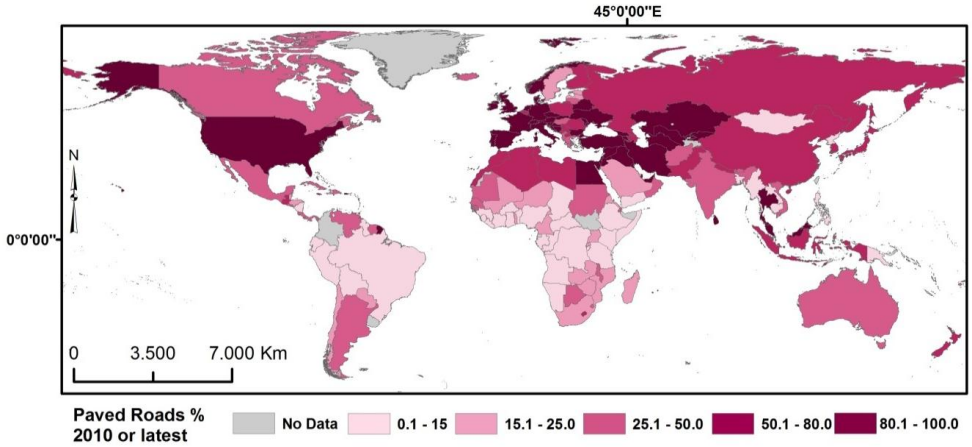


Fig. 3.3 Percentage of paved roads relatively to the total road length (2010)

In rural areas, social inclusion and individual development is dependent on the presence of an adequate inland transport network i.e. the presence of roads or railways that can facilitate the required social and economic functions efficiently and safely. Nevertheless, accessibility is not a concern only in rural areas. Urban areas also face transport challenges, due to the ever-increasing

[22] However, statistical analysis (Table A2) has shown that there is no significant correlation neither between land area nor between population and road density.

[23] The Human Development Index (HDI-UNDP) is a composite statistical parameter that contains information on life expectancy, education and economic indices of the countries and is used to rank them into tiers of human development. It sets a minimum and a maximum for each dimension, called goalposts, and then assesses country standing in relation to these goalposts (expressed as a value between 0 and 1). For further information see http://hdr.undp.org/en/statistics/hdi.

[24] Data sources for figure: HDI - http://hdr.undp.org/en/content/table-1-human-development-index-and-its-components; Road density - http://data.worldbank.org/indicator/IS.ROD.DNST.K2.

transport needs and to their already intensive land-use, which constrains further transport infrastructure development. Further urbanization may lead to traffic congestion and, thus, increased air pollution, to traffic noise and nuisance as well as to a scarcity of parking spaces. For example, rapid private motorization has resulted in reduced availability and higher costs of parking spaces in Chinese cities, presenting a major urban transport challenge. Management of this situation requires intervention by city authorities that are not necessarily institutionally prepared for efficient planning, regulation and management of private car parking facilities (e.g. Wang and Yuan, 2013).

Mobility of groups with special needs can also be challenging. Children and young individuals require special attention, as adequate transport access to educational institutions is crucial for their development. At the same time, elderly and/or disabled individuals also have specific transport requirements. The World Health Organization (WHO) estimates for the previous decade indicate that about 2.9 % of the global population was severely disabled and about 12.4 % was moderately disabled. Social inclusion of these groups requires reasonable access to health institutions and cultural and social activities and, therefore, increased requirements regarding transport accessibility (UNECE, 2012).

3.1.2 Regional trends

Road, railway and Inland waterway density[25]

Most African and, to a lesser extent, Asian and Latin American countries are characterised by low road densities per unit of land area (Figs 3.1 and 3.2); such road density distribution, coupled with the relatively large rural populations, explains the low Rural Access Index- RAI[26] in these countries (Fig. 3.6 below). Figure 3.4 plots a regional comparison of km of road per 100 km^2 and km of road per 1000 inhabitants.

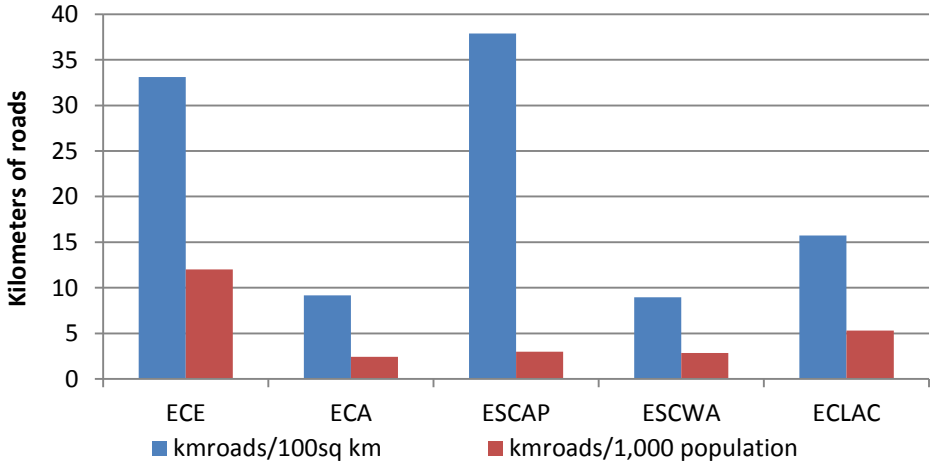


Fig. 3.4 Regional comparisons of kilometre of road per 100 km2 of area and kilometre of road per 1,000 inhabitants in 2011.

[25] National road density data source: http://data.worldbank.org/indicator/IS.ROD.DNST.K2

[26] The RAI is an index measuring the proportion of rural population living within 2 Km (typically equivalent to a walk of 20-25 minutes) of an 'all-season road', relatively to the total rural population. An 'all-season road' is a road that is accessible all year round by the prevailing means of rural transport (typically non-four wheel drive pick-ups or trucks); occasional interruptions of short duration during bad weather (e.g. heavy downpours) are accepted, particularly on lightly trafficked roads (Roberts et al., 2006).

Road density per unit of population is variable in the ECE region. Sweden has the highest road density (56 km of roads per 1,000 inhabitants), followed by Estonia (41 km per 1,000 inhabitants) and Iceland (39 km per 1,000 inhabitants). There are considerable differences within the ESCWA region in terms of road density, both in the per capita and spatial dimensions. The proportion of paved roads is above 50% in all countries with available data (2010). Road density in Asia and the Pacific continues to increase, but remains low in comparison to more developed regions of the world. From 2005 to 2011, the road spatial density in Asia and the Pacific increased from 25 to 38 km of road per 100 km^2 of land area, an increase of 50.1 per cent compared to a global growth of 10 per cent over the same period. However, the spatial density remains low compared to EU28 at 134 km per 100 km^2 (2011), or USA at 67 km per 100 km^2 (2011).

Canada has the highest per-capita railway density among ECE member states (1.7 km of railway lines per 1,000 inhabitants). In terms of spatial density, the highest rail density in the ECE region is found in Belgium and the Czech Republic while the lowest is recorded in Kyrgyzstan (Fig. 3.6). Some ECLAC countries, like Argentina and Uruguay exhibit high levels of rail density, as measured by the ratio of total railway lengths to the national territory (17 and 12 km/1.000 km^2, respectively) (Sánchez R. and Tomassian G., 2012), but even these levels are significantly lower than the average for the Western Europe (48 km/1.000 km^2) and the United States (20 km/1.000 km^2).

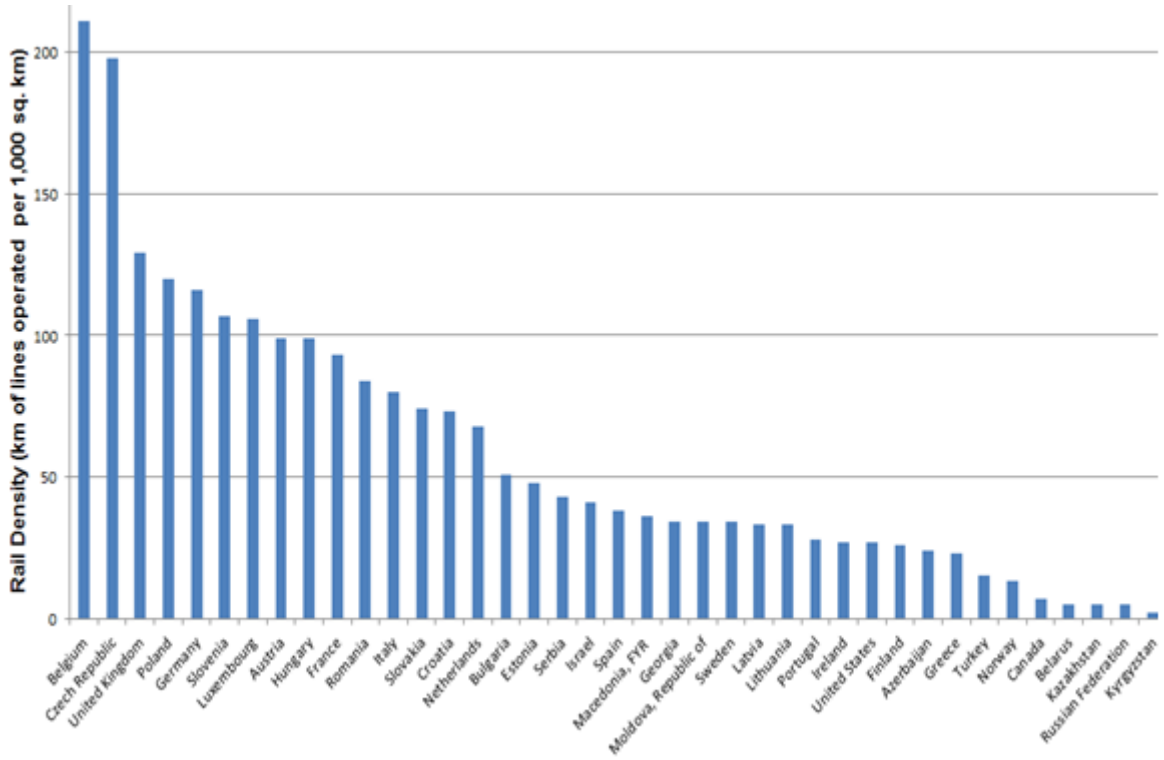


Fig. 3.5 Rail Density in the UNECE region (data from 2012, or the most recent year available)

The ESCWA region has one of the lowest density rail networks in the world. Transport of goods and passengers has proved ineffective in many Arab countries. Railways of Tunisia and Jordan are being operated for the haul of phosphates at a financial loss which has prohibited investments in improving the service. Even in cases where railway is used for passenger traffic, such as Egypt, substantial losses are being incurred. Nonetheless, the only cost effective rail transportation in the

region is experienced in the Moroccan and Syrian contexts. The railway density in these two countries is 4.7 and 11.6 km/1,000km^2. The percentage of freight transported through rail in the Arab region represented 5% of the total freight calculated by weight hauled in the 1990s and dropped further to 2.4% in 2005.

Railway density in Asia and the Pacific has not seen great progress historically; however, increased government investment in railways continues to improve the overall availability and quality of rail services. Railway density in the region remained at 6.5 km per 1,000 km2 in 2010. This is low compared with railway density in North America and in Europe. However, the increased investment in railways by Governments in the region reflects concern regarding the carbon footprint of the transport sector and the need to make greater use of the capabilities offered by intermodal transport[27].

The density of inland navigation waterways is typically less than 200 m per 1,000 inhabitants in the ECE region with a few exceptions; for instance, in the Netherlands there are almost 400 m of inland navigation waterways per 1,000 inhabitants (UNECE, 2012). The ECLAC region is characterized by a significant inland navigation potential, however the average share of this mode of transport in passenger and cargo transport remains – in most of the cases – very modest (Sánchez and Tomassian 2012).

Private motorization[28]

Private motorization varies considerably from country to country. The highest motorisation rates are in small countries, with Malta (596 passenger cars per 1,000 inhabitants), Iceland (646 passenger cars per 1,000 inhabitants) and Luxembourg (664 passenger cars per 1,000 inhabitants) topping the 2011 European list. Twenty-four of the 41 ECE countries for which data are available show motorisation levels of 400 to 600 vehicles per 1,000 inhabitants.

The numbers are drastically different on the African continent, which has the lowest average motorization rates of all continents. Out of 45 African countries with available data, only eleven have motorization levels above 100 vehicles per 1,000 inhabitants, out of which only Libya surpassed the 200 vehicles threshold (2007 data), while thirteen countries have motorization levels below 10 vehicles per 1,000 inhabitants. In 2010, the car ownership rate for the ESCAP region was much lower than the global average, but the ownership rate in its high-income economies (405 per 1,000 people) was similar to that of Europe (434 per 1,000 people), but lower than that of North America (606 per 1,000 people) [29].

The total number of vehicles (excluding motorcycles) in the ESCWA region in 2008 was about 26.7 million, with an average annual growth rate of 4.2% between 1997 and 2008, exceeding the at the time predicted annual growth rates of 2.8% for developing countries. Passenger cars in the region represent about 60% of the total road transport fleet. There is a considerable diversity in the structure of the transport sector among ESCWA countries. In 2008, the regional motorization rate was 91 vehicles per 1,000 inhabitants, with a considerable diversity among countries, as it varies from 555 in Qatar, to 36 in Egypt, to 19 in the Sudan.

[27] http://www.unescap.org/stat/data/syb2013/h.2-transport.asp
[28] Data source unless otherwise indicated: http://data.worldbank.org/indicator/IS.VEH.NVEH.P3
[29] http://www.unescap.org/stat/data/syb2013/h.2-transport.asp

Urban accessibility

As mentioned at the beginning of this chapter, accessibility refers to the opportunity of citizens to reach goods, services, activities (jobs, education, healthcare, recreation, etc.) and destinations from a given starting location, using the available transportation system (infrastructure and modes). Accessibility in a particular urban setting very much depends on the synergy and interaction of the existing urban layout, transport infrastructure, public transport system, urban population size and density, private motorization rates and the existing transport modal share. While no two urban agglomerations are alike, they are all based on one or another form of urban layout and transport system, and various combinations of the two, facilitating different levels of accessibility for their citizens. Cities can be densely populated, compact and walkable or public transport based, or sprawling and car oriented. These different types of cities exist all over the world, at various different levels of development (Rode et al., 2014).

A key indicator of sustainable mobility in an urban setting is the degree to which a city as a whole and the goods, services and activities pursued by its citizens are accessible to all of them. Accessibility is central to the concept of achieving more sustainable urban transport and improving the sustainability of cities. From the perspective of accessibility, enhancing urban mobility transcends infrastructure and transport systems improvements merely for the sake of achieving greater speeds, effectiveness and efficiency of transport systems. Rather than enabling a simple means to reach destinations, transport systems improvements should aim at ensuring equitable access for citizens to reach desired destinations (services, healthcare, recreation) and access opportunities (employment, education), regardless of individual wealth, age, gender or possible health condition resulting in reduced mobility. Thus, equitable mobility is not only a matter of developing transport infrastructure and services, but of overcoming social, economic, political and physical constraints to peoples' movement (UN-Habitat, 2013).

Urbanization

Available data (UN-Habitat, 2013) demonstrates that we can very much count on the urbanization trend, increasingly present since the industrial revolution, to continue for the foreseeable future, especially strongly in the coming years in Asia and Africa. The global urban population rose above 50% of total population in 2008. In 2010 it reached 52% and it is projected that 63.2% of the global population will be living in cities in 2030. The trend of increasing urbanization during the next 15 years will be led by strong population growth in cities of the ECA region, the total population of which will double compared to 2010 levels during the period, increasing urban population share of total in the region from 36% in 2010 to 46% in 2030.

Strong urban population growth is also expected in ESCWA and ESCAP cities, which will expand by 54% and 46% respectively compared to 2010 populations, reaching in 63% of total population in the ESCWA, and the 60% of total population ESCAP region by 2030. Urban population growth in the ECE and ECLAC region will not be as pronounced in the next 15 years, growing by 7% and 18% respectively, however these two regions are already, and by a significant margin, ahead of the rest of the world in terms of the urban to rural population ratio, as in 2010 the proportion of total population living in cities in the was 73% ECE region (78% projected by 2030) and 79% in the ECLAC region (83% projected by 2030).

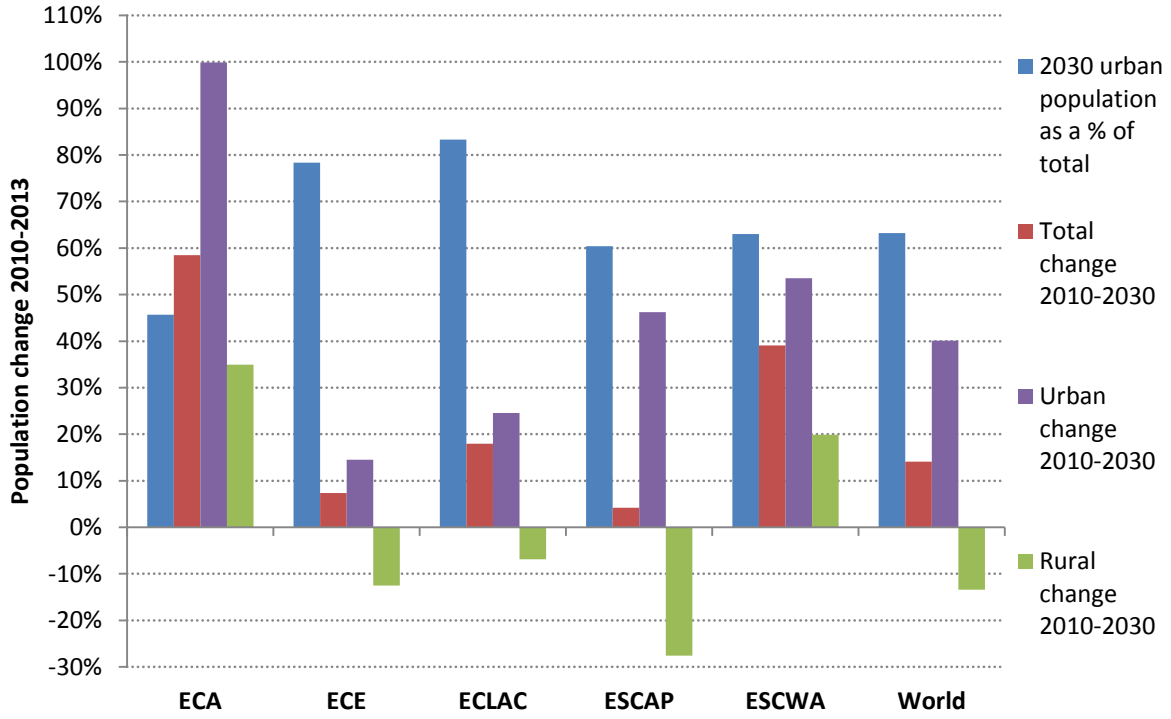


Fig. 3.6 Regional urban population changes 2010-2030 (data source: UN-Habitat, 2013)

Although urbanization is certainly a global trend (Fig. 3.6), urbanization rate projections for 2030 are very diverse among members of individual UN economic and social commissions. In ECA countries projected 2030 urbanization rates are between 17.5% and 90%, the spread in the ECE region moves between 30.7% and 89.2%. ECLAC countries 2030 urbanization rate projections vary between 56.6% and 95.5%, ESCAP between 17% and 96.8%, while the urbanization rate projections in ESCWA states are between 39.2% and 99.7%.

Urban Mobility

As cities and their populations are constantly growing, new mobility and accessibility challenges arise relative to the individual concepts of urban planning and expansion implemented out across the globe. Such challenges are particularly pronounced in developing countries where strong migration to urban areas and increased private motorization fuelled by strong economic growth, are outpacing infrastructure development and the expansion and modernization of public transport systems.

Chile, 8 years of successful Free-Flow Tolling

Over the last two decades, the Chilean government has developed a plan of concessions under the BOT (Build, Operate and Transfer) model and has transferred the role of the investor in the construction of the public infrastructure (particularly on the main road network) to the private sector. Private groups account for the investments to build, equip the roads, operate and maintain them. Investment and maintenance costs are recovered applying a “user pays” approach and collecting toll fees for the concession period.

In 2005, the capital city of Chile, Santiago pioneered the development of concession-interoperable and multi-lane free-flow urban highways. This network crosses the city from North to South (Autopista Central), from East to West (Costanera Norte), whilst it also covers the Northwestern

(Vespucio Norte) and Southern (Vespucio Sur) ring road surrounding the busy metropolitan area of 7 million people. The urban highway network was also extended to the San Cristobal Tunnel connecting the downtown and the Northern areas of the city. Another concession (AMB) was awarded to operate a fast route to Santiago International Airport. In 2014, the Ministry of Public Works contracted the Spanish group OHL for the Vespucio Oriente motorway completing a ring road linking Vespucio Norte and Sur.

In this context, interoperability enables any customer of one of these concessions to use one single electronic identification On Board Unit (OBU) for all electronically operated concessions, and to receive only one single invoice at the end of the month with the accumulated toll fees (1 provider/1 contract/1 invoice principle). Interoperability further enables access to newly installed multi-lane free-flow networks and to new applications such as parking and traffic management.

The Ministry of Publics Works ensured interoperability by establishing a well-structured legal and technical framework and a central database of the National Record of OBU Users (RNUT) as well as by using the DSRC CEN-278 standard as common electronic transaction protocol based on the Chilean ST1 norm.

Between 2003 and 2013, the applied scheme for the Metropolitan Area of the city was able to cope with an almost doubled population from 925,000 to 1,695,000 vehicles. The initial investment of 1,500 Million USD by road concessionaires have had an important impact on the local economy and proven to attract further investments. The multi-lane free-flow system, implemented and technically maintained by the Austrian company Kapsch, has not only increased customer convenience and a number of add-on services, but has also freed the urban space of the former infrastructure toll plazas. The changes contributed to road safety and to travel time savings of up to 50% as well as considerable reductions in gas consumption and negative externalities such as air pollution and noise.

Government institutions and planning processes should emphasize accessibility over mobility. The process of achieving more sustainable urban transportation systems designed with the principle of accessibility at their core is dependent on the participation of all stakeholders in cities, the authorities, the private sector and the citizens, along the lines of principles of democracy. A successful process will depend on effective governance of land use and transportation, where new housing and commercial planning will entail simultaneous transportation systems design, careful neighbourhood design, strategic infrastructure investments, and fair, efficient and stable funding (Kennedy et al., 2005; UN-Habitat, 2013).

As a result of a range of factors such as diverse urbanization rates, variety in existing urban layouts, existing modal splits, different governance structures and resource availabilities worldwide, there is no universal optimal formula that can be applied to secure sustainable urban mobility and accessibility of citizens of the different urban agglomerations. Compact, mixed-use cities with high quality infrastructure, combined with policy measures that facilitate inclusion of all stakeholders in decision making processes, along with charging the true social cost of using private motorized vehicles to secure increased modal share of sustainable modes, are components of sound strategies for achieving of sustainable urban mobility in cities.

Rural accessibility

Rural accessibility is variable across the world (Fig. 3.7). Rural Access Index-RAI estimates (Roberts et al., 2006) have shown that about 900 million rural dwellers do not have adequate access to transport systems, with the index being lower in developing countries and, particularly, the countries of South Asia (RAI = 57 %) and Sub-Saharan Africa (RAI = 34 %). It appears that there is a correlation between the RAI and various social factors such as poverty, maternal mortality and gender equity, indicating that improved transport accessibility for individuals can have impacts on major development goals, such as poverty reduction. For example, the improvement of rural accessibility in Vietnam has also been associated with significant poverty reduction (UNECE, 2012).

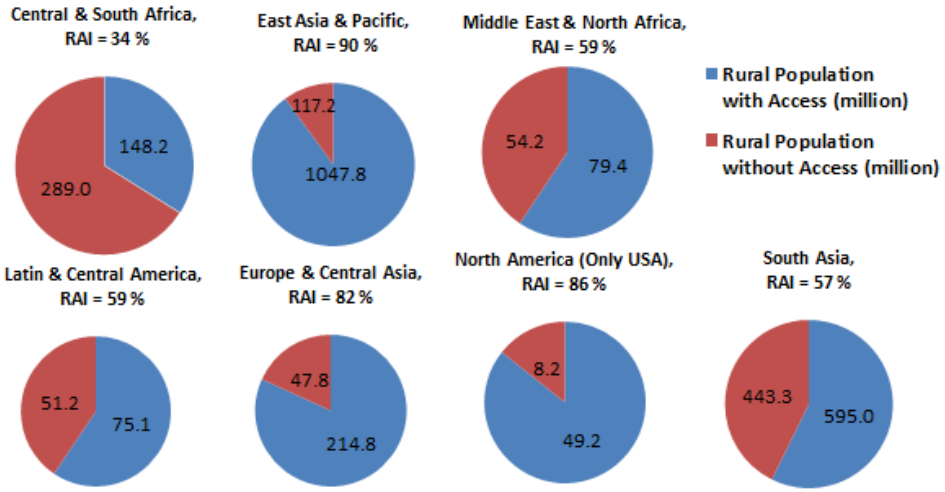


Fig. 3.7 Rural populations in the different regions living, within 2 km of an all-season road (2004 data).

During the past decades, rural accessibility has been considerably improved in the ECE region (UNECE, 2012). Nevertheless, significant challenges still exist. Improved accessibility, especially in the rural areas, is important for economic and social sustainability. However, with regard to the broad scope of rural areas economies in transition of the region, improving transport infrastructure is a particular challenge due to the scarcity of public funds, the relatively low financial return on transport infrastructure investment and the considerable environmental footprint as a result thereof. For example, there are about 39,000 settlements (i.e. about 10 % of the total population) in the Russian Federation that access the transport network only through non-paved roads. Therefore, as a considerable section of this population is at risk of losing links to the transport network during the annual periods with high precipitation, ensuring transport access for these people has been amongst the main objectives of the Russian Federation's transport strategy towards 2030 (UNECE, 2012).

A number of achievements in integrating road networks and sustaining rural transportation at regional and national levels were reached in ESCWA countries during the past decade. Between 2008 and 2009 Jordan carried out development of road networks, extension of roads to rural areas and linking provinces by building bridges and tunnels, in addition to maintaining, rehabilitating and asphalting roads linking remote areas. Within the scope of a five year plan, from 2007 until 2011, the government of Qatar implemented 32 projects to build new roads, bridges and tunnels, as well as to carry out maintenance of existing roads, with a total value of US$8.24 billion. At the

beginning of 2008, ten major projects were launched in villages and remote towns for the purpose of establishing an integrated road network with modern infrastructure (US$101.6 million). Egypt raised road construction investments from US$73.3 million in 2003 to about US$366.3 million in 2008. In addition, it raised road maintenance investments from US$36.6 million in 2003 to about US$146.5 million in 2008. As a result, the length of the network serving remote and poor areas increased by about 2,640 km during the period of 2003-2008. Finally, Palestine allocated US$70 million in 2009 for rehabilitation of old roads and construction of new, mainly agricultural roads.

Population trends

Population aging can also affect transport accessibility. Fig. 3.8 shows the changes in the proportion of the population older than 65 years during the period 1993–2013. The proportion of elderly populations to the total have increased in 50 of the 52 ECE Member States for which data are available, with nineteen Member States showing increases greater than 30%, a further four greater than 50%, Bosnia and Herzegovina by more than 100%, while only Norway, Tajikistan and Kyrgyzstan showed an actual proportion decrease compared to 1993 rates. In absolute terms, the over 65 population increased by 31% in the ECE region between 1993 and 2013 (and is 15% of total population); it was doubled in three countries, while increased by more than 50% in a further six states.

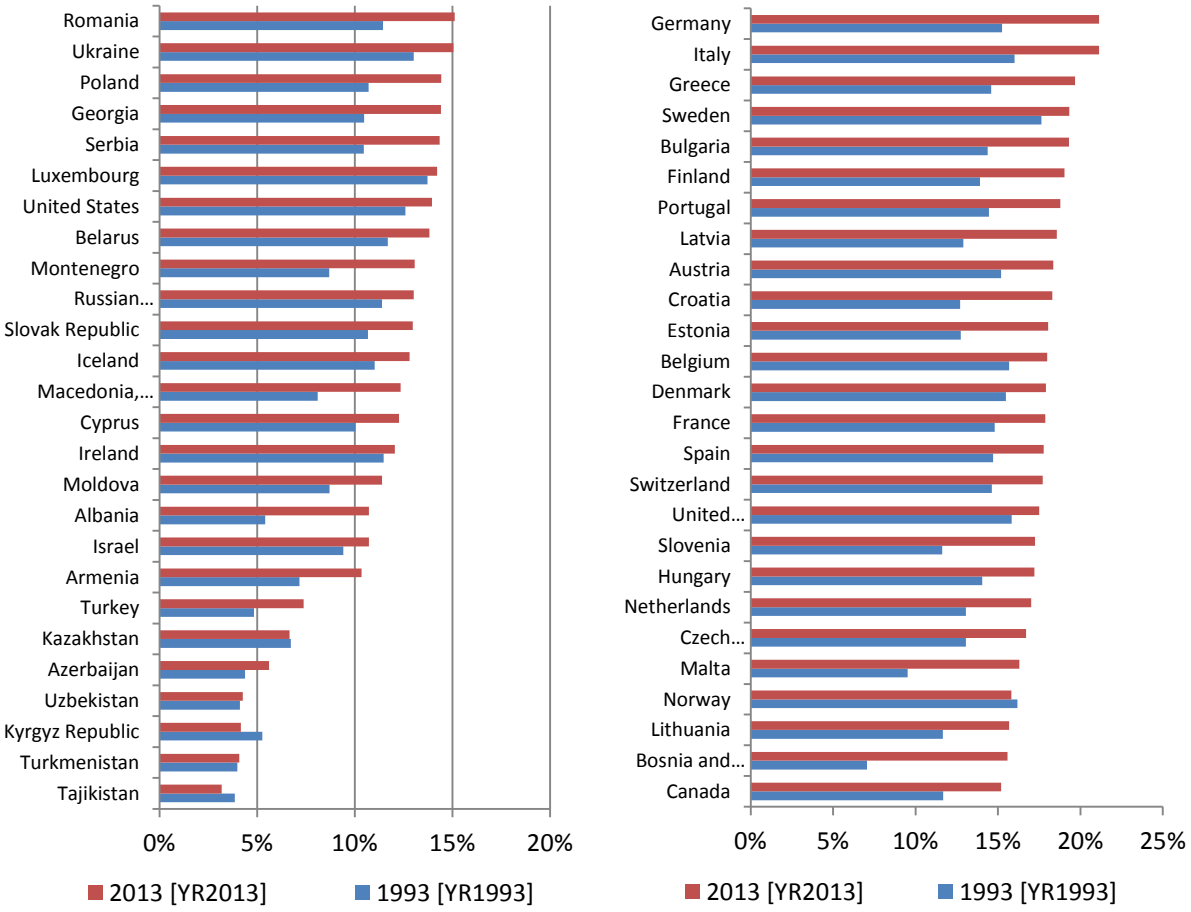


Fig. 3.8 Change (1990-2013) in the proportion of elderly (over 65 years old) population in ECE Member States (source: The World Bank)[30]

[30] http://data.worldbank.org/indicator/SP.POP.65UP.TO.ZS

The trends are similar in other regions of the world. Growth in the over 65 years of age population is exceeding the total population growth rate on all continents, as much as by a factor of three in Asia-Pacific and Latin America. Such changes in the population age distributions must be considered carefully when designing future transport systems; elderly people are likely to have particular needs, which must be accommodated.

Similarly, individuals with long standing illness and/or poor health have also particular needs that must be considered in the planning/design of the future transportation systems. This is especially important in recent war/conflict areas where not only have there been transport infrastructure damages but also numbers of people with long standing health issues and special needs are increased. Fig. 3.9 shows the share of the population with a long-standing health problem in the EU-27 Member States for 2012. It appears that very substantial proportions of both the total and the employed EU-28 populations are burdened with a long-standing health problem. It is interesting to note the high proportion of employed people with long-standing health problems in some countries, which indicates that health problems do not necessarily imply exclusion from the labour market; it also suggests that, at least for those countries, the existing transport infrastructure and services can facilitate the social and economic inclusion of individuals with health problems.

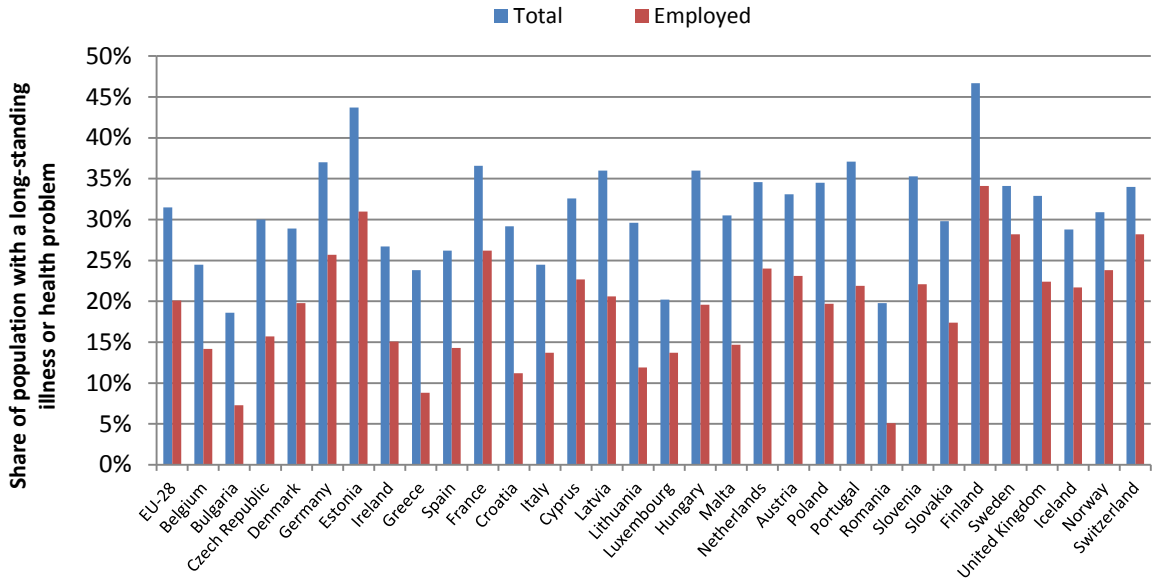


Fig. 3.9 Share of the population with a long standing illness or health problems in the EU-28 Member States in 2012 (Source: Eurostat)

In general, contemporary train coaches and buses are, more or less, accessible to nearly all users, whereas terminals and interchanges in e.g. the mature, large transportation systems of old metropolitan areas are usually not so well equipped; this presents operators with extensive and costly challenges. Ferrari et al. (2013) have found that 50% of the most frequently monitored journeys in London may become 50 % longer due to wheelchair accessibility constraints. Nevertheless, total travel times could be reduced very significantly if network approach methodologies were implemented to rank stations in order to minimise the divergence between accessible and non-accessible routes. Such studies highlight the potential of 'smart card' data analysis to provide operators with maximum value from their infrastructure investments. It

appears that the growing mobility needs of the elderly and people with disabilities and diminishing public finances require investment prioritisation in areas that could deliver the greatest benefits to users. The factors, and their interactions, affecting transport accessibility for individuals, as well potential policy/activity outcomes (abandon, relocate, reschedule and replace) are summarised in Figure 3.10.

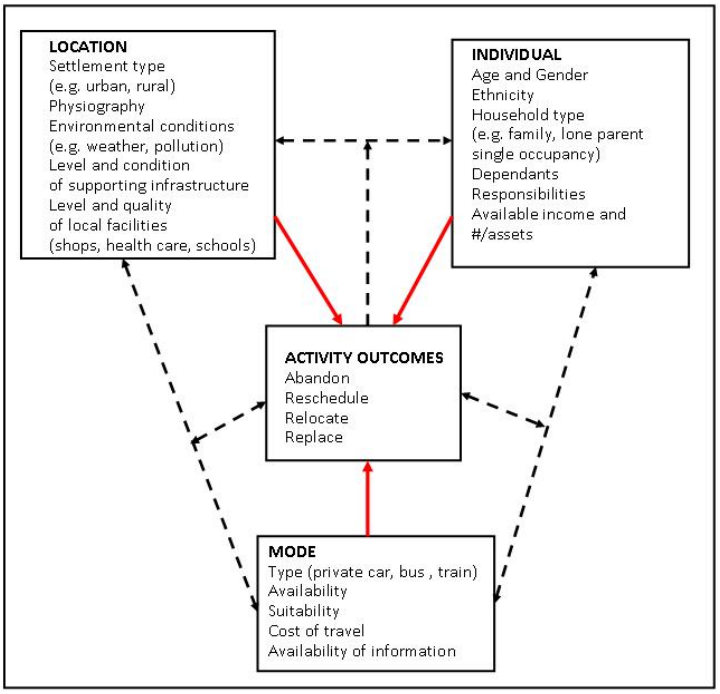


Fig. 3.10 Factors affecting individual transport accessibility and their interactions. It should be noted that these operate in the context of the wider economic and legislative framework (e.g. employment opportunities, pricing mechanisms, local and national regulatory system and transport policies). (Source: Lucas (2010)).

3.2 Transport Accessibility: Access to international markets

International transport links are the most important facilitator of global trade and a prerequisite for economic development. Participation in global supply chains is essential for attracting foreign investment and enterprises as well as human capital. Foreign trade is especially important for small, land-locked and sea-locked economies, which are also dependent on hinterland and/or sea connections and border crossings. Emerging land- and sea-locked economies require particular attention, as their geography constrains trade and economic development.

International accessibility ⇨ Participate in global trade ⇨ Increased competitiveness⇨ Economic development	
Key challenges	➢ Underdeveloped international transport links are undermining national and regional competitiveness; ➢ The burden of crossing borders is high in parts of South-eastern Europe, the Caucasus, the Central and East Asia, countries of the ESCWA region and Africa; ➢ Landlocked countries are particularly disadvantaged with respect to international trade; ➢ Linking continents requires global harmonization of transport competitiveness.

Role of the United Nations	➢ Provide platforms of cooperation to connect regions and continents through internationally harmonized inland infrastructures, e.g. TEM, TER, EATL; ➢ Provides assistance in identification of bottlenecks, missing links and quality of service in infrastructure networks; ➢ Promote trade and transport facilitation legal instruments and practical solutions, such as the Harmonization Convention, the TIR convention, CTU Code; ➢ Assist in the improvement of transport competitiveness.

3.2.1 Accessibility factors

Fig. 3.11 shows the total foreign trade (imports plus exports) as a percentage of (nominal) GDP. In some countries total foreign trade appears to be the dominant economic activity (e.g. Africa and Southeast Asia), indicating a great dependence on international trade. In these countries, domestic production and/or demand are limited, creating a significant need for foreign trade. Inefficient transport links can hamper both export and import due to increases in the final pricing of goods and services, thus efficient and reliable international links are essential for their economic growth, particularly in the case of developing and/or land-locked economies. At the same time, there is a scope for such countries to facilitate increases in domestic trade, which may 'unlock' their socio-economic potential; these increases should be underlined by an increase in inland transport infrastructure investment (see also Chapter 4).

In comparison, foreign trade appears not to be as dominant a factor in developed economies and/or large countries, such as the United States of America, Western European nations, Australia, Brazil and the Russian Federation; in these countries, the domestic markets are large enough to create sufficient demand for goods and services, and most industries are well represented.

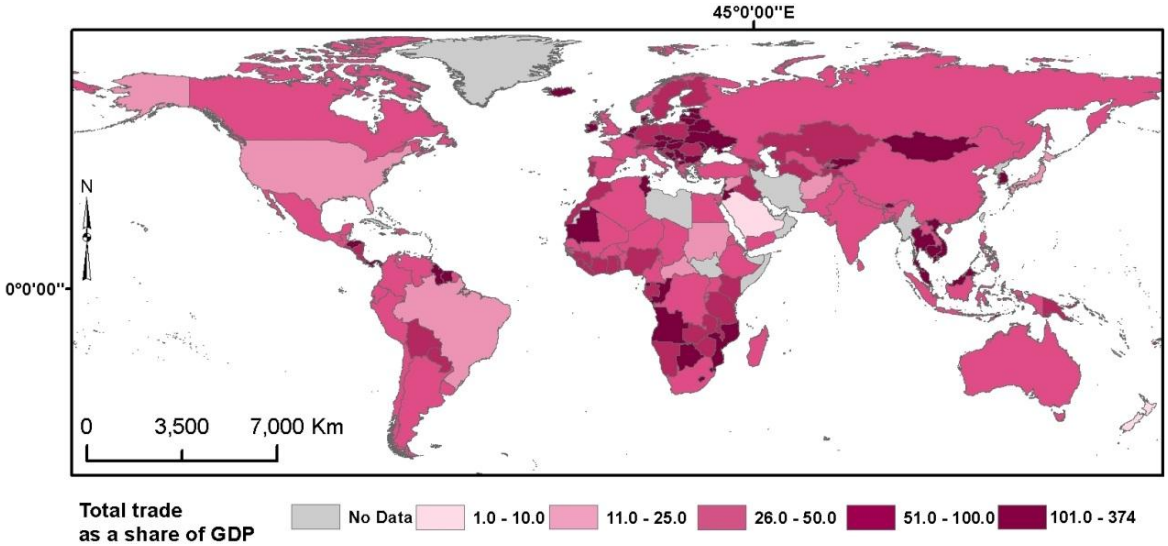


Fig. 3.11 Total international trade (the sum of exports and imports of goods and services) as a share of GDP (in current U.S. dollars) in the period 2005-2012 (Source: The World Bank)

International trade is a very significant constituent of many ECE Member States economies (Fig. 3.12). However, no particular pattern emerges, as the statement is valid for both developed economies of the Western Europe (e.g. Luxemburg) and economies in transition. In several ESCWA

countries, Bahrain, Iraq, Jordan and United Arab Emirates total foreign trade is larger than GDP, indicating their dependence on engaging in international trade patterns.

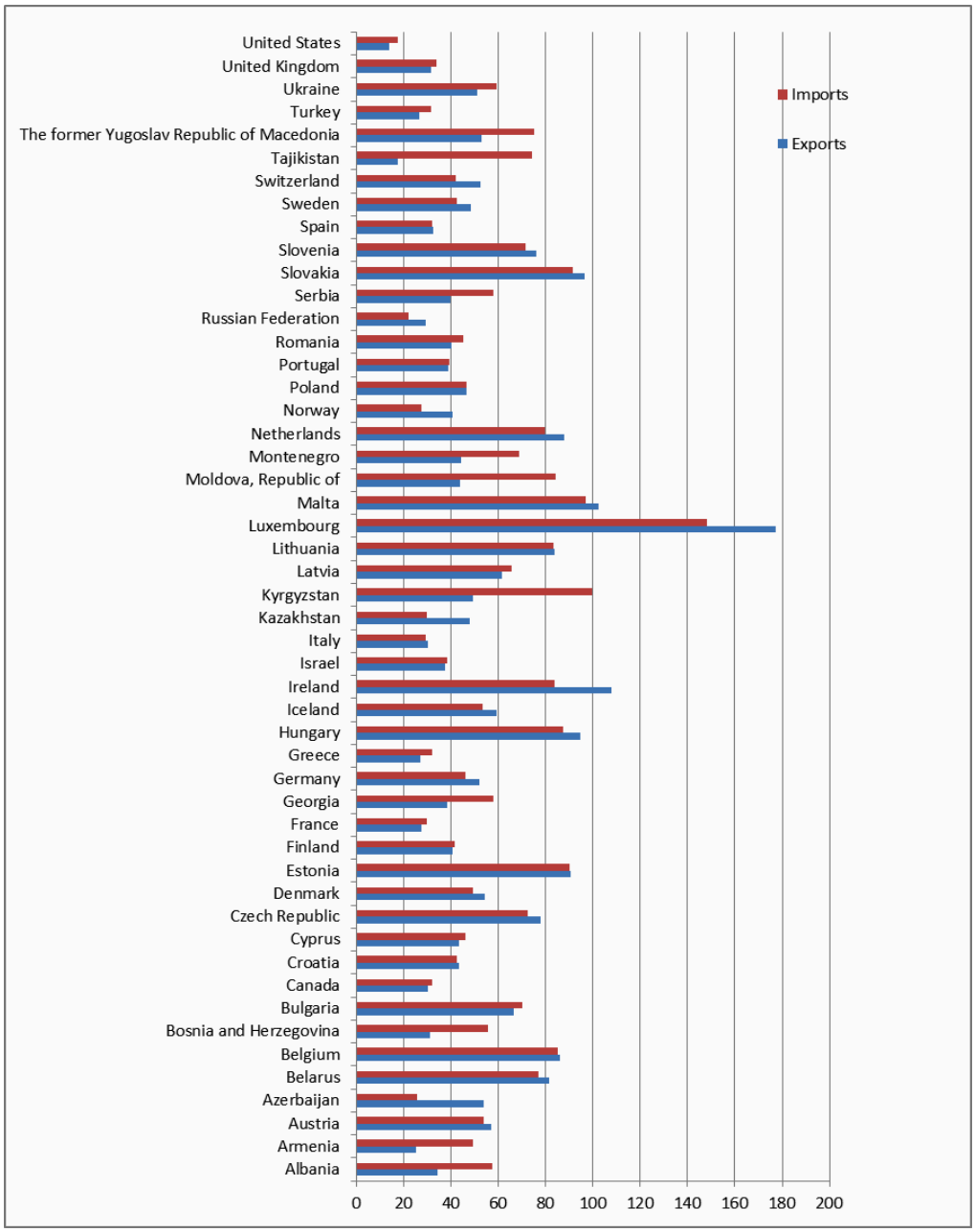


Fig. 3.12 Foreign trade of goods/services as a share of GDP (2012) in ECE Member States (where data exists)

The above trends can be also recognized in the global distribution of inland freight transport volumes (Fig. 3.13). Inland freight transport tends to involve higher volumes in developed and/or large countries, where the dependence on international trade (which is mostly facilitated by maritime and/or air transport) is lower than that of the smaller and/or land- and sea-locked countries.

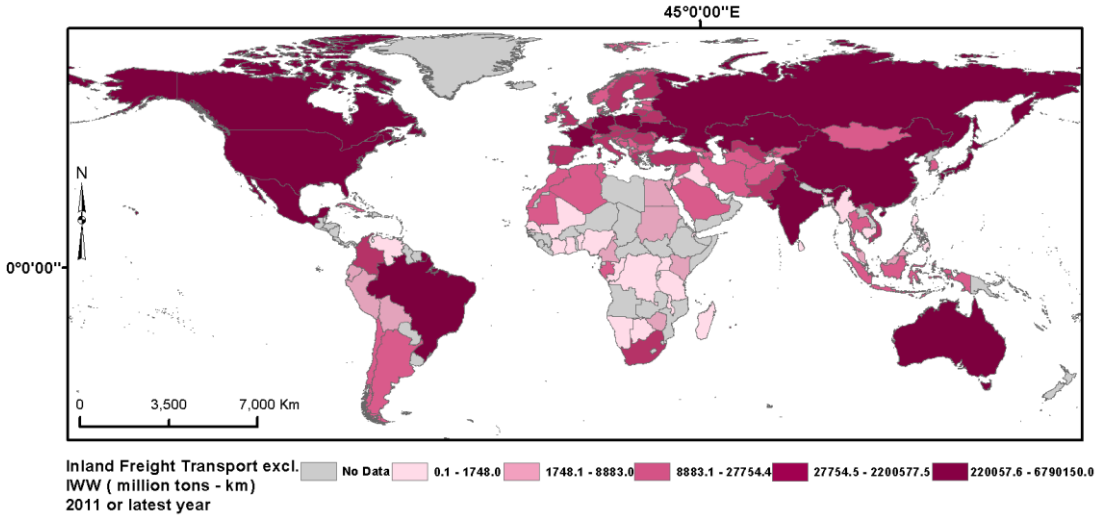


Fig. 3.13 Inland freight transport, excluding Inland Waterways transport-IWT. It includes goods transported by railway (metric tons times km travelled) http://data.worldbank.org/indicator/IS.RRS.GOOD.MT.K6 *and goods transported by road (millions of metric tons times km travelled)* http://data.worldbank.org/indicator/IS.ROD.GOOD.MT.K6.

In the EU, road transport, although more flexible than the other transport modes, lags behind maritime and air transport. In terms of value (imports and exports), maritime transport has been by far the most important transport mode. In September 2010, freight with a worth of €128 billion was transported by sea, €57 billion by air and €43 billion by road. In terms of inland transport volume, as shown in fig. fig. 3.13, road transport is the dominant mode for goods in the EU.

Table 3.1 Modal split of freight transport volume in select regions and countries (adapted from: EC, 2014)

FREIGHT TRANSPORT					
	CHINA	EU-28	JAPAN	RUSSIA	USA
billion tkm	2012	2012	2012	2012	2011
Road	5953.5	1692.6	210	249	2038.9
Rail	2918.7	407.2	20.5	2222	2649.2***
Inland waterways	2829.6	150		61	464.7
Oil pipeline	317.7**	114.8		2453	968.6
Sea	5341.2	1401*	177.6	45	263.1

*(domestic / intra EU28); ** oil and gas pipelines; *** Class I rail.

Intra-regional trade has always been less important in intra- Latin American trade than in Europe (i.e. within the European Union), but since the foundation of the Latin American Integration Association (LAIA) intra-regional trade in the South America, in particular, has more than doubled its shares until the year 2000. The total intra-regional trade in South America amounted to 85.4 billion current USD in 2010. The total value of intra-regional trade has therefore increased 2.9 times since 2000. The volume of trade (tons) in the region increased from 60 million tons in 2000, reaching a level of 64 million tons in 2010. Brazil, Chile, Colombia and Peru trade over 75% of their overall trade with markets outside the region in 2010. Bolivia, Paraguay and Uruguay are the countries with the greatest share of intraregional share in terms of value in 2010. The maritime transport remains the most important mode in terms of volume and value in intraregional trade,

with a share of 60.1% (volume) and 46.1% (value) respectively, followed by road transport with 34.6% (volume) and 41.8% (value). Air transport is only of relevance in terms of value as it was responsible for 8.8% of all intraregional trade in terms of value[31].

In addition, international trade also depends on the efficiency and reliability of border crossings. Border controls including customs can be costly and time- and resource-consuming. Fig. 3.14 provides data on the efficiency of border crossing, based on the World Banks's Logistics Performance Index (LPI). It appears that a dedicated effort is required in order to improve efficiency across the board, as many countries (mostly in South-eastern Europe, the Caucasus, the Central and East Asia and Africa) show below average scores. Such border crossing inefficiency may hamper economic development, as it makes business less attractive. In comparison, the relatively high LPIs of most of the EU countries demonstrate the usefulness of international cooperation agreements and practices.

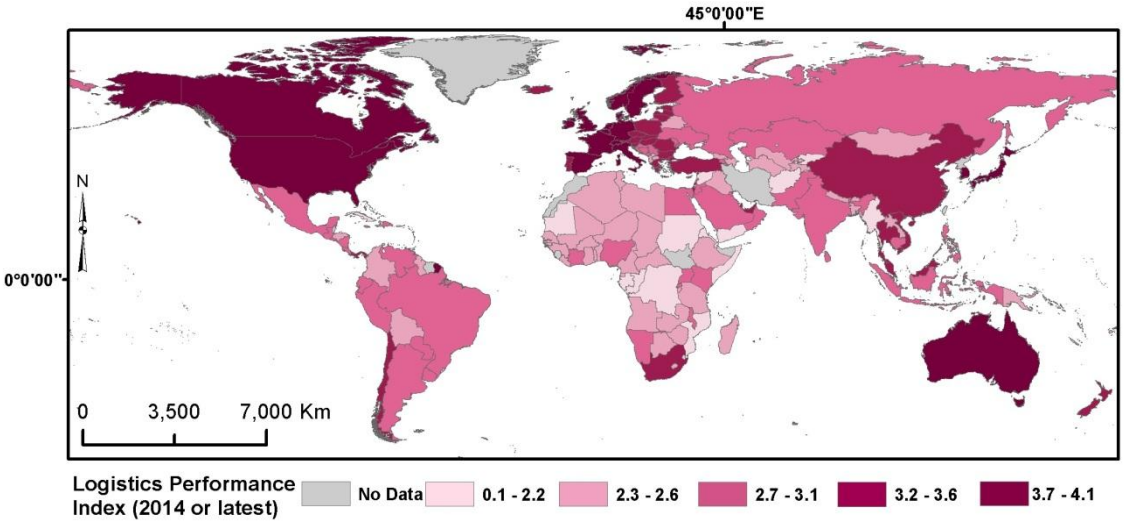


Fig. 3.14 Global distribution of the Logistics Performance Index (The World Bank) that assesses the efficiency of the customs clearance process (1-low to 5-high)[32].

Cost of land transport in the ESCWA region is relatively low when compared to the rest of the world due to low fuel prices and cheap labour. Even unofficial costs associated with the transportation of goods by land are low compared to other regions. However, the low cost of land transport in the region is undermined by the long delay at the borders which increases the overall cost of transport.

A recent survey of costs, time and distance on international corridors in the Arab region between 2012 and 2013, indicates that trucks spend on average 48% of the trip time at the border

[31] Source: Wilmsmeier, G. and Guidry, L. (2013). The Evolution of Modal Split for Goods Transport in South America. Bulletin FAL Issue 325, No. 9/2013, ECLAC, Santiago, Chile..

[32] Information is gathered from a large number of World Bank surveys, conducted in partnership with academic and international institutions and private companies/individuals engaged in international logistics; the 2009 surveys covered more than 5,000 country assessments by nearly 1,000 international freight forwarders. Respondents the speed, simplicity and predictability of custom clearance process on a rating ranging from 1 (very low) to 5 (very high). Respondent scores are averaged across all respondents. Details on the survey methodology can be found in Arvis et al. (2010).

in the League of Arab States (LAS) corridor which includes Jordan, Iraq, Saudi Arabia, Kuwait, Lebanon, Syria, Oman, Yemen, Libya and Qatar.

Table 3.2 below shows that the average speed of trucks on the LAS corridor is around 12 km/h, a low speed compared to 15km/h for the Economic Cooperation Organization (ECO) corridor through Afghanistan, Azerbaijan, Kazakhstan, Kyrgyzstan, Iran, Tajikistan, Turkey and Turkmenistan.

Table 3.2 Comparison of transport in countries of the League of Arab States and countries of the Economic Cooperation Organization (Source: IRU, 2012)

	LAS (NELTI[33] 4)	ECO (NELTI 3)
Average Speed/ trip	11.8 km/h	14.6 km/h
Average Distance per day	283 km	352 km
Average waiting in queues at borders	48% of total time trip	17% of total time trip
Average Unofficial payment	24 USD	718 USD

3. 3 Challenges and best practices for transport accessibility

3.3.1 Individuals and households

In passenger transport, improved accessibility promotes mobility and, thus, better access to education, food, health and employment. A decade ago, a study of the impacts of low transport accessibility was carried out in the United Kingdom (Social Exclusion Unit, 2003). The study found that: (a) lack of transportation was an employment barrier for 38 % of jobseekers; (b) 1.4 million individuals did not seek medical assistance due to transport access problems, over a 12-month period; (c) amongst people without access to a private car, 16 % had difficulties accessing the supermarket (compared to 6 % of the total population) and 18 % had difficulties meeting friends and relatives (compared to 8 % in the total population); and (d) 45 % of the respondents said that, according to their opinion, the most serious transport problem has been the inadequate public transport. National and local initiatives have been created to deal with these issues, including increased funding for rural and urban bus services, integration of routes and new ticketing systems, as well as a transport schemes to support access to work (UNECE, 2012).

Improving accessibility is a challenging task. In rural areas, investment for expanding/upgrading the transport network is scarce, whereas, at the same time, expanding rural transport networks might have significant environmental impacts. In urban areas, the lack of space constrains expansion of and/or structural changes in the transport network; moreover, the environmental and health impacts of an expanding urban transport network may be very significant. Traffic congestion is an increasing problem, particularly for fast industrializing non-OECD countries. For example, many urban areas in Malaysia are faced frequently with severe traffic congestions and associated efficiency losses (idle road time), particularly in areas where increased private motorization couples with constrains in traffic capacity and limited space availability for further transport network expansion. In such cases, the promotion of public transport and/or of alternative transport modes appears to be the only sustainable solution (Chee and Fernandez, 2013).

[33] IRU New Eurasian Land Transport Initiatives

Establishing and operating a community bus service in Sri Lanka[34]

In 1998 a pilot project was implemented in Sri Lanka to assess the feasibility and capacity of a village community to manage its own community bus service. The bus service is still in operation, despite the fact that the project implementing agency withdrew its support about six years after the service was established. One of the indirect impacts of the project was the improvement of a rural access road, which resulted in a number of similar rural transport projects which drew on the experiences of this project.

The target group of the project, the 3,500 (at project start) inhabitants of Kosgala, Kitulpe and Halpe villages, is situated 13 km north-west and 6 km south of the closest major settlements where they can access markets for their agricultural products, purchase consumer goods and access health, education, police and postal service. In 1996, the only public transport available for reaching those major settlements was a 4-6 km walk away.

The outcome of the project secured the following benefits for the inhabitants of the three beneficiary communities:

- *Access to education*

  Students and teachers have a regular and timely bus service facilitating access to regular and extracurricular education activities

- *Access to healthcare*

  Inhabitants have dependable and scheduled transportation to visit clinics seeking medical assistance or in order to visit hospitalised family members.

- *Meeting economic and other daily needs*

  Easier access to markets where the target population engages in trade and procurement of goods. Shop keepers enjoy savings in cost and time spent on public transportation, and transport goods with greater ease. As the population no longer needs to walk 4-6 kilometres to reach public transport, the surplus time is used instead for leisure or additional production, leading to an improved quality of life for residents of the three villages.

- *Improved road quality as an added value and decreased cost of hired private transport as a result of market mechanisms*

Similarly, a rapid decline in bus and rail use in many Chinese metropolitan areas due to large-scale sub-urbanization has driven a rapid expansion of private motorization, leading to higher traffic congestion and air pollution, and reduced traffic safety. Presently, many Chinese cities consider using the concept of Transit-Oriented Development (TOD) to lead urban growth onto a more sustainable pathway. A recent study in Dalian, a coastal city with a population of over 6 million and a long tradition in public transport where TOD planning has been officially embraced, indicates that before attempting to pursue TOD policies in other Chinese cities, these should meet some critical conditions, such as pedestrian friendly urban design, high quality transit services and good transport governance (Mu and De Jong, 2012).

[34] Further information about the project can be found in *"Transport and Communications Bulletin for the Asia and the Pacific"* No.84,2014

The diagnosis and prognosis for the long-term sustainability of urban transport depends on the region. In West Africa, 'paratransit'[35] in its various shapes constitutes a strong transport component, which, however, is difficult to regulate/organize. Designing sustainable schemes for fixed-route mass public transport is hampered in a significant part of the West African urban populations by the gap between public transport costs and income levels. In comparison, there have been large investments in mass public transport systems in the North African urban areas (Godard, 2013). In some South African cities, public transport transformation projects have been initiated, which in most cases ultimately envisage replacement of 'paratransit' operations with formal transport systems. Complex and lengthy negotiations with existing operators as well as budget constraints are likely to delay or even block a total transformation. As a result, South African cities are likely to depend on a 'hybrid' public transport system that combines both formal and 'paratransit' operators for decades (Ferro et al., 2013).

It is a widely-accepted notion, that the distribution/location of the mass-transport (transit) infrastructure controls the distribution of publicly-funded benefits to urban populations, in both developing and developed economies. In order to have an equitable distribution amongst different population groups, targeted policies, which should strive to improve substantially transport accessibility and travel times for the socially and economically disadvantaged sections of the population, are required (see e.g. Foth et al., 2013).

Rural Ambulance Services in India - Karnataka and Tamil Nadu States[36]

The National Rural Health Mission (NRHM) in India funded a nationwide initiative to support rural ambulance service - the "Dial 108 service". This was largely adopted from a not-for-profit organization, the Emergency Medical Research Institute (EMRI), which has initiated 108 services early on. The aim is to extend universal access to basic and advanced life support services to those living in rural areas. One of the key objectives is to reduce maternal, infant, and child mortality by transporting those who need emergency medical attention within the 'Golden Hour'. Emergency Response Services (ERS) transports pregnant women, infants, children, trauma (accidents, cardiac arrest and others), and other patients, and provide referral transport (inter-facility transfer).

As a result of the program the annual child and maternal mortality rates decreased between 4% and 11% in the two states, thus contributing towards efforts dedicated to achieving progress in the MDG indicators.

The case study demonstrates the usefulness of the public-private partnership model in converging technology, management, skill-building, funds and political will, and offers useful suggestions for setting up low-cost emergency medical transportation services for the rural population, which can also serve urban areas, both in India and in other countries.

Generally, improving transport accessibility and, thus, achievement sustainable transport, requires the implementation of innovative/creative policies and solutions. It appears that it could

[35] Paratransit is an alternative mode of flexible passenger transportation that does not follow fixed routes or schedules, using typically minibuses and or sharing of taxis. Paratransit services can be operated by public transit agencies, community groups, non-profit organizations, and private companies or operators.

[36] Further information about the project can be found in *"Transport and Communications Bulletin for the Asia and the Pacific"* No.84,2014

be beneficial if the focus of such policies would shift from plans/projects responding to the existing trends (reactive approach), to plans/projects attempting to modify those trends so they can be addressed in a more innovative, efficient and cost effective manner (pro-active approach). In this context, there have been efforts to identify challenges, try new approaches and share experiences, ideas and 'best 'practices (see e.g. Mitric, 2013). One of the tasks at hand to address the problem is the recording and analysis of up-to-date information directly relevant to transport accessibility (e.g. road and rail density, time series of freight and passenger transport volumes, distribution and efficiency of intermodal nodes, the Rural Access Index). This exercise should be undertaken at the international level, using common, user-friendly platforms and analysis tools. Moreover, there is a necessity for new initiatives that study new approaches, both from the theoretical perspective and as case studies. At the same time, regions/countries that do not perform well in the traditional accessibility indicators (e.g. the RAI) should be provided with assistance in order to upgrade their systems to achieve an acceptable level; otherwise, these regions/countries will be left behind in the race to improve human development.

There are numerous examples of good practices associated with increasing the transport accessibility of individuals with special needs. For instance, the Linz's (Austria) 'barrier-free travel (Ungehindert mobil) for individuals with special needs' project has created a transport system friendly to individuals with special needs through the installation of widespread wheelchair ramps, designated spaces in public transport and ground marking to assist individuals with impaired vision, and the availability of public transport maps and timetables in Braille. In another example, an adequately equipped and staffed waiting room for people with impaired hearing was set up in the main train station of Düsseldorf (Germany) in 2007 (UNECE, 2012). Analysis of the challenges and efficiency of such efforts, as well as the dissemination of the lessons learned can provide valuable insights into the different approaches to improve transport accessibility.

World Bank support in Armenia - 'Lifeline Roads Improvement Project - LRIP'

The project was initiated in July 2013, with a World Bank financing of US$ 146.6 million[37]. In addition, the World Bank advises on road construction standards, the improvement of road safety, the enhancement of the sustainability of road financing and management, the adoption of new road design and maintenance technologies and approaches. It has also provided a US$ 40 million loan to rehabilitate 190 km of roads in rural Armenia, where low rural access hinders the transport of crops to market having as a result, in some cases, a loss of at least 40 % of the harvest; this project had also a direct impact on employment, as its total job impact (direct and indirect) has been estimated to be 19,000 person-months of employment equivalent.

It appears that issues related to transport accessibility for individuals are of paramount importance for the sustainability of transport and require a multi-level approach. As a first step, relevant, up-to-date information should be collated in a user- and analysis-friendly format at international level, involving as many countries as possible. In the ECE region, the UNECE statistical platform, which provides information about national transport infrastructure and allows countries to compare/evaluate relevant development, identify problems, raise awareness and share ideas

[37] See http://www.worldbank.org/en/country/armenia

and practices, could be utilised/expanded and linked with other relevant transport information platforms to meet this challenge. It should be also noted that cross-cutting issues, such as transport, environment and health, should be also considered (see e.g. The Transport, Health and Environment Pan-European Programme - PEP)[38], as they are likely to have large impacts on the assessment and planning options of transport accessibility.

3.3.2 Access to international markets

International transport accessibility is a key factor for the attractiveness of an economy. It facilitates a more efficient and cost effective movement of goods and people, increases competitiveness and attracts human and economic resources, leading to the achievement of a 'critical mass' of business activities and knowledge. Nevertheless, accessibility to international markets presents its own challenges in addition to those mentioned to above.

Firstly, improvements in connectivity through *strategic long-distance links* should be considered and planned. These links, which can promote cooperation, trade and engagement in an international economic environment and allow for exchanges of ideas/practices, should also involve integration of transport modes that could enable connectivity/intermodality between the different inland transport modes. Furthermore, the international nature of the strategic long distance links requires international infrastructure agreements covering all inland transport modes, such as road, rail, inland waterways as well as combined transport. Such agreements reinforce relationships between international trade partners through coordinated plans for the construction/development of international transport infrastructure, built under compatible technical standards.

A number of important international inland transport infrastructure agreements are in place in Europe, such as the ECE's 1975 European Agreement on Main International Traffic Arteries (AGR), the 1985 European Agreement on Main International Railway Lines (AGC) and its Protocol, the 1991 European Agreement on Important International Combined Transport Lines and Related Installations (AGTC) and its Inland Waterways Protocol, and the 1996 European Agreement on Main Inland Waterways of International Importance (AGN) (UNECE, 2012). In complementing these international agreements, ECE has carried out 3 sub-regional infrastructure projects in collaboration with participating countries, i.e. the Trans European Motorways (TEM) Project[39], the Trans European Railways (TER) project[40] and the Euro-Asian Transport Links (EATL) project[41], the main objectives of which have been the facilitation of road traffic in Europe as well as development of an efficient international road, railway and combined transport system in the ECE region. The TEM and TER projects form the backbone of the Pan-European Road Corridors and are linked to EU's Trans-European Transport Network-TEN-T projects[42]. The Euro-Asian Transport Links (EATL) is a joint undertaking between UNECE and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) with designated national focal points from 18

[38] See www.thepep.org/en/publications/THEPEP.assessment.en.pdf)
[39] See http://www.unece.org/trans/main/tem/tem.html
[40] See http://www.unece.org/trans/main/ter/ter.html
[41] See http://www.unece.org/trans/main/eatl.html
[42] See http://ec.europa.eu/transport/themes/infrastructure/index_en.htm. For the state of the TEN-T Priority Projects see http://tentea.ec.europa.eu/en/ten-t_projects/30_priority_projects/)

participating countries[43]; its main objective has been to identify main Euro-Asian road and rail routes for priority development and a large number of projects have been already evaluated/prioritized in many participating countries.

BelToll – Belarus' electronic toll collection system

Built and operated by Kapsch, the Belarus' toll collection system is boosting the country's attractiveness for international transit

The M1 (*Magistrale* No. 1) is the strategically most important road in the country of Belarus. It is part of the E30 expressway, a stretch of which – approximately 560 kilometres between Brest in the western part of the country and Orscha in the east – has been expanded into a highway. The M1 links two key economic areas: the European Union and the Russian Federation. The M1's fully electronic toll collection system enables smooth traffic flow along the route – and subsequently on other Belarusian roads. The toll collection is fully automatic, and functions without any disruption of traffic or stopping of vehicles. Moreover, the collected revenues can be used for maintenance, modernization and expansion of the road network.

The most attractive route between Europe and Russia

The transit road through Belarus has become the most attractive route for transport between Europe and Russia. With alternative routes being approximately 1,000 kilometres longer, the passage through Belarus is time-saving and contributes to a reduction in CO2 emissions. Since Belarus is a member of a customs union with Russia and Kazakhstan, there are further logistical advantages. The reduction in transit time and fuel costs underscores the M1's attractiveness in comparison to alternative routes – on which tolls are also collected. These advantages are also reflected in the road's utilization. Around half of the traffic on the M1 is attributed to transit. Most of the vehicles come from Russia (12 percent), the Ukraine (10 percent), Poland (10 percent), and Lithuania (7 percent). Around 80 percent of all vehicles have a total weight of more than 3.5 tons and only around 16 percent weigh less than 3.5 tons. 5 percent of the tolls collected are attributable to busses. In summation, more than 200,000 vehicles have been registered for BelToll since its launch in July 2013.

A proven system

The BelToll system is based on a proven technology that is utilized in various countries all over the world. In Europe alone, eight of the national "multi-lane free-flow" (MLFF) toll collection systems are already in daily use. Kapsch has built five of them. The Austrian company was selected to build similar systems in Australia, New Zealand, South Africa, Chile, and the in the US. These systems consist of an on-board unit (OBU) placed inside the vehicle and providing communications with the road-side infrastructure via DSRC (Dedicated Short Range Communication, or "microwaves" as commonly called). The vehicles pass through the toll collection points, and fees are calculated and charged automatically. There are already 90 such check points in Belarus alone – found along its most important highways. Including the M1, the network has a total length of

[43] The 18 countries from the Euro-Asian region were: Afghanistan, Armenia, Azerbaijan, Belarus, Bulgaria, China, Georgia, Iran (Islamic Republic of), Kazakhstan, Kyrgyzstan, Republic of Moldova, Romania, Russian Federation, Tajikistan, Turkey, Turkmenistan, Ukraine and Uzbekistan. At a later stage, Greece also joined the initiative.

1,189 kilometres. 52 customer service centres distributed throughout the country provide road use contracts, borrow OBUs in return for deposits, and top up customer's credits. In Belarus, the launch was accompanied by a major informational campaign which is partly responsible for BelToll's high acceptance level in the country.

Advance financing and additional jobs

Just 16 months after the awarding of the contract the BelToll system has already been commissioned in July 2013. Kapsch provided full advance financing for the system so the Belarusian budget was not impacted. The majority of the revenues flow into modernization and safety measures for the toll roads. This has an immediately visible impact. What is less obvious, but of great significance for the economic development of the country, is the fact that BelToll has created new jobs in Belarus. All of the approximately 150 employees are citizens of Belarus.

http://www.beltoll.by/

In the region of Latin America, several regional integration initiatives deal with the issue of the transport infrastructure integration. Of particular interest is the Initiative for the Integration of Regional Infrastructure in South America (IIRSA), which since 2000 has coordinated the development of transport, energy and telecommunications infrastructure in the region. It has now become the technical arm of UNASUR - the Union of South American Nations, an intergovernmental organization that integrates the regional agreements, including the Common Market of the South (MERCOSUR) and the Andean Community of Nations. In December 2012 the total number of transport projects in the UNASUR/COSIPLAN/IIRSA portfolio was 474, with highway projects accounting for the largest share at 47.5%, while multimodal projects accounted for the smallest share with 3% (Sánchez R. and Tomassian G., 2012).

Towards national and regional public policies on sustainable transport: Promoting integrated and sustainable policies on logistics and mobility in Latin America and the Caribbean

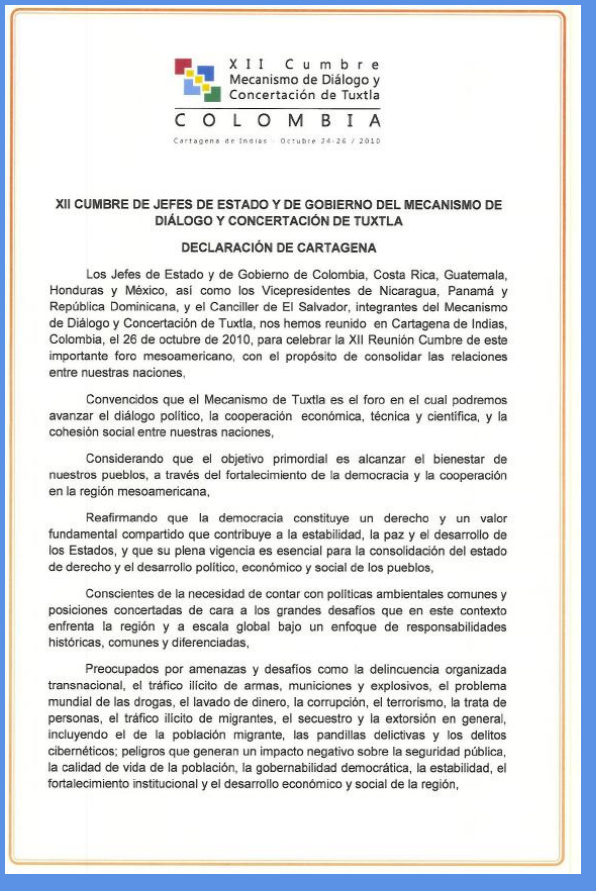
The fragmented and unimodal approach of national transport policies, characterized by an excessive focus on specific infrastructure projects and by a lack of a sustainable long term vision for the transport sector, are, to a large degree, behind the existing transport challenges in the region of Latin America and the Caribbean.

Improving and modernizing public policies dealing with freight and passenger transport issues is, therefore, an indispensable step in identifying and implementing concrete solutions which effectively address the gaps in terms of existing infrastructure and quality of its services in the context of globalized economy and the region's sustainable development goals.

Modern national and regional transport policies should be based on the advanced concepts of logistics for freight transport and of mobility for the transport of passengers. They also need to incorporate - from the start - some fundamental principles, to govern all policy making steps, from determining the policy objectives to proposing, implementing and evaluating specific programmes, plans and actions. One such principle is that of sustainability, i.e. striking the balance between the social, environmental, economic and institutional dimensions of sustainability. Another essential principle is the principle of integrality, which implies aligning the goals of transport sector with

that of the national development goals, considering all technological and modal solutions available and ensuring the stakeholders' involvement in the elaboration and implementation of the transport policies. The latter element is essential for accurately identifying and effectively resolving the causes behind inefficient transport services, high transport costs for goods and passengers and well as negative social and environmental externalities of the transport operations.

In this context, a major part of the ECLAC's analytical work and technical assistance is dedicated to promoting the concept of "integrated and sustainable policies on logistics and mobility", helping Governments and regional integration mechanisms reach a balanced approach to the logistics and mobility needs and respect the fundamental goals and principles of sustainable development. This work is mandated by the Presidential (under the Tuxtla Mechanism for Dialogue and Coordination) and Ministerial meetings in Central American, Mesoamerican and South American region. Bringing together the efforts of researchers, practitioners and policy makers in the transport sector, it is expected to result in a regional strategy for logistics and mobility, marking a major step in making the transport sector more sustainable and in progressing towards the region's economic integration.



XII Cumbre
Mecanismo de Diálogo y
Concertación de Tuxtla
COLOMBIA
Cartagena de Indias - Octubre 24-26 / 2010

XII CUMBRE DE JEFES DE ESTADO Y DE GOBIERNO DEL MECANISMO DE DIÁLOGO Y CONCERTACIÓN DE TUXTLA

DECLARACIÓN DE CARTAGENA

Los Jefes de Estado y de Gobierno de Colombia, Costa Rica, Guatemala, Honduras y México, así como los Vicepresidentes de Nicaragua, Panamá y República Dominicana, y el Canciller de El Salvador, integrantes del Mecanismo de Diálogo y Concertación de Tuxtla, nos hemos reunido en Cartagena de Indias, Colombia, el 26 de octubre de 2010, para celebrar la XII Reunión Cumbre de este importante foro mesoamericano, con el propósito de consolidar las relaciones entre nuestras naciones,

Convencidos que el Mecanismo de Tuxtla es el foro en el cual podremos avanzar el diálogo político, la cooperación económica, técnica y científica, y la cohesión social entre nuestras naciones,

Considerando que el objetivo primordial es alcanzar el bienestar de nuestros pueblos, a través del fortalecimiento de la democracia y la cooperación en la región mesoamericana,

Reafirmando que la democracia constituye un derecho y un valor fundamental compartido que contribuye a la estabilidad, la paz y el desarrollo de los Estados, y que su plena vigencia es esencial para la consolidación del estado de derecho y el desarrollo político, económico y social de los pueblos,

Conscientes de la necesidad de contar con políticas ambientales comunes y posiciones concertadas de cara a los grandes desafíos que en este contexto enfrenta la región y a escala global bajo un enfoque de responsabilidades históricas, comunes y diferenciadas,

Preocupados por amenazas y desafíos como la delincuencia organizada transnacional, el tráfico ilícito de armas, municiones y explosivos, el problema mundial de las drogas, el lavado de dinero, la corrupción, el terrorismo, la trata de personas, el tráfico ilícito de migrantes, el secuestro y la extorsión en general, incluyendo el de la población migrante, las pandillas delictivas y los delitos cibernéticos; peligros que generan un impacto negativo sobre la seguridad pública, la calidad de vida de la población, la gobernabilidad democrática, la estabilidad, el fortalecimiento institucional y el desarrollo económico y social de la región,

In 1999, a consensus was reached among ESCWA member countries on the need to develop an Integrated Transport System in the Arab Mashreq (ITSAM) which aims to facilitate trade and transport between the countries of the region, in view of enhancing regional integration. The chief goals of the ITSAM include the reduction of transportation costs, enhancing the exchange of trade and tourism in the region and facilitation of multimodal transport. The Agreement on International Roads in the Arab Mashreq was developed under the umbrella of ITSAM and mainly aims at the identification of an international road network which links countries of the Arab Mashreq. It was adopted on 10 May 2001 and entered into force on 19 October 2003. It is worth to note that this Agreement is the first UN treaty to be negotiated within ESCWA. According to provisions of the agreement, the length of the international road network is expected to reach 35,900 km. One of the direct advantages of the agreement is that it has put in place a regional numbering system with flexibility to include potential joining members. As of 2013, the agreement had been ratified by 13 ESCWA member states; and based on national reports compiled by end of 2012 from 11 of the 13 ratifying countries; the agreement percentage implementation is estimated at around 70%.

Within the framework of ITSAM, the Agreement on International Railways in the Arab Mashreq aims at the identification of an international railway network that links countries of the Arab Mashreq Region. It was adopted on 14 April 2003 and entered into force on 23 May 2005. The Agreement has been ratified by eleven countries in the region. Based on provisions of the agreement, the length of the international railway network is expected to reach 20,896 km. ESCWA Countries have implemented the agreement provisions with varying degrees of compliance. Overall, the rate of implementation is over 70 per cent according to feedback collected in national reports received by end 2012. When countries are examined on an individual basis; as such Yemen for example has 100 per cent implementation whereas Egypt has only executed 7 % of what was agreed.

Such initiatives are very significant in promoting international transport accessibility and, ultimately, transport sustainability. Nevertheless, additional efforts are required, particularly concerning the collation/analysis of spatial data (in Spatial Data Infrastructures-SDIs), the strengthening of national capacities, the identification of network bottlenecks and missing links[44], as well as assessments of the criticality, sensitivity and resilience of indispensible components of the transport system (e.g. bridges and tunnels), and the sharing of experiences and 'best' practices (e.g. UNECE, 2012; UNECE, 2013).

Secondly, administrative bottlenecks, such as *border crossings*, may cause significant socio-economic losses and affect the efficiency of logistics systems. As shown by the distribution of the Logistics Performance Index-LPI (Fig. 3.11), certain improvements are necessary in many regions. International agreements and cooperation are required together with the adoption of widely-accepted/trusted uniform standards, in order to promptly identify goods and facilitate faster border and customs clearing. Increasing border efficiency can unlock the trade potential and enhance growth.

Multilateral agreements on transport and border-crossing facilitate international mobility of freight, vehicles and their drivers. The *International Convention on the Harmonization of Frontier Controls of Goods* (Harmonization Convention) aims to reduce the number and duration of all types of controls for e.g. health reasons (medico-sanitary, veterinary, phytosanitary) and technical standards' reasons. It is applicable to all goods in import, export or in transit[45]. The Customs Convention on the International Transport of Goods under Cover of TIR Carnets (*TIR* Convention), originally agreed for the European transport, has been gradually expanded to other regions, including the Central Asia, the Middle East, North Africa and Latin America. It applies to goods carried by road vehicles or containers, provided that a portion of the journey is undertaken by

[44] See also http://www.unece.org/trans/ministerialitc70/search?q=bottlenecks

[45] Fifty-three states and the European Union are Contracting Parties to this Convention. The 1982 Harmonization Convention also establishes commonly agreed requirements for coordinated border management, whereas there have been modernising amendments such as the Annex 8 to the Convention that covers, amongst others, visa procedures for professional drivers, standardized weighing operations and vehicle weight certification, minimum infrastructure requirements for border crossing points, and provisions for monitoring border crossing performance. See www.unece.org/trans/conventn/harmone.pdf and http://ec.europa.eu/world/agreements/prepareCreateTreatiesWorkspace/treatiesGeneralData.do?step=0&redirect=true&treatyId=509 .

road[46]. Automation of the procedures is under way through e.g. the *e-TIR* project[47] which will facilitate customs-to-customs information exchange as well as establish an information management system, contributing to the improvement of the goods transit operations and the security of the international supply chain.

eTIR Pilot: going paperless

The UNECE and the IRU are partnering on the eTIR Pilot project, as a result of significant progress made in fully computerising the TIR process. eTIR Pilot is the TIR Carnet procedure gone paperless. Guaranteeing Associations issue electronic TIR Carnets upon request to authorised TIR holders online, allowing them to send TIR Electronic Pre-Declaration (TIR-EPDs). This allows Customs authorities to assess risks in advance with enhanced IT risk management features for increased security and enforcement, thus expediting controls and substantially reducing border waiting times and transport costs.

Applicable globally, including for intermodal transport, eTIR Pilot will be operational on one corridor between 2 countries and 4 of their Customs offices to ultimately expand geographically, towards a permanent solution for all countries over the coming years, as it demonstrates its full feasibility.

Other important agreements include the 1956-*1972 Customs Convention on Containers*[48], the 1994 *Convention on Customs Treatment of Pool Containers used in International Transport*[49] and the 1956/*1992 Customs Convention on the Temporary Importation of Commercial Road Vehicles* (*Carnet de Passage*)[50]. Access to international markets means also that international carriage of goods is done in conditions of safety, security and prevention of pollution that are acceptable to all countries concerned, and this is the main objective of certain multilateral agreements such as the European Agreement concerning the International Carriage of Dangerous Goods by Road (AD) (see also section 5.4) and the Agreement on the International Carriage of Perishable Foodstuffs and on the Special Equipment to be Used for such Carriage (ATP) (see box.... below). In addition these agreements contain harmonised requirements accepted in all Contracting Parties and provisions for mutual recognition of certificates which contribute to a great extent to the facilitation of international transport of such sensitive goods.

[46] Sixty-seven states and the European Union are Contracting Parties to the TIR Convention. More than 40,000 operators are authorized to use the TIR system. The success of the TIR customs transit system is explained by its special features that offer transport operators and customs authorities a simple, flexible, cost-effective and secure customs system for the transport of goods across frontiers. See www.unece.org/tir/tirconv/conv75.html

[47] See www.unece.org/trans/bcf/etir/welcome.html

[48] See www.unece.org/trans/conventn/ccc_1972e.pdf

[49] See www.unece.org/trans/conventn/poolcon.pdf

[50] See www.unece.org/trans/conventn/impcom-e.pdf

Transport of perishable foodstuffs (refrigerated transport)

The Agreement on the International Carriage of Perishable Foodstuffs and on the Special Equipment to be Used for such Carriage (ATP) is intended to ensure that deep-frozen and chilled foodstuffs are transported efficiently, safely and hygienically and do not pose a danger to human health. It also helps countries avoid the wastage of food through spoilage caused by poor temperature control during carriage.

The ATP Agreement provides common standards for temperature-controlled transport equipment such as road vehicles, railway wagons and sea containers (for sea journeys under 150 km) and the tests to ensure the insulating capacity of the equipment and the effectiveness of thermal appliances. New ATP equipment is required to undergo a test of its K coefficient, to prove that heat losses from the inside to the outside of the body meet the values defined by ATP. All 49 Contracting Parties to the Agreement – including non-UNECE countries (Morocco, Tunisia and Saudi Arabia) – are required to recognize ATP certificates for equipment that conforms to the standards issued by the competent authorities of other Contracting Parties.

The ATP lists the products that can be carried under ATP and sets the warmest possible temperature of the load. Fruit and vegetables unless processed are as yet outside the scope of ATP.

ATP applies if the point at which the goods are loaded and unloaded are in two different States and the point at which they are unloaded is situated in the territory of a Contracting Party. In other words it applies even if the State where the goods are loaded is not a Contracting Party. Some countries also use the ATP as the basis for their domestic legislation for temperature-controlled transport.

The UNECE Working Party on the Transport of Perishable Foodstuffs (WP.11) is the body that ensures that the technical requirements of ATP are updated to take account of technological progress or new political concerns and proposes amendments to Contracting Parties to that effect. For example, the transport of chilled and deep-frozen foodstuffs has an impact on global warming on a number of levels. Firstly, the containers or refrigerated vehicles are insulated using foams. The refrigerated and chilled-transport industry is searching for new insulating foams and blowing agents that are both safe for the ozone layer and highly effective. Secondly, energy efficiency is a major concern because of the costs of fuel and the harmful emissions released. In order to save energy, it is essential to measure fuel consumption. In this regard, the WP.11 has added to the *ATP Handbook* details of a procedure for determining the fuel consumption of vehicle-powered refrigeration units. Thirdly, the insulating capacity of isothermal transport equipment (K value) has a direct influence on the final CO_2 emissions of a thermal engine since a reduction in this capacity has to be compensated by a direct increase in the working time of the engine. The influence of ageing on thermal capacity is a subject of frequent discussion by WP.11. The ATP defines the method that should be used when measuring this thermal capacity.

Energy-labelling schemes or minimum-efficiency standards already exist for many appliances such as domestic refrigerators or supermarket display cabinets. These schemes have been shown to push the market towards more energy-efficient products. Proposals have been made to extend these schemes to the refrigerated transport industry.

The WP.11 keeps abreast of all developments in this field and discusses how environmental aspects can be incorporated into the ATP so that it continues to meet the challenge of sustainable development.

In the United Nations, UNECE is a focal point for setting standards, recommendations and best practices for the facilitation of the international trade. The Centre for Trade Facilitation and Electronic Business (UN/CEFACT) provides standards for efficiency and security of cross-border trade such as: the UN Layout Key for Trade Documents (UNLK) for the simplification of international trade and transport documents; the UN Trade Data Elements Directory (UNTDED, ISO 7372) for the standardization and simplification of trade data; and the UN Recommendation on establishing a Single Window concept and Recommendations on the use of code lists for trade information[51]. The Centre also develops international standards for the automation of information processing along the supply chains; the UN/EDIFACT (UN Electronic Data Interchange for Administration, Commerce and Transport)[52] is the leading global standard for data interchange in the customs, transport and logistics sectors. The Centre is developing a set of e-Business standards including UN/CEFACT XML Message specifications[53] and the UN/CEFACT Core Component Library (CCL)[54] which contains information on data and structures used in e.g. the Data Model of the World Customs Organization (UNECE, 2012).

Thirdly, there are particular challenges involving land-locked countries, where border crossing issues may have very significant effects. As maritime transport is the dominant mode for international transport, land-locked countries access to international market depends on efficient border crossings, in addition to the improvements in inland transport infrastructure, in order to engage in international trade. In these cases, seaport-hinterland connections are particular important, as inefficient hinterland links may lead to increased supply chain costs and adverse environmental impacts (e.g. Roso et al., 2008; UNECE, 2010). Regional and sub-regional cooperation in development of efficient international transport links could significantly improve accessibility.

There are several examples of plans/programmes than have increased international transport accessibility. One of the examples is sub-regional cooperation of landlocked Central Asian countries is the Special Programme for the Economies of Central Asia (SPECA) Transport Infrastructure and Border Crossing Facilitation Project Working Group (TBCPWG). Since 1998, Central Asian countries with support of the ECE and ESCAP, established sub-regional working group for transport infrastructure development and facilitation of border-crossing and transit procedures. The SPECA TBC PWG priority programme areas are defined to promote transport cooperation and support economic development in the SPECA sub-region[55].

Others include the optimal routing from Austria to Hamburg, the Bosporus Europe Express, the rail freight corridor Rotterdam–Genoa, the Uzen-Bereket-Etrek-Gurgen railway, the Beijing-Hamburg rail service, and the Canada's Gateways initiative (for more details on these plans/programmes, see UNECE (2012). Experiences from such programmes can be used in order to identify good practices.

[51] See: www.unece.org/cefact/recommendations/rec_index.htm
[52] See: www.unece.org/trade/untdid/welcome.htm
[53] See: www.unece.org/cefact/xml_schemas/index.htm#2009B
[54] See: www.unece.org/cefact/codesfortrade/unccl/CCL_index.htm
[55] Additionally info can be found at http://www.unece.org/trans/main/speca/speca_about.html

3.4 Concluding remarks

Transport system performance is often evaluated on the basis of infrastructure density and travel speeds and, thus, favours faster modes and quantitative improvements over slower modes and qualitative improvements such as increased passenger convenience and comfort. Simultaneously, traditional transport statistics frequently overlook important transport components, such as the short and non-commuting trips and the non-motorized stages of motorized trips. Such premises may result in policies and systems that undervalue/ignore alternative options in improving accessibility.

Generally, traditional evaluation and planning practices reflect traffic-based (vehicle movement) and/or mobility-based (people and freight movement) analysis and are associated with solutions favouring the accommodation/improvement of an ever-increasing flow of freight and passengers; this is despite the diminishing benefits and increasing costs of the ever-expanding transportation networks and freight and passenger traffic (e.g. Litman, 2012). Such solutions also tend to promote road transport over other forms of transport accessibility, with little consideration for the promotion of alternative transport modes, improved mobility management, intermodality, better and swifter information provision to the transport users and more efficient land use.

It has been suggested that a paradigm shift in transportation planning/management may be required; one that could move the focus from mobility-oriented analysis, i.e. the evaluation of the transport system performance on the basis of the quantity of transportation, to accessibility-oriented analysis that places people at the center of the transportation system and considers more options, such as the introduction/improvement of alternative transport modes, intermodality, incentives to change travel behavior, and more efficient land use (Cambridge Systematics 2010; Litman, 2012).

4. Affordability: Affordable mobility for individuals and society

Transport is critical for the functioning of societies; it facilitates production and distribution of goods as well as human mobility allowing people to take part in social and economic activities and access basic services, such as health and education. At the same time, it costs money and, thus, transport accessibility is controlled by the costs (and returns) of the passenger and freight transport services as well as by the sustainability of the investments associated with the up-grading and/or the planning and construction of transportation infrastructure. In this chapter we will take a look closer look at transport affordability, another crucial dimension of sustainable transport, define it, and provide an overview of factors impact transport affordability for individuals and societies, discuss challenges and perspectives at the global and regional level, and showcase a number of best practice cases from various regions of the world.

4.1 Transport affordability for individuals and households

Transport affordability refers to the financial ability of people and societies to access adequate transport services without compromising their ability to purchase other basic goods and services, such as food, housing, education and health. It can be assessed under several perspectives, e.g. the level of private motorization, the costs of owning, driving and parking private vehicles as well as the quality and cost of alternative transport modes such as public transport and cycling.

There is a clear relationship between income and transport affordability: individuals/households with high incomes can spend more on transportation to achieve adequate mobility which, in turn, can provide them with improved market access and economic opportunities and, ultimately, with a higher income potential. In comparison, individuals/households who cannot afford adequate mobility may be marginalised both economically and socially. Lower income individuals/households tend to be also more heavily impacted by changes in the cost of public transport services, since they tend to use them more than individuals/households with higher incomes. At the same time, private motorization exposes users to fuel price volatility, is resource-intensive and requires costly infrastructure.

Key challenges	➢ National and local government capacity to offer affordable public transport is diminished by lack of availability of public funds; ➢ High income inequality is omnipresent an issue in all regions; ➢ Transport expenses represent a high proportion of household expenditures of the middle class and even more of the poor; ➢ Low-income groups are particularly dependent on the availability of public transport.
Role of the United Nations	➢ Promote intergovernmental platforms for sharing of best practices, such as the Inland Transport Committee (ITC); ➢ Provide statistical and analytical information that assists governments to recognize and deal with affordability of transport for individuals.

4.1.1 Affordability factors

The affordability of the transport services depends on income and pricing. Generally, transport services tend to be generally more affordable for the citizens of countries with relatively low income inequalities than those of countries with high income inequalities. In this context, the

global distribution of the Gini index, which measures the deviation from a perfectly equal distribution of income or consumption expenditure among individuals/households within an economy[56], can provide an initial assessment of transport affordability at a global level (Fig. 4.1).

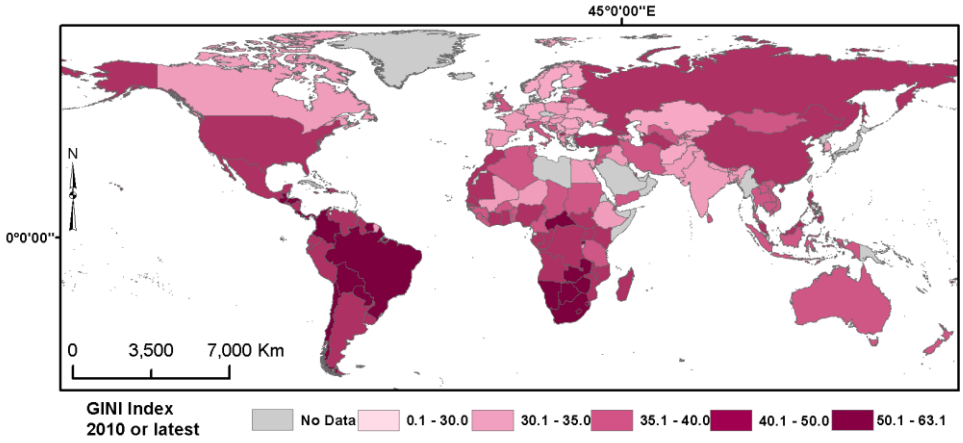
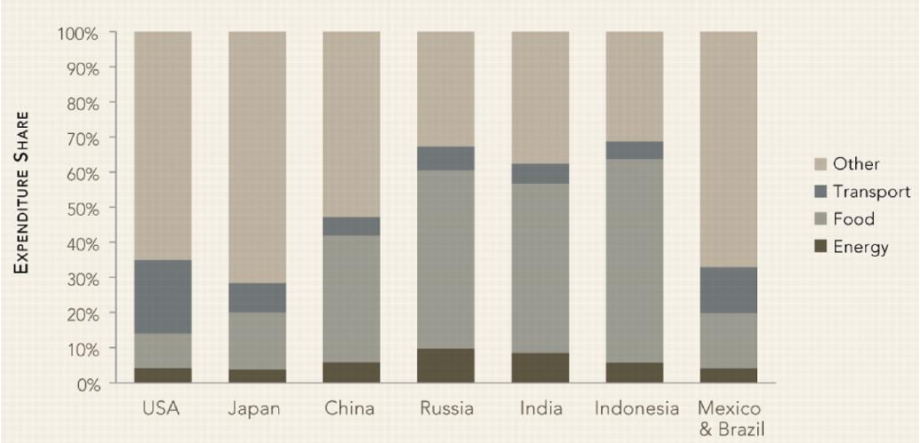


Fig. 4.1 Global distribution of the Gini index (a Gini index of a 0 represents perfect equality, whereas an index of a 100 implies absolute inequality).

The index appears to be high in many regions, particularly in Africa, Latin America and parts of Asia, whereas in Europe and N. America income inequality appears to be less pronounced. Nevertheless, although country income inequality can provide a general assessment of the affordability of transport in these countries, there are also additional determinants for individuals/households, such as the pricing of other basic goods and services, their rural or urban location, the presence of adequate/affordable public transport services, and the existence of transport policies, plans and schemes that support transport affordability for the poorer sections of the population (e.g. transport subsidies). Figure 4.2 shows the household expenditure share of 4 categories of basic goods and services in different countries. It appears that transport costs command a larger expenditure share in countries where the expenditure share of e.g. food is low.



[56] A Lorenz curve plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individuals/households. The GINI index estimates the area between the Lorenz curve and a line of perfect equality, expressed as a percentage of the maximum area under this line.

Fig. 4.2 Simulated household expenditure shares on 4 categories of goods and services for 7 different countries for 2010 (O'Neill et al., 2010).

Individual and social factors also influence transport affordability. Generally, individuals/households with low incomes spend a much greater share of their income on food than those with higher incomes (O'Neill et al., 2010); they also tend to spend a greater share of their income on transportation (Fig. 4.3). Commuters have greater transportation requirements than people working closer to home, whereas elderly people and/or people with special needs require more expensive transportation services. Transportation affordability depends also on planning. For instance, current transport planning tends to favour private motorization at the expense of more affordable transport modes (e.g. walking, cycling and public transit travel) and does not take enough consideration of the significance of efficient land-use i.e. of the development of affordable housing in accessible locations (e.g. Weltch, 2013).

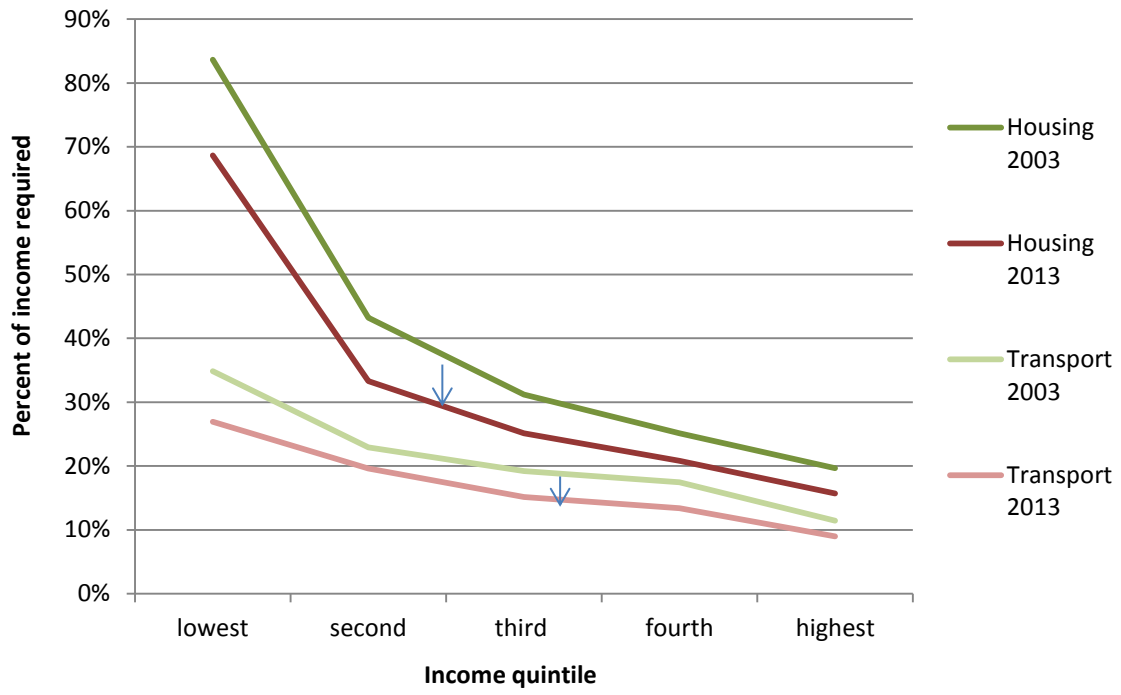


Fig. 4.3 Housing and transport expenditures by income quintile on the basis of the 2003 and 2013 U.S. household budget data (BLS, 2013[57;58]).

Transport affordability depends also on location, being controlled by different factors in urban and in rural settings. Generally, rural areas are more sprawled and, thus, rural households tend to depend more on private motorization. McCann (2000) has found that households in sprawled areas devote on average more than 20% of their expenditure to transportation; in comparison, households in communities with more efficient land use spend less than 17% on transportation.

In past decades, demand for passenger travel has developed roughly in line with per capita GDP and population growth, but there is now evidence to suggest weakening of this relationship in advanced economies. Private motorization (car) travel volumes in some countries have stopped growing, despite continued GDP growth. Van Dender and Clever (2012) have suggested that such

[57] http://www.bls.gov/cex/csxann03.pdf
[58] http://www.bls.gov/news.release/cesmy.nr0.htm

trends could be the result of many interacting factors, such as ageing populations, movement to urban centres where more transit options are available and particular policy interventions, such as Carbon emissions mitigation and traffic congestion management.

In urban settings, transport can be provided by various transport modes. In recent decades, however, urban transport planning has been largely favouring private motorization over mass public transport systems and/or alternative transport modes. This has been particularly the case in suburban settings, where transport is mainly provided by private motorization (Dodson and Sipe, 2006; Lau, 2011). Studies on the transportation costs in metropolitan areas of the United States of America have found that transportation costs average 19 % of the total household expenditure, ranging from about 10 % in multi-modal communities to about 25% in communities that are dependent on private motorization (e.g. Lipman, 2006). It follows that that the improvement of mass public transport systems can advance transport affordability in many urban areas.

Nevertheless, mass public transport also presents challenges. First, public transportation is highly subsidized. The presence of public subsidies may affect user willingness to pay for public transport services and, thus, may affect (reduce) fare revenues. A recent empirical study (Drevs et al., 2014) has found that public transportation companies and financing institutions should be transparent over the existence and level of subsidies in order to produce crowding-in effects in the willingness to pay for public transportation. Secondly, improvements in transport accessibility in urban and suburban settings do not necessarily translate into improved affordability. For example, Singapore Government has invested heavily in a world-class mass transport system (hub and spoke network) that has improved accessibility and reduced travel times between the new towns/suburbs and the city centre. Nevertheless, a recent study has found that concessions should be offered to encourage use of this network by the low income citizens (Lau, 2011).

Finally, it should be noted that the general economic environment can also affect transport affordability. In Greece, the economic crisis that started in late 2008 and is still in progress, has led to a particularly harsh austerity program (under the joint auspices of the International Monetary Fund (IMF), the European Union and the European Central Bank) aiming at primary budget surpluses. The program has dramatically increased fuel taxes (about 82 % for unleaded petrol and 31% for diesel) which has, along with high oil prices and the decline in GDP, had serious impacts on road traffic demand and transport affordability (Musso et al., 2013).

4.1.2 Trends

Figure 4.4 shows the development of the transport price index (Harmonized Index of Consumer Price-HICP)[59] for selected ECE areas in the period 1996-2013. It appears that although the EU-28 Member States (on average) and the United States of America have experienced slow development in transport prices, other countries have had much higher increases. However, when the rate of transport price increase in e.g. the EU-28 countries is compared against the inflation (e.g. Fig. 4.5), then it is clear that transport has become more expensive in real terms during this period. In contrast, although the annual rate of increase of transport prices in e.g. Turkey has been

[59] The Harmonized Indices of Consumer Prices (HICPs) are a set of European Union Consumer Price Indices calculated according to a harmonized approach and a single set of definitions. The HICP was launched in order to provide a comparable measure of consumer price inflation in the EU.

significant, the higher rate of inflation during the same period (30% annual average) suggests that transport has become cheaper in real terms.

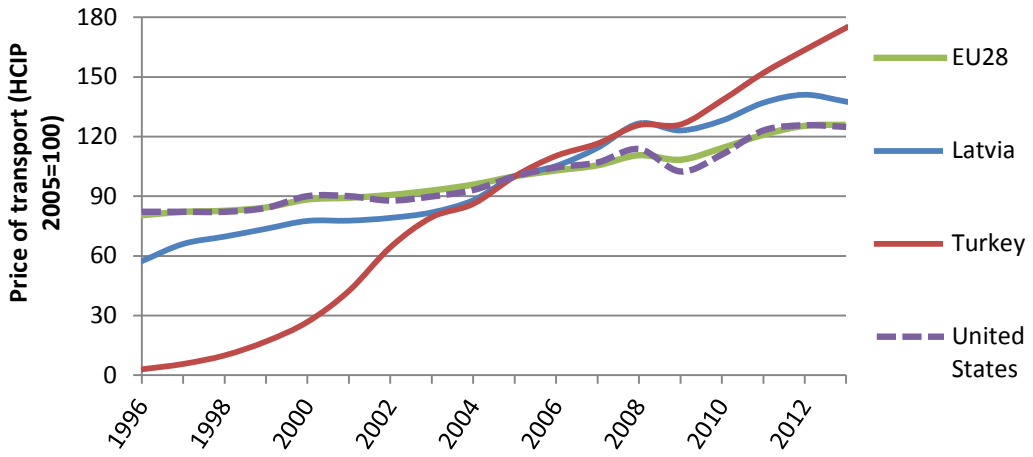


Fig. 4.4 Development in the price of transport in selected countries (1996-2012)

In the EU, passenger transport prices rose faster (at 3.6 % annually) than the rate of inflation (2.1 % annually) in the period 2003-2013 (data adjusted for new members states entering in 2004, 2007 and 2013). The highest average annual price increases (3.8 %) were recorded for railway, followed by road and air transport services, with 3.7 and 3.3 %, respectively. In the same period, the costs of private motorization increased at lower rates; purchasing costs of vehicles grew on average by only 0.5% annually, whereas operational expenses (e.g. fuel, maintenance and spare parts) increased on average by 3.4% per year between 2003 and 2013 (Fig. 4.5). It appears that private motorization (purchase, operation, maintenance, fuel) costs have increased at a lower average rate than those of public transport services and less than the overall inflation rate; this is likely to have had significant effects on the choice of travel mode.

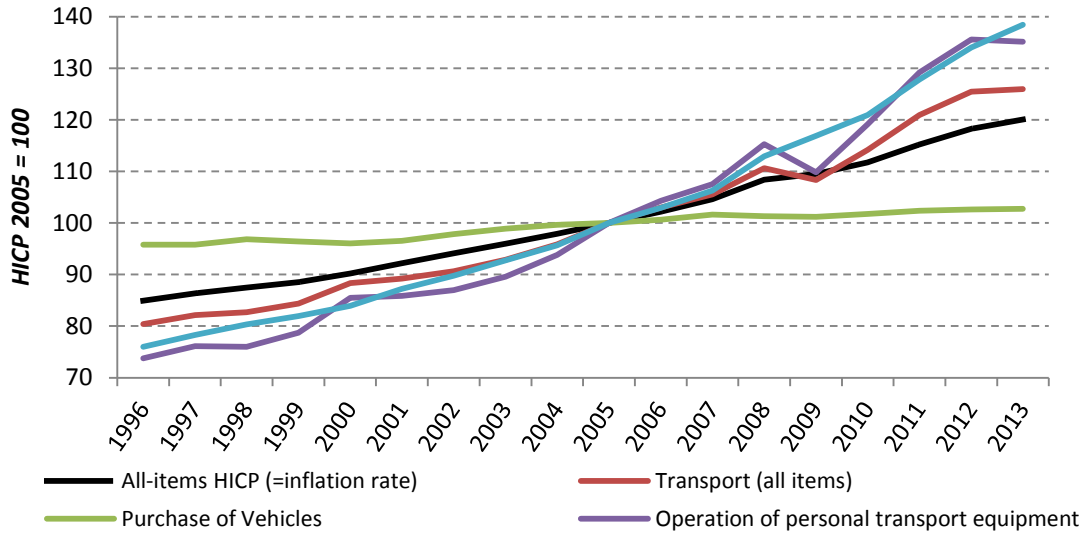


Fig. 4.5 Annual Harmonized Index of Consumer Prices (HICP) for transport in the EU http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Sustainable_development_-_transport (HICP 2005 = 100).

In terms of transport expenditure across income levels, an EU-household survey has revealed some interesting characteristics (Fig. 4.6). Expenditure on private transport (purchase and

operational costs) has been found to increase with income, with the share of transport expenditure compared to the total consumption being about 93% higher in the highest income quintile than in the first lowest income quintile (15 percentage point increase in difference compared with 2005 survey (UNECE, 2012)).

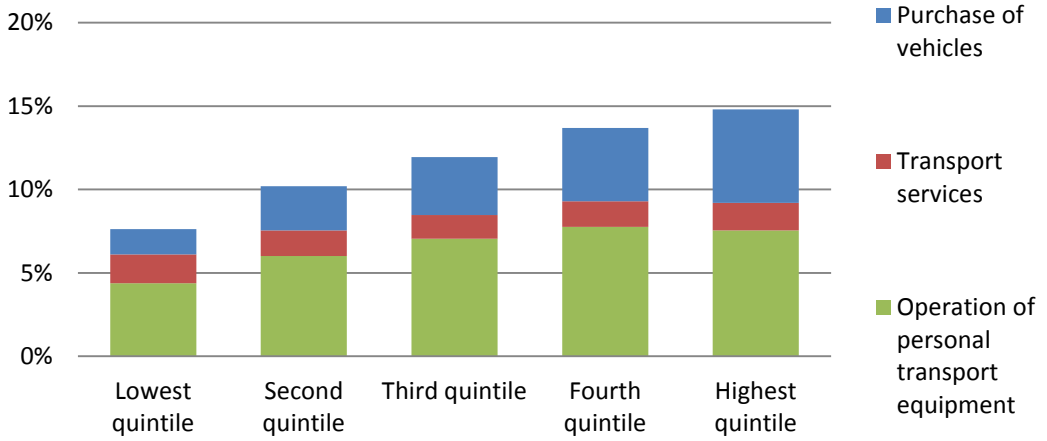


Fig. 4.6 Household spending on transport according to the income class in the European Union in 2010 (Eurostat)

In the ECE region, a survey involving 31 Member States (Fig. 4.7) has found that Finish households spend on average 17.5% of their total expenditure (consumption) on transport, the highest proportion in the region. In comparison, Romanian households spend on average 4.6% of their total expenditure on transport, the lowest share in all surveyed countries; such differences can be attributed mostly to differences in private motorisation (purchase of vehicles, fuel and maintenance costs).

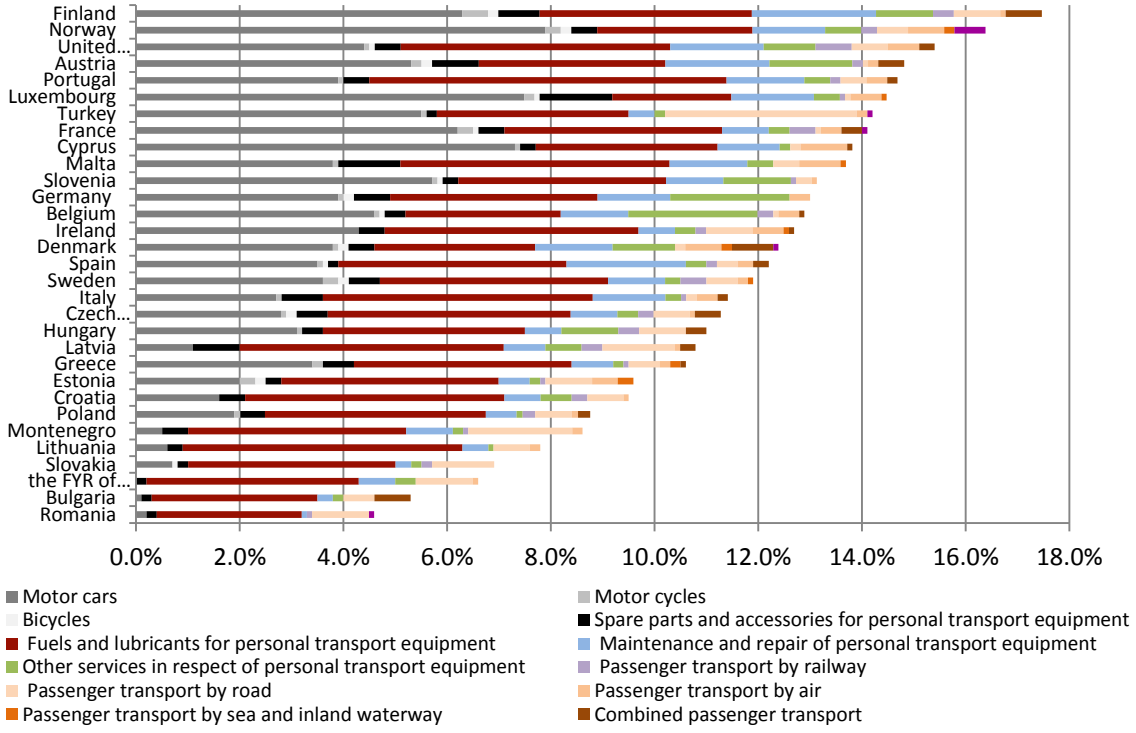


Fig. 4.7 Average expenditure for transport, as a percentage of expenditure in 2012 in 31 ECE Member States (Eurostat)

With regard to transport spending according to the household location, an EU household expenditure survey has revealed that transport spending differs only slightly between rural and urban areas; households in densely-populated urban areas spend on average about 11.7 % of their total consumption on transport, whereas in rural areas about 13 %. In rural areas households spend more on private motorization and less on public transport services. In terms of age, households where the reference person is older than 60 years old have been found to spend on average 7.7 % on transport, whereas households where the reference person is younger than 30 years old about 12 % (UNECE, 2012).

In Latin America, the data compiled by the World Bank and Development Bank of Latin America, and analysed by ECLAC shows a significant variation in the importance of the household's spending on public transport. In some cases, like Sao Paolo and Rio de Janerio, the proportion reaches 30 percent of the minimum salary, while in other cities (like San Jose, Buenos Aires, Caracas and Mexico City), the cost of 50 bus trips does not exceed 7 percent of the minimal salary. When put in the context of the economic inequality prevailing in the regions, these data and the additional information, gathered by ECLAC through a household survey, shows that the spending on the public transport represents the second largest component of the household's spending, superseded only by the energy expenditures. The significance of the public transport expenditures diminishes with the increase of the household's income, while the spending on private transport increases. (ECLAC, 2014, forthcoming).

4.2 Transport affordability for societies

All available trends and projections relating to passenger and freight volumes suggest a strong future growth particularly in the non-OECD regions (see also Chapter 2). The expected growth in freight and passenger transport will require the planning and construction of new transportation infrastructure as well as the establishment of sustainable funding mechanisms for the transport sector (e.g. OECD/ITF, 2013).

Efficient, safe and environmentally sustainable transport infrastructure costs money and, despite recent improvements, transport networks in many regions still suffer from the under-investment of the previous decades. At the same time, infrastructure development is generally planned and financed within national budgets and under macro-economic constraints, being in competition with other needs such as education, health, housing or security. The 2008 financial crisis and its aftermath has increased pressures on national budgets and reduced public funding for transport infrastructure development, making private sector funding flows much more important (e.g. OECD/ITF, 2013).

	Long term planning ⇨ Thorough preparation material⇨ Prioritizing transport projects⇨ Private sector participation⇨	Social affordability
Key challenges	➢ Pressure on transport infrastructure capacity; ➢ Public funds are scarce; more rigorous assessment of feasibility is warranted. (no "white elephant" investments); ➢ Transport projects are long term and politically less interesting.	

Role of the United Nations	➢ Provide guidance on reforms aiming at efficient financing of infrastructure and public transport services, including the use of Public Private Partnerships; ➢ Provide a common framework for socio-economic cost-benefit analysis; ➢ Provide a harmonized methodology for transport infrastructure planning.

4.2.1 The global situation

Investment in inland transport infrastructure varies considerably. In many developed countries, transport infrastructure investment has amounted to less than 1 % of their GDP in 2011; in comparison, Canada, the Russian Federation and Australia have spent a considerably larger share of their GDP on transport infrastructure (Fig. 4.8).

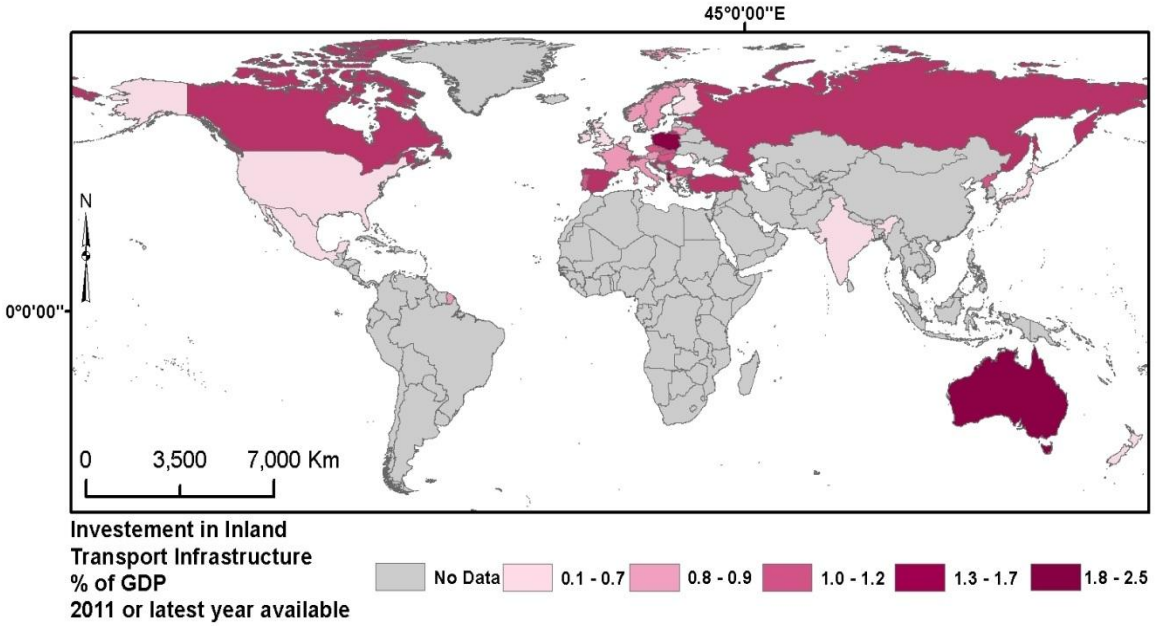


Fig. 4.8 Investment in inland transport infrastructure as a share of GDP for 2011 (Source: OECD)

Private funding in transport infrastructure development is becoming increasingly popular as a concept, although its attractiveness should be also based on pre-investment economic impact evaluations, similar to those used as prioritization instruments in public transport investments (UNECE, 2012). Generally, private transport infrastructure investments have been moderate in recent years, with the large majority of countries showing investments less than US $ 0.5 billion on aggregate during the period 2000-2012. There have been some notable exceptions, mostly in non-OECD countries, with India and Brazil showing the highest private investments in transport infrastructure (Fig. 4.9).

In terms of infrastructure development needs, there are particular challenges associated with the growing medium-sized cities in developing countries. The World Bank analysed urban transport problems in developing and transitional economies and recommended (in 2002) a framework for national and city authorities under its urban transport strategy 'Cities on the Move'. However, although a recent assessment of the implementation of the 2002 recommendations has shown progress in some areas (e.g. in mass public transport analysis and investment and some environmental policies), the performance of the private sector in meeting infrastructure and public transport supply deficiencies has not been deemed adequate (Gwilliam, 2013).

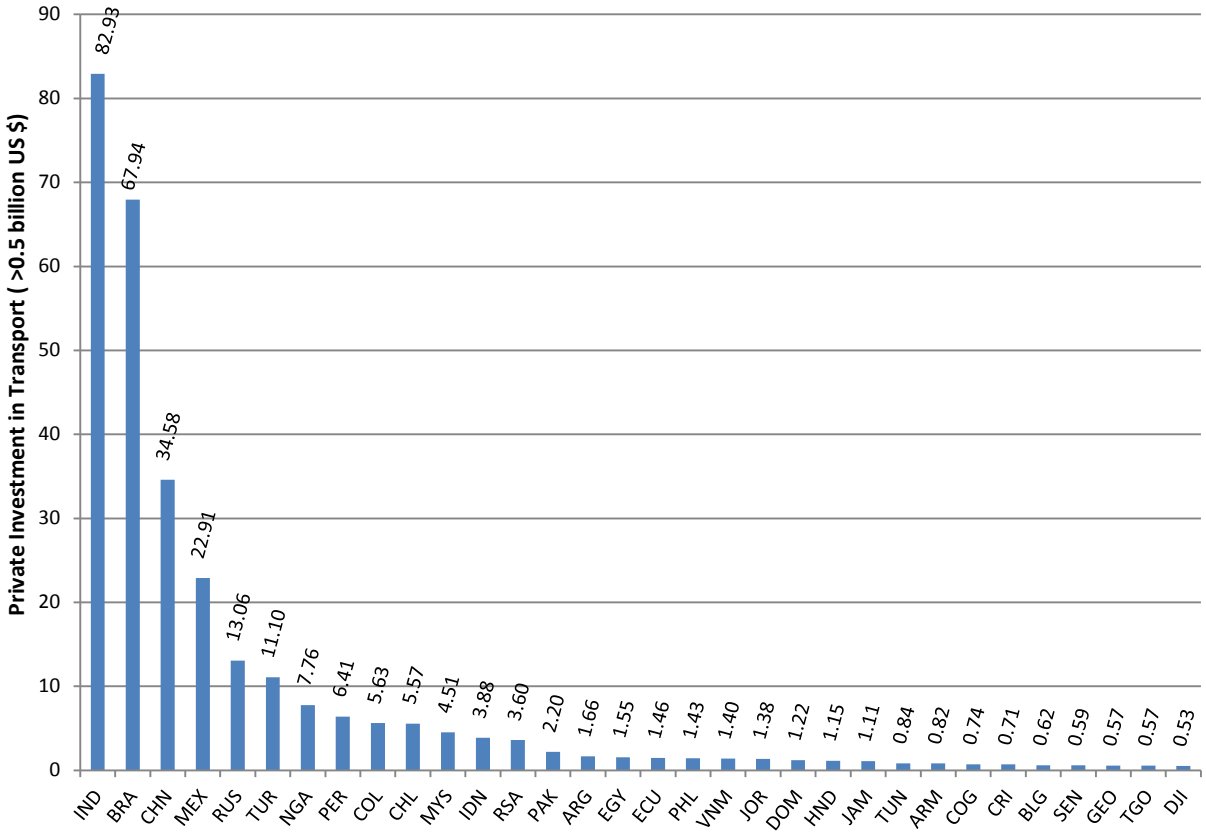


Fig. 4.9 Private investment (in US $ billions) in transport infrastructure (movable assets/small projects excluded) in the countries showing an aggregate (2003-2013) investment higher than US $ 0.5 billion (Source: The World Bank)

Over the last decade, the World Bank has committed about US$ 7.5bn in loans for urban transport projects in its client countries, mostly on public transport modes. There have been efforts to introduce private operators and competition into all-public sectors and to tighten weakly regulated, 'informal' public transport markets. Notable objectives for many projects have been the improvement of transport services, the affordability for low-income passengers, the attraction of new passengers, the reduction of negative environmental impacts, and the complementary reform of relevant policies and institutions. Nevertheless, it appears that there should have also been a higher consideration for the sustainability of urban road traffic involving congestion easing, modal shift prioritization and the generation of sustainable revenues (Mitric, 2013).

Finally it should be noted that collective behaviours may also affect transport affordability, with direct effects on trade. For example, modern supply chains tend to favour medium-sized or large producers that are already engaged in export; this can price out of the transport markets small sized enterprises with very significant economic effects on regions where production is dominated by such businesses. A possible solution could be the creation of co-operations of small/medium businesses and/or farmers and trade brokering which can negotiate freights and freight caps more effectively[60].

[60] See see also http://www.ppiaf.org/freighttoolkit/node/283 and www.rail-reg.gov.uk/pr13/PDF/dd-june-2013-for.pdf.

4.2.2 Regional trends

Over the last two decades, inland transport infrastructure investment has been 0.8% to 0.9 % of the GDP in most of the developed Western European countries, with the notable exceptions of Spain, Switzerland, Greece and Portugal (investments of 1.6%–2.0 % of GDP)[61]. In comparison, inland transport infrastructure investment in Central and Eastern European countries, which until 2002 was at 1.0% of GDP, has grown to about 2.0 % (in 2009). Although investment fell to about 1.7 % of the GDP in 2010, in 2011 the trend was reversed and it sits at 1.8 % of GDP. Rising levels of investment in transition economies reflect efforts to meet rising needs, especially for road networks.

Concerning the modal distribution of infrastructure investment, road infrastructure has consistently taken the 'lion's share' (Fig. 4.10) in most ECE countries; in 2011, only Austria, Georgia, Russia and the United Kingdom have made larger investments for rail than for road infrastructure (OECD, 2014[62]). In the EU, the share of investments in inland transport modes with lower environmental impact (rail and inland waterways) also decreased slightly in the period 2000-2009[63].

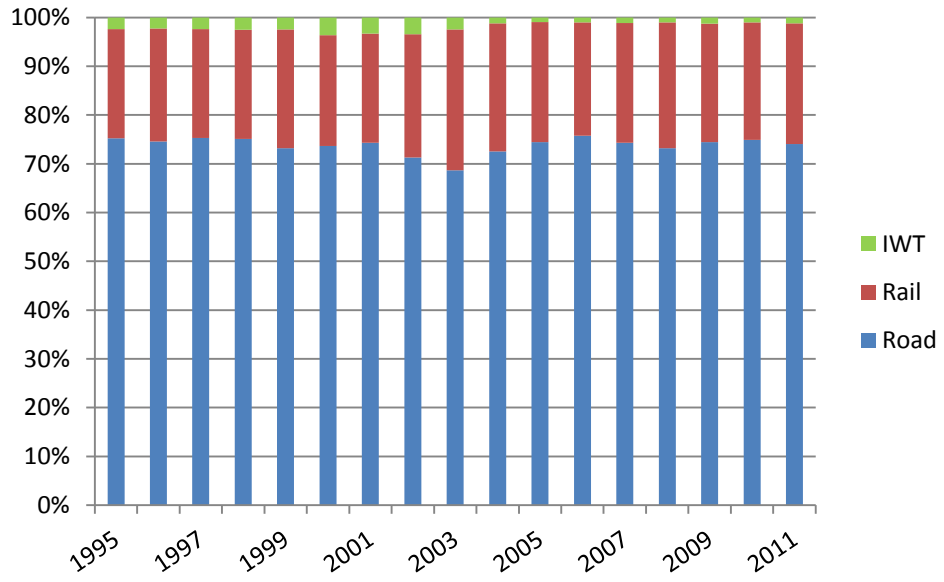


Fig. 4.10 Investment in road, rail and inland waterway (IW) transport as a share of the total inland transport investment for 40 ECE Member States

One of the major reasons for the observed trends is probably associated with the planning decisions taken in many regions/countries. For example, Australian cities are highly dependent on private motorization, with private cars being used for most trips[64]. One of the reasons for this

[61] Since 2007, transport investment in both Greece and Portugal has fallen closer to the European average (about 1.0 % of GDP).
[62] http://stats.oecd.org/Index.aspx?DataSetCode=ITF_INV-MTN_DATA#
[63] http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Sustainable_development_-_transport
[64] Private motorization dependence is also unevenly distributed within the Australian cities; households located close to central business districts depend less on private motorization for urban travel (about 49 % of work journeys) than those located in middle/outer suburbs (about 76 % of work journeys) (Dodson and Sipe, 2006).

overdependence might be associated with the transport investment decisions taken in recent decades; many Australian cities have opted for large private toll freeway projects instead for mass public transport projects (Zeibots 2005). Nevertheless, Public transport investment has made some inroads. For example, rail investment in Perth, obtained through the postponement of major road projects, has managed to redress the overdependence on private motorization in this city (Dodson and Sipe, 2006).

Private sector investment in road and rail transport infrastructure, has increased in recent years (after 2005), particularly in the developing countries (Fig. 4.11; 4.12). In 2011 and 2012, private investment (by both the number of projects and by funds) was primarily concentrated in South Asia, with total investment amounting to US$ 37.9 billion (115 projects), a value greater than the sum of all private investment in road and rail since 1995 in the region. In 2013, the major focus of private investment in road and rail infrastructure shifted to In Latin America and the Caribbean where there were 17 road projects, and 3 railway project, with total investment of US$ 16.2 billion (an annual record in value for the region and a 97 % increase from 2012 levels).

East Asia and the Pacific saw two new road and two new railway projects in 2013, with a total investment of US$ 4.9 billion. Sub-Saharan Africa did not have a new project in either road or railway infrastructure since the 2011 cross-border highway project in Zimbabwe and South Africa (the Beitbridge Border Post), with a total investment of US$ 97 million. Europe and Central Asia have likewise not had a significant private investment in railway infrastructure since 2011 (two projects, US$ 4.3 billion) or road infrastructure since 2012 (two projects, US$ 5.1 billion). Finally, there were no new private sector projects/investments in Middle East and North Africa in 2013, the region with the lowest total private investment in railway infrastructure and with no recoded private investments in road infrastructure (World Bank, 2014).

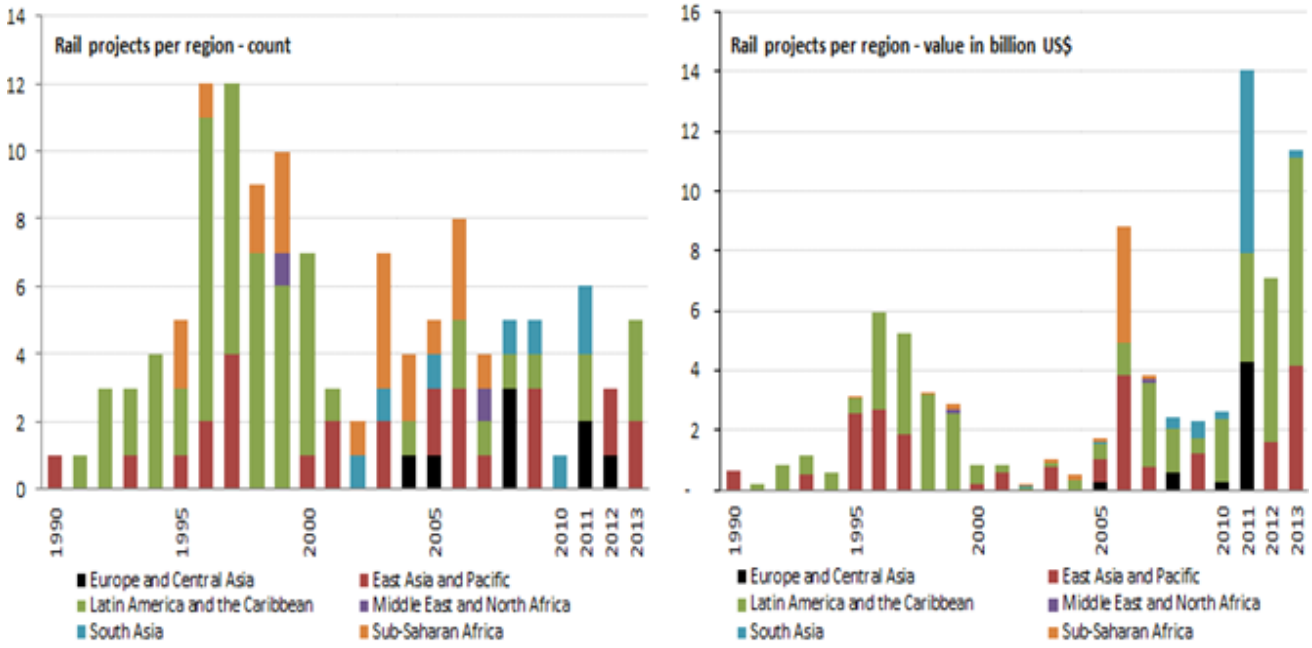


Fig. 4.11 Number and value of rail transport projects (1990-2013) in low and medium income countries with private sector participation in investment (World Bank, 2014[65])

[65] http://ppi.worldbank.org/explore/ppi_exploreSubSector.aspx?SubSectorID=6

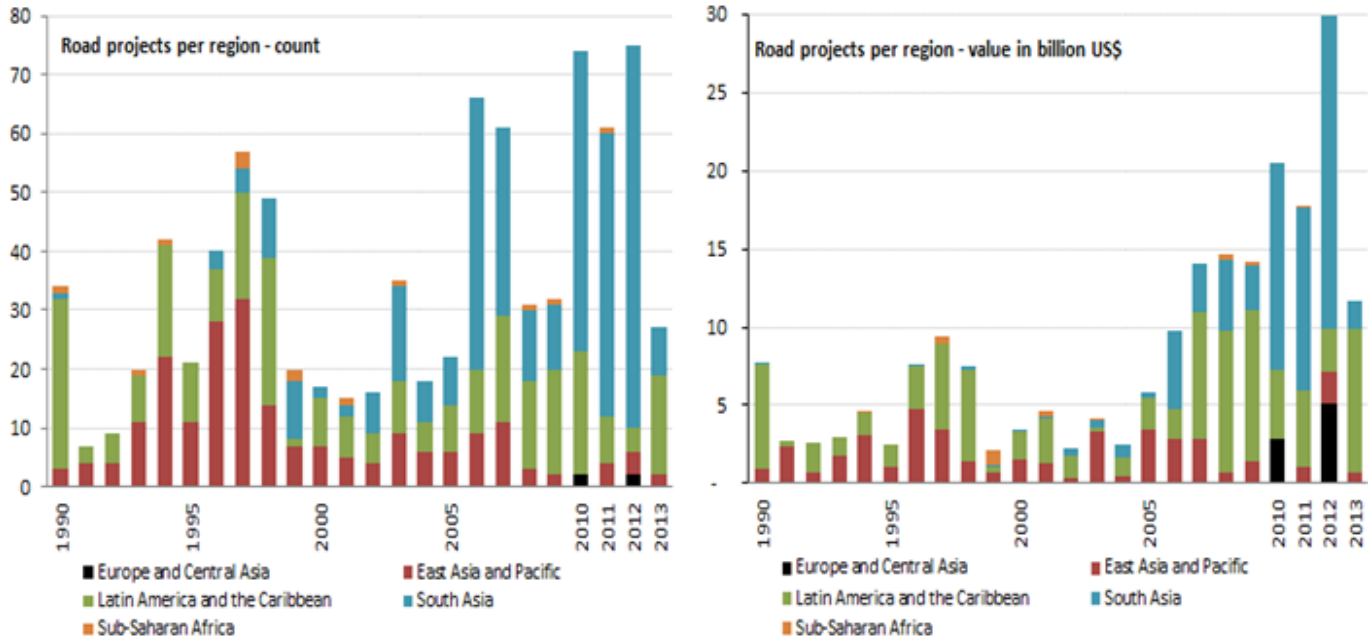


Fig. 4.12 Number and value of road transport projects (1990-2013) in low and middle income countries (World Bank, 2014[66])

Finally, it should be noted that increasing investment in transport infrastructure should not necessarily increase capacity; funding directed towards improvements in infrastructure resilience and/or safety and security may not increase capacity, but can contribute to the overall sustainability of transport.

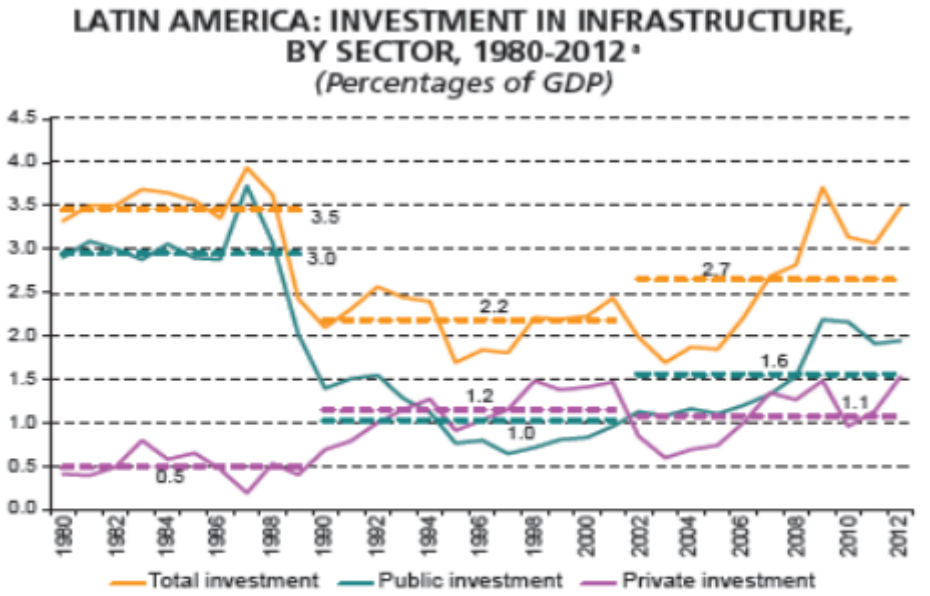
In the region of Latin America and the Caribbean, ECLAC data and analysis show that the public and private investment in infrastructure in the region, at their recent and current level, are not sufficient to provide the infrastructure that the region needs for its sustainable development. According to ECLAC's estimates the region's countries should invest annually 6.2% of their Gross Domestic Product (GDP)-some $320 billion dollars-to satisfy their infrastructure demands in the period 2012-2020.[67] However, according to the recently published Economic Infrastructure Investment in Latin America and the Caribbean Database 1980-2012 (EII-LAC-DB)[68], the average 2.7% of GDP allotted to infrastructure investment in the last decade shows that the region is not investing enough. An analysis of the figures in the EII-LAC-DB database reveals a trend towards increasing investment in economic infrastructure during the period 2003-2012, showing that the transport sector has drawn the biggest amount of investment since 2005, followed by energy, telecommunications, and water and sanitation[69] (Fig. 4.13).

[66] http://ppi.worldbank.org/explore/ppi_exploreSubSector.aspx?SubSectorID=7

[67] The figure of 6.2% of GDP comes from applying the investment trajectory to expected infrastructure needs, and it assumes that the historic pattern of country investments will be repeated. As such, it is an approximation and not a strict recommendation.

[68] EII-LAC-DB collects and systematizes figures by country and investment origin (public or private) covering the annual investment in four main economic infrastructure sectors (transportation, energy, telecommunications, and water and sanitation).

[69] (Jeannette Lardé and Ricardo J. Sánchez, ECLAC, FAL Bulletin, No. 332 – Number 4 / 2014. "The economic infrastructure gap and investment in Latin America", Perrotti, Daniel and Ricardo J. Sánchez (2011), "La



Source: Infrastructure Services Unit of the Natural Resources and Infrastructure Division of ECLAC.

[a] Preliminary data.

Fig. 4.13 Investment in infrastructure by sector in Latin America 1980-2012

4.3 Challenges and best practices

4.3.1 Affordability for individuals and households

A key challenge for society is to ensure that individual mobility does not depend on individual income. Low income individuals/households tend to spend less than those with higher incomes and, yet, their transport expenditure comprises a greater share of their income. At the same time, inland transport services have become relatively more expensive in some regions; this development is worrying, as the mobility (and the social and economic development) of particular groups such as the elderly and people with special needs, who are mostly dependent on public transport services, is likely to be negatively affected

Spending on transport varies considerably with age. Younger households tend to spend more on transport and are, consequently more mobile than older households. As the current demographic trends are towards older populations, the risk of the social and economic exclusion of the elderly is increasing; future transport policies should certainly take into consideration this issue. A study on the impact of transport on social exclusion in the G7 countries (Lucas, 2004) has found that low private car availability can determine social inclusion in the case of inadequate public transport services. The study has also found that about every fourth household had no access to a car in Canada, France, Germany and the United Kingdom (ranging from a low of 21 % in Canada to 29 % in the United Kingdom), with elderly people, people with special needs, women and ethnic minorities being less likely to have a driver's licence and more likely to live in a household without a private car.

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brecha de infraestructura en América Latina y el Caribe", Natural Resources and Infrastructure Series No. 153, United Nations publication, Santiago, Chile).

As public transport prices are generally rising (see Chapter 4.1.2), certain initiatives should be put in place that could increase transport affordability for these particular groups. Public transport is often provided at a price close or, even, below marginal costs on both rural and urban locations (e.g. UNECE, 2012). In these cases, its supply depends on public subsidies which in the current economic climate tend to be curtailed in many countries. Finally it should be noted that transport affordability is largely connected with the affordability of other basic needs as housing (Lau, 2011; Weltch, 2013).

According to a recent ECLAC study[70] , urban mobility systems in the region of Latin America and the Caribbean are not routinely designed with the poor as a priority. At best, they are designed with an awareness of issues of transport equity such as affordability or minimal levels of access, but not from the perspective of meeting the routine needs of the poor and thus are not completely in line with the aims to move towards a more sustainable mobility in urban and metropolitan areas. The study considers that "Social sustainability" should be a partner term to "environmental sustainability" and should be linked with "liveability" of cities —reducing carbon emissions makes for more pleasant city living. There is a need to relate the transport and poverty discourse to these strategies since the social sustainability concept has been adopted fairly recently by cities, planners and international agencies. It is thus timely to rethink the urban development paradigm in terms of the constraints on mobility as a solution to spatial inequities and inequalities, at the global, regional and local levels.

In this context, it is important to consider the price of public transport and how this is determined. Public transport pricing are set by operators and typically depends on the type of public transport. In many countries, urban public transport is the responsibility of local authorities, while non-urban public transport is also organized in cooperation with the state[71]. For instance, in Croatia the price of road public transport is freely set by the operator, except in urban areas where local authorities can set price ceilings; rail transport prices are also set by the operators, but they must be approved by the Government.

Similar approaches are seen in several ECE Member States. These approaches frequently require agreements between the operators and public authorities, which typically include a public service obligation (PSO)[72]. In any case, it will be counter-productive if prices continue to increase at the rates seen at some countries in recent years, even though such increases could have been the result of improvements in infrastructure quality and services

The analysis and the planning/implementation of effective policies/solutions to increase the affordability of transport services are not straightforward exercises. It requires concentrated efforts, cooperation and sharing of experiences and 'best' practices at many spatio-temporal scales; some of those practices will be briefly referred to below.

[70] for detailed discussion see: Grieco, M. (2013). Transport, the poor and moving towards low-carbon societies. Bulletin FAL, Issue No. 318 - Number 2 / 2013

[71] Information given by Albania, Armenia, Croatia, Czech Republic, Latvia, Poland and Switzerland in the questionnaire on Transport for Sustainable Development, December 2010 (UNECE, 2012).

[72] In these cases, public authorities tender the servicing of route networks, with the winning operator having the monopoly in this network with public subsidies if and when required; such subsides are necessary, because profitability of some routes is either absent or so low that the free market cannot provide a service. PSOs also include requirements on minimum frequency, network capacity and ticket pricing.

Best practices in improving accessibility of vulnerable groups

The social and economic inclusion of the elderly and individuals with special needs depends on their mobility, which, in turn, depends on transport accessibility and affordability.

- The 2008 National Concessionary Travel Scheme introduced in the United Kingdom gives persons with reduced mobility the right to free off-peak travel on local buses.
- In some areas (e.g. Manchester and the West Midlands) the system has been extended to trains and trams (PTEG, 2010). The West Midlands' Passenger Transport Executive (United Kingdom) has been working with local employment agencies to improve transport affordability also for job-seekers, who often cannot afford to travel for job interviews.
- A project called WorkWise[73] was introduced in Birmingham that provides job-seekers with free travel information, free travel by public transport to job interviews and free travel passes for the first month of work; an evaluation of the scheme has shown that it has positively affected employment, as 80 % of newly employed job-seekers have reported that they would not have been successful without it.

In the United States of America, Federal Agencies are required to work towards providing equal access to quality public transportation for low-income and minority populations. Such efforts require comprehensive and quantitative approaches to assess the accessibility, affordability and quality of transport services at each transit node in a network and plan for effective remedial action. As a defining factor for the affordability of transport in urban areas is the distribution of affordable residential housing, the review of approaches and proposed solutions should take into account the relationship between transport and housing. Results from a recent study in Baltimore (Weltch, 2013) have shown that developers of affordable housing and transportation planners should work together to find development locations that place more emphasis on transit locations with high connectivity rather than simply reducing transit distances.

In Singapore, current practices involve the improvement of the sustainability, safety and smartness of the transportation system. Sustainability can be improved by policies aiming at the integration of land-use and transport planning, adequate transport supply measures, efficient management of travel demand and the incorporation of environment-friendly strategies. Safety initiatives should aim at minimizing injuries and incidents for all users, including motorists, public transport passengers, pedestrians, and cyclists. The objectives of 'transport smartness' policies should be the improvement of certain transport system qualities, such as real time sensing, fast information processing and decision making, and automated control/monitoring of travel information and revenue collection. It has been shown that all the above objectives could be adequately facilitated by the adoption of 'smart' technologies (Haque et al., 2013).

4.3.2 Affordability for societies

Many countries are still reeling from the 2008 global financial crisis and government budgets are tight. Public financing of transport infrastructure projects have been reduced in most countries,

[73] See http://www.networkwestmidlands.com/workwise/WorkWise_Home.aspx

although large infrastructure projects could have also socio-economic benefits in times of economic downturn; most transport infrastructure projects can positively affect employment and consumption and, in the long-term, unlock economic and human potential. Nevertheless, as pure public financing is getting scarcer, private sector financing should be mobilized to provide reliable funding flows for transport infrastructure (e.g. OECD/ITF, 2013).

When funds are scarce, infrastructure needs must be prioritized. However, this can only be carried out if all necessary information is available; this includes not only an analysis of the internal rate of return (IRR) of the infrastructure investment, but also an analysis on the short- and long-term impacts on employment, economic development and social inclusion (e.g. Dodson and Sipe, 2006; Lucas, 2013). Nevertheless, such studies are not straightforward exercises, requiring the development of tools, realistic scenarios and collation/acquisition of a large variety of relevant data (e.g. OECD/ITF, 2013) as well as improved mechanisms of sharing information/practices.

A significant challenge is associated with backlogs in the maintenance of existing transportation systems[74]. Investment for existing infrastructure is important for keeping the safety, fluidity and reliability levels high. A recent study (UNECE, 2012), which asked ECE member States to describe the main obstacles they face in the development of transport, has found that backlogs in maintenance investments form significant obstacles for many countries. For example, in addition to significant shortages in rolling stock, the state of the existing rail infrastructure in Kazakhstan has been assessed as poor and operated using outdated technology. The Government of Kazakhstan has reacted to these findings by approving a large program for transport infrastructure development in the period 2010-2014[75]. Investment backlogs are, however, not only an issue for low- and middle-income countries. The UNECE survey has also found that lack of funds is a major obstacle for the development of transport in most countries[76]; highlighting the need for considered planning, prioritization and cooperation. For example, some ECE member States (e.g. Belgium) mentioned that decades of poor investment in rail infrastructure has led to a significant backlog, with supply no longer being able to match increasing demand. In April 2009, the United States Department of Transportation (USDOT) published the Rail Modernization Study[77]; this study has found that the investment backlog of the 7 largest rail operators is close to US$ 50 billion and that only 2 of the 7 operators were using '*a rigorous process to help rank and prioritize their investment needs*'. In this context, it should be noted that the present trends in weather related extreme events have increased significantly the funding needs for infrastructure maintenance as well as for infrastructure adaptation and resilience (e.g. UNECE, 2013) which, however, will require additional funding.

There are several examples of plans/programmes associated with the provision of transport infrastructure funding under private and/or public private initiatives. These include the Cross-Israel Highway (Israel Highway 6), the US$ 1.3 billion construction costs of which were financed through

[74] See e.g. http://www.wsdot.wa.gov/finance/budget/ and http://www.regionforward.org/highway-and-transit-maintenance-identified-as-top-priority-in-regional-transportation-priorities-plan

[75] See http://mtc.gov.kz/index.php/en/programma-po-razvitiyu-transportnoj-infrastruktury-v-respublike-kazakhstan-na-2010-2014-gody

[76] Information provided by a questionnaire on Transport for Sustainable Development, December 2010.

[77] See www.fta.dot.gov/.../Rail_Mod_Final_Report.pdf .

90 % commercial debt and 10 % equity, the construction of the Saint Petersburg Highway [78] in the Russian Federation, the Switzerland's Infrastructure Fund for Agglomeration Transport[79], the Czech State Fund of Transport Infrastructure (SFDI) and 'The Building Canada Fund'[80] (for more details on some of these initiatives, see UNECE (2012)). Experiences from such programmes can be used in order to identify good practices.

As the provision of adequate funding flows in a prerequisite for the sustainability of the transport sector, there should be increased cooperation between States as well as the involvement of International Organizations. In addition to OECD/ITF[81] which provides reliable statistics and reports on transport infrastructure funding, other International Organizations such as the World Bank and the UNECE have been considerably active. The World Bank has been providing financing to a large number of transport infrastructure projects (see e.g. World Bank, 2012), whereas the UNECE has been active in: (a) providing common methodologies and guidelines[82] for the socio-economic analysis of transport investment projects; (b) making available planning tools based on multi-criteria approaches that complement the quantitative analysis of the data with the qualitative evaluation of strategic and political concerns[83]; and (c) facilitating an improved understanding of Public-Private Partnerships (PPPs)[84] in all fields of infrastructure development by information and practical experience sharing among its member States. UNECE has provided guidelines and examples of best practice and contributes to the implementation of capacity-building programmes for public and private sector officials from transition economies.

[78] Information given in the UNECE questionnaire survey on Transport for Sustainable Development, December 2010.
[79] For further details see http://www.are.admin.ch/themen/verkehr/00250/00460/?lang=en
[80] See http://www.infrastructure.gc.ca/prog/bcf-fcc-eng.html
[81] International Transport Federation
[82] See www.unece.org/trans/main/wp5/wp5.htm.
[83] For a detailed description of the multi-criteria model used in UNECE infrastructure planning projects, see Tsamboulas (2007).
[84] See the 'Guidebook on Promoting Good Governance in PPPs' (www.unece.org/ceci/publications/ppp.pdf) and the UNECE Training module on PPP and sustainable development 'How to do PPP' *ppp@unece.org*

5. Transport Safety

Transport related injuries are a major social, economic, development and public health problem. Developing countries and economies in transition bear the majority of this burden so that road traffic crashes are a development issue that disproportionately affects the poor in low and middle-income countries. Globally, well over a million people are killed annually in road traffic accidents causing, in addition, to human loss and suffering, billions of dollars of associated costs which, in some countries, amount to 1-3 % of the GDP (UNECE, 2012). The need for improving road safety has been acknowledged by the United Nations system and its member States for almost 60 years and extensive road safety work has been carried out by various global and regional organizations including the United Nations regional commissions, the World Health Organization (WHO) and the World Bank.

This chapter will provide an overview of factors and trends controlling safety aspects in the major inland transport modes, road, rail and inland waterway, key global and regional statistics, as well as an overview of challenges on the path to improving transport safety, with a summary of regional best practices.

	Prevention and mitigation **Holistic approach across the modes of inland transport and terminals**
Key challenges	➢ At the global level, overall development of transport safety is slow. ➢ High rate of trespassing incidents particularly in railways leading to fatalities; ➢ Inadequate recognition of the need for a high level of safety in transportation of dangerous goods; ➢ Underreporting and insufficient harmonization in statistics is a serious issue across the board.
Role of the United Nations	➢ Promote the UN transport Safety Conventions and other legal instruments, such as the Agreement on transport of Dangerous Goods, the CTU code of conduct; ➢ Promote intergovernmental platforms for sharing best practice, such as ITC; ➢ Provide statistical and analytical information that enables regions to identify problems and develop optimal policies.

5.1 Road

Road safety depends on driver behaviour, infrastructure quality and vehicle safety, and improvements can be achieved only by considering all these contributing factors. The global average fatality rate was 18.04 persons per 100,000 inhabitants (WHO, 2013). Road safety performance however differs widely between countries. For example, road safety measured in terms of fatalities per 100,000 citizens across OECD-IRTAD[85] member States reveals a wide

[85] The International Traffic Safety Data and Analysis Group (IRTAD) is a permanent working group of the Joint Transport Research Centre of the OECD and the International Transport Forum. It is composed of road safety experts and statisticians from safety research institutes, national road and transport administrations, International Organisations, universities, road user associations, the automobile industry, and others from both OECD and non-OECD countries. Its main objective is to contribute to international co-operation on the collection and analysis of traffic safety data by being: (a) a forum of exchange on road safety data collection and reporting systems and on trends in road safety policies; (b) a point of collection/analysis of accident data as well as of advice on specific road safety issues; and (c) a contributor to international co-operation on road accident data and its analysis. Currently, more than 70 organisations from 34 countries are members of

distribution, with fatality rates being about 3 times lower in the best performer than those in the worst performer (IRTAD, 2013).

Prevention and mitigation Safe driver behaviour + safe infrastructure + safe vehicles + mitigation of impact	
Key challenges	➢ At the global level, road safety is hardly improving; ➢ Inefficient road safety management, weak regulatory framework and underfunded road safety programmes at national and local levels in several countries; ➢ Keeping vehicles safe throughout their lifetime – lack of vehicle maintenance challenges safety; ➢ Motorcycle casualties are overrepresented in road accidents; still they lack adequate attention.
Role of the United Nations	➢ Promote access to and implementation of the UN Road Safety legal instruments, such as the Vienna Conventions of 1968 on road traffic and on road signs and signals; ➢ Promote a framework for vehicle safety UN Conventions, e.g. the 1997 agreement on periodic technical inspections. ➢ Provide technical assistance and capacity building to improve road safety; ➢ Carry out analytical activities and provide support to road safety policies.

5.1.1 Trends

The risk exposure of the different road users varies between countries (see Figure 5.1). Pedestrians are the largest group of vulnerable road users in most countries and account for around 19% of all fatalities in IRTAD countries. Close to 40% of all pedestrians killed belong to the age group of 65 and above; this share has constantly increased from less than 34% in 2000, indicating the changing safety requirements of an ageing society which will have to be met by our transport systems.

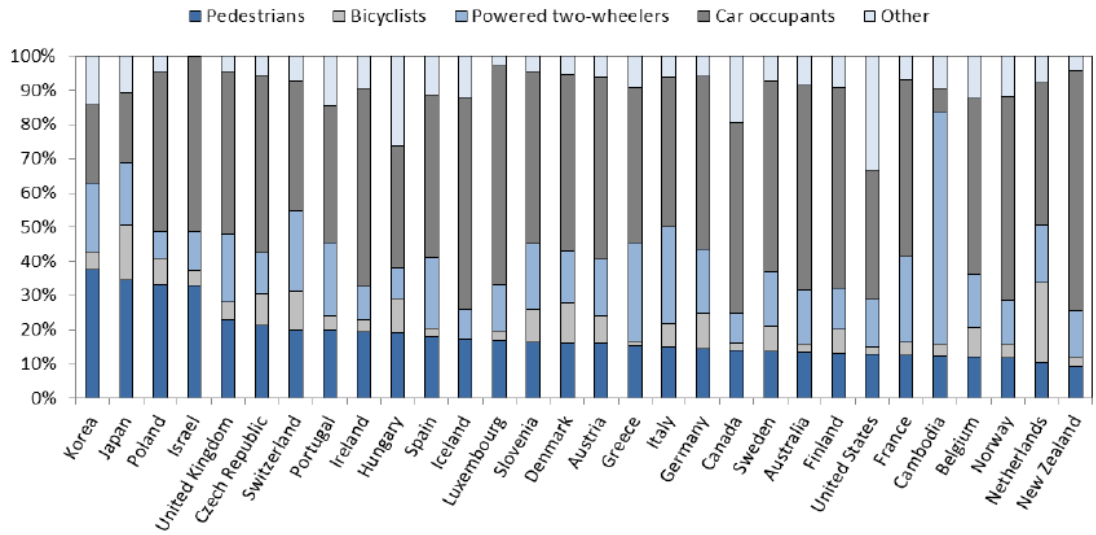

Fig. 5.1 Fatalities as a share of different road user classes - average of the 2008-2012 period (IRTAD, 2014)

IRTAD. The IRTAD Group operates the International Road Traffic and Accident Database, which includes aggregated data on injury accidents, road fatalities, relevant exposure data, population, motor vehicle fleet, road network length, vehicle-kilometres and seatbelt wearing rates from 32 countries, covering every year since 1970. See http://internationaltransportforum.org/irtadpublic/index.html

The highest shares of pedestrian fatalities were recorded in Korea, Japan, Poland and Israel, whereas in New Zealand, the Netherlands and Norway they account for only about 10% of all fatalities. Pedestrian safety continues to be one of the major road safety issues around the world, especially in lower income countries. At the same time, cyclists are involved in considerably more fatal crashes in the Netherlands (22% of all fatalities), in Japan (16 %) and Hungary (13 %) than in the USA and Greece (1-2 % of all fatalities), whereas fatalities involving powered two wheeler-PTW (motorcycles) riders are extremely high in Cambodia (about 65% of all fatalities), and of increasing concern in Greece (30 %), Italy (27 %), France (25 %) and Switzerland (22 %).

Trends in road fatalities are mixed. In some countries there have been sharp reductions in fatalities over the last decade (Fig. 5.2). Most of these reductions are related to car drivers/passengers, due probably to the increased passive safety of cars, improved speed management and more effective drinking/driving policies. However, the record has been less satisfactory for vulnerable road users, such as pedestrians, cyclists and PTW riders (IRTAD, 2014). In any case, 2013 has been the year with lowest ever overall fatality figures in most OECD-IRTAD countries; it should be noted, however, that the 2008 economic crisis may have influenced the number of road casualties, through a general decrease in overall mobility.

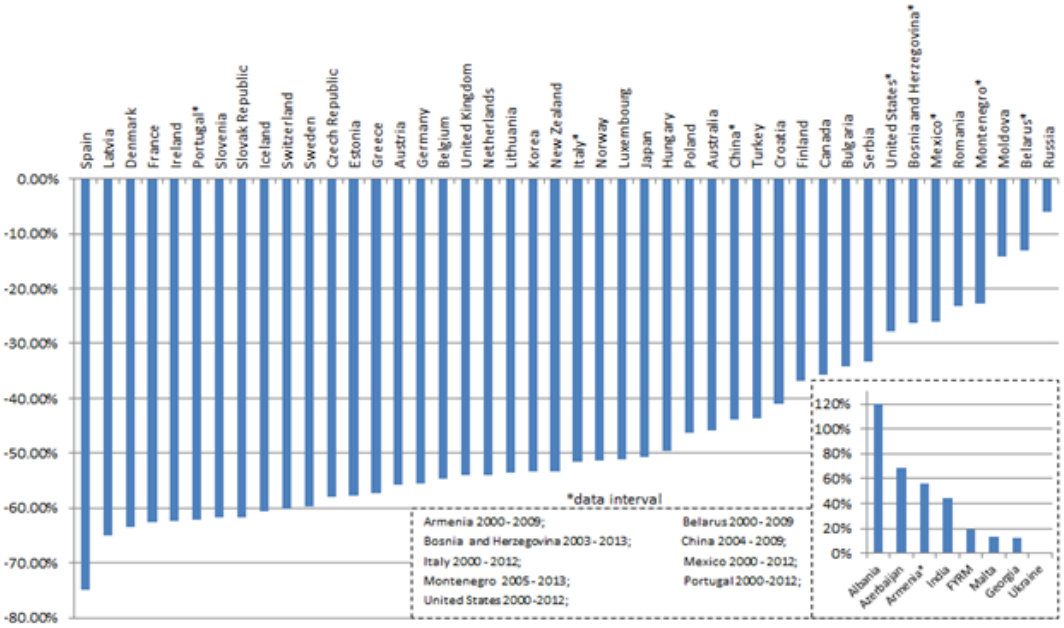

Fig. 5.2 Road fatality changes in the period 2000-2013 (unless otherwise indicated) (OECD, 2014[86]).

These trends may also be related to the introduction/implementation of more effective road safety policies and measures in these countries. In contrast, many emerging economies that show rapid private motorization are associated with increasing road casualties. The UN World Health Organisation (WHO) has found that '… *worldwide, the total number of road traffic deaths remains unacceptably high at 1.24 million per year. Only 28 countries, covering 7% of the world's population, have comprehensive road safety laws on the 5 key risk factors: drinking and driving, speeding, and failing to use motorcycle helmets, seat-belts, and child restraints*[87].

[86] http://data.oecd.org/transport/road-accidents.htm

[87] See The Global Status Report on Road Safety 2013 UN World Health Organisation. The Status Report serves as a baseline for the Decade of Action for Road Safety 2011-2020 and the 50% fatality reduction

In the ECE region, road fatalities vary considerably, but the situation is generally improving as compared to previous years data. In terms of the overall population, ECE Member States had on average 75 fatalities per one million inhabitants in 2013. On the basis of this indicator[88], the available data also show that, although there have been reductions in road fatalities in the last decade there is still a large variability between Member States (Fig. 5.3). The trend is the similar in ESCAP countries with available data.

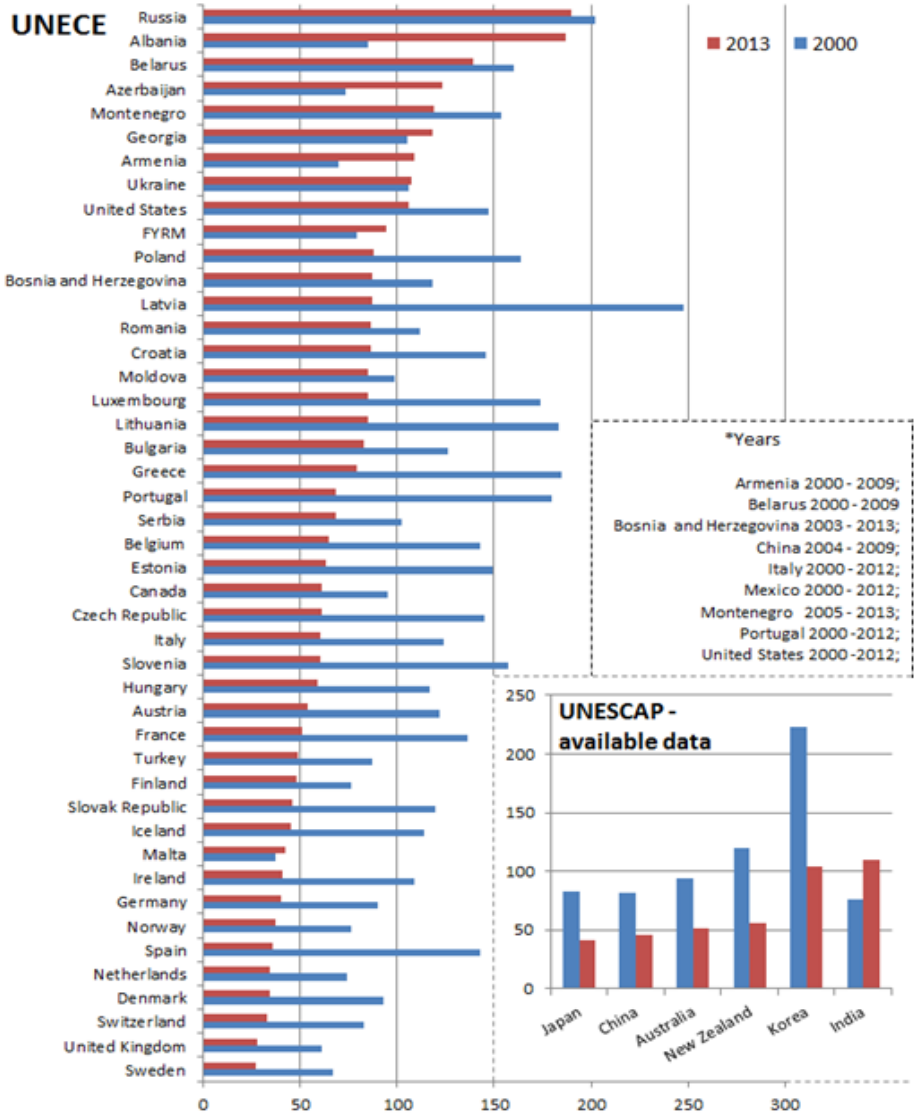

Fig. 5.3 Road fatalities per 1 million inhabitants in the ECE region and five ESCAP states, 2000 and 2013 (Source: OECD, 2014[89])

In 2013, more than half of the UNECE Member States (33 countries out of 40 for which information is available) had less than 50 road fatalities per 100,000 passenger cars. The lowest rates have been in Iceland (6), the United Kingdom of Great Britain and Northern Ireland, Sweden,

target for 2020, declared by the UN General Assembly.
http://www.who.int/violence_injury_prevention/road_safety_status/2013/en/

[88]. There is a considerable debate over which indicator is most appropriate to measure risk exposure to risk. For a discussion, see IRTAD (2013).

[89] http://data.oecd.org/transport/road-accidents.htm

Norway, Malta and Liechtenstein (7), Switzerland and the Netherlands (8) and Germany and Spain (9). Eastern and South-Eastern Member States as well as certain Central Asian States appear, however, to experience substantial road safety challenges; in 2011, road fatality rates have been 169 per 100,000 passenger cars in Georgia, 98 in Albania, 97 in Moldova and 69 in Kazakhstan.

With the rapid growth in the motorization rate and the length of road network in ESCAP countries, the number of road traffic deaths in many developing countries of the region has dramatically increased in the recent years. The World Health Organization (WHO) and its Global Status Report on Road Safety 2013 provide several. More than 777,000 people were killed on roads of the ESCAP region in 2010. At a rate of 18.62 fatalities per 100,000 inhabitants, this amounted to more than half of the world's road traffic deaths in 2010.

Based on available data, between 2007 and 2010, the progress in road safety in the ESCAP region has been mixed. In terms of estimated deaths, ESCAP region saw approximately an 11 percent increase in number of road traffic deaths. At country level, some 25[90] countries in ESCAP region showed reduction in the number of deaths on their roads between 2007 and 2010 (Fig. 5.4). In the majority South-East Asia (SEA) countries the number of road traffic deaths increased during the period, while North and Central Asian (NCA) countries achieved mixed results. Pacific sub region (PAC) has the highest number of countries (9) that made progress. East and North-East Asia (ENEA) and South and South-West Asia (SSWA) are another two sub regions in which the number of countries that have made progress exceed number of countries that have not. These encouraging figures show that road safety improvement is possible.

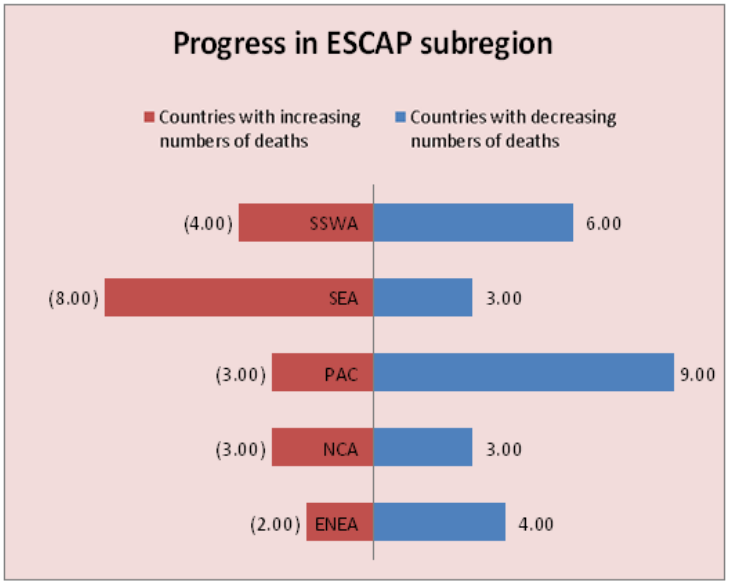

Fig. 5.4 Progress in ESCAP sub-regions between 2007 and 2010

[90] Calculated based on countries with available data of 2007 and 2010 - Pacific :Australia, Fiji, Kiribati, Marshall Islands, Micronesia (Federated States of), New Zealand, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu; North and Central Asia: Armenia, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan; East and North-East Asia: China, Democratic People's Republic of Korea, Japan, Mongolia, Republic of Korea and Russian Federation; South-East Asia: Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste and Viet Nam; South and South-West Asia: Afghanistan, Bangladesh, Bhutan, India, Iran (Islamic Republic of), Maldives, Nepal, Pakistan, Sri Lanka and Turkey.

In the ESCAP region, nearly 55 per cent of road traffic deaths are among vulnerable road users (VRUs). Among different types of VRUs, drivers and passengers of motorized two and three-wheelers has the highest proportion of 30.98 per cent. Pedestrians and cyclists have a lower share of 18.93 per cent and 4.88 per cent, respectively (Fig. 5.5).

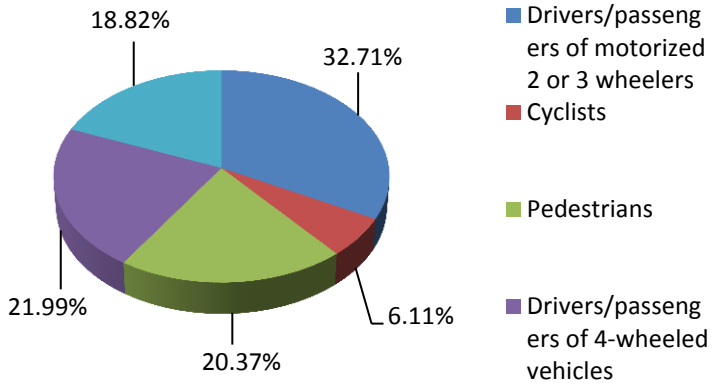

Fig. 5.5 Fatalities by road user types in ESCAP region in 2010[91]

On the basis of the comparison between motorization and road fatality levels, it appears that whereas several ECE member States have been able to fully decouple motorization levels (passenger cars per 1,000 inhabitants) from road fatalities over the two past decades, most middle-income countries in Eastern/South-Eastern Europe and especially Central Asia have not (Fig. 5.6).

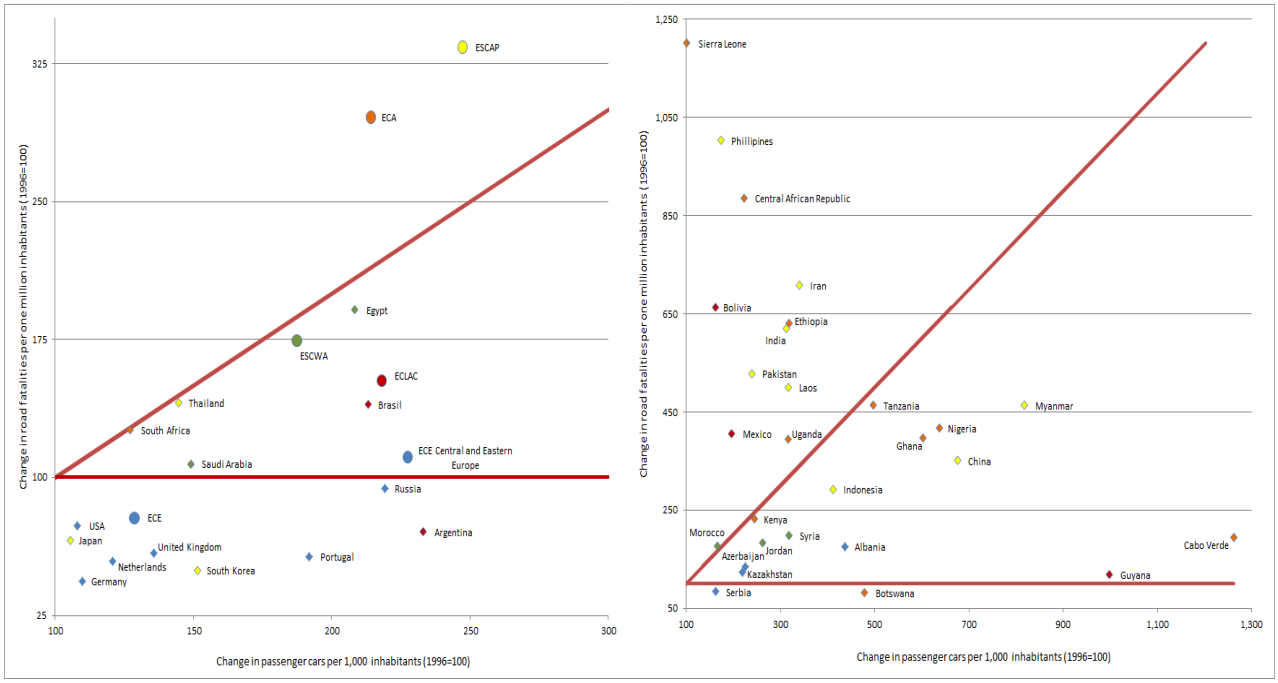

Fig. 5.6 Change in Motorization levels and road fatalities – a) all regions 1996 – 2010; b) Country comparisons and examples of notable dimensional shifts 1996 - 2010

[91] Refers to 35 countries in the ESCAP region based on data availability in the second WHO Global Road Safety Report 2013 (**East and North-East Asia** (5): China, Japan, Mongolia, Republic of Korea, and Russian Federation/ **North and Central Asia** (6): Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, and Tajikistan/ **Pacific** (7): Australia, Kiribati, Marshall Islands, New Zealand, Palau, Papua New Guinea, Solomon Islands, Tonga, Vanuatu/ **South-East Asia** (7): Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Singapore, and Thailand/ **South and South-West** (8): Bangladesh, Bhutan, India, Islamic Republic of Iran, Maldives, Pakistan, Sri Lanka, and Turkey.

The countries and regions between the red 45 degree line and the red horizontal line in Figure 5.6 have managed relative decoupling of motorization and road fatalities. In other words, road fatalities have increased less than motorization levels. UNECE is the only region in which absolute decoupling has been achieved. However this is driven by significant reductions in road fatalities in Western and Northern European Countries, whereas Central and Eastern Europe, the Caucuses and Central Asia have thus far on average managed relative decoupling of motorization and fatality levels. Never the less the trend is quite positive in these countries. Year after year the relationship between motorization levels and road fatalities is improving.

Relative decoupling between motorization rates and number of fatalities has been achieved in ECLAC and ESCWA regions during observed time period, however some countries such as Bolivia and Mexico still experience very high annual road fatality rate increases. The most critical countries in terms of road fatality levels are members of ECA and ESCAP. This development can be explained by the high economic growth rates and increased transport demand in these countries that resulted in rapid increases in private motorization levels and backlogs in road safety policies.

It should be noted that information on fatal road crashes is relatively easy to collate. In contrast, although road accidents can also result in serious, non-fatal injuries having serious impacts on people's lives and the economy, it has been a challenging task to record serious injuries in a compatible format, inhibiting international comparisons of serious injuries. In 2011, an IRTAD publication[92] made a number of recommendations regarding the analysis of serious injury data and proposed a common definition for serious road accident injuries, based on medical diagnosis. The European Commission subsequently adopted a similar definition and is expected to set serious EU injury reduction targets for 2020 (IRTAD, 2013).

5.1.2 Factors controlling road accidents

Following the establishment of common road traffic rules and road signs and signals[93], the larger road safety risks are related to drink driving, speeding, non-wearing of seat belts and helmets, and the use of mobile phone while driving. Experience has shown that targeted educational schemes, as well as regulation and enforcement to modify driver behaviour can bring substantial benefits.

Driving under the influence of alcohol

Drink driving accidents are defined as those accidents where at least one of the road users involved in the crash has been under the influence of alcohol. Countries define "*being under the influence of alcohol*" in two different manners: drivers with positive blood alcohol contents and drivers with blood alcohol contents above the maximum allowed limit. In addition, as alcohol content limits are different in different countries (see e.g. Table 4, IRTAD, 2013), comparisons between countries cannot easily be standardized. Nevertheless, nearly all countries indicate that

[92] IRTAD 2011. Reporting serious road traffic casualties. http://internationaltransportforum.org/irtadpublic/pdf/Road-Casualties-Web.pdf

[93] The Conventions on Road Traffic and on Road Signs and Signals from 1949 were followed by the so-called Vienna Conventions on Road Traffic and Road Signs and Signals in 1968; these conventions aimed to increase road safety by standardizing traffic rules road signs, traffic lights and road markings. One of the newest amendments adopted in 2003 was on priority in roundabouts and signs in tunnels For more details, see http://www.unece.org/transport/international-agreements/transconventnlegalinst/list-of-agreements-for-tabs/road-traffic-and-road-signs-and-signals-agreements-and-conventions.html

drink driving is a major contributing factor in fatal crashes, which, in many countries, is involved in about one third of all fatal crashes (IRTAD, 2013). Drink driving is also a major issue for several ECE member States. The majority of these countries apply a maximum blood concentration level of alcohol of 0.05 %; nevertheless, the number of road fatalities attributed to alcohol remains high in many countries, with Slovenia and the United States of America topping the list (UNECE, 2012).

Speeding

Inappropriate or excessive speed is also reported as the defining forcing behind a large proportion of fatal crashes (typically around 30 %). There appears to be a close relationship between changes in speed limits and the number of fatal crashes. In the ECE region, many countries have now reduced the speed limits within towns to 50 km/h and, in some urban areas, to 30 km/h. On motorways the speed limit in ECE countries varies between 100 and 130 km/h; this variability could be important as a speed limit difference of 20-30 km/h can have important implications on road fatalities (UNECE, 2012).

Seatbelts

Seatbelts are compulsory in front seats for the majority of countries[94], whereas in many countries there are also mandatory seatbelt laws for rear car seats. Although there are generally high levels of compliance, in the ECE region there is still a significant difference in seatbelt usage between the front and the rear car seats; for front seats, values typically range between 80% and 100% whereas for rear seats the range is between 3% (Serbia) and over 90% (Germany, Australia). Therefore, there is scope for improvement of the compliance rates in both front and rear seats, particularly as it has been found that drivers not wearing a seatbelt are more likely to exhibit additional high risk driving habits, such as speeding and/or drink driving (IRTAD, 2013).

Protective gear

The majority of countries have passed national helmet laws for the riders/passengers of motorized two wheelers (mopeds and motorcycles). Wearing rates are generally good (more than 90 %) in countries with an overall high road safety performance. Concerning cyclists, helmets are compulsory for all cyclists only in few countries (e.g. Australia, Finland and New Zealand), whereas several countries require helmet use for children. There is little information on wearing rates. Finally, although in many countries there are laws prohibiting the use of (hand-held) mobile phones while driving, there are many drivers that still use hand-held and hand-free mobile phones in these countries.

Infrastructure quality

It should be also noted that safer road networks and improvements in road infrastructure can prevent and/or reduce considerably the severity of road accidents. For example, according to the data available from the ESCAP's Asian Highway Database, primary class Asian Highway roads have the best safety record, while those below class III have the worst record. The upgrading of roads to access-controlled primary class had significant benefits in reducing fatality rates. Substantial improvement in terms of safety can also be gained when roads below class III are upgraded to the

[94] It is interesting to note that many States of the United States of America do not have primary seatbelt laws (IRTAD, 2013).

minimum class III standards[95]. As safety management through road design and maintenance standards is different between countries, there is scope for further studies in order to identify good practices as well as indicators that would assist the assessment of road safety in terms of road infrastructure quality (IRTAD, 2013).

5.1.3 Challenges and best practices

Road safety presents many challenges. First, reduction of road fatalities and/or injuries can be challenging, particularly in areas with rapid growth rates in economic development and motorization levels. In order to achieve such reductions, special attention should be placed in understanding better the controlling factors of road accidents and the design of plans/programs that could provide effective solutions. Secondly, particular emphasis should be given to address the increasing problem of motorcycle safety particularly in the well-developed economies where related fatality numbers appear to be elevated. Thirdly, as roads are getting quieter with the introduction of electrical vehicles ('silent' vehicles) and increasing bicycle use, elderly people and people with vision and/or hearing problems are under elevated accident risks. Fourthly, children, who have less experience and are often difficult to be spotted in road traffic, face increased accident risks; early education on road safety rules, blind spots and safe cycling and walking habits is essential for reducing such risks. Finally, many accidents occur in particular road sections ('black spots'), due to road design/maintenance problems, such as sharp corners, reduced visibility, missing signs or other reasons; therefore, removal of 'black spots' should be given a high priority (see also, UNECE, 2012).

For road tunnels, in particular, there is evidence that the rate of accidents is higher in bi-directional tunnels (up to 40 % higher) than in unidirectional tunnels. According to the World Road Association, the frequency of breakdowns is about 1300 per 100 million vehicle kilometres in tunnels under rivers and urban areas, 300–600 in tunnels in the open countryside, and 900–1900 n mountain tunnels. It has been also found that the frequency of fires in road tunnels is about 25 per one million vehicle-kilometres [96]. Following the incidents at the road tunnels of Mont Blanc and Tauern (1999) and St. Gotthard (2001), UNECE created a Multidisciplinary Group of Experts on Safety that dealt with road tunnels. The Inland Transport Committee subsequently also set up a group of experts to consider the issue of safety in rail tunnels[97].

There are several examples of plans/programs associated increasing road safety. These include the Dutch Educational campaigns for young road users, the 'Bob the designated driver' campaign to reduce drink-driving[98] ,systems for better enforcement of drink-driving laws, introduction of 'collision free roads'[99], the Northern European Cooperation program on traffic law enforcement

[95] Definitions of different class of Asian Highway roads can be found at: http://www.unescap.org/ttdw/common/tis/ah/IGA_intro.asp. Findings presented in this paragraph are based on road safety data are available for 33 per cent of the length of the Asian Highway, including 630 road sections (or 42.7 per cent of all sections), covering 47,939 km in 21 countries.

[96] See PIARC (1999)

[97] See http://www.unece.org/transport/areas-of-work/safety-in-tunnels/meetings/multidisciplinary-group-of-experts-on-rail-safety-in-tunnels-ac9.html

[98] See e.g. www.ec.europa.eu/health/archive/ph.../life.../ev_20080220_co01_en.pdf

[99] See e.g. www.righttoride.co.uk/virtuallibrary/barriers/R636ASve.pdf

[100], the Swedish 2010-2020 strategy for the improvement of road safety for moped and motorcycle riders[101], the trial driver's license in Germany, the EuroNCAP classification system of new car safety[102] the EU road safety targets[103], the introduction of digital tachygraphy and speed cameras and the IRTAD twinning program[104] (for more details on these plans/programs, see also UNECE (2012)).

It should be also noted that the UNECE has pioneered road safety activities in the United Nations system with the establishment of an Ad Hoc Working Group on the prevention of road accidents in 1950 and the 1988 establishment of the intergovernmental Working Party on Road Traffic Safety (WP.1), the only permanent body in the United Nations system that focuses on improving road safety and is as guardian of the United Nations legal instruments aimed at harmonizing traffic rules. Therefore, more relevant information on road safety can be found in http://www.unece.org/trans/main/welcwp1.html.

Professional road transport training: championing excellence worldwide

The IRU Academy, the training arm of the IRU, is the only global body dedicated to road transport training. By developing top-quality training programmes and ensuring quality control of training delivery, the IRU Academy ensures capacity building and development of professional competence for road transport managers and drivers across the board.

With its unique structure, the IRU Academy is involved in a number of training initiatives ranging from road safety to HIV/AIDS, and eco-driving, and offers its portfolio of training programmes to road transport professionals through its global network of Accredited Training Institutes to ensure that we support the industry in achieving its priorities in sustainable development, facilitation, safety and security.

Road safety training: Focusing on human behaviour through training

For true road transport professionals, every road accident is one too many. That is why the road transport industry is committed to reducing the number and severity of accidents involving commercial vehicles by addressing the main cause of accidents – the human factor.

The IRU Academy's professional training and knowledge transfer are key elements to effectively tackle the main causes of road accidents and significantly reduce their number. Committed to actively supporting the UN Decade of Action for Road Safety, the IRU Academy has strived to enlarge its training portfolio by developing road safety specific programmes:

- **Crash Prevention Programme**
  Aims to increase risk awareness and encourage road safety best practices among commercial drivers to reduce the number of accidents and ultimately save lives.

[100] Information provided by Sweden and Denmark in the questionnaire on Transport for Sustainable Development, December 2010.
[101] See www.polisen.se/Global/.../Improved_safety_for_mc_moped_1.0_Engelsk.pdf
[102] See http://www.euroncap.com/home.aspx
[103] See www.etsc.eu/documents/PIN_Report_6_web.pdf
[104] See http://www.internationaltransportforum.org/irtadpublic/pdf/13IrtadReport.pdf

- **Safe Loading and Cargo Securing Programme**
  Addresses road safety by training road transport professionals in loading and cargo securing theory and practice to ensure safe and legal cargo traffic on roads.

To further support the IRU Academy's work, the IRU continuously develops road safety publications such as driver safety cards and checklists.

The challenge of the safe mobility of people is especially important for the Latin America and the Caribbean countries, where, despite national and multilateral efforts in the framework of the Decade of Action for Road Safety, the estimated road traffic death rates are still high. Most of these deaths occur among vulnerable road users, with pedestrians accounting for up to 31% of total road traffic fatalities recorded in the region, while in countries such as the United States and Canada the figure is 12% and 14% respectively (Road Safety in Latin America and the Caribbean: Recent Performance and Future Challenges, FAL Bulletin No.322, 2013)

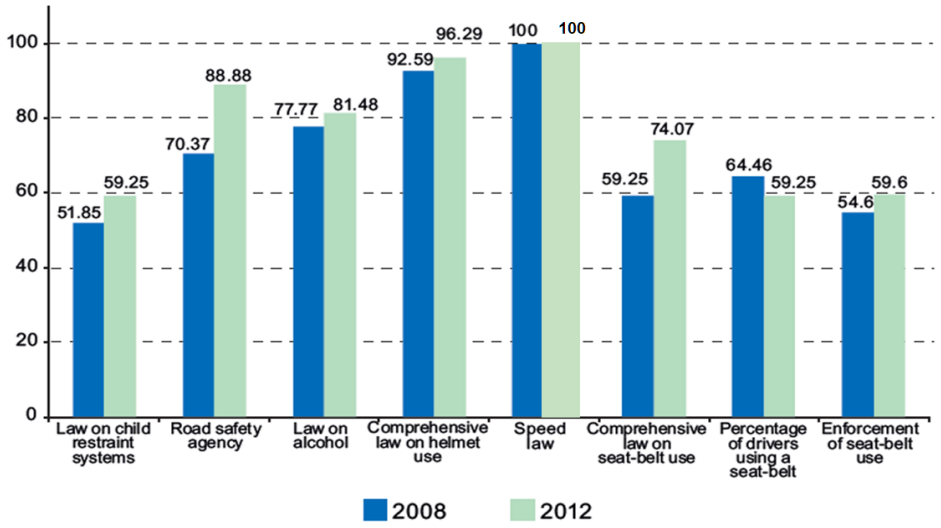

Fig. 5.7 Trends in road safety policies in the ECLAC region (based on: WHO, 2013; PAHO, 2009)

Recently, ECLAC reviewed the progress of the road safety measures implemented in 27 countries across the region for the period 2008 -2012 (Fig. 5.7). In general terms, the region shows positive trends for most of the selected indicators, in particular a substantial rise in the creation of road safety agencies and advances in the laws on alcohol and mandatory helmet use. However, it is noted that legislation on the compulsory use of child restraint systems in vehicles has achieved the least penetration in the region and it cannot be ruled out that acquired behaviours have been relaxed due to weaker law enforcement. It must therefore be emphasized that for a substantial reduction in the number of those killed and injured, measures require continuity over time.

For these reasons, ECLAC is promoting that road-safety measures that are part of a comprehensive and sustainable mobility policy. This approach not only allows the application of broad solutions, but also permits the consideration of their effects on other public spheres, such as their financial impacts on the national budget and on social welfare. By correctly anticipating these direct and indirect effects, fiscal space may be discovered (for example, through savings on health costs or insurance premiums) in order to fund effective road safety measures and to ensure that

they are economically sustainable. The environmental benefits of certain means of transport, insofar as they are provided with appropriate infrastructure and regulations (cycle paths, pavements and pedestrian overpasses and underpasses), can also be properly assessed under this approach.

5.2 Rail

Since their inception, railways have been built upon the need for transport to be as safe as possible. As technical performance has improved and the significance of railways as a mode of transport has grown, so have the volumes carried, the density of traffic, and the extent of services offered by the railways. Rules and regulations are already in place and continue to develop, becoming ever more precise and applying to all stakeholders, whether infrastructure managers, railway operators or even service providers and contractors working in the railways. Although rail transport is operated exclusively by professionals and one of the safest transport modes, safety incidents and accidents remain a fact of life.

5.2.1 Trends

The fatality risk for EU-28 countries is plotted against the fatality risk for the USA, Canada, South Korea and Australia in fig 5.8 below. No official data could be obtained from other major countries such as Russia, Japan, Brazil or China. For four of the five countries analysed the trend is a strong decrease in fatalities over the last decade. The pace of the decrease for the EU-28 is comparable to the trend in the USA and Canada; however it falls short when compared to the trend registered in South Korea (ERA, 2014).

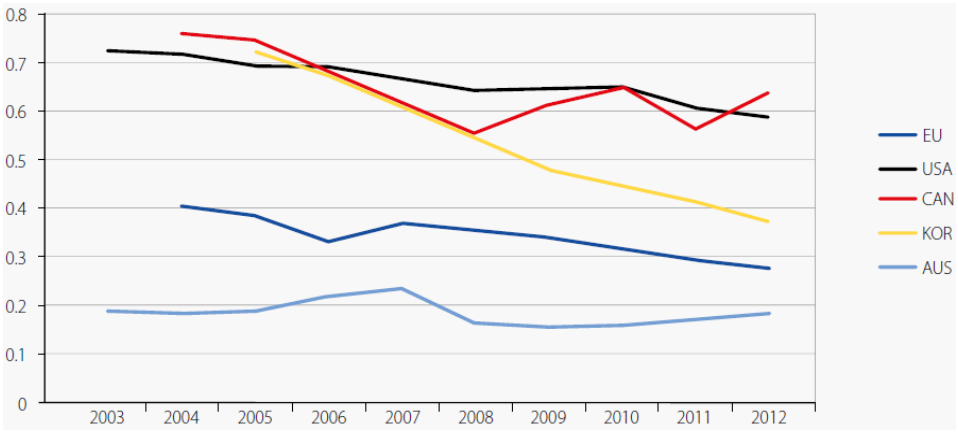

Fig. 5.8 Railway fatalities (excluding suicides) per million train-kilometres in 2003–2012 for the EU-28, USA, Canada, South Korea and Australia (ERA, 2014)

In the EU, there has been a continuous decrease in major accidents and resulting fatalities since the beginning of the 1980's. Nevertheless, serious accidents have a significant effect on the trend in the annual number of fatalities as a result of their relatively infrequent nature. Figure 5.9 shows the serious rail accidents during the period 1980–2013, which include not only train collisions and derailments with 5 or more fatalities, but also the major level-crossing accidents, train fires, and accidents involving people struck by rolling stock in motion. Trends in major accidents have substantially decreased over the period 1980-2012, but more so in the period 1990-2012. Unfortunately 2013 saw the highest rail accident casualty levels since 1998 as a result of the tragic

high speed train accident in the north of Spain claiming 79 lives in July of that year. On average, there were 8 major railway accidents each year during the 1990s, and about 5 major accidents per year in the 2000s.

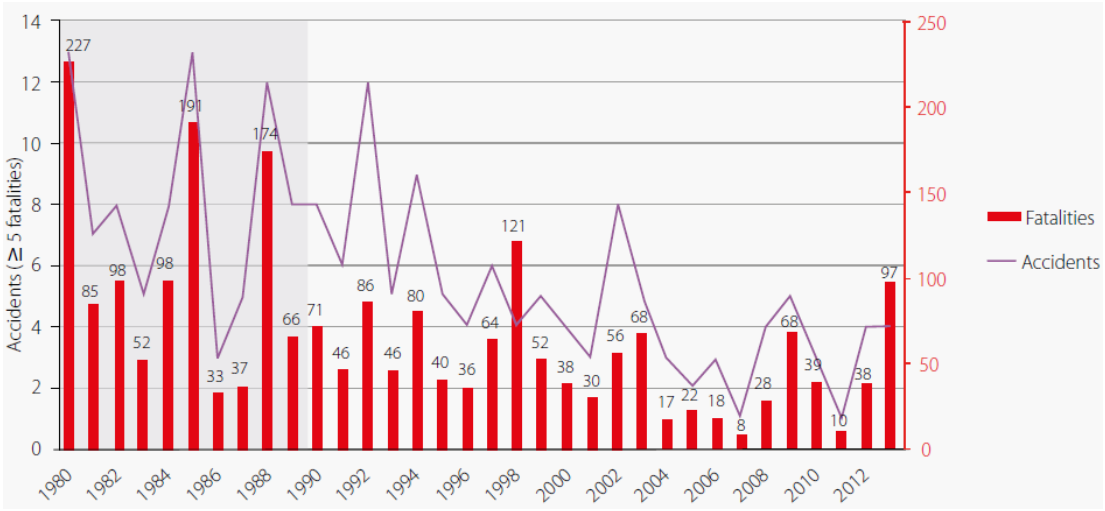

Fig. 5.9 Railway accidents in Europe with 5 or more fatalities, 1980-2013[105] *(ERA, 2014)*

An analysis of the rail incidents in the EU-28 in the period 2006-2013 (Fig. 5.10) shows that about 95 % of these fatalities were caused by rolling stock in motion and/or occurred at level crossings. More than two thirds of the fatalities (7328, 66.9 %) were due to accidents caused by rolling stock in motion (ERA, 2014).

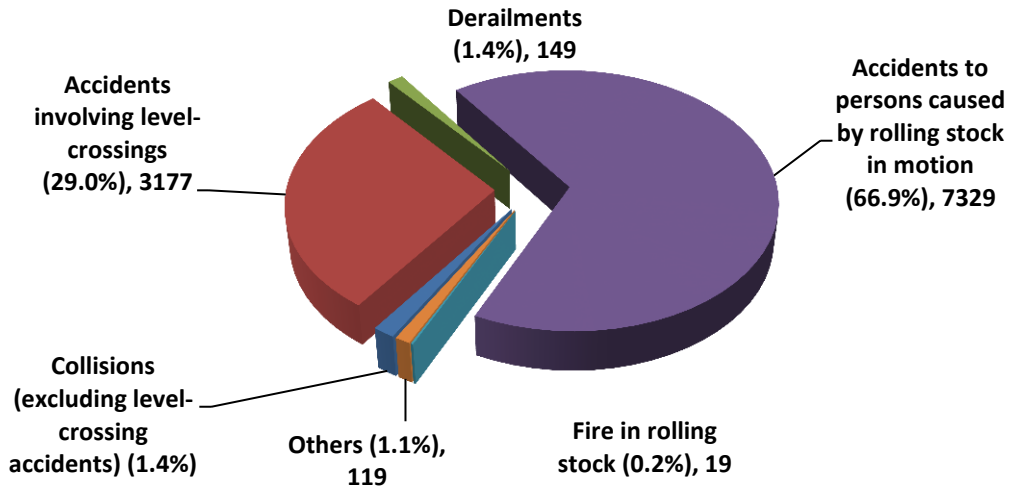

Fig. 5.10 Rail fatalities in the EU28, 2006-2013

As previously mentioned, the positive trend in the EU in recent years has suffered in 2013, during which 9% of fatalities were passengers, 3% were staff of the railway companies, while the remaining 88% were mostly trespassers, i.e. illegal access of persons to railway assets, and persons using a level crossing to cross a railway line by any means of transport or by walking (Fig. 5.11).

[105] Including EU28, Norway and Switzerland, and excluding Romania and Croatia for the period 1980–1989.

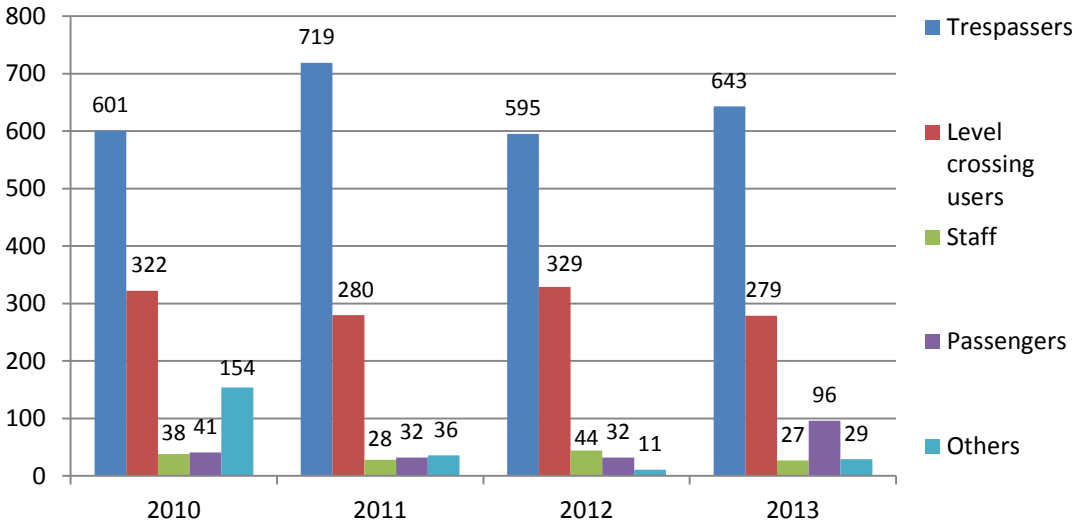

Fig. 5.11 Split of railway fatalities per category of victim in 2013 (21 UIC Safety Database members)

The trend is similar in Canada, where an average of 96% of fatalities between 2004 and 2012 resulted from trespassing and level crossing incidents. Similarly to the situation in Europe, one single incident changed the trend in 2013, namely a severe freight train derailment in Quebec was responsible for the deaths of 47 inhabitants dwellers of the town in which the incident took place (40% of total national rail fatalities in that year). In the United States of America there were 231 fatalities as a result of 2097 accidents that occurred on level crossings in 2013. The total number of fatalities in 2013 rail accidents in the country was 939, while that from trespassing was 553. In line with trends in the EU and Canada, a very high percentage of railway accident fatalities in the USA are the result of trespassing and level crossing incidents, which between 2010 and 2013 accounted for an average 84% of the total railway accident fatalities.

5.2.2 Factors causing rail accidents

The International Union of Railways (UIC) differentiates between two groups of factors that are the root cause of railway accidents, namely those instances within the responsibility of the railway system, and accidents as a result of external causes. According to UIC Safety Database data for 2012 (Fig. 5.12), 79% of accidents happened as a result of external causes, while internal causes are split between technical failures (15%) and human factors (6%).

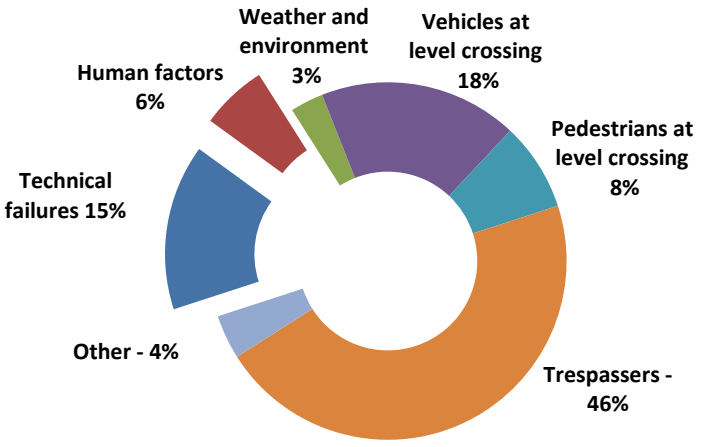

Fig. 5.12 Main causes of railway accidents in 2012 (21 UIC Safety Database members)

Technical failures and human factors

The European Railway Agency has identified the most common technical failures which are cause or railway accidents and established guidelines for safety management system through which relevant authorities in EU member states monitor the occurrence of these technical malfunctions, namely broken rails, broken track buckles, signals passed at danger, wrong side signalling failures, broken wheels and broken axels. A more detailed overview of these factors is provided in the best practices segment of this chapter section. Excessive speeds, the lack of or malfunction of the automatic speed reduction safety system are and additional factor leading to significant accidents (as defined by the ERA as accidents with 5 or more fatalities).

Trespassing and suicides

The accident and fatality data in the EU, USA, Canada and other countries covered in the previous overview does not take into account suicides. Such incidents are treated as a separate category due to the intentional nature of the act, because of which it is primarily a security concern rather than a safety issue[106]. During the 2006-2012 period on average, suicides represented 70% of fatalities on and together with trespassers accidents, constitute 88% of all fatalities occurring within the railway system in the EU (Fig. 5.13).

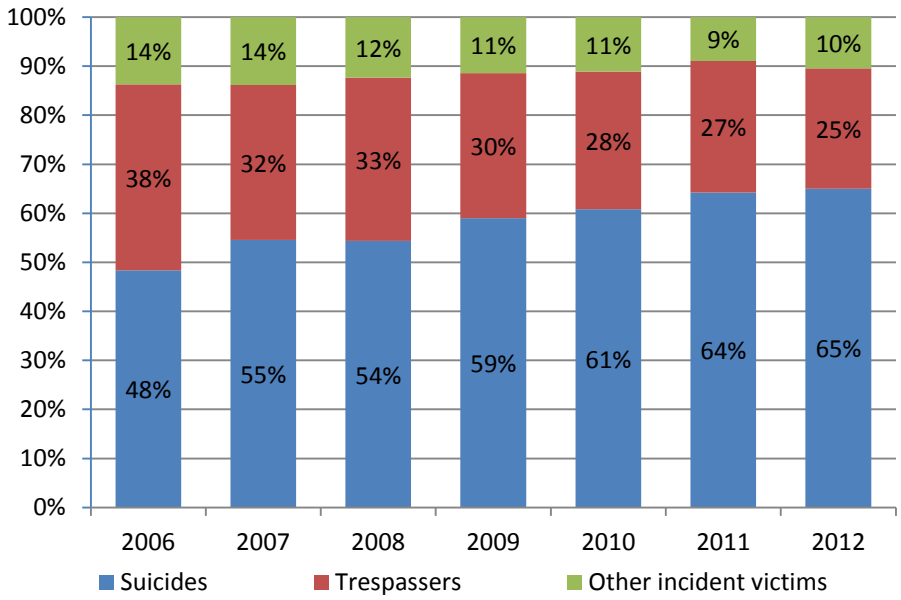

Fig. 5.13 Causes of fatal accidents in railway systems in the EU 28 (adapted from: ERA, 2014)

Several European countries registered a significant increase in railway suicide events in 2012, in particular the UK, Sweden, Poland, Portugal and Lithuania, with the frequency of such incidents in those countries increasing by 25% on a year-to-year basis. Therefore suicides, which on average increase by 6% per annum, and trespassing incidents, demand urgent mitigation measures in the EU, and are a serious security concern within railway systems (see chapter 6). In the United States the recorded suicide rates are somewhat lower in terms of total fatalities, but still represent a significant proportion of total loss of life, with an average of 250 annual incidents between 2011 and 2014 (Federal Railroad Administration).

[106] For a more detailed explanation of the distinction between safety and security see chapter 6.

Level crossings

Intersections between roads and rail tracks present special challenges for the safety of both rail transport and road transport, as they involve two interacting transport modes with very different operational characteristics. For example, road users are individual drivers with high operational flexibility, whereas train drivers follow strict schedules and guidelines and are restricted to the railway tracks. Trains have priority at level crossings. Road users are warned through audible signals such as horns or bells, visible signals such as lights and gates and/or physical signals through vibration of road bumps. There are currently more than 118,000 level crossings in the EU28 alone, i.e. 5 level crossings per 10 rail line-km (although there is a current 2% average annual decrease through investments aimed at replacing level crossings with other infrastructure). Half of these crossings are active level crossings, equipped with some sort of user warning; the remainder are passive level crossings, typically equipped with only a St. Andrew's cross traffic sign (Fig. 5.14). Level crossings with automatic user-side warning (typically flashing lights and sound warning) are the most common type of active crossings (43 %), closely followed by level crossings with automatic user-side protection and warning (barriers with lights) (34 %). Sweden, Austria, the Czech Republic, Hungary and the Netherlands have the highest density of level crossings per rail line-km. A low ratio of active level crossings to all level crossings is typical for less densely-populated countries. For example, Spain has the lowest average number of level crossings per line-km, i.e. one level crossing per 5 line-km (ERA, 2014**).**

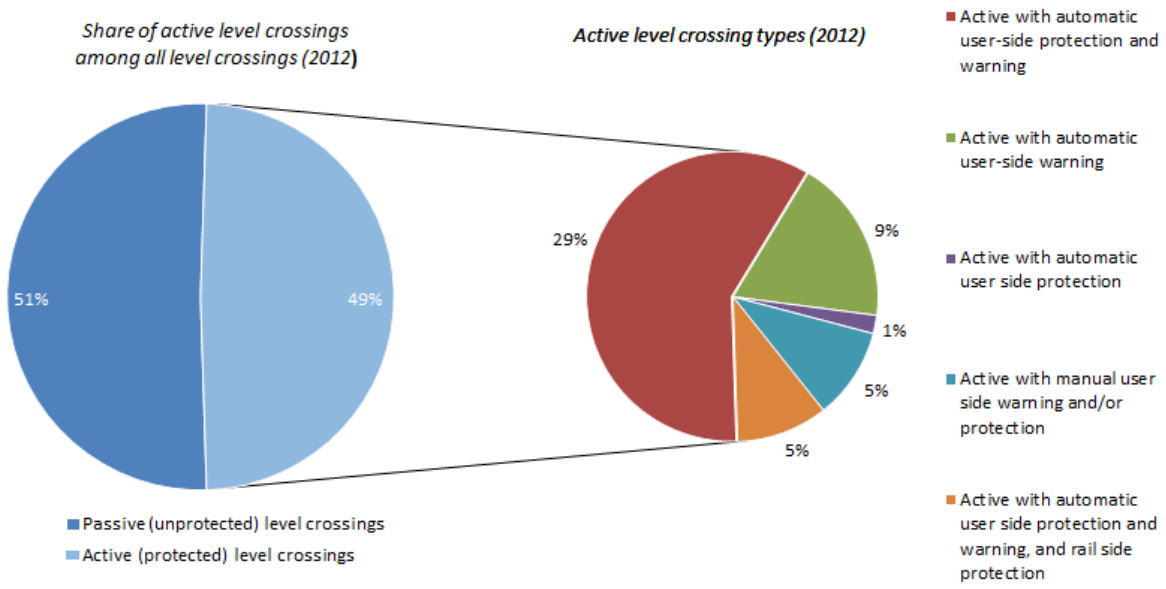

Fig. 5.14 Active level crossings in the EU[107] (ERA, 2014).

5.2.3 Challenges and best practices

Effective safety management is a prerequisite for maintaining and improving the safety of the railway system over time, with regard to technical, organizational and human factors affecting the inner workings of railway systems. A safety management system is a proactive system that identifies hazards of the activity, assesses risks that those hazards present, and takes action to

[107] An active level crossing means that users are either warned (unprotected) or protected (by a barrier/gates).

reduce those risks to acceptable levels. It involves continuous checks and timely identification of new hazards.

There are two key methods for evaluating and managing accident risks. One is to use historical accident data to identify the accident types with the highest risk or frequency; the other is to develop a model to examine the potential causes of – or precursors to – an accident. Serious railway accidents are rare and just using historical accident data may conclude that the risk of such events occurring is remote or non-existent. To proactively manage accident risk, it is therefore important to look beyond the accident statistics and identify and estimate possible accident causation sequences. The frequency of such causes and sequences is large enough within the rail industry to provide a reasonable empirical base for estimating risks. The aim of a risk model is to determine how particular minor events could interact to lead to a more serious accident.

Precursors to Accidents

As railway accidents are rare, monitoring events with less serious consequences is an essential tool of a proactive safety management system. An example of such an approach is the EU system of proactive monitoring of railway safety through reporting of common safety indicators (CSIs) by national safety authorities (NSA) to the European Railway Agency. One such measure is the investigation and reporting of "Precursors to accidents", indicators of incidents that under other circumstances, i.e. if not monitored and mitigated, could lead to accidents. These indicators have been determined (Transport Research Laboratory) by studying the causes of major incidents:

- derailment,
- collision of trains,
- collision with obstacle,
- level crossing accident,
- accidents to persons caused by rolling stock in motion (excluding suicide),
- fires in rolling stock,

by identifying the precursors reported as triggers to the incidents, and developing a harmonized set of accident precursors for safety management at the EU, NSA, Railway Undertaking (RU) and Infrastructure Management (IM) levels:

- broken rails,
- broken track buckles,
- danger signals passed,
- wrong side signalling failures,
- broken wheels,
- broken axels.

Over the period between 2010 and 2012, EU countries reported more than 10 000 precursors to accidents per year.

As described in the previous section suicide incidents are a significant cause of fatalities in railway systems. Although rates of such incidents in Canada are not as high as in the EU, the concern regarding the issue motivated the Department of Transport of Canada to fund a program targeted at researching the causes, reducing the rates and mitigating the consequences of such tragedies.

Railway Suicide Prevention and Reduction of Negative Consequences

The Centre for Research and Intervention on Suicide and Euthanasia (CRISE) of the University of Québec in Montréal (UQAM) conducted their Railway Suicide Prevention and Reduction of Negative Consequences program between 2007 and 2013, resulting in an online database providing assistance to all interested parties and stakeholders affected by railway suicides. The objectives of the program are to:

- provide railway stakeholders from Canada and around the world with relevant scientific information to improve prevention of railway fatalities and reduce their impact on employees,
- promote sharing of information among railway network stakeholders regarding suicide prevention and support for employees,
- encourage and support the development of evidence based suicide prevention practices
- encourage and support the development of evidence based support and trauma prevention practices,
- encourage and support the evaluation of practices in order to improve practices and insure continuing quality control.

The program resulted in a very detailed data and knowledge base that can be accessed at http://www.railwaysuicideprevention.com. It contains structured analysis of suicide prevention challenges, suicide and trespassing prevention methods and descriptions of measures for monitoring incidents and discouraging perpetrators, advice for identification of hotspots, preventive measure effectiveness evaluation methodologies, and many more tools to address the occurrences of trespassing and suicides on railways.

Besides suicides and trespassing leading to fatalities, level crossings are another weak link of the rail system in terms of safety. According to European statistics level crossing accidents account for only 1% of road deaths but they comprise 29% of all rail accidents, and the risk of injury or death is extremely high and unacceptable because it is mostly preventable. Numerous efforts have been undertaken for the purpose of raising awareness of level crossing safety issues. A significant number of accidents at level crossing are the result of negligence upon crossing by motorists, cyclists and pedestrians, either deliberately or mostly by mistake. As a result, educating users is a very important measure for highlighting the risks and raising awareness among the public of the potential consequences of ignoring traffic rules and safety signals and barriers.

In 2009 the International Level Crossing Awareness Day (ILCAD), a yearly campaign aimed at making the road users and pedestrians aware of the dangers at and around level crossings worldwide campaign was initiated and organized by the International Union of Railways (UIC).

International Level Crossing Awareness Day

The first campaign, named ELCAD (European Level Crossing Awareness Day), started in Europe plus Israel and was held on 25 June 2009. This was a collaborative effort involving major railway undertakings, the road sector, infrastructure managers, and government agencies from many UIC

Member States, the European Commission, law enforcement authorities and media.

The focus was to link together a series of existing national campaigns all on the same date around a common theme and branded in a unique way which would be held at various locations in every participating member state of the European Union. The key message to be delivered was, "Stop accidents! Europe for safer level crossings!".

The objective was to raise awareness of the risks at the road/rail interface, focusing on the behaviour of users at level crossings. It got such a success internationally speaking that it was finally named ILCAD (International Level Crossing Awareness Day).

In the 2010 International Level Crossing Awareness Day (22 June) more than 40 countries (including Estonia, France, Germany, Italy, Lithuania, Poland, Portugal, Russian Federation and the United Kingdom) have presented their awareness-raising videos, posters and other relevant material. This 2010 edition expanded to cover all five continents[108]. The campaign has been growing over the last 5 years gathering up to 45 countries in the 2013 edition.

In UNECE there are Working Parties on Road Safety (WP.1), on Rail Transport (SC.2) and on Road Transport (SC.1). These provide an adequate framework for knowledge sharing and capacity-building to tackle problems related to level crossings. It has been suggested that a multidisciplinary group of experts, including members of each working party and other stakeholders, should be formed in order to improve safety at level crossings. Finally it should be mentioned that the UNECE informal task force on rail security deals with the terror threat to the railway system and provides a framework for sharing best practices. The task force works on key issues using a risk-based approach. The UNECE Working Party on Rail transport works together with the International Union of Railways to raise awareness on the importance of rail security; this work involves workshops, joint meetings and knowledge sharing.

5.3 Inland Waterways

Inland waterway (IW) transport is more than 50 times safer than road and more than 5 times safer than rail (in persons killed per ton-km) transport (UNECE, 2011). IW vessels are not only operated by professionals, but are in contrast to road and rail, predominantly used for freight transport, especially in Europe and North America, therefore limiting the scope for accidents involving individuals.

In contrast, certain parts of Africa and Asia are suffering from a high rate of accidents on internal waterways involving commuters, which occur in densely populated areas in proximity of large rivers where a lack of adequate road infrastructure, high traffic volumes and the relatively high cost of overland travel stretch existing IW transport capacities.

5.3.1 Trends

Available accident statistics show very low accident rates in European IW (Fig. 5.15). Exceptions to the concept of infrequent and victimless accident trends are serious river cruise or ferry

[108] See also www.ILCAD.org.

accidents such as the 2011 *Bulgaria* cruise disaster on the Volga River (Russian Federation), which resulted in 123 fatalities.

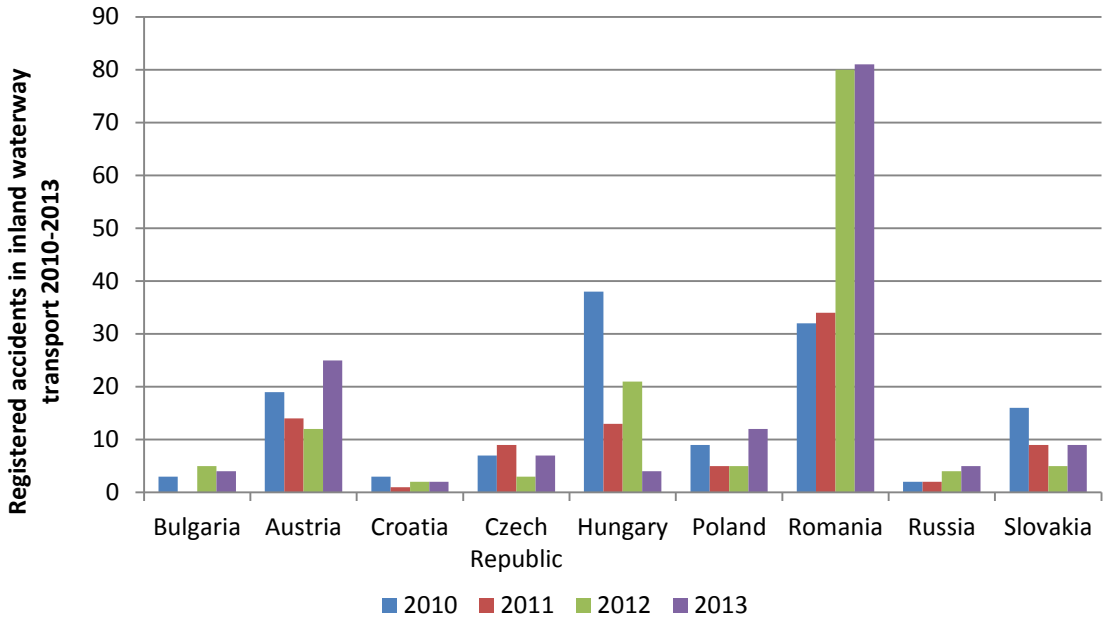

Fig. 5.15 Accidents in the European inland waterways, 2010-2013 (source: Eurostat, Russian Federation Ministry of Transport)

Transport of dangerous goods requires special attention as accidents can have severe consequences on the environment and for the individuals involved. Dangerous goods transported include toxic, corrosive, explosive, radioactive or flammable substances and mitigation of the risk from transport of these goods requires special safety precautions. According to Eurostat, there have been 23 reported accidents involving transport of dangerous goods on European inland waterways between 2004 and 2013, of which seven occurred in Austria while five happened in Romania.

The Netherland's, having one of the most developed national inland waterway transport networks in Europe and the World and the highest per capita carriage of goods by inland waterway have developed a thorough practice of monitoring IW traffic incidents. Instances and causes of internal waterway accidents are monitored and published by the Dutch Ministry of Infrastructure and Environment, and include data on number of accidents, type of accidents (according to a defined damage and casualty scale), environmental damage and victims in commuter, freight and recreational waterway traffic. Nevertheless, in the past few years, the number of accidents on inland waterways in the Netherlands has increased (as has traffic) (Fig. 5.16).

The national accident registration system shows that recreational craft are relatively more frequently involved in accidents than had previously been thought. In 2013, four serious accidents involving professional and recreational vessels claimed seven lives. Between 2004 and 2012, the number of registered accidents involving professional and recreational vessels was on a slightly upward trend, leading, on average, to no more than a single fatality per year.

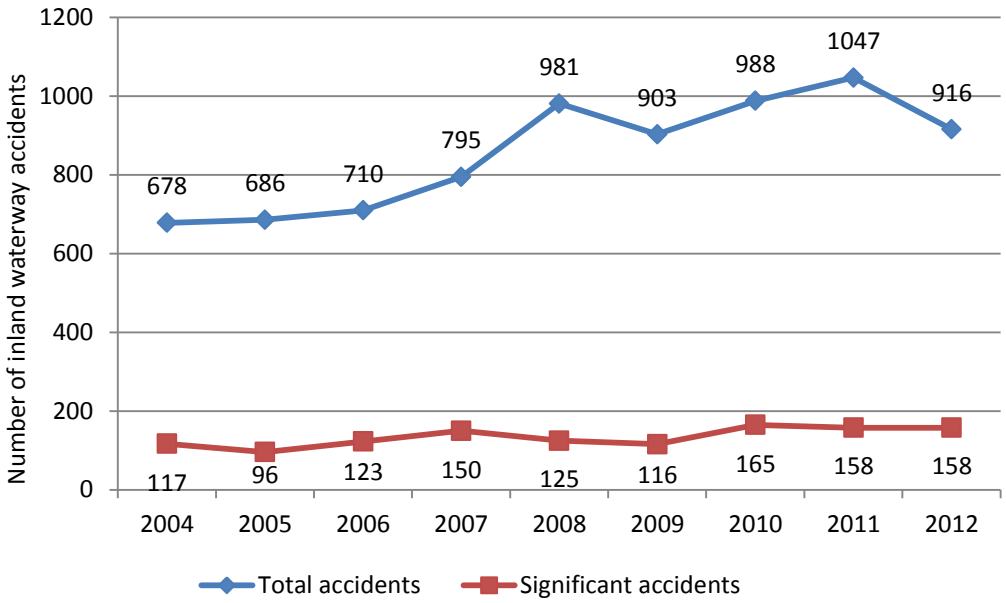

Fig. 5.16 Inland waterways accidents in the Netherlands, 2004-2012 (Netherlands Ministry of Infrastructure and Environment, 2010 and 2013)

A cross-country or international comparison of inland waterway safety data is difficult to establish as definitions of serious accidents on inland waterways differ from country to country and by scope of accidents considered. The box below shows a comparison of select definitions in the Netherlands and in the USA:

Inland waterway transport (Netherlands)	Inland waterway towing industry (USA)
• Victims: There are casualties missing, dead or severely wounded; • Damage: waterway or ship damage of € 50,000 or more; more than 10 tons of cargo, or at least 1 container is damaged or lost; • Environment: stage 2 or 3 environmental damage; • Navigation suspension: if the waterway traffic is blocked for an hour or longer.	• Victims: Any injuries or deaths • Damage: More or equal to $250,001 • Pollution: 1,001 or more gallons of oil spilled

The U.S Coast Guard and the American Waterway Operators have established a Safety partnership in 1994 for the purpose of measuring and tracking the overall trends in safety and environmental protection in waterway transport. While not all-encompassing, the measures are considered as useful safety indicators and consist of: a) the number of crew fatalities on towing vessels, b) gallons of oil spilled, and c) number of accidents and degree of severity. During the past decade incidents of high and medium severity have both followed a decreasing trend line. Medium and high severity incidents accounted for an average of 11% of all incidents in the towing industry in the USA between 2004 and 2012 (Fig. 5.17).

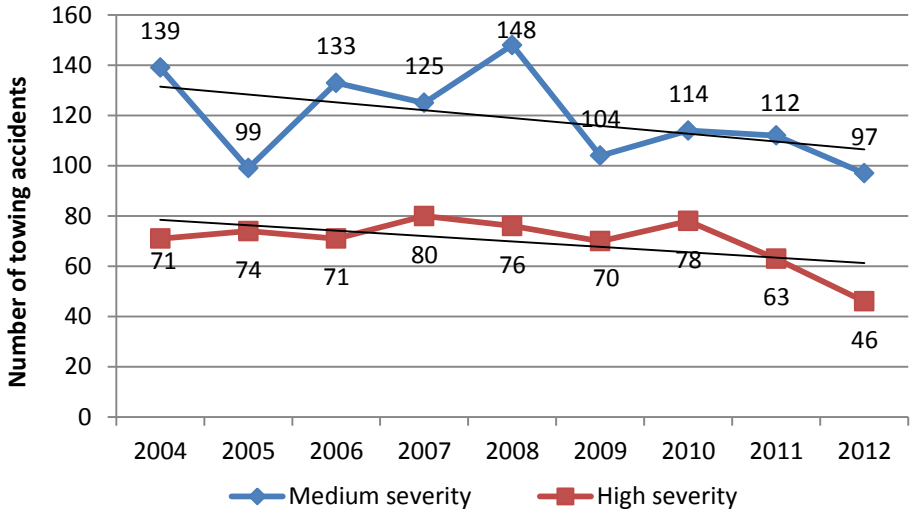

Fig. 5.17 Inland waterways towing accidents in the USA 2004-2012 (U.S Coast Guard - American Waterway Operators, 2013)

Some of the most common causes of medium and high severity accidents between 2000 and 2012 in the USA have been allision (38%), material failure (19%), collision (11%), grounding (10%), vessel manoeuvrability issues (8%) and flooding (5%).

South East Asia, West and Central Africa and to a lesser extent the Amazon and Parana River regions in South America are areas with reoccurring severe accidents with high fatality rates. Lack of adequate road infrastructure, high traffic volumes and the relatively high cost of overland and air travel make waterways in these regions, foremost large rivers such as the Padma and Meghna Rivers in Bangladesh and Congo and Niger River in West Africa, and their tributaries, important transport arteries for the general population as well as specifically for traders and market vendors.

Between 2003 and 2013 at least one thousand persons have died in numerous ferry accidents in Bangladesh, often blamed on vessel overloading, poor construction and a lack of appropriate safety measures and their enforcement. The same causes are reported as precursors to two accidents on the Congo River in 2008 and 2010 in which 185 people drowned, and to three accidents on the Niger River in 2013 resulting in 264 fatalities. Severe accidents with dozens of fatalities involving ferries have occurred on the Nile in Sudan and Egypt and on large rivers in Brazil and Paraguay and Myanmar and Vietnam in the past decade. The most common causes of passenger river vessel accidents in these regions are poor vessel maintenance, overcrowding with cargo and passengers and commutes during storms with heavy precipitation and strong winds.

In South America the inland shipping sector has received little attention. In the majority of regional countries no standards and/or specific policies exist, creating a high level of informality within the sector. The level of informality is particularly high in the remote areas of the continent where river transport in many cases is the only mobility option for the local communities. This situation significantly increases the risks accidents, particularly as minimum standards such as the wearing of life vests and position lights of vessels are absent in many parts of the region.[109]

[109] Wilmsmeier G. (2013): Conectando América del Sur: Movilidad fluvial y sistemas de navegación fluvial. Bulletin FAL Issue 327, No. 11/2013. ECLAC. Santiago, Chile.

5.3.2 Challenges and best practices

A path to increased levels of safety of navigation in inland waterways worldwide can be based on international agreements and conventions. The result of such agreements is the improvement of existing infrastructure, development of new waterways, introduction of new regulations on safety of navigation and environmental protection, implementation of existing regulations, standards and customs, etc.

In response to frequent severe accidents and a lack of rules and regulation procedures in the shipping industry in the inland water masses of African countries, in 2002, International Maritime Organization (IMO) adopted the Model safety regulations for inland waterways vessels and non-conventional craft, including fishing vessels operating in African lakes and navigable rivers. The model regulations were agreed by representatives of: Burundi, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Sierra Leone, Tanzania, Uganda, Zambia and Zimbabwe during a Workshop held in Mwanza, Tanzania between 15 and 19 October 2001. The model regulations provide a regional safety and pollution prevention standard for new vessels and barges and, as appropriate, existing vessels and convention-sized vessels that trade regularly and consistently on inland waterways and at sea on non-international voyages, and for personnel serving aboard them.

The non-intervention scenario has contributed to the continuing tragic loss of life, damage to property and the marine environment in many of Africa's, Asia's and South America's inland waterways. The need for harmonized standards, regulatory laws, rules, procedures and practices for vessels operating on inland waterways in these continents cannot be over emphasized. The IMO project based regulations can serve as a model for further urgently required improvements in inland navigation safety standards.

5.4 Transport of dangerous goods

Dangerous goods (e.g toxic, infectious, corrosive, explosive, radioactive, flammable substances) are produced and transported in very large quantities and they cover an extensive range of products of great economic importance. They present risks for the population in general, property and the environment, which are present at the stage of extraction, production, transport, and use at the workplace and when handled by consumers. Transport is a delicate part of the lifecycle of such goods, since it, or part of it, takes place in areas where people and the environment are particularly exposed.

Although in recent years there have been relatively few major accidents involving dangerous goods (particularly in developed countries), dangerous goods have been involved in some of the worst disasters in transport history:

- In April 1947, a freighter being loaded with ammonium nitrate (used as an agricultural fertilizer) in the port of Texas City caught fire in one of the holds and exploded. Two light planes flying overhead were destroyed by the blast. The explosion also blew the hatch covers off another ship, also carrying ammonium nitrate, which was moored some 180 m away. As a result, she also caught fire and subsequently blew up. A total of 468 people were killed, mostly as a result of the first explosion.

- In July 1978, a road tanker transporting liquefied propylene sprang a leak as it passed a camp site at Los Alfaques in Spain. The leak resulted in some of the liquefied gas escaping and pouring rapidly across the camp site in a huge cloud which immediately ignited. The explosion resulted in a fireball some 180 m in diameter which was so intense that more than 200 people were burnt to death. The devastation spread for 360 m in all directions. The truck was carrying only 43 cubic metres of liquefied gas. Nowadays, some inland navigation vessels carry more than 2500 cubic metres of such gases and some sea-going vessels may carry 250,000 cubic metres of liquefied natural gas.
- In November 1979, a train of 106 wagons derailed at night in the city of Mississauga (Canada). The first derailed wagon was a tank-wagon loaded with toluene (flammable liquid). It took with it 23 other wagons into the derailment, 19 of which were tank-wagons loaded with dangerous goods. Fire spread through most of the derailed cars; three of which were loaded with propane (flammable gas) and exploded in a fireball causing considerable damage to neighbouring property. One tank-wagon loaded with chlorine (toxic gas) suffered a hole in its shell 76 cm in diameter, and because of the fear of the consequence of the escape of this gas, almost 250 000 people from the city were evacuated from their homes and businesses for up to 5 days.

Catastrophic accidents like these have prompted Governments to develop and ensure the regular updating of regulations intended to eliminate, or to minimize to the extent possible, the risk associated with the transport of dangerous goods. In addition, due to the economic importance of international transport of dangerous goods, it has been necessary to discuss these regulations internationally in order to ensure a high level of safety acceptable to all countries and authorities responsible for different modes of transport while making international and multimodal transport possible through the harmonization of transport conditions.

This is being done at United Nations level since the creation in 1953 of the United Nations Economic and Social Council (ECOSOC) Committee of Experts on the Transport of Dangerous Goods, to which the UNECE provides secretariat services.

The original mandate of the Committee was to elaborate recommendations addressed to all Governments and international organizations concerned with the safe transport of dangerous goods that would allow the uniform development of national and international regulations governing the various modes of transport. In 1999, it was extended to cover worldwide harmonization of classification criteria and hazard communication of chemicals not only for the purpose of transport safety, but also for workplace safety, protection of consumers and of the environment.

For transport, the recommendations of the Committee are contained in the “Recommendations on the Transport of Dangerous Goods, Model Regulations”, also known as the “Orange Book”. They contain provisions aiming at:

- Identifying which goods are dangerous for transport, and defining, according to their specific characteristics how they can be transported safely.

- Ensuring that the potential risks of the dangerous goods offered for transport are adequately communicated to all those who may come into contact with them during the course of transport. This is accomplished through internationally harmonized marking and labelling and placarding of means of containment (packaging and cargo transport units) to indicate the hazards of a consignment and through the inclusion of relevant information in the transport documents.
- Identifying the means of containment and cargo transport units to be used for transport of dangerous goods taking into account its characteristics. These include for instance, provisions for their use, construction, approval, inspection, testing and marking.
- Identifying incompatible dangerous goods and defining the conditions for their segregation from one another during transport so as to prevent or effectively minimize hazards in the case of leakage, spillage or any other accident during transport.
- Defining the requirements for training (general awareness; function specific training and safety training) for all individuals involved in the transport of dangerous goods, such as those who classify, pack, mark, label, carry or handle, offer or accept dangerous goods, who prepare transport documents for dangerous goods or mark, placard or load or unload packages of dangerous goods into or from cargo transport units.

Although they apply to all modes of transport, the Recommendations remain flexible enough to accommodate any special additional requirements that have to be met by specific modes of transport, or at national or regional level. They are not legally binding per se but they are applied worldwide since they have been transposed into international legislation, thanks to the commitment of United Nations departments and specialized agencies or other intergovernmental organizations to implement them through their respective legal instruments, i.e.:

(a) For maritime transport: International Maritime Dangerous Goods Code (IMO), of mandatory application for the 162 Contracting Parties to the 1974 International Convention for the Safety of Life at Sea;

(b) For air transport: Technical Instructions for the Safe Transport of Dangerous Goods by Air (International Civil Aviation Organization (ICAO)), of mandatory application for the 192 Contracting Parties to the Convention on International Civil Aviation;

(c) For inland international transport (road, rail, inland waterways):

  (i) ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road (UNECE) (48 Contracting Parties)

  (ii) ADN: European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (UNECE) (18 Contracting Parties)

  (iii) RID: Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) (appendix C to the Convention concerning International Carriage by Rail), Intergovernmental Organization for International Carriage by Rail (OTIF) (48 Contracting Parties)

They are also applied in a number of countries through national legislation applicable to domestic inland transport. For example, all EU countries are bound to apply ADR, RID and ADN to domestic traffic. Many other countries in the world also use the United Nations recommendations for their national legislation, e.g. USA, Canada, Mexico, Colombia, Brazil, Australia, New Zealand, South Africa, Malaysia, Russian Federation and Thailand.

As a result, the number of serious accidents involving dangerous goods has significantly decreased. Nevertheless, zero risk does not exist, as shown for example by the Tauern tunnel fire in May 1999 in Austria, (12 deaths, 50 people injured; 17 million German marks cost for the reconstruction and renovation of the tunnel); the derailment of a freight train carrying liquefied petroleum gas in 2009 in Italy (31 deaths, 30 people injured, 32 million euros of estimated damage cost to buildings and rail infrastructure), or the capsizing and final sank of a ship carrying 2,378 tonnes of sulphuric acid 96% in the Rhine, in 2011 (2 deaths, 2 persons injured, approximately 900 tonnes of sulphuric acid leaked into the Rhine and approximately 50-55 million euros of associated lost profits and damages associated to the accident).

Accidents occurring in developing countries lacking appropriate transport infrastructure, safety measures, trained personnel etc., and where the regulatory system is almost inexistent or not implemented usually result in a significantly higher number of casualties and injured people or greater damage to property and the environment (e.g. accidents involving petroleum products in the African region: Yaounde (Cameroun, 1998): 220 deaths and 130 persons injured; Molo (Kenya, 2009): 122 people killed; about 200 injured; Sange (Democratic Republic of Congo 2010): 230 people killed; about 200 injured.

Unfortunately, despite the significant industrial development in an increasing number of developing countries, which results in a parallel increase of transport of dangerous goods, many of them still lack proper legislation for regulating inland transport of dangerous goods and improving safety in this respect. For this reason, the UNECE has published a “Road Map for accession to and implementation of ADR”[110] intended to help such countries to put in place a suitable legislative framework to regulate transport of dangerous goods by road by applying the mechanisms recommended by the United Nations

5.4.1 Trends

Dangerous goods shipments move by road, rail, inland waterways, sea and air transport in quantities ranging from several grams to thousands of tonnes. Some statistics have been published by international organizations, chemical industry associations, or national Governments. From the statistics available in the United States and in the European Union, it appears that:

(a) Transport of dangerous goods is increasing regularly;

(b) The highest volumes transported are energy products (petroleum products, flammable gases), followed by flammable liquids and gases other than energy products, and by corrosive substances;

(c) Road transport is by far the most used inland transport mode, not only in terms of quantities carried but especially in terms of number of shipments.

[110] http://www.unece.org/trans/danger/publi/adr/adr_roadmap.html

Type and quantity of dangerous goods carried

Maritime transport

The IMO[111] estimated in 1989 that more than 50 % of the cargoes transported by sea could be regarded as dangerous, hazardous and/or harmful under the IMO classification criteria, but this estimation probably included not only carriage in packaged form, but also bulk carriage by oil tankers, chemical tankers and gas tankers, and solid bulk cargoes in bulk carriers.

United States of America (all modes)

Data published in the 2002 and 2007 U.S. Commodity Flow Survey (CFS) showed that there were around 2.2 billion tons of dangerous goods [112] shipments in the United States. In 2008, it was estimated that more than 3 billion tons of dangerous goods would be transported each year in the USA with about 1.2 million daily dangerous goods movements through the air, on the railroads, seas, waterways and highways[113].

European Union

Statistical data provided by Eurostat exhibits interesting information but should be interpreted with caution because the methodologies used for collecting data imply considerable uncertainties. In addition these data do not seem to include "dangerous goods packed in limited quantities" which represent a large number of shipments. From 1990 to 2002 the transport of dangerous goods (all inland transport modes) in the EU 15[114] increased from 98.3 billion tonne-km in the year 1990 to 111.1 billion tonne-km in the year 2002 (+ 13.0 %). The highest increase was by road (+ 27.4 %), followed by inland waterways (+ 11.1 %) and rail (-9.4 %). The market share of road transport in all transport of dangerous goods increased from 51 % in 1990 to 58 % in 2002.

Data available in Eurostat from 2003 to 2010 concern mainly road transport, although data are available for rail transport for certain years or for certain countries. For road transport only, the transport of dangerous goods in EU 27 increased from 74.3 billion tonne-km in 2003 to 84.7 billion tonne-km in 2008, then fell to 78.2 billion tonne-km in 2009 to increase again up to 80.2 billion in 2012. The transport of dangerous goods by rail in EU 27 in 2006 was of 64.9 billion tonnes-km.

EU dangerous goods transport by dangerous goods class and mode

From 1990 to 2002 the share of dangerous goods (EU 15) decreased from 9.1 % to 7.8 % meaning that transport of dangerous goods was increasing more slowly than the whole transport market. The growth rate from 1990 to 2002 for the total market was 31 % whilst dangerous goods increased by 13 % only.

For **road transport**, the share varies considerably depending on the country, ranging from 2% to 28%, with figures in the 4% to 8% range for major economies. In 2010 (EU 28), the largest specific

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111 *Focus on IMO, the Safe Transport of Dangerous, Hazardous and Harmful Cargoes by Sea, August 1989.*

112 *The term "hazardous materials" is used in the United States to designate dangerous goods.*

113 *U.S. Department of Transportation. Transportation vision for 2030. January 2008.*

114 *EU15 was the number of member countries in the European Union prior to the accession of ten candidate countries on 1 May 2004. The EU15 comprised the following 15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom.*

product group was flammable liquids, taking over a half of the total. Two other groups, gases (compressed, liquefied or dissolved under pressure) and corrosives, accounted for 13.6% and 10.3% respectively. This represents very little change compared with previous years when there was a very similar distribution between the product groups.

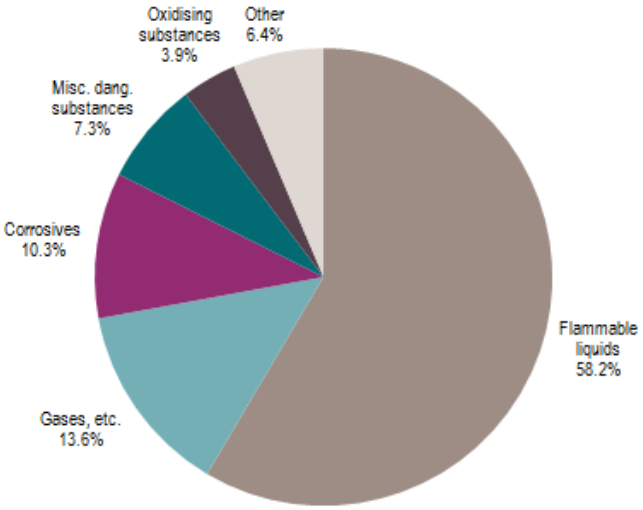
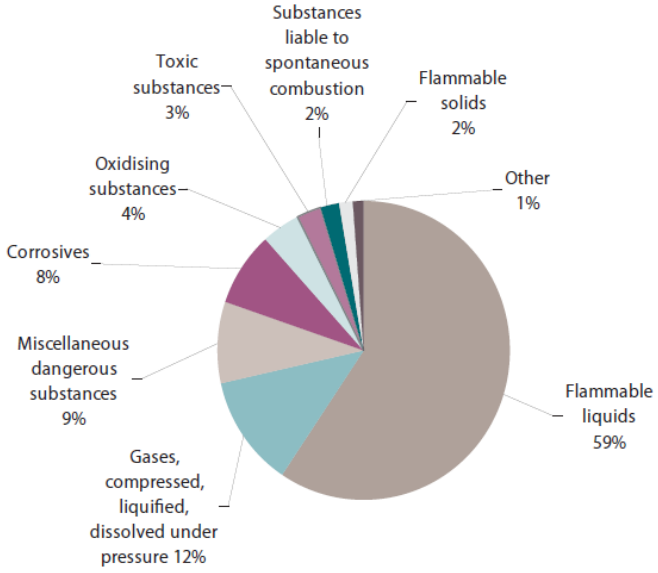


Fig. 5.18 EU-28 (provisional data) Road transport of dangerous goods by type of dangerous goods, 2010 (% in tonne-km) (Source: Eurostat (road_go_ta_dg))

For **rail transport** dangerous goods including gases, liquid hydrocarbons and corrosives accounted for an estimated 14.0 % of the total tonne kilometres performed by rail goods transport in 2006. Flammable liquids (59.4 %), which mostly consist of hydrocarbons used for fuel, made up by far the largest share of performance in transport of dangerous goods by Rail. They were followed by Gases, compressed, liquefied, dissolved under pressure (12.0 %) and miscellaneous dangerous substances (9.0 %).



* excluding BG, CY, MT & RO

Fig. 5.19 Dangerous goods transported by rail EU-27 (2006) (%tkm) (Source: Traffic and transport quantities and performances. Eurostat Statistical books 2009 Edition)

For **inland waterways transport i**n the European Union in 2006, three groups of goods, all of mineral origin, accounted for over half of the weight of goods transported by Inland waterways: crude and manufactured minerals (27.0 %), petroleum products (16.9 %) and solid mineral fuels (e.g.: coal) (9.2 %). While Miscellaneous articles accounted for 9.1 % of total, the next four groups of goods, including ores, metals and chemicals, accounted for 20.9 %. Very few EU countries have reported data concerning dangerous goods by inland waterways, but from those reported it would seem that flammable liquids represent 80% of dangerous goods carried.

Accidents/Incidents

United States of America

Between 2002 and 2011, dangerous goods incidents totalled 161,617 and resulted in 129 fatalities in the United States of America. Since reaching a peak of 20,336 incidents in 2006, numbers have declined every subsequent year. Approximately 87 percent of the incidents and 85 percent of the fatalities from dangerous goods occurred on highways--the most common mode of dangerous goods transport. In 2011 alone, nearly 12,300 of the 14,400 total dangerous goods incidents occurred on highways, with 10 fatalities. Gasoline and sulphuric acid were by far the most common materials involved in dangerous goods incidents, accounting for 67 percent of total incidents. The most common source of casualties is derailment or rollover of vehicles, followed by human error. Due to high product demand and frequency of use, rail and road transport of dangerous goods are expected to increase over the next decade, raising the number of opportunities for incidents.[115]

Table 5.1 Incidents by mode and incident calendar year[116]

Mode of transport	2007	2008	2009	2010
Air	1,556	1,278	1,356	1,293
Highway	16,930	14,804	12,730	12,637
Railway	753	749	643	750
Water	61	99	90	105
Total	**19 300**	**16 930**	**14 819**	**14 785**

Table 5.2 Fatalities and major injuries by mode and incident calendar year[117]

Mode of transport	Fatalities		Major injuries	
Year	**2009**	**2010**	**2009**	**2010**
Air	0	0	0	0
Highway	11	8	17	17
Railway	1	0	10	0
Water	0	0	0	0
Total	**12**	**8**	**27**	**17**

[115] Source : Senate Report 112-162 - HAZARDOUS MATERIALS TRANSPORTATION SAFETY IMPROVEMENT ACT OF 2011
[116] Source : Hazmat Intelligent Portal, U.S. Department of Transportation. Data as of 14 September 2011.
[117] Source : Hazmat Intelligent Portal, U.S. Department of Transportation. Data as of 7 July 2011

European Union

In 2012, EU Member States reported a total of 61 accidents involving the transport of dangerous goods by rail; in 32 of these, the dangerous goods being transported were released during the accident (Source Eurostat). Data concerning other modes of transport are not available from Eurostat.

5.4.2 Economic and social impact of regulatory measures intended to increase safety and protection of the environment

Safety – and protection of the environment – during the transport of dangerous goods may be ensured through:

(a) The use of containment systems of good quality, adapted to the danger presented by the goods to be transported and compatible with them, meeting the construction requirements and the performance tests or other tests contained in the UN Model Regulations on the Transport of Dangerous Goods, as appropriate, in order to withstand stresses, impacts and other wear and tear to which packages may be submitted during normal conditions of transport. Failure of containment systems can lead to leakage or spillages or even explosion of the containment system itself in case of pressure build-up.

The means of transport themselves may also have to meet certain safety requirements depending on the goods carried (e.g. tank-vehicles, holds of ships, maritime or inland navigation tankers);

(b) Good operational practices;

(c) An adequate hazard communication system (labelling, marking, placarding, documentation) which provides appropriate information to:

(i) Transport workers involved in dangerous goods handling;

(ii) Emergency responders who have to take immediate action in case of incidents or accidents;

(d) Training of transport workers and all participants involved in a chain of transport of dangerous goods;

(e) Effective control and enforcement by competent authorities.

Irrespective of the economic value of the dangerous goods transported, the safety measures to be applied according to the regulations have important economic effects on various industrial sectors, in particular in relation to the construction of packaging, gas receptacles, and tanks since all authorized containment systems must meet certain performance requirements and must be tested and certified accordingly.

European yearly market for some specific types of "UN" certified dangerous goods packaging

Plastics drums	Steel drums	Flexible IBCs ("Big bags")	Other IBCs
11 million	45 million	5 million	3.8 million

Source: Estimates provided by representatives of the International Confederation of Plastics Packaging Manufacturers (ICPP) and by the European Association of Steel Drum Manufacturers (SEFA) provided in 2007 (relating mainly to EU market).

The European Industrial Gases Association (EIGA) reported in 2007 that its companies fill, store, transport and maintain an inventory of about 40 million cylinders to serve the market, and these cylinders are moved several times a year for refilling. To supply in bulk or in cylinders its 4 million customers at its 4.5 million delivery points, they operate a fleet of 14 000 vehicles covering 500 million km per year.

Similarly the European Association of Liquid Petroleum Gases (AEGPL) reports that its companies fill, store, transport and maintain 200 million gas cylinders per year (involving a fleet of 20 000 to 30 000 vehicles for delivery) and operate a fleet of 9700 road tank vehicles for bulk carriage of GPL.

For carriage of all kind of dangerous goods in tanks, 150 000 railway tank-wagons are operating in the EU, and 3000 new tank-wagons are built in Europe every year, according to the International Union of Private Wagons (UIP).

The introduction of new requirements in ADN for prevention of pollution from inland navigation tank vessels has entailed, since 2007, a conversion of the Western European tankers fleet from single hull to double hull vessels and construction of new double hull tankers, reaching a peak of 121 new double hull tankers in 2010, and still 42 new double hull tankers in 2012 and 45 in 2013 (source: European Barge Inspection System).

The proper implementation of the regulations also requires that appropriate administrative structures are put in place by governments, e.g. in relation to design type testing and certification of packaging and tanks, approval and inspection of road vehicles and inland navigation vessels. For example 1748 tank type approval certificates were issued in Bulgaria in 2007. In the same year, 38203 ADR certificates of approval were issued in Germany for vehicles carrying certain dangerous goods (vehicles for carriage in tanks or carriage of explosives). Such vehicle certificates have to be renewed every year after inspection. Inland navigation vessels carrying dangerous goods must also be provided with an appropriate certificate of approval, to be renewed every five years after inspection.

Operational requirements

Since the Model Regulations contained in the United Nations Recommendations on the Transport of Dangerous Goods are intended to apply to all modes of transport, the operational requirements contained therein are only those relevant for all modes, mainly concerning the use

of packaging, bulk packaging and tanks. The applicable regulations usually contain additional requirements specific to the mode of transport, e.g.:

(a) For maritime transport: stowage and segregation; restrictions on passenger ships; some restrictions on quantities allowed for certain packagings; provisions in the event of incidents and for fire precautions;

(b) For air transport: stowage and segregation; restrictions on quantities allowed per packaging; passenger aircraft restrictions;

(c) For road and rail transport in Europe: provisions concerning loading, unloading and handling; requirements for vehicle crew and equipment; restrictions for the passage of vehicles through road tunnels; supervision of vehicles;

(d) For inland navigation (ADN): requirements for loading, carriage, unloading and handling of cargo on board dry cargo vessels or tank vessels; provisions concerning vessel crew and equipment.

In order to comply with these requirements, all those involved in transport of dangerous goods must be appropriately trained (see “Training” section below).

Hazard communication, emergency response

Hazard communication in the transport of dangerous goods consists in:

(a) Affixing appropriate hazard label(s) on the packages;

(b) Marking the UN (identification) number of the goods on the package, and (except for inland transport in Europe) the “Proper Shipping Name”;

(c) Affixing placards identical to hazard labels but of a bigger format on the cargo transport units (vehicles, wagons, containers, tanks) and displaying, either on these placards or on separate orange plates, the UN identification number;

(d) Providing details of the dangerous goods offered for shipment in the transport document (i.e. UN No., name, hazard class, etc).

The labels, marks and placards provide information to transport workers as to the dangerous nature of the consignments, and help them in deciding how to stow such goods in the means of transport and checking compliance with relevant stowage and segregation requirements. They also provide essential information to emergency responders since the UN number itself provides sufficient information for immediate emergency action. Databases and guide books have been published in order to provide emergency responders with appropriate emergency action guidelines, on the basis of the UN number (e.g. North American Emergency Response Guidebook, IMO Emergency Procedures for Ships carrying Dangerous Goods (EmS) and Medical First Aid Guide for Use in Accidents involving Dangerous Goods (MFAG), ICAO Emergency Response Guidance for Aircraft Incidents involving Dangerous Goods).

For road transport in Europe (ADR), drivers also have to be provided with instructions in writing informing them of the nature of the danger presented by the cargoes, proper use of personal

protection equipment, action to be taken to protect themselves and to inform road users and emergency response services, first aid and how to deal with minor leakages or minor fires if this can be done without personal risk.

The information which has to be entered in the transport document by the consignor allows the carrier to take appropriate steps to comply with the transport requirements applicable to the dangerous goods carried. It is also an important tool for advance planning in particular for multimodal transport, for emergency response, and for control by authorities.

Training

As shown by accident statistics, one of the main causes of accidents in the transport of dangerous goods is human error. The United Nations Model Regulations and the related legal instruments require that all persons engaged in the transport of dangerous goods receive training in the contents of dangerous goods requirements commensurate with their responsibilities and they lay down specific provisions regarding general awareness/familiarization training, function specific training, safety training, records of training, etc. This training can be provided by the employer and concerns all persons involved in classification, packing, filling, labelling, documentation etc. as well as drivers and transport workers in general.

In Europe, additional mandatory and certified training is required for drivers of road vehicles (ADR driver training certificate). This involves mandatory initial training for about three days and examination for all drivers of vehicles carrying certain quantities of dangerous goods; two-day refresher courses and a new examination every five years; additional training is required for drivers of tank vehicles, vehicles carrying explosives and vehicles carrying radioactive material. In 2007, 68560 drivers held a valid ADR training certificate in Sweden.

For inland navigation, experts are required to be on board chemical and gas tankers (under ADN), and these experts also have to undergo training every 5 years and to pass examinations.

Finally, in Europe, in all countries applying ADR, RID or ADN, each undertaking, the activities of which include the carriage, or the related packing, loading, filling or unloading of dangerous goods, has to appoint one or more dangerous goods safety advisers (DGSA) for the carriage of dangerous goods, responsible for helping to prevent the risks inherent in such activities with regard to persons, property and the environment. These DGSAs also have to hold a vocational training certificate issued after examination which has to be renewed every five years. In 2007, there were 21,221 DGSA holding a valid vocational training certificate in Spain.

Apart from the safety benefits that result from these various training requirements, it is important to note that they also have important economic and social implications. They have of course a cost for the various employers concerned, but they also raise significantly the professional qualifications of the workers trained.

Controls

Controls or other enforcement actions are normally carried out under the direct responsibility of national authorities designated for these purposes. The number of controls and the level of penalties in case of infringement may vary considerably from one country to the other, but

controls are deemed necessary to ensure compliance. They are also an effective tool in revealing problems connected with the safety of the transport of dangerous goods or with the practicability of regulations, and in improving them. Some guidance may be found in Chapter 1.8 of ADR, RID and ADN on how to carry out control operations without causing major disruption of transport services. ADR, RID and ADN also require their Contracting Parties to agree on mutual administrative support for the implementation of these legal instruments.

Problems of compliance occur very often in countries where the requirements applicable to international transport by one mode of transport differ from those applicable nationally to domestic transport by the same mode. This problem no longer exists in EU countries since all domestic regulations have been replaced by ADR, RID and ADN. This is nevertheless still a problem in many European countries outside the EU, and in particular for the controls in international transport by road since road transport controllers themselves may be confused when checking vehicles involved in international transport if the regulations are not the same as those they are used to when checking vehicles involved in domestic traffic. Harmonization of national and international rules, in particular in the road sector is therefore an important factor not only for better compliance with safety requirements but also for transport facilitation.

Controls in the United States of America

According to the US Department of Transportation, there are approximately 47,000 firms shipping significant quantities of hazardous materials. This figure, however, does not include small or occasional shippers. The figure of 75,000 represents the total of hazardous materials shippers in the United States. However, this figure may be understated because many "firms" or shippers have multiple business locations. The US Department of Transportation also estimates that there are approximately 500,000 potential carriers of hazardous materials in the United States. About 43,000 carriers are dedicated hazardous materials transporters that primarily move petroleum products and corrosives in cargo tank trucks. Yet, every carrier can knowingly, or even unknowingly, carry hazardous materials. Table 29 shows the number of hazardous materials carriers which could potentially carry hazardous materials.

Table 5.3 Number of potential hazardous materials carriers (United States)[118]

Mode	Number of carriers
Air	3,500
Highway	497,908
Rail	559
Marine	1,300
Total	**503,267**

Approximately 444,000 vehicles and vessels are dedicated to hazardous materials transport in the United States, primarily highway tank trucks and railroad tank cars. Potentially, another 7.6 million vehicles, vessels, and aircraft could carry hazardous materials on a periodic basis. When one considers the potential for hazardous materials to be undeclared, either due to economics or

[118] Sources: FAA Air Carrier data; FMCSA National Carrier Census Summary Report; FRA Inspection Database; and U.S. Army Corps of Engineers Waterborne Transportation Lines of the United States, Calendar Year 1997, Volume 1, National Summary.

lack of knowledge, any vehicle, vessel, or aircraft could carry hazardous materials. The fleet breakdown for hazardous materials by mode in the United States is shown in Table 30.

Table 5.4 Hazardous materials fleet/vehicles (United States)[119]

Mode	Dedicated HM Fleet/Vehicles	Additional potential HM fleet	Total potential fleet
Truck	195,000	6,436,000	6,631,000
Rail	238,000	1,078,000	1,316,000
Waterborne[1]	11,000	68,000	79,000
Air (commercial aircraft)[2,3]	0	12,000	12,000
Total	**444,000**	**7,594,000**	**8,038,000**

[1] Represents both United States and foreign flag vessels including barges.
[2] The figures are based on the air fleet of carriers who "will carry" hazardous materials.
[3] Aircraft are not typically dedicated to hazardous materials transport.

The US administration carried out about 250 000 inspections in 1998 (all modes of transport), which showed 95 361 violations. 40% of the violations were attributed to shipper functions, 37% to either the shipper or the carrier, and almost 23% to the carrier. The situation remained almost the same in 2009 (248 126 inspections, 96 885 violations which led to 2 520 penalties).

Road checks in Europe

EU Council Directive 95/50/EC on uniform procedures for checks on the transport of dangerous goods by road requires EU Member States to report on its application.

In 2006, the average in the EU was 2.95 checks per million tonne-kilometres; in 2007, it was 3.50. This implies an increase of 18.6%. Bulgaria and Hungary had an exceptionally high frequency of checks. Without the numbers of Bulgaria and Hungary, the EU average would have been 2.33 in 2006 and 2.90 in 2007 and the annual increase would be 24.5%.

Approximately in one check out of eight an infringement was detected. Some 40% of these infringements were of the most serious type. Consequently, almost 10 000 vehicles were immobilised following their check. This clearly demonstrates that practical enforcement of rules on the transport of dangerous goods at the roadside is useful and helps to improve safety.

[119] Source: United States Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Department wide evaluation of hazardous materials shipments, March 2000

6. Transport Security

The notion of transport security encompasses all malevolent acts towards the prevention of which a range of stakeholders within transport systems, state and government institutions, local authorities, regulatory agencies, infrastructure managers or owners and operators, railway companies, road concessionaires, shipping and freight forwarding companies, are taking action. Such acts range from ordinary infliction of damage and everyday delinquency to highly orchestrated acts of terrorism directed towards transport systems and facilitating infrastructure and passenger and freight vehicles.

Inter/trans-modal security of transport ⇨	**Infrastructure ⇨** **Passengers ⇨** **Staff ⇨** **Freight ⇨**	**Secure transport**
Key challenges	➢ High rate of transport related crime in many parts of the world; ➢ Enhance collaboration between state security services and transport systems operators; ➢ Balance between personal freedoms and collective security ➢ Due to their open areas, inland transport systems are relatively unprotected from security threats in comparison with ports and airports; ➢ Strengthening analytical and statistical information on transport related crime (freight theft, vehicles theft, etc.); ➢ Boosting international cooperation in coordination of responsive action towards cross-border transport related crime.	
Role of the United Nations	➢ Promote international frameworks that can ensure the security of transport infrastructure, persons and freight; ➢ Provide analytical and technical assistance activities to reduce vulnerabilities of transport infrastructure and services.	

Safety vs. Security

Although safety and security, as two related dimensions of sustainable development of the transport sector, may intuitively seem as overlapping fields, and the approach towards the analysis of security problems in transport systems are often inspired by work on transport safety, they are in fact fundamentally different issues. Safety standards are set by specific bodies and implemented by transport sector companies, whereas ensuring a secure environment is the shared responsibility of transport sector stakeholders and the state. Furthermore, safety is associated with risk while security is associated with uncertainty.

In the case of risk, such as accident risk, the events are unintentional and their likelihood can be reasonably estimated from empirical observations. Conversely, the probability with which intentional events that cause security breaches will occur is much harder to quantify, specifically for the following two reasons. Firstly, security breaches or criminal activity, especially severe instances such as extreme terrorist attacks, are infrequent. For such infrequent events, analysis of past incidents cannot render sufficient information on future probabilities. Second, attaching probabilities to intentional acts is particularly problematic because of the possibility of strategic behaviour of culprits. For example, criminals and terrorists adapt their strategy to changes in the

security environment in which they operate. Since little is known about how they will respond (because the set of available strategies is very large), it is not clear how security policies or other relevant changes affect attack probabilities. In sum, security concerns are not characterised by risk but by uncertainty, meaning that no credible objective probability can be assigned to their occurrence (OECD, 2009).

It is within this challenging and unpredictable environment that transportation sector stakeholders, from the public and private sector, must work to establish national, regional and international frameworks that can ensure security of persons, infrastructure and freight, having in mind that the economic cost of transportation crime must not be overlooked and that security systems in place should not interfere with the efficiency of operations and the movement of persons and freight within and across transport modes.

6.1 Minimizing terrorism threats and preventing attacks

Inland transport systems are potentially vulnerable and attractive terrorism targets. Infrastructure such as roads, rail lines and inland waterways, including bridges and tunnels, are located in open areas and are largely without surveillance; both passenger and freight transport may become a terrorist target or be used as vehicle for terrorist activities. Improving security is, however, a complex matter as transport systems involve large numbers of transnational companies that operate across borders, as well as a wide range of public and private sector stakeholders.

Effective measures require close cooperation of transport authorities with other authorities such as intelligence, security, customs and border services, as well as with a broad range of private sector stakeholders. The objective is to improve the security of domestic and international transport systems by reducing the likelihood of transport becoming a target or being used as a vehicle for terrorism without unduly hindering passenger mobility and the flow of goods.

The context: why are mass transit networks and transport infrastructure attractive terrorism targets?

- Potential for mass casualties;
- Transport systems are accessible, open to the public and vulnerable to attacks;
- Spectacular imagery and infliction of shock, fear and anxiety to the global audience;
- Broad opportunities and likelihood of success;
- Potentially severe economic impact of attacks;
- Symbolic statement and source of inspiration and motivation for further extremist plots.

Following the events of September 11, 2001, safety and security considerations have moved to the forefront of international concerns. As world trade is dependent on safe and secure transportation of goods across global supply-chains, there has been general recognition that the

security of transportation systems deserves particular attention.[120] Thus, over recent years, a variety of different unilateral and multilateral security measures, regulations and legislative initiatives have been developed at the national, regional and international level.[121]

Much of the focus has been directed at enhancing maritime transport security and at addressing the particular challenges posed by containerised transport[122]. Relevant initiatives at the national level include those first developed in the United States, such as the Customs Trade Partnership Against Terrorism (C-TPAT), the Container Security Initiative (CSI), which focus on establishing partnership relations with industry actors and ports, as well as the so-called "24-Hour Rule", requiring advance notification of US-bound container-shipments. Furthermore, under the scope of the National Infrastructure Protection Plan, the US has developed the Transportation System Sector Specific Plan (SSP)[123] which includes included modal annexes consolidate strategic planning and infrastructure protection requirements for aviation, maritime, mass transit (public transport) and passenger rail, highway infrastructure and motor carrier, freight rail, and pipeline sectors. The Transportation Systems SSP describes collaboratively developed strategies to reduce risks to critical transportation infrastructure from the broad range of known and unknown terrorism threats. The SSP adopts and amplifies the National Infrastructure Protection Plan risk management framework by describing a process intended to encourage wider participation in risk-reduction decision making activities. The main objective of the process is declared as developing a set of programs and initiatives that will reduce the transport sector's most significant risks in an efficient, practical, and cost-effective manner.

Australia has established its framework for inland transport security through the National Surface Transport Security Strategy. The strategy was first developed and adopted in 2004 and is reviewed and updated on a three year basis, or more frequently if the Transport Security Committee sees fit, most recently in 2013. The main purpose of the Strategy to achieve "*surface transport systems across Australia that are more secure and resilient to the effects of terrorism"*. The surface transport security policy in Australia rests on two fundamentals: regularory responsibility in the surface transport sector rests with the state and territory governments; surface transport owners adn operators have primary responsibility for security arrangements at their own facilities, assets and networks.

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[120] Note for instance that the former European Conference of Ministers of Transport developed a Ministerial Declaration on Combating Terrorism in Transport, which was approved by the Council of Ministers in 2002. The Ministers declared their determination to work on the continued smooth and secure flow of goods and people nationally and internationally, unhindered by the threat of terrorism.

[121] The UNCTAD secretariat has been monitoring legal and regulatory developments in the field of maritime and supply-chain security and has been reporting on these in its annual Review of Maritime Transport (see unctad.org/rmt), as well as in some analytical reports. For further information, see http://unctad.org/en/Pages/DTL/TTL/Legal.aspx and http://unctad.org/en/Pages/DTL/TTL/Legal/Maritime-Security.aspx.

[122] For an overview of relevant regulatory initiatives, see the UNCTAD report "Container Security: Major Initiatives and Related International Developments" UNCTAD/SDTE/TLB/2004/1, available at unctad.org/ttl/legal.

[123] Transportation Systems Sector-Specific Plan (SSP) is the strategic plan fulfilling the requirements of Homeland Security legislation: Critical Infrastructure Identification, Prioritization, and Protection, and the requirements of the Intelligence Reform and Terrorism Prevention Act of 2004 for the National Strategy for Transportation Security.

In accordance with Articles 91 and 222 of the Treaty on the Functioning of the EU (TFEU), transport security policy is a matter of shared competence between the EU and its Member States. At the EU level amendments to the Community Customs Code have introduced a number of measures aimed at increasing the security of shipments entering or leaving the EU, including obligations regarding advance electronic declaration of security data, as well as detailed rules regarding so-called Authorized Economic Operators (AEOs).[124] Nevertheless, unlike in the aviation and maritime sectors, there are no EU level security standards/requirements in the road, rail or waterway transport, apart from one regulation on rail passenger rights in which a short reference to security is made[125]. In response to those circumstances, the European Commission (EC) Staff Working Document on Transport Security (31.05.2012) was drafted with the goal of initiating discussions on what can be done at the EU level to improve transport security in inland transport modes, "*particularly in areas where putting in place common security requirements would succeed in making Europe's transport systems more resilient to acts of unlawful interference*". The document explores issues currently hindering transport security and the potential added value of action, as well as potential areas for land transport security policy development at the EU level. Reiterating the position established in the EC 2011 White Paper on Transport, the document successfully argued for the establishment of an EU Experts Advisory Group on Land Transport Security (LANDSEC). The LANDSEC group was established on the day of publication of the working document to examine its recommendations, and it consists of representatives from Member States and stakeholders with responsibilities for land transport security. Group sessions have been held five times since it was established, most recently in September 2014[126].

At the international level, regulatory developments worth highlighting include those under the auspices of a number of international organizations, such as the IMO. IMO adopted the International Ship and Port Facility Security (ISPS) Code, which entered into force on 1 July 2004 and imposed wide-ranging obligations on Governments, shipping companies and port facilities[127]. The International Organization for Standardization (ISO) developed and published a range of relevant security standards[128], whereas the World Customs Organization (WCO) adopted in 2005 the Framework of Standards to Secure and Facilitate Global Trade (SAFE) with the objective of developing a global supply-chain security framework.[129] The WCO SAFE Framework provides a set

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[124] For further information, see the European Commission website at http://ec.europa.eu/ecip/security_amendment/index_en.htm. See also UNCTAD, Review of Maritime Transport 2013, Chapter 5.

[125] See below: "Consistency at European and international level"

[126] http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=2821

[127] In December 2002, the International Maritime Organization (IMO) had adopted the ISPS Code as part of an additional chapter XI-2 to the 1974 Safety of Life at Sea Convention (SOLAS). The Code, together with a number of other amendments to SOLAS, provides a new comprehensive security regime for international shipping. It applies to all cargo ships of 500 gross tonnage or above, passenger vessels, mobile offshore drilling units and port facilities serving such ships engaged in international voyages (see www.imo.org). For further information, see also Asariotis (2005) and an UNCTAD report, "Maritime security: ISPS code implementation, costs and related financing" UNCTAD/SDTE/TLB/2007/1, available at http://unctad.org/en/Docs/sdtetlb20071_en.pdf.

[128] For an up-to-date overview of ISO standards, published or under development, see UNCTAD (2013).

[129] See also the WCO website at http://www.wcoomd.org/en/topics/facilitation/instrument-and-tools/tools/safe_package.aspx and UNCTAD (2013).

of minimum standards and principles that must be adopted by national customs administrations. These standards are contained within two pillars – namely (1) customs-to-customs network arrangements and (2) customs–business partnerships. As of July 2013, 168 national Customs administrations had expressed their intention to implement the WCO Framework of Standards.[130]

One evolving multilateral initiative is the International Working Group on Land Transport Security (IWGLTS), established in Tokyo, Japan, in January 2006, by the Ministerial Conference on Global Environment and Energy in Transport. The IWGLTS is composed of 20 member countries, including G8 states, and includes representatives of the UNECE, EU, UIC and UITP (International Association of Public Transport). The purpose of the initiative is to provide an international forum that allows countries that have been affected by terrorism to share information and experiences, develop new security solutions to common challenges and collaborate on new research where appropriate. The role of the group is to share information and develop best practices, while unlike the IMO or ICAO (International Civil Aviation Organization) it will not produce international security standards.

A very practical output conceived by the IWGLTS is the "SMARToolbox" (Security Measures and Resources Toolbox) developed by the US Transportation Security Administration (TSA). It is a searchable database of inland transportation security measures, enhanced by additional self-assessment functions. Users of the tool are members of industry, local, national and regional governments and law enforcement professionals. It is a resource for inland transport professionals to consider security measures they have in place as part of their security programs, and to discover relevant insights into security practices by peers throughout the industry. Although the database does not include sensitive security information, it is housed on a password secured website.

SMARToolbox

- Smart tool box contains over 350 security measures which are searchable by a combination of filters, including: mode, user type, asset type, phase, attack type;
- The security measures were provided by IWGLTS and other international security organizations, facilitated by TSA;
- The tool is envisaged for use by governments and transport systems operators.

[130] For a list of the relevant WCO members, see http://www.wcoomd.org/en/topics/facilitation/instrument-and-tools/tools/safe_package/~/media/2E5C6962E0FD4424976432BC440FAC6B.ashx.

UNECE and its Inland Transport Committee (ITC) have also given careful consideration to the issue of transport security. This work was first conducted under the auspices of various Working Parties, which addressed the underlying issues within their field of competence. In addition, to ensure a comprehensive inter-sectorial approach to this topic, ITC established a *Multidisciplinary Group of Experts on Inland Transport Security* that worked from 2007-2009 and delivered a report on the private sector's standards, industry initiatives, guidelines and best practices in inland transport security.[131]

The group consisted of experts from ECE member States as well as international governments and NGOs. The work showed that internationally there is a lack of organizational work for the improvement of passenger safety, especially in urban transport. Secondly, inland transport systems are relatively unprotected compared to ports and airports, due to their open areas. Inland transport is often the weakest link in supply-chain security. In their report the group of experts concluded that there was no single international body for security in inland transport that was comparable to IMO (Maritime Transport Security) and ICAO (Air Transport Security). The group of experts emphasized the importance of strengthening UNECE's work on inland transport. UNECE has continued its work in the field by providing a forum for expert discussion, such as through the *Inland Transport Security Discussion Forum*, held annually since 2010 and the *Workshop on Rail Security*, held in October 2013.

6.2 Criminal activities

Inland transport is also vulnerable to vehicle and cargo theft, burglary and other criminal activities. Concentration of transport activities, busy borders and lack of safe border facilities increase the risk, especially for professional road users[132]. Theft of goods and vehicles and fraud in road-transit systems is an important issue for road transport, while theft of goods, illegal immigration and transit fraud are issues that require special attention in rail transport. Analytical information is generally missing for transport security. However, the International Transport Forum estimated that up to 1 % of vehicles may be stolen annually (Short, 2003). In the United States it has been estimated that in 2004 a vehicle was stolen every 26 seconds and only 13 % of these thefts were followed by arrests (Auto Theft, 2011).

Transport related crime: an example from Berlin

On 12 January 2015, in Berlin-Tempelhof, a truck carrying tobacco was attacked and hijacked by several hooded gangsters who made off with an unspecified amount of cigarettes. At around 5.50am, the driver of the truck was tricked into stopping at Gottlieb-Dunkel-Straße in an industrial estate by criminals who blocked the road with a large Christmas tree! When he stopped and left his vehicle to clear the road, he was immediately attacked and overwhelmed by several hooded individuals who bound his hands and feet and pulled a plastic bag over his head and upper body. He was then pushed into the back of the truck while the criminals drove away with the load.

[131] See also http://www.unece.org/trans/main/ac11/ac11_about.html.

[132] As noted for instance in UNECE 2012, an IRU survey of drivers of heavy goods vehicles showed that about one in six had been attacked in the period 2003-2008.

After a short drive, the perpetrators stopped and laid the pinioned driver on a park bench at Schlosspark Britz. After some time, he managed to free himself and alert the police. Two hours later, the empty truck was found in Neukölln; the thieves had set fire to it. A large number of pallets with cigarettes had been transferred into another truck and driven away (source: http://www.tapaemea.com/recent/tobacco-truck-hijacked-in-berlin.html).

Trends in vehicle thefts[133] are variable. In Germany and the United States of America, the number of reported vehicle thefts in 2012 was lower than in 2003 by 36% and 43% respectively, whereas in the Russian Federation and Turkey vehicle thefts varied from year to year but the number of instances remained more or less constant. It appears that there is a general downward trend, at least for the ECE region. In 2005 approximately 2.8 million car thefts were recorded in 41 of the ECE Member States where data have been available, whereas in 2012 recorded thefts fell to approximately 1.6 million.

Only six ECE countries had increasing trends in car thefts in the period 2005-2012; in Greece, thefts reached 31,166 in 2012 from 17,552 recorded in 2005. However, six ECE countries, experienced a high per capita vehicle theft rate in 2012 of more than 200 vehicles stolen per 100,000 citizens, namely, Canada, France, Greece, Italy, Sweden and the USA. Finally, bicycles are also at high risk due to lack of safe parking spaces; in Copenhagen, for instance, 60 bicycles on average were stolen every day in 2009 (DST, 2011).

Conversely, motor vehicle theft rates are on the rise in all but one of eight ESCWA states for which data is available, most severely in Egypt where the number of stolen cars in 2003 was 1,994, reaching 20,221 in 2011. The car theft trend in ESCAP region indicates that in high income countries such as Australia, Japan, New Zealand, Singapore and South Korea the number incidents is decreasing, whereas India, Indonesia and Iran are suffering increasing instances of vehicle theft, with rates in India almost dubbing between 2004 and 2010.

In the ECLAC region, Uruguay, Columbia, Mexico had the highest per capita car theft rates in 2012, reaching 438, 189 and 172 stolen vehicles per 100,000 citizens respectively. The United Nations Office on Drugs and Crime reported vehicle theft statistics for only a handful of ECA region countries, most of which have breaks in time series, with continuous data for the period 2004-2012 available for Kenya, which is seeing a rise in vehicle theft numbers from 2.3 to 2.8 stolen vehicles per 100,000 citizens during the period.

Data of the Transport Asset Protection Association (TAPA) identifies that, within TAPA member countries, most incidents of theft occur while vehicles are parked in non-secured locations, as opposed to secure parking locations. This is an increasing trend according to the data as 67% of vehicle thefts in TAPA members occurred in 2010, as opposed to 55% of the thefts in 2008.

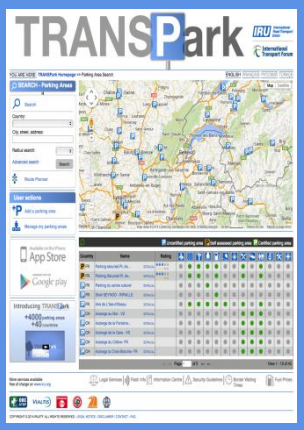
[133] All vehicle theft data is based on figures published by the United Nations Office on Drugs and Crime (http://www.unodc.org/unodc/en/data-and-analysis/statistics/crime.html)

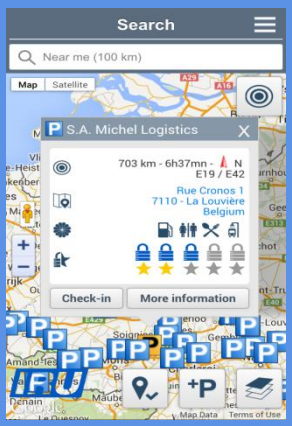
TRANSPark

A lack of adequate parking facilities and a serious problem of criminal gangs targeting commercial vehicles, their loads and the drivers themselves, led to the creation in 2009 of the IRU's online platform TRANSPark. In 2014, the IRU launched the TRANSPark mobile app to help commercial drivers and road transport fleet managers search, locate and contact over 4,000 parking areas in more than 40 countries worldwide.

By listing the security features and amenities available within each parking area, it adds and extra level of security and comfort for drivers on duty, who have to follow strict driving and rest time rules that sometimes force them to stop at unsafe roadsides or insecure parking areas.

The app makes it easy for drivers and managers to communicate and stay connected throughout the entire journey, sharing invaluable information and experiences through the TRANSPark community. Drivers can help each other by adding favourite parking areas and sharing experiences on ones visited. The new check-in feature helps drivers see languages spoken by other drivers who checked-in at nearby parking areas, for friendlier stops and journeys.





TRANSPark is available for download on Google Play and the iTunes store.

Another element with huge impact on the economy - especially affecting the area of second hand cars- is the phenomena of mileage fraud. This is considered to affect between 5 % and 12 % of used car sales in general and 30% to 50% for cross-border transactions. In the area of the European Union (EU 25) the economic effect of mileage fraud is estimated of € 5.6 billion to € 9.6 billion134. For the US, the Department of Transportation, National Highway Traffic Safety Administration (NHTSA), has estimated annual consumer loss from this fraud as between $ 4 and $ 10 billion[135].

Transport related crime in the ECLAC region[136]

The Security of the terrestrial logistical chain in Latin America report, prepared by the UN Economic Commission for Latin America and the Caribbean indicates that crimes and thefts

[134] Study of the economical impact of mileage fraud, CRM used car management (in proceedings of Cars2010 conference, Brussels 2010)
[135] http://www.odometertampering.com/Federal%20odometer%20criminal%20statute.htm
[136] Salaz, G.P., Seguridad de la cadena logistica terrestre en America Latina, 2013 UNECLAC

involving freight on inland routes in Latin America are not only a security problem that is responsible for economic losses, but that they also impact the full supply chain, thereby hampering national competitiveness of countries. According to the report, transport related crime is serious concern in countries in the region, most prominently in Brazil and in Mexico, where the number of vehicle thefts per capital increased by 23% between 2004 and 2012. Urgent implementation of effective and coordinated regional measures aimed at addressing the issues are strongly recommended in the document. Freight terminals, areas near ports, logistics transfer infrastructures and freight consolidation zones are most vulnerable to robberies. Crimes are mainly concentrated on road cargo transport, although railway attacks are also common, occurring mostly in urban areas at weekends and during the daytime.

Estimates are that annual global losses due to related crime are USD$ 30 billion. However, many developing countries do not have official records documenting the extent of the phenomena. According to the report, the lack of regular and comparable sectorial statistics on such crimes has hidden or underestimated their impact in the region. As a result, not enough public policies to tackle the problem in an effective and sustainable way have been developed thus far. Private initiatives in this respect, such as armed escorts or self-defence by transporters have not only been ineffective, but have also increased the costs and strengthened the perception of insecurity among the population. The lack of security in logistics chains also reduces tax income and discourages enterprise and private investment, hampering competition and maintaining high prices of consumer goods, all of which are factors that reduce economic growth and social development.

The document also emphasizes that criminal gangs are not bound by national borders, constantly moving their operations in search of vulnerable areas, which makes it vital for countries to coordinate responsive actions aimed at tackling these challenges threatening the region's competitiveness and hampering the coordination of intraregional logistics chains.

The report describes best business practices and calls for policy changes to deal with the phenomenon effectively without impacting regional competitiveness. It offers a series of recommendations, including: generating knowledge of the problem, implementing regionally coordinated legal changes, investing in infrastructure and promoting facilitation, establishing regional insurance and promoting collaboration to achieve a safer and more competitive logistics chain for everyone. The only way of reducing risks in the logistics chain without affecting economic competitiveness is to adopt a systematic and comprehensive approach to security. It is therefore vital for States to ensure necessary security conditions that facilitate an efficient and effective flow of goods and information, so that companies can take advantage of the competitive advantages resulting from minimum inventories, be actively involved in value chains and attract more investment.

6.3 Elements of railway security – a view from the International Union of Railways (UIC)

The definition of security as the rail sector's response, in partnership with the public authorities, to malicious intentions or acts, is a very broad one and covers extremely disparate realities and constraints, between which a choice must be made or which must be combined in an overall strategy to offer customers and staff the responses they expect.

Everyday security in the railway scenario

When we think of security, we mostly think of terrorist attacks targeting transport – whether everyday commuter services or high speed trains – as a way of destabilizing governments. However, we must not neglect everyday offences such as graffiti, vandalism and antisocial behaviour, which create delays and disruptions and which harm the image of public transport, preventing those who most rely on it from using it to remain connected to the rest of society.

Security is very often to the forefront of people's minds when choosing a mode of public transport for a journey, and this concern needs to be taken on board, since for many people the fundamental freedom to come and go as they please is underpinned by the ability (whether subjective or objective) to use public transport. The matter becomes complicated when we start trying to distinguish between objective security and feelings of security. A UIC study conducted some years ago into major stations (in London, Paris, and Brussels) highlighted some remarkable aspects. When asked to define what they considered a particularly secure place, a place where nothing could happen, most travellers cited military bases, embassies, etc., that is places where the coordinated deployment of technical and human resources to protect and monitor on a massive scale (with all the associated constraints) rendered any security breach or attack impossible or so unlikely that it was unworthy of consideration. However, when the same travellers were asked to name a place in which they felt particularly secure, they mentioned their home, where they went on holiday - places where there were no specific external constraints in place but where they did not imagine anything could happen to them.

Railway companies' security policies must distinguish between what is more a matter of objective security (video protection, specialist uniformed staff, technical monitoring systems, etc.) and what is more a feeling of security (cleanliness and agreeableness of facilities, customer service staff in company colours, etc.). Of course they have to involve themselves in both, level of security and feeling of security, and remain in touch with the clients in order to define the priorities accordingly to their requests.

In addition, all the measures taken, particularly when they result in constraints on customers, must be understood and accepted by customers: no security policy can survive if the measures it provides for are not accepted by customers. Beyond this, the effectiveness of security policies will be boosted if the travelling public backs them and plays an active part in ensuring its own security: remaining vigilant, reporting unusual situations, unattended objects, etc.

Personal freedoms and collective security

Introducing security restrictions for passengers, particularly in publicly-operated urban or other everyday transport systems, also raises a problem of principle, one which is variable according to the political and institutional make-up of each country, that is, the balance between personal freedom and the need for better collective security. Whereas a demonstrable terrorist threat may necessitate the taking of strict emergency protective measures, which may be coercive in their application, everyday security must for its part be underpinned by clear principles where each party's rights and obligations are defined.

This issue has arisen in particular with regard to video protection systems, specifically the permitted retention period for recorded material, the authorized viewers of this material, and

under what circumstances and with what controls it may be viewed. It also arises in the legal and technical division of labour between the public authorities in charge of security and their various partners such as railway companies' in-house security services and private contractors allowed to work on or monitor railway property.

The terrorist threat

Their extent, complexity, and impact on everyday life mean the railways are a target for domestic or international terrorism, and we do not need to recall the attacks in Madrid Atocha, London, the Russian Federation, India, and elsewhere. Constant allowance must be made for this threat, and only close collaboration between the services of the state, particularly intelligence services (which are tasked with gauging the threat to the country) and railway companies (which are aware of their own vulnerabilities) can allow any headway to be made.

Probability-based analysis used in safety management cannot apply in the same way when the task is to counter the acts of individuals or groups with significant intellectual and financial wherewithal, whose singular determination is deployed in support of a strategy which evolves in tandem with the policies developed to protect against it. Although anti-terrorist strategy feeds off past experience, it must constantly take account of new threats and adapt to them.

The particularity of the railways, given their extensive infrastructure and the significant traffic flows they carry, requires them to develop their own strategy, since the examples of other transport modes (airlines, for instance) can only be followed to a limited degree and in very specific circumstances, otherwise the efficiency and capacity of rail transport would be compromised. The question arising is whether significant flows can be securely monitored without jeopardizing the atmosphere, duration or cost of carriage by rail.

The cost of security

Since security does not obey probability-based reasoning, it is difficult to assess the efficiency of security measures, impossible to establish a direct mathematical link between the money spent and the outcome in terms of the number of offences committed, culprits arrested, etc. It is difficult enough even to gauge the real cost of security, beyond the cost of the staff and infrastructure directly allocated to this task. It is particularly difficult to gauge the effect of prevention policies, the goal of which is to avoid malicious acts being committed.

It would perhaps be useful to reason in terms of a feeling of security. That would involve, as some railways do, regularly questioning both customers and those reluctant to travel by train to assess how important feelings of security or insecurity are in their decision and in the image they have or will retain of their journey and the rail-sector stakeholders which executed it. In any case, it remains to be clarified what is the carrier's responsibility and thus included in the cost of carriage as paid by the user, and what is the public authority's responsibility and paid for by the taxpayer. Here again, the challenge is also the terms of competition between transport modes.

Security of stations: the challenge of joined-up thinking

Stations are set to play an increasingly complex role. Initially solely transport-focused, over time they have become places where people live their lives, and form part of the urban environment. Their long opening hours mean that at some times of day they are the only building open to the

public when all others are shut, and are thus frequented by various groups and categories of people, whose goals in using or occupying them are not necessarily the same.

The development within stations of bigger and bigger retail areas, of which high-street shops are a particular feature, creates other everyday security issues, and suggests we need to clearly define the roles of the various security players for each area of the station affected. It is logical that a security guard working for a railway's in-house security service should come to the aid of passengers on a platform, though the police of course retain jurisdiction, but what about being called to assist with a security incident in the retail area of a station - perhaps between people who are not even there to catch a train? Moreover, major termini are also multi-modal transport hubs served by various transport companies at any one time - these may not share the same view or analysis of their security commitments in terms of policy or financial outlay, which may again raise issues of consistency.

Lastly, within the European Union, the ongoing development of community law and the adoption of the Fourth Railway Package mean that one day, even within "the railways" in the narrowest sense, stations could one day simultaneously host trains from different companies, of different nationalities, incumbents or newcomers. There are already an increasing number of such players operating in the same place at the same time, a number set to increase further under the Fourth Railway Package given its emphasis on boosting competition between rail-sector players. The challenge will be to ensure consistency between their operations and security policies, and to avoid security becoming or causing a distortion of competition between them.

Consistency in managing the security of a space comprising various locations, each of which obeys its own logic, and playing host to stakeholders who alternate between being collaborators and competitors, is becoming a major challenge, since stations, as well as being multi-modal, are also increasingly multi-stakeholder.

Consistency at European and international level

The issue of consistency already raised with regard to stations also extends to international traffic, which is certain to prove a source of traffic and railway business growth, particularly due to the development of high speed systems.

Guaranteeing a "sufficient" level of security throughout the journey in international traffic may convince people to travel by train rather than another mode. Alongside this "commercial" argument, within the European Union there are the provisions of Regulation (EC) no 1371/2007 European Parliament and Council of 23 October 2007 on rail passengers' rights and obligations, published on 3 December 2007, article 26 of which makes the following provision: Personal security of passengers:

"In agreement with public authorities, railway undertakings, infrastructure managers and station managers shall take adequate measures in their respective fields of responsibility and adapt them to the level of security defined by the public authorities to ensure passengers' personal security in railway stations and on trains and to manage risks. They shall cooperate and exchange information on best practices concerning the prevention of acts, which are likely to deteriorate the level of security."

Here again, then, consistency needs to be sought, in a shape which remains to be defined, in order to guarantee the involvement of domestic and international players throughout the journey; this consistency cannot merely be limited to an array or succession of bilateral agreements such as those developed for specific infrastructure (e.g. the Channel Tunnel, etc.).

Specific aspects of high speed systems: risks and opportunities

What has been said for major stations and international traffic is naturally also true of high speed systems, with some specific aspects and limitations. As regards terrorism, though the most notorious recent acts have tended to strike at urban networks, high speed rail definitely offers an attractive target, given what it represents.

Firstly, it is an important symbol of technological development in industrialized countries, attacking which guarantees immense political attention and media coverage of the acts perpetrated and the culprits thereof (or those claiming responsibility). Beyond that, any safety-critical consequences of such acts risk being magnified by the speed of the train (obstacle on the track, potential derailment, etc.).

Travellers on high speed services have a legitimate demand for high-quality service due to the highest price. If a local train is graffiti or looks the worse for wear, the least-worst solution for the operator may be to continue running it nonetheless, as long as it does not present a safety risk, since cancelling such services would create chaos in terms of service punctuality. At the same time, travellers will use such trains because they do not really have a choice, even if they feel uncomfortable doing so, that is, they feel the opposite of a feeling of security.

What passengers will tolerate for local services they will not tolerate for high speed. Set against this, the high speed rail system also offers helpful opportunities: the speed with which it is developing means there is always new-build or upgrading going on, allowing security of operation to be integrated upstream as one factor in quality of service, rather than adding-on measures or operating restrictions post-fact.

A complex balance must therefore be struck. Railway security, preventive action and anti-terrorism form a whole: passengers have a right to travel in security both in daily travel and on high speed services. However, the high speed sector presents specific risks calling for a specific and tailored response. High speed rail represents a very significant investment by society and thus requires protection. At the same time, the rapid roll-out of high speed services in many countries means that security issues can be integrated upstream in the design and management of such systems, bringing maximum effectiveness at an optimum cost: security is one part of service quality, not an additional constraint imposed post-fact.

The way forward

The rail sector has had to learn to live with a number of external constraints, which impact on its environment, above and beyond the internal safety constraints which are a constant of its business. This is the challenge to be met by the security policies to be developed. The challenge is complex since it involves taking on-board external systems of thought which need to be joined up or synergized with those within the railways. But the challenge is also to meet the expectations of customers who wish to be able to travel undisturbed and of staff who wish to work without undue

risk: this is the legitimizing basis for railways' actions, whether they are infrastructure managers or operators.

The task is simultaneously to construct a set of principles, which may require updating or strengthening by legal texts defining the rights and obligations of each party and its role in the process, and to develop constant awareness of security amongst the various players - including customers.

Customers expect their transport to be secure, but also that transport operators allow for all their various concerns, and for the random events which may disrupt their journey. Their vision if one of integrated protection for rail transport, to achieve which each component part must be integrated. This is no easy task, but to quote the philosopher Seneca: "It is not because things are difficult that we do not dare, it is because we do not dare that things are difficult."

UIC Security Platform

Both in its working groups and at its annual congress, the Security Platform brings together UIC members from across the world wishing to make headway on the subjects they consider vital priorities. The Steering Committee is attended by representatives of the various rail business units (passenger, freight, rail system), representatives of the UIC regions (Europe, Asia, Middle East, Africa), representatives of the major industry, technical and institutional partners, and by the chairs of the working groups, guaranteeing that the needs of each party and of the rail sector in all its complexity are optimally attended to.

Overseen by the Security Division, which also acts as a centre of expertise and think-tank, the platform acts both as a standing venue for exchange between members and as an arena for partnership with the various European and international institutions and bodies with responsibility for railway security. Chaired by a European and a non-European on a rotating basis, it has a global dimension which goes beyond regional particularities. The platform holds an annual world security congress on a mutually-agreed subject which is defined based on members' needs. Meanwhile, the working groups continue to address:

- three "constants", developed by UIC, which form the core planks of security policy: human factors, technologies, strategy and regulations. The idea is to develop these three aspects in parallel: an effective security policy starts by supplying frontline staff (human factor) with the information and decision-making support they need (technology), all within a legal or regulatory framework in partnership with the public authorities (strategy and regulations).

- two priority subjects, requested by UIC members in the light of current events and the problems encountered on the ground: metal theft, and border crossings and security of international transport corridors. Metal theft represents an intolerable burden for railway companies both in terms of the direct costs caused by theft (replacement, repair, etc.) and in terms of the indirect costs (compensation for delay, damage to company image, etc.). In terms of the second subject, developing international traffic is assumed to bring time savings and ensure the end-to-end integrity of convoys: in this context it has been deemed a priority to conduct a pragmatic examination of security conditions on international

routes (predominantly Eurasian freight corridors) and of border crossings en route (customs, compatibility between systems, etc.), in order later to define a shared method of analysis and a joined-up response, where necessary, along the whole route.

In addition, the Security Division provides various services, either at the request of the technical departments (e.g. the aforementioned work under way on a handbook on security in high speed systems, in collaboration with the Passenger Department), or at the request of UIC members (participating in studies, organising working seminars, disseminating results and documentation, etc.)

UIC projects

PROTECTRAIL - RESTRAIL

In the areas of security, prevention, and combating crime and terrorism, perhaps even more than in other fields, tomorrow's challenges will not be met with today's solutions. The threat is ever-evolving, and the response must develop at the same pace, at least.

UIC is thus involved in various research projects, including those funded by the European Commission, focusing on the general protection of the rail system (stations, infrastructure, rolling stock), and on the reduction of suicides and trespass, protection of the most vulnerable infrastructure against threats of all kinds, etc.

One output of the PROTECTRAIL project was a general demonstration of the project proposals in Zmigrod (Poland) in October 2013; the project will conclude at a final conference to be held at UIC in Paris in June 2014. The goal is to coordinate the various useable security technologies within a consistent architecture, providing railway undertakings with solutions and standards for the security issues they encounter, whether these are objects blocking the tracks, unattended items in stations, identifying those responsible for risky behaviour, etc. The project takes a modular approach to the various aspects, and developments in problem-solving technologies can be included and integrated within the whole without adverse effects on the rest.

The RESTRAIL project (Reduction of Suicides and Trespass on Railway property) for its part aims to produce a toolbox for decision–makers in order both to reduce the number of suicides and trespass incidents and to mitigate the consequences of these acts. Some of the various measures identified and examined come under education and communications policy; others draw on early-warning or infrastructure-protection technologies. The most promising solutions are being field-tested during the second half of 2013, and the final toolbox should be available by the end of 2014.

The other projects underway include, in particular, those touching on cybercrime, which is undoubtedly a future threat. Beyond the inherent value of these projects, they offer opportunities for partnership and joint thinking between disparate communities: railway companies, research centres, universities, specialist consultants, technical service-providers, etc., and allow us to broaden the scope of our enquiry, compare and contrast our analyses, and obtain a broader view of the roles, capabilities, and rights and obligations of the various potential players.

6.4 Security of Transport of Dangerous Goods

After 11 September 2001, transport of dangerous goods was rapidly identified as one of the areas where appropriate international action should be taken urgently. As a result, the United Nations ECOSOC Sub-Committee of Experts on the Transport of Dangerous Goods issued, already in December 2002, recommendations as regards the security measures or precautions that should be provided through transport of dangerous goods regulations in order to minimize the risk of theft or misuse of dangerous goods that may endanger persons or property, for inclusion in the United Nations Recommendations on the Transport of Dangerous Goods, Model Regulations and related instruments (see also section 5.4). These security provisions consist of:

- General provisions applicable to all dangerous goods: the security of areas used for the temporary storage during carriage of dangerous goods; identification of carriers and their staff; training; registration of valid training certificates;
- Provisions applicable to the so-called "high consequence dangerous goods" i.e. those which have the potential for misuse in a terrorist incident and which, as a result, could produce serious consequences such as mass casualties, mass destruction or, particularly for radioactive material, mass socio-economic disruption. They require special measures to be applied to prevent theft of the vehicles and cargoes. Arrangements between consignors, carriers and any other participants in the transport operation have to be made for adopting, implementing and complying with a security plan.

These security provisions are contained in Chapter 1.4 of the United Nations Model Regulations. They have been included in the International Maritime Dangerous Goods (IMDG) Code (for maritime transport) and the ICAO TI (for air transport) with the reservations nevertheless that:

(a) For maritime transport, they remain recommendations to Governments, that national competent authorities may apply additional security provisions, and that the relevant security provisions of Chapter XI-2 of the 1974 SOLAS[137] Convention and of the International Ship and Port Facility Security (ISPS) Code apply;

(b) For air transport, they supplement (and do not supersede) the provisions of Annex 17 (Security) of the Convention on International Civil Aviation and of the ICAO Security Manual for Safeguarding Civil Aviation against Acts of Unlawful Interference.

The provisions of Chapter 1.4 of the United Nations Model Regulations are reproduced in Chapter 1.10 of ADR, RID and ADN, for mandatory application to international transport (and in the EU also for domestic transport) by road, rail and inland waterways.

[137] International Convention for the Safety of Life at Sea, International Maritime Organization, 1974

Challenges

In 2005, the European Commission conducted a study[138] on the evaluation of the security provisions for the transport of dangerous goods adopted by the land modal regulations (RID/ADR/ADN), their effective implementation and practicability, as well as their consistency and deficiencies.

The study showed that the regulations covering security during the transport of dangerous goods had provided the right level of protection to the public taking account of the factor that trade in dangerous goods must continue with the minimum of restrictions as it provides important raw materials for many different sectors of the economies of Europe. It was noted, however, that the three sets of modal regulations have adopted the same provisions (with very minor changes) despite the fact that the individual modes do present different security risks. Vehicles, for instance, are easily stolen and easily moved from one place to another whilst barges and trains are unlikely to be stolen and the most likely scenario is that the contents of the barge or train are stolen. The current provisions do not take into account this distinction and it was recognized that it may be necessary to consider this aspect of modal differences in the future.

The study also identified some shortcomings which have been addressed since then , but also some problems of enforcement and implementation e.g. in relation to proper security training of staff, security inspections on the road-site and at premises, and the lack of secure parking facilities, which are still under discussion.

[138] Study on transport of high consequence dangerous goods (HCDG). EU Ref: TREN/07/ST/S07.76239. 13 October 2008, available at : http://ec.europa.eu/transport/themes/security/studies/doc/2008_10_hcdg_study.pdf

7. Inland Transport and the Environment

Inland Transport requires infrastructure which involves land-use and loss of natural habitat. It also requires energy, most of it non-renewable. Unfortunately, many of the most popular transport modes depend on non-renewable energy sources, which add to the direct reduction of natural resources and contribute to the emission of greenhouse gases and harmful pollutants.

Much can be done to reduce the negative impact of transport on environmental sustainability, such as the discovery of new energy sources and use of renewables, use of intelligent transportation systems and improved engine efficiency.

	Energy-efficient behaviour ⇨ Renewable energy sources ⇨ Environmentally sustainable transport Low-emission technologies ⇨
Key challenges	➢ Despite energy efficiency improvements, energy consumption in transport is increasing; ➢ Environmental impacts of new technologies are not fully understood yet; ➢ Greenhouse gas emissions from transport are increasing; ➢ Keeping vehicles environmentally friendly throughout their lifetime; ➢ Modal split is not in favour of environmentally friendly modes; ➢ Noise from transport is affecting large numbers of people in agglomerations; ➢ Transport infrastructure is vulnerable to the effects of climate change induced natural disasters.
Role of the United Nations	➢ Service the World Forum for Harmonization of Vehicle Regulations (ITC, WP 29); ➢ Encourage governments to pursue an integrated approach to transport policy; ➢ Define regulations limiting the maximum admissible level of vehicle emissions; ➢ Promote the use of tools such as the "For Future Inland Transport Systems" (ForFits) Co_2 reduction scenario builder; ➢ Promote the accession to and implementation of agreements on vehicle regulations and periodic technical inspection of vehicles.

7.1 Energy use

Currently, the transportation sector accounts for about 27.9 % of the total world final energy consumption and 55 % of the total liquid fuel consumption in 2012 (IEA, 2014[139]). In the period 2001-2012, energy use (Fig. 7.1) was increasing in most countries, but at a slower pace than (nominal) GDP (see e.g. Fig. 2.10 and Chapter 2.3). Energy consumption is projected to increase substantially in the following decades (EIA, 2013) and this development will control the sustainability of the transportation sector.

[139] http://www.iea.org/Sankey/index.html#?c=World&s=Final%20consumption

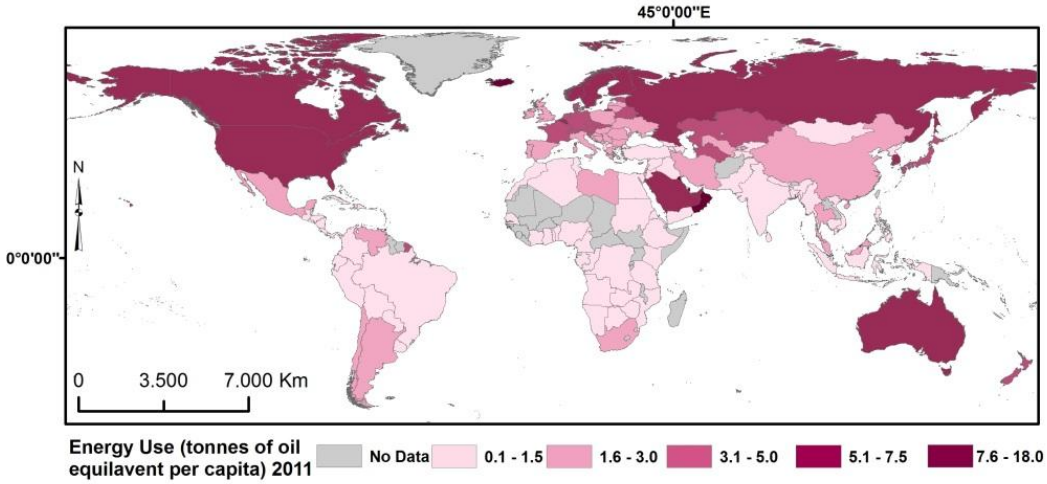


Fig. 7.1 Energy use per capita (in TOE-Tonnes of Oil Equivalent) in 2011

According to recent projections (EIA, 2013), transportation energy use will grow by 1.1 % annually at a global level in the period 2010-2040, driven by an increase of 2.3 % annually in the non-OECD economies; in comparison, energy use in the OECD countries will decline by an average of 0.1 % annually.

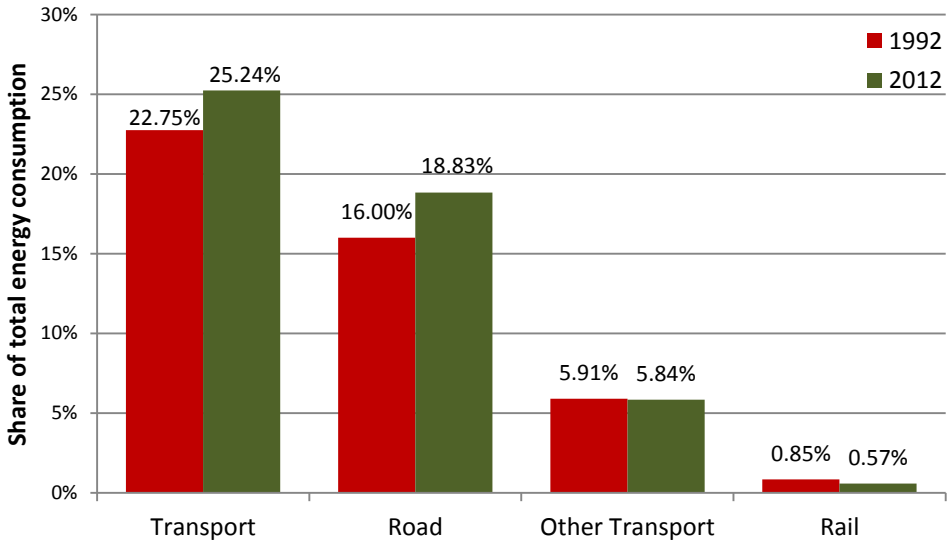


Fig. 7.2 Share of energy use in transport of total energy consumption- global, 1992-2012 (OECD, 2014[140]).

It is interesting to note that, in some regions, total energy consumption has been decreasing in recent, in contrast to that related to transport; this is the result of the substantial increase in the energy used in road transport (about 20 % in the period 1992-2012), while both rail and other transport modes are experiencing reduction in energy use (Fig 7.2). This shows that, in terms of resource use and environmental impact, the ball is firmly in the court of road transport.

In recent years, alternative and renewable energy sources have been increasingly introduced in transport. For example, the world wide use of renewable energy sources has increased in road transport much more than the total energy use. In the period 1992–2012 the use of combustible

[140] http://stats.oecd.org

renewables has increased almost eight-fold (Fig. 7.3), with the total energy use increasing by only 4.83%. Nevertheless, the use of renewable sources is still very low; in 2012 total share of renewables in transport energy use was only 3.4 % (REN21, 2013[141]).

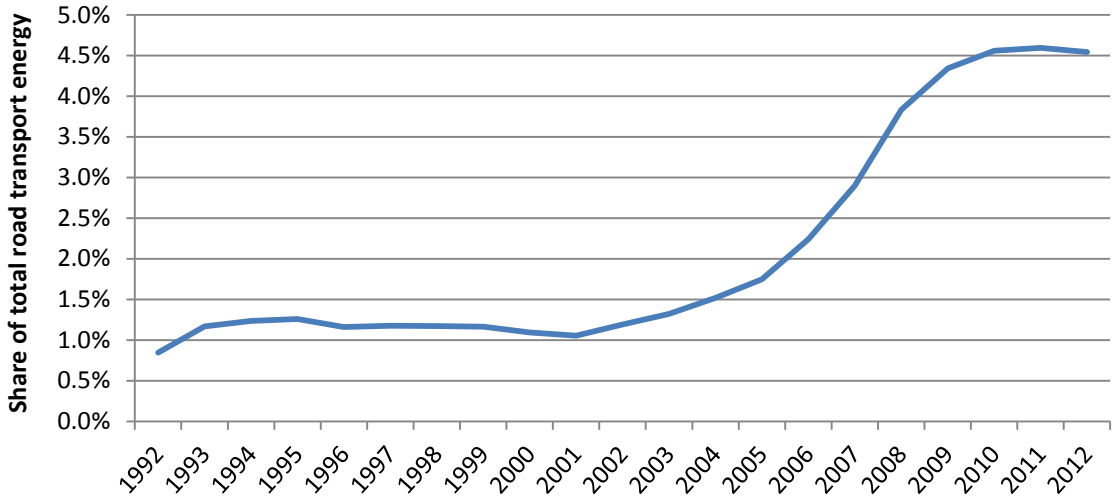


Fig. 7.3 Proportion of combustible renewables and waste of total energy use in road transport – global, 1992-2012 (OECD, 2014[142]).

Transport energy consumption increased substantially in the European Economic area during the period 1995- 2012 (Fig. 7.4a) with the higher rates of increase observed in air and road transport; nevertheless, an significant drop in energy consumption of transport per unit of GDP has been achieved between 2000 and 2012[143]

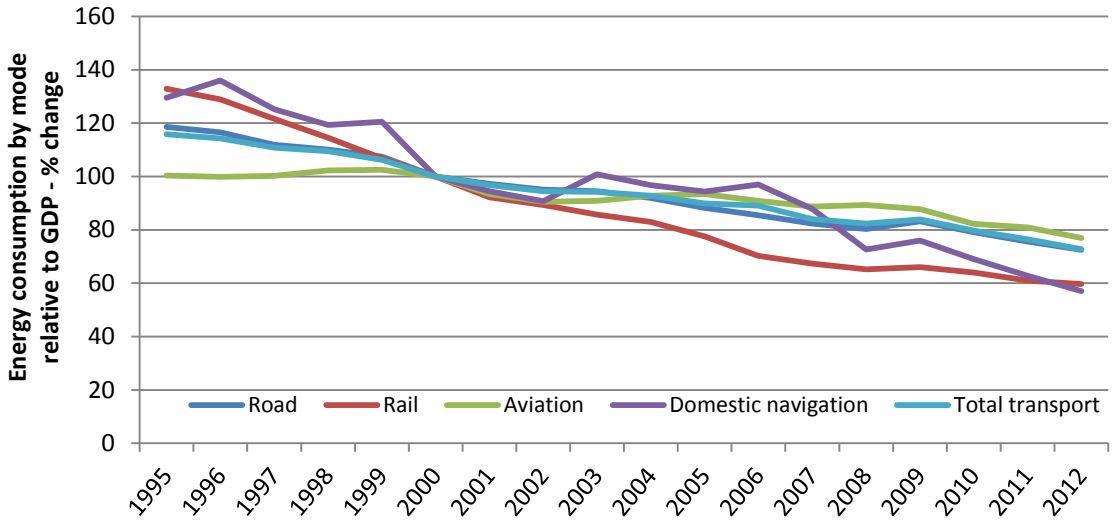


Fig. 7.4a Energy consumption of transport relative to GDP, by mode in the EU-27 +Norway and Switzerland (index 2000 = 100) (source: Eurostat; European Energy Agency)

Globally, energy consumption of transport relative to GDP (7.3b) is decreasing, i.e. the oil equivalent for each $ of GDP used to satisfy the total transport demand is decreasing. This ongoing, almost steady decline indicates a relative decoupling over the 1992-2012 period.

[141] http://www.ren21.net/portals/0/documents/resources/gsr/2013/gsr2013_lowres.pdf
[142] http://stats.oecd.org
[143] See: http://ec.europa.eu/eurostat/statistics-explained/index.php/Sustainable_development_-_transport

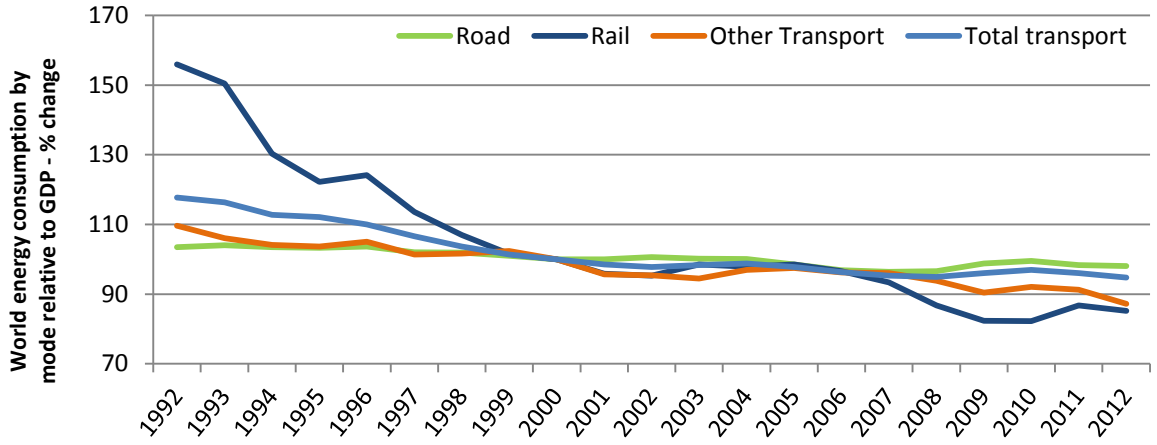


Fig. 7.4b Energy consumption of transport relative to GDP, by mode - global (index 2000 = 100) (OECD, 2014[144])

Fossil fuel consumption has large effects on the environment, mainly through Carbon emissions, which have been steadily increasing over time (Fig. 7.5). R & D allows the progressive introduction of more environmentally friendly energy sources, such as biofuels; however, it should be kept in mind that such sources should be also sustainable. Another increasingly popular energy source in road transport is electricity together and/or instead of fossil fuels; this has the potential to make some significant inroads into the Carbon footprint of road transport (see e.g. Daly and Ó Gallachóir (2012)), but further R & D is required to increase efficiency. Nevertheless, we must bear in mind that electric automobiles can contribute to the reduction of carbon emissions if the electricity used by the car comes from non-fossil fuel sources. Without supportive public policies, the uptake of new technology will depend mostly on household income. Low income households cannot afford and/or are generally reluctant to spend on e.g. hybrid/electric vehicles (Andrich et al., 2013).

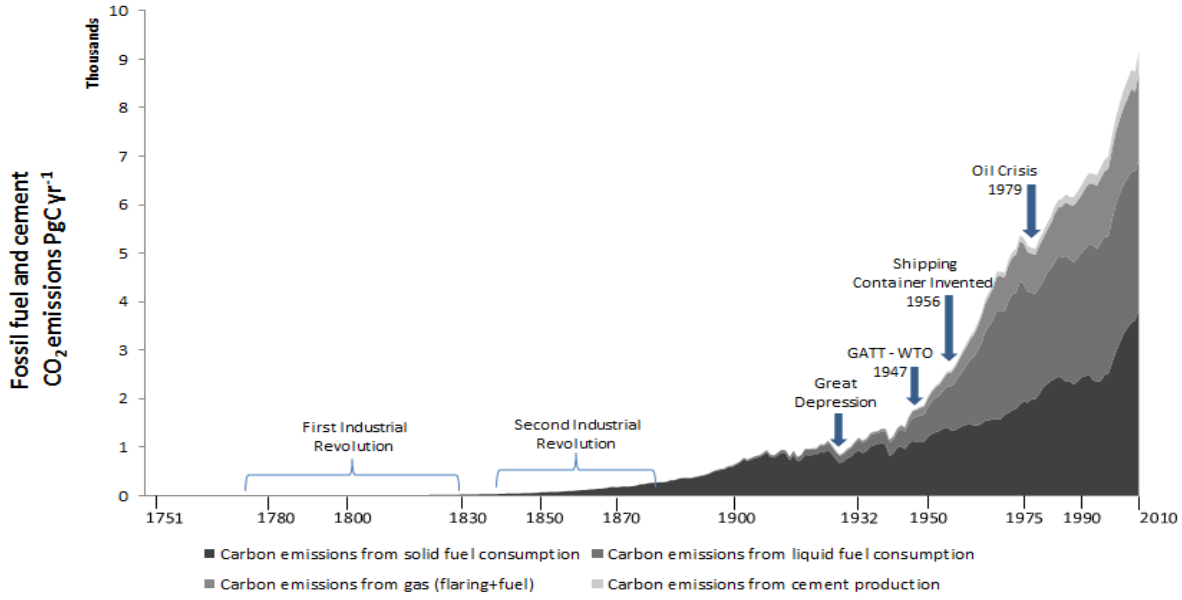


Fig. 7.5 Annual anthropogenic CO2 emissions (PgC/yr), 1750 - 2011. Fossil fuel and cement CO_2 emissions by category, estimated by the Carbon Dioxide Information Analysis Center (CDIAC) (IPCC, 2013). Since the 1950s liquid fossil fuels are the most significant driver of this increase.

[144] http://stats.oecd.org

A recent ECLAC publication illustrates the relevance of energy consumption in strategic infrastructure, especially in ports. The evolution of energy consumption in ports has become a more relevant issue as the Latin American region has become more integrated in the global trade network. Furthermore, the change in the structure of trade in the region, as a result of establishing the region as a main exporter or perishable products, is significantly altering energy demand of infrastructure, transport services and the whole supply chain[145]. Understanding these trends is of significant relevance to understand future demand of the transport and logistics sector and when establishing carbon footprint calculations and energy efficiency standards in the future.

7.2 Transport effects on the environment

Transport can affect the environment in many ways and at different spatio-temporal scales. Inland transport requires infrastructure, the construction of which could involve extensive land-use and, consequently, potential loss of natural habitat. Transport also influences air quality; air pollutants from transport (i.e. nitrogen oxides, particles, carbon monoxide and hydrocarbons) can have damaging (local) impacts on human health and ecosystems. Moreover, transport produces noise, which can also have significant implications for human health/ecosystem services, and uses a great amount of primary natural resources (e.g. metals and fossil fuels). It can also affect quality of life: traffic can be dangerous and intimidating and divide communities. Last, but not least, transport produces GHG emissions and, thus, can severely affect environment at the global level.

7.2.1 Climate change

Fossil fuel combustion emits CO_2[146], which contributes to global warming and, thus, to climate change. CO_2 emissions (and of the other GHGs) are now considered as the major cause of the observed climatic changes, as they result in increased atmospheric concentrations of Greenhouse Gases-GHGs than can absorb heat reflected back from the Earth's surface and, thus, increase the Earth's heat storage (IPCC, 2013). Carbon emissions due to fossil fuels have been increasing steadily since the 1950s. Projections to the 2100 (IPCC, 2013) show that with the exception of the most mild Representative Concentration Pathways (RCP) 2.6 scenario, fossil fuel emissions will continue growing at least until 2050 (Fig. 7.6).

Presently, CO_2 emissions from transport show significant spatial variability, with the highest emissions found in the United States of America, the Russian Federation, China, Japan and Brazil, with Western Europe, Australia and India also associated with high emissions; in comparison, Africa and the central Asia are characterized by the lowest transport-generated emissions (see also Chapter 2.3). In the ECE region, CO_2 emissions from transport have been increasing (on average) across the region during the past few decades. In 1990, about 2.75 billion tonnes of CO_2 were emitted from the ECE transport sector; in 2008, emissions were over 3.2 billion tonnes, an increase of 17 %. In 2008, 85 % of total transport CO_2 emissions originated from road transport, showing an increase of 23 % from early 1990s; this despite the increasing efficiency of vehicles (UNECE, 2012). Nevertheless, measured in emissions per capita, a number of Western European countries have decreased emissions over the last decade.

[145] Wilmsmeier G. et al. (2014). Energy Consumption and Efficiency: Emerging Challenges from Reefer Trade in South American Container Terminals. Bulletin FAL. Issue 329, N. 1/2014. ECLAC. Santiago. Chile

[146] Amongst other gases

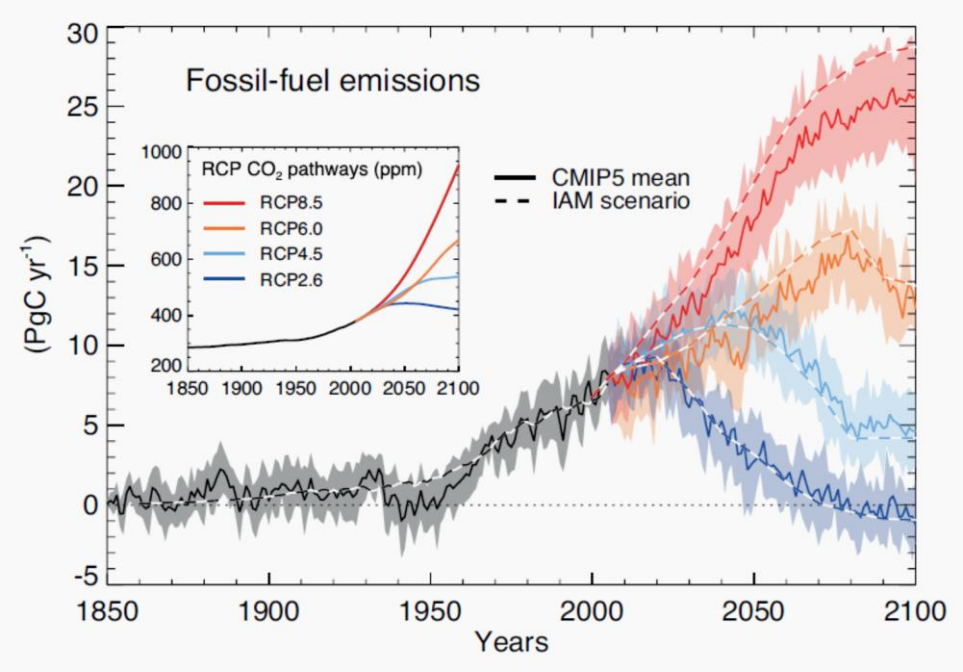


Fig. 7.6 Trend and projections of Carbon emissions (PgC/yr147) due to fossil fuel combustion according to the 4 RCP scenarios[148]. Dashed lines represent the historical estimates. RCP emissions calculated by the Integrated Assessment Models (IAMs) were used to define the RCP scenarios. Solid lines and plumes show results from CMIP5 Earth System Models (ESMs, model mean, with one standard deviation shaded) (IPCC, 2013).

7.2.2 Other environmental effects

Transport emits directly certain pollutants as carbon monoxide (CO), a product of incomplete combustion that reduces the blood's ability to carry oxygen, is poisonous in high concentrations and dangerous for people with lung and heart diseases. Volatile organic compounds, composed of unburned or partially burned fuel, are also toxic causing liver damage and, possibly, cancers. Nitrogen oxides (NOx), generated by gaseous reactions in engine combustion chambers can irritate lungs and contribute to the creation of 'photochemical smog' and acid rain. Nitrogen pollution from vehicles as well as from industry, agriculture and waste treatment costs the EU up to € 320 billion per year; whereas bad air quality causes nearly 500,000 premature deaths a year across all EU countries[149]. Finally, increased concentrations in atmospheric particulate material (mostly carbon particulates) can cause respiratory problems; in recent years, improved car technology (e.g. particle filter installation) has significantly reduced PM emissions. In the EU, Member States have generally managed to reduce emissions of fuel combustion gases (e.g. CO, NOx, SOx, PM_{10}, $PM_{2.5}$) over the past few decades (Fig. 7.7); this however, does not represent a global trend[150] (see UNECE, 2012)

[147] 1 PgC = 10^{15} grams of carbon = 1 Gigatonne of carbon = 1 GtC. This corresponds to 3.667 GtCO2.

[148] In the last IPCC Assessment Report AR5 (2013) forecasts are made on the basis of the Representative Concentration Pathways-RCP scenarios and not the IPCC SRES scenarios. The CO2 equivalent concentrations have been set to (e.g. Moss et al., 2010): RCP 8.5, 1370 C02-equivalent in 2100; RCP 6.0 850 CO2-equivalent in 2100; RCP 4.5, 650 CO2-equivalent in 2100; and RCP 2.6, peak at 490 CO2-equivalent before 2100.

[149] [149]see http://www.millennium-project.org/millennium/Global_Challenges/chall-01.html

[150] The new (2014) IPCC AR5 report on Climate Change Mitigation, released in early 2014 contains detailed information related to GHG and pollutant emissions and mitigations, see http://www.ipcc.ch/.

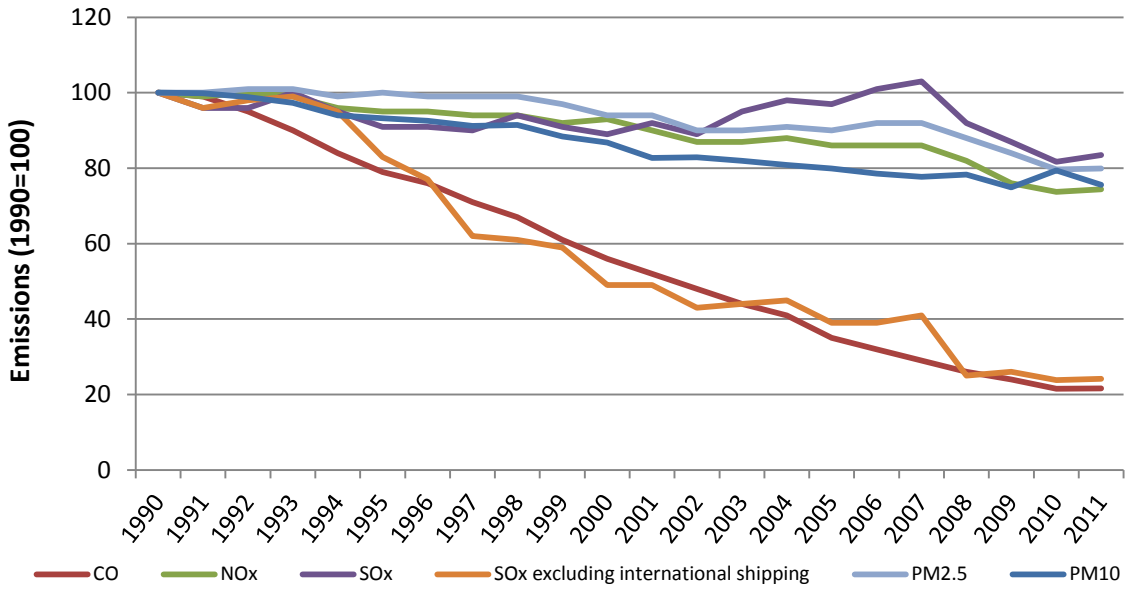


Fig. 7.7 EU emissions of fuel combustion gases (CO, NOx, PM10 and SOx), 1990-2011 (see also UNECE, 2012)

In town centres and alongside busy roads, vehicles are responsible for most local pollution. Vehicles tend to emit more pollution during the first few miles of journey, when their engines are warming up. Although new technology and cleaner fuel formulations will continue to cut emissions of pollutants, the increasing number of vehicles on the road and miles driven is eroding these benefits.

Noise from transport can also be a serious health issue, as it can cause stress, sleep disturbance and other harmful health effects. In urban agglomerations, noise from road transport affects considerably more people than noise from rail, inland waterway and air transport as well as noise from the industrial sector (UNECE, 2012). With regard to road transport, noise sources include car engine noises, tyre-on-the-road noises, car horn and music noises, door slamming, and squeaking brakes. In urban areas, engine sound appears to be the most significant problem, whereas in rural areas tyre noise on busy highways (which increases with speed) is the main noise source.

In the EU in 2010 at least 60 million people were exposed to road noise above 55 decibels (db) every day (Fig. 7.8), although vehicles have been subject to noise standards for many years mainly through EU legislation. The same study repeated in 2014 by the Noise Observation and Information Service for Europe of the European Environment Agency, obtaining results from a similar sample size (- 5%), showed a significant improvement compared to the 2010 study results, concluding that the number of surveyed persons exposed noise higher than 55db, has decreased from four years prior in all categories, most significantly by 15% in road transport noise exposure. Low-noise road surfaces, effective noise barriers in sensitive locations, and low noise tyres can all help reduce noise levels.

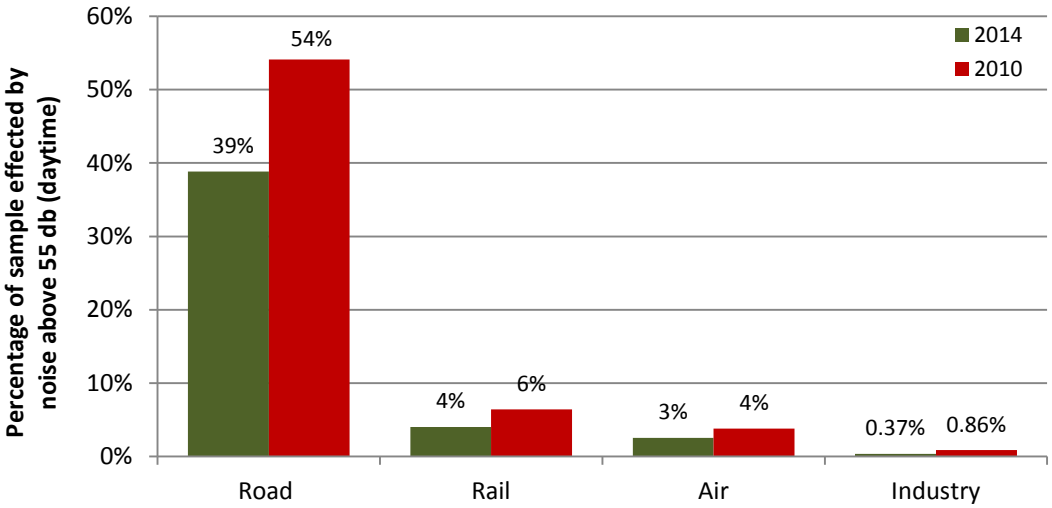


Fig. 7.8 Exposure to noise above 55db in daytime in selected EU countries in 2010 and 2014 (EC, 2014[151]).

Nevertheless, it should be noted that environmental effects of transport (e.g. noise and nuisance) should not be considered independently of its positive socio-economic effects. A recent survey involving 1225 people living close (within a distance of 1 km) from a highway in the Netherlands (Hamersma et al., 2014) has found that 85% of respondents (on average) were satisfied with living near a highway. It appears that negative feelings driven by considerations of air quality, noise and nuisance can be balanced by interests in improved transport accessibility and a positive attitude towards private motorization.

Transport can also have major environmental impacts through the construction, use and eventual disposal of its components (infrastructure and rolling stock). For example, it has been estimated that of the CO_2 emissions produced over a car's lifespan, 10 % originate from its manufacture and 5% from its disposal, with the remaining 85% coming from fuel use and servicing operations[152] .

In addition to the above effects, the expansion/upgrading of transport infrastructure can have considerable adverse effects on the environment. Such effects are generally considered in the national and international environmental impact regulation that is in force in many countries and regions[153].

7.3 Environmental effects on transport

Transport is not only a major contributor to the observed carbon emission growth and, thus, a probable forcing of climatic changes (IPCC, 2013); it is also a 'victim' of climatic change

[151] http://noise.eionet.europa.eu/

[152] For more information see e.g. http://www.environmental-protection.org.uk/committees/air-quality/air-pollution-and-transport/car-pollution/

[153] For example, the 1992 Espoo Convention and its 2003 Kiev Protocol (http://www.unece.org/fileadmin/DAM/env/eia/documents/legaltexts/conventiontextenglish.pdf and http://www.unece.org/fileadmin/DAM/env/eia/documents/legaltexts/protocolenglish.pdf.), and the European Environmental Impact Assessment Amended Directive (97/11/EC) (http://ec.europa.eu/environment/eia/full-legal-text/9711.htm) and the the Strategic Environmental Assessment Directive (2001/42/EC) (http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:197:0030:0037:EN:PDF).

effects/extreme events which can have a range of diverse impacts on transport infrastructure and services. These impacts will vary significantly by mode, climate change factor, and will depend on the local or regional circumstances and vulnerabilities, including those associated with the natural environment, as well as a broad range of socio-economic factors (see also UNECE, 2013).

Sea level rise, storm surges and waves are likely to have major impacts, including transient and permanent flooding of roads, rail lines and tunnels. Coastal inundation (e.g. Figs 7.8) can render transportation systems unusable for the duration of the event (for several hours/days) and damage terminals, intermodal facilities, freight villages, storage areas and cargo and, thus, disrupt intermodal supply chains and transport connectivity for longer periods (USDOT, 2012).

Heat waves will limit operations and cause road pavement damages (PIARC, 2012), whereas increased intensities of tropical storms or hurricanes could lead in infrastructure damages or failures and transportation interruptions. Arctic warming will continue to reduce sea ice (IPCC, 2013), lengthening the arctic shipping season, but also resulting in greater coastal erosion due to increased wave activity at the polar shorelines of Canada, the Russian Federation and the United States of America (e.g. Lantuit and Pollard, 2008); it will also cause permafrost thaws that will damage severely transport infrastructure.

With regard to the sensitivity of inland transport networks to climate variability and change forcing, a recent review (UNECE, 2013) has found that: (i) transportation assets tend to be more sensitive to extreme events, such as storm surges, heavy precipitation events, heat waves and high wind events than to incremental changes in the mean of the climate variables; (ii) services (e.g. maintenance, traffic conveyance and safety) are generally more sensitive to climate forcing than physical assets, as thresholds for e.g. delaying or cancelling transport services are generally lower than those for damage to infrastructure and (iii) transport assets are sensitive to stressors whose occurrence is relatively unlikely in comparison to typical weather variability. For example, during the 2005 Katrina hurricane, the superstructure of the United States of America Gulf Coast bridges proved to be susceptible to excessive loading from direct wave impacts due to the unprecedented coastal sea levels induced by the storm surge (USDOT, 2012).

Fig. 7.9 Weather related damages to transport infrastructure. (a) Many roads, including sections of the US Highway 34 (black arrows) .were washed away by the floods of South Platte River, in Colorado (USA) in mid-September 2013 (http://landsat.visibleearth.nasa.gov/view.php?id=82090) (b) Damaged rail track from storm surge and waves along the Dawlish seafront, South-eastern England in February 2014 (photograph, Toby Melville/Reuters).

Two recent EU Framework Programme 7 (FP7) projects have studied the impacts of climate change and extreme events on the European transport systems: the WEATHER[154] and the EWENT[155] projects. The WEATHER Project aimed at identifying risks, economic impacts and adaptation strategies for all modes of transport, whereas the EWENT Project considered long term climate scenarios in more detail. Both projects found that there is a lack of reliable statistical data relevant to the vulnerability of the different transport modes. In the WEATHER Project, the total costs borne by the transport sector (e.g. damages, infrastructure repair/maintenance, vehicle damages, increased operation costs) have been estimated for the period 1998-2010 as € 2.5 billion annually, with indirect costs through transport disruptions as €1 billion annually. Rail has been the most affected transport mode, with 'hot spots' in E. Europe and Scandinavia, whereas the effects on roads have been found to be more evenly distributed. The EWENT project assessed average annual costs due to weather extremes for the current and future (2041–2070) periods. Costs from extreme climate events in the baseline period (1998-2010) have been estimated as more than €15 billion, dominated by road accident costs.

Other studies (e.g. Pecherin et al., 2010) have also projected substantial impacts on coastal transport infrastructure. It has been estimated that a 1 m increase in sea level above the inundation level of the current 1-in 100 year-storm event, and assuming an average linear property cost at €10 million/km of road surface and repair costs at about €250 thousands/km, would amount to asset costs (i.e. excluding operational and connectivity costs) for mainland French A-roads of up to €2 billion. It has also been found that such sea level rise could inundate 2.9 % of motorways, 1.7 % of national roads, and 6.3 % cent of the railway network. Another recent study (EC, 2012b) has provided an initial estimate of the future risk of the European coastal transport infrastructure due to mean sea level rise (MSLR) and storm surges on the basis of a comparison between the coastal infrastructure elevation and the combined level of 1 m MSLR and the 100-year storm surge height; it was found that coastal transport infrastructure (e.g. coastal roads) at risk represents the 4.1 % of the total, with an asset value of about €18.5 billion.

Changes in precipitation may result in stream flow changes. River floods are likely to be particularly catastrophic for transport networks as major roadways and railways are located within and/or crossing flood plains (see e.g. Fig. 7.8a); they can also have significant effects on bus/coach stations, train terminal facilities and inland waterway operations. There can be direct damages during and immediately after the precipitation event, requiring emergency responses, as well as deleterious effects for the structural integrity and maintenance of roads, bridges, drainage systems, and tunnels (USDOT, 2012). One area of particular concern is the potential increase in winter rainfall, which may result in failure of drainage systems (Galbraith et al., 2005). A recent study in the United Kingdom of Great Britain and Northern Ireland (DEFRA, 2012) has suggested that transportation infrastructure will be affected by both extreme weather events and long-term gradual change in the climate. Road and railway networks have been projected to face significant risks of flooding as well as bridge scouring. Increases in heavy precipitation events/floods will also cause more weather-related accidents due to vehicle and road damages and poor visibility, delays, and traffic disruptions (e.g. Potter et al., 2008; Hambly et al., 2012).

[154] See http://www.weather-project.eu
[155] See (http://www.weather-project.eu/weather/inhalte/research-network/ewent.php)

Regions where flooding is already common will face more frequent and severe problems. Standing flood waters could have severe impacts on roads; for example, damages due to long-term road submersion in Louisiana have been estimated as $50 million for 200 miles of the state highways (e.g. Karl et al., 2009). Inland waterways can be affected by suspension of navigation, silting and changes in the river morphology and damage of banks and flood protection. A recent study (Wright et al., 2012) which assessed the potential impacts of climate change-induced river flooding on the continental USA bridges, has estimated that the adaptation costs of vulnerable bridges will be $140-$ 250 billion through the 21st century; estimations for the EU 27 bridges (EC, 2012a) are lower, with the future cost for bridge protection against flood scouring been estimated as €0.38 - 0.54 billion per year, 80 % of which is for road and 20 % for rail bridges (see also UNECE, 2013).

Studies on the effect of climate changes on the British railway network also suggest that infrastructure will be impacted severely, with impacts including track and line side equipment failure, flood scours at bridges and embankments due to high river levels and culvert washouts, landslides, as well as problems associated with personnel safety and the accessibility of fleet and maintenance depots. Costs related to extreme precipitation and floods and other extreme events, which are already estimated as £50 million a year, could increase to up to £500 million a year by 2040s (e.g. Rona, 2011). Road networks are also expected to be severely affected by the projected increases in heavy rainfall and flooding, with diverse impacts on the different types of pavement, asphalt and concrete, which would require adaptive maintenance practices such as construction of adequate drainage and the use of permeable pavements and polymer modified binders (e.g. Willway et al., 2008). In addition, the cost of flood-related traffic disruption on roads has been estimated as at least €123,000 per hour delay on each main road affected (Arkell and Darch, 2006); If there is more frequent flooding in the future as a result of increased heavy precipitation, then it is likely that these costs will increase significantly (Hooper and Chapman, 2012).

Extreme winds, which are often, but not exclusively, associated with tropical storms, are also projected to be more catastrophic in the future (e.g. Rahmstorf, 2012). Such events can cause overtopping on defences and flooding at coastal and estuarine railways (RSSB, 2010), damage port and airport facilities and affect severely road and rail infrastructure and services through wind-generated debris (e.g. Karl et al., 2009).

Heat waves, i.e. extended periods (days to weeks scale) of abnormally hot weather, may have substantial impacts to transport services and infrastructure, potentially being quite devastating (Hooper and Chapman, 2012). For example, the European 2003 heat wave has affected the water levels of many major rivers (e.g. the Po, Rhine and Loire rivers), resulting in disruption of inland navigation, irrigation and power-plant cooling (Beniston and Díaz, 2004). Long and repeated periods of extreme summer heat (sustained air temperatures over 90 °F - ~32 °C) can damage roads through asphalt softening that could lead to rutting from heavy traffic (Field et al., 2007). Extreme heat waves can also deform rail tracks, causing derailments and speed restrictions (e.g. Baker et al., 2010). A recent European study (EC, 2012b) has estimated significant increases in the

21st century of the number of days per year that the maximum temperatures (Tmax) in Europe will exceed CRT30[156]., suggesting increases in delays/operational costs.

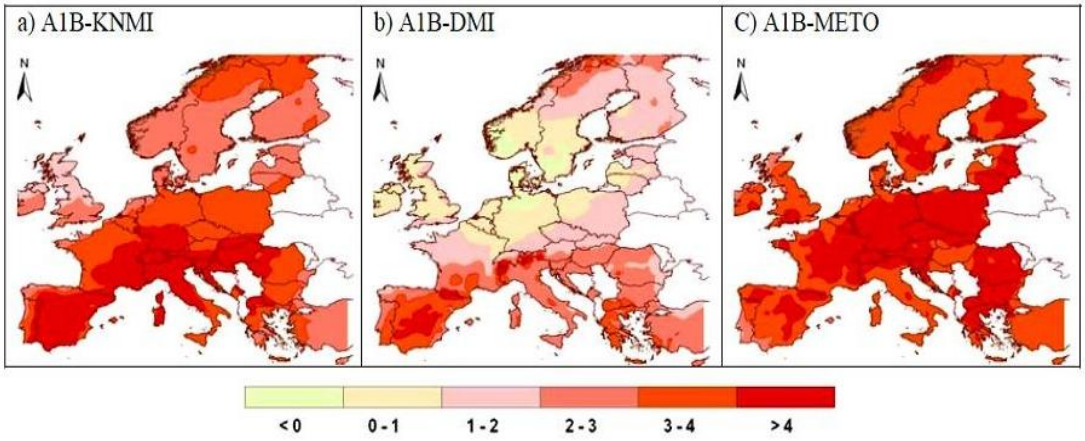


Fig.7.10 Change in the 7-day maximum pavement temperature in the different European climate zones, in the case of the A1B scenario (comparison between the periods 2040-2070 and 1990-2010) (EC, 2012b).

Temperatures above 100 °F (about 38 °C) can lead to other transport component failure. Drier and hotter summers will lead to road pavement deterioration/subsidence, affecting pavement performance and resilience (e.g. PIARC, 2012; DEFRA, 2012). A recent European study (EC, 2012b) has used model predictions (e.g. Fig. 7.10) to provide annual costs to upgrade asphalt binder for different climate temperature scenarios. The study suggested that, for example the A1B IPCC SRES scenario, the additional cost for the EU27 would be €38.5–135 million per yr by 2040-2070 and €65-210 million per year by 2070-2100. Nevertheless, it must be noted that as road surfaces are typically replaced every 20 years, climate change effects could be considered at the time of replacement (SREX, 2012).

Inland waterways (IW) can also be affected by low water levels during heat waves. Recent research (the EU FP7-ECCONET Project[157]) has assessed impacts of climate change on inland waterway transport, as well as potential adaptation**.** The project used the Rhine–Main–Danube (RMD) corridor as a case study, focusing on low water conditions. It has been found that over a period of 20 years, the average annual loss due to low water levels has been about €28 million, with the 2003 extreme low water conditions associated with a loss of €91 million (see also Jonkeren et al., 2007). Results based on projections from different climate models have shown no significant effects on low flow conditions for the RMD corridor until 2050, whereas the upper Danube might experience a moderate increase in such conditions. The study has also estimated that dry years may lead to a 6–7 % increase in total transport costs compared to ''wet'' years (see also EEA, 2012).

Permafrost thawing (e.g. Streletskiy et al., 2012; Zhang et al., 2012) presents serious challenges for transportation (e.g. Qingbai et al., 2008), such as settling and/or frost heaves at roads that can affect their structural integrity and load-carrying capacity. In polar areas many highways are

[156] Critical Rail track Temperatures (CRT) denote the critical temperatures above which speed limits apply; for example CRT70 and CRT30 denote the critical temperatures above which speed restrictions of 70 km/h and 30 km/h, respectively, should be applied.
[157] See http://www.tmleuven.be/project/ecconet/home.htm

already located in areas with discontinuous, patchy permafrost, resulting in substantial maintenance costs as well as usage restrictions; for example, the number of days when travel is allowed has decreased from 200 to 100 days per year in certain Alaskan regions in the past 30 years (Karl et al., 2009).

Finally, it should not be forgotten that the transport industry is a demand-driven industry. Climate change can have significant effects in, almost all, sectors of economy, and thus affect indirectly transport services through e.g. changes in demand for commodity and tourism transportation (see UNECE, 2013).

7.4 Challenges and best practices

7.4.1 Environmental impacts of transport

Mitigation of the environmental impacts of transport constitutes a major challenge. With regard to Carbon emissions, major steps should be taken in order to reduce the carbon footprint of transport and particularly of road transport. These steps, however, might be significantly different in different regions[158]. Africa's total ecological footprint is set to double by 2040 and will need about US $ 675 billion by 2030 to achieve low-carbon sustainable growth, a cost that the current carbon market for mitigation cannot bear, as the Clean Development Mechanism (CDM), the Reducing Emissions from Deforestation and Forest Degradation program and the voluntary offset program have not been fully utilized. Re-afforestation, saltwater agriculture along the coasts, and solar energy in the Sahara could be effective sources of sustainable growth. The Asia-Pacific region has half of the world's megacities, poor, densely-populated urban areas which are more vulnerable to climatic changes and extremes; rapid applications of innovative urban system changes will be vital for the sustainable development of the region.

About half of the carbon stored in tropical forests worldwide is found in Latin America. Deforestation rates are currently going down in Brazil (a fall by 75% since their last peak in 2004), but growing demand for hydropower and bio-fuels may impact further the tropical forests. Recycling in Brazil generates US $ 2 billion a year and reduces GHG emissions by 10 million tons, whereas Mexico's new Climate Change Law (2012) has set legally binding goals to reduce C02 emissions by 30 % in 2020, provided that it could get the necessary international technological and financial assistance[159]. Without a successful green technology transition, the United States of America GHG emissions may increase by 6% between 2005 and 2035. In addition to a Federal investment of US $ 880 million to clean up Florida Everglades, Bank of America announced in 2012 a 10-year, $50-billion green investment program[160].

The EU is close to achieve its 2020 climate target to cut CO_2 emissions 20 % below 1990 levels, but the Euro debt crisis might create a climate funding gap of US $45 billion by 2015. Due to allowance excesses and sluggish economy, the EU carbon price dropped to around € 3 per tonne in early 2013 (down from its peak of over € 30 per tonne), undermining the Emissions Trading Scheme (ETS) role in encouraging EU's industry to decarbonize. The EU is discussing a new gas

[158] For further details see http://www.millennium-project.org/millennium/Global_Challenges/chall-01.html
[159] See e.g. http://www.nature.com/news/mexico-passes-climate-change-law-1.10496
[160] See http://about.bankofamerica.com/en-us/global-impact/environmental-sustainability.html#fbid=-87AqVQcCf7

emission reduction objective toward 2030 to take into account the delays in achieving Europe 2020 climate/energy objectives (GHG emissions 20% lower than 1990; 20% of energy from renewables; 20% increase in energy efficiency). Finally, the Russian Federation aims to reduce GHG emissions by 22–25% by 2020 compared with 1990.

SolaRoad – solar bicycle road in the province of Noord-Holland, The Netherlands

In Krommenie, a village at 25 km from Amsterdam in The Netherlands, 2000 cyclist daily use a SolaRoad bicycle path. The pavement harvests the incident solar energy and converts it to electricity. The stretch of approximately 100 m was opened in November 2014 as the world's first public road with embedded solar cells. It is a field operational test of SolaRoad to assess the performance, as a basis for further development and subsequent large scale deployment on roads in The Netherlands and throughout the world.

The two-lane bicycle path consists of interconnected concrete elements of 3.5 m x 2.5 m. In one lane, solar cells are embedded beneath a translucent top layer. The protective top layer is one of the innovative features of SolaRoad: it has to transmit as much sunlight as possible, repel dirt, offer sufficient road grip for safe use by cyclists and be strong enough. The solar electricity from the road is fed into the grid, and can be used for a variety of energy users, i.e. traffic lights, households, or charging of electric cars. It is expected that 50-70 m2 of SolaRoad will provide sufficient electricity for one average Dutch household (3500 kWh/year).

The road network in The Netherlands consists of 140.000 km of roads, and more than 30.000 km of bicycle roads. The roads catch a lot of sun, more than all Dutch rooftops together. Rooftops are increasingly used for the installation of solar panels. However, to extend the potential of solar energy generation beyond rooftops, and realise a significant contribution to the renewable energy goals of the EU, more surface area is required. By integration of solar technology in roads this can be achieved without additional spatial claims, and without extra impact on the landscape: by multi-functional use of the roads that are needed anyway. This makes SolaRoad an interesting option for application in densely populated regions such as The Netherlands.

SolaRoad is being developed by a public-private Dutch consortium consisting of TNO - organization for applied research, the province of Noord-Holland, Ooms Civiel – road construction company, and Imtech – technical service provider. The consortium intends to build more bicycle roads with embedded solar technology over the next couple of years, developing the product for large-scale production and application. In parallel, an advanced version for application in regular roads will be developed. The fraction of the Dutch road network that could economically and practically be equipped with SolaRoad technology is estimated at 10-20%. If this potential would be realised sufficient solar electricity could be produced on an annual basis to power 2-3 million electric cars (the total number of motor vehicles in The Netherlands is currently 8 million).

By powering electric vehicles with the green electricity from the road, a large step towards a more sustainable, low-carbon mobility system can be made. Moreover, the electricity is used at the same location where it is generated. This is favourable in matching the intermittent supply and demand of electricity when SolaRoad is applied on large scale, and reduces distribution losses. For these reasons, the possibilities of the integration of SolaRoad with electric mobility and EV-

charging systems are being investigated. The primary focus is on applications for electric buses. Explorations of potential system solutions and the associated total cost of ownership (TOC) can be found in Bolech M. et al., 2013 (Electric buses for SolaRoad, TNO-report 2013 R11533).

An obvious way to achieve decreases in the transport Carbon footprint is to increase the price of energy, thereby encouraging road users to adopt more energy-efficient driving behaviour and/or to consider other transport modes. In the ECE region, most Member States have introduced fuel taxes constituting more than 50 % of the total fuel price (UNECE, 2012). However, high fuel taxation can have important implications on mobility[161], if not complemented by measures promoting viable alternative transport options such as adequate public transport. It must be also noted that fuel taxation should be used as a financial instrument that gives the transport sector/road users incentives for energy efficiency and not as a means to balance public finances (Musso et al, 2013).

Taxation of new cars can be used to promote energy-efficient and low-emission vehicles. For instance, in the last decade Austria introduced a differentiated tax system on the purchase of new vehicles, according to which cars are taxed according to their CO_2 emission levels; as a result the number of cars emitting less than 120gr/km tripled in this period. In the Russian Federation, a regional transport tax in Moscow is set on the basis of car engine power, whereas trucks and buses are taxed according to their age to promote fleet renewal. Replacing cars with newer, more environmentally friendly versions can be promoted by bonus/penalty programs, such as that of Belgium, according to which car owners receive bonuses for replacing their old cars with cars that produce CO_2 emissions lower than 146gr/km and penalties if the replacement cars have higher emissions that their old car. A favoured financial instrument in urban areas is congestion charges. For example, in Stockholm (Sweden) there are congestion charges from which electric vehicles are exempt. In other countries, highway road tolls depend also on emission levels (UNECE, 2012).

Kapsch TrafficCom solution for Rome a Limited Traffic Zone, a pioneering project in City Access Management

Today, nearly 4.2 square km of Rome has some type of access restriction, making it the world's second largest traffic managed urban area after London. The aim is to protect an immense historical and archaeological heritage, safeguard the quality of the citizens' life, and promote the use of public transport to reduce environmental pollution.

The law on Limited Traffic Zones (LTZ) in Italy dates back to the Seventies. Rome implemented a system for reducing the number of cars in the central historic area in 1989. At first the LTZ was controlled by paper permits, physical gates, and police-manned access points, however, this method required a great deal of resources, and so an automated access control system (ACS) was implemented in 1998.

Rome was a pioneer in the field: it implemented prototypes, created procedures, and tested technological processes. The access control system of Italy's capital, created by Kapsch TrafficCom, was the first to be authorized to operate by the relevant authorities in 1999 and started

[161] Fuel taxation is considerably lower in the United States (about 20 %) and Canada (32 %) (UNECE, 2012). These countries are amongst those with the highest mobility levels.

operations in 2000 (270 such systems are in operation in Italy today).

A flexible and scalable solution

Roma Municipality needed to develop flexible control processes that could be tailored on different mobility segments. The "Centro Storico" and Trastevere Limited Traffic Zones were established (day and night usage), followed by San Lorenzo and Testaccio (only night) and most recently by systems for the control of bus lanes and the management of accesses to the "Tangenziale Est" elevated freeway. The flexibility feature is particularly important when considering that today there are 63 sites in Rome subject to control with electronic gates.

The entire LTZ system is managed by Roma Agenzia per la Mobilità s.r.l., a private company under the control of the Roma Municipality. Residents and other drivers who want to access the city centre must register, and non-residents have to pay an annual fee. The controls are carried out by an Automatic Number Plate Recognition (ANPR) process operated by the cameras placed on the gantries at LTZ access points, while the enforcement is handled by the police.

The areas managed by the Kapsch system are "Centro Storico", Trastevere and "Tangenziale Est". The system can establish whether the driver is authorized or not to enter the restricted area thanks to plate recognition and by matching the collected data with a municipal register of authorized vehicles. Moreover, thanks to this technology, it is possible to define access restrictions at different times of the day, (for example, 24 hours for the historic centre or night hours in the nightlife areas). The flexibility of the technology allows the urban mobility planners to easily apply control strategies, and quickly adapt the system configuration to the changing needs of the city.

An example of how this technology can be successfully used to benefit the local public transportation company (ATAC) was the application of the city access solutions to monitor bus lanes. In the past, unauthorized private vehicles in designated bus lanes generated traffic jams and caused delays on timetables. The extension of the city access management system includes 17 bus lanes bringing a 20% increase of the public transportation speed in an area where bus lanes had not been monitored by the urban system before.

Achievements

In terms of results, already in 2000, the year of activation for the LTZ, the use of public transportation increased by 10%. In the longer term, from 2000 to 2010, there has been a progressive annual reduction of vehicles entering the historic town centre, which has stabilized to the equivalent of 11 million vehicles per year not accessing LTZ thanks to the restrictions applied and to more effective electronically enforced controls. The impact on reducing damage to the historic buildings and to the protection of the city's globally recognized heritage is almost impossible to measure.

The future of Rome

In 2014 the New General Plan to regulate urban traffic in Rome has been compiled (Nuovo Piano Generale del Traffico Urbano di Roma Capitale), it has been approved by the City Council and it is now under the evaluation of the Rome Municipalities. With the implementation of future strategies for urban mobility control, it has been estimated that the environmental pollution will be reduced by an average of 14%.

There are non-financial instruments that can promote environmentally sustainable transport. These include amongst others (UNECE, 2012): rules for governments and public authorities that serve as good examples for road users, such as those in Sweden where government agencies are allowed to buy only environmentally friendly vehicles; eco-labelling of vehicles according to their emission levels[162]; schemes to promote vehicle fuel efficiency through improvements in driver behaviour, such as maintaining a steady speed, anticipating traffic, slow, smooth accelerations and keeping the correct tyre pressure[163]; and national initiatives to promote eco-friendly transport, such as those of the Canadian Government[164].

In addition, regulations setting maximum emission levels of new vehicles have been introduced; for example, EU that has defined emissions standards for new vehicles, mainly through several secondary legislation instruments (Directives)[165]. There are also important regulations discussed and adopted through the UNECE World Forum for Harmonization of Vehicle Regulations (WP.29).

The World Forum for Harmonization of Vehicle Regulations – WP.29

WP.29 is the worldwide leading institution for standardisation of safety and environmental provisions for road vehicles. It administers the following three agreements:

- 1958 Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be fitted and / or be used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions,
- 1997 Agreement Concerning the Adoption of Uniform Conditions for Periodical Technical Inspections (PTI) of Wheeled Vehicles and the Reciprocal Recognition of Such Inspections, and
- 1998 Agreement concerning the Establishing of Global Technical Regulations (GTR) for Wheeled Vehicles, Equipment and Parts which can be fitted and / or be used on Wheeled Vehicles.

Today 133 UN Regulations, 16 Global Technical Regulations and 2 Rules for PTI are providing a legal framework for road vehicles harmonising their safety and environmental performance at highest standards.

Fifty-three countries (including the EU Member States) are Contracting Parties to at least one of the two United Nations agreements on vehicle regulations (1958 and 1998 agreements) [166] and

[162] For more information see Codagnone et al. (2013).
[163] See e.g. http://www.afdc.energy.gov/conserve/driving_behavior.html
[164] See https://www.ec.gc.ca/financement-funding/sv-gs/search_results_e.cfm?action=details&id=315&start_row=1&all_records_details=region&region=nat
[165] In EU, pollutant emissions from road vehicles are regulated separately for light-duty vehicles (cars and light vans) and for heavy-duty vehicles (trucks and buses). For light-duty vehicles, emission standard Euro 4, as defined by Directive 98/70/EC were replaced by Euro 5 in September 2009, the main effects of which has been to reduce emissions of particulate matter from diesel cars. Euro 6 is scheduled to enter into force in 2014 and will reduce emissions from diesel cars further. For more information, see http://ec.europa.eu/environment/air/transport/road.htm
[166] See http://www.unece.org/trans/main/welcwp29.html

apply the vehicle regulations adopted by the WP.29. These countries, representing five continents (almost all European countries, Australia, Canada, China, India, Japan, Korea, Malaysia, New Zealand, South Africa, Thailand and the United States of America), manufacture more than 80 % of vehicles worldwide. Other countries (e.g. Argentina, Brazil, Cambodia, Mexico, Philippines, Vietnam, the Community of the Arab Gulf Countries, the Southern African Developing Community (SADC), the Association of South East Asian Nations (ASEAN)) are either in the process of acceding to the 1958 and 1998 agreements or have shown interest in acceding to them. With regard to the reduction of GHG emissions in the transport sector, the World Forum and its subsidiary Working Parties have already considered measures to improve the energy efficiency of the vehicle fleet.

Focus on ESCWA - Adopting standards and regulations

Significant achievements have been observed in the past two decades in the evolution of regulations addressing the sustainability of transport:

(a) *Emission control and fuel specifications*

Environmental laws and regulations in the Arab countries usually include articles prohibiting the use of machines, engines or vehicles that produce emissions exceeding set limits. In many cases, however, the regulations are either not yet sufficiently developed or enforced and/or the standards they set have not been adequately defined. Countries in the region have revised, updated or issued many regulations and standards and included one or several of the following emission control abatement regulations and standards.

(i) ***Fuel specifications and emission performance standards****:* In the Arab countries, several standards and regulations related to fuel quality have been issued during the last years, including **Qatar, Saudi Arabia**, **Syrian Arab Republic, Sudan, United Arab Emirates** and **Bahrain.**

(ii) ***Technology standards***: This category includes such advanced vehicle technology as electric vehicles and fuel-cell vehicles; **natural gas vehicle** technologies; and vehicle pollution control technologies. Since the uses of advanced transport technologies are limited in the Arab region, the effort related to regulations and standards of these technologies is also limited. In this regard, standards for Compressed Natural Gas (CNG) vehicle and CNG refilling station were established by the Egyptian Organization for Standardization and Quality Control and the CNG programme in 2002.

(iii) ***Standards relating to transport practices***: Standards in this category are established in order to moderate the growth of road traffic and the environmental impacts of transport activity. They include: fuel pricing, regulations favouring clean fuels; regulations for retiring old and/or polluting cars; regulations restricting the import of cars that are highly polluting and/or consume fuel at an excessive rate; regulations restricting vehicle use and ownership; regulations relating to road and traffic taxes; and regulations relating to driver instruction. Many such Arab countries as GCC countries, Egypt, Iraq, Jordan, Lebanon, the Sudan, Syrian Arab Republic and Yemen achieved remarkable progress issuing standards and regulations on transport practices, but these standards and regulations need revision, updating and activation.

(iii) a. *Improving vehicle maintenance and implementing inspection programmes*

In many Arab countries, vehicle efficiency is low and specific fuel consumption is high. Regular

maintenance, inspection, and tuning can improve fuel consumption and deliver such other benefits as reducing exhaust emissions, optimizing fuel efficiency, extending vehicle life, increasing vehicle resale value, and reducing running costs. It is not unusual to find that more than 70 per cent of the light-duty vehicle fleet in a developing country does not receive regular maintenance or diagnostic testing, and has an average age of about 15 years. In certain cases, the most technically advanced testing and repair programmes can reduce air pollution by as much as 30 per cent.

(iii) b. *Replacement of old vehicles with new ones*

Wear and tear makes vehicles more polluting and less roadworthy over time. Older vehicles are more likely to break down on the road, causing congestion and posing a danger to other road users. In Arab countries, replacement of old vehicles would impose a heavy economic burden, making implementation very difficult. Therefore, it is recommended that Governments take appropriate measures, especially incentives, to encourage car owners to replace old vehicles with new ones. Since Arab countries import most of their vehicles, it will be necessary to modify their importing specifications in order to introduce vehicles of better quality and with low emission engines to replace older ones. However, this would have a major economic cost and need long-term plans.

(iii) c. Vehicle *emissions testing and tuning*

Many Arab countries (e.g. Egypt, Jordan, Kuwait, Lebanon, Saudi Arabia and the Syrian Arab Republic) established regular vehicle emission testing (VET) programmes. The programme of Egypt, for example, was applied on 13,000 vehicles in Cairo in 1999 and revealed that 66 per cent complied with national emission standards and 34 per cent did not comply. It is estimated that the average emission reduction due to emissions tuning would be 62 per cent for CO and 35 per cent for HC, while fuel saving would be about 15 per cent.

(iii) b. *Noise pollution*

In the Arab region, noise from traffic has not yet been considered as a major environmental problem that deserves strict measures. Furthermore, there are no fully satisfactory means to measure noise and the nuisance it causes. However, with the increasing dependence on road transportation and the subsequent rise in the number of operating vehicles, noise pollution will definitely require more attention and regulatory steps. Limited Arab countries such as Egypt and Lebanon have certain regulations related to noise intensity limitation.

Finally, there have been initiatives with regard to more environmentally-friendly transport of refrigerated foods (UNECE, 2012) as well as to establish freight transport corridors for vehicles using compressed natural gas instead of diesel because of the economic and environmental advantages (the Blue Corridor Project)[167].

A global project *For Future Inland Transport Systems (ForFITS)*

This UNDA project led by UNECE involves all five UN Regional Commissions. The aim of project activities was to develop a decision making support tool for mitigating climate change impacts by

[167] See http://www.bluecorridor.org/

helping to assess a country's CO_2 emissions from inland transport. ForFITS has a dual function. It helps building CO_2 safe scenarios and includes a policy converter thus assisting governments in assessing the potential impacts on CO_2 emissions of various policy options before they actually implement them[168].

Five capacity building workshops were carried out, one in each of the 5 UN regional commissions, during 2013 to raise awareness and disseminate technical knowledge for using the tool. During the regional workshops, at least one regional pilot case study was developed for selected countries of the workshop hosting region.

ForFITS was developed as a software tool allowing for the evaluation of transport activity, energy use, and CO2 emissions in a range of possible policy contexts. It is suitable for the analysis of transport systems having a regional, national and/or local dimension, with a primary focus on national systems. The ForFits tool is an open access software platform that can be downloaded at http://www.unece.org/trans/theme_forfits.html, along with its detailed user manual and pilot case studies.

7.4.2 Environmental impacts on transport

Although climate change impacts on various human activities have been considered by both governments and international organizations for some time now, relatively little attention has been paid to the assessment of climate change impacts on transport infrastructure and operations as well as on potential adaptation measures. However, recent work undertaken by Governments, International Organizations as well as the transport industry has shown that climate change–induced weather conditions may have very significant implications for transport (UNECE, 2013), and, thus, for the sustainability of the global and regional economy and livelihood.

There is no globalization without efficient transport networks and services. Efficiency can be better achieved by the optimal combination of various transport modes within the transport chains, which will promote technical innovation and a shift towards the most sustainable, energy efficient and least polluting modes of transport[169]. At the same time, sustainable transport strategies should certainly consider the very significant impacts that climate change and variability may have on transport infrastructure/services, and plan for effective adaptation measures.

Adaptation measures aim to reduce vulnerabilities and increase the resilience[170] of transport systems to climatic impacts. It must be noted that adaptation to climate change does not involve

[168] See http://www.unece.org/trans/theme_forfits.html

[169] Emissions for freight by transport mode (in kg CO_2 per ton times km): Road transport (> 35 t lorries) 0.051-0.091; diesel trains 0.017-0.069, electric trains 0.019-0.040; bulk carriers 0.0025-0.008, container ships (< 8000 TEU) 0.013-0.020; Ro-Ro vessels, 0.050-0.060; air long haul transport (> 1600 km) 0.57-0.63 (Crist, 2012, see also http://www.airportwatch.org.uk/?page_id=3262 (accessed 17.08/2013)). Emissions for passengers by mode (in kg CO_2 per passenger for each km): Passenger cars 0.124, two wheelers 0.083, city buses 0.067, coaches 0.034; rail transport 0.045; maritime transport 0.043; air transport 0.130 (http://knowledge.allianz.com/mobility/transportation_safety/?813/which-transport-methods-produce-most-emissions, accessed 17/08/2013).

[170] Resilience refers to the ability of a system to withstand negative environmental impacts without losing its basic functions. In the transport context, resilience does not only concern the physical robustness and

only managing risks; it may also offer opportunities to develop innovative transport infrastructure systems and services. Most of the present transport infrastructure has been developed under national policy regimes. There are several factors that determine national and regional adaptation options, including amongst others risk assessments and short, mid- and long-term financial implications. To identify priorities for climate change adaptation, facilities must be first classified in terms of their criticality within the transport network and according to the difficulties and costs involved to make them climate resilient (e.g. USDOT, 2012). At the same time, adaptation options will rely on financing, the availability of which from public, 'hybrid' or private entities may prove to be an important determinant of the adaptation policy approaches.

A necessary prerequisite for the development and formulation of effective climate change adaptation strategies should be a clear understanding and systematic mapping of the transport sector vulnerabilities to climate change. These are determined by 3 main factors: the nature and the extent of climate change, the transport system sensitivity and the required capacity to adapt to changes. It appears therefore that concrete steps should be made by Governments, in collaboration with owners and operators of transport infrastructure and International Organizations to: (i) establish inventories of critical and sensitive nodes of the transport infrastructure and supply chains; (ii) incorporate climate change effects into the long-term capital improvement plans, facility designs and engineering practices, operations and emergency response plans; (iii) promote necessary institutional and regulatory adaptation; (iv) incorporate climate change adaptation measures into integrated natural hazard management frameworks and (v) create national and international databases of digitized network data, disruption hotspots and incidents, management and maintenance plans and asset management practices that could eventually form the core of an efficient natural hazard management system for the transport sector.

With regard to practices in transport adaptation measures these obviously depend on the transport mode. Roads face major threats from prolonged rainfall and downpours, floods, heat waves, droughts, snow and frost, extreme winds and fogs and, in the coastal areas, from storm surges. Railways also face major threats from storm surges in coastal and estuarine settings, downpours, floods, heat waves, snowfall, extreme winds, and high humidity that can affect trackside equipment. Rail terminals may be also vulnerable to floods, droughts and extreme temperatures, whereas underground railways in coastal areas may be also vulnerable to storm surge and/or river flooding. Finally, inland waterway transport can be affected by both river floods and droughts. Therefore, different approaches should be taken which should also take into consideration national and/or regional particularities and regulatory frameworks as well as financial constraints [171].

durability of infrastructure, but also the ability of the transport system to recover from an incident quickly and at minimal cost.

[171] In a forthcoming, UNECE report 'Climate Change Impacts and Adaptation for International Transport Networks', Inland Transport Committee Expert Group, United Nations Economic Commission for Europe ECE/TRANS/238 221 pp. http://www.unece.org/trans/main/itc/itc_inf_76.html (in press)) a range of best practices in adaptation measures that will promote transport sustainability can be found.

8. Modality in inland transport

Economic, social and environmental sustainability can only be achieved through an integrated transport system. When water, road and rail transport work together, the comparative advantage of each mode can be exploited optimally. For example, containerization, which allows for multi-modal transportation of goods, has enabled stakeholders to benefit from the respective advantages of different modes of transport. Integration of transport systems is a complex task with many dimensions.

The optimal modal split of freight and passenger transport depends on countries geographic, demographic, economic and historic conditions. Cooperation across transport modes, regions and borders as well as between public and private operators is needed. Creating an efficient integrated transport network requires international cooperation for which the United Nations regional economic and social commissions can provide a convenient framework.

8.1 Trends in freight and passenger transport

Each of the transport modes has comparative advantages. Therefore, it is important to note that there is no optimal modal split which can serve all requirements. Different modes can have economic, environmental and/or operational advantages in different occasions. For example, although rail transport certainly has environmental advantages over road transport for both passengers and freight (Fig. 8.1), there could be other considerations that could determine transport mode choices, such as costs, convenience and operational advantages. Road transport, although less environmentally friendly, can also provide increased accessibility for individuals and freights as well as be more economical for low volume freights.

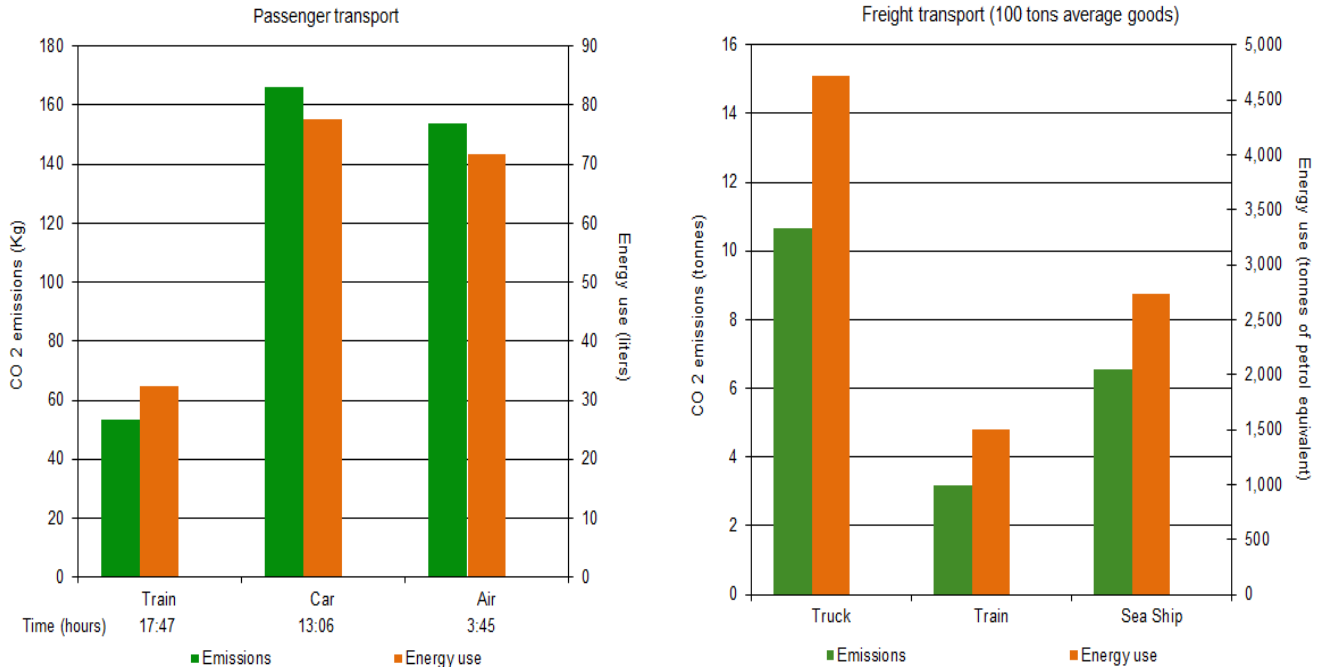


Fig. 8.1 Energy use and CO2 emissions across the transport alternatives for the Berlin-Rome route for (a) passenger (www.ecopassenger.orgU) and freight (www.ecotransit.orgU) transport (UNECE, 2012). Calculations include transport to and from airports, as well as intermodal transfers for train and maritime transport.

8.1.1 Freight transport

Each of the different modes provides freight transportation options that have both advantages and disadvantages in terms of speed, reliability, accessibility, affordability, safety and security. In addition, capacity, cost, and service differences, combined with economic competition, compel each mode to target particular market niches. Consequently, road and air transport are generally used for high-value and low volume/weight freight that is also more time-sensitive, whereas the rail and inland waterway modes usually move lower-value, higher volume/weight and less time-sensitive freights.

ECE region

The relative importance of road freight transport, as a share of total inland freight transport in the EU, was mostly unchanged between 2002 and 2012. As the share of inland freight carried by road remained just above three quarters of the total, the share carried by rail was also relatively unchanged over the most recent decade, while during the same period there was a modest increase in the relative share of inland waterways freight transport.

European Union freight transport		
modal split in %	2002	2012
Railways	18.3	18.2
Roads	75.5	75.1
Inland waterways	6.2	6.7

Particularly large increases in the share of freight transported by road (2002–12) were recorded in Estonia and several eastern EU Member States: the share of road transport in Estonia increased by 22.7%, while double-digit growth rates were also recorded for Poland (19.3%), Slovakia (18.9%), Slovenia (12.1%) and Bulgaria (11.8%). On the other hand, the share of inland road freight transport decreased in 11 EU Member States between 2002 and 2012, most notably in Belgium (-19.2%) and Austria (-11.2%). In most of the EU Member States the change in the share of freight transported by road was accompanied by a similar and opposite change in the share transported by rail, while Romania, Belgium and Bulgaria recorded substantial increases in domestic shares of inland freight transported by inland waterways.

Inland freight transport grew at a slower pace in the EU than constant price gross domestic product (GDP) during the period from 2000–2012. The index of inland freight transport relative to GDP peaked in 2007 (105.4), and it was consistently above 100 during the period 2004–2008, indicating that inland freight transport had increased more rapidly than GDP between 2000 and 2004. With the onset of the global financial and economic crisis, the index fell sharply in 2009 (as the decline in constant price GDP outweighed the reduction in the quantity of freight transported). Thereafter, the index of inland freight transport relative to GDP followed a fluctuating development through to 2012.

Figure 8.2 below shows the modal split of freight transport in 45 UNECE Member States. In most countries, inland freight transport appears to be dominated by road transport, whereas in Canada, the Russian Federation and the United States rail takes a more prominent role in transporting goods. The large distances to be covered in these states as well as the need to move large freights of high volume/low value (e.g. commodities) in these countries may explain these trends. It should be also noted that for some countries (e.g. the Netherlands, Romania and Belgium) inland waterway transportation can be a very significant.

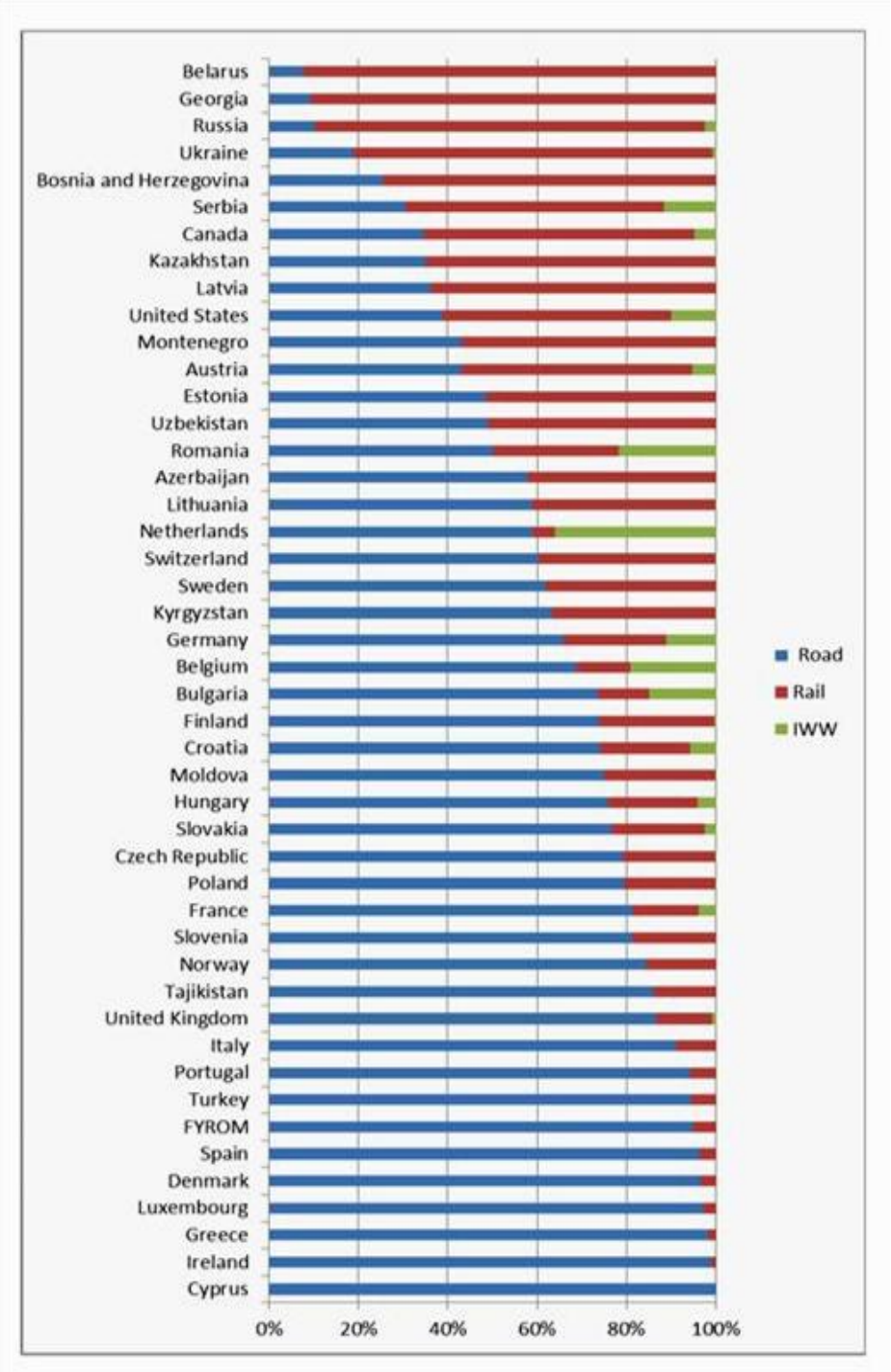


Fig. 8.2 Modal split of inland freight transport in the ECE region in 2011 (or latest available) Percentages are estimated on the basis of the total freight transport in million tonne-km.

In 2012 (estimate figures), 19.65 billion tons of goods were moved within the United States, generating near 6 trillion ton-miles of transport, with a value approaching $ 17.4 trillion (FHWA, 2013). Road transport (trucks) accounted for about 67% of all freight tonnage, 45% of all ton-miles and 64% of freight value. In comparison, rail transport accounted for only 10% of tonnage moved, but about 29 % of ton-miles, and 3.1 % of total value; this reflects the cost-effectiveness of rail in transporting heavier commodities (e.g. coal and grain), but of lower-value, over long distances.

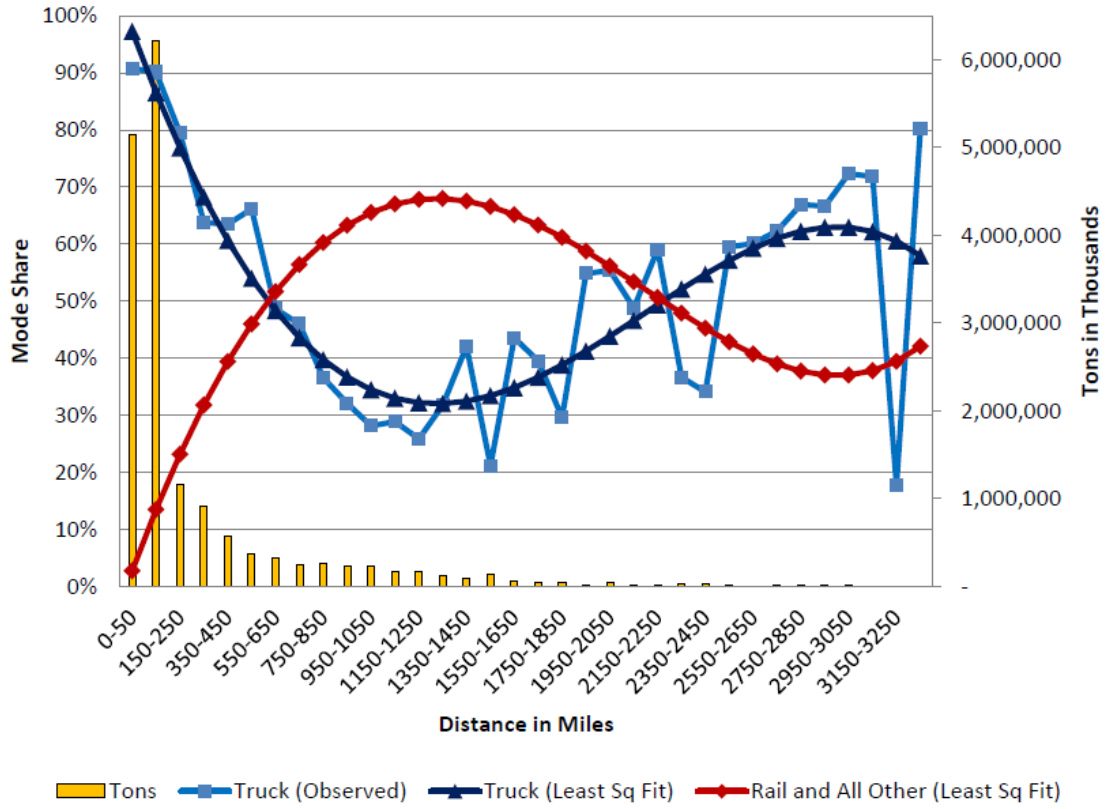


Fig.8.3 Freight modal share, and freight transport weight by distance, USA-2007. Note: Lines represent the least squares fits (Brogan et al., 2013).

In terms of distance, in 2007 road transport dominated the market for shipments under 550 miles, which account for almost 80% of all domestic freight tonnage. Figure 8.3 compares modal shares in tons by shipment distance for road and rail and other inland transport modes (2007 data). The amount of tonnage moving distances of 500-1500 miles is much smaller than the amount being moved less than 500 miles. Therefore, although there is a potential to shift some of the longer distance freight from road to rail or water, the small volumes of freight to be transported over 500 miles limits this potential (Brogan et al, 2013).

ECLAC region

The value of intra-regional trade among South American countries in 2010 represented nearly a quarter of total trade realized by the countries (ECLAC, 2013). Only a subset of countries collest and publish statistics on the modal split in the transport of goods. Intra-regional trade in South America is almost exclusively dependent on maritime and road transport modes. This trend has been stable during the period 2000-2010. Road transport was the dominant inland transport mode in terms of both freight volume and value of import and export operations, amounting respectively to 34.64% and 41.75% of total trade in 2010 (ECLAC International Transport Database). Rail and inland waterway transport represent only a fraction of intraregional trade during the same year, namely 1.3% and 1% of volume and 0.7% and 0.4% of value respectively.

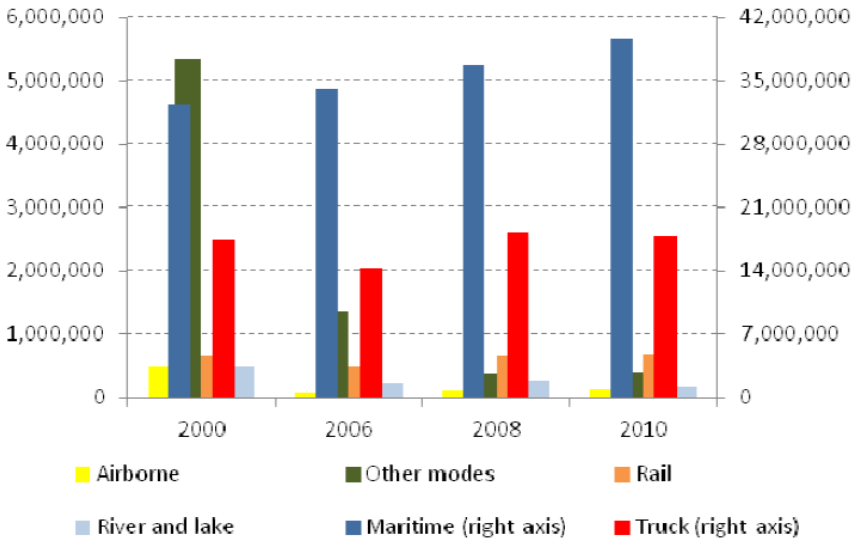


*Fig.8.4 Transport modal split within South American countries (hundred thousand tons) (*ECLAC International Transport Database*).*

ESCAP region

One of the key policy challenges for sustainable transport development in the ESCAP region is to increase the modal share of "greener" modes of transport such as railways and waterways through the increased use of multimodal transport in the context of an integrated transport networks. Figure 8.4 illustrates the freight modal split of China and Thailand and indicates that road transport has a major share of total tons of freight carried in these countries. The figure also shows a slight growth of freight carried by inland waterways in the two countries.

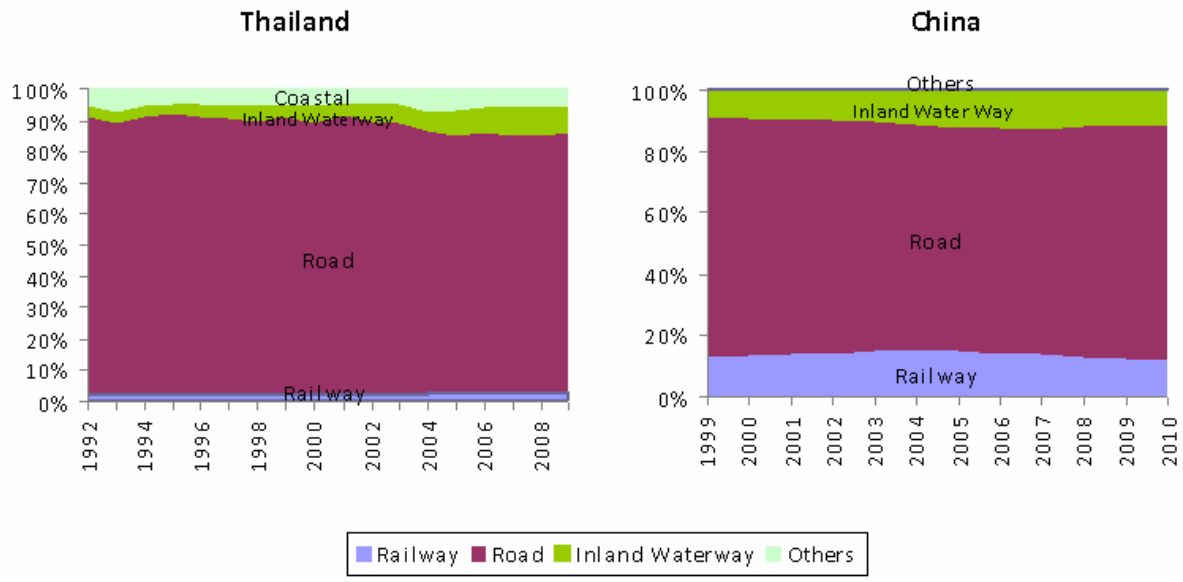


Fig.8.5 Modal share of freight transport volume in Thailand and China (ESCAP, 2011).

Considering freight transportation in tonne-kilometres, total freight in China was 11,030 billion tonne-km in 2009, of which highways accounted for 30 per cent, railway 21 per cent and water transport 47 per cent. In India total freight was 1,410 billion tonne-kilometres in fiscal year 2007/8, of which road accounted for 50 per cent, railway 36 per cent and water transport 6 per cent (ESCAP, 2011).

ESCWA region

It is estimated that around 85% of trade among the countries of the Arab region is transported through inland transportation means. Geographic proximity and weakness of other modes of transport such as maritime and rails make it the most preferred means for trade in the region. Only 5 percent of total weight transported in the Arab region was sent by rail in the 1990s, and this dropped further to 2.4 percent in 2005[172].

8.1.2 Passenger transport

Private motorisation (cars) generally dominates inland passenger transport. In the ECE region, this domination has been, more or less, universal[173] and rather consistent, as in the period 1999–2008 the modal shares of private passenger cars, buses/coaches and railways have been, more or less, stable. In most European countries, bus/coach transport constitutes less than 15 % of the total passenger transport, whereas in Canada and the United States bus/coach transport is less, as passengers prefer more private motorization; in the United States more than 90 % of all inland passenger transport is by private car (UNECE, 2012).

In the EU, the private car share of passenger transport was about 83.3 % in 2008, being slightly higher than its share in 2000 (83.1 %); there has been no indication of a shift towards more environmentally friendly modes[174]. At the same period, GDP growth (about 2.0 % per year) exceeded the growth of passenger transport volumes (1.1 %), signifying a potential 'decoupling' effect; nevertheless, this decoupling could have also been a consequence of the economic crisis (as in the freight transport) than a sign of a sustainable trend.

In urban areas, public transport (usually by buses and/or electrified rail) plays a much more important role. As discussed in Chapters 3 and 4, accessible and affordable mass public transport is important not only for the management of traffic congestion and environmental reasons, particularly in the growing cities in emerging economies (Wang and Yuan, 2013; Chee and Fernandez, 2013), but also for the economic and social inclusion of the low-income households, the elderly and people with special needs (e.g. Lucas, 2010). Nevertheless, although overall passenger transport has been increasing over the past few decades, the mass public transport share has been declining. For example, in Latvia public transport usage has declined by about 60 % since the early 1990s and in Russian Federation by 50 % (UNECE, 2012).

[172] E/ESCWA/SDPD/2009/WP.1. TRANSPORT FOR SUSTAINABLE DEVELOPMENT IN THE ARAB REGION: MEASURES, PROGRESS ACHIEVED, CHALLENGES AND POLICY FRAMEWORK.

[173] In Russian Federation rail is quite important for passenger transport as rail has close to 50% of the passenger transport

[174] See http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Sustainable_development_-_transport

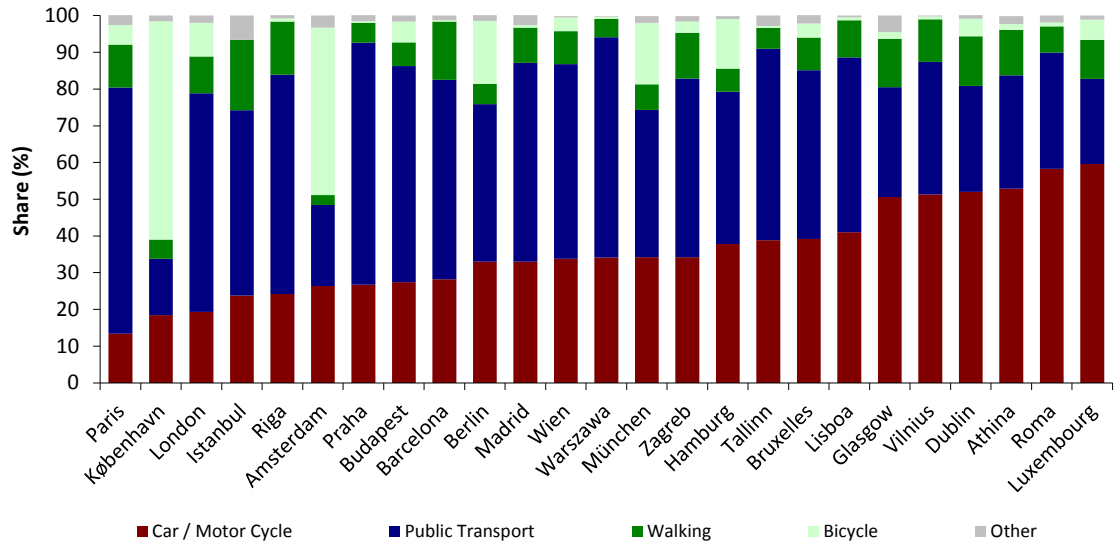


Fig.8.6 Modal split for transport to work/training in selected European cities in 2009 (UNECE, 2012)

Nevertheless, economic and environmental reasons, traffic congestion as well as particular policies aiming at constraining private motorization in urban areas have resulted in the uptake of alternative modes of transport in many European cities (Fig. 8.6). These results indicate that urban public transport shares depend on many factors, with the most dominant being the availability of effective transport systems as well as targeted policies (e.g. congestions charges); this may explain why 67 % of all passengers in Paris use public transport whereas, in Luxemburg, only about 20%. Copenhagen leads by far when it comes to use alternative transport modes, as about 60 % of transport is by bicycle.

In the cities of Latin America, public transport is still the predominant mode of urban transport. In 2007 in the main fifteen cities of the region, the public transport was used – in average - by 43 percent of the users in their daily travels, while only 26 % used private transport, according to the data of the American Development Bank (2010), "Observatorio de movilidad urbana para América Latina", CAF, Caracas, Venezuela, http//omu.caf.com/). More recent data, compiled by ECLAC based on the national statistics, confirms the continuing predominance of the public transport.

Table 8.1 Modal split in the transport of passengers, selected Latin American Cities, 2010[175]

	Bogotá	Buenos Aires	La Paz	Lima	Montevideo	Quito	Santiago
Collective motorized transport	57	40	75	53	54	51	36
Individual motorized transport	25	51	15	21	19	29	27
Walking and cycling	18	9	10	26	27	20	37

Nevertheless, in most cases the quality of the public transport together with ever increasing motorization in the Latin American cities suggests that this prima facie sustainable modal split in the passenger transport may not be maintained in the long run. Moreover, the high externalities generated by the existing public transport systems in the region, in terms of their environmental

[175] Source: Survey FTSUNCRD / BID 2011 and CELADE/ECLAC

impact, in particular, mean that, even with the predominant use of public transport, the sustainability of the urban transport in the region has not been achieved.

The average modal split in urban agglomerations varies across countries and regions due to factors such as development of road infrastructure, GDP per capita, availability of accessibility to public transport as well as existing transport policies in cities. In its resent study the ITF estimated modal shares in urban transport in Latin American, Indian and Chinese cities, and developed 2050 projections based on a variety of policy scenarios, forecasting in accordance with the 2010 baseline passenger-kilometre modal split data (Fig.8.7). Currently public transport share in passenger transport in the observed countries constitutes between 32% and 49%.

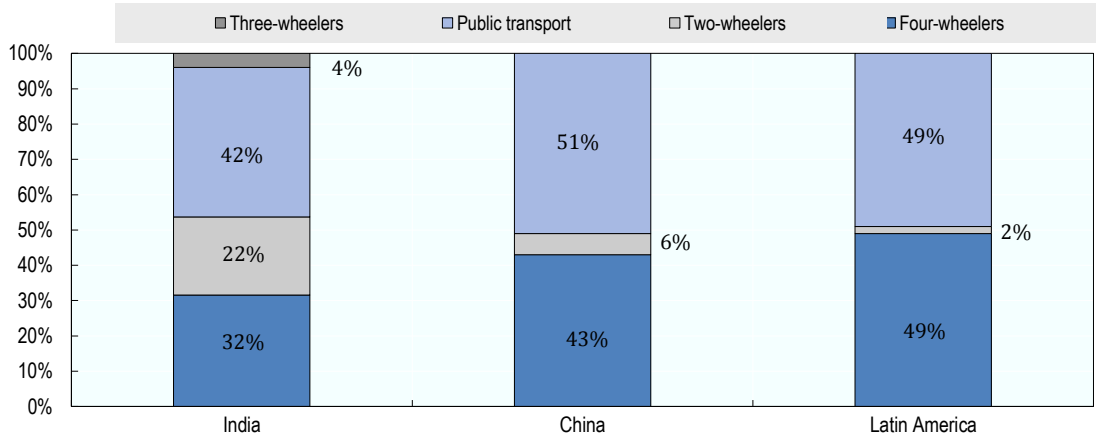


Fig.8.7 Transport modal split in cities in Latin America, China and India (ITF, 2014)

However, in accordance with the projections based on considered scenarios in the development of urban infrastructure, GDP growth and public policies, private four-wheeler motorization levels are forecast to reach 40-67% in India, 55-78% in China and up to 88% in Latin America, while respective public transportation shares in passenger-kilometres are projected to be between 11% and 39%, 9% and 34% and 11% and 50% in 2050.

8.1.3 Modal shifts and intermodal transport

Shifts of freight traffic, wherever possible, from roads to railways and inland waterways would be very beneficial, as they will free up road capacity, tackle congestion and achieve a better carbon footprint for inland land transport. However, for most transport operations road transport is indispensable to ensure door-to-door transport, particularly for consumer products. It should be always kept in mind that different transport modes offer different services, this constrains opportunities for shifting freight from one mode to another.

Certain policies (i.e., fuel taxes, investments that reduce modal travel times and costs associated with more stringent environmental regulation) can affect the pricing of the different transport modes. Nevertheless, recent elasticity studies (Brogan et al., 2013) have indicated a high level of uncertainty in the modal shifting potential in response to price, suggesting that the effectiveness of modal shifting policies will vary by goods and by market. It appears that although opportunities for transport modal shifts may exist, not all freight can be moved effectively by all modes. Nevertheless, the best opportunities for modal shifts in freight transport can be between road (trucks) and rail intermodal services (Fig. 8.8).

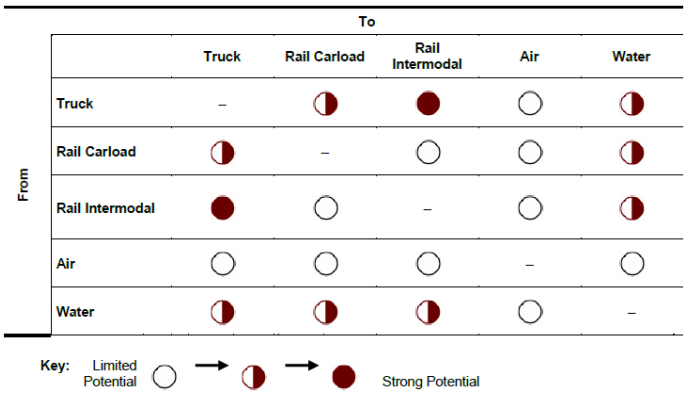


Fig. 8.8 Freight modal shift potential (Brogan et al., 2013).

Another factor limiting the potential for large-scale shifts among freight modes is the demand growth in different freights. In the USA, projections for the 2040 indicate show growth in the overall freight movement (66% by weight and 145% by value between 2009 and 2040), but declining market shares for non-road (truck) modes (FHWA 2012). Road transport share has been projected to increase by weight but to decline by value and rail and inland waterway transport shares to decline by both weight and value; in comparison, air transport share is projected to increase marginally by weight but quite considerably (8–16) % by value. These changes in modal share may be due to (i) qualitative changes in freight i.e. a movement from low value/large weight freight to high value/lighter weight freight, and (ii) shifts in the economic geography of the United States of America that may reduce the haul distances of many shipments. It should be noted, that such modal shifts may have significant implications for (fossil) fuel use and GHG emissions, as well as for traffic congestion.

Rail and inland waterway transport often entails trans-shipment operations using containers and other intermodal transport units that can be shifted swiftly and safely from one mode to the other. Nevertheless, integration of transport systems is a complex exercise at many levels; cooperation across transport modes, regions and borders as well as transfers between public and private operators is required. The objective of improving modal split is to integrate the transport system so that each mode is used in an optimal manner and to take benefits from economies of scale. The optimal modal split of freight and passenger transport depends also on a country's geographic, demographic, economic and historic conditions.

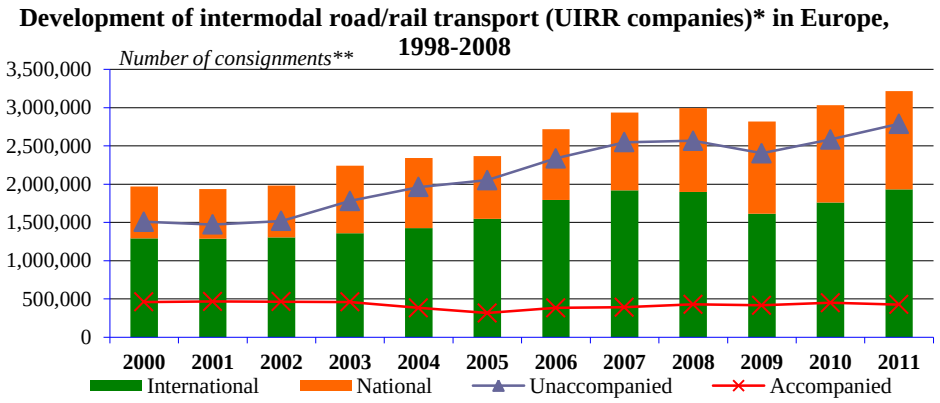


Fig. 8.9 Development of intermodal road/trail transport in Europe 2000-2011. Source: UIRR: International Union of Combined Road/Rail Transport Companies;** One consignment is equivalent to two (2) twenty-foot units (TEU)*

The development in intermodal road/rail transport in Europe is illustrated on Fig 8.9. It shows that 2009 was the first year since 2001 when the total amount of combined transport declined compared to the previous year. Total combined transport was reduced by 17 % in 2009 to 5 million TEU, compared to 6 million in 2008 as a result of the 2008-2009 financial crises. International combined transport declined slightly less (16 %) than national combined transport (18 %). The major part of the decline was associated with unaccompanied transport, which experienced a reduction of 19 %. Accompanied combined transport was reduced by only 3 % in 2009 compared to 2008. The average annual growth in combined transport from 2000 to 2011 was 5 %, with a drop of about 6 % cent in 2009. Combined transport grew rapidly from 2002 to 2007 with an average annual growth rate of 11 %.

Major modal shifts are unlikely without substantial changes in costs/pricing or strong regulatory measures. Road-to-rail modal shifts have the greatest overall potential for energy reduction, as trucks are the dominant mode in terms of freight tonnage and value and rail can serve many of the same routes, using substantially less energy taking advantage of economies of scale.

8.2 Challenges and best practices

8.2.1 Freight transport

The present modal share in freight transport has developed in accordance with technological improvements, economic and demographic conditions, and the regulatory framework. Future modal shifts will be dependent on changes in the underlying drivers of modal choice, such as logistical constraints, time sensitivity of shipments, and quality of flows. It is expected that the energy efficiency of transportation could be improved, especially in urban areas, but shifting the transport of longer haul freight from one mode to another has a relatively small potential to reduce energy use.

Freight transportation markets match service needs to modal characteristics. Road, rail, water and air transport offer different advantages/disadvantages in speed, reliability, accessibility, affordability, security, and safety. These differences mean that, while modes do compete, they are also complementary, since each mode targets the commodities and markets that it serves most effectively. Higher-value, lower-weight, and more time-sensitive freight generally uses road (and air) modes, whereas low value, large weight and less time-sensitive freight uses rail and inland waterway transport. Service differentiation limits the potential of modal shifting, as different modes are not perfect substitutes for one another. Road to rail modal shifts appear to have the greatest overall potential for energy reduction, because trucks are the dominant mode in terms of freight tonnage and freight commodity value, while rail serves many of the same routes and uses substantially less energy.

It appears that major modal shifts are unlikely without substantial changes in costs/pricing, strong regulatory measures and, in some cases, changes in the governance structure. Policy measures that may affect transport mode choices include economic instruments (e.g. fuel taxes, congestion and/or emission charges), labour and safety regulations and investments in infrastructure and service improvement.

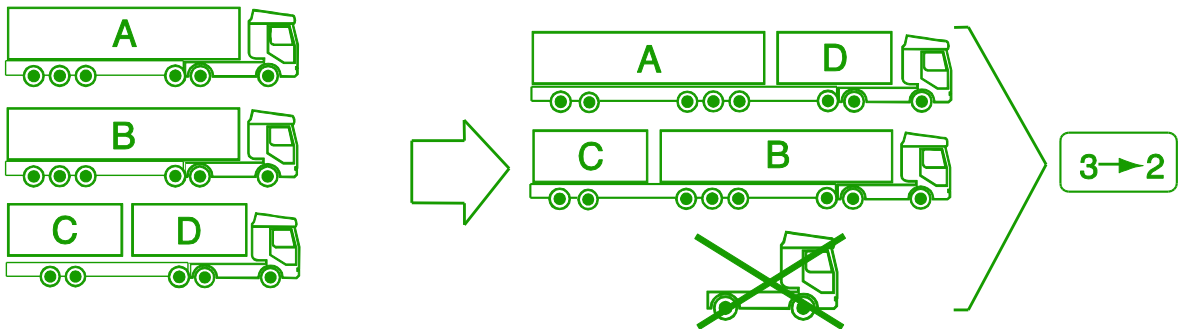
Under the present economic climate, public sector investment in e.g. the rail industry is small, with much of it focused on upgrading short line railroad track serving local industries. It may require a radical increase in rail investment to reduce prices and improve services, allowing rail to increase its market share. For example, a study of a $12 billion investment program for a Norfolk rail corridor in Virginia (USA) determined that the project could transfer to rail about 17 % of road freight hauls longer than 500 miles and 6 % of all road freight hauls (Brogan et al., 2013).

Modular Concept: Moving more with less

The Modular Concept – or eco-combi - is a key contributor to improving the environmental performance of road freight transport and further developing intermodal transport. It offers an optimal transport solution by offering longer vehicle combinations whenever possible (e.g. long haul transport) and shorter combinations wherever necessary (e.g. urban deliveries).

In countries where such eco-combis are allowed, they contribute significantly to road transport and energy efficiency, as well as environmental performance, by matching transport offer with volume and infrastructure demand, while moving a greater amount of goods using fewer tractors. As such, they can cut fuel consumption and thus the carbon footprint by up to 30% and also reduce overall costs for the entire transport chain - making it more sustainable.

With standardised loading units, using eco-combis can also facilitate intermodal transport operations, as swap bodies and containers are easy to transfer from one mode to another, thus considerably increasing interoperability. The challenge is now to allow the cross-border operation of these vehicles and agree on standardised weights and dimensions to move towards fully integrated intermodal transport networks.



There have been many national initiatives to increase freight transport inter-modality. For example, Austria has committed public funding for intermodal terminals and infrastructure and introduced subsidies for transport across the Alps and possible reimbursements of vehicle taxes

for road vehicles used in intermodal transport. In addition, Austria ban on the use of heavy road vehicles on Saturday evenings and Sundays, is lifted if vehicles are part of an intermodal transport chain. There are similar strategies for the promotion of intermodal transportation in other countries (e.g. Croatia and Switzerland[176]).

The Seine-Nord Europe Canal project implemented by "*Voies Navigables de France"* will remedy one of the major missing links within European inland waterways by connecting the Seine basin, with its high-traffic capacity, and the rest of the European network of inland waterways of international importance. The canal will connect seven major ports in the north of Europe (Havre, Rouen, Dunkirk, Ghent, Zeebrugge, Antwerp and Rotterdam), raising their competitiveness in the context of growing maritime traffic. Finally, the canal will offer four multimodal platforms, whose loading/unloading, storage and transhipment capacities will enable the integration of rail and water traffic in the global logistics chain (UNECE, 2012).

8.1.2 Passenger transport

With regard to passenger transport in urban areas**,** EuroTest[177] has evaluated the quality of mass public transport in 23 European cities (see also UNECE, 2012). Twelve of these cities (amongst them Paris, Brussels, Amsterdam, London and Oslo) were assessed to have acceptable levels of public transport, on the basis of travel time, efficiency of the transfer between transport modes, information and ticketing. However, almost half of all examined cities performed modestly or poorly, with user information being an issue in most cities.

The Czech Republic has defined targets for its passenger transport system in the document *Transport Policy for the Czech Republic 2005-2013*[178]. It includes specific targets for both freight and passenger transport [179]. At least 50 % of all municipalities should be in an integrated passenger transport system by 2013, split between private and public passenger transport should be maintained and the use of rail for passenger transport in urban areas should be increased. Sweden aims to double public transport by 2020 compared to 2006. Austria introduced a national cycling strategy in 2006 ('Masterplan Radfahren') that aims to double the share of cycling from 5 to 10 %. The plan involves investment in cycling infrastructure; free cycling consultations; bike2business awards for cycling friendly companies, cyclist competition, and introduction of cycling coordination in national agencies. In Belgium, firms with more than 100 employees are obliged to survey the means employees use to travel to work every 3 years and consider measures to improve sustainable transport; This allows for the identification of solutions to environmentally unsustainable travel habits. In Moscow, a traffic management system called START was introduced to increase the capacity of the city's roads. A computer collects data from traffic detectors and optimizes traffic lights for the entire network. The system also includes observations through video cameras and dynamic traffic signs as a way to communicate with drivers. The estimated impact of the system is an increase in road capacity of about 10–12 % (UNECE, 2012).

[176] Information provided by Croatia in the questionnaire on Transport for Sustainable Development, December 2010.
[177] See: www.eurotestmobility.com
[178] See http://www.mdcr.cz/en/Strategy/Transportation+Policy+for+2005+%e2%80%93+2013/default.htm
[179] According to the information given by the Czech Republic in the questionnaire on Transport for Sustainable Development, December 2010.

Modal shits can be driven environmental policies and regulations[180]. For, example, Freiburg has been known as Germany's ecological capital since the 1970s. The old town centre became car free in 1973 and public transport is paid by a low-cost monthly fee. About one third of the population has chosen to live without a car and due to a 1970 cycling plan, there are now more than 500 km of cycle paths in the city. The plan aims at giving communities incentives and tools for sustainable energy policies[181].

Buses and coaches

a Smart Move for sustainable mobility and development

Initiated by the IRU and Busworld, Smart Move is a long-term awareness and advocacy campaign that aims to provide policy and opinion makers with accurate and reliable facts and figures, to ensure informed legislation and induce policies for doubling the use of buses and coaches.

Placing buses and coaches at the centre of the political debate and facilitating their use is the smartest way to achieve sustainable mobility for all. Buses and coaches are the backbone of a safe, environmentally-friendly, affordable, user-friendly and efficient public transport system. As such, they constitute an optimal response to current and future mobility and travel challenges.

The campaign also uses strong arguments to encourage citizens to switch from private cars to collective passenger transport whenever possible. By documenting and advocating the implementation of policies that support, promote and incentivise a greater use of bus and coach transport at local, national, regional and global level, hundreds of millions of cars can be taken off the road, thus dramatically contributing to carbon reduction targets of governments worldwide.

In Europe alone, achieving the Smart Move objective and doubling the use of bus and coach transport would:

- reduce CO_2 emissions by at least 50 million tonnes per year;
- reduce road fatalities by over 3,000 per year;
- cut congestion in cities at zero cost for taxpayers subsequent to an estimated 10-15% reduction in car traffic;
- create 4 million new jobs.

Other examples of good practices in modal shifts in urban transport include Strasbourg (France), the Jubilee Line extension in London (UK), the Metro tram in Volgograd (Russian Federation) and the The Marmaray project in Istanbul (Turkey) (for more details see UNECE, 2012). In Canada, a database of policies implemented in Canadian communities to promote sustainable development in urban transport has been created[182]; more than 60 examples of best practices are included in the database, with a description of project results, costs and policy context.

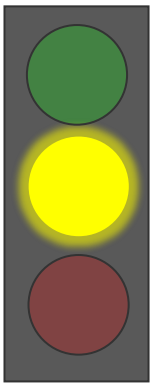
[180] See e.g. the The European Energy Award initiative www.european-energy-award.org
[181] http://www.c40.org
[182] See also the website at http://www.ec.gc.ca/financement-funding/svgs/search_results_e.cfm?action=details&id=314&start_row=1&all_records_details=fund&type_of_funder=Federal

9. Sustainable development: the current situation and the way forward

Transport is an essential component of sustainable development. Its sustainability is controlled by socio-economic, demographic and environmental megatrends, i.e. major shifts in economic, social and environmental conditions that can impact people at all levels and transform societies. The present economic growth, which has been associated with a 'reversed' geographical fragmentation of production, has created particular transport patterns such as increasing transport volumes mostly in the non-OECD regions. At the same time, the significant changes in global population size, age structure, household size and urbanization expected for the 21st century may have substantial implications for inland transport, in terms of transport patterns, energy use and Greenhouse Gas (GHG) emissions. These will be further complicated by the mounting effects of climate change and variability on the transport infrastructure and services.

9.1 Verdict - the current situation

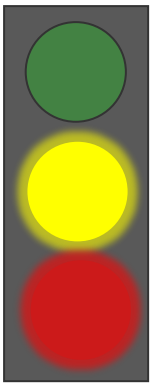
Transport accessibility for individuals/households



The highest density of roads is found in the developed countries, with certain industrializing countries (e.g. China) catching up rapidly. Nevertheless, the data also show that road density reflects also the physiography and demography, as well as various other factors related to social and economic development. In rural areas, estimates have shown that about 900 million of rural dwellers do not have adequate access to the transport system, with the situation being worse in the developing countries and, particularly, the countries of South Asia and those of the Sub-Saharan Africa; this can have negative impacts on major development goals, such as poverty reduction.

Urban areas also pose transport challenges, due to the ever-increasing transport needs and to their already intensive land-use that constrains further transport infrastructure development. Increased urbanization may lead to traffic congestion and, thus, increased air pollution, traffic noise and nuisance as well as to a scarcity of parking spaces. The mobility of groups with special needs can also be challenging; children and young individuals, as well as elderly and/or disabled individuals have specific transport requirements, the absence of which can affect their access to economic, cultural and social activities and health institutions.

Transport accessibility to international markets

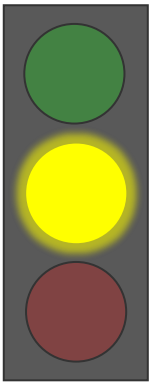


Participation in global supply chains is essential for attracting foreign investment and enterprises as well as human capital. Foreign trade, which is particularly important for small and land-locked economies, is dependent on hinterland and/or sea connections and border crossings. Currently, total foreign trade appears to be the dominant economic activity for many countries in which domestic production and/or demand are limited. At the same time, inland freight transport tends to involve higher volumes in developed and/or large countries, where the dependence on international trade is lower than that of the smaller and/or land-locked countries. In addition, international trade also depends on the efficiency and reliability of border crossings.

The available information shows that a greater effort is required in order to improve efficiency across the board, as many countries (mostly in Southeast Europe, the Caucasus, the Central and East Asia and Africa) demonstrate low efficiency at border crossings.

Affordability of transport services for individuals/households

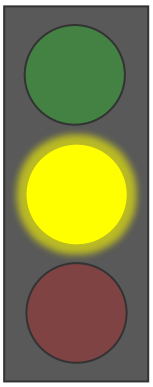
Transport costs money and, thus, transport accessibility is controlled by the costs (and returns) of the passenger and freight transport services as well as by the sustainability of the investments associated with the up-grading and/or the planning and construction of transportation infrastructure. Affordability of transport services depends on income and pricing. Generally, transport services tend to be more affordable for the citizens of countries with relatively low income inequalities.



Nevertheless, there are additional affordability determinants, such as the pricing of other basic goods and services, the rural or urban location of households, the presence of adequate/affordable public transport services, and the existence of transport policies, plans and schemes that support transport affordability for the poorer sections of the population. The available information shows that transport has become more expensive in real terms during the last decade in many regions (e.g. the EU). More initiatives are needed to tackle these and other issues related to transport affordability (see chapter 4) especially in developing countries.

Affordability of transport services for societies

All available trends/projections relating to passenger and freight volumes suggest a strong future growth particularly in the non-OECD regions, which will require the planning and construction of new transportation infrastructure as well as the establishment of sustainable funding mechanisms for the transport sector. However, infrastructure development is generally planned/financed under macro-economic constraints.

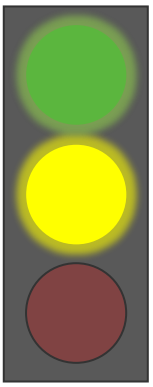


The 2008 financial crisis and its aftermath have increased pressures on national budgets, making private sector funding flows much more important. In recent years, transport infrastructure investment in the most developed countries has been lower than that of the non-OECD countries. At the same time, private transport infrastructure investments have been also moderate, with the large majority of countries showing private investment funding less than US $ 0.5 billion on aggregate during the period 2000-2012. Concerning the modal distribution of the infrastructure investment, road infrastructure has consistently taken the ‘lion’s share’ in most countries for which data are available.

Transport safety

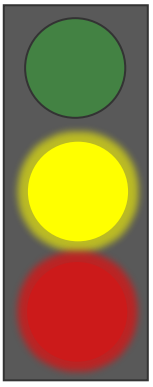
Well over a million people are killed annually in road traffic accidents. Road safety depends on driver behaviour, infrastructure quality and vehicle safety, and improvements can be achieved only by considering all these contributing factors. Road safety performance differs widely between countries. Road safety (measured in terms of fatalities per 100000 population) although improving, it also shows large variability. Trends in road fatalities are mixed. In some countries there have been sharp reductions in fatalities over the last decade, particularly for car

drivers/passengers; however, the record has been less satisfactory for vulnerable road users, such as pedestrians, cyclists and PTW (Powered Two Wheel) riders. Many emerging economies that show rapid private motorisation are associated with increasing road fatalities.



Following the establishment of common road traffic rules, road signs and signals, the higher road safety risks are mostly related to drink driving, speeding, non-wearing of seat belts and helmets, and the use of mobile phone while driving. In comparison, rail transport is one of the safest transport modes. There has been a continuous decrease in major accidents (and fatalities) in the last three decades, with most fatalities being caused by rolling stock in motion and/or taken place at level crossings. Finally, inland waterway transport is mostly associated with freight transport; therefore, there is a limited scope for accidents involving individuals. This is confirmed by the accident statistics, which show very low accident rates.

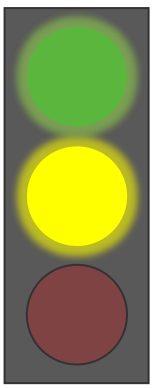
Transport security



Increasing transport volumes are associated with elevated risks in terms of terrorist attacks and organised crime. Experience has shown that all transport modes are vulnerable to such attacks, particularly large urban transport systems. Political cooperation through multilateral institutions can further assist the international community to develop effective measures against cross-border security breaches. At present, apart from national security legislation, other national issues constitutional, cultural, may be preventing enhanced international cooperation in this field. Transport related crime is also an issue that is a challenge in many parts of the world, especially in Latin America. Numerous initiatives directed at prevention crime affecting of road freight transport are in place throughout Europe.

Environmental sustainability of transport

Inland transport infrastructure requires land-use and loss of natural habitat. It also requires energy, most of it non-renewable. In recent years (2010), the transportation sector accounts for about 26 % of the total world delivered energy consumption and 55 % of the total liquid fuel consumption. According to the latest projections, transportation energy use will grow by 1.1 % annually at a global level in the period 2010-2040, driven by an increase of 2.3 % annually in the non-OECD economies. In comparison, energy use in the OECD countries will decline by an average of 0.1 % annually.



Transport can affect environment in many ways and at different spatio-temporal scales. Transport influences air quality, produces noise and uses a great amount of primary natural resources (e.g. metals and fossil fuels). It can also affect quality of life: traffic can be dangerous and can divide communities. Last, but not least, transport produces GHG emissions and, thus, can affect environment at the global level. Presently, CO2 emissions from transport show significant spatial variability, with the highest emissions found in the United States of America, the Russian Federation, China, Japan and Brazil, with Western Europe, Australia and India also associated with high emissions.

In comparison, Africa and the central Asia are characterized by the lowest transport-generated emissions. Transport is not only a major contributor to the observed carbon emission growth and, thus, a probable forcing of climatic changes; it is also a 'victim' of climatic change/extreme events which can have diverse impacts on transport infrastructure and services. These impacts will vary by mode and climate change factor, and will depend on the local or regional circumstances and vulnerabilities, including those associated with the natural environment.

In the present study a (statistical) analysis has been undertaken to assess the interrelations between different recorded socio-economic and environmental attributes pertinent to transport. Although there have been several constrains related to the available information (information gaps/synchronicity)[183] some correlations have been found to occur. For example, there are significant correlations between the population and GDP, the goods transported on roads and by rail and the CO_2 emissions, whereas there are no significant correlations between population size and the HDI and RAI indexes, the road and rail density as well as the transport fatalities. Similarly, there appears to be significant correlations between the country land area and GDP, the total trade, the goods transported on roads and by rail and the CO_2 emissions, but not with the HDI and RAI indexes, the road and rail density and the transport fatalities.

9.2 Sustainable inland transport in the post-2015 development agenda

The Rio+20 outcome document, *The Future We Want*, set out a mandate to establish an Open Working Group (OWG) to develop a set of Sustainable Development Goals (SDG) for consideration and appropriate action by the UN General Assembly at its 68th session (2013). It also provided the basis for their conceptualization. The Rio outcome gave the mandate that the SDGs should be coherent with and integrated into the UN development agenda beyond 2015.

Although the recently concluded OWG process did not propose sustainable (inland) transport as a goal in itself, the dimensions of sustainable inland transport and corresponding challenges as described within this study are embedded as a cross cutting issue throughout the 17 proposed SDG and their targets, most directly in as illustrated in figure 9.1[184].

[183] Information has not been readily available for all attributes; moreover, where such information has been available it was not always so for the same year (see Annex Table A1). Therefore, rigorous statistical analysis was only applicable to some combinations, and multiple regression modeling has not been meaningful. If further (and synchronous) information becomes available, then data statistics could be revisited.

[184] The goal of the overview presented in *figure 9.1* is to indicate the coverage of dimensions of sustainable inland transport by the proposed SDGs. It should not be understood as exclusive or exhaustive. For more details on SDG targets see: https://sustainabledevelopment.un.org/sdgsproposal

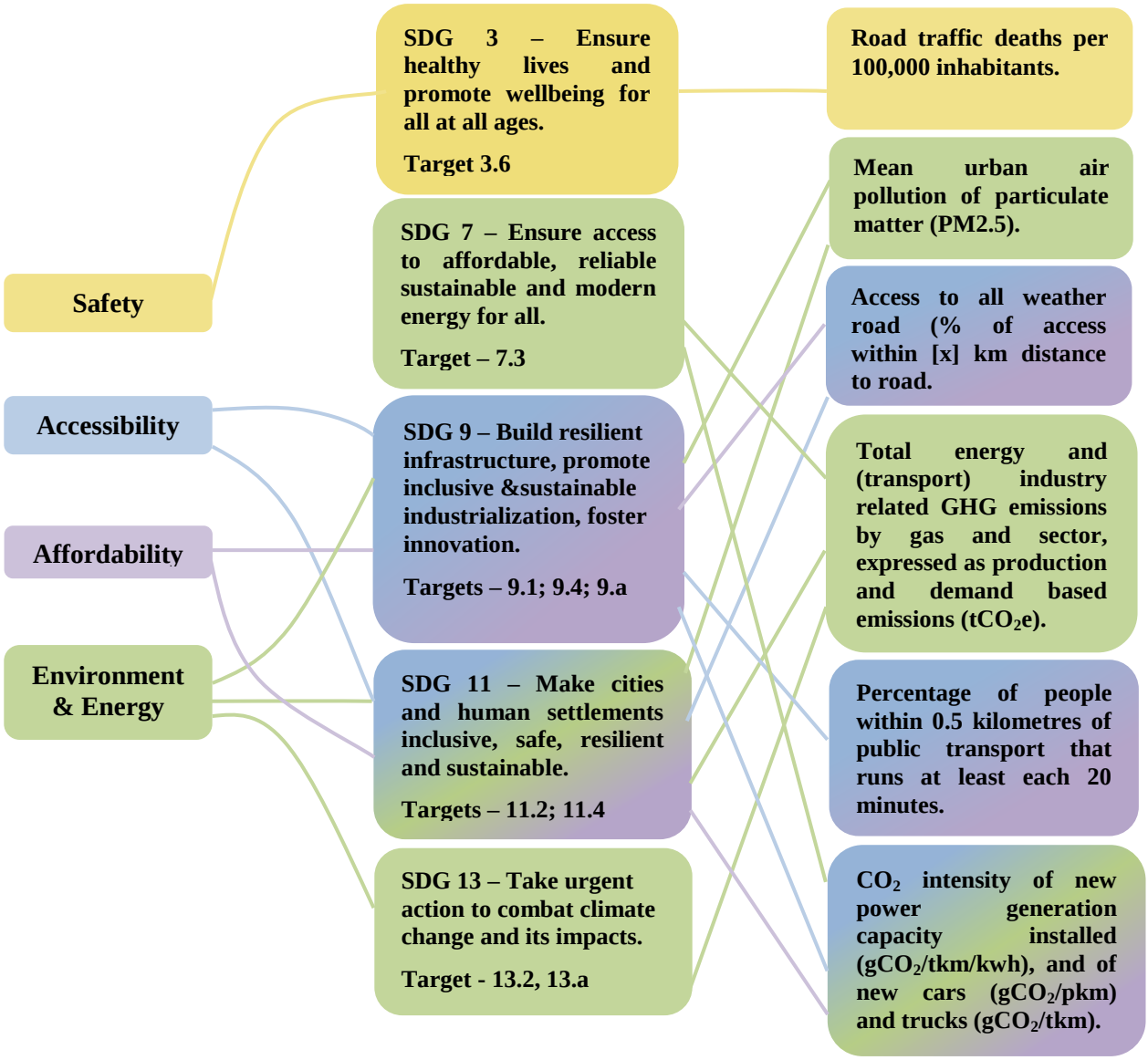


Fig 9.1 Sustainable inland transport within proposed post-2015 Sustainable Development Goals

The right column of figure 9.1 lists indicators proposed in a Sustainable Development Solutions Network report[185] for the purpose of monitoring and tracking progress in the effort to achieve the respective SDGs.

9.3 Policy Implications

Working towards sustainable transport systems requires all aspects of sustainable development to be considered. With policies targeting only one aspect, there is a risk that other dimensions may be neglected or even negatively affected. Environmental concerns, for example, are important and have to be addressed but by focusing only on those concerns certain policies may hinder social and economic sustainability. It is, therefore, imperative to consider challenges to sustainable transport under all its different dimensions. The nature of sustainable development goals calls for a comprehensive and sustainable approach to public policies in transport area. Transport and

[185] "Indicators and a Monitoring Framework for Sustainable Development Goals – Launching a data revolution for the SDGs", January, 2015.

mobility policies should be comprehensive and in line with a sustainable and equitable economic and social development model. They should not differentiate between passenger and freight transport or the geographical context and they must address the mobility needs of all individuals and businesses, regardless of the particular transport mode. (Tomassian C., Pérez, G and Sánchez R., Políticas integradas de infraestructura, transporte y logística: experiencias internacionales y propuestas iniciales, ECLAC, Natural Resources and Infrastructure Series No. 150, United Nations publication, Santiago, Chile, 2011).

Improving *transport accessibility* is a challenging task. In rural areas, investment for expanding/upgrading the transport network is scarce, whereas expanding rural transport networks may have also significant environmental footprints. In urban areas, the lack of space constrains expansion of and/or structural changes in the transport network. Traffic congestion is an increasing problem, particularly for fast industrializing non-OECD countries. It appears that issues related to transport accessibility for individuals are of paramount importance for the sustainability of transport and require a multi-level approach. As a first step, relevant, up-to-date information should be collated in a user- and analysis-friendly format at international level, involving as many countries as possible. The UNECE statistical platform, which provides information about national transport infrastructure and allows countries to compare development, identify problems, raise awareness and share ideas and practices, could be utilised/expanded and linked with other relevant transport information platforms to meet this challenge.

Generally, in order to improve transport accessibility and, thus, achieve sustainable transport, innovative/creative policies and solutions are required. It appears that it could be beneficial if the focus of such policies would be shifted from plans/projects responding to the existing trends (re-active approach), to plans/projects attempting to modify those trends so they can be addressed in a more innovative, efficient and cost effective manner (pro-active approach).

International transport accessibility is a key for the attractiveness of an economy. It promotes more efficient and cost effective movements of goods and people, increases competitiveness and attracts human and economic resources leading to the achievement of a 'critical mass' of business activities and knowledge. Nevertheless, accessibility to international markets presents its own challenges. First, improvements in connectivity through *strategic long-distance links* should be considered and planned; these will require international infrastructure agreements as well as the planning and implementation of international infrastructure projects. Collation/analysis of spatial data (in Spatial Data Infrastructures-SDIs) is required as well as strengthening of national capacities, the identification of network bottlenecks and missing links, together with assessments of the criticality, sensitivity and resilience of indispensable components of the transport system (e.g. bridges and tunnels), and the sharing of experiences and 'best' practices. Secondly, administrative bottlenecks, such as border crossings, that may cause significant socio-economic losses and affect the efficiency of logistics systems should be removed. Certain improvements are necessary, which could be facilitated by international agreements and cooperation as well as the adoption of widely-accepted/trusted uniform standards and the introduction of efficient information management systems. Thirdly, there are particular challenges involving land-locked countries, where border crossing issues may have very significant effects.

A key challenge for society is to ensure that individual mobility does not depend on individual income. Nevertheless, the analysis and the planning/implementation of effective policies/solutions to increase the affordability of transport services are not straightforward exercises. It requires concentrated efforts, cooperation and sharing of experiences and 'best' practices at many spatio-temporal scales.

Road safety presents many challenges. First, reduction of road fatalities and/or injuries can be challenging, particularly in areas with rapid growth in motorization levels. In order to achieve such reductions, special attention should be placed in understanding better the controlling factors of road accidents and the design of plans/programs that could provide effective solutions. Secondly, particular emphasis should be given to address the increasing problem of motorcycle safety. Thirdly, the introduction of electrical vehicles ('silent' vehicles) and increasing bicycle use, could pose additional safety risks to elderly people and people with vision and/or hearing problems. Fourthly, children face increased accident risks; early education on road safety rules, blind spots and safe cycling and walking habits is essential for reducing such risks. Finally, many accidents occur in particular road sections ('black spots'), due to road design/maintenance problems; therefore, removal of 'black spots' should be given a high priority.

Mitigation of the *environmental impacts of transport* constitutes a major challenge. With regard to Carbon emissions, major steps should be taken in order to reduce the carbon footprint of transport and particularly of road transport. These steps, however, might be significantly different in different regions. Without a successful green technology transition, GHG emissions may increase substantially in the nest decades. An obvious way to achieve decreases in the transport Carbon footprint is to increase the price of energy through taxation, thereby encouraging road users to adopt more energy-efficient driving behaviour and/or to consider other transport modes. However, high fuel taxation can have important implications on mobility, if not complemented by measures promoting viable alternative transport options such as adequate public transport. There are also non-financial instruments that can promote environmentally sustainable transport. These include amongst others: dynamic speed limits; rules for governments and public authorities that serve as good examples for road users; eco-labelling of vehicles according to their emission levels; schemes to promote vehicle fuel efficiency through improvements in driver behaviour; and national initiatives to promote eco-friendly transport.

Relatively little attention has been paid until now to the assessment of climate change impacts on transport infrastructure and operations as well as on potential adaptation measures. However, recent studies have shown that climate change–induced weather conditions may have very significant implications for transport, and, thus, for the sustainability of the global and regional economy and livelihood. Therefore, sustainable transport strategies should certainly consider the significant impacts that climate change and variability may have on transport infrastructure/services, and plan for effective adaptation measures.

There are several factors that determine national and regional adaptation options, including amongst others risk assessments and short, mid- and long-term financial implications. To identify priorities for climate change adaptation, facilities must be first classified in terms of their criticality within the transport network and according to the difficulties and costs involved to make them

climate resilient. At the same time, adaptation options will rely on financing, the availability of which from public, 'hybrid' or private entities may prove to be an important determinant of the adaptation policy approaches.

Finally it should be noted that transport system performance/sustainability is often evaluated on the basis of quantitative indicators (e.g. infrastructure density and travel speeds), whereas traditional transport statistics frequently overlook important transport components, such as the short and non-commuting trips and the non-motorized links of motorized trips. Such conceptions may result in policies/systems promoting road transport over other forms of transport accessibility, with little consideration for alternative transport modes, improved mobility management, intermodality, and the provision of better and swifter information to the transport users and more efficient land use. Therefore, a paradigm shift may be required in transportation planning/management that could move the focus from mobility-oriented analysis, i.e. the evaluation of the transport system performance on the basis of the quantity of transportation, to accessibility-oriented analysis that places people at the centre of the transportation system and considers a broader range of alternatives.

10. International organizations and institutions committed for sustainable transport

The Transport for Sustainable Development study was prepared as a joint effort of United Nations Regional Economic Commissions, along with the participation of numerous other international organizations and institutions dedicated towards achieving enhanced sustainability within the transport sector. The following is a very brief overview of the activities of the UN regional commissions in the field of transport. More detailed information about the work of these institutions, regional statistics and reports addressing the transport sector, can be found on their respective websites.

10.1 UN Economic Commission for Africa (ECA)

The Economic Commission for Africa has been at the forefront of transport development in Africa since its establishment in 1958. In this regard, its interventions have cut across the economic, social and environmental pillars of sustainable development. These interventions have also addressed the different dimensions of sustainable transport, including accessibility, affordability, safety and security, and protection of the environment. Made up of 54 member States, and playing a dual role as a regional arm of the UN and as a key component of the African institutional landscape, ECA is well positioned to make unique contributions to address the Continent's development challenges.

In 2005, ECA collaborated with the African Union Commission (AUC), African Development Bank, World Bank and the Sub-Saharan African Transport Policy Programme (SSATP) - now the African Transport Policy Programme - to develop transport targets and indicators related to the Millennium Development Goals. The targets were related to improving access to inputs and markets and generating employment opportunities; improving rural access and urban mobility; providing affordable access for all households; reducing road crash fatalities; promoting environmental sustainability in all transport operations and development programmes; reducing transport costs for landlocked countries, and completing missing links of regional corridors, among others.

Over the years, ECA has supported transport development in Africa in the context of the continent's regional integration and economic transformation agenda. In this regard, ECA worked closely with the African Union Commission (AUC) to prepare the Intergovernmental Agreement on the Trans-African Highways (TAH) network which was endorsed by African Heads of State in 2014. The Agreement includes guidelines on road standards, road classification and design, road safety, social development and environmental norms for TAH. ECA also advocates for such standards and norms to be harmonized in projects of the Programme for Infrastructure Development in Africa (PIDA) as well as other projects with regional dimension.

ECA plays a leading role in efforts to improve the safety of Africa's roads. In this context, it has organised several high-level road safety events on the continent, bringing together different stakeholders to brainstorm on the continent's road safety challenges and opportunities. ECA spearheaded the preparation of the African Road Safety Action Plan for the period 2011-2020, in the context of the UN Global Decade of Action for Road Safety (2011-2020). It also has an

important role in monitoring and evaluating the implementation of the Action Plan. Recently, ECA worked closely with the African Union Commission to prepare the African Road Safety Charter that was endorsed at the 3rd Ordinary Session of the Conference of African Ministers of Transport, held in Malabo, Equatorial Guinea, from 7-11 April 2014.

Regarding the environmental dimension of sustainable transport, ECA's involvement goes beyond advocacy for mainstreaming environmental considerations in transport infrastructure projects and includes the application of tools to measure CO_2 emissions in African countries. As part of a United Nations Development Account (UNDA) project to enhance international cooperation and planning towards sustainable transport policies, ECA collaborated with ECE in 2013 to apply the ForFITs (Future Inland Transport Systems) model in Ethiopia. The model allows for the evaluation of transport activity, energy use, and CO_2 emissions in a range of possible policy contexts.

ECA recognizes the growing importance of ensuring the sustainability of transport in Africa, particularly in light of recent sustained economic growth and rapid urbanization on the continent. As a result, the Commission has spearheaded efforts to mainstream sustainable transport in the Post-2015 Development Agenda – notably in the Common African Position (CAP), as well as in discussions on the Sustainable Development Goals.

Going forward, ECA will place more attention to the environmental impact of transport as well as the impact of climate change on Africa's infrastructure. The Commission's interventions will continue to be in the areas of knowledge generation and dissemination, advocacy and capacity building. ECA's African Institute for Economic Development and Planning (IDEP) provides a channel to train African officials on a wide range of development issues. It is envisaged that IDEP will launch a course on transport development with a module on sustainable transport in 2015.

10.2 UN Economic Commission for Europe (ECE)

The ECE was established in 1947 with a mandate to help rebuild post-war Europe, develop economies, strengthen economic relations among European countries, and between Europe and the rest of the world. The ECE is the forum where the countries of Western, Central and Eastern Europe, Central Asia and North America, 56 countries in all, come together to forge the tools of their economic cooperation. That cooperation concerns economics, statistics, environment, transport, trade, sustainable energy, timber and habitat. The Commission, among other objectives, offers a regional framework for the elaboration and harmonization of conventions, norms and standards in various sectors of its activities. The Commission's experts engage in policy dialogue and provide technical assistance to the countries which need guidance on sustainable development, as well as on accession and implementation of international agreements and conventions.

The main objective of ECE Transport Division is to facilitate the development of sustainable inland transport. It pays special attention to the international movement of persons and goods and aims to improve competitiveness, safety, energy efficiency and security in the transport sector as a whole. The UNECE Transport Division's work and its impact have a dual feature: they are both regional and global. It services global and regional bodies, that address global transport issues through their norms and standard setting and through the legal instruments that have a global geographical coverage (for example in road safety, vehicle regulations, or dangerous goods transport.). In some regulatory and legal areas it promotes regional solutions and also in capacity building activities it has a regional focus.

The UNECE Sub programme on Transport

1. **Centre of UN transport conventions,** more specifically for inland transport, vehicle regulations and dangerous goods transport (57).
2. The **Inland Transport Committee** (ITC) and **its working parties**, as well as the **ECOSOC Committees** serviced by the UNECE Transport Division are **decision making bodies** that can have an **impact on the daily life of people and businesses.**
3. The nature of the work is **global, regional and sub-regional**.

For more than six decades, the UNECE Inland Transport Committee (ITC**)** has provided a platform for intergovernmental cooperation to develop local and international transport infrastructure and services while improving safety and minimizing environmental impact. The results of this critical work are reflected in more than 50 international agreements and conventions that provide an international legal framework and technical regulations for the development of international road, rail, inland water and intermodal transport, as well as dangerous goods transport and vehicle construction. UNECE is a centre for negotiating multilateral transport standards and agreements in Europe and beyond, e.g. regulations for dangerous goods transport and road vehicle construction at the global level. Transport division provides technical assistance and exchange of best practices; promotes multi-country investment planning; is a substantive partner for transport and border crossing facilitation initiatives; and collects and analyses transport statistics.

UNECE addresses sustainability of transport through a variety of legal instruments, through its analytical work and technical assistance activities, as well as its main governing structures, i.e. the traditional work of its Working Parties. The following table summarizes how sustainability and its key areas, access, affordability, safety, security and environmental protection are incorporated into the UNECE work programme. Experience and lessons of the past activities underline that sustainability measures require a system approach, i.e. considering local, regional, national and international transport.

Table 10.1 Main activities of the UNECE in relation to sustainable development and transport

	Legal instruments and standards	Analytical work and capacity building	Governance structure: Working Parties
Access	Infrastructure agreements: AGC, AGTC, AGR, AGN Border Crossing Facilitation: TIR Convention, Harmonization of Border Crossing Procedures Convention UN Centre for Trade Facilitation and Electronic Business (UN/CEFACT) Trade standards	Support to investment planning at regional level: - Euro-Asian Transport Linkages Project - Trans-European Railways project - Trans-European Road project Support to Land-locked transition countries Ports and their hinterland connection	ITC/ Transport Trends and Economics (WP.5) ITC/ Customs and Transport (WP.30) CEFACT WP Trade Committee
Affordability		Socio-economic analysis of transport investments Common criteria on identification of bottlenecks, missing links, quality of service Capacity building in PPPs in infrastructure development	ITC/ Transport Trends and Economics (WP.5) Committee on Economic Competition and Innovation (CECI)
Safe transport	Conventions on road traffic and road signs and signals (Vienna Conventions) European Agreement concerning the International Carriage of Dangerous Goods by Road (ADN, ADR, RID*) European Code for Inland Waterways (CEVNI), Technical requirements for the construction of inland navigation vessels, Signs and Signals on Inland Waterways (SIGNI) Vehicle regulations	Road safety target setting Recommendations on tunnel safety	ITC/ Road Safety Forum (WP.1) ITC/ Working Party on the Transport of Dangerous Goods ITC/ Working Party on Railway Transport (SC.2) ITC/ Inland Waterway Transport (SC.3 and WP.3) ITC/ World Forum for Harmonization of Vehicle Regulations (WP. 29)
Transport Security	To be developed	Conferences, seminars and workshops addressing transport security issues	Multidisciplinary group of experts on Transport Security
Environmentally friendly transport	Vehicle regulations Technical requirements for the construction of inland navigation vessels Int. Carriage of Dangerous Goods by Road (ADR), Inland Waterways (ADN) and Rail (RID*)	ForFITS: Facilitating climate change adaptation in transport through addressing the energy-environment linkage The PEP conferences and workshops addressing environmental and health aspects of transport Reduction of pollution by inland vessels	ITC/ World Forum for Harmonization of Vehicle Regulations (WP. 29) The PEP – The Pan-European Programme on Transport, Health and Environment ITC/ Inland Waterway Transport (SC.3 and WP.3)

10.3 UN Economic Commission for Latin America and the Caribbean (ECLAC)

The Economic Commission for Latin America and the Caribbean is headquartered in Santiago, Chile. It was founded with the purpose of contributing to the economic development of Latin America and later the Caribbean, coordinating actions directed towards this end, and reinforcing economic ties among countries and with other nations of the world. The promotion of the region's social development was later included among its primary objectives. The Commission maintains sub regional headquarters in Mexico City and in Port-of-Spain, country offices in Buenos Aires, Brasilia, Montevideo and Bogotá, as well as a liaison office in Washington, D.C.

Building upon more than sixty years of transport related work in the region, ECLAC's approach in this area is based on its comprehensive vision of transport and its role in the region's economic development and progress to greater equality and social inclusion. Addressing the transport issues from the perspective of "infrastructure services" allows the Commission to effectively include both infrastructure and regulatory issues and to account for the close linkages between the transport and other components of economic infrastructure, such as energy and information and telecommunications services. ECLAC also endorses the modern concepts of logistics and mobility, which encompass both transport infrastructure and the quality of the services that it provides for the transport of goods and people and which are line with the concept and the goals of sustainable development.

Another fundamental aspect is the ECLAC's commitment to promote the regional integration of the physical infrastructure through providing technical assistance and technical and policy advice to the main regional integration initiatives in Latin America and the Caribbean.

In accordance with this vision, ELCAC's work in transport area includes a wide set of issues, ranging from assessing the state of economic infrastructure to analyzing the current logistics and mobility services and their regulatory framework. In the area of economic infrastructure, ECLAC reviews and assesses the trends in the public and private infrastructure spending and supports the regional efforts to move towards a multi-modal regional transport network and associated logistics and mobility services. In the area of logistics and mobility, ECLAC works on the issues of maritime transport, port governance system, hinderland, as well as energy efficiency of the transport services. ELCAC analytical work on transport regulations focuses on issues of transport financing, access to domestic and regional markets and the quality of national and regional policies on transport, infrastructure and logistics.

ECLAC has a strong record of analytical work and a high rate of penetration in the region due to active capacity building and technical assistance activities. Seeking to improve the quality of public policies and academic research in the region, ECLAC also provides statistical data on infrastructure financing, maritime transport and transport services for intra-regional trade. ECLAC's current priority in the transport area consists in helping countries advance toward integrated and sustainable logistics and mobility public policies and providing technical assistance to elaboration of a regional strategy on logistics and mobility. Another important area of the Commission's ongoing work consists in assessing the linkages between the infrastructure and logistics services and the exploitation of the region's natural resources. In addition to promoting the use of part of the revenues from natural resources mobilized through taxation for ensuring and stimulating

infrastructure investment, ECLAC seeks to promote access to and shared use of the infrastructure, initially developed for the exclusive use by the mineral industry.

As far as the transport agreements are concerned, as can be seen in the following table, many ECLAC countries are contracting parties to several global transport agreements, and two ECLAC Countries (Chile and Uruguay) are Contracting Parties to the TIR Convention.

10.4 UN Economic and Social Commission for Asia and the Pacific (ESCAP)

ESCAP, established in 1947, is the regional development arm of the United Nations and serves as the main economic and social development centre in Asia and the Pacific. Its mandate is to foster cooperation between its 53 members and 9 associate members in Central Asia, North-Northeast Asia, Southeast Asia, South and Southwest Asia, and the Pacific. The overall objective of ESCAP is to promote inclusive and sustainable economic and social development in the Asia-Pacific region through inter-governmental process, norm setting, regional research and analysis, capacity building and development of partnership.

ESCAP Transport Division works in the areas of policy, infrastructure, facilitation and logistics with a vision of building regional integrated intermodal transport and logistics systems.

ESCAP promotes and recommends various policy options that can enhance the sustainability and inclusiveness of transportation systems. These policies include: (i) enhancing efficiency of transport operations; (ii) promoting regional standards and guidelines for infrastructure, alternative fuels, vehicle fuel economy and road safety; (iii) inclusive and integrated transport planning encompassing regional, national, intercity, urban, and rural transport; and (iv) strengthening institutional capacities of national, local and city agencies and institutional coordination. While development patterns across the region vary, countries that have been able to improve transport capacities and efficiency have been the most successful in achieving sustainable development.

By supporting the development of a regional intermodal transport network, incorporating the Asian Highway network, the Trans-Asian Railway network and the network of Dry Ports, ESCAP works with its member States to strengthen connectivity, optimize the use of existing infrastructure and increase the level of integration between the different transport modes. In order to finance these transport infrastructure and systems, ESCAP offers advice on financing options and advocates public-private partnerships including network coordination, diagnostic workshops and online training materials and courses.

While infrastructure development is a prerequisite for achieving regional connectivity, tackling non-physical barriers to cross-border and transit transport is also essential. To this end, ESCAP promotes the unhindered and safe movement of vehicles, goods and people across borders and through countries of the region through the establishment of regional facilitation frameworks and standards, provision of facilitation tools, assistance in formulating and implementing subregional and bilateral agreements, and the harmonization of documentation and procedures. ESCAP also assists countries in developing transport logistics policies and in enhancing the professionalism of logistics service providers.

Working closely with the organizations involved in sustainable transport solutions, ESCAP also facilitates the sharing of knowledge on sustainable transport solutions, including modal shift to rail, more use of inland and coastal waterways, safer transport systems and promotion of public transport, non-motorized vehicles and creation of pedestrian spaces in urban environments.

10.5 UN Economic and Social Commission for Western Asia (ESCWA)

The Economic and Social Commission for Western Asia was established on 9 August 1973 pursuant to the Economic and Social Council's resolution 1818 (LV). The purpose of setting up the Commission was to raise the level of economic activity in member countries and strengthen cooperation among them. It was also intended to meet the need of the countries in Western Asia for the services of a regional economic commission to promote the development efforts in the region. In recognition of the social component of its work, the Commission was entrusted with new responsibilities in the social field by virtue of Economic and Social Council resolution 69/ 1985 of July 1985. Its name therefore became the Economic and Social Commission for Western Asia. ESCWA comprises 17 Arab countries in Western Asia and North Africa.

ESCWA meetings provide a unique international platform, which acts as a forum for governments and transport professionals and researchers to get together and share experiences. Furthermore, UNESCWA statistical database provides information about national infrastructure and allows countries to compare and evaluate the development. Moreover information material is provided to identify problems, share measures and best practices and raise awareness.

In 2000, ESCWA prepared the first analytical field study on the cross-border transport of goods in the ESCWA region. The study included an explanation of procedures adopted for the transport of goods through international outlets in five member countries, namely, Egypt, Jordan, Lebanon, the Syrian Arab Republic, and the United Arab Emirates. It also outlined obstacles and solutions and made several recommendations, mainly on the establishment of national committees to coordinate the facilitation of transport and trade in the countries of the ESCWA region. As a result, ESCWA developed a manual for the establishment of national transport and trade facilitation committees (NTTFCs) .The Committees are envisaged to have a crucial role to play in supporting effective institutional arrangements between all public and private sector participants in activities related to trade facilitation. Ten member countries established NTTFCs between 2003-2012, namely, Egypt, Iraq, Jordan, Lebanon, Oman, Palestine, Saudi Arabia, the Sudan, the Syrian Arab Republic, and Yemen.

Also, ESCWA initiated work on a Single Window (SW) for Trade Facilitation in 2010. An assessment was carried out on the status of the SW development in ESCWA countries. A quantitative and qualitative ranking of the countries in the region showed variations across the countries with regard to the factors identified for the evaluation: There are a number of countries in the region that have made significant progress towards developing the SW for trade facilitation. These include Lebanon, Morocco, Saudi Arabia, Tunisia, and the United Arab Emirates. However, other countries need to invest more in improving their trade facilitation by developing the SW system.[186]

[186] Trade Facilitation Initiatives in the ESCWA Region, E/ESCWA/EDGD/2013/Technical Paper 3.

10.6 International Road Transport Union (IRU)

The International Road Transport Union is the world road transport organisation, which upholds the interests of bus, coach, taxi and truck operators to ensure economic growth and prosperity via the sustainable mobility of people and goods by road worldwide and its commitment to sustainable development.

After the adoption of Agenda 21, the road transport industry proactively committed to drive towards achieving sustainable development by unanimously adopting the IRU Charter for Sustainable Development in 1996. Striving for sustainable development has since become a constitutional obligation, as per Article 2 of the IRU Constitution.

For the road transport industry, achieving sustainable development translates into the challenge of satisfying market demands at the lowest economic, social and environmental cost possible, notably by achieving better and cleaner rather than more road transport, in developing and industrialised countries alike.

The IRU established the IRU Academy to foster professional excellence at all levels, and developed the IRU 3 "i" Strategy, endorsed by the United Nations Environment Programme (UNEP), as the most cost-effective way to achieve sustainable development.

- **Innovation** to develop ever more effective **"**at-source**"** technical measures and operating practices to reduce environmental impact
- **Incentives** to encourage faster introduction by transport operators of best available technology and practices.
- **Infrastructure** used at its full potential and adequate investments to remove bottlenecks and missing links, as the other two measures are useless without free-flowing traffic.

As a result, the road transport industry has invested massively in the latest technologies and training, reducing its toxic and non-toxic emissions by up to 98% over the last 20 years. However, globalisation has generated booming tourism and trade flows and, in turn, transport, leading to a dramatic increase in fuel consumption and CO2 emissions. The commercial road transport sector has therefore taken up the challenge of reducing the 3% of total CO2 emissions it is responsible for, by proactively committing in 2009 to reduce its CO2 emissions by 30% by 2030.

The IRU is also a member of UN Global Compact, the world's largest corporate responsibility initiative with over 8,000 business and non-business participants in 135 countries. IRU priorities and related activities of trade and road transport facilitation, as well as sustainable development, are truly in line with the Global Compact's "Ten Principles" on human rights, labour, environment and anti-corruption measures. In order to further support the implementation of the Sustainable Development Goals, the IRU initiated, together with competent international partners and organisations under the UN umbrella, a Global Partnership for Sustainable Transport (GPST).

The overall objective of the GPST is to provide an international public-private platform and a framework for multilateral dialogue on policy options and possible measures to enhance sustainable transport systems, particularly in developing countries. Like other global partnerships,

the GPST will also encourage its members, as well as all relevant transport development stakeholders, to announce and implement commitments on sustainable transport development.

The GPST will focus on development needs and opportunities of the transport sector and its contribution to sustainable development in developing countries, notably in least developed countries, countries with economies in transition, land-locked developing countries and small island developing states. Furthermore, the GPST will function as a high-level platform under the United Nations auspices for the promotion of sustainable development of all modes of transport in the interests of globally inclusive socio-economic development and the facilitation of international trade and regional integration.

10.7 International Union of Railways (UIC)

UIC was founded in 1922 by governments seeking to "*create a permanent conference of railway administrations to harmonies and improve the conditions governing the establishment and operation of railways with regard to international traffic*".

UIC currently has almost 240 members on 5 continents, including integrated railways, infrastructure managers, rail and intermodal operators, and service companies. UIC's chief task is thus to:

- promote rail transport at world level,
- promote interoperability between rail systems,
- develop and facilitate all forms of international cooperation between its members,
- support its members in their efforts to develop new markets and new areas of business,
- propose improvement pathways for the technical and environmental performance of railways to improve their competitiveness

Since 2009, UIC has been structured on the basis of four technical departments: passenger, freight, rail system (infrastructure and associated aspects), and fundamental values. The latter department brings together railway protection and promotion of its social and environmental credentials: security thus sits alongside safety, environment and sustainability, training, and research.

Alongside the action taken by UIC member railways, UIC itself has addressed the subject of security, developing activities in various shapes and forms since the late 1990s and focusing particularly on the development of the terrorist threat following the 11 September 2001 attacks in the USA.

The idea is to share experience and best practice and to define shared ways and means of action so that members can learn from and successfully apply lessons from elsewhere when developing their own strategies, in partnership with their national authorities and, potentially, in accordance with a general international framework.

UIC Fundamental Values

Alongside its three "technical" departments - Passenger, Freight and Rail System - corresponding to the business units conventionally used in the rail sector, UIC has also created a "Fundamental Values" department bringing together various subjects which cut across the traditional lines but which also serve to protect the rail sector or spotlight its economic and societal benefits.

Security and safety are thus part of this department, alongside sustainable development, international training, expertise development, and research. As regards security, this serves as a reminder to the rail sector that its security policy must be designed in the service of its various businesses, alongside and complementary to the vital role played by the public authorities, not as a substitute for them. The security priorities of the sector and those of the authorities may thus differ, but must remain consistent and a source of synergy.

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Annex I

Table A1a UN TRANSPORT AGREEMENTS SERVICED BY UNECE

Legend:
X = Ratification, accession, definite signature;
S = Signature;

	Infrastructure networks						Road traffic and road safety										Vehicles			Other Legal Instruments Related to Road Transport										Inland navigation							Border crossing facilitation														Dangerous goods & special cargoes				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	-	53	54	55	56	57
COUNTRY																																																									
Afghanistan																																							X	X		X																	
Albania		X	X	X			X	X		X	X	X	X		X	X		X	X		X	X	X		X	X										X	X	X	X	X		X					X	X				X	X			X
Algeria							X														X																X	X	X		X	X	X				X	X				X	X			
Andorra																					X																																	X	X			X
Antigua and Barbuda																																																								
Argentina							X																														X	X	S																	
Armenia		X						X													X				X	X																X								X						
Australia							X											X		X		X															X	X	X									X	X	X						
Austria	X	S	X	X	S	X	X	X	X	X	X	X		X		X		X	S		X	X	X	X	X	X				X	X				S		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X	X
Azerbaijan		X						X		X		X				X		X		X	X				X															X		X							X					X	X			X
Bahamas								X																																																
Bahrain								X		X																																														
Bangladesh							X																																																	
Barbados							X																														X	X	X																	
Belarus		X	X	X		X		X		X	X	X				X		X	X	X	X				X	X				X	X	X								X		X							X					X				X
Belgium	X	X	X	X			X	X	X	X	X	X	X	X	X	X		X	S		X	S			X	X	S			S	S	S	X					X	X	X	X	X	X	X	X	X	X	X		X	X		X	X
Benin							X																																																
Bosnia and Herzegovina	X	X	X			X		X		X	X	X			X	X	X	X			X	X	X	X	X			X									X		X		X		X					X			X	X				X
Botswana							X																																																
Brazil								X		S																																													
Bulgaria	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X		X				X		X						X				X	X	X	X	X		X				X	X	X	X			X	X	X	X
Burkina Faso							X		X																																													
Burundi																																																							
Cambodia							X		X													X															X	S	S				X				X									
Cameroon																																																							
Canada							X													X																	X		X	X	X					X	X									
Central African Republic							X	X		X																											X	X	X								X	X								
Chile							X	S		X																											X	X	X		X														
China							X[1]	S[1]		S[1]										X																															X								
Congo							X																																																	
Costa Rica								S		S																											X	X	X																	
Côte d'Ivoire							X	X		X																																														
Croatia		X	X	X		X		X		X	X						X	X			X				X			X									X		X		X	X	X					X		X	X				X	X
Cuba							X	X	X	X													X	X													X	X	X				X				X	X	X	X	X					

Legend:
X = Ratification, accession, definite signature;
S = Signature;

	Infrastructure networks						Road traffic and road safety										Vehicles			Other Legal Instruments Related to Road Transport										Inland navigation							Border crossing facilitation												Dangerous goods & special cargoes					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	-	53	54	55	56	57
COUNTRY	Construction Traffic Arteries, 1950	E Road Network (AGR), 1975	E Rail Network (AGC), 1985	E Comb. Tr. Network (AGTC), 1991	Protocol Inl. Nav. to AGTC, 1997	E Inl. Water Network (AGN), 1996	Road Traffic, 1949	Road Traffic, 1968	Protocol on Road Signs & Signals, 1949	Road Signs & Signals, 1968	Suppl. 1968 Convention Road Traffic, 1971	Suppl.1968 Conv. Road Signs & Signals, 1971	Weights and Dimensions, 1950	Suppl. 1949 Conv. and Protocol, 1950	Road Markings, 1957	Protocol Road Markings, 1973	Issue and Validity of Driving Permits (APC)	Vehicles Regulations, 1958	Techn. Inspect. Vehicles, 1997	Global Vehicles Regulations , 1998	Work of Crews Int. Road Transport (AETR), 1970	Taxation Priv. Road Vehic. , 1956	Taxation Road Passenger Vehic. , 1956	Taxation Road Goods Vehic. , 1956	Contract Road Goods Transport (CMR) ,1956	Protocol to CMR, 1978	Add'l Protocol to CMR, (e-CMR) 2008	Contract Pass. & Lugg. Rd. Transp. (CVR) , 1973	Protocol to CVR, 1978	Econ. Regulat. Road Transp. , 1954	Collision Inl. Nav. , 1960	Registr. Inl. Nav. Vessels, 1965	Measurement Inl. Nav. Vessels, 1966	Liability Vessel Owners (CLN), 1973	Protocol to CLN, 1978	Contract Inl. Nav. Pass. & Lugg. (CVN) , 1976	Protocol to CVN, 1978	Touring Facilities, 1954	Protocol Touring Facilities, 1954	Temp. Import. Priv. Road Vehicles, 1954	TIR Convention, 1959	TIR Convention, 1975	Temp. Import-Aircraft & Boats, 1956	Temp. Import. Commerc. Vehicles, 1956	Cross. Front. Pass. Bagg. Rail, 1952	Cross. Front. Goods Rail, 1952	Spare Parts Europ Wagons, 1958	Customs Container Convention, 1956	Customs Container Convention, 1972	Customs Treatment Pallets, 1960	Harmoniz. Frontier Controls Goods, 1982	Customs Pool Containers, 1994	SMGS Transit by Rail, 2006	Dang. Goods by Road (ADR), 1957	Protocol to ADR, 1993	Liabil. Dang. Goods (CRTD), 1989	Dang. Goods by Inland Waterways (ADN), 2000	Perishable Foodstuffs (ATP), 1970
Cyprus							X								X				S	X	X				X	X											X	X	X	X	X		X						X			X	X			
Czech Republic	X	X	X	X	X	X	X	X	X	X	X	X			X	X		X	S		X	X	X	X	X	X	X	X			X							X		X	X						X	X	X	X	X		X	X		X	X
Democratic Rep. of the Congo							X	X		X																																														
Denmark	X	X		X	X		X	X	X	X	X	X				X		X	S		X	X	X	X	X	X				S							X	X	X	X	X	X	X			X	X		X	X	S		X	X			X
Dominican Republic							X		X																													S		S						X	X								
Ecuador							X	S	X	S																												X	X	X																
Egypt							X		X																												X	X	X																
El Salvador																																				X	X	X																
Estonia								X		X	X	X						X	X		X				X	X															X								X			X	X			X
EUROPEAN UNION																		X		X																			X			X								X	X			
Fiji							X																													X	X	X																
Finland	X	X		S		S	X	X	X	X	X	X				X		X	X	X	X	X	X	X	X	X	S										X	X	X	X	X	X	X				X	X	X	X			X	X			X
France	X	X	X	X	S	S	X	X	X	X	X	X		X	X			X	S	X	X	X			X	X				X	X	X				X	X	X	X	X	X	X	X	X	X	X		X	X			X	X		X	X
Georgia		X		X			X	X		X		X				X			S		X				X	X															X						X						X				X
Germany	X	X	X	X	S	S		X		X	X	X			X	X		X	S	X	X	X			X	X		S	S		X	S	X	S	S			X	X	X	X	X	X			X	X		X	X			X	X	S	X	X
Ghana							X	S		S					X							X	X	X														X	X	X																
Greece	X	X	X	X	S	S	X	X	X	X	X	X	X	X		X		X	S		X				X	X				X							X	X		X	X		X				X	S		X				X	X			X
Guatemala							X																														S		S																
Guyana								X		X																																														
Haiti							X		X																											X	X	X																
Holy See							X	S	X	S				X																							S	S	S																
Honduras																																				S	S	S																
Hungary	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X				X	X				X		X				X	X	X	X	X	X	X				X	X	X	X			X	X		X	X
Iceland							X																																														X				
India							X		S	X										X																X	X	X																		
Indonesia								S		S																														X																
Iran, Islamic Republic of								X		X															X	X										X	X	X	X	X								X								
Iraq										X																																															
Ireland	X						X												S		X	X	X	X	X	X										X	X	X	X	X		X						X			X			X	X			X
Israel							X	X	S																											X	X	X	X	X						X				X						
Italy	X	X	X	X	S	X	X	X	X	X	X	X	X	X	S	X		X	S	X	X				X	X				X						X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		S	X			
Jamaica							X																													X	X	X			X					X										
Japan							X											X		X																X	X	X	X							X										
Jordan							X																		X	X										X	X	X	X	X										X						

Legend:
X = Ratification, accession, definite signature;
S = Signature;

	Infrastructure networks						Road traffic and road safety										Vehicles			Other Legal Instruments Related to Road Transport										Inland navigation							Border crossing facilitation												Dangerous goods & special cargoes				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	-	53	54	55	56	57
COUNTRY	Construction Traffic Arteries, 1950	E Road Network (AGR), 1975	E Rail Network (AGC), 1985	E Comb. Tr. Network (AGTC), 1991	Protocol Inl. Nav. to AGTC, 1997	E Inl. Water Network (AGN), 1996	Road Traffic, 1949	Road Traffic, 1968	Protocol on Road Signs & Signals, 1949	Road Signs & Signals, 1968	Suppl. 1968 Convention Road Traffic, 1971	Suppl.1968 Conv. Road Signs & Signals, 1971	Weights and Dimensions, 1950	Suppl. 1949 Conv. and Protocol, 1950	Road Markings, 1957	Protocol Road Markings, 1973	Issue and Validity of Driving Permits (APC)	Vehicles Regulations, 1958	Techn. Inspect. Vehicles, 1997	Global Vehicles Regulations, 1998	Work of Crews Int. Road Transport (AETR), 1970	Taxation Priv. Road Vehic. , 1956	Taxation Priv. Road Vehic. , 1956	Taxation Road Goods. Vehic. , 1956	Contract Road Goods Transport (CMR), 1956	Protocol to CMR, 1978	Add'l Protocol to CMR, (e-CMR) 2008	Contract Pass. & Lagg. Rd. Transp. (CVR) , 1973	Protocol to CVR, 1978	Econ. Regulat. Road Transp. , 1954	Collision Inl. Nav., 1960	Registr. Inl. Nav. Vessels, 1965	Measurement Inl. Nav. Vessels, 1966	Liability Vessel Owners (CLN), 1973	Protocol to CLN, 1978	Contract Inl. Nav. Pass. & Lagg. (CVN), 1976	Protocol to CVN, 1978	Touring Facilities, 1954	Protocol Touring Facilities, 1954	Temp. Import. Priv. Road Vehicles, 1954	TIR Convention, 1959	TIR Convention, 1975	Temp. Import.Aircraft & Boats, 1956	Temp. Import. Commerc. Vehicles, 1956	Cross. Front. Pass. Bagg. Rail, 1952	Cross. Front. Goods Rail, 1952	Spare Parts Europ Wagons, 1958	Customs Container Convention, 1956	Customs Container Convention, 1972	Customs Treatment Pallets, 1960	Harmoniz. Frontier Controls Goods, 1982	Customs Pool Containers, 1994	SMGS Transit by Rail, 2006	Dang. Goods by Road (ADR), 1957	Protocol to ADR, 1993	Liabil. Dang. Goods (CRTD) , 1989	Dang. Goods by Inland Waterways (ADN), 2000	Perishable Foodstuffs (ATP), 1970
Kazakhstan		X		X				X		X	X	X				X		X	X	X	X				X					X									X						X		X			X				X
Kenya								X																																																
Kuwait								X		X																																X	X												
Kyrgyzstan							X	X	X	X															X	X																X		X			X		X				X
Lao People's Dem. Rep.							X																																										X						
Latvia		X	X	X				X		X	X	X						X			X		X	X	X	X	X	X												X						X		X			X	X			X
Lebanon							X		S																X	X					X										X													
Lesotho							X																																											X						
Liberia								X		X																												X	X	X		X						X		X	X					
Liechtenstein																					X																																		X	X			
Lithuania		X	X	X		X		X		X	X	X						X		X	X				X	X	X										X	X	X		X		X				X		X	X		X	X			X
Luxembourg	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		S		S		X		X			X	X	X	X	X	X	X	X	X	X		X	X		X	X			X
Madagascar							X																																																	
Malawi							X																																										X						
Malaysia							X											X		X																	X	X	X																
Mali							X																														X	X	X																
Malta							X											X			X	X			X	X											X	X	X	X	X	X								X		X				
Mauritius																																					X	X	X			X					X								
Mexico								S		S																											X	X	X															
Monaco							X	X	X		X										X																S	S	S															X
Mongolia								X		X															X																X									X						
Morocco							X	X		X							X						X	X												X	X	X	X	X					X		X					X	
Namibia							X																																																	
Nepal																																				X	X	X																
Netherlands	X	X		X	X	X	X	X	X	X	X	X	X	X	S	X		X	X	X	X	X	X	X	X	X	X		S	X	X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X	X
New Zealand							X											X		X																X	X	X								X								
Niger							X	X	X																																													
Nigeria							X			X																											X	X	X																
Norway	X	X		X			X	X	S	X								X		X	X	X	X	X	X	X	S		X							X	X	X	X	X		X	X	X		X		X	X			X	X			X
Pakistan								X		X																											X	X	X																
Panama																																				S	S	S																
Papua New Guinea							X																																																	
Paraguay							X																																																
Peru							X	X																													X	X	X																
Philippines							X	X		X																											X	X	X																
Poland	X	X	X	X			X	X	X	X	X	X		X		X		X			X	X	X	X	X	X				X						X	X	X	X	X	X		X			X	X	X	X	X	X		X	X	X
Portugal	X	X	S	X	S		X	S	X	X					X			X	S		X				X	X				X						X	X	X	X	X	X		X	X		X		X		X			X	X			X
Qatar								X																																															
Republic of Korea							X	S		S								X		X																						X					X								
Republic of Moldova		X	X	X		X		X			X								X	X	X	X			X	X		X													X						X		X			X	X			X
Republic of Montenegro	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X			X	X		X	X	X				X	X	X		X	X	X				X	X	X			X				X

Legend:
X = Ratification, accession, definite signature;
S = Signature;

	Infrastructure networks						Road traffic and road safety										Vehicles			Other Legal Instruments Related to Road Transport										Inland navigation							Border crossing facilitation												Dangerous goods & special cargoes					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	-	53	54	55	56	57
COUNTRY	Construction Traffic Arteries, 1950	E Road Network (AGR), 1975	E Rail Network (AGC), 1985	E Comb. Tr. Network (AGTC), 1991	Protocol Int. Nav. to AGTC, 1997	E Int. Water Network (AGN), 1996	Road Traffic, 1949	Road Traffic, 1968	Protocol on Road Signs & Signals, 1949	Road Signs & Signals, 1968	Suppl. 1968 Convention Road Traffic, 1971	Suppl.1968 Conv. Road Signs & Signals, 1971	Weights and Dimensions, 1950	Suppl. 1949 Conv. and Protocol, 1950	Road Markings, 1957	Protocol Road Markings, 1973	Issue and Validity of Driving Permits (APC)	Vehicles Regulations, 1958	Techn. Inspect. Vehicles, 1997	Global Vehicles Regulations, 1998	Work of Crews Int. Road Transport (AETR), 1970	Taxation Priv. Road Vehic., 1956	Taxation Road Passenger Vehic., 1956	Taxation Road Goods. Vehic., 1956	Contract Road Goods Transport (CMR), 1956	Protocol to CMR, 1978	Add'l Protocol to CMR, (e-CMR) 2008	Contract Pass. & Lugg. Rd. Transp. (CVR), 1973	Protocol to CVR, 1978	Econ. Regulat. Road Transp., 1954	Protocol to CVN, 1978	Collision Int. Nav., 1960	Registr. Int. Nav. Vessels, 1965	Measurement Int. Nav. Vessels, 1966	Liability Vessel Owners (CLN), 1973	Protocol to CLN, 1978	Contract Int. Nav. Pass. & Lugg. (CVN), 1976	Protocol to CVN, 1978	Touring Facilities, 1954	Protocol Touring Facilities, 1954	Temp. Import Priv. Road Vehicles, 1954	TIR Convention, 1959	TIR Convention, 1975	Temp. Import Aircraft & Boats, 1956	Temp. Import. Commerc. Vehicles, 1956	Cross. Front. Pass. Bagg. Rail, 1952	Cross. Front. Goods Rail, 1952	Spare Parts Europ Wagons, 1958	Customs Container Convention, 1956	Customs Container Convention, 1972	Customs Treatment Pallets, 1960	Harmoniz. Frontier Controls Goods, 1982	Customs Pool Containers, 1994	SMGS Transit by Rail, 2006	Dang. Goods by Road (ADR), 1957	Protocol to ADR, 1993	Liabil. Dang. Goods (CRTD), 1989	Dang. Goods by Inland Waterways (ADN), 2000	Perishable Foodstuffs (ATP), 1970
Romania	X	X	X	X	X	X	X	X	X	X	X	X			X			X	X	X	X	X	X		X	X				X		X				X	X	X	X	X		X			X	X	X	X			X	X		X	X
Russian Federation		X	X	X		X	X	X	X	X	X	X				X		X	X	X	X				X					X		X	X			X	X	X	X	X			X		X						X	X		X	X
Rwanda							X		X																											X	X	X																
San Marino							X	X	X	X											X																																				
Saudi Arabia																																						X			X							X										X
Senegal							X	X	X	X																										X	X	X								X										
Serbia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X			X		S	X	X	X				X	X	X		X	X	X				X	X	X	X			X		X	X
Seychelles								X		X																																														
Sierra Leone							X																													X	X	X			X	X				X											
Singapore							X																														X	X				X														
Slovakia	X	X	X	X	S	X	X	X	X	X	X	X			X	X		X	S	X	X	X	X	X	X	X	X	X				X					X		X		X					X	X	X	X	X		X	X		X	X
Slovenia	X	X	X	X				X		X	X							X		X	X				X	X											X		X		X	X	X			X		X	X	X			X	X			X
Solomon Islands																																				X	X	X			X					X										
South Africa							X	X										X		X																														X								
Spain	X						X	S	X	S				X	X			X	S	X	X				X	X	X									X	X	X	X	X	X	X		X		X	X	X	X			X	X			X
Sri Lanka							X																													X		X																		
Sudan																																						X																		
Sweden	X	X					X	X	X	X	X	X				X		X	S	X	X	X	X	X	X	X	S			S							X	X	X	X	X	X	X	S	S		X		X	X	X			X	X			X
Switzerland		X		X	X	X	S	X	S	X	X	X			S	X		X	S		X				X	X	X			S	X	X	X	S			X	X	X	X	X	X	X	X	X	X	X	X	X	S			X	X		X	S
Syrian Arab Republic							X														X				X						X	X	X				X	X	X		X																
Tajikistan								X		X										X	X				X																X														X				X
Thailand							X	S	X	S								X																																								
The FYR of Macedonia		X	X					X		X	X	X				X		X			X				X	X													X		X		X										X				X			X
Togo							X																																																		
Tonga																																				X	X	X																		
Trinidad and Tobago							X																													X	X	X			X					X	X									
Tunisia							X	X	X	X								X		X					X	X										X	X	X		X						X		X				X				X	X
Turkey	X	X	X	X			X	X			X				X			X		X	X				X	X										X	X	X	X	X		X					X	X	X			X				X	X
Turkmenistan								X		X											X				X	X															X								X	X	X			X				X	X
Uganda							X		X																											X	X	X											S							
Ukraine		X	X	X		X		X		X	X	X				X		X	X		X				X			X												X									X				X				X	X
United Arab Emirates							X	X		X																												X		X																	
United Kingdom	X	S					X	S	X	S	S	S		X	S			X	S	X	X	X	X	X	X	X			S								X	X	X	X	X	X	X				X		X	X	X			X	X			X
United Rep. of Tanzania																																				X	X	X																		
United States							X													X																X		X	X		X					X	X									X
Uruguay								X																												X		S		X																	
Uzbekistan								X		X											X			X	X	X														X		X							X		X	X				X	
Venezuela							X	S		S																																															
Viet Nam							X	X		X																																															
Zimbabwe							X	X																																																

Table A1b UN TRANSPORT AGREEMENTS SERVICED BY ESCAP

Legend: X = Ratification, accession, definite signature; S = Signature;	Intergovernmental Agreement on the Asian Highway Network, 2003	Intergovernmental Agreement on the Trans-Asian Railway Network (with annexes), 2006	Intergovernmental Agreement on Dry Ports, 2013
	Infrastructure networks		
	1	2	3
COUNTRY			
Afghanistan	X		
Armenia	X	S	S
Azerbaijan	X	S	
Bangladesh	X	X	S
Bhutan	X		
Cambodia	X	X	S
China	X	X	S
Democratic People's Republic of Korea	X	X	
Georgia	X	X	
India	X	X	
Indonesia	X	S	S
Iran (Islamic Republic of)	X	X	S
Japan	X		
Kazakhstan	X	S	
Kyrgyzstan	X		
Lao People's Democratic Republic	X	X	S
Malaysia	S		
Mongolia	X	X	S
Myanmar	X		S
Nepal	X	X	S
Pakistan	X	X	
Philippines	X		
Republic of Korea	X	X	X
Russian Federation	X	X	S
Sri Lanka	X	X	S
Tajikistan	X	X	S
Thailand	X	X	X
Turkey	X	S	S
Uzbekistan	X	X	
Viet Nam	X	X	X

Table A1c UN TRANSPORT AGREEMENTS SERVICED BY ESCWA

Legend: **X = Ratification, accession, definite signature;** **S = Signature;**	**Agreement on International Roads in the Arab Mashreq, 2001**	**Agreement on International Railways in the Arab Mashreq, 2003**
	Infrastructure networks	
	1	**2**
COUNTRY		
Bahrain	**X**	**X**
Egypt	**X**	**X**
Iraq	**X**	
Jordan	**X**	**X**
Kuwait	**X**	**X**
Lebanon	**X**	**X**
Qatar	**X**	
Saudi Arabia	**X**	**X**
State of Palestine	**X**	**X**
Sudan	**X**	**X**
Syrian Arab Republic	**X**	**X**
United Arab Emirates	**X**	**X**
Yemen	**X**	**X**

ANNEX II

Table A2a. Statistics for 210 countries of the world (The World Bank)

		CO2 Emissions from Transport excl. marine bunkers and international aviation (million metric tonnes), 2001	CO2 Emissions from Transport excl. marine bunkers and international aviation (million metric tonnes), 2011	Energy Use per capita for transport, incl. indigenous production plus imports and stock changes (TOE), 2001	Energy Use per capita for transport, incl. indigenous production plus imports and stock changes (TOE), 2011	Nominal GDP (Current Billion US $), 2001	Nominal GDP (Current Billion US $), 2011	Nominal GDP (Current Billion US $), 2012	Average GDP Annual Growth Rate (%), 2001-2013
Afghanistan	AFG					2.5	17.9	20.5	9.8
Albania	ALB	1.5	2.3	0.5	0.7	4.1	13.0	12.6	4.1
Algeria	DZA	16.9	32.3	0.8	1.1	54.7	199.1	205.8	3.0
American Samoa	ASM								
Andorra	AND					1.3			4.4
Angola	AGO	1.2	6.8	0.5	0.7	8.9	104.1	114.1	10.7
Antigua and Barbuda	ATG					0.8	1.1	1.1	1.1
Argentina	ARG	36.5	46.9	1.6	2.0	268.7	446.0	475.5	6.9
Armenia	ARM	0.6	1.3	0.7	0.9	2.1	10.1	10.0	9.1
Aruba	ABW					1.9	2.6		-2.7
Australia	AUS	73.7	86.0	5.4	5.5	378.6	1386.9	1532.4	2.9
Austria	AUT	20.0	21.6	3.8	3.9	191.7	415.6	394.7	1.5
Azerbaijan	AZE	2.6	5.8	1.4	1.4	5.7	66.0	66.6	13.2
Bahamas. The	BHS					6.5	7.9	8.1	0.7
Bahrain	BHR	1.6	2.9	8.7	7.4	7.9	29.0		5.3
Bangladesh	BGD	3.8	8.4	0.2	0.2	47.0	111.9	116.4	6.2
Barbados	BRB					3.1	4.4	4.2	1.1
Belarus	BLR	6.1	11.0	2.5	3.1	12.4	64.3	63.3	6.0
Belgium	BEL	25.1	26.4	5.7	5.3	232.5	512.9	483.3	1.1
Belize	BLZ					0.9	1.5		2.8
Benin	BEN	1.0	3.3	0.3	0.4	2.5	7.3	7.6	4.0
Bermuda	BMU					3.7	5.6	5.5	-0.5
Bhutan	BTN					0.5	1.8	1.8	8.7
Bolivia	BOL	2.8	5.9	0.3	0.7	8.1	23.9	27.0	4.9
Bosnia and Herzegovina	BIH	2.1	3.4	1.1	1.8	5.7	18.3	17.5	2.5
Botswana	BWA	1.3	2.1	1.0	1.1	5.5	15.3	14.5	4.7
Brazil	BRA	126.7	181.9	1.1	1.4	553.6	2476.7	2252.7	3.5
Brunei Darussalam	BRN	0.8	1.3	6.5	9.4	5.6	16.4	17.0	0.7
Bulgaria	BGR	5.6	7.9	2.4	2.6	13.9	53.5	51.0	2.7
Burkina Faso	BFA					2.8	10.4	10.4	6.3

Burundi	BDI					0.9	2.4	2.5	4.0
Cambodia	KHM	1.5	2.0	0.3	0.4	4.0	12.8	14.0	7.6
Cameroon	CMR	1.8	2.8	0.4	0.3	9.6	25.5	25.3	3.5
Canada	CAN	146.7	166.0	8.0	7.3	715.4	1777.8	1821.4	1.7
Cape Verde	CPV					0.6	1.9	1.8	5.6
Cayman Islands	CYM								
Central African Republic	CAF					0.9	2.2	2.2	1.4
Chad	TCD					1.7	12.2	12.9	6.1
Channel Islands	CHI					6.2			4.1
Chile	CHL	15.9	21.6	1.6	1.9	72.3	251.2	269.9	4.3
China	CHN	259.3	623.3	0.9	2.0	1324.8	7321.9	8227.1	10.2
Colombia	COL	19.3	23.8	0.6	0.7	98.2	336.6	369.6	4.7
Comoros	COM					0.2	0.6	0.6	2.2
Congo. Dem. Rep.	COD	0.6	1.8	0.4	0.4	4.7	15.7	17.2	6.5
Congo. Rep.	COG	0.5	1.6	0.3	0.4	2.8	14.4	13.7	5.0
Costa Rica	CRI	3.1	4.6	0.7	1.0	16.4	41.0	45.1	4.7
Cote d'Ivoire	CIV	1.3	1.5	0.4	0.6	10.5	24.1	24.7	2.8
Croatia	HRV	4.5	5.8	1.8	2.0	23.1	61.8	59.2	0.5
Cuba	CUB	2.2	1.4	1.1	1.0	31.7	68.2		5.9
Curacao	CUW								
Cyprus	CYP	1.8	2.1	2.2	2.1	9.7	24.9	22.8	1.0
Czech Republic	CZE	12.9	16.5	4.1	4.1	64.4	216.0	196.4	2.3
Denmark	DNK	12.0	12.3	3.6	3.2	160.5	333.6	314.9	0.4
Djibouti	DJI					0.6			4.5
Dominica	DMA					0.3	0.5	0.5	2.4
Dominican Republic	DOM	5.7	4.9	0.8	0.7	24.9	55.7	59.0	6.4
Ecuador	ECU	9.5	16.0	0.7	0.8	24.5	76.8	84.0	4.3
Egypt. Arab Rep.	EGY	27.3	40.0	0.7	1.0	97.6	236.0	262.8	4.6
El Salvador	SLV	2.5	3.1	0.7	0.7	13.8	23.1	23.9	1.8
Equatorial Guinea	GNQ					1.7	16.8	17.7	3.8
Eritrea	ERI	0.3	0.2	0.2	0.1	0.8	2.6	3.1	1.8
Estonia	EST	2.0	2.2	3.6	4.2	6.2	22.5	22.4	2.8
Ethiopia	ETH	1.9	2.9	0.4	0.4	8.1	29.9	41.6	10.0
Faeroe Islands	FRO					1.2			
Fiji	FJI					1.7	3.8	3.9	0.9
Finland	FIN	11.9	12.3	6.4	6.4	124.6	262.1	247.5	0.9
France	FRA	133.5	122.1	4.2	3.9	1338.3	2779.7	2612.9	0.8
French Polynesia	PYF								
Gabon	GAB	0.3	0.5	1.3	1.3	4.7	18.8	18.4	3.7
Gambia. The	GMB					0.7	0.9	0.9	3.3
Georgia	GEO	1.1	2.3	0.6	0.8	3.2	14.4	15.7	5.8
Germany	DEU	168.0	148.7	4.2	3.8	1880.9	3624.9	3428.1	1.3
Ghana	GHA	2.8	5.5	0.4	0.4	5.3	39.6	40.7	7.7
Greece	GRC	19.7	19.5	2.6	2.4	129.8	289.6	249.1	-1.6
Greenland	GRL					1.1			1.4
Grenada	GRD					0.5	0.8	0.8	1.5

Guam	GUM								
Guatemala	GTM	4.1	5.5	0.6	0.7	18.7	47.7	50.2	3.6
Guinea	GIN					2.8	5.1	5.6	2.7
Guinea-Bissau	GNB					0.4	1.0	0.8	2.3
Guyana	GUY					0.7	2.6	2.9	2.8
Haiti	HTI	0.8	1.1	0.2	0.3	3.5	7.3	7.8	2.0
Honduras	HND	2.2	3.1	0.5	0.6	7.6	17.6	18.4	3.8
Hungary	HUN	9.2	11.3	2.5	2.5	52.7	137.4	124.6	0.5
Iceland	ISL	0.6	0.8	11.4	18.0	7.9	14.0	13.6	1.8
India	IND	93.9	169.9	0.4	0.6	494.0	1872.8	1841.7	7.3
Indonesia	IDN	69.2	114.8	0.7	0.9	160.4	846.3	878.0	5.9
Iran. Islamic Rep.	IRN	79.5	117.2	2.0	2.8	115.4	514.1		2.8
Iraq	IRQ	28.8	34.2	1.1	1.3	18.9	180.6	210.3	4.6
Ireland	IRL	10.7	10.5	3.7	2.9	105.2	225.8	210.8	1.2
Isle of Man	IMN					1.6			7.0
Israel	ISR	9.4	11.1	3.0	3.0	122.9	258.2		4.2
Italy	ITA	117.7	108.2	3.0	2.8	1123.7	2195.0	2014.7	-0.4
Jamaica	JAM	1.9	2.1	1.5	1.1	9.1	14.4	14.8	-0.4
Japan	JPN	258.4	219.7	4.0	3.6	4159.9	5896.8	5959.7	0.7
Jordan	JOR	3.7	5.3	1.0	1.1	9.0	28.8	31.0	5.3
Kazakhstan	KAZ	8.1	12.5	2.3	4.7	22.2	188.0	203.5	6.6
Kenya	KEN	2.7	4.7	0.4	0.5	13.0	33.6	40.7	4.8
Kiribati	KIR					0.1	0.2	0.2	1.4
Korea. Dem. Rep.	PRK	1.6	1.3	0.9	0.8				
Korea. Rep.	KOR	80.9	85.6	4.0	5.2	504.6	1114.5	1129.6	3.5
Kosovo	KSV	0.7	1.0	1.1	1.4	2.5	6.6	6.4	4.6
Kuwait	KWT	6.1	11.6	10.1	10.4	34.9	160.9		3.4
Kyrgyz Republic	KGZ	0.9	2.8	0.4	0.6	1.5	6.2	6.5	4.2
Lao PDR	LAO					1.8	8.3	9.4	8.0
Latvia	LVA	2.5	3.1	1.7	2.1	8.3	28.5	28.4	2.7
Lebanon	LBN	3.7	5.0	1.6	1.4	17.6	40.1	42.9	4.4
Lesotho	LSO					0.7	2.5	2.4	4.7
Liberia	LBR					0.5	1.5	1.7	11.2
Libya	LBY	11.4	12.0	3.1	2.2	28.4			3.1
Liechtenstein	LIE					2.5			3.5
Lithuania	LTU	3.3	4.2	2.4	2.4	12.2	42.9	42.3	3.1
Luxembourg	LUX	5.1	6.9	7.9	8.0	20.2	58.0	55.2	1.9
Macedonia. FYR	MKD	1.0	1.4	1.2	1.5	3.4	10.4	9.6	3.1
Madagascar	MDG					4.5	9.9	10.0	2.9
Malawi	MWI					1.7	5.6	4.3	3.7
Malaysia	MYS	33.6	43.0	2.1	2.6	92.8	289.3	305.0	4.8
Maldives	MDV					0.8	2.2	2.2	5.7
Mali	MLI					2.6	10.7	10.3	4.2
Malta	MLT	0.4	0.5	2.0	2.1	3.9	9.2	8.7	2.3
Marshall Islands	MHL					0.1	0.2	0.2	1.5
Mauritania	MRT					1.3	4.3	4.2	6.1

Mauritius	MUS					4.5	11.3	10.5	3.8
Mexico	MEX	107.3	152.0	1.4	1.6	733.5	1159.9	1178.1	2.4
Micronesia. Fed. Sts.	FSM					0.2	0.3	0.3	0.4
Moldova	MDA	0.5	1.1	0.8	0.9	1.5	7.0	7.3	4.3
Monaco	MCO					2.7	6.1		7.9
Mongolia	MNG	0.9	1.6	1.0	1.3	1.3	8.8	10.3	9.1
Montenegro	MNE		0.6		1.9	1.2	4.5	4.4	3.7
Morocco	MAR	8.5	14.3	0.4	0.5	37.7	99.2	96.0	4.6
Mozambique	MOZ	0.8	1.9	0.4	0.4	4.1	12.6	14.2	7.2
Myanmar	MMR	2.8	2.3	0.3	0.3				
Namibia	NAM	1.3	1.8	0.6	0.7	3.5	12.6	13.1	4.3
Nepal	NPL	0.7	1.9	0.4	0.4	6.0	19.1	19.0	4.2
Netherlands	NLD	32.6	33.4	4.7	4.6	400.7	832.0	770.6	0.9
New Caledonia	NCL								
New Zealand	NZL	12.0	13.5	4.4	4.1	53.3	162.6	167.3	1.6
Nicaragua	NIC	1.5	1.7	0.5	0.5	5.3	9.6	10.5	3.8
Niger	NER					1.9	6.4	6.8	5.3
Nigeria	NGA	26.3	23.6	0.8	0.7	44.1	245.7	262.6	6.5
Northern Mariana Islands	MNP								
Norway	NOR	12.1	13.6	5.9	5.7	170.9	491.1	499.7	1.3
Oman	OMN	2.9	8.8	3.8	8.4	19.9	70.0		5.1
Pakistan	PAK	26.7	36.2	0.4	0.5	72.3	213.9	225.1	4.2
Palau	PLW					0.2	0.2	0.2	-0.3
Panama	PAN	2.2	3.6	0.9	1.1	11.8	31.3	36.3	8.8
Papua New Guinea	PNG					3.1	12.4	15.7	6.2
Paraguay	PRY	3.0	4.5	0.7	0.7	7.7	26.0	25.5	4.9
Peru	PER	9.0	16.9	0.4	0.7	53.9	181.0	203.8	6.9
Philippines	PHL	26.4	23.3	0.5	0.4	76.3	224.1	250.2	5.2
Poland	POL	27.0	47.4	2.3	2.6	190.4	515.7	489.8	3.9
Portugal	PRT	17.9	17.1	2.4	2.2	120.3	237.7	212.3	-0.3
Puerto Rico	PRI					69.2	98.8	101.5	-1.0
Qatar	QAT	2.6	14.5	20.4	17.4	17.5	171.5		12.8
Romania	ROU	11.5	14.1	1.7	1.7	40.2	189.8	192.7	3.0
Russian Federation	RUS	194.0	247.5	4.3	5.1	306.6	1899.1	2014.8	3.8
Rwanda	RWA					1.7	6.4	7.1	7.8
Samoa	WSM					0.2	0.6	0.7	1.3
San Marino	SMR					0.8			2.9
Sao Tome and Principe	STP					0.1	0.2	0.3	4.4
Saudi Arabia	SAU	62.1	109.2	5.1	6.7	183.0	669.5	711.0	6.0
Senegal	SEN	1.2	2.1	0.3	0.3	4.9	14.4	14.0	3.7
Serbia	SRB	3.7	5.7	2.0	2.2	11.4	43.3	37.5	2.0
Seychelles	SYC					0.6	1.1	1.1	5.1
Sierra Leone	SLE					1.1	2.9	3.8	8.2
Singapore	SGP	6.0	8.1	5.1	6.5	91.1	245.0	274.7	5.7
Slovak Republic	SVK	5.3	7.1	3.5	3.2	30.3	95.9	91.1	4.0
Slovenia	SVN	3.7	5.6	3.4	3.5	20.5	50.3	45.3	1.2

Solomon Islands	SLB					0.4	0.9	1.0	5.8
Somalia	SOM								
South Africa	ZAF	36.1	51.2	2.5	2.8	118.5	401.8	384.3	3.3
South Sudan	SSD						19.1	10.2	-2.6
Spain	ESP	94.0	91.3	3.1	2.7	608.9	1453.2	1323.0	0.6
Sri Lanka	LKA	5.2	7.2	0.4	0.5	15.7	59.2	59.4	6.7
St. Kitts & Nevis	KNA					0.5	0.7	0.8	2.6
St. Lucia	LCA					0.7	1.3	1.2	1.8
St. Vincent & the Grenadines	VCT					0.4	0.7	0.7	1.7
Sudan	SDN	3.5	7.6	0.4	0.4	13.2	64.0	58.8	2.2
Suriname	SUR					0.8	4.4	5.0	4.3
Swaziland	SWZ					1.3	4.0	3.7	1.8
Sweden	SWE	21.2	22.4	5.7	5.2	227.4	536.3	523.8	1.9
Switzerland	CHE	16.1	16.9	3.7	3.2	262.6	657.4	631.2	2.0
Syrian Arab Republic	SYR	8.0	11.9	0.9	0.9	21.1		73.7	5.1
Tajikistan	TJK	0.1	0.3	0.3	0.3	1.1	6.5	7.0	6.9
Tanzania	TZA	1.7	3.2	0.4	0.4	10.4	23.9	28.2	6.9
Thailand	THA	44.9	58.3	1.2	1.8	115.5	345.7	366.0	3.4
Timor-Leste	TLS					0.4	1.1	1.3	8.1
Togo	TGO	0.3	1.0	0.4	0.4	1.3	3.7	3.8	3.6
Tonga	TON					0.2	0.4	0.5	0.9
Trinidad and Tobago	TTO	1.6	2.8	9.2	15.7	8.8	23.6	23.3	2.8
Tunisia	TUN	4.1	5.7	0.8	0.9	22.1	46.4	45.7	3.4
Turkey	TUR	33.3	45.7	1.1	1.5	196.0	774.8	789.3	4.4
Turkmenistan	TKM	5.3	7.2	3.3	4.8	3.5	29.2	35.2	11.2
Turks and Caicos Islands	TCA								
Tuvalu	TUV					0.0	0.0	0.0	1.7
Uganda	UGA					5.8	16.8	19.9	7.0
Ukraine	UKR	28.2	32.6	2.8	2.8	38.0	163.4	176.3	1.9
United Arab Emirates	ARE	16.1	30.9	11.9	7.4	103.3	348.6		3.3
United Kingdom	GBR	121.1	116.8	3.8	3.0	1485.1	2478.9	2471.8	0.9
United States	USA	1709.8	1638.1	7.8	7.0	10625.3	15533.8	16244.6	1.5
Uruguay	URY	2.4	3.2	0.8	1.3	20.9	46.4	49.9	1.8
Uzbekistan	UZB	10.2	7.9	2.0	1.6	11.4	45.3	51.1	8.2
Vanuatu	VUT					0.3	0.8	0.8	4.1
Venezuela. RB	VEN	36.4	43.0	2.3	2.4	122.9	316.5	381.3	4.5
Vietnam	VNM	11.2	32.9	0.4	0.7	35.3	135.5	155.8	6.2
Virgin Islands (U.S.)	VIR								
West Bank and Gaza	PSE					3.3			6.3
Yemen. Rep.	YEM	4.8	5.8	0.3	0.3	9.9	31.7	35.6	2.3
Zambia	ZMB	0.8	0.7	0.6	0.6	3.7	19.2	20.7	6.4
Zimbabwe	ZWE	1.7	1.3	0.8	0.7	6.8	8.9	9.8	0.2

Table A2b. Statistics for 210 countries of the world (The World Bank, UNECE, OECD)

		GINI Index (0-perfect equality, 100 - perfect inequality), 2010 or latest	Logistics performance index (1=low to 5=high), 2014	Paved Roads (% of total), 2011 or latest	Change in Population Older than 65 years old (%), 2003-2013	Road Density (km of road per 100 sq. km of land area), 2011 or latest	Rail Density (km of lines operated per 1,000 sq. km), 2012 or latest	Total trade- sum of merchandise and services exports and imports, (% of GDP), 2012	Investment in Inland Transport Infrastructure (% of GDP), 2011 or latest	Private Investment in Inland Transport Infrastructure (billion US $), 2000-2012
Afghanistan	AFG	27.82 ('08)	2.1	36.4 ('10)	16.0	4 ('10)		25.9		
Albania	ALB	34.51 ('08)	2.4('10)	39.0 ('02)	37.3	63 ('02)		86.1	2.3	0.3
Algeria	DZA	35.30 ('95)	2.6	77.1 ('10)	9.2	5 ('10)		65.4		0.3
American Samoa	ASM									
Andorra	AND									
Angola	AGO	42.66 ('09)	2.5	10.4 ('01)	-2.4	4 ('01)		105.0		0.1
Antigua and Barbuda	ATG			33.0 ('02)	0.1			112.2		
Argentina	ARG	44.49	3.0	32.2	8.3	9		38.6		1.9
Armenia	ARM	31.30	2.7	93.6 ('09)	-7.4	26		78.8		0.8
Aruba	ABW				39.5					
Australia	AUS	35.20 ('98)	3.8	43.3	12.6	11		41.7	1.8	
Austria	AUT	29.15 ('00)	3.6	100.0	16.8	137	99 ('07)	112.3	0.8	
Azerbaijan	AZE	33.71 ('08)	2.4	55.6	-9.8	22	24 ('10)	81.3	3.4	
Bahamas, The	BHS		2.9	57.4 ('01)	30.6	19 ('01)		107.4		
Bahrain	BHR		3.1	83.7	-4.6	546				
Bangladesh	BGD	32.12	2.6	9.5 ('03)	14.0	15 ('09)		58.2		
Barbados	BRB			100.0 ('04)	-2.9	372 ('01)				
Belarus	BLR	26.48 ('11)	2.6	86.5	-3.5	42	5 ('11)	162.1		0.0
Belgium	BEL	32.97 ('00)	4.0	78.2	4.4	504	211 ('09)	221.4	0.8 ('09)	
Belize	BLZ			17.0 ('01)	-4.7	13 ('01)				0.0
Benin	BEN	38.62 ('04)	2.6	9.5 (04)	2.3	17 ('01)		47.6		0.5
Bermuda	BMU							43.6		
Bhutan	BTN	38.73 ('12)	2.3	34.2	20.9	22		104.0		
Bolivia	BOL	56.29 ('08)	2.5	11.6	13.5	7		81.7		0.0
Bosnia and Herzegovina	BIH	36.21 ('07)	2.7	92.1 ('10)	27.9	45		102.9		
Botswana	BWA	61,00 ('94)	2.5	32.6 ('05)	17.2	4 ('05)		103.4		
Brazil	BRA	54.69 ('09)	2.9	13.5	27.8	19		26.5		59.2
Brunei Darussalam	BRN			82.3	41.9	54		100.0		
Bulgaria	BGR	28.19 ('07)	3.2	98.6	12.8	18	51	139.4	1.1	0.5
Burkina Faso	BFA	39.79 ('09)	2.6	20.6	-7.0	6		52.7		
Burundi	BDI	33.27 ('06)	2.6	10.4 ('04)	-14.3	44 ('04)		49.1		
Cambodia	KHM	36.03 ('09)	2.7	6.3 ('04)	29.2	22 ('09)		165.7		0.2

Cameroon	CMR	38.91 ('07)	2.3	10.1 ('10)	-3.4	6 ('08)		61.2		
Canada	CAN	32.56 ('00)	3.9	39.9 ('04)	18.1	10 ('10)	7 ('09)	61.6	1.3	
Cape Verde	CPV	50.52 ('02)		69.0 ('01)	-5.2	33 (’01)		93.5		
Cayman Islands	CYM			97.9		184				
Central African Republic	CAF	56.30 ('08)	2.4	6.8 ('10)	-3.3	3 ('10)		24.8		
Chad	TCD	39.78 ('03)	2.5	0.8 ('00)	-11.8	3 ('06)		59.0		
Channel Islands	CHI				13.6			0.0		
Chile	CHL	52.06 ('09)	3.3	23.8	29.7	10		69.2		7.9
China	CHN	42.06 ('09)	3.5	63.7	20.6	43		52.8		33.7
Colombia	COL	55.91	2.6		25.3	19		36.5		6.0
Comoros	COM	64.30 ('04)	2.4	76.5 ('01)	-6.2	39 (’01)		54.5		0.0
Congo, Dem. Rep.	COD	44.43 ('06)	1.9	1.8 ('04)	1.6	7 ('04)		69.4		
Congo, Rep.	COG	47.32 ('05)	2.1	7.1 ('06)	-4.5	5 ('06)		118.4		0.7
Costa Rica	CRI	50.73 ('09)	2.7	26.0	23.4	83		84.8		0.9
Cote d'Ivoire	CIV	41.50 ('08)	2.8	7.9 ('07)	8.6	25 ('07)		89.7		0.2
Croatia	HRV	33.65 ('08)	3.1	91.1	10.2	52	73 ('11)	85.4	1.2	
Cuba	CUB		2.2	49.0 ('01)	26.9	55 (’01)				
Curacao	CUW				22.7					
Cyprus	CYP		3.0	65.8	17.1	141		86.6		
Czech Republic	CZE		3.5	100.0 ('04)	19.8	166	198	173.7	1.1	
Denmark	DNK		3.8	100.0	20.1	172		102.4	0.6 ('10)	
Djibouti	DJI	39.96 ('02)	2.1	45.0 ('01)	23.6	14 (’01)				0.6
Dominica	DMA			81.9 ('10)		121 ('10)		93.9		
Dominican Republic	DOM	47.20	2.9	49.4 ('01)	15.0	26 (’01)		62.5		1.8
Ecuador	ECU	49.26	2.7	14.8 ('07)	20.3	17 ('07)		64.1		1.5
Egypt, Arab Rep.	EGY	30.77 ('08)	3.0	92.2 ('10)	6.3	14 ('10)		53.1		2.2
El Salvador	SLV	48.33 ('09)	3.0	53.1	20.1	35		78.6		
Equatorial Guinea	GNQ		2.4		-18.6	10 (’01)		121.5		
Eritrea	ERI		2.1	21.8 ('01)	18.9	3 (’01)		45.9		
Estonia	EST	36.00 ('04)	3.3	18.2	10.9	129	48	197.4	1.6	
Ethiopia	ETH	33.60 ('11)	2.6	13.7 ('07)	11.0	4 ('07)		50.0		
Faeroe Islands	FRO									
Fiji	FJI	42.83 ('09)	2.5	49.2 ('01)	42.2	19 (’01)		87.3		
Finland	FIN	26.88 ('00)	3.6	65.8	22.6	23	26 ('11)	81.6	0.7	
France	FRA	32.70 (’95)	3.8	100.0	9.5	192	93 ('09)	61.9	0.9	
French Polynesia	PYF				54.7					
Gabon	GAB	41.45 ('05)	2.2	12.0 ('07)	-10.2	3 ('07)		85.2		0.2
Gambia, The	GMB	47.28 ('03)	2.2	19.3 ('04)	-7.8	33 ('04)		77.6		
Georgia	GEO	42.10	2.5	94.1 ('07)	3.7	27	34 ('10)	90.0	4.5	0.6
Germany	DEU	28.31 ('00)	4.1	100.0 ('03)	18.4	180	116	92.4	0.6	
Ghana	GHA	42.76 ('06)	2.6	12.6 ('09)	7.6	46 ('09)		92.1		0.0
Greece	GRC	34.27 ('00)	3.2	92.0 ('00)	9.4	89	23 ('08)	58.6	1.0 ('07)	
Greenland	GRL									
Grenada	GRD			61.0 ('01)	-7.8	306 (’01)		79.5		
Guam	GUM				34.8					
Guatemala	GTM	55.89 ('06)	2.8	44.8	8.1	15		62.8		

Guinea	GIN	39.35 ('07)	2.5	9.8 ('03)	-6.1	18		73.3		0.2
Guinea-Bissau	GNB	35.52 ('02)	2.4	27.9 ('02)	-3.3	12 (’02)		42.3		
Guyana	GUY	44.50 (’98)	2.5	7.4 ('01)	-16.1	4 (’01)		141.0		
Haiti	HTI	59.21 ('01)	2.3	24.3 ('01)	10.8	15 (’01)		64.3		
Honduras	HND	56.95 ('09)	2.6	20.4 ('01)	9.3	12 (’01)		126.3		0.1
Hungary	HUN	31.18 ('07)	3.5	37.9	11.3	216	99 ('10)	189.0	1.2 ('10)	
Iceland	ISL		3.4	40.7	9.6	13		114.7	0.4	
India	IND	33.90	3.1	53.8	15.4	143		57.4	0.2	79.6
Indonesia	IDN	38.14 ('11)	3.1	57.0	8.5	26		49.7		3.9
Iran, Islamic Rep.	IRN	38.28 ('05)		74.3	13.4	13				
Iraq	IRQ	30.86 ('07)	2.3	84.3 ('01)	-8.3	10 ('10)		79.7		0.5
Ireland	IRL	34.28 ('00)	3.9	100.0 ('10)	8.6	137 ('10)	27 ('10)	189.2	0.9 ('07)	
Isle of Man	IMN									
Israel	ISR	39.20 ('01)	3.3	100.0	7.2	84	41 ('06)			
Italy	ITA	36.03 ('00)	3.7	100.0 ('03)	10.3	162 ('05)	80 ('11)	59.4	0.5 ('10)	
Jamaica	JAM	45.51 ('04)	2.8	73.3 ('05)	4.1	201		87.8		0.9
Japan	JPN		3.9	78.2 ('03)	33.7	90		33.6	1.1 ('10)	
Jordan	JOR	35.43	2.9	100.0	12.6	8		124.4		1.4
Kazakhstan	KAZ	29.04 ('09)	2.7	88.7	-9.6	4	5 ('07)	76.6		0.3
Kenya	KEN	47.68 ('05)	2.8	7.0	-2.7	28		78.2		0.4
Kiribati	KIR				17.7	92 (’01)		62.6		
Korea, Dem. Rep.	PRK			2.8 ('06)	39.1	21 ('06)				
Korea, Rep.	KOR	31.6 (’98)	3.7	80.4	43.3	106		113.9	0 ('08)	
Kosovo	KSV			26.0 ('10)		64 ('10)		19.0		0.1
Kuwait	KWT		3.0	85.0 ('04)	-32.2	39				
Kyrgyz Republic	KGZ	33.38 ('11)	2.2	91.1 ('01)	-26.4	17 ('07)	2 ('08)	154.9		
Lao PDR	LAO	36.74 ('08)	2.4	13.7 ('09)	2.4	17		64.6		0.0
Latvia	LVA	34.81 ('09)	3.4	20.9 ('09)	13.9	108	33	134.9	1.4	
Lebanon	LBN		2.7		18.8	67 ('05)		144.6		0.2
Lesotho	LSO	52.50 ('03)	2.4	53.0 ('05)	-9.0	20 (’01)		172.6		
Liberia	LBR	38.16 ('07)	2.6	6.2 ('01)	-0.1	10 (’01)		86.3		0.1
Libya	LBY		2.5	57.2 ('01)	16.1	5 (’01)				
Liechtenstein	LIE								0.9 ('05)	
Lithuania	LTU	37.57 ('08)	3.2	30.1	6.5	127	33 ('11)	172.8	1.5	
Luxembourg	LUX	30.76 ('00)	3.9	100.0 ('04)	-0.9	202 ('04)	106 ('09)	289.5	0.9	
Macedonia, FYR	MKD	43.56	2.5	58.3	14.2	54	36 ('11)	133.4	0.5	0.3
Madagascar	MDG	44.11	2.4	16.3	-4.4	6		45.6		0.1
Malawi	MWI	43.91	2.8	45.0 ('03)	5.0	13 ('03)		93.6		
Malaysia	MYS	46.21 ('09)	3.6	80.9	29.0	47		166.0		5.9
Maldives	MDV	37.37 ('04)	2.7	100.0 ('05)	15.2	29 ('05)		201.2		0.5
Mali	MLI	33.02	2.5	24.6 ('09)	-13.2	2 ('09)		49.5		0.1
Malta	MLT		3.1	87.5 ('08)	32.4	968 ('08)		208.4	0.1 ('05)	
Marshall Islands	MHL							93.6		
Mauritania	MRT	40.46 ('08)	2.2	34.6	0.4	1		126.2		
Mauritius	MUS		2.5	98.0 ('09)	36.0	102 ('10)		130.6		
Mexico	MEX	47.16	3.1	37.8	24.6	19		67.8	0.5	17.6

Micronesia, Fed. Sts.	FSM	61.10 ('00)		17.5 ('01)	3.7	34 (’01)		74.9		
Moldova	MDA	33.03	2.7	86.2	5.4	38	34 ('10)	129.8	0.1	0.1
Monaco	MCO			100.0 ('10)		3850('10)				
Mongolia	MNG	36.52 ('08)	2.4	3.5 ('02)	2.9	1 ('09)		137.8		
Montenegro	MNE	28.58	2.9	70.4	4.7	57		104.3	0.5	
Morocco	MAR	40.88 (07)		70.6	1.8	13		92.2		0.4
Mozambique	MOZ	45.66 ('08)	2.2	20.8 ('09)	3.3	4 ('09)		111.7		0.3
Myanmar	MMR		2.2	45.7	7.8	6				
Namibia	NAM	63.90 ('04)	2.7	14.5 ('10)	7.3	6		84.7		
Nepal	NPL	32.82	2.6	53.9 ('08)	24.6	14 ('08)		48.0		
Netherlands	NLD		4.0	90.0 ('00)	23.4	331	68 ('05)	187.4	0.6	
New Caledonia	NCL				56.2	30 ('06)				
New Zealand	NZL	36.20 (’97)	3.6	66.2	17.6	35		13.8	0.7	
Nicaragua	NIC	40.47 ('05)	2.7	13.3	17.8	18		98.2		0.1
Niger	NER	34.55 ('08)	2.4	20.6 ('08)	3.8	2 ('10)		67.0		
Nigeria	NGA	48.83	2.8	15.0 ('04)	-0.4	21 ('04)		72.9		3.4
Northern Mariana Islands	MNP									
Norway	NOR	25.79 ('00)	4.0	80.7 ('10)	6.6	29	13	66.6	0.9	
Oman	OMN		3.0	49.3	14.6	19				
Pakistan	PAK	30.02 ('08)	2.8	72.6	8.3	33		36.3		2.2
Palau	PLW							64.4		
Panama	PAN	51.92	3.2	41.8	23.6	20		143.8		0.1
Papua New Guinea	PNG		2.4	3.5 ('01)	13.8	4 (’01)		76.7		
Paraguay	PRY	52.42	2.8	15.6	18.4	8		80.0		
Peru	PER	48.14	2.8	13.3	23.8	10		50.5		5.7
Philippines	PHL	42.98 ('09)	3.0	9.9 ('03)	16.7	67 ('03)		60.2		2.3
Poland	POL	32.73 ('11)	3.5	68.0	11.4	132	120	91.7	2.5	
Portugal	PRT	32.73 (’97)	3.6	86.0 ('04)	11.8	24	28	79.2	1.1 ('10)	
Puerto Rico	PRI			95.0 ('04)	17.5	303 ('10)				
Qatar	QAT	41.10 ('07)	3.5	90.0 ('00)	-34.1	79				
Romania	ROU	27.42 ('11)	3.3	56.5 ('09)	5.6	47	84	86.2	2.9	0.1
Russian Federation	RUS	40.11 ('09)	2.7	67.4 ('99)	-2.4	6	5 ('08)	51.4	1.4	9.3
Rwanda	RWA	50.82 ('11)	2.8	19.0 ('04)	-13.1	53 ('04)		48.1		
Samoa	WSM			14.2 ('01)	9.3	82 (’01)		108.4		
San Marino	SMR					584				
Sao Tome and Principe	STP	50.82 ('01)	2.7	68.1 ('01)	-16.2	33 (’01)		73.5		
Saudi Arabia	SAU		3.1	21.5 ('05)	-12.3	11 ('05)		11.9		
Senegal	SEN	40.30 ('11)	2.6	35.5 ('10)	-6.1	8		63.2		0.5
Serbia	SRB	29.62	3.0	63.5	4.7	50	43 ('10)	101.7	1.2	
Seychelles	SYC	65.77 ('07)		96.5	-0.3	110		129.8		
Sierra Leone	SLE	35.35 ('11)		8.0 ('02)	10.0			81.7		0.1
Singapore	SGP		4.0	100.0	28.8	481		373.5		
Slovak Republic	SVK	26.00 ('09)	3.3	100.0	12.2	88	74	188.8	1.1	
Slovenia	SVN	31.15 ('04)	3.4	100.0	15.0	193	107 ('11)	164.7	0.6	
Solomon Islands	SLB		2.6	2.4 ('01)	15.8	5 (’01)		130.6		
Somalia	SOM		1.8	11.8 ('01)	-3.3	3 (’01)				

South Africa	ZAF	63.14 ('09)	3.4	17.3 ('01)	40.3	30 (’01)		63.2		4.1
South Sudan	SSD	45.53 ('09)			10.9					
Spain	ESP	34.66 ('00)	3.7	99.0 ('03)	5.4	132	38 ('11)	63.4	1.3	
Sri Lanka	LKA	36.40	2.7	14.9 ('10)	26.4	174 ('10)		62.0		0.5
St. Kitts & Nevis	KNA							75.0		
St. Lucia	LCA				21.0			123.2		
St. Vincent & the Grenadines	VCT			70.0 ('03)	-2.1	213 ('03)		87.8		
Sudan	SDN	35.29 ('09)	2.2	36.3 ('01)	7.6	1 (’01)		26.2		0.0
Suriname	SUR	52.90 (’99)		26.3 ('03)	11.8	3 ('03)		104.3		
Swaziland	SWZ	51.49		30.0 ('02)	13.4	21 (’02)		102.8		
Sweden	SWE	25.00 ('00)	4.0	23.2	12.4	129	34 ('10)	85.9	0.8	
Switzerland	CHE	33.68 ('00)	3.8	100.0	13.7	173		86.5	1.5 ('10)	
Syrian Arab Republic	SYR	35.78 ('04)	2.1	64.9 ('10)	20.6	38 ('10)		16.0		0.1
Tajikistan	TJK	30.83 ('09)	2.5		-13.9	19 (’01)		98.0		
Tanzania	TZA	37.58 ('07)	2.3	14.9 ('09)	8.3	9		76.5		0.2
Thailand	THA	39.37	3.4	98.5 ('00)	33.7	35 ('06)		158.6		0.9
Timor-Leste	TLS		1.6(’12)		26.5			111.6		
Togo	TGO	39.29 ('11)	2.3	21.0 ('07)	-1.6	21 ('07)		73.4		0.6
Tonga	TON			27.0 ('01)	-1.3	91 (’01)		47.9		
Trinidad and Tobago	TTO			51.1 ('01)	30.6	162 (’01)		93.8		
Tunisia	TUN	36.06	2.6	76.3	10.5	12		109.0		0.8
Turkey	TUR	40.03	3.5	89.4 ('10)	16.0	47	15 ('10)	57.5	1.2	10.7
Turkmenistan	TKM	40.80 (’98)	2.3	81.2 ('01)	-9.8	5 (’01)		76.3		
Turks and Caicos Islands	TCA									
Tuvalu	TUV							68.6		
Uganda	UGA	44.30 ('09)	2.8(’10)	23.0 ('03)	-5.7	29 ('03)		63.8		0.4
Ukraine	UKR	25.62	3.0	97.9	0.2	28		107.5		0.1
United Arab Emirates	ARE		3.5	100.0 ('00)	-59.0	5 ('04)				
United Kingdom	GBR	36.00 ('99)	4.0	100.0	10.2	172	129 ('10)	66.3	0.7	
United States	USA	40.81 ('00)	3.9	100.0 ('09)	13.6	67	27 ('10)	31.5	0.6 ('03)	
Uruguay	URY	45.32	2.7	10.0 ('04)	5.5	44 ('04)		52.9		0.3
Uzbekistan	UZB	36.72 ('03)	2.4	87.3 ('01)	-7.0	18 (’01)		43.2		0.0
Vanuatu	VUT			23.9 ('01)	21.3	9 (’01)		104.0		
Venezuela, RB	VEN	44.77 ('06)	2.8	33.6 ('01)	28.7	11 (’01)		46.5		0.0
Vietnam	VNM	35.57 ('08)	3.2	47.6 ('07)	0.5	48 ('07)		175.4		1.1
Virgin Islands (U.S.)	VIR				66.3					
West Bank and Gaza	PSE	35.50 ('09)		100.0	21.9	78				
Yemen, Rep.	YEM	37.69 ('06)	2.2	8.7 ('05)	6.3	14 ('05)		57.5		0.2
Zambia	ZMB	57.49	2.5	22.0 ('01)	-3.7	12 ('01)		88.3		0.0
Zimbabwe	ZWE	50.10 (’95)	2.3	19.0 ('02)	9.1	25 (’02)		75.8		0.1

Table A2c. Statistics for 210 countries of the world (The World Bank, UNECE, UNDP)

		Goods Transported by Road (million tons - km), 2011 or latest	Goods Transported by Rail (million tons - km), 2012 or latest	Unemployment (% of total labor force), 2012 or latest	HDI Index (0-low human development, 1-very high human development), 2012	RAI Index (% of), 2004	Passenger Cars per 1,000 inhabitants, 2001	Passenger Cars per 1,000 inhabitants, 2011	Fatalities per 100,000 passenger cars, 2001	Fatalities per 100,000 passenger cars, 2011
Afghanistan	AFG	7033		8.5 ('05)	0.374	22				
Albania	ALB	4600 ('10)	46	14.2 10)	0.749	31	44	102 ('10)	222	98
Algeria	DZA	1822	1248	10 ('11)	0.713	59				
American Samoa	ASM									
Andorra	AND				0.846					
Angola	AGO	4709 ('01)			0.508	42				
Antigua and Barbuda	ATG				0.76					
Argentina	ARG		12111	7.2	0.811	77				
Armenia	ARM	287	346	18.4 ('11)	0.729	80				
Aruba	ABW			5.7 ('07)						
Australia	AUS	194906	59649	5.2	0.938					
Austria	AUT	16997	21683	4.3	0.895	95	520	531 ('10)	23	12
Azerbaijan	AZE	12356	8212	5.2	0.734	67	42	90 ('10)	163	113
Bahamas, The	BHS			14.0	0.794	82				
Bahrain	BHR			1.1 ('10)	0.796	99				
Bangladesh	BGD		710	5.0 ('09)	0.515	37				
Barbados	BRB			11.6	0.825	100				
Belarus	BLR	19436	48351	6.1 ('09)	0.793	64				
Belgium	BEL	43658	5439	7.5	0.897	100	461	493	31	16
Belize	BLZ			8.2 ('08)	0.702	78				
Benin	BEN		36 ('08)	0.7 ('02)	0.436	32				
Bermuda	BMU									
Bhutan	BTN			2.1	0.538	47				
Bolivia	BOL		1060 ('08)	3.4 ('09)	0.675	48				
Bosnia and Herzegovina	BIH	2363	1325	28.1	0.735	81				
Botswana	BWA		674	17.6 ('06)	0.634	79				
Brazil	BRA		267700	6.7 ('11)	0.73	53				
Brunei Darussalam	BRN				0.855	81				

Bulgaria	BGR	17943	2850	12.3	0.782	98	263	367	48	24
Burkina Faso	BFA		1	3.3 ('07)	0.343	25				
Burundi	BDI				0.355	19				
Cambodia	KHM		92 ('05)	0.2	0.543	81				
Cameroon	CMR		1057	3.8 ('10)	0.495	20				
Canada	CAN	136393	352535	7.2	0.911		458	497 ('09)	19	13
Cape Verde	CPV				0.586	82				
Cayman Islands	CYM			4.0 ('08)						
Central African Republic	CAF				0.352					
Chad	TCD				0.34	5				
Channel Islands	CHI									
Chile	CHL		4032	6.4	0.819	76				
China	CHN	5137474	2518310	4.0 ('07)	0.699	97				
Colombia	COL	65688 ('09)	12 ('09)	10.6	0.719	78				
Comoros	COM				0.429	73				
Congo, Dem. Rep.	COD		170		0.304	26				
Congo, Rep.	COG		257		0.534	48				
Costa Rica	CRI			7.8	0.773	82				
Cote d'Ivoire	CIV		675 ('07)		0.432	56				
Croatia	HRV	8926	2332	15.8	0.805	84	267	355	55	28
Cuba	CUB	2461	1351 ('08)	3.2 ('11)	0.78	81				
Curacao	CUW									
Cyprus	CYP	923		11.8	0.848	89	399	552	35	15
Czech Republic	CZE	54830	11423	7.0	0.873	97	345	437	38	17
Denmark	DNK	12025	2030 ('04)	7.5	0.901	99	350	384 ('09)	23	14
Djibouti	DJI		97 ('05)	59.5 ('02)	0.445	81				
Dominica	DMA				0.745	88				
Dominican Republic	DOM			14.7 ('11)	0.702	62				
Ecuador	ECU	1193 ('07)		4.1	0.724	73				
Egypt, Arab Rep.	EGY		1592	12.7	0.662	77				
El Salvador	SLV			6.1	0.68	64				
Equatorial Guinea	GNQ				0.554	53				
Eritrea	ERI				0.351	29				
Estonia	EST	7365	4807	10.1	0.846	86	298	428	49	18
Ethiopia	ETH	2456 ('01)		17.0 ('06)	0.396	32				
Faeroe Islands	FRO			3.2 ('05)						
Fiji	FJI			8.7 ('09)	0.702	76				
Finland	FIN	23770	9275	7.6	0.892	82	417	553	20	10
France	FRA	293000	31616	9.9	0.893	99	469	483	28	13
French Polynesia	PYF			11.7 ('07)						
Gabon	GAB		2417		0.683	45				
Gambia, The	GMB				0.439	77				
Georgia	GEO	628	6055 ('10)	15.0	0.745	82	56	11	225	1069
Germany	DEU	468900	105894	5.4	0.92	89	539	525	16	9
Ghana	GHA		181 ('08)	4.2 ('10)	0.558	61				

Greece	GRC	20597	538	24.2	0.86	90				
Greenland	GRL			8.4 ('06)						
Grenada	GRD				0.77	98				
Guam	GUM			12.2						
Guatemala	GTM			2.9	0.581	55				
Guinea	GIN				0.355	22				
Guinea-Bissau	GNB				0.364	52				
Guyana	GUY				0.636	46				
Haiti	HTI				0.456	28				
Honduras	HND			4.4 ('11)	0.632	40				
Hungary	HUN	34528	1179	10.9	0.831	98	244	298	50	21
Iceland	ISL	810		6.0	0.906	81	561	646	15	6
India	IND	1106500	625723	3.6	0.554	61				
Indonesia	IDN		7166	6.6 ('11)	0.629	94				
Iran, Islamic Rep.	IRN		22604	10.5 ('08)	0.742	66				
Iraq	IRQ		249	15.3 ('08)	0.59	58				
Ireland	IRL	9941	91	14.7	0.916	93	363	426	29	11 ('10)
Isle of Man	IMN			2.4 ('06)						
Israel	ISR		1099	6.9	0.9	88	231	275 ('10)	36	16
Italy	ITA	118565	11249	10.7	0.881	98	583	611	21	10
Jamaica	JAM			13.7	0.73	93				
Japan	JPN	254078 ('10)	20255	4.3	0.912	99				
Jordan	JOR		344	12.2	0.7	79				
Kazakhstan	KAZ	121074	235846	5.3	0.754	77	71	193 ('10)	210	69
Kenya	KEN		1399 ('06)		0.519	44				
Kiribati	KIR				0.629					
Korea, Dem. Rep.	PRK					44				
Korea, Rep.	KOR	12545 ('04)	9996	3.2	0.909	89				
Kosovo	KSV			30.9						
Kuwait	KWT			3.6 ('11)	0.79	82				
Kyrgyz Republic	KGZ	1302,8	923	8.2 ('08)	0.622	76	39	58 ('08)	370	373 ('08)
Lao PDR	LAO	320		1.4 ('05)	0.543	64				
Latvia	LVA	12131	16930	14.9	0.814	90	251	297	88	29
Lebanon	LBN			6.2 ('09)	0.745	87				
Lesotho	LSO			25.3 ('08)	0.461	67				
Liberia	LBR			3.7 ('10)	0.388	66				
Libya	LBY				0.769	78				
Liechtenstein	LIE	300 ('10)			0.883					
Lithuania	LTU	21512	14172	13.2	0.818	97	327	566	62	17
Luxembourg	LUX	8837	189	5.1	0.875		636	664	25	10
Macedonia, FYR	MKD	5381	497 ('10)	31.0	0.74	78	152	152	35	55
Madagascar	MDG		12 ('02)	2.6 ('05)	0.483	25				
Malawi	MWI		33 ('08)	7.8 ('04)	0.418	38				
Malaysia	MYS		3071	3.0	0.769	82				
Maldives	MDV			14.4 ('06)	0.688					
Mali	MLI		189 ('02)	8.8 ('04)	0.344	14				

Malta	MLT	250		6.4	0.847	100	497	594	8	7
Marshall Islands	MHL									
Mauritania	MRT		7536	31.2 ('08)	0.467	31				
Mauritius	MUS			8.7	0.737	70				
Mexico	MEX	226900	69185	4.9	0.775	61				
Micronesia, Fed. Sts.	FSM				0.645	82				
Moldova	MDA	3538,1	945	5.6	0.66	66	71	126	164	97
Monaco	MCO									
Mongolia	MNG	1834 ('10)	11418	4.8 ('11)	0.675	36				
Montenegro	MNE	102,465		19.6	0.791					
Morocco	MAR	800 ('09)	5976	9.0	0.591	36				
Mozambique	MOZ		1193		0.327	27				
Myanmar	MMR	4	885 ('06)		0.498	23				
Namibia	NAM	591 ('02)		16.7	0.608	57				
Nepal	NPL			2.7 ('08)	0.463	17				
Netherlands	NLD	75747	4331 ('04)	5.3	0.921	100	418	471	15	8
New Caledonia	NCL									
New Zealand	NZL	18110		6.9	0.919	83				
Nicaragua	NIC			8.0 (10)	0.599	28				
Niger	NER				0.304	37				
Nigeria	NGA		77 ('07)		0.471	47				
N. Mariana Islands	MNP			6.5 ('05)						
Norway	NOR	16965	2092 ('05)	3.2	0.955	83	415	480	15	7
Oman	OMN				0.731	81				
Pakistan	PAK	177954	1757	5.0 ('08)	0.515	61				
Palau	PLW			4.2 ('05)	0.791					
Panama	PAN			4.0	0.78	77				
Papua New Guinea	PNG				0.466	68				
Paraguay	PRY	11785 ('10)		4.9	0.669	54				
Peru	PER		900	3.6	0.741	43				
Philippines	PHL		1 ('04)	7.0	0.654	80				
Poland	POL	218888	32904	10.1	0.821	95	275	470	53	23
Portugal	PRT	37472	2064	15.6	0.816	88	538	444	30	19
Puerto Rico	PRI			14.5		98				
Qatar	QAT			0.5	0.834	81				
Romania	ROU	26347	11200	7.0	0.786	89	144	203	76	47
Russian Federation	RUS	247936	2222388	5.5	0.788	81	178('05)	255	133('0	64
Rwanda	RWA				0.434	52				
Samoa	WSM			5.7 ('11)	0.702	71				
San Marino	SMR			2.6 ('07)						
Sao Tome and Principe	STP			16.7 ('06)	0.525	83				
Saudi Arabia	SAU		1852	5.6	0.782	75				
Senegal	SEN		384 ('07)	10.0 ('06)	0.47	29				
Serbia	SRB	446	2955	23.9	0.769	74	199('05)	231	57	43
Seychelles	SYC			5.5 ('05)	0.806					

Sierra Leone	SLE			3.4 ('04)	0.359	65				
Singapore	SGP			2.8	0.895					
Slovak Republic	SVK	29045	7262	13.9	0.84		240	324	47	19
Slovenia	SVN	15931	3227	8.8	0.892	95	444	520	31	13
Solomon Islands	SLB				0.53	77				
Somalia	SOM					40				
South Africa	ZAF		113342	25.0	0.629	21				
South Sudan	SSD									
Spain	ESP	264806	7507	25.0	0.885	95	446	483	30	9
Sri Lanka	LKA		135 ('08)	4.0	0.715	92				
St. Kitts & Nevis	KNA				0.745	89				
St. Lucia	LCA			20.6 ('10)	0.725	89				
St. Vincent & the Grenadines	VCT			18.8 ('08)	0.733	97				
Sudan	SDN		770	14.8 ('08)	0.414	5				
Suriname	SUR			9.5 ('04)	0.684	79				
Swaziland	SWZ		862		0.536					
Sweden	SWE	33400	11500	8.0	0.916	86	452	466	15	7
Switzerland	CHE	17510	8110	4.2	0.913		498	529	15	8
Syrian Arab Republic	SYR		2206	8.4 ('10)	0.648	49				
Tajikistan	TJK		555	11.5 ('09)	0.622	74				
Tanzania	TZA	7 ('08)	728 ('06)	3.5 ('11)	0.476	38				
Thailand	THA		2455	0.7	0.69	33				
Timor-Leste	TLS			3.9 ('10)	0.576	90				
Togo	TGO				0.459	22				
Tonga	TON			1.1 ('06)	0.71	86				
Trinidad and Tobago	TTO			4.6 ('08)	0.76	91				
Tunisia	TUN	16611 ('02)	2024	18.3 ('11)	0.712	39				
Turkey	TUR	203072	10691	9.2	0.722	69	70	103('10)	97	54('10)
Turkmenistan	TKM		11992		0.698	66				
Turks and Caicos	TCA			5.4 ('07)						
Tuvalu	TUV			6.5 ('05)						
Uganda	UGA		218 ('04)	4.2 ('09)	0.456	27				
Ukraine	UKR	38596	237722	7.5	0.74	56	118('05)	151	131('0	70
United Arab Emirates	ARE			4.2 ('09)	0.818	76				
United Kingdom	GBR	152990	19230	7.9	0.875	96	436	454	14	7
United States	USA		2524585	8.1	0.937	86	778	403	19	26
Uruguay	URY			6.5	0.792	84				
Uzbekistan	UZB	24500 ('10)	22482		0.654	57				
Vanuatu	VUT			4.6 ('09)	0.626	77				
Venezuela, RB	VEN		81 ('07)	8.1	0.748	78				
Vietnam	VNM	36179 ('10)	3959	1.8	0.617	84				
Virgin Islands (U.S.)	VIR									
West Bank and Gaza	PSE			23.0	0.67					
Yemen, Rep.	YEM			17.8 ('10)	0.458	21				
Zambia	ZMB			15.9 ('05)	0.448	64				
Zimbabwe	ZWE		1580 ('08)	4.2 ('04)	0.397	65				

Table A2d Correlation between population and land area with different transport factors (SPSS correlation) (**, correlation significant at 0.01 level; *, correlation significant at 0.05 level). The data analysed have been for the years 2001 and 2011 (where available).

Factor 1	**Factor 2**	**Correlation** (*Pearson's r*)	**Correlation** (*Significance level*)
Population (individuals) 2011	Land Area (km^2) 2011	.457**	Significant at the 0.01 level
	CO^2 emissions from transport, excluding marine bunkers and international aviation (million metric tonnes) 2001	.297**	Significant at the 0.01 level
	CO^2 Emissions from transport, excluding marine bunkers and international aviation (million metric tonnes) 2011	.462**	Significant at the 0.01 level
	Energy use per capita for transport (TOE-Tonnes of Oil Equivalent) 2001	-0.08638	Not significant
	Energy use per capita for transport (TOE-Tonnes of Oil Equivalent) 2011	-0.07126	Not significant
	Nominal GDP (current billion US $) 2001	.274**	Significant at the 0.01 level
	Nominal GDP (current billion US $) 2011	.498**	Significant at the 0.01 level
	Paved Roads (% of total) 2011 or latest	0.033203	Not significant
	Road Density (road km per 100 km^2 of land area) 2011 or latest	-.032	Not significant
	Rail Density (line km/1,000 km^2) 2012 or latest (UNECE)	-0.07497	Not significant
	Total trade (merchandise and services, exports and imports) (% of GDP) 2011	-0.09227	Not significant
	Goods transported on roads (million tons-km) 2011	.990**	Significant at the 0.01 level
	Goods transported by rail (million tons-km) 2011	.635**	Significant at the 0.01 level
	Unemployment (% of labor force) 2011	-0.14766	Not significant
	Human Development Index–HDI (0 (low) to 1 (high) scale) 2012 (UNDP)	-0.02119	Not significant
	RAI Index (%) 2004	0.042645	Not significant
	Passenger cars per 1,000 inhabitants 2001 (UNECE)	.412**	Significant at the 0.01 level
	Passenger cars per 1,000 inhabitants 2011 (UNECE)	-0.03049	Not significant
	Fatalities per 100,000 passenger cars 2001 (UNECE)	-0.15214	Not significant
	Fatalities per 100,000 passenger cars 2011 (UNECE)	-0.06246	Not significant
Land Area (km^2) 2011	CO^2 Emissions from transport, excl. marine bunkers and international aviation (million metric tones) 2001	.491**	Significant at the 0.01 level
	CO^2 Emissions from transport, excl. marine bunkers and international aviation (million metric tonnes) 2011	.579**	Significant at the 0.01 level
	Energy Use per capita for transport TOE-Tonnes of Oil Equivalent) 2001	.094	Not significant
	Energy Use per capita for transport (TOE-Tonnes of Oil Equivalent) 2011	.097	Not significant

	Nominal GDP (Current Billion US $), 2001	.391**	Significant at the 0.01 level
	Nominal GDP (current billion US $) 2011	.549**	Significant at the 0.01 level
	Paved Roads (% of total) 2011 or latest	-.030	Not significant
	Road Density (road km per 100 km^2 of land area) 2011 or latest	-.088	Not significant
	Rail Density (line km per 1,000 km^2) 2012 or latest (UNECE)	-.292	Not significant
	Total trade (merchandise and services, exports and imports) (% of GDP) 2011	-.148*	Significant at the 0.05 level
	Goods transported on roads (million tons-km) 2011	.437**	Significant at the 0.01 level
	Goods Transported by Rail (million tons-km) 2011	.777**	Significant at the 0.01 level
	Unemployment (% of labor force) 2011	-.106	Not significant
	Human Development Index–HDI (0 (low) to 1 (high) scale) 2012 (UNDP)	.091	Not significant
	RAI Index (%) 2004	-.025	Not significant
	Passenger cars per 1,000 inhabitants 2001 (UNECE)	.291	Not significant
	Passenger cars per 1,000 inhabitants 2011 (UNECE)	-.159	Not significant
	Fatalities per 100,000 passenger cars 2001 (UNECE)	-.071	Not significant
	Fatalities per 100,000 passenger cars 2011 (UNECE)	-.023	Not significant