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CEEC	Central and Eastern European countries
CHP	Combined heat and power
CO_2	Carbon dioxide
EEA	European Economic Area
ETS	Emissions Trading Scheme
EU	European Union
EU-15	European Union before the enlargement of May 2004
EU-25	Enlarged European Union
Eurostat	Statistical Office of the European Communities
FED	Final energy demand
GDP	Gross domestic product
GHG	Greenhouse gas
GIC	Gross inland consumption
GW	Gigawatt, or 10^9 watt
IEA	International Energy Agency
km	Kilometre
ktoe	Thousand toe
kWh	Kilowatt-hour
LNG	Liquefied natural gas
MEuro	Million euro
Mt	Million metric tonnes
Mtoe	Million toe
OECD	Organisation for Economic Cooperation and Development
pkm	Passenger-kilometre (one passenger transported a distance of one kilometre)
t	Metric tonne, or 1,000 kilogrammes
TEN	Trans-European networks
tkm	Tonne-kilometre (one tonne transported a distance of one kilometre)
toe	Tonne of oil equivalent,or 10^7 kilocalories, or 41.86 GJ (Gigajoule)
TWh	Terawatt-hour, or 10^{12} watt-hour
UN	United Nations

Price (excluding VAT) in Luxembourg: EUR 65

Publications Office
Publications.europa.eu

ISBN 92-79-00652-5
9 789279 006524

KO-BR-05-001-EN-C

THE ANNUAL ENERGY AND TRANSPORT REVIEW FOR 2004

December 2005

ISSN 1683-142X

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Directorate-General for Energy and Transport

EUROPEAN COMMISSION

European Commission

Directorate-General for Energy and Transport

THE ANNUAL ENERGY AND TRANSPORT REVIEW FOR 2004

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Includes a CD-Rom with global energy balances and indicators for the EU's 25 Member States and its main trading partners

This publication was produced by Global Insight, SA (Paris, France) and IWW (Karlsruhe, Germany) for the Directorate-General for Energy and Transport and represents those organisations' views on energy and transport facts and figures. These views have not been adopted or in any way approved by the Commission and should not be relied upon as a statement of the Commission's or the Directorate-General's views.

The European Commission does not guarantee the accuracy of the data included in this publication, nor does it accept responsibility for any use made thereof.

The analysis made in the publication is based on the most recent and most reliable data, which in general date from the year 2003. To ensure the coherence of this analysis, the same data base has been kept throughout the publication, although in some cases new statistics have been made available.

Design and layout by Design Studio People (London, United Kingdom)

The manuscript was completed on 16 December 2005.

Any comments and questions on this publication may be sent to: tren-review@ec.europa.eu

A great deal of additional information on the European Union is available on the Internet. It can be accessed through the Europa server (http://europa.eu).

Cataloguing data can be found at the end of this publication.

Luxembourg: Office for Official Publications of the European Communities, 2006

ISBN 92-79-00652-5

Printed in Belgium

PRINTED ON WHITE CHLORINE-FREE BLEACHED PAPER

Foreword

The energy and transport sectors are fundamental to our way of life and to the functioning of our economy. They have many things in common. Both are crucial to the development of basic strategies such as the Lisbon agenda and the sustainable development strategy. They are essential to economic competitiveness; they contribute to social and territorial cohesion; and they have a major influence on our quality of life and the environment. Also, both have a security impact and an international dimension.
The European Commission has been supporting the realisation of the major objectives of the two sectors, *i.e.* strengthening the European economy, meeting the need for safety, security and environmental protection, and increasing the influence of an enlarged Europe in the world.

Thanks to major efforts made in energy and transport during recent years, both are now redefined to meet the new challenges of competitiveness and globalisation. Following the release of a Green Paper on energy efficiency in 2005, a Green Paper on a European strategy for sustainable, competitive and secure energy was published in March 2006. For transport, the mid-term review of the White Paper shall take place in 2006. This is why it is important to take stock and analyse the developments to date.

This publication aims to provide a description of the evolution of the two sectors. It is based on statistics and other factual information, mainly from the years 2003 and 2004. The editorial style has been kept straightforward, without technical details, to allow a wide readership, ranging from political decision-makers to government officials and the private sector.

All your comments are welcome and can be mailed to the electronic address on the opposite page. Our *Europa* internet site provides you with detailed information on energy and transport policies and market developments. Finally, we hope that the data and information included in this publication give interesting and constructive backgrounds on how the energy and transport sectors are evolving.

Jacques BARROT
Vice-President of the European Commission
with responsibility for transport

Andris PIEBALGS
Member of the European Commission
with responsibility for energy

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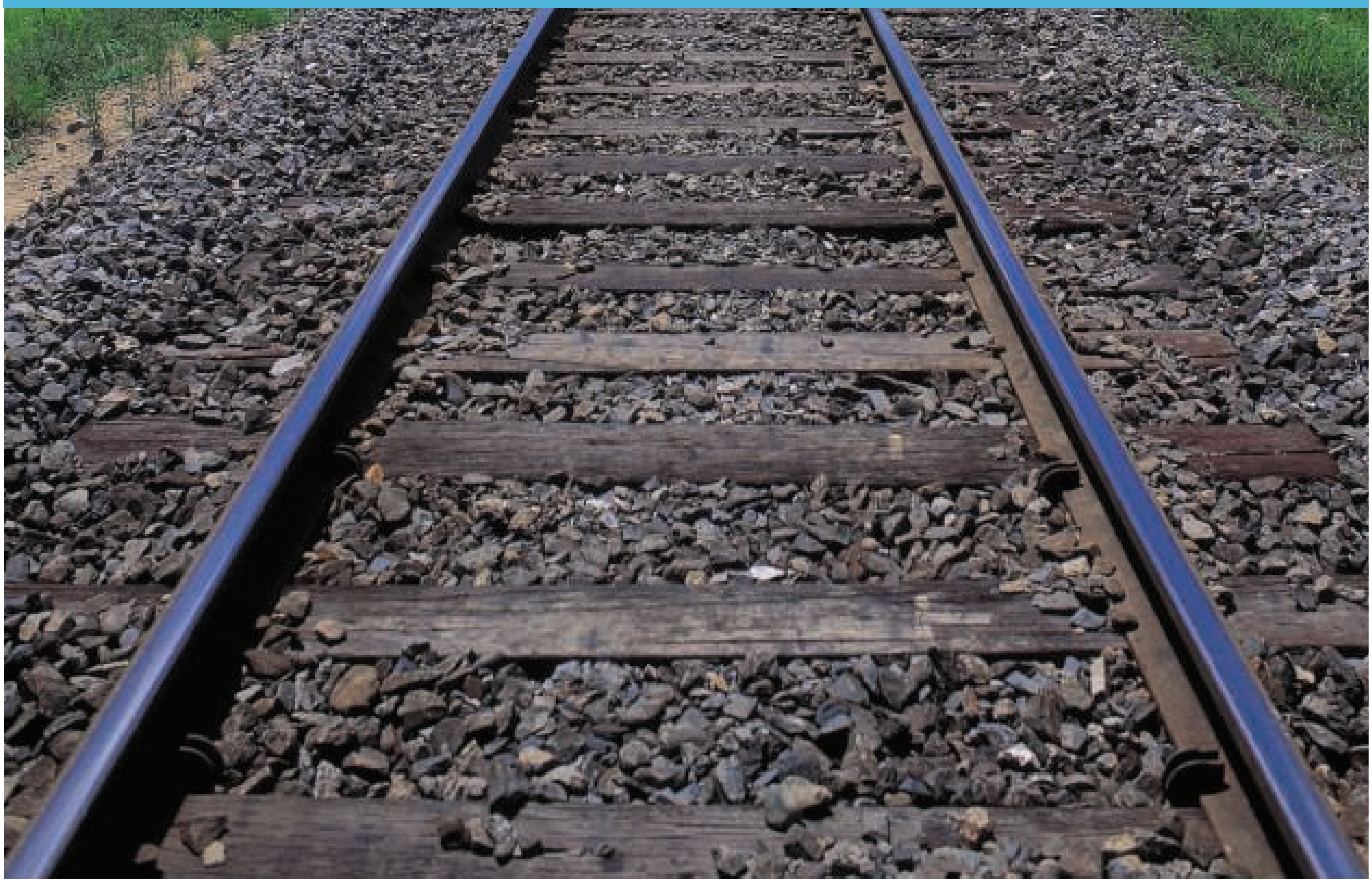


1. ENERGY

Policy, market opening, competition and infrastructure
Electricity and gas Directives were adopted in 2003, accompanied by measures to address infrastructure issues in these sectors, in order to speed up market opening and reinforce crucial issues such as infrastructure, supply security and public service, among others. A Regulation on cross-boarder exchanges in electricity was also adopted the same year. The Directives in force require complete opening of both markets by 2007.

Electricity markets had been fully opened in nine Member States by the end of 2004. Half of the new Member States had achieved significant progress in this process. Progress of market opening is slower in the gas sector. Whilst national, state-controlled electricity and gas champions are less dominant in most Member States, many are still active in the new Member States. Large oil companies have moved further downstream and now directly market their products (especially natural gas) to end users. They are increasingly present in gas import infrastructure.

A set of TEN-E guidelines was adopted in 2003. A new set of guidelines was proposed on 10 December 2003, which better reflects the realities of rapidly changing energy markets and the enlarged EU. The new and the proposed guidelines define a series of priority axes and projects and establish the notion of projects of European interest. New financial rules for TEN projects were adopted in 2004, allowing priority projects and projects of European interest to receive Community financial support of up to 20% of the total investment.

Trends in the energy sector
Although energy prices had been falling steadily during the 1990s, the trend has reversed from 2000 to 2001 and onwards, driven principally by rising oil prices. Even coal, for which the market is largely independent of the oil market, has experienced increases due to shipping constraints. International oil prices affect the cost of power generation through their effect on natural gas prices, these effects are then passed on to electricity prices. The effects of increased international oil prices have been partially buffered by the reduction in the value of the dollar against the euro.

Retail electricity prices vary considerably across Member States. In real terms, retail electricity prices decreased from 1995-2001, but increased after this. Similar trends are found in other energy prices. In the EU-15 differing energy taxes within Member States on the different energy sources remains a key barrier to achieving a single energy market. To counter these divergences a Directive was adopted in 2003 to widen the scope of the EU minimum rate system, which was previously limited to mineral oils, to include all energy products. Despite some progress there is still wide variation of taxes.

Energy activity is primarily determined by overall economic performance, climatic conditions and demographics. Energy intensity, which is measured by energy consumption divided by GDP, has fallen significantly in the EU-10. The EU-15 has also shown reductions, but at a lesser pace than the EU-10, although some countries' energy intensities increased.

After the US, the EU-25 is the world's second largest energy-consuming region. The demand for primary energy (Gross inland consumption) grew at an average annual rate of 0.8% between 1990 and 2003, with the volumes accelerating in recent years. Oil met more than 38% of primary energy demand in 2003, with natural gas accounting for 24%, nuclear energy representing less than 15%, and coal 18%. The primary consumption of renewable energies grew by 8.4% between 2002 and 2003, accounting for 6% of consumption.

In the EU-15 the value (excluding taxes and VAT) of the final energy demand (FED) as a percentage of GDP has increased from 3.1% in 1995 to 4.2% in 2003, with a value of more than 323 billion. This is in part attributable to the consumption of electricity, which has increased its share of the FED from 48% in 2001 to 50.5% in 2003. Motor fuels represent 24% of FED; natural gas 23%. The share of GDP rises to 6.2% with the inclusion of taxes and VAT. In recent years, the share of FED in GDP has risen along with rising fuel prices. The structure of FED continues to change along two main axes: On the one hand, a declining coal demand offset by increased gas and electricity demand; on the other, growing demand from households and transport in the face of reducing demand from industry.

Aggregate installed capacity for electricity generation in the EU-25 has increased by 28% since 1990, to 697 GW in 2003. At 57%, the majority of this capacity is generated by fossil fuels despite significant decommissioning and replacement by more sustainable combined cycle gas turbines. Generation from renewable sources has also risen. Nuclear capacity has increased in certain Member States. Refining capacity has also increased, but is generally concentrated within the larger economies.

Co-operation among electricity utilities has resulted in the emergence of four regional Transmission System Operators (TSO) across Europe to improve reliability, quality and to optimise the use of primary energy and capacity resources. The gas network spanned 1.8 million km in 2003, of which 220,000 km were high pressure pipelines for transport.

The EU is a net importer of primary energy, with an import dependency (the ratio of net imports to the sum of gross inland consumption and marine bunkers) of 49.4% for the EU-25 in 2003.

Steady growth in the production of nuclear power and renewables characterised the EU's domestic production between 1990 and 2003. Natural gas production, which had been increasing throughout most of the period, began to stabilise, while oil production continued the decline begun in the late 1990s. The rate of decline of coal production slowed down in the latter part of the period.

Environment, renewable energies and energy efficiency

In 2003, energy contributed to 39% of total carbon dioxide emissions, making it the largest source of these emissions. Some progress has been made in decoupling emissions from the production and consumption of energy, because while the generation of electricity and the final energy demand of electricity grew by more than 27% between 1990 and 2003, carbon dioxide emissions from the sector grew by only 2.3%, due to less CO_2-intensive technologies. The launch of the EU Emission Trading Scheme will lead to further abatement in this sector.

The share of renewables in the EU-25's total GIC represented 6% of the total in 2003. Bio-mass & wastes, along with hydropower were by far the most abundant sources of renewable energy. Production of renewable energy from wind continued its rapid growth. Production from that source has increased by an average 37% per year between 1990 and 2003.

Concerning efficiency, the situation has progressed positively over the last years. The total energy output to input ratio of conventional power stations grew from 38% in 1990 to 48% in 2003, largely reflecting the introduction of more efficient combined cycle gas turbines. Higher efficiency was also reflected by reductions in own consumption of electricity as a percentage of total generation, which declined from some 6.5% in 1990 to around 5.7% in 2003. The specific energy consumption of most industrial sectors as well as the aggregate energy intensity of the European economy also decreased over the period between 1990 and 2003.

2.TRANSPORT

Policy, market opening, competition and infrastructure

The European Aviation Safety Agency (EASA) came into operation in 2003. The first rail package designed to simplify access to rail networks thereby increasing the competitiveness of rail freight transport became effective in 2003. This was followed in 2004 by the second package to speed up the establishment of an integrated railway area. The third package will deal with passenger rights and certification of locomotive drivers.

Aviation and road haulage have achieved significant levels of market opening, with substantial growth rates, and increased competitiveness. The growth in aviation has caused some congestion problems at airports and on air traffic control systems. The Commission wishes to harmonise user charges for hauliers. Market opening has been completed for maritime and inland waterway transport in all but port services. The railway sector is slower to open its markets.

Revision of the Transport Trans-European Networks (TEN-T) guidelines in 2004 had focused European investments on 30 priority axes and projects. Rail transport and inter-modality has received particular attention, as has the concept of motorways of the sea. The investments for the twenty-six priority projects not yet completed amount to 225 billion up to 2020.

Trends in the transport sector

Generally, levels of freight transport follow GDP trends. Trade flows have become an increasingly important driver of freight transport. Passenger transport is driven by population and demographic characteristics, and also economic drivers such as person income, and to some extent fuel prices.

The economic output of the transport sector, including auxiliary transport sector accounts for approximately 4.5% of the Gross Value Added (GVA) of the EU-15. The addition of the output of transport-related industries such as car manufacturing adds a further 2% to GVA. New Member States show a much higher contribution of transport activities (excluding manufacturing) to GVA of between 6% and 15%. Across the EU-25 approximately 7.5 million people are employed in the transport sector, with the majority working in the road transport field.

Wholesale fuel prices affect transport activities through the price of automotive fuel. These effects have in part been mitigated by the exchange rate of the dollar against the euro. Common rules for the harmonisation of fuel taxes were adopted in 2003 with higher minimum excise duty rates for oil products. Prices for automotive fuels vary considerably across the EU. Varying transport charges hamper the move towards an internal transport market. In 2003, to aid harmonisation of charges the Commission introduced a proposal to amend the 'Eurovignette' Directive (1999/62/EC) on the charging of heavy goods vehicles on motorways.

Growth of freight transport was primarily driven by increasing maritime and road transports. Road transport increased its share from42.5% to 44.2% from 1995 to 2003; sea transport from 37.3% to 38.7%; with rail declining from 12.4% to 10%; and inland waterways from 4.1% to 3.6%. At approximately 3.5% pipelines remained broadly constant.

Individual road transports account for approximately 78% of total passenger-kilometres. Marginal shifts can be observed by other modes. High-speed rail connections have gone some way to reversing trends towards aviation on certain routes.

Environment, safety and efficiency

Transport contributed to about a quarter of total carbon dioxide emissions in 2003. There has been consistent growth in emissions from this sector since 1990, and in 1996 it overtook the household sector as the EU's second largest source of emissions, growing at an average rate of 1.8% per year. Growing traffic volumes and increased motorisation have been the main drivers of this growth, while only modest increases have been achieved in efficiency. The EURO standards for vehicles have gone some way to curbing carbon monoxide and acidifying emissions from vehicles. While improved engine technologies have reduced the emissions of particulate matter from all modes of transport by 24% between 1990 and 2001 in the EU-15.

Due to a rapid growth in transport, particularly in road and air transport, over 120 million people in the EU are exposed to noise levels above 55 dB(A) in the front of their houses.

Road accident rates in the EU have declined, but reducing fatalities further is a key priority for the Common transport policy. Between 1995 and 2002, despite a 13.5% increase in passenger car and bus performance, there was a reduction in road fatalities of approximately 20%. Maritime safety is of great importance too, and the Commission established the European Maritime Safety Agency in 2002. The Prestige accident sped up the period of the phasing-out of single-hull tankers.

Since 1990 passenger and freight transport intensities, which are respectively measured in passenger km (pkm) per Euro of GDP and in tonne km (tkm) per Euro of GDP, have been stable in the EU-15 and declining in the EU-10. The energy performance of passenger and freight transport, as measured by the ratio of pkm and tkm per unit of energy consumed, has increased slightly over the period across all modes. The greatest improvements in energy performance occurred in passenger and freight rail transport and in passenger air transport.

Introduction

1. THE IMPORTANCE OF THE ENERGY AND TRANSPORT SECTORS FOR THE ENLARGED EU: CURRENT SITUATION AND CHALLENGES

Energy and transport are at the heart of many of the issues affecting Europe's current prosperity and longer-term international competitiveness. Fuel prices are rising rapidly, with serious consequences for economic growth. Europe's economies are becoming increasingly dependent on imported energy, raising their exposure to supply risk and posing questions about sustainability of future supplies and the geopolitical balance. There are mounting environmental and other risks directly linked to activity levels in the two sectors. In sum, European citizens' welfare and way of life relies in many ways on the good functioning of these two key sectors.

The energy and transport industries are often referred to as the arteries of modern industrial societies. They themselves have a strong mutual dependency, with all forms of transport relying on energy to operate, and energy supply relying upon transport – waterways, rail, road and pipelines – to bring fuels and energies to the transformation and consumption centres. Their symbiotic relationship, the fact that they are the largest network industries (along with telecoms) and their importance

for the economy, all underline the need for a common, integrated and co-ordinated policy approach. As 70% of final oil demand is used for transport, it is essential to take a grip on transport policy as a means of controlling oil demand and simultaneously reducing various forms of emissions.

Looking back, much has been accomplished over the years, both from public and private efforts. Europe's energy industry has become a world leader on many fronts: It heads the way in the production of renewable energies and the equipment required to exploit them, such as wind turbines; it is the market leader of civil nuclear technology and of modern combined cycle gas turbines; it possesses the largest network and is the biggest exporter of high-speed trains; it is building the first civil satellite navigation system; and it has spearheaded the way towards trans-national greenhouse gas and acidifying emissions abatement policies. However, much remains to be done because the Union has grown to 25 Member States of which the 10 new Member States have much ground to cover to catch up with the 15 older Member States in many fields, especially in infrastructure and market opening. Also major issues remain to be tackled: Emissions must be reduced, supply security must be maintained, and passenger safety must be increased, all whilst ensuring that the European economy remains competitive on the global stage.

2. SPECIAL CHARACTERISTICS OF THE ENERGY AND TRANSPORT SECTORS

A number of special characteristics of the transport and energy systems lead to constraints and social considerations that do not apply to most other industrial sectors.

1. The transport and energy industries are classic network industries with three specific elements – a fixed network infrastructure, a control system for the operations, and a set of services for firms and consumers. In the absence of any state regulation, these industries would develop into natural monopolies. The supply sides of the energy and transport markets were either managed by public enterprises or by strictly regulated private industries. For more than two decades (in the European Community starting with the path-breaking decision of the European Court of Justice in 1985), worldwide political initiatives have started to reorganise these industries so as to introduce market forces and competition.

2. They are very capital intensive, which leads to low flexibility and long lead-times when inducing changes as well as long payback periods. Various kinds of network or indirect effects occur such that a private network provider might not be able to capture all benefits produced by network provision. This causes complex problems if private investors are going to commit themselves in a public/private partnership and carry a part of the project risks.

3. The networks are visually intrusive and can occupy large areas of land. Operations on them may cause negative externalities such as noise, air pollution, accidents and other types of social risks. This leads to a public resistance to infrastructure investments such that parallel competitive networks cannot be built, necessary extensions of existing networks are delayed and improvements are suppressed. This can then lead to serious consequences such as a temporary breakdown of energy supply or heavy congestions on transport networks.

4. Competition and price mechanisms work differently for the three specific elements of network economies. In respect of infrastructure and control systems, complex pricing schemes must be used to ensure an adequate provision is complemented with sufficient incentives to invest over the long term. Prices are normally set by public regulation (usually on the basis of the cost of efficient provision) and show little flexibility. In respect of activity/services, prices are set for the consumers: Here competition can work as in other markets and prices may be very flexible and market-driven. The energy sector has become very competitive with flexible market-driven prices in countries where the liberalisation process is very advanced. In the transport sectors, the situation varies considerably: Whereas in the road and air sectors competition is strong and prices adjust rapidly to cost or demand changes (e.g. low-cost flight carriers), in the highly state-influenced railway and public local transport sectors, there is generally much less competition.

Within the energy and transport sectors, there are three components of primary importance for the economic competitiveness of the EU, and for the social cohesion and welfare of its citizens:

- The level and stability of electricity prices to households, commerce and industry, coupled with the security of supply of other fuels (whose prices are largely determined in international markets);
- A dynamic and competitive transport sector in air, road and short sea shipping, combined with the continuing improvement of the rail system for freight and passengers, including high-speed systems; and
- The level of externalities (emissions, accidents, fatalities) and the measures used to prevent and reduce them.

The two following sections summarise the main developments in the Energy and Transport sectors in the European Union.

3. ENERGY

A feature of the energy sector is that different policy issues interact so that satisfying one objective may hinder a different one. For instance, switching fuels in a given plant from domestic coal to imported gas reduces environmental emissions but contributes to increased dependence on external supplies. For such reasons, the Commission's initiatives in the energy sector have, for some years, focused their attention on co-ordinating policies for three main areas: Supply security, completion of the internal market and the promotion of environmental sustainability. The broad guidelines of that three-tiered energy policy were laid down in its Green Paper on Supply Security (COM(2000)769), adopted in 2000. Today, new challenges, which include mounting energy prices, growing environmental concerns and a rapidly changing geopolitical balance, have prompted the Commission to re-centre its focus around the promotion of energy efficiency, a central concept that covers all variables of the energy equation. This initiative is presented in the Commission's recently adopted Green Paper (COM (2005) 265) on energy efficiency.

3.1. Main initiatives since 2000

Table I-1 below gives an overview of the most recent and important energy policy initiatives.

Table I-1: Summary of Community energy initiatives since 2000[1]

Demand side management	Renewables and environment	Nuclear energy	Supply security	Market opening	Other
MAIN FRAMEWORK POLICY DOCUMENT - 2000 Green Paper: Towards a European Strategy for the Security of Energy Supply MAIN FRAMEWORK POLICY DOCUMENT - 2005 Green Paper: Energy efficiency or Doing more with less					
2003 Decision adopting a multi annual programme for action in the field of energy "Intelligent Energy Europe" 2004 Decision setting up an executive agency Intelligent Energy Executive Agency					
			2003 Decision on Guidelines for TEN-E 2003 Proposal for a new decision on guidelines for TEN-E 2004 Amending regulation on the granting of community financial aid to TEN 2003 Regulation on conditions for the access to the network for cross border exchanges		
2002 Directive on energy performance of buildings 2002-2003 Three directives on the energy labelling of air-conditioners and other household appliances *2003 Proposal for a directive on a framework for the setting of eco-design requirements for energy-using products* *2003 Proposal for a directive on energy end use efficiency and energy services* 2004 6th Framework programme for R & D 2004 Directive on the promotion of cogeneration based on a useful heat demand 2004-7 Public awareness campaign for energy sustainability	2001 Directive on promotion of electricity produced from renewable energy sources 2003 - Directive on restructuring of energy taxation 2003 - Directive on the promotion of the use of bio-fuels 2003 - Directive establishing the European Emissions Trading System 2004 A Public Awareness Campaign for an Energy Sustainable Europe	2002 Regulation on the application of Euratom safeguards 2004 Directive of application of Art. 82 of the Euratom Treaty ("Sellafield Directive") 2003 Euratom Directive on the control of high activity sealed radioactive sources and orphan sources 2003 Recommendation on standardised information on radioactive airborne and liquid discharges from nuclear reactors and processing plants *2003 Proposal for two directives on management of radioactive waste and principles on the safety of nuclear installations*	*2002* Proposal on the alignment of measures with regard to security of supply for petroleum products *2003* Proposal on measures to safeguard security of electricity supply and infrastructure investment 2004 Directive on measures to safeguard security of gas supply 2004 Communication on Critical Infrastructure Protection in the fight against terrorism	2003 Directive on Common Rules for the Internal Gas Market 2003 Directive on Common Rules for the Internal Electricity Market *2003* Proposal for a regulation on conditions for access to the gas transmission networks	2002 Regulation restructuring state aids to the coal industry 2003 6th Framework Programme for Research and Technological Development (RTD) with its energy research, demonstration and dissemination

[1]*Proposals in italics.*

3.2. OVERVIEW OF THE ENERGY BALANCES OF THE EU AND ITS MAIN TRADING PARTNERS

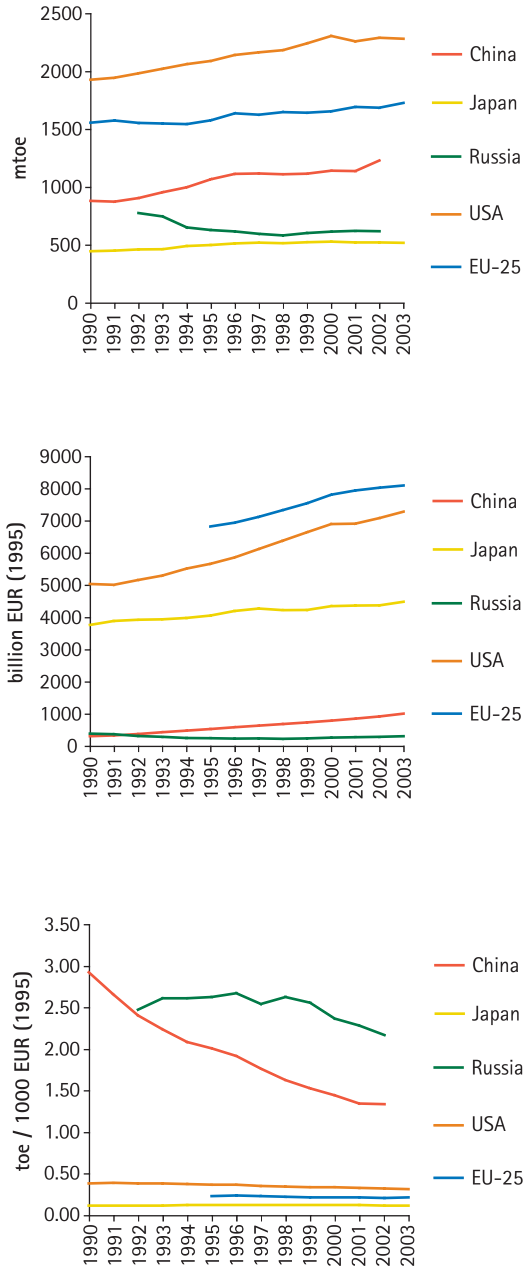
3.2.1. Primary energy demand

The structure of gross inland consumption (GIC) – also referred to as primary energy supply – is a country or region's most fundamental energy characteristic. GIC determines and is determined by a series of factors. These factors include the structure of the power-generating sector, the structural composition of its economy, the degree of economic and industrial development, the endowment of indigenous resources, and also policy choices and consumer behaviour, among others.

In general, the consumption of primary energy grows along with the expansion of economic activity. GIC in the EU-25 grew by 1.1%/year between 1995 and 2003, reaching 1726 Mtoe (million tonne oil equivalent) in 2003. With the exception of Russia, Figure I-1 shows a homogeneous trend of upwards-sloping GIC for the

EU-25 and its main trading partners. The correlation between energy demand and economic activity is confirmed in the centre graph of Figure I-1, which also shows increasing GDP for all countries except Russia over the period. Like its primary consumption, GDP growth in the latter country presented rather an "inverted U" shaped path, declining in the first half of the 1990s and returning to growth from 1999 onwards. However, and despite the correlation, both the rate of growth of energy consumption relative to GDP growth, as well as the ratio of the two indicators varies across countries. Between 1995 and 2003, the EU-25's GDP grew by an average 2.2%/year.
The ratio of GIC to GDP –or energy intensity– in the emerging economies of China and Russia is quite different to that of the USA, Japan and the EU. The energy intensity level is much greater in the emerging economies, which reflects the fact that their economies' share of energy-intensive manufacturing and heavy industry is greater than in the more services-orientated, postindustrial economies. Another reason explaining the lower intensities in the more developed economies is the use of more modern and efficient systems, such as power stations, machinery or infrastructure. But as was mentioned before, many other factors, including the indigenous availability of certain fuels or government policies, determine the ratio.

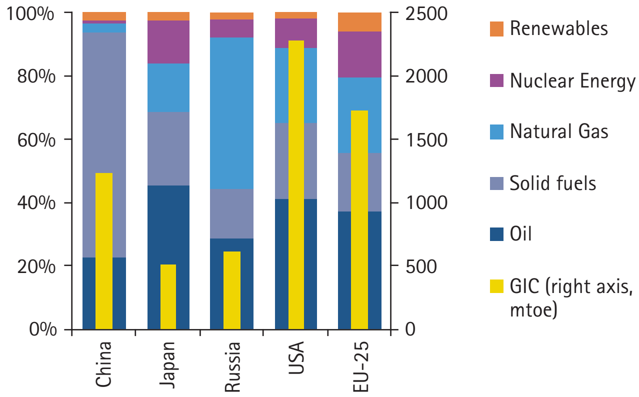
Figure I-1: Evolution of GIC and energy intensity in the EU-25 and its main trading partners



Source: Eurostat and IEA

Certain patterns also emerge in respect of the structure of GIC between modern and emerging economies. Indeed, the share of oil in the more modern economies is usually higher as a result of higher motorisation and road transport levels. Figure I-2 shows that the share of oil in the USA, Japan and the EU-25 is close to or above 40%, whereas it is under 30% for China and Russia. In fact, the bulk of primary energy in each of those countries corresponds to the cheapest available indigenous resource: Coal in the case of China; gas in Russia. In any case, the larger part of primary energy in all countries takes the form of fossil fuels (oil, gas and coal), with renewables and nuclear energy only contributing to a small share of the total. The share of the latter energies is significantly larger in the more developed economies.

Figure I-2: Primary energy mix and consumption in the EU-25 and its main trading partners (2003)



Source: Eurostat and IEA

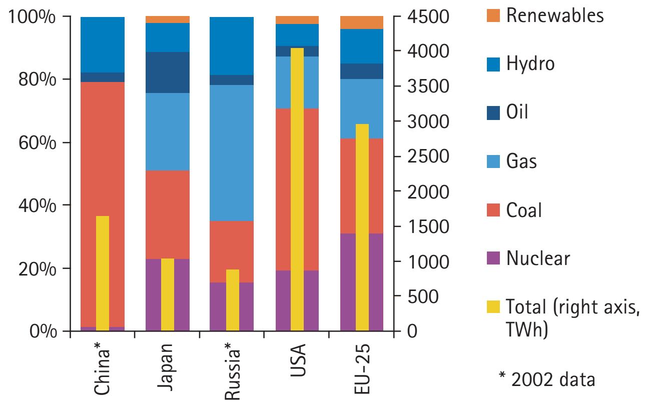
3.2.2. Power generation

The structure of power generation, which is typically one of the largest sources of primary energy demand within a country, is a major determinant of GIC. Figure I-3 shows that GIC and power generation structures are highly correlated, with the exception of oil (which goes mainly to the transport sector). Also worth noting is the reliance on individual fuels. For example, power generation in the USA depends heavily on coal, which, combined with supply security concerns, goes some way to explain that country's reluctance to signing up to the Kyoto protocol on greenhouse gas emissions. China's high dependence on coal also illustrates the potential impact of this fast growing economy on the environment. Among the countries considered, Japan and the EU have the most balanced power generation portfolios. Power generation in the EU-25 rose to 2964 TWh (Tera Watt-hours) in 2003, and grew at an average annual rate of 2.2% between 1995 and 2003.

3.2.3. Final energy demand

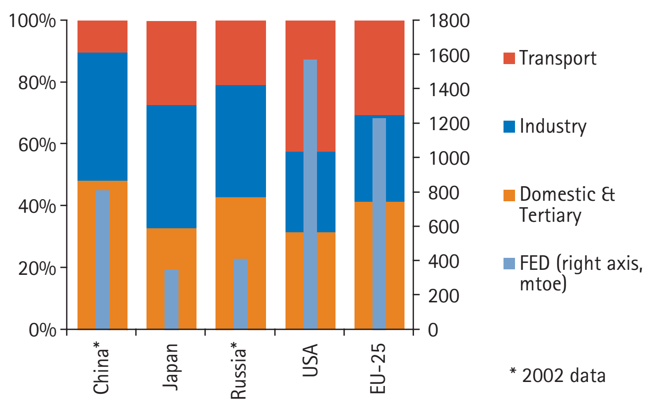
Final energy demand (FED) also illustrates a given country's economic structure. For example, the widespread use of road transport in the USA is reflected by the high share of transport in FED. Conversely, in Japan it is the large and highly-efficient industrial sector that takes up the larger part of final demand. Although the share of household demand is relatively similar in China and Russia, industry has a significantly larger share in China as a result of its sizeable manufacturing sector. The structure of final demand in the EU-25 is a midway point between the highly motorised USA and the very efficient Japanese economy. In 2003, the EU-25's FED was 1132 Mtoe. Between 1995 and 2003, FED has grown by an average of 1.2% per year.

Figure I-3: Power Generation mix and production in the EU-25 and its main trading partners (2003)



Source: Eurostat and IEA

Figure I-4: Structure of FED in the EU-25 and its main trading partners (2003)

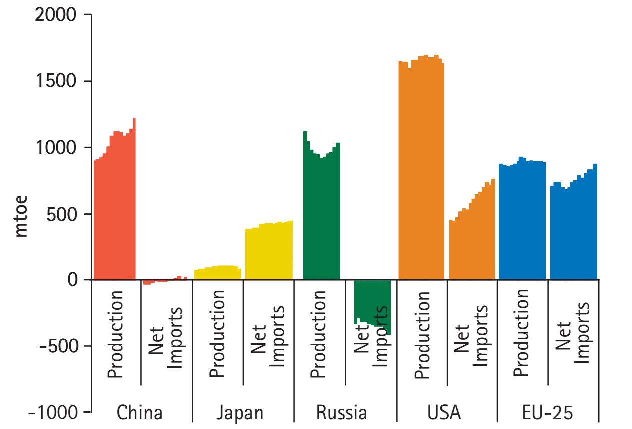


Source: Eurostat and IEA

3.2.4. Energy supply: Indigenous production and self sufficiency

Self-sufficiency and indigenous production are also key aspects of a country's energy sector. Self-sufficiency (the reciprocal of import dependency) is a good measure of supply security and is a major driver of energy policies. Although the emerging countries considered here have a higher degree of self-sufficiency than the developed ones, Figure I-5 shows that the degree of selfsufficiency across Japan and the USA also presents variations. Japan's almost total lack of indigenous fossil fuel production makes its level of self-sufficiency almost zero (its sole source of indigenous production is nuclear energy). The USA has a high degree of self-sufficiency in coal and gas, but not for oil. The EU-25 is even more reliant on imported oil, and depends on imports for half of its total energy requirements.

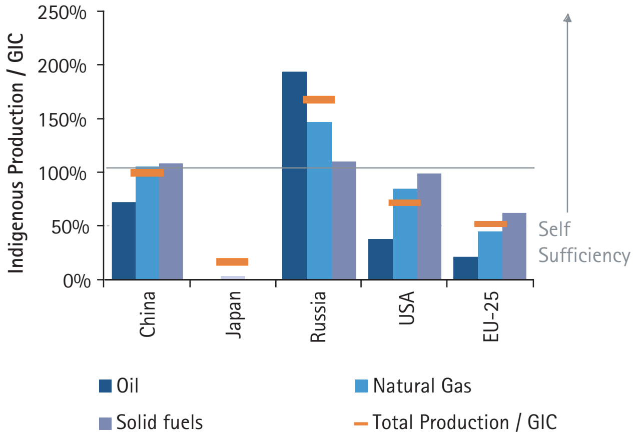
Figure I-6: Production and net imports between 1990 and 2003*



* no data for Russia in 1990-1991, 2003 / no data for China in 2003

Source: Eurostat and IEA

Figure I-5: Self-sufficiency by trade block (2003)



Source: Eurostat and IEA

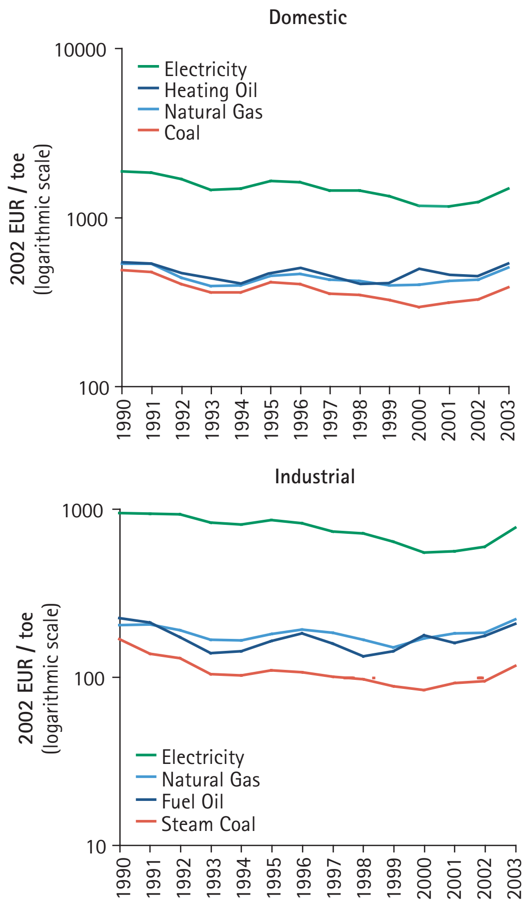
Self-sufficiency is naturally a function of a country or region's indigenous production of primary energy. Figure I-6 shows that, with the exception of Japan, the countries considered are all large producers of energy, but have very different production and energy trade profiles. China's production is growing, but its rapid economic growth has recently taken it from being a net exporter to a net importer. Russia's production has grown in recent years, hand in hand with its net exports, mainly of gas and oil. Russia is by far the largest exporter of gas to Europe. In the USA, production has gone from flat to decreasing over the period considered, but imports are booming. The same can be said of the EU-25.

3.3. Prices and competition

The price and reliability of energy supplies, electricity in particular, is a key element of a country's energy supply and perhaps the most critical in respect of international competitiveness. This includes competitiveness between Member States within the EuropeanUnion. This is because electricity represents the highest proportion of energy costs to households and industries. The cost of electricity is also the area where there is the greatest price range at an international level. Fossil fuels, which are traded within global markets, have relatively uniform prices.

Good progress has been made in the opening of European energy markets. In the electricity market, nine Member States already have fully open markets while seven Member States have fully opened their gas market. Only six countries have markets with less than 50% opening in the electricity sector and only three countries have gas markets with a level of opening below 50%. There are good examples where the recent opening up of energy markets has reduced prices. Although it has not been possible to avoid the recent international trends in fossil fuel prices and the resultant effects on energy prices, increased competition may have contributed to buffer the level of the impact that higher fossil fuel prices have had on energy prices. The opening of energy markets, however, has led to a wave of consolidation within the sector with a number of large trans-European energy players emerging. As the electricity and gas markets converge, these large companies are increasingly active on both market segments. There are both advantages and disadvantages of such developments. It is important that Europe has companies with strong buying power on the international market (especially for natural gas), but excessive market power in certain regions can limit the benefits of competition.

Figure I-7: Average retail fuel prices to domestic and industrial customers in the EU-25



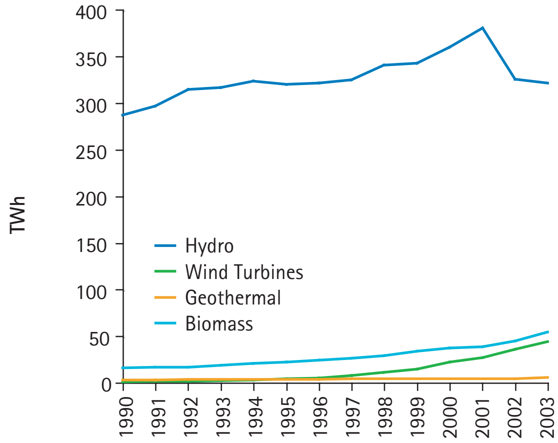
Source: Global Insight and IEA

Figure I-7 shows recent developments in average domestic and industrial electricity prices for the EU-25. The declining trend observed from the early the 1990s has taken an upwards path from 2000 onwards, mainly as the result of increasing international oil and gas prices. The important price differences between electricity and the other energy sources available to final consumers is clearly underlined in the figure: The cost of electricity (a very high quality and versatile form of energy) to customers is 3 to 6 times that of alternative energy sources.

3.4. Environment and sustainability

The EU has made significant efforts to increase the sustainability of its energy sector. For instance, good progress has been made in the promotion of electricity generation from renewable sources such as biomass and wind. Wind in particular, which was previously almost non-existent, has experienced growth over the 2000s. Generation from the combustion of biomass has also grown well, particularly in the EU-10. However, the two sources combined represented only 3.3% of the total electricity generated in the EU-25 in 2003.

Figure I-8: Evolution of generation from renewable sources in the EU-25



Source: Eurostat

In the EU-25, almost 40% of carbon dioxide (CO_2) emissions arise from electricity production. In 2003, CO_2 emissions rose to 4028 million tonnes in the EU-25, the second largest source after the USA, by far the largest contributor to global CO_2 emissions. The EU-25 emits around 2 million tonnes less than the USA while having a much larger population and producing higher GDP. China is also a major contributor, and its emissions are rising rapidly as its economy develops. Nonetheless, as a result of industrial restructuring and modernisation, most markedly in the case of China, the emissions intensities in that country and Russia have dropped significantly between 1995 and 2002.

4. TRANSPORT

The White Paper on European transport policy for 2010, adopted in 2001, defines the general framework of transport policy in the EU.

4.1. Main initiatives since 2000

Higher quality of transport services, the alleviation of infrastructure bottlenecks, the completion of market opening, as well as environmental and safety issues, are the most important areas for European transport policy. The White Paper on European transport policy for 2010 addresses these issues in detail.

The White Paper places users at the heart of transport policy. This aim implies a higher quality of transport services, increasing safety standards and a clear definition of users' rights. Mode-specific safety programmes and the establishment of Galileo – a modern satellite-navigation system - further strengthen these objectives. The smooth functioning of the transport system relies heavily on a region's endowment of modern transport infrastructure. The alleviation of transport bottlenecks and the continuous upgrading of the TEN-T network are therefore necessary conditions for increasing a region's competitiveness. The development of the high-speed rail network is a good example of this. Travel-time reductions, combined with increased frequencies and punctuality have clearly improved the quality for passengers and, at the same time, added to the respective region's attractiveness. Infrastructure development has recently been influenced by the revision of guidelines for the development of the trans-European networks in April 2004. In total, the new guidelines propose 30 high priority infrastructure projects. As land-borne freight transport is dominated by road haulage the Commission has put much emphasis on harmonising the conditions for road-infrastructure use in the Union. Directive 1999/62, which sets the basis for motorway tolling of heavy goods vehicles, plays a crucial role in this context. The Directive, which was revised in early 2005 after a long process of negotiation, links the level of tolls to the allocated average costs of infrastructure provision and use. As it allows for price differentiation, based on congestion levels and exhaust emission categories, tolling systems with strong environmental incentives can be established. Furthermore, Directive 1999/30 on air quality fosters environmental progress in the road transport sector. This Directive sets upper limits to the average concentrations of particulate matter (as PM10) from 2005 and to the average concentrations of nitrogen oxides from 2010.

Table I-2 below provides an overview of the most recent and important transport policy initiatives.

Table I-2: Summary of Community transport initiatives since 2000

	Road transport	Rail transport	Maritime transport and inland waterways	Air transport	Galileo
Market access and infrastructure charging	***2000:** Proposal for a regulation on action by Member States concerning public service requirements and the award of public service contracts in passenger transport by rail, road and inland waterway [COM(2003)471]*			**2002:** Regulation (EC) No 894/2002 amending Council Regulation (EEC) No 95/93 on common rules for the allocation of slots at Community airports	
	2004: Directive 2004/52/EC on the widespread introduction and interoperability of electronic road toll systems in the Community	**2001:** Directive 2001/12/EC amending directive 91/440/EEC on the development of the community's railways	**2001:** Directive 2001/106/EC amending Council Directive 95/21/EC concerning the enforcement, in respect of shipping using community ports.		
		2001: Directive 2001/13/EC amending council directive 95/18/EC on the licensing of railway undertakings		**2004:** Regulation (EC) No 793/2004 amending council regulation (EEC) No 95/93 on common rules for the allocation of slots at community airports	
	***2003:** Proposal for a directive amending directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures [COM(2003)448]*	**2001:** Directive 2001/14/EC in respect of the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure		**2004:** Regulation (EC) No 785/2004 on insurance requirements for air carriers and aircraft operators	
		2004: Directive 2004/51/EC amending council directive 91/440/EEC on the development of the community's railways		**2004:** Regulation (EC) No 549/2004 laying down the framework for the creation of the single European sky	
		***2004:** Proposal for a Regulation on compensation in cases of non-compliance with contractual quality requirements for rail freight services [COM(2004)144]*			

Table I-2: Summary of Community transport initiatives since 2000 (continued)

	Road transport	Rail transport	Maritime transport and inland waterways	Air transport	Galileo
Infrastructure development, intermodality	***2004:*** Decision No 884/2004/EC amending Decision No 1692/96/EC on community guidelines for the development of the Trans-European transport network				
	2003: Regulation (EC) No 1382/2003 on the granting of community financial assistance to improve the environmental performance of the freight transport system (Marco Polo programme)			**2004:** Regulation (EC) No 552/2004 on the interoperability of the European air traffic management network	**2002:** Council regulation (EC) No 876/2002 setting up the Galileo joint undertaking
		2004: Directive 2004/50/EC amending council directive 96/48/EC on the interoperability of the trans-European high-speed rail system and directive 2001/16/EC on the interoperability of the trans-European conventional rail system			
Traffic control, traffic monitoring, safety and environment	**2003:** Directive 91/671/EEC on the approximation of the laws of the Member States relating to compulsory use of safety belts in vehicles of less than 3,5 tonnes (April 2003)	**2004:** Regulation (EC) No 881/2004 establishing a European railway agency	**2001:** Directive 2001/106/EC amending council directive 95/21/EC concerning the enforcement, in respect of international standards for ship safety and pollution prevention.	**2002:** Directive 2002/30/EC on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at community airports	***2003:*** *Proposal for a council regulation on the establishment of structures for the management of the European satellite radionavigation programme [COM(2003)471]*
		2004: Directive 2004/49/EC on safety on the community's railways and amending council directive 95/18/EC on the licensing of railway undertakings and directive 2001/14/EC of February 2001 in respect of safety certification	**2002:** Directive 2002/59/EC establishing a community vessel traffic monitoring and information system and repealing council directive 93/75/EEC	**2002:** Regulation (EC) No 1592/2002 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency	
			2002: Directive 2002/84/EC amending the directives on maritime safety and the prevention of pollution from ships	**2004:** Regulation (EC) No 550/2004 on the provision of air navigation services in the single European sky	
	2004: Directive 2004/54/EC on minimum safety requirements for tunnels in the trans-European road network		**2002:** Regulation (EC) No 1406/2002 establishing a European Maritime Safety Agency	**2004:** Regulation (EC) No 551/2004 on the organisation and use of the airspace in the single European sky	
			2003: Directive 2003/24/EC amending council directive 98/18/EC on safety rules and standards for passenger ships	**2004:** Directive 2004/36/EC on the safety of third-country aircraft using community airports	
			2003: Regulation (EC) No 1726/2003 amending Regulation (EC) No 417/2002 on the accelerated phasing-in of double-hull or equivalent single-hull oil tankers		

Table I-2: Summary of Community transport initiatives since 2000 (continued)

	Road transport	Rail transport	Maritime transport and inland waterways	Air transport	Galileo
Social conditions	**2002:** Directive 2002/15/EC on the working time for mobile road transport activities	***2004:*** *Proposal for a Regulation on international Rail Passengers' Rights and Obligations [COM(2004)142]*	**2001:** Directive 2001/106/EC amending council directive 95/21/EC concerning the enforcement, in respect of shipboard living and working conditions	**2004:** Regulation (EC) No 849/2004 amending regulation (EC) No 2320/2002 establishing common rules in the field of civil aviation security	
	2001: *Proposal for a regulation on the harmonisation of certain social legislation relating to road transport*			**2004:** Regulation (EC) No 261/2004 establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of flights, and repealing Regulation (EEC) No 295/91	

4.2. Freight transport

Between 1995 and 2003 the EU-25's freight transport performance, measured in tonne-kilometres, increased by approximately 24%. Several driving forces can be identified. First and above all, there is still a strong correlation between trends in freighttransportation and GDP. In fact, transport intensities, measured in tonne-km per unit GDP, remained relatively stable between 1995 and 2003. Compared to the former EU-15 Member States, intensities are clearly higher in the 10 new Member States. Second, increasing international trade flows further stimulate freight transports. In this context, maritime transports have become more important in recent years.

At the same time, the majority of the EU-25 economies have become increasingly service-oriented. The results of this development should, in principle, have been less material-intensive production processes and subsequently reduced demand for transport services.

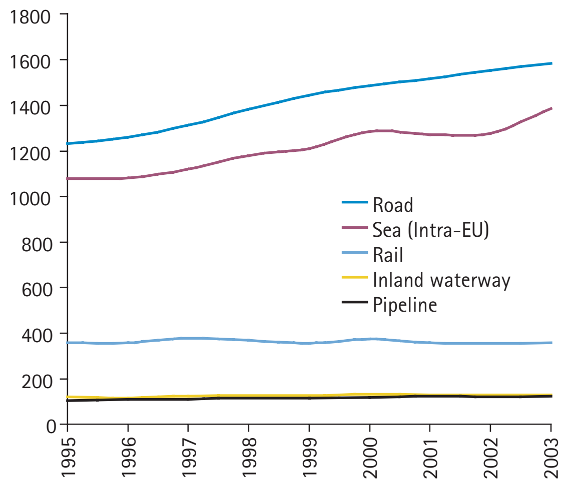
Increasing absolute output levels and the reorganisation of production processes in modern industries can explain these contradictory trends. In particular, the success of 'day-by-day deliveries' and 'just-in-time production' depends on a flexible supply of transport services. This in turn is often accompanied by an increasing number of runs and a decreasing size of the transported units. The adaptation of road carriers caused a renewal of the vehicle fleet with a clear tendency towards Light Goods Vehicles (LGV). The demand for highly flexible transport services favoured road transport and steadily increased its competitiveness over rail transportation in the last decades. Consequently, rail transportation increasingly dwindled in the 1980s and early 1990s. Due to the ongoing efforts of European and national transport policies to revitalise the rail market, it was possible to stop the negative trend.

Rail transport activity could thus have been stabilised in recent years. In fact, rail freight's performance in 2003 was just about the level of 1995. However, despite political efforts at EU and national levels, the forces of the liberalised transport market were too strong for transport policy to compensate. As a result, the rail shares in the inland freight market further declined from 19.8% in 1995 to 16.4% in 2003. At the same time road haulage has continuously increased its share which amounted to 72.2% in 2003.

In addition to the inland transport modes discussed above, maritime transport should also be considered an extremely important element of the transport system. Regarding freight transport performances, intra-EU and domestic sea transport accounted for more than 1387 billion tkm in 2003. This corresponds to a share of 38.7% for the whole transport market (inland and other transport). Thus maritime transports almost equal road transport's performance of 1,583 billion tkm (44.2%).

Figure I-9 gives an insight into the development of the freight transport performances. Trends concerning EU-25 sea transports are estimated according to EU-15 trends on sea transports and empirical data on international trade flows which are available for all Member States.

Figure I-9: Development of freight transport performance in the EU-25



Source: Energy and Transport in Figures

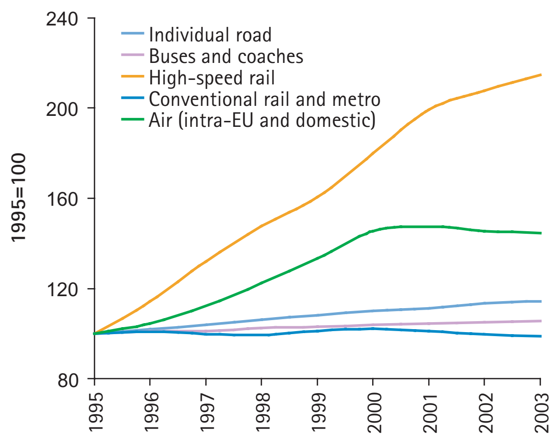
4.3. Passenger transport

While freight transport was up by 24% between 1995 and 2003, EU-15 passenger transport only increased by approximately 14% in this period. Nonetheless, the growth of the rail passenger sector was significantly stronger (9%) compared to freight transports. The establishment of high-speed rail connections has particularly increased rail's competitiveness with regard to longer distances. Nevertheless, rail transport's lost market share to individual motorised road-transport, which experienced growth in its performance by 14%. Passenger transport by air has also increased(+44%). However, growth rates of the air market have started to decrease in recent years.

Increasing road shares in most EU-25 countries have usually gone hand in hand with increasing levels of motorization. This was the case in the early and mid 1990s but continued at a decreasing growth rate for most countries in the late 1990s. Interestingly enough, in some countries with low motorization levels such as Denmark, motorization is stagnating while it continues to rise in other countries that already show higher motorization levels such as Italy or Luxembourg. Reasons for this trend vary and disposable incomes cannot solely be held responsible. In most new Member States the growth of motorization is significantly higher than the growth of real incomes. As a matter of fact, vehicle taxes, special VAT, ecological awareness, quality of public transport services as well as national and individual habits affect motorization to the same extent.

Data on individual transport activity has become increasingly available to a high degree for most EU-25 Member States, but some gaps in the data availability for new Member States prevail. In order to present a complete picture of passenger transport development, figures on individual motorised road transport are partly based on model results. This is particularly true for the Baltic States, where the development of individual road transport is based on the performance of one given year and changing levels of motorization. Figure I-10 compares relative growth of individual road, bus and coach, rail and air transport. Rail transports are further subdivided into conventional and high-speed rail transport performances.

Figure I-10: Relative growth of passenger transport performance in the EU-25



Source: Energy and Transport in Figures

Growth of high-speed railway performance clearly outperforms the development of the other sectors. Though, the favourable trend partly results from the shift of conventional rail transports, which slightly declined in the considered period, further extensions of the European high-speed rail network can be considered an important element to revitalise European railways. Common drivers for passenger transport can hardly be identified. Clearly personal income affects the level of motorization and thus individual road transport performance. However, time constraints, structure of households and changing life styles are of high relevance as well.

4.4. Infrastructure policy

Transport infrastructure can be seen as one of the most important public goods of a region. A high quality network guarantees the smooth functioning of the transport system, which in turn contributes to the wellbeing of the people. Thus, infrastructure policy plays a central role within the widespread field of transport policy. European infrastructure policy is mainly determined by the guidelines for the development of the Trans-European Transport Networks (TEN-T). One such guideline suggests that infrastructure investments should, in the light of their financial dimension, focus on priority projects. In the meantime, the original list of 14 projects, the so-called "Essen List" from 1994, was extended to 30 priority projects (including Galileo) in 2004, following the proposal of the so-called "Van Miert Group". In general, it can be said that the projects affect infrastructure of all modes (including intermodal links) but have a particular focus on railway links. Almost all priority projects focus on important corridors that are characterised by a high level of cross-border activity. The corridor concept has proved a highly efficient instrument to foster trans-border interconnectivity between countries.

Besides the development of the TEN-T, European transport policy deals with the implementation of tolling schemes to better use infrastructure capacity. According to the White Paper on European transport policy for 2010, imbalances in the transport system partly derive from the fact that transport modes do not fully pay the costs they are responsible for. Infrastructure charging for the rail sector is included in the first rail package (Directives 2001/12/EC to 2001/14/EC), Infrastructure charging for motorways was regulated in Directive 1999/62/EC and is presently considered for revision. Road charging follows four main principles: First, tolls should reflect the costs for the construction, operation, maintenance and development of the network and they should further account for the costs of accidents. Second, tolls should reflect the distance travelled and may vary by geographical locations, infrastructure types and speed, vehicle characteristics like weight and emission level as well as (potential) congestion levels. Third, charging should target all users over 3.5 tonnes as well as the main itineraries defined by the TEN-T. Finally, revenues from fees should be reinvested into the transport sector in order to promote the balanced development of transport networks.

4.5. Market opening and competition

The EU pursues as its principle goal the establishment of the internal market that ensures the free movement of people, goods, services and capital. The transport system obviously plays an important role in this context, and consequently, the opening of the transport markets has become a very important issue on the Commission's agenda. Particularly for the transport market, market opening is not only an economic issue. The opening of transport markets additionally makes common standards and policies necessary to ensure the interoperability of networks, their interconnection and a sufficient capacity. In some transportation sectors, such as in the air and road sectors, market opening is far advanced. The air sector in particular has witnessed some low-cost new entrants that have quickly captured large market shares and have exercised major pressure on the incumbent airlines. The road sector is now very competitive and benefits from high flexibility and low costs. However, high cost pressures provide an incentive for road hauliers to violate social regulations and safety standards. In contrast, competition is comparatively low in the rail sector. However, as a consequence of the first railway package adopted in 2001, the railway sector has experienced a significant development in market opening. Among other things, the package ensures free access to the trans-European rail infrastructure for freight services and defines the charging rule. The second railway package deals with common principles of interoperability and rail safety, as well as other issues One consequence is that the market for railway service and for railway technology will be opened to international competition. Market opening does not only concern inland transport modes but also maritime transport. Though major steps to open this market have been taken, access rules to port services are still a central point of discussion. The Commission proposed to establish an 'open, transparent and non-discriminatory procedure for access to port services', however, the European Parliament rejected the relevant proposal.

It can be concluded that the increased competition following the EU market opening has led to a dynamic development of road freight and air transportation markets. The markets for rail and maritime transport will follow but are waiting for the appropriate Directives to be transposed. According to the recent White Paper on services of general interest (2004), it can be expected that a competitive transport market will improve efficiency, increase the number of choices and, in the end, make a number of services of general interest more affordable.

4.6. Environment and safety

Generally, increasing road transport performances are responsible for the fact that CO_2 emissions from transport activities grew by almost 30% between 1991 and 2001. Thus, the transport sector further increased its already high share on the overall production of CO_2 emissions to approximately 25%. In order for the EU to reduce its greenhouse gas emissions by an average of 8% on 1990 levels over the period 2008-2012 as defined by the Kyoto Protocol, emissions from transport will have to decline significantly in the coming years. In contrast to the increase of CO_2, acidifying emissions clearly decreased in the same period. Due to technological (e.g. catalytic converter) or chemical (composition of gasoline) improvements, NOx and SO2 emissions respectively passenger cars are now only minor offenders. However, the development is less favourable for heavy goods vehicles and for maritime transport. For the maritime transport, the production of nitrogen oxides increased between 1991 and 2001.

The relatively high number of vessel casualties observed during the past years as well as increasing acidifying emissions have turned maritime safety and emissions into prominent topics on the national, European and international level. In order to define clear standards and strategies to counter these problems the Commission developed diverse packages and measures in this context (e.g. Erika I and II, Directive 1999/32/EC).

Accidents and fatalities resulting from the transport sectors are the final aspect under consideration. Regarding the number of road fatalities, the positive trend of a sustained reduction is obvious, especially against the background of increasing road transport performances. This is clearly a result of improved safety standards, which have continuously been pushed by the Commission, national governments and the technological progress of car manufacturing. Nonetheless, the remaining number of road accidents is still high and leaves room for measures promoting road safety. Consequently, the Commission introduced a Road Safety Action Programme the aim of which is to cut the number of road fatalities in half by the year 2010 compared to 1990 levels.

European Union energy and transport developments

1. POLICIES, MARKET OPENING AND COMPETITION

- Since January 2000, the Directorate General for Energy and Transport is the service in charge of energy and transport issues at the Commission level.
- The TEN concept was introduced by the 1992 Treaty of Maastricht. The framework within which TEN are developed consists of a Community Decision on TEN Guidelines and a Community Regulation on TEN financing.
- Focal points of transport policy are users' demands including safety, fairness, efficient infrastructure charges.
- Other main policy objectives include the elimination of bottlenecks and the promotion of balanced transport modes. These major instruments are simultaneously aimed at reducing environmental impact from the transport sector.

1.1.1. General policies affecting both sectors
The framework within which the energy and transportation sectors evolve in the EU is formed from a wide range of guidelines and goals comprising legislation, regulations and policies. The main policy guidelines are set out in two fundamental documents: The Green Paper entitled "Towards a European strategy for the security of energy supply", published in November 2000, and the White Paper entitled "European transport policy for 2010: Time to decide", published in September 2001. In June 2005, the Commission adopted the Green Paper "Energy Efficiency or Doing More with Less". This framework policy document is intended to launch a debate and later define the framework on the increasingly central role that efficiency is bound to play in Europe's energy and transport markets.

The main objectives of these policy guidelines are:

1. Complete the internal European market in energy and transport

2. Ensure sustainable development of transport and energy

3. Deploy major networks in Europe



1.1. Policies
The Directorate-General for Energy and Transport, the service in charge of energy and transport at the European Commission level, was born on the 1st January 2000 after the merging of the Directorate-General for Transport and the Directorate-General for Energy. It is responsible for developing and monitoring European policies in the energy and transport field, ensuring that these are designed for the benefit of all sectors of society: Businesses, cities, rural areas and, above all, of citizens. Given the pivotal nature of the energy and transport sectors to the European way of life and to the functioning of its economy, the Directorate-General oversees their good operation in economic, environmental, safety and social terms. The Directorate-General carries out this mission using legislative proposals and programme management, including the financing of projects, and works in close co-operation with other Directorates-General, inter alia, in the fields of enlargement, the environment, research, and international relations. In addition to developing Community policies in the energy and transport sectors and handling State aid dossiers, the Directorate-General manages the funding programmes for the trans-European networks (TEN), and technological development and innovation. Based in Brussels, the Directorate-General reports to the Commissioner for Transport and the Commissioner for Energy.

4. Space management

5. Improve safety and supply security

6. Accomplish enlargement

7. Develop international co-operation

Following recent events in Spain and the UK, an eighth general objective was added to the list:

8. Conceive and implement measures to improve security, mainly to protect citizens against terrorism.

- Co-operate with the other Commission services covering subjects of law enforcement administrations (police, justice, customs etc), with Transport and Energy operators and with third countries and the relevant international institutions.

- Propose legislation, implement inspection programs and allocate funds for research.

1.1.2. Energy policies
The Commission's main energy policies concern energy efficiency, energy supply security, promotion of renewable energy sources, completion of the internal market and competition, management of the energy aspects of the enlargement process and climate

change, although not necessarily in that order of priority. Other policy areas include international co-operation and specific regulations for the domestic coal and nuclear industries.

1.1.2.1. Energy efficiency and demand management
In June 2005, the Commission adopted the Green Paper "Energy Efficiency or Doing More with Less", which seeks to put energy savings on the top of the energy agenda. It is intended to start a discussion on how to save energy and lists a number of options to achieve a 20% savings of energy consumption by 2020 in a cost effective way, mainly through changes in consumer behaviour and energy efficient technologies. Chapter 4 of this paper is especially dedicated to these important policy goals. The Commission's first broad strategy on energy efficiency, however, dates back to 2000, when the Action Plan for Energy Efficiency, an umbrella document outlining programmes of Community legislative and non-legislative efficiency-enhancing actions, was adopted. Instruments and measures implementing measures in this field include:

- Directive 2004/8/EC on the promotion of cogeneration, aimed at consolidating and, where feasible, promoting new highefficiency cogeneration installations in the internal energy market (legislation in force)

- Directive 2002/91/EC on the energy performance of buildings, designed to improve the energy efficiency in private and public buildings (legislation in force)

- A range of legislative measures for EU labelling schemes and minimum efficiency requirements in the domestic sector (legislation in force)

- The Intelligent Energy for Europe (2003-2006) programme, the Community's support programme for non-technological actions in the field of energy and which encompasses previous separate Community efforts in the fields of renewable energy and energy efficiency. The SAVE (1998-2002) programme's objectives –to promote energy efficiency and encourage energy-saving behaviour– have been incorporated into this broader programme.

- The Campaign for Sustainable Energy (2004-2007), which will cover the four areas of the Intelligent Energy Programme and will build on the success achieved by the Renewable Energy Campaign for Take Off (1999-2003). The Campaign will cover a variety of public awareness measures to encourage European citizens to invest in technologies and practices

- The EU's 6th Framework Programme for Research and Technological Development (RTD) with its energy research, demonstration and dissemination

- A proposal for a Directive on the promotion of end-use efficiency and energy services (COM/2003/739) intended to enhance the cost-effective and efficient end-use of energy in Member States by providing the necessary targets, mechanisms, incentives and institutional, financial and legal frameworks to remove existing market barriers and imperfections for the efficient end use of energy (in legislative process).

- A proposal for a Directive (COM/2003/453) on establishing a framework for the setting of eco-design requirements for energyusing products, aimed at creating a comprehensive and coherent legislative framework for addressing eco-design requirements (in legislative process).

- A range of voluntary agreements and other self-commitments by industry.

- A series of promotional initiatives on energy efficiency for office equipment, motor driven systems and lighting.

The instruments and actions that are expected to achieve the largest increases in savings and efficiency are briefly discussed below.

- Promotion of end-use efficiency and energy services

Estimates suggest that the Community's energy consumption is approximately 20% higher than can be justified on economic grounds. Significant energy savings can be realised through energy services and other end-use efficiency measures. The Commission adopted in late 2003 a proposal for a Directive (COM (2003) 739) on the promotion of end-use efficiency and energy services to enhance the cost-effective and efficient end-use of energy in Member States. The proposal sets out clear mandatory targets for annual energy savings at Member States' level and for the share of energy-efficient public procurement for the period 2006-2012. For the same period, the proposed Directive gives Member States strong incentives to ensure that suppliers of energy offer a certain level of energy services. The proposed Directive is in legislative co-decision process.

- Energy efficiency in buildings

In 2003, final energy demand (FED) from the residential and tertiary sector, the major part of which is buildings, accounted for almost 42% of the EU's total FED. The sector therefore offers the largest single potential source for energy efficiency improvements through cost-effective measures. Research shows that more than 20% of the present energy consumption and up to 30-45 million tonnes of CO_2 per year could be saved by 2010 by applying more ambitious standards when constructing or refurbishing buildings. The aim of improved energy efficiency has already been set out in earlier existing legal instruments. Previous legislation for the sector includes the Boiler Directive (92/42/EEC), the Construction Products Directive (89/106/EEC) and the buildings provisions in the SAVE Directive (93/76/EEC). The Directive on the energy performance of buildings (2002/91/EC), in force since January 2003 builds on those measures with ambitious aims to increase the energy performance of public, commercial and private buildings in all Member States.

- Combined heat and power (CHP)

Due to its potential for increased energy efficiency and its lower impact on the environment, the promotion of CHP (also called cogeneration) is a priority area for many Member States. The Community began promoting cogeneration through the adoption of Directive 92/42/EEC on efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels in 1992. Later in 1997, the Commission's strategy was outlined in a Communication on cogeneration (COM/97/514) that set an overall indicative target of doubling the share of electricity production from cogeneration to 18% by 2010. The Cogeneration

Directive (2004/8/EC) adopted by the European Parliament and the Council late in 2004 and amending Directive 92/42/EEC concentrates on providing a framework for the promotion of this efficient technique in order to overcome existing barriers, to advance its penetration within increasingly open energy markets and to help mobilise unused potential. This "Cogeneration Directive", urges Member States to carry out analyses of their potential for high efficiency cogeneration (defined as cogeneration providing at least 10% energy savings over separate production).

1.1.2.2. The EU supply security strategy: A policy objective that encompasses every dimension of the energy chain

In 2003, the EU imported 51% of its total energy requirements. Forecasts indicate that the EU's energy imports will represent 70% of its total energy requirements by 2030. This reality called for a comprehensive energy supply security strategy, whose guidelines, as well as a set of issues that were opened for debate, were summarised in the Green Paper, Towards a European strategy for the security of energy supply (COM/2000/769), adopted in 2000. The main conclusions resulting from that debate were summarised in a Communication from the Commission to the Council and the Parliament adopted in June 2002 (COM/2002/321). The debate confirmed the Commission's view that supply security is not a question of seeking to maximise energy self-sufficiency or to minimise dependence, but rather to produce policies aimed at reducing the risks linked to such dependence by balancing between, and diversifying across, the various sources of supply by energy source and by geographical region. Specific objectives involve the entire energy chain.

With respect to the security of electricity and gas supplies, the Commission adopted in 2003 a Communication on the Energy Infrastructure and Security of Supply (COM/2003/743) as well as a proposal for amending the guidelines for TEN-E network (COM 2003/742), a framework policy document that contributed to the debate which resulted in a proposal for a Directive concerning measures to safeguard security of electricity supply and infrastructure investment (COM/2003/740) –currently being debated in the Parliament– and in the later adoption of Directive 2004/67/EC on the security of gas supplies in the framework of the energy internal market. Concerning security against terrorism, see the next section below.

1.1.2.3. Security against terrorism

The proper functioning of energy infrastructures is a necessary condition for citizens' well being and for the functioning of the EU's economies. Although the EU's energy markets are closely linked and interdependent, it remains the responsibility of national authorities to take measures to prevent and eventually mitigate any damage to energy supply. The appearance of new threats of international dimension requests concerted capacity of awareness, prevention and response, and will only be fully effective if formulated at European level. The EU has taken initiative towards a common approach to the protection of energy infrastructures. The Communication COM/2004/702 on "Critical Infrastructure Protection in the fight against terrorism" adopted by the European Commission on October 2004 defines an agenda for prevention of acts of terrorism in vital areas at EU level. Its key tasks are:

- Establish legal instruments for the security of energy infrastructure (networks, storage, installations, nuclear installations)
- Security of radioactive sources
- Recommendations to Members States and technical assistance
- Follow-up of national verification programs, including nuclear security
- Co-ordination of contacts with the Member States and operators
- Co-ordination with specialised international organisations

Critical infrastructure is to be defined at Member State level and at European level. A first inventory is to be established by the end of 2005.

1.1.2.4. Renewable energies

The development of renewable energy sources, particularly from wind, water, bio-mass and solar power, is one of the pillars of the Community's energy policy. Several of the technologies, especially wind energy, but also small-scale hydropower, energy from biomass, and solar thermal applications, are being successfully and increasingly developed by several Member States. The others, especially photovoltaic cells, depend among other things on increasing demand and thus a greater production volume to reach the economies of scale necessary to arrive at an adequate level of competitiveness with centralised generation.

The Green Paper on Energy Supply Security set in 2000 the goal of doubling the share of renewable energies in the EU's 1997 gross inland consumption by 2010 (i.e. from 6% to 12%) and presented a timetable of actions to achieve this objective. The Community Strategy and Action Plan introduced by the Green Paper included internal market measures in the regulatory and fiscal spheres, reinforcement of those Community policies that have a bearing on increased penetration by renewable energies, proposals for strengthening co-operation between Member States, and support measures to facilitate investment and enhance dissemination and information in the renewables field. The latest efforts since then are:

- The Renewable Energy Partnerships were established between the Commission and promoters of renewable energy programmes, projects and initiatives and were basically an expression of willingness in form of a declaration. These Partnerships provided a tool to encourage and enhance the visible commitment of public authorities in regions, cities and municipalities, industries, agencies and universities. They benefited from a series of promotional tools co-ordinated on European level. One hundred and thirty renewable energy programmes and projects involving more than 700 partner organisations in the EU became Renewable Energy Partners between 2000 and 2003 and will continue to be partners of the new Campaign for Sustainable Energy.
- The ManagEnergy initiative aims to support the work of actors working on renewable energies and energy demand management at local and regional levels. ManagEnergy was launched in March 2002, based on the requests for further improved communication and information dissemination on locally relevant energy issues.

1.1.2.5. Completion of the internal energy market
The completion of the internal energy market, one of the Commission's major policy areas, is treated in detail in Section 1.3.

1.1.2.6. Climate change and environmental quality

• Climate change

In January 2005, the EU greenhouse gas Emission Trading Scheme (EU ETS) commenced operation as the world's largest multicountry, multi-sector greenhouse gas (GHG) emission trading scheme. The ETS is based on Directive 2003/87/EC, which entered into force on 25 October 2003 and is one of the main EU instruments to achieve its Kyoto commitments. The EU ETS is designed to give countries and polluting sources flexibility in their abatement efforts. In particular, it allows them to choose their preferred method of abatement as well as offering those that reduce emissions beyond their allocations to trade excess emissions with others having difficulty in achieving their own targets. Subject to Commission approval, the initial allocation of emissions across sources in each Member State was established through a National Allocation Plan (NAP). By June 2005, 24 out of 25 Member States (with the exception of Greece) had had their NAPs approved by the Commission. A second round of NAPs are expected to be submitted by mid 2006, leading towards the second trading period to begin in 2007. The Commission and the Council of Ministers are already discussing the strategies to be adopted after 2012, when the ETS system expires. The central issue of the discussions is how to draw in all major world emitters –including the US and China– into a binding emissions-abatement scheme.

• Air quality

Air Quality is one of the areas in which the Commission has been most active and where great progress has been made. The Commission's aim has been to develop a comprehensive strategy through the setting of long-term air quality objectives. To this end, a series of Directives to control the levels of certain pollutants and to monitor their evolution have been adopted by the European Parliament and the Council and implemented by the Member States.

Although the achieved levels of abatement have been impressive, there is still significant scope for improvement, especially in view of the EU-10, whose power generation structure relies heavily on solid fuels, a major source of polluting emissions.

Broader air quality policies and regulations of relevance to energy sector include:

• Directive 2001/81/EC on National Emission Ceilings (NECs) for certain pollutants, adopted in 2001. The Directive sets upper limits for each Member State for the total emissions of SO_2, NOx, VOCs and ammonia by 2010, but leaves it largely to the Member States to decide which measures to take in order to comply.

• The Clean Air for Europe (CAFE) programme, launched in March 2001. It provides for technical analysis and policy development which will lead to the adoption of a thematic strategy on air pollution under the Sixth Environmental Action Programme by mid 2005. The major elements of CAFE are outlined in the Communication on CAFE (COM/2001/245)).

• Directive 2000/76/EC on the incineration of waste, which covers the incineration of hazardous (formerly Directive 94/67/EC) and non-hazardous (89/369/EEC and 89/429/EEC) waste. It prevents and/or reduces the possible negative effects caused by the incineration and co-incineration of waste through stringent operational conditions and technical requirements and by setting emission limit values for waste incineration and co-incineration plants within the Community.

• Directive 1999/32/EC relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC.

• Framework Directive 96/62/EC on ambient air quality assessment and management, adopted in 1996. This Directive covers the revision of previously existing legislation and the introduction of new air quality standards for previously unregulated air pollutants, setting the timetable for the development of daughter Directives on a range of pollutants.

1.1.2.7. Nuclear energy and safety
The Commission submitted in January 2003 a proposal for two Directives (COM/2003/32) on the management of radioactive waste and on the setting out of basic obligations and general principles on the safety of nuclear installations, including binding requirements affecting decommissioning funds. In June of the same year, the European Parliament adopted a resolution on the internal electricity market that involves a compromise on the matter of decommissioning funds. These proposals provoked a diverse set of reactions from Member States, and ultimately led the European Parliament to introduce a series of modifications to the Commission's initial version. The Commission acknowledged the changes and responded by submitting in September 2004 two modified proposals (COM/2004/526) for the aforementioned Directives. Since then no progress was made.

1.1.2.8. Enlargement
After successfully growing from 15 to 25 members in May 2004, the European Union is now preparing for the next enlargement. As regards the two accession countries, Bulgaria and Romania hope to join by 2007. Turkey, a candidate country, will start soon negotiating its membership.

Croatia applied for EU membership in February 2003, and in April 2004 the Commission issued a positive opinion on this application and recommended the opening of accession negotiations. This recommendation was endorsed by the June 2004 European Council who decided that Croatia was a candidate country and that the accession process should be launched. The December 2004 European Council requested the Council to agree on a negotiating framework with a view to opening the accession negotiations with Croatia on March 2005 provided that there is full co-operation with the International Criminal Tribunal for the former Yugoslavia.

The key issues in the energy sector for preparation of EU membership are:

• The need to develop an overall energy policy with clear timetables for restructuring and alignment with the energy acquis;

• the internal energy market (gas and electricity Directives) including improvement of trans-European energy networks; emergency preparedness and notably the constitution of 90 days of mandatory oil stocks; preparedness and notably the constitution of 90 days of mandatory oil stocks;

- the social and regional consequences of restructuring of the solid fuels sector and,
- improvement of energy efficiency and promoting the use of renewable energy; and nuclear energy including ensuring the highest nuclear safety standards.

1.1.3. Transport policies

Transport policies aim to improve the competitiveness of Europe's businesses and increase environmental protection, higher levels of safety and strengthen consumers' rights. Objectives also include the stimulation of technological innovation and the strengthening of investments in infrastructure through ambitious projects, such as "Galileo", the European satellite navigation system, and the expansion of the trans-European networks (TENs) to cover the enlarged Union.

Transport policy plays a central role in the EU: The transport sector represents a significant share of the EU's GDP (~10%) and employment (7.5 million jobs in the transport services sector[1]). One of the pillars of EU cohesion policy is to foster regional competitiveness by realising the spatial comparative cost advantages within the Union. This requires the free movement of passengers, goods, services and capital. It is therefore easy to see why the smooth functioning of the transport system is a necessary condition for the creation of the Single Market.

The objective to establish a European-wide efficient transport system implies a rather complex set of political issues. Four main challenges have been identified. First, the EU transport network is composed of country networks, which means that co-ordination of European and national transport policies is highly important. For example, since the benefits stemming from trans-European networks for transport (TEN-T) projects are mainly determined by the regions' interconnection with the respective trans-European corridors, TEN-T projects must be planned at the European and the national level, as national plans determine the interconnections with the primary and secondary networks of other Member States.

Second, the co-ordination of transport policies requires a dynamic process of harmonisation. This holds for charging systems, fuel taxes and subsidies, among which there still exists significant differences. Harmonisation is particularly important for the interoperability of the railway system because the objective of increasing railways' competitiveness presupposes free access to the rail networks with a standard technology for the rolling stock.

The third challenge relates to deregulation and market opening. Previously characterised by a strong regulation until the mid 1980s, EU policies have been actively promoting deregulation and market opening in the transport sector. As a result, the level of competition has increased rapidly. This is particularly true for road haulage and inland waterway transport (complete opening of these markets took place in 1998) but also holds, with some exceptions, for maritime transport as well. In contrast, the opening of railway markets is still lagging behind. However, the recent adoption of a series of far-reaching Directives (the so-called "railway packages") is expected to open rail transport markets to competition by 2006.

Fourthly, transport systems must take into account the negative external effects often associated with their operation, even if they are efficient from a commercial point of view. These include congestion, accidents and environmental impacts. The Commission has initiated several programmes aimed at increasing safety and security of the transport system and to minimise the impact of transport activities on the environment.

Beside these sector-specific challenges, EU transport policy is also affected by more general ones. An immediate effect of the EU's recent enlargement is the restructuring of transport flows. As transport activity follows economic and societal integration, East-West transport flows will experience a substantial increase. Infrastructure planning at the EU level has responded to these new challenges through a revision of the TEN-T concept to include the new Member States and candidate countries. Moreover, transport policies also take account of the ongoing and rapid processes of globalisation, where an efficient integration of transport, communication and logistic systems is required.

The EU's strategy to meet these transport-specific and general challenges were defined in the White Paper "European transport policy 2010: Time to decide", which is the EU's framework document on transport policy. One of the central views stated therein is the importance that the Commission attaches to citizens' demands and needs, which is why one of the document's main policy axes is to places the user at the heart of transport policy. The challenge of co-ordination is particularly important with regard to eliminating infrastructure bottlenecks. Whilst, this is true for the planning period, where the regional stakeholders should be involved at an early stage, it also holds for funding. Major projects, such as the completion of Alpine routes or an easier passage through the Pyrenees require very large investments, which would be difficult to finance by a single source. Thus, the elimination of infrastructure bottlenecks can only succeed if institutional bottlenecks are alleviated as well. The White paper also lays down the steps to achieve a complete market opening and improved interoperability in the rail sector. Once these obstacles are overcome, the revitalising of the railways and the objective of shifting the balance between modes of transport can be achieved in the longer run.

The enlargement of the Union has lead to an integrated economic area with some 450 million people and a trading power comparable only with that of North America. In that context, the transport sector stands out as one of the key building blocks for the realisation of the single internal market and for the competitiveness of Europe on the world economic stage. Indeed, the aim to connect the internal market with the rest of the world can only be achieved successfully with efficient communication and transport systems. To that end, the White paper defines clear guidelines for managing the globalisation of transport.

1.1.3.1. Placing users at the heart of transport policy

The orientation of transport policy to satisfy users' demands and needs relies on three main principles: Safety, security, fairness.

Safety for the mobility of goods and persons is of high priority for all transport modes. The European Road Safety Action Programme aims to have the number of fatal road accident victims in the EU cut by half by 2010 compared with 2000. This

[1] *Source: Eurostat and Energy and Transport in Figures.*

ambitious goal is to be achieved by progress in vehicle design, by improved accident protection and through safer infrastructure. Progress in design includes safer car fronts for pedestrians and cyclists which account for more than 40% of fatal accident victims. With respect to infrastructure, a strong emphasis is put on the safety of tunnels and new 'intelligent road' concepts supported by the Galileo navigation system. As for the framework for safety in rail and air transport, new safety authorities have been established in recent years. The European Aviation Safety Agency (EASA), in operation since September 2003, operates at the European level. In contrast, the second railway package established the framework for national rail safety authorities, which issue safety certificates to railway companies. The European Railway agency is expected to harmonise safety certifications in the medium term. Finally, the maritime packages "Erika I" and "Erika II" define the fundamental principles of maritime safety. Accidents such as those of the Erika in 1999 and the Prestige in 2002, which polluted hundreds of kilometres of coastline, as well as the EU enlargement, which led to a near doubling of the EU fleet (particularly through the accession of Malta and Cyprus), point to the high importance of maritime safety.

The September 2001 terrorist attacks showed the vulnerability of the transport system and led to various initiatives on the security of transport systems. Initiatives initially focused on the protection of air transport but the terrorist attacks in Madrid in 2004 and London in 2005 direly showed that the entire transport system is exposed to the risk of international terrorism. Transport security must also consider the effects of natural disasters. Infrastructure damage from storms, earthquakes or flooding has severe impacts on the security of the system. Floods are the most common threat for several Member States, and European institutions are actively involved in initiatives for monitoring and managing the risks affecting the transport sector.

Aside from reliability, which includes safety and security issues, fairness is another important property of an efficient system. Fairness in transport systems means transparent infrastructure charges, which reflect the real transport costs. As such, the Commission's objective of fair and efficient prices is accompanied by a continuous harmonisation of infrastructure charging systems and fuel taxes. For this reason, the Commission's charging policy is based on the "user-pays" and "polluter-pays" principles. The costs of infrastructure maintenance and operation, as well as external costs caused by congestion, accidents, pollution and noise, should therefore be included in the charging system, such that it is non-discriminatory and guarantees an efficient use of transport infrastructure. The legislative initiatives in this field include the railways Directive 2001/14, and the "Eurovignette" Directive 1999/62, which was revised in April 2005.

1.1.3.2. Eliminating bottlenecks

One of the major challenges faced by the Commission and by national governments is to provide a modern infrastructure network and thus to improve the traffic conditions within the internal market. Community investments focus on multi-modal corridors interconnecting several countries. In this context, high importance is given to improve on environmentally friendly transport modes such that the increase of transport, which will be inevitable in the process of further integration, can be managed without further risks for safety and the environment. Improving railway, inland waterway transport and coastal shipping ("motorways of the sea") is necessary for the freight transport market.

In the passenger market, further development of high speed rail connections will be used to buffer the growth of car travel and short distance flights. A more competitive rail sector is also an important goal, but co-operation among modes is of equal importance. The high-speed rail passenger network is expected to become increasingly competitive with air transportation, and inter-modal cooperation between high-speed trains and air transportation will further enhance efficiency. As for freight transport, the Commission is promoting the development of rail access to ports and the establishment of freight terminals open to all operators.

The concept of trans-European networks in Transport, which was adopted in 1995, was revised in 2004 assisted by the fundamental work of the van Miert high level group. The TEN-T is composed of 30 main priority axis. The investment costs are estimated to amount to about EUR 600 billion, while the investment on priority projects will need a budget of EUR 220 billion for the period 2004-2020. Against the background of these huge funding requirements, financing schemes were revised as well. With the new EUfunding rules, the maximum co-financing of the relevant projects was increased to 20%. Studies costs can be co-financed up to 50% in specific cases. Furthermore, a concept of pooling funds was developed such that projects in environmentally sensitive areas can be funded partly from road user charges on existing roads.

1.1.3.3. Shifting the balance between modes of transport

The deregulation process of road haulage and air transportation, which was completed in the late 1990s, has resulted in fast growth for both sectors. In the case of freight transport, road's share of inland transport (in tonne-km) was about 60% in the early 1980s when deregulation began. Nowadays, the EU-15 average is close to 80% and is clearly above that in some countries. The upswing of road haulage was accompanied by a strong decline of railway's share, which was almost cut into half (from 24% to 13%) over the same period. Simultaneously, rail shares in passenger transportation (in passenger-km) dropped from almost 8.5% to 6%. This is partly explained by increasing road shares, but also by a continuously increasing share of air transportation, which experienced annual growth rates of 5% to 8% over the period.

High competition in the road haulage and air transportation markets has been accompanied by a strong decrease in transportation costs. However, that success story brought about a strong increase of greenhouse gas (GHG) emissions. Furthermore, it caused serious congestion on 10% of the trans-European road network and in industrialised urban regions. In air transportation, airports are operating close to their maximum capacity, and are constantly struggling to avoid delays. This explains why low-cost carriers therefore deviate to less congested regional airports, which in many cases are heavily subsidised by regional and national funding. This is a source of distortion in the air market, with effects on the competitiveness between air and rail. Fierce competition has led to extreme working conditions, in particular in the road freight sector, where regulations are frequently violated. The Commission proposed measures for tightening up controls and penalties by promoting further harmonisation and uniform interpretation of legislation across Member States in this field.

To tackle traffic management in air sector, European transport policy created the concept of a single European sky. The concept introduced measures to restructure the European airspace according to traffic flows instead of national borders, to increase

capacities of air traffic control and thus to improve the reliability and safety of the system.
The Commission has also launched a strategy for the revitalisation of European railways in order to shift the balance between modes. To this end, three railway packages were introduced to foster deregulation. The first rail package, adopted in 2001 through Council Directives 2001/12/EC to 2001/14/EC, included the unbundling of essential functions, the establishment of a new regulatory body, guaranteed access rights, rules for the setting of track charges and the definition of a transparent procedure for the allocation of train paths. This package is a milestone in the opening of railway markets (see sections 1.3.1.2 and 1.3.3 for further details). Moreover, accompanying measures have been established with regard to safety standards, interoperability and the quality of services.

These institutional changes have come along with policies aimed at the elimination of bottlenecks. Most of the priority projects focus on either rail (freight corridors, high-speed network) or on inter-modal transport. With respect to the latter, the TEN-T priority project "motorways of the sea" plans to link sea, inland waterway and rail traffic and, in doing so, create a competitive alternative to road transportation. To ensure the project's success, new rules on market access in port services and the standardisation of containers have been introduced. The high importance of inter-modal transport is best illustrated if sea transport is taken into account. Maritime transport performance almost equals the performance of road transportation (ca. 1 300 billion tkm versus ca. 1 400 billion tkm in 2003).

At first glance, the enlargement of the EU seemed to contribute to the ambitious goal of shifting the balance of transport modes, given that many Central and Eastern European countries show significantly higher rail shares than their Western European neighbours. Nonetheless, road shares are rapidly increasing in these countries and national rail companies are unprepared for competition with the highly dynamic road markets. This is true for freight transportation, but also holds for passenger transport, where rapidly increasing motorization indicates a shift from rail to road transport as well.

1.1.3.4. Enlargement

The enlarged EU is home to 450 million persons, producing goods worth almost EUR 10 000 billion and trading goods worth almost EUR 5 500 billion. These volumes speak for themselves in respect of the need for an efficient transport system, which can only be guaranteed with sufficient infrastructure endowment. New investments required to connect people and markets between EU-15 and the new Member States sum up to approximately EUR 100 billion between 2000 and 2015 (in total, required transport infrastructure investments for the EU-25 amount to more than EUR 600 billion over the period).

The majority of the new Member States possess a rather competitive road haulage industry, which in many cases has been operating within the EU's markets for some time. However, full integration into the EU's road haulage market requires a strict application of existing fiscal, social and technical rules and standards. The same holds for the air sector, where most of the new Member States show similar structures and face similar problems to those in the EU-15.

In general, new Member States are subject to the entire body of Community legislation in the field of transport. This is particularly true for air and maritime transport and safety. Transitional solutions were agreed on in the Transport content of the Community Acquis with regard to full market access in the road and rail sector.

1.1.3.5. Manage the globalisation of transport

The ongoing process of completing the internal market has strengthened the European identity and has increased European competitiveness relative to other important world markets. However, while the internal market is highly developed, international relations are still characterised by a heterogeneous set of agreements between Member States and other countries. This is particularly true for the transport sector which is, to a great extent, regulated on the international level by multilateral conventions and bilateral agreements. Since the European Union aims to be perceived as a unique political body, it is claiming its own voice in the relevant international bodies in aviation, sea and inland waterway transport.

Besides the institutional aspects, globalisation also requires technical developments. Faced with road traffic congestion and limited access to railway services, the management of growing trade volumes must be backed by new logistical concepts. To this respect, the European Galileo civil satellite radio-navigation system, which is expected to be implemented by 2008, will provide a reliable and high performance platform for the necessary communication processes.

1.2. Changes in the structure and ownership of the two sectors

The European energy and transport sectors have experienced profound changes over the past 15 years. In the Western Member States, these sectors were once largely owned and controlled by State-run monopolies, but are now a complex web of private, public and mixed capital companies operating under a combination of national and EU regulatory frameworks. An identical process is advancing rapidly in the new Member States.

- Whilst national, state-controlled electricity and gas champions have disappeared in most Member States, many are still active in the EU-10.
- Large oil companies have moved further downstream and now directly market their products (especially natural gas) to end users. They are increasingly present in gas import infrastructure.
- Market opening led to substantial restructuring of air transport companies through alliances and mergers, but also co-operation of low cost companies and airports.
- The first steps in transforming national rail freight carriers into trans-European players were made.
- Demand for complex logistics in the road freight market has developed alongside an increase in the average size of haulers.

Two main trends underlie this modified structure: On the one hand, the unbundling of accounting, management and ownership of the networks (which are natural monopolies), from the mobile units that circulate through them (which are not); and, on the other, the partial or total privatisation of many of the historically State-owned and controlled companies that operated and owned these assets.

1.2.1. Public / private ownership issues

The legal framework that has prompted the opening of the energy and transport markets does not explicitly call for privatisations, but it does require that there should be no benefits (hence distortions) arising from State ownership of firms within the industries. Member States have opted for different organisational strategies to comply with market opening requirements, ranging from full privatisation of all the components of the two industries (as in the UK), to mixed private/public ownership structures, sometimes as part of gradual privatisation schemes (which is the case in most other Member States). Often, Member States have chosen to retain ownership or participation only in the companies owning and operating the physical networks (rails, pipelines, cables), whilst operation and ownership of the mobile units is left to the private sector.

1.2.2. Consolidation, new entrants and vertical integration

1.2.2.1. Transition of national gas and power incumbents to trans-European regional energy players

Europe's energy companies have expanded outside their national borders and are continuing to do so. The most rapid phase of expansion occurred during 2001-2002, with Germany's RWE and E.ON, France's EdF and GdF, Franco-Belgian Suez, and Italy's ENI and Enel topping the list of trans-national deals. E.ON acquired large energy companies and interests in the U.K., Scandinavia (Sweden and Finland) and Eastern Europe (Czech Republic, Slovak Republic, Hungary, Bulgaria) and went on to acquire Ruhrgas, Germany's leading gas player. It is now the largest downstream energy company in Europe and one of the largest in the world. Rival RWE also acquired a major U.K. power company and assets in nearly the same list of countries as E.On. In France, state-owned EDF and Gaz de France have very gradually shed market share, but they have simultaneously acquired numerous foreign assets. Both companies have expanded their interests in Germany, the U.K., Italy, Spain and in most Eastern European Member States. In turn, Franco Belgian multi-utility Suez has also become a sizeable energy player, with important electricity, gas, water and waste disposal operations not only in Europe but also across the world. Italian and Spanish companies' response to this European-wide restructuring was to "swap" assets, mainly in the power sector, where Italian companies (Enel) bought into Spanish generation, while Spanish companies (Endesa) did the same in Italy. The scenario repeated itself in the gas. Italy's ENI acquired a significant participation in the Spanish gas sector and the Spanish incumbent gas company Gas Natural acquired a distribution company in the Italian market. More recently, a similar pattern has been observed between Spanish and Portuguese energy companies. The overall picture is that many national players have become trans-national, focused on strategic (and often neighbouring) regions. More recently, there have been talks of further consolidation, especially in Spain (Gas Natural and Endesa) and in the UK.

The situation is quite different in the EU-10 where, despite the aforementioned partnerships and/or mergers with German, French, Italian and Scandinavian companies, national energy companies continue to subsist. This is not to say that progress in implementing the gas and power market opening Directives has been slow: Effective unbundling of some of the network companies as well as privatisations have taken place in several countries, including the Czech Republic, Estonia, Hungary, Latvia, Lithuania and Poland.

This expansive activity slowed down in 2003 but it appears to have picked up in 2004. Table 2-1 presents the major deals in the gas and power sectors between 2002 and 2004, illustrating the ongoing privatisations as well as the continued transformation of national gas and power companies into large trans-European regional energy players.

1.2.2.2. Upstream oil companies reposition themselves in the gas markets

A striking feature of the European energy industry is the role of large oil companies, in particular the following four companies – ExxonMobil, Shell, BP and Total which have enormous influence in

Table 2-1a: Major Mergers and Acquisitions in the European Gas and Power Industries in 2004

Buyer	Buyer's country of origin	Acquired company	Acquisitor's country
Market Purchase	International	ENEL SpA (20%)	Italy
SSE, Borealis Infrastructure Management and Ontario Teachers' Pension Fund	International	National Grid Transco plc	U.K.
Danish Oil & Natural gas (DONG)	Denmark	Elsam A/S (60.11%)	Denmark
EDP	Portugal	Hidroelectrica del Cantabrico SA (56.2%)	Spain
CKI Holdings Ltd.	International	National Grid Transco plc	U.K.
Casa Depositi e Prestiti	Italy	Terna SPA (29.9%)	Italy
Enel Spa	Italy	Slovenske Elektrame as (66%)	Slovak Republic
Market Purchase	International	Snam Rete Gas SpA (9.05%)	Italy
Danish Oil & Natural gas (DONG)	Denmark	Elsam A/S (22.2%)	Denmark
Cajastur	Portugal	Energias de Portugal SA (5.64%)	Portugal
Participacoes Publicas SGPS SA	Portugal	Energias de Portugal SA (5.64%)	Portugal
Gaz de France	France	Distrigaz Sud (51%)	Romania
E.ON AG	Germany	Distrigaz Nord (51%)	Romania
Gas Natural	Spain	DEPA SA (35%)	Greece

Source: Global Insight and PriceWaterhouseCoopers

Table 2-1b: Major Mergers and Acquisitions in the European Gas and Power Industries between 2002 and 2003

Buyer	Buyer's country of origin	Acquired company	Acquisitor's country
National Grid Group	U.K.	Lattice Group Plc	U.K.
RWE AG	Germany	Innogy Holdings Plc	U.K.
E.On	Germany	Ruhrgas AG (58.4%)	Germany
E.On	Germany	TXU Europe Group Plc (U.K. retail business)	U.K.
E.On	Germany	Graninge AB (61.3%)	Sweden
E.On	Germany	Thuega AG (13.7%)	Germany
Eni SpA	Italy	Italgas SpA (56%)	Italy
Edipower	Italy	Eurogen	Italy
Gaz de France, Ruhrgas, Gazprom	France	Slovensky Plynarensky Priemysel AS (49%)	Slovakia
EDF SA	France	Seeboard Plc	U.K.
Elsam	Denmark	NESA (78.75%)	Denmark
Eneco Energie	Netherlands	REMU NV	Netherlands
CVC Capital Partners (IBO)	U.K.	Viterra Energy Services AG	Germany
Market Purchase	International	Public Power Corporation (15.73%)	Greece
Weser-Ems-Energiebeteiligungen	Germany	EWE (27.4%)	Germany
Hidroelectrica del Cantabrico	Spain	Naturcorp (62%)	Spain

Source: Global Insight and PriceWaterhouseCoopers

the industry. Three other companies could be added to the list: Russia's Gazprom, with easily the largest gas reserves in the world, Algeria's Sonatrach and Norway's Statoil. Together, the three companies supply the larger part of the gas consumed in Europe. These large suppliers have become increasingly active in the European gas wholesale business, where they have captured market shares from wholesale companies, and are often partners inmajor transport and import infrastructure developments. Whilst some of them have ventured into gas-fired power generation operations, they are increasingly present in key gas import infrastructure such as liquefied natural gas (LNG) import terminals and international gas pipelines.

1.2.2.3. Horizontal and vertical integration in the transport sector

The dynamics of the road haulage market are mainly driven by the sector's high flexibility. In turn, this is guaranteed by the large number of competing haulers, which range from one-man undertakings to very large companies. Due to relatively low capital costs compared to other transport modes, the number of market entries and of bankruptcies is relatively high. However, new production concepts, which include day-to-day or just-in-time deliveries, require complex logistical solutions that can be accomplished by bigger companies more easily. Consequently, the hauler industry has experienced increasing merger activities. The implementation of new road pricing systems in several EU countries has contributed to this trend.

In the air transport market, successful deregulation has been accompanied by a process of horizontal and vertical integration. Initially, horizontal integration was characterised by the formation of alliances (Star-Alliance, One World). More recently, mergers have been observed as well. Worth noting is the fusion of Air France and KLM. Due to the high dynamics of the market, which is characterised by the entry of no-frills airlines (e.g. Ryanair, Easy-jet etc.) and by traditional airlines vanishing from the market (e.g. Sabena, Swissair), further merger activities can be expected. This trend will continue with the replacement of the numerous bilateral and multi-lateral agreements between Member States and the rest of the world with non-discriminatory agreements between the EU and these countries, particularly the United States. The aviation market has also experienced vertical integration, i.e. the cooperation of airlines and airports. Although an effect of these agreements between certain airports and airlines (e.g. grandfather rights) is reduced competition at specific airports, competition between the airports themselves has proved strong enough to overcompensate this effect. Furthermore, this co-operation is often accompanied by investments that improve the quality of services at the airport.

Vertical integration is also expected in maritime and inland waterway transport, which should be boosted by the legislative framework guaranteeing free access to port services. Services such as freight handling and passenger management could partly be performed by the shipping industry. This is of particular relevance for the operators of ferries, who could minimise their transaction costs if they would be allowed to use their own personnel and equipment for loading activities. Due to the accession of Malta and Cyprus the European fleet almost doubled. This is expected to increase competition and might also result in increased merger activities.

In rail sector, the market is clearly characterised by strong vertical integration. However, this integration is hardly the result of negotiations between independent partners. Operations and networks are separated "de jure", but the separation is "de facto" not completed yet. In most countries, former national operators still hold a dominant position, especially in terms of slot allocation. Indeed, vertical integration is not a reaction to deregulation but rather a result of historical developments. Although strong vertical integration has ensured a high quality of the network (carriers have a strong interest in an efficient and well-maintained system), the current situation hampers competition. Consequently, only a limited number of new market entries have been observed in recent years. Nevertheless, the first steps in transforming national railway companies into trans-European players have already taken place (horizontal integration). The most significant of these is without doubt the merger of German, Dutch, Danish, Italian and

Swiss freight railway companies to the international operating freight carrier 'Railion'. This restructuring process has proved successful, with business volumes on the central North-South corridors growing remarkably in 2003.

1.3. Progress with market opening

- By 2004, nine Member States had fully opened their electricity markets and seven had fully opened their gas markets. The Directives in force require complete opening of both markets by 2007.
- Market opening in air transportation, road haulage and inland waterway transport is complete. In maritime transport, competition in port services is lagging behind.
- The recent adoption of three railway packages opened the door to market opening in the near future.

The development of a competitive and smoothly functioning internal market is one of the Commission's main policy objectives. Although much progress has been made by Member States in implementing the EU Energy and Transport Directives for market opening, there is still significant scope for improving citizens' welfare with respect to quality of service, prices and security. However, the process of market opening is still in its youth and the full benefits of market opening will only be realised after the remaining barriers are removed and the internal market becomes fully operational.

1.3.1. Legislative developments

1.3.1.1. New electricity and gas Directives and other measures pertaining to the internal market

In 2003, two new Directives concerning common rules for the internal market in electricity (2003/54/EC) and gas (2003/55/EC) were adopted, thus repealing the electricity and gas Directives in force since 1997-1998. The new Directives were accompanied by a package of measures addressing electricity and gas infrastructure issues. In the electricity market, a Regulation on cross-border exchanges in electricity (1228/2003) was adopted in 2003. In the gas market, a Regulation on conditions for access to the gas transmission networks (COM/2003/741) has been recently adopted on 12 July 2005.

1.3.1.2. Main Directives in the field of transport

In 1985 the European Court of Justice ruled that "the Council had infringed the Treaty of Rome by failing to ensure the freedom to provide services in the sphere of international transport and to lay down conditions under which non-resident carriers could operate transport services within a Member State." (Court Judgement 13/83). As a result of the judgement, 1992 was defined as the completion date. In fact, Council Regulation No 881/92, which was adopted in 1992, can be seen as the starting point of market opening in the sector. Council Regulation No 3118/93 continued the opening process up to its completion, i.e. the total deregulation of haulier business by 1998. After the completion of the opening process in that sub-sector, European legislation has focused on infrastructure charging policy. In order to harmonise road charging policies in Europe, the Eurovignette Directive 1999/62/EC was adopted. That Directive defines the framework for charges on heavy goods vehicles on motorways with a ceiling of average toll levels defined by the costs of road infrastructure. It was followed by the recent European Commission proposal for a further Directive amending Directive 1999/62/EC. The proposal, which was adopted in April 2005, defines common principles for the design of infrastructure user charges.

The deregulation of the air market was carried into execution in parallel to the market opening of road haulage. The opening process was mainly driven by the implementation of four so-called "Air Packages". The first, which was adopted in 1988, introduced initial reforms to established structures, the second (1990) allowed for a more flexible setting of tariffs and the third (1993) enabled carriers to provide the first intra-EU services. Finally, the fourth package (1997) completed the process and guaranteed the freedom to provide cabotage, i.e. to operate any route within the EU.

Deregulation of the railway market traces back to 1991 when the Council of Ministers adopted Directive 91/440/EEC. The Directive encouraged national railways to open their markets in specific areas. The Directive was expanded by the first "Railway Package" that came along with Directives 2001/12/EC, 2001/13/EC, 2001/14/EC. The first package, which has been considered to simplify access to rail networks and therefore to make rail freight transport more competitive, became effective in March 2003. The second package, which followed in 2004, proposed to speed up the establishment of an integrated railway area. Thereby the foci were on freight transportation, safety and interoperability. Finally, the third package deals with passenger rights and a common European certification for locomotive drivers.

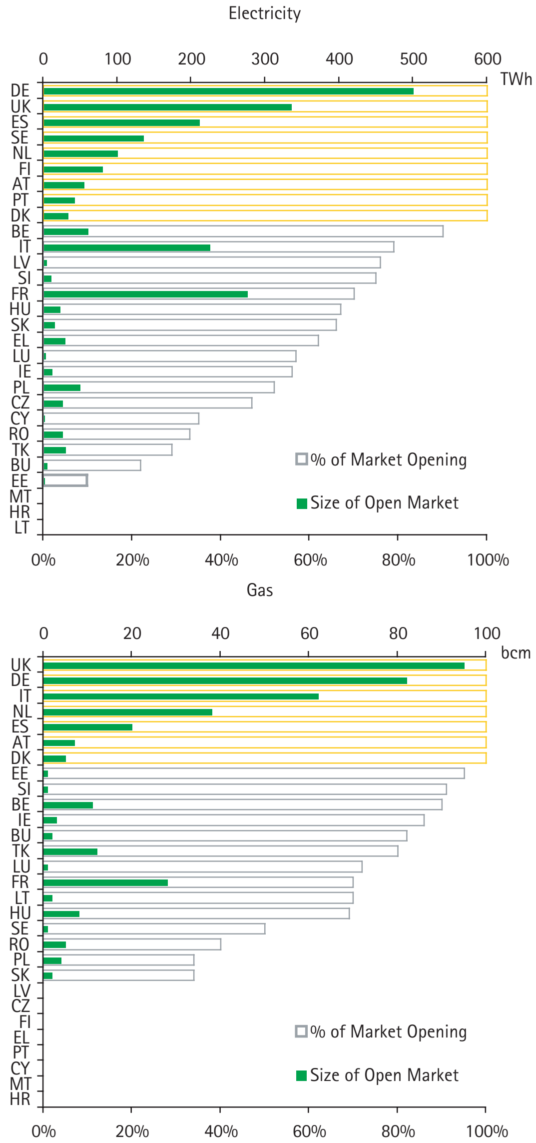
The opening of the inland waterway transport market was achieved in the 1990s through Council Regulation 3921/91, which introduced the right of cabotage throughout the EU, through Regulation 1356/96, which gave the freedom to provide goods or passenger transport services on all international traffic routes within the Community, and through Directive 96/75, which dealt with pricing and chartering systems for inland waterways.

1.3.2. Progress with market opening in the electricity and gas sectors

By January 2005, nine Member States (Germany, UK, Spain, Sweden, Netherlands, Finland, Austria, Portugal and Denmark Spain, Sweden and the U.K.) had fully opened their electricity markets, meaning that all customers were free to choose their own supplier. Significant progress was also achieved by the EU-10: In Latvia, Slovenia, Hungary, Slovak Republic and Poland, the degree of market opening exceeded the 50% mark. Greece and France, which were lagging behind schedule in the Commission's previous assessment report, made good progress. Member states not having fully opened their electricity markets to non-household customers are in breach of the new electricity Directive, which required market opening for those customers to have been fully implemented by July 2004. Member States have until 2007 to implement the entire set of market opening measures.

Gas market opening has advanced less rapidly than in the electricity sector, but it also exhibited good progress between 2003 and 2004. Seven countries had completely opened their markets

Figure 2-1: Progress in implementing the electricity and gas Directives in the EU (2004 data)



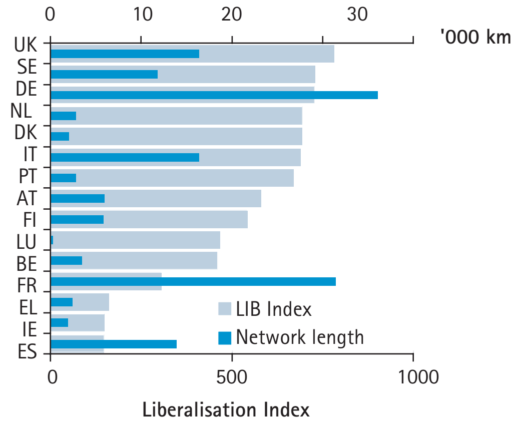
Source: Commission Annual report on the implementation of the gas and electricity internal market, 2005

by the end of 2004 (UK, Germany, Italy, Netherlands, Spain, Austria and Denmark), but countries that had until recently exhibited a low degree of market opening such as France and the Netherlands advanced significantly. Several of the EU-10 also increased the degree of opening of their gas markets, with Slovenia, Lithuania and Hungary all exceeding 69%. Finland, Greece, Portugal, Cyprus, Malta and Croatia have a derogation in the implementation of the Gas Directive. Latvia and the Czech Republic have yet to open their gas markets to competition.

1.3.3. Opening of the transport markets

Due to the different time schedules of implementation, progress in the opening of transport markets differs significantly by modes, with road haulage and air transportation leading the way. Both markets are highly dynamic and growth rates are substantial. In fact, these highly competitive markets have generated falling

Figure 2-2: Implementation of European railway legislation and degree of market opening



Source: IBM Liberalisation Index, Energy and Transport in Figures 2003

transport costs: In central European states transport costs dropped by more than 40% between 1985 and 2004. The obvious success in these markets voiced fears that the opening of the markets might lead to a general decline in working conditions and adversely affect safety and the environment.

In aviation, the boom in air travel has exacerbated problems relating to airport saturation levels and overloaded air traffic control systems. Airlines have complained about inefficiency and delays. The Commission has therefore proposed a new legislation on constructing a single European sky. The proposal includes an initiative to reform the architecture of European air traffic control to meet future capacity and safety needs.

With regard to road haulage, the Commission has emphasised the need to harmonise user charges for heavy goods vehicles. Such a common framework should contribute to reducing external costs of transport.

With the exception of port services, the opening of the maritime and the inland waterway transport markets is complete. That exception, however, is of high significance. Indeed, port services are one of the key sectors of European freight transport. Approximately 90% of the external trade (in tonnes) and 30% of the internal trade is related to maritime transport. The Commission had prepared a proposal that defines transparent and non-discriminatory procedures for access to port services, but the European Parliament rejected the proposal in 2004.

Compared to the other modes, market opening in the railway sector is less advanced. In some countries, the first rail package has not yet been transposed into national law. But even in countries where the Directives were integrated, problems persist. Member States whose national carriers grant de facto free access to other competitors can rarely be found. Furthermore, charges are far from being transparent. However, there have also been positive developments. The number of competitors has grown in almost every national network. Also, national carriers are now required to provide detailed plans for the extension of capacities, if they deny access for reasons of capacity bottlenecks. Since the plans must include financing, there is a clear incentive to find a slot for the competitor in the end.

2. COMPLETION OF EUROPEAN INFRASTRUCTURE

- The TEN concept was introduced by the 1992 Treaty of Maastricht. The framework within which TEN are developed consists of a Community Decision on TEN Guidelines and a Community Regulation on TEN financing.
- In 2003, a set of TEN-E guidelines were adopted. A new set of guidelines was proposed on 10 December 2003, better reflecting the realities of rapidly changing energy markets and the enlarged EU. The new and proposed guidelines define a series of priority axes, projects and establish the notion of projects of European interest.
- New financial rules for TEN projects were adopted in 2004, allowing priority projects and projects of European interest to receive Community financial aid of up to 20% of the total investment.
- Community Aid for TEN-E projects is expected to average EUR 48 million per year between 2007-2013.
- In 2004, a new set of TEN-T guidelines were adopted, including the definition of 30 high priority projects as well as new financial rules allowing projects of European interest to receive Community financial aid of up to 20% of the total investment.
- Overall investments for the 26 priority projects of European interest that have not yet been completed amount to EUR 220 billion up to the year 2020.
- In October 2004, a new High Level Group was set up by the Commission, charged with determining the extension of the major trans-European axes of the TENs to neighbouring countries.
- In January 2005, the EC granted EUR 620 million to major transport infrastructure projects including the transalpine border crossing railway tunnels, the rail link between Perpignan and Figueras crossing the Pyrenées and the Galileo project.

The concept of trans-European networks (TEN) emerged in the late 1980s as a necessary condition for the proposed Single Market. trans- European networks have been defined for the three main network industries: Energy, transport and telecommunications and have been in continuous development since the early 1990s. These networks are considered to be a key element for the realisation and development of the internal market and for promoting economic and social cohesion within the EU. The interconnection of and interoperability between national networks as well as access to them are central to the concept of TEN.

Between 1995 and 2003, the EU financed nearly EUR 154 million in Energy TEN (or TEN-E) projects. The TEN-E programme co-finances up to 50% of feasibility studies for TEN projects, spending about EUR 25 million per year over the period between 1995 and 2003. In very limited cases, the TEN-E programme also provides direct aid to infrastructure, financing 10-20% of the total cost of projects. Indeed, the total planned investments in TEN-E projects are of considerable volume. Priority electricity and gas projects to be constructed between 2003 and 2013 are forecast to cost up to EUR 28 billion, of which some EUR 20 billion within the EU. Of this, some EUR 6 billion are being destined to electricity projects and EUR 22 billion for gas projects.

Planned investments in Transport TEN are on a totally different scale, and must be treated with caution. With the information available, total costs for implementing the TEN-T as developed in the revision of the guidelines of 2004 are pre-estimated to be around EUR 600 billion up to 2020, which poses a major funding challenge. Furthermore, differences in national planning processes and objectives in priorities hamper the progress of implementation. A better co-ordination of European and national investment policies, the improvement of communication between Member States and the European Commission as well as additional incentives for national governments to reinforce their efforts for completing their network parts of the TEN remain on the political agenda.

2.1. The TEN process

The Treaty of Rome (1957) that established the EU provided the legal basis for TEN, but it was the Maastricht treaty (1992) which initially defined and underlined the importance of trans-European networks. TEN-E and TEN-T are defined by a Community Decision that establishes TEN guidelines and by a Community Regulation containing the framework for financing TEN projects.

Infrastructure projects that qualify as a TEN project according to the guidelines may, under certain conditions, receive Community financial aid for up to 10% of the total cost of investment through the TEN-budget line as well as through the EU's Structural Funds and the Cohesion Fund. The European Investment Bank (EIB) also contributes to the financing of these projects through loans and the European Investment Fund (EIF) gives loan guarantees for TEN projects. The framework governing the financing of TEN projects was established by a Council Regulation (EC) 2236/95 laying down general rules for the granting of Community financial aid in the field of trans-European networks. That Regulation was amended by Regulation (EC) 1655/99 in 1999. Then, in 2002, the Commission submitted a proposal to amend the existing Regulations. Two additional amendments to 1995 Regulation were adopted in 2004 (Regulation (EC) 788/2004 and Regulation (EC) 807/2004). These new Regulations allow for Community aid to rise to 20% of the total investment cost for priority projects and for sections of projects of European interest.

2.2. Trans-European networks – energy

The creation of a fully-functioning single market for electricity and gas is dependent on greater interconnection between Member States and a more rational use of the infrastructure through greater co-ordination and transparency. Moreover, a necessary condition for the development and efficient functioning of an integrated European internal market is the availability of secure, reliable networks to transport energy supplies from points of production to the load centres. The TEN-E programme identifies the missing links and congestion points on the network, as well as priority routes that are in need of upgrading, and aids in their development. In doing so, the TEN-E programme serves some of the major components of the Commission's strategy: Increasing and reinforcing the security of energy supplies and enhancing environmental performance through higher efficiencies in energy systems, by developing additional supply routes and ameliorating existing ones, and by augmenting the proportion of energy from renewable energy sources available to and within the EU.

2.2.1. TEN-E guidelines

TEN-E guidelines stipulate the objectives, identify and define priorities, the projects of common interest (PCI), priority projects and axes and lay down the conditions for creating a favourable context for the development of TEN-E.

The development of TEN-E began in 1994 when the European Council of Essen identified a list of 10 priority projects. Decision 1254/96/EC of 1996 established TEN-E objectives and priorities, and identified a list of 43 PCI, in which the 10 original projects were included. The 1996 Decision was subsequently amended in 1997 (97/1047/EC), when 31 more projects were added and then again in 1999 (1741/99/EC) when 5 projects were redefined and 16 more projects were added, adding up to a total of 90 PCI.

By 2001, significant efforts had been put into developing the TEN-E but a Commission report that year revealed that the current levels of interconnection in electricity (in particular) and gas (to a lesser extent) networks were still insufficient. As a result, and in view of the development of the internal electricity and gas markets, a proposal for a new set of guidelines was presented in 2001, leading to the adoption of Community Decision 1229/2003/EC on TEN-E guidelines on 26 June. That decision replaced the original and amended guidelines of 1996 and is currently the legislation in force. One of the main changes introduced by the 2003 guidelines was the identification of priority projects and the broader concept of priority axes, that is, those that have been identified as most important for supply security concerns or for the competitive operation of the internal market. 12 priority axes were identified: Seven for electricity networks and five for natural gas networks. The new guidelines also established a series of revised objectives for Member States:

- Ensure a stable and favourable regulatory environment for investment in new infrastructure. The target for all Member States is to achieve a level of electricity interconnection of at least 10% of their installed capacity by 2005.

- Improve the use of existing infrastructure through different "structural measures" such as improved co-ordination between system operators.

- Refocus Community financial support towards priority projects to be implemented and increase the ceiling for possible EU cofinancing from 10% to 20% of total investment costs of Priority Projects.

To take account of the enlargement of the EU to 25 Member States, the changes brought about by the adoption of the two new Directives on market opening (see section 1.3.1.1), and to better respond to structural problems (insufficient electricity interconnections in some areas as well as bottlenecks in others), the Commission submitted in December 2003 a proposal for a Decision (COM/2003/742) laying down revised guidelines for trans-European energy networks and repealing Decisions No 96/391/EC and No 1229/2003/EC. The proposal is currently in legislative process and the changes introduced include:

- The possibility to give a project a "Declaration of European interest"

- empowers the Commission to designate a co-ordinator for a priority axis or project

- enlarges the guidelines of projects of common interest to account for the EU's neighbouring countries

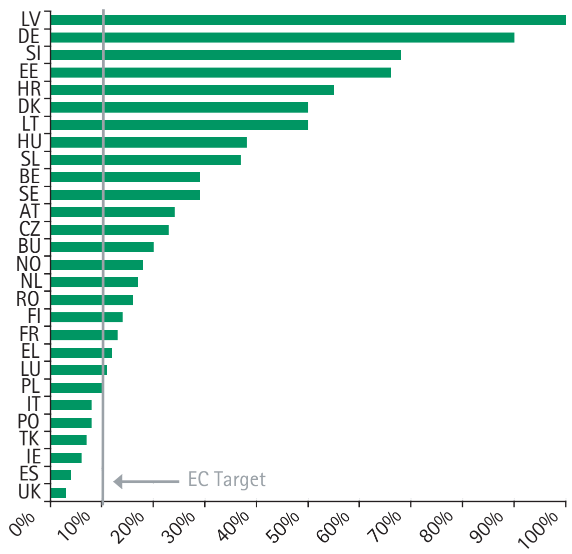
The creation of a favourable context for the development of TEN-E was established by a Council Decision (96/391/EC) in 1996, and was followed by a Commission recommendation (1999/28/EC) on improving the authorisation procedures for trans-European energy networks. The latter Decision and Recommendation will be repealed if the proposal for new guidelines introduced in December 2003 is adopted.

2.2.2. Electricity capacity and interconnection

The development of international electricity interconnections is, in a number of cases, a necessary condition to ensure effective use of available generation capacity and to reduce the strain on the system caused by congestion at certain key bottlenecks. Member States are still some way from the objective fixed by the European Council at Barcelona stating that cross border interconnections should represent at least 10% of production capacity in each Member State by 2005. To address this urgent issue, the Commission's proposed Directive on Electricity Security of Supply and Infrastructure establishes that the degree of co-ordination should be increased and that the role of national regulators be enhanced in relation to the question of interconnections.

The Commission's 2005 assessment on the implementation of the gas and electricity internal markets found that the level of electricity interconnections within the EU remained inadequate in some cases. Nonetheless, it should be noted that some of the Member States and candidate countries possessing import capacities below the 10% target –Italy, Portugal, Turkey, Ireland, Spain and the UK– are among the countries that lie outside what is called the European "core" electrical system (i.e. continental Western Europe excluding the British Isles, Scandinavia, the Iberian and Italian peninsulas, and Greece). Regulators in these peripheral

Figure 2-3: Electricity import capacity as a percentage of total generation capacity in the EU-25 and candidate countries (2004)



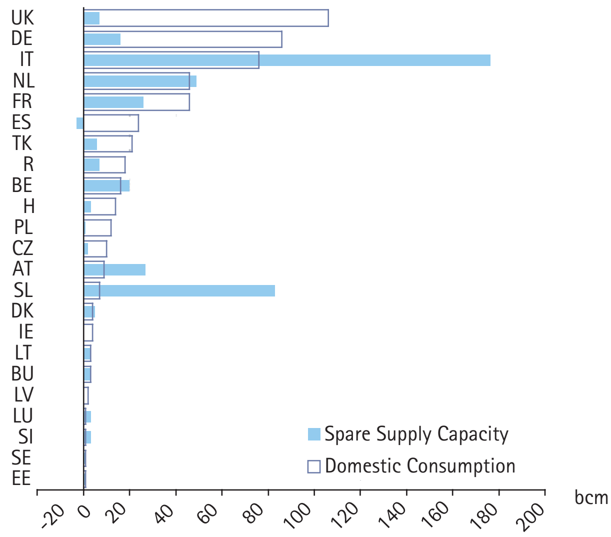
Source: EC – Annual Report on the implementation of the gas and electricity internal markets, 2005 countries have recommended that a minimum level of interconnection of around 20% could help eliminate segmented markets and create a truly competitive internal market with free movement of fuels and services.

2.2.3. Gas supply capacity and interconnection

Gas interconnectivity within the EU and between the EU and its neighbours is not as critical as with electricity, due in part, to its physical characteristics (gas can be stored and consumption is more interruptible), and because network congestion is less frequent. In its latest assessment on market opening, the Commission deemed the EU's gas import capacity to be more than adequate to serve demand.

Figure 2-4 compares domestic gas consumption with spare supply capacity[2]. The analysis shows that some Member States and candidate countries have a relatively urgent need for investment in additional import capacity, particularly the UK, Spain, Hungary, Poland, Czech Republic and Ireland. Some of the investments required to ameliorate the situation do, however, seem to be coming forward and a number of projects –both pipeline and liquefied natural gas (LNG)– are being planned to bring additional gas to the European market.

Figure 2-4: Spare supply capacity and domestic gas consumption in the EU-25 and candidate countries (2004)



Source: EC – Annual Report on the implementation of the gas and electricity internal markets, 2005

2.2.4. Development of expenditures and project status

According to the latest Commission report on the implementation of TEN-E guidelines, expenditures for TEN-E rose to nearly EUR 19 million in 2001. From this, about 53% was destined to gas projects and the remaining 47% went to electricity projects, which contrasts with the financing structure of 2000 where 54% of expenditure went to electricity projects. Total Energy TEN expenditure in 2001 increased by 36% with respect to the previous year. Between 1995 and 2001, a total of EUR 123 million had been spent on Energy TEN projects, with some EUR 69 million having gone to gas projects and the remaining EUR 54 million to electricity projects.

Table 2-2: Summary of Commission decisions on TEN-E projects

	1995-1999		2000		2001		Total	
	EUR Million	%	EUR Million	%	EUR Million	%	EUR Million	%
Electricity	38.1	42	7.5	54	8.4	47	54	44
Gas	52.1	58	6.3	46	10.4	53	68.8	56
Total	90.2	100	13.8	100	18.8	100	122.8	100

Table 2-3: Projected investments in TEN-E priority projects: 2004-2013*

	Project	Estimated cost of Projects (EUR million)	EU support from TEN-E (EUR million)
Electricity			
	EL 1: Route Trans-border connection France-Belgium	53.00	
	EL 2: Route Trans-border connection France-Italy	996.00	1.25
	EL 3: Route Trans-border connection France-Spain	275.00	4.47
	EL 4: Route Trans-border connections in the Balkans	287.00	
	EL 5: Route Britain-Netherlands Interconnector: BritNed	350.00	4.55
	EL 6: Route Interconnector Ireland-UK (Wales)	400.00	6.43
	EL 7: Route Germany-Denmark-Norway-Sweden interconnector	2,418.00	0.15
	EL 8: Route Germany-Poland: East-west interconnector	886.00	
Total electricity		**5,665.00**	**16.85**
Gas			
	NG 1: Route	14,361.70	3.00
	NG 2: Route	3,403.10	1.00
	NG3: Route	15,237.40	2.70
	NG 4: Ports	3,107.00	0.00
	NG 5: Storage	478.20	50.17
Total Gas		**36,587.40**	**56.87**
Grand Total		**42,252.40**	**73.72**

(*): Includes financing of projects inside and outside the EU. Does not include the new proposed projects EL-8, EL-9 and NG-6.

Source: EC- Trans-European energy networks, TEN-E Priority Projects, June 2004

[2] Defined as total supply capacity (i.e. indigenous production + import capacity) minus domestic consumption. Import capacity is defined as all physical import pipelines directly or indirectly linked to producing countries plus LNG.

The guidelines proposed in 2003 project total investments in TEN-E in excess of EUR 42 billion. Of this, the EU is planning to grant financial aid rising to EUR 73 million. Out of the total Community aid, 23% will be destined to electricity projects while the remaining 77% will go to gas projects. Details are shown in Table 2-3.

2.2.5. TEN-E priority projects[3]

The TEN-E guidelines adopted in June 2003, identified a series of priority axes and projects. A proposal for a revision of those guidelines was introduced in December of that year. The priority projects and axes contained in the approved and proposed guidelines are presented below.

2.2.5.1. Electricity networks

EL.1. France – Belgium – Netherlands – Germany: Electricity network reinforcements in order to resolve congestion in electricity flow through the Benelux.

EL.2. Borders of Italy with France, Austria, Slovenia and Switzerland: Increasing electricity interconnection capacities.

EL.3. France – Spain – Portugal: Increasing electricity interconnection capacities between these countries and for the Iberian peninsula and grid development in island regions.

EL.4. Greece – Balkan countries – UCTE System: Development of electricity infrastructure to connect Greece to the UCTE System and to enable the South-Eastern Europe electricity market.

EL.5. United Kingdom – Continental Europe and Northern Europe: Establishing/increasing electricity interconnection capacities and possible integration of offshore wind energy.

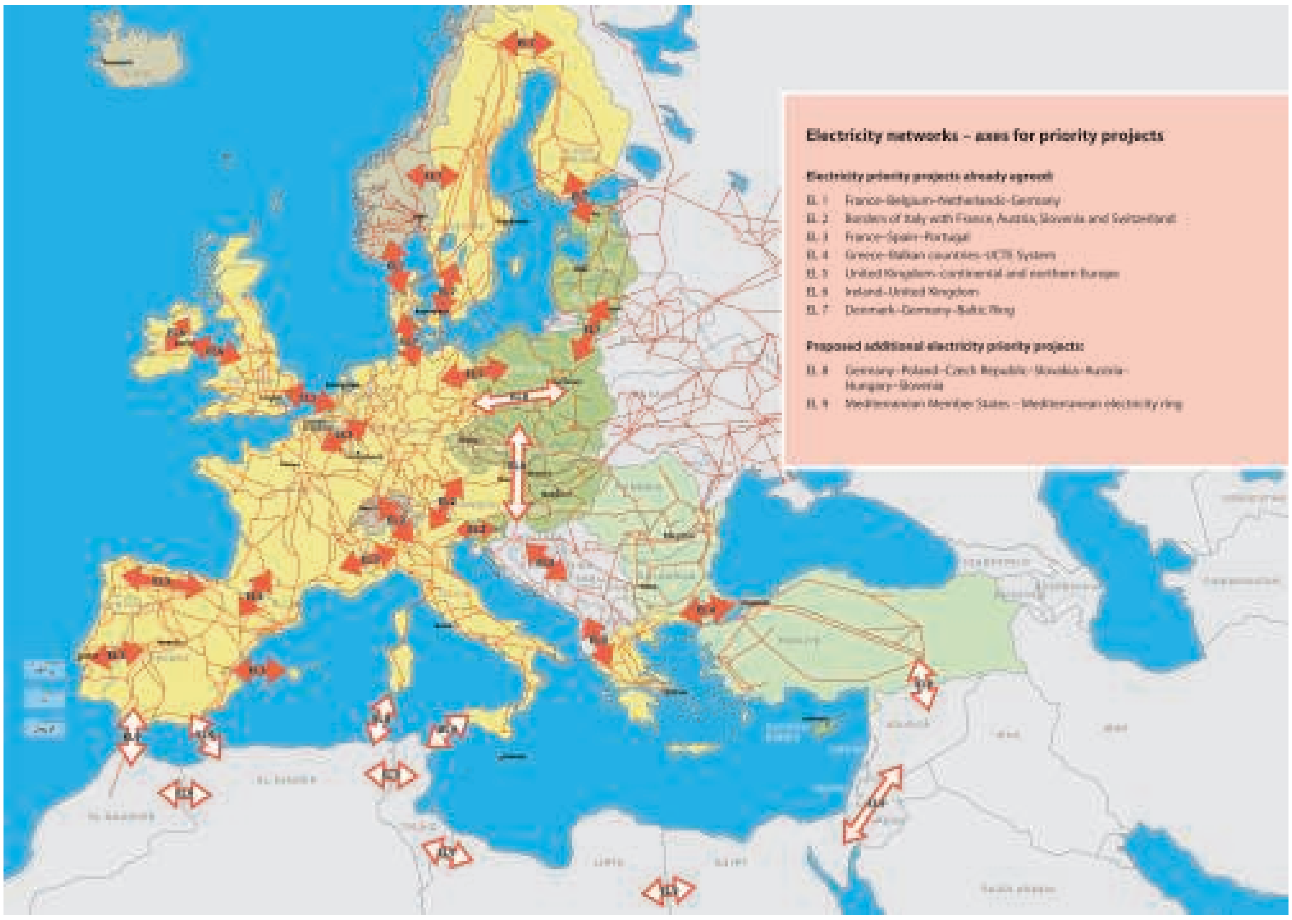
EL.6. Ireland – United Kingdom: Increasing electricity interconnection capacities and possible integration of offshore wind energy.

EL.7. Denmark – Germany – Baltic Ring (including Norway – Sweden – Finland – Denmark – Germany – Poland – Baltic States – Russia): Increasing electricity interconnection capacities and possible integration of offshore wind energy.

EL.8. (Proposed) Germany – Poland – Czech Republic – Slovakia – Austria – Hungary – Slovenia: Increasing electricity interconnection capacities.

EL.9. (Proposed) Mediterranean Member States – Mediterranean Electricity Ring: Increasing electricity interconnection capacities between Mediterranean Member States and Morocco – Algeria – Tunisia – Libya – Egypt – Near-East Countries – Turkey.

Figure 2-5: TEN-E Priority Electricity Projects



[3] *As established in COM/2003/742: Proposal for a Decision of the European Parliament and of the Council laying down guidelines for trans-European energy networks and repealing Decisions No 96/391/EC and No 1229/2003/EC.*

2.2.5.2. Gas networks

NG.1. United Kingdom – Northern Continental Europe, including Netherlands, Denmark and Germany – Poland – Lithuania – Latvia – Estonia – Finland – Russia: North Transgas natural gas pipeline and Yamal – Europe natural gas pipeline, connecting some of the main sources of gas in Europe, improving the interoperability of the networks, and increasing the security of supply.

NG.2. Algeria – Spain – Italy – France – Northern Continental Europe: Construction of new natural gas pipelines from Algeria to Spain, France and Italy, and increasing network capacities in and between Spain, France and Italy.

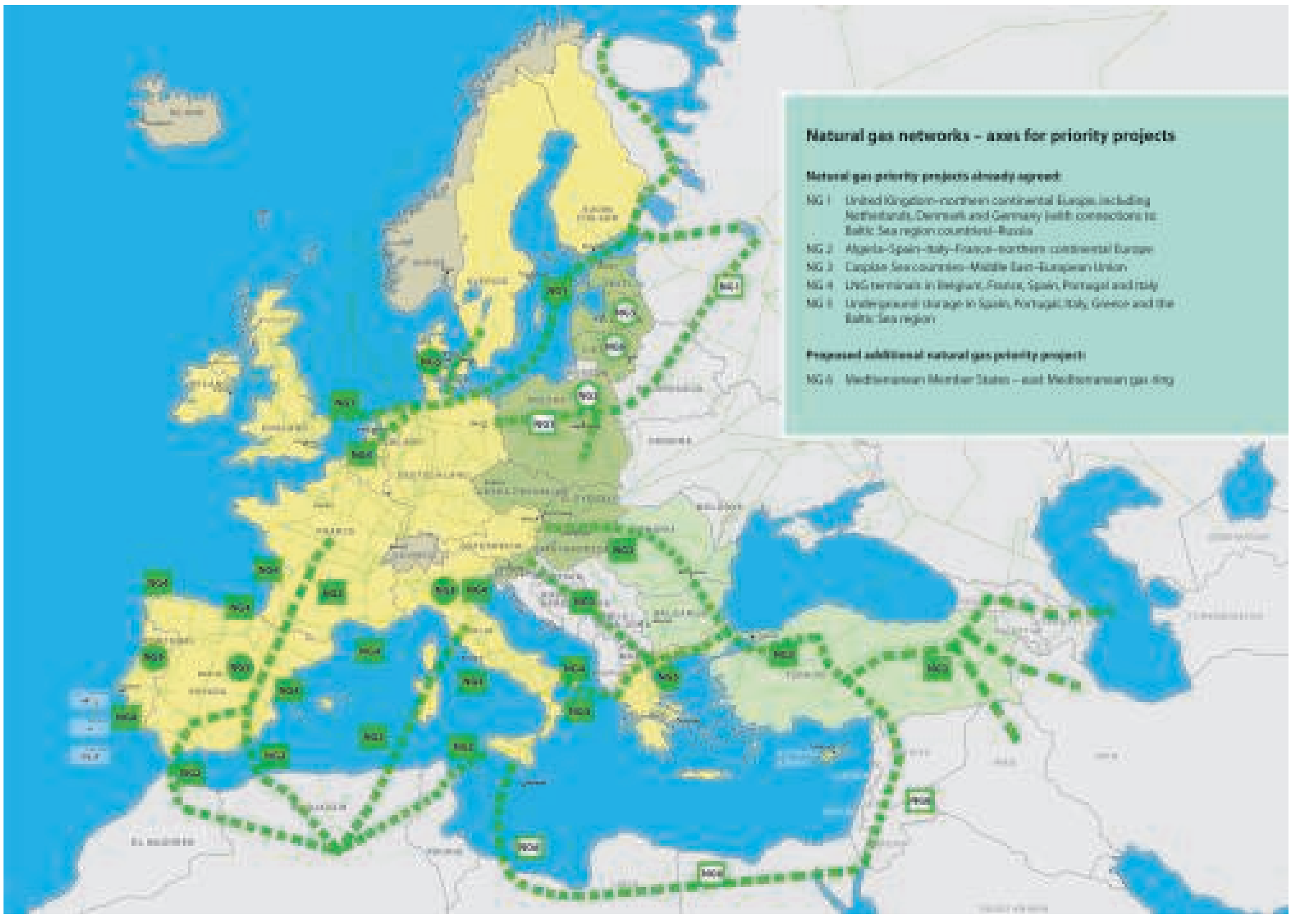
NG.3. Caspian Sea countries – Middle East – European Union: New natural gas pipeline networks to the European Union from new sources, including Turkey – Greece, Greece – Italy and Turkey – Austria natural gas pipelines.

NG.4. LNG terminals in Belgium, France, Spain, Portugal, Italy and Poland: Diversifying sources of supply and entry points, including the LNG terminals connections with the transmission grid.

NG.5. Underground natural gas storage in Spain, Portugal, Italy, Greece and the Baltic Sea Region: Increasing capacity in Spain, Italy and the Baltic Sea Region and construction of the first facilities in Portugal and Greece.

NG.6. (Proposed) Mediterranean Member States – East Mediterranean Gas Ring: Establishing and increasing natural gas pipeline capacities between the Mediterranean Member States and Libya – Egypt – Jordan – Syria – Turkey.

Figure 2-6: TEN-E Priority Gas Projects



2.3. Trans-European networks - transport

2.3.1. Revision of TEN-T guidelines in 2004

The ongoing process of European integration and the creation of a competitive single market calls for an efficient and sustainable transport system. Good progress in the development of a high-performance trans-European transport network is therefore essential for the mobility of people and goods in the enlarged Union. By introducing the concept of the TEN in the Maastricht treaty in 1993 the importance of a true trans-European transport system was officially recognised for the first time. The TEN guidelines, first adopted in 1996, represent a comprehensive planning approach for all transport modes. They are aimed at integrating the national networks and transport modes into one true European system, thereby promoting a better linkage of the peripheral regions of the Union to the centre and improving the safety and efficiency of the transportation processes to these networks.

Against the background of the enlargement of the European Union by ten countries in May 2004, the need for a revision of the guidelines became indispensable. New challenges evolved in terms of stimulating the economic development in the EU-10 comprising increasing trade and traffic volumes as well as the need to ensure sustainability by rebalancing the modal split and improving inter-modality and interoperability on the networks. The consequent development of traffic management systems and of the Galileo satellite navigation system are essential to improve safety and security.

Consequently, the initial activities were complemented by further proposals for revisions of the TEN-T criteria in 2001 and 2003 that led to a major reform of the 1996 TEN-T guidelines and the TEN financial Regulation adopted by the Council and the Parliament in April 2004 that takes up the new challenges[4]. To assist in this revision, a High-Level-Group "On the trans-European transport network", composed by experts from the 25 Member States, Romania and Bulgaria as well as the European Investment Bank (EIB) and chaired by the former Commissioner Karel van Miert was set up. In this revision, European priorities are targeted by focusing on investments on 30 priority axes and projects. Sustainability requirements are addressed by promoting especially rail transport and inter-modality as well as by introducing the concept of motorways of the sea. To facilitate the co-ordination of implementing and funding projects along the major transport axes, organisational means have been improved. Furthermore, the financial framework has been adapted helping to target infrastructure bottlenecks at cross-border sections.

As a result, the new plan modernises the plans from the 1990s by concentrating investment on a limited core network of major trans-European axes that primarily serve long-distance and international traffic. The territory covered includes all 25 Member States as well as the candidate countries Bulgaria and Romania. The time horizon for the completion of the full trans-European transport network has been extended to the year 2020. The revised TEN-T network serves also as a reference network for the application of other European transport policies, for example infrastructure charging and interoperability as well as several other European initiatives.

[4] *EC(2004) 884 Official Journal 7 June 2004*

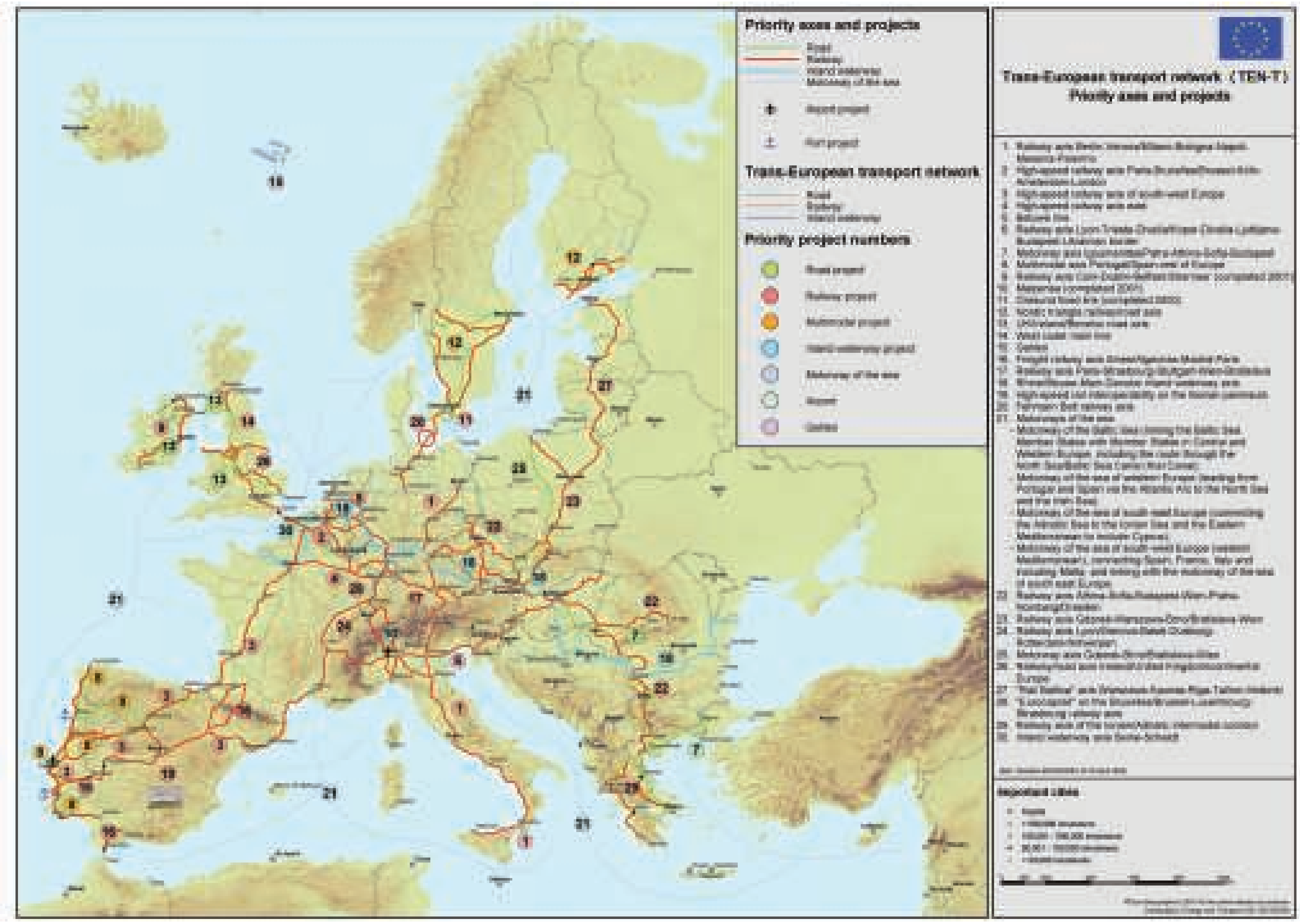
2.3.2. TEN-T Priority Projects

Table 2-4: The 30 TEN-T priority projects according to the revision of the guidelines adopted in April 2004

No.	Project name	Status	Distance in km	Investments as reported in 2003 (EUR million)	Total as reported in 2003 (EUR million)
1	Railway line Berlin-Verona/Milano-Bologna-Napoli-Messina-Palermo	ongoing	958	5839	20166
2	High-speed railway line Paris-Bruxelles/Brussel-Köln-Amsterdam-London	ongoing	1065	15961	22578
3	High-speed railway line South-Western Europe	ongoing	1601	7489	19263
4	High-speed railway line East	ongoing	551	1358	5667
5	Conventional rail/combined transport: Betuwe line	ongoing	160	2913	4712
6	Railway line Lyon-Trieste-Divaca-Ljubljana-Budapest-Ukrainian border	ongoing	770	1900	32218
7	Motorway Igoumenitsa/Patra-Athina-Sofia-Budapest	ongoing	1580	6931	12604
8	Multimodal connection Portugal/Spain with the rest of Europe	ongoing	-		
9	Railway line Cork-Dublin-Belfast-Larne-Stranraer	completed	502	357	357
10	Malpensa Airport (completed in 2001)	completed	-	964	964
11	Fixed rail/road link between Denmark and Sweden (completed in 2000)	completed	52.5	4158	4158
12	Nordic Triangle rail/road link	ongoing	2517	2223	6966
13	United Kingdom/ Ireland/Benelux road link	ongoing	1530	3149	3949
14	West Coast Main line	ongoing	850	1002	16900
15	Galileo	ongoing	-	100	3200
16	Freight railway line Sines/Algeciras-Madrid-Paris	ongoing	150		5000
17	Railway line Paris-Strasbourg-Stuttgart-Wien-Bratislava	ongoing	672	1368	8164
18	Rhine-Meuse-Main-Danube waterway	ongoing	70	-	137
19	Interoperability of the high-speed rail network on the Iberian peninsula	ongoing	-	742	23746
20	Femer Bælt/Fehmarnbelt railway	ongoing	19	-	2800
21	Motorways of the sea - Motorway of the Baltic Sea (linking the Baltic Sea Member States to those in Central and Western Europe) - the Western Europe motorway of the sea (linking Portugal and Spain, via the Atlantic Arc, to the North Sea and the Irish Sea) - the South-Eastern European motorway of the sea (linking the Adriatic Sea to the Ionian Sea and to the eastern Mediterranean in order to include Cyprus) - the South-Western Europe (Western Mediterranean) motorway of the sea, linking Spain, France, Italy and Malta, and linking up with the South-Eastern European motorway of the sea	new project			
22	Railway line Athina-Sofia-Budapest-Wien-Praha-Nürnberg/Dresden	new project			
23	Railway line Gdansk-Warszawa-Brno/Bratislava-Wien	new project			
24	Railway line Lyon/Genova-Basel-Duisburg-Rotterdam/Antwerpen	new project			
25	Motorway Gdansk-Brno/Bratislava-Wien	new project			
26	Rail/road link Ireland/United Kingdom/continental Europe	new project			
27	"Rail Baltica": Line Warszawa-Kaunas-Riga-Tallinn-Helsinki	new project			
28	"Eurocaprail" on the railway line Bruxelles/Brussel-Luxembourg-Strasbourg	new project			
29	Railway line on the Ionian/Adriatic intermodal corridor	new project			
30	Seine-Escaut Canal	new project			

Sources: European Commission, TEN-T implementation report 1998-2001, Commission TEN-T priority projects, 2002

Figure 2-7: Priority transport projects of the European Union



2.3.3. Connecting the European Union to its neighbours

Undoubtedly, the enlargement of the European Union has brought forward the need for a high-capacity intra-EU transportation system. But the accession of ten new Member States on May 2004 introduced a set of new neighbouring countries in the East and South of the EU. Since the enhancement of the strategic partnership with its neighbouring countries is a major element of the European Neighbourhood Policy, the change of the geo-political situation must be accompanied by good transport connections to candidate and pre-candidate countries at the Union's new borders. The existing transport infrastructure, however, does not yet reflect this new situation.

The future development of transport flows between the EU and its neighbours requires efficient, inter-modal and inter-operable transport systems. Forecasts produced in the context of the TEN-STAC research project predict that the land borne traffic of goods between the EU and its neighbours will more than double by 2020. Thus, it is essential to improve the physical transport infrastructure that connects the Union with the neighbouring countries. A similarly dynamic development is expected for passenger air transport. In this context, it is necessary to intensify the aviation relations with partner countries as regards the co-operation on safety and security issues as well as on market opening.

In several of the neighbouring regions a significant development in the field of transport infrastructure has already taken place. Since the 1990s co-operation exists in the context of the Pan-European Corridors and areas which are now to a great extent within the enlarged EU territory. The remaining sections are located in the territory of the Balkans, Russia, Belarus, Moldova, Ukraine and in Turkey. Other regions are currently in the process of identifying their priority transport axes and projects.

Figure 2-8: Pan-European transport corridors and areas

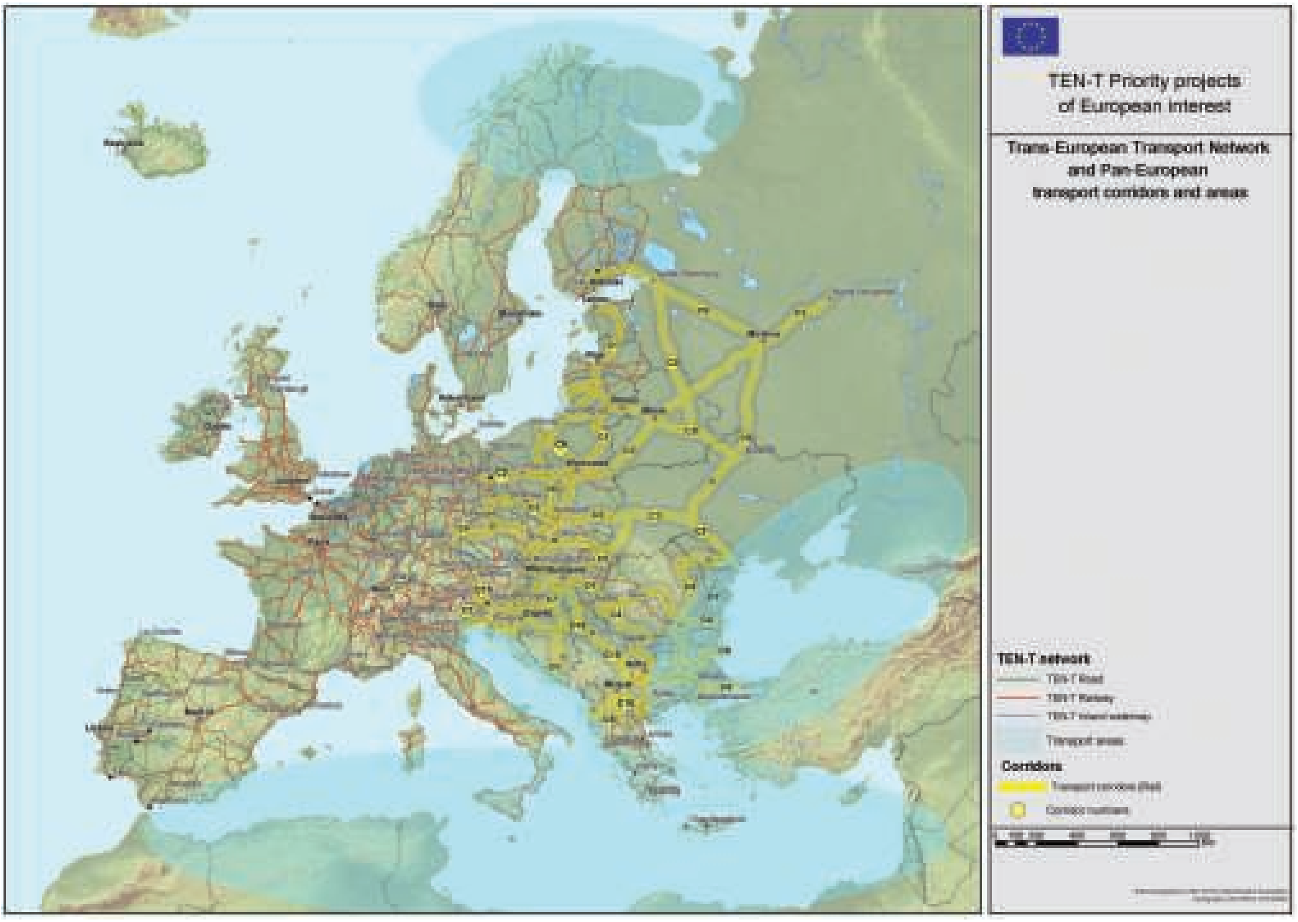


Table 2-5: The ten Pan-European transport corridors and areas

Corridor number	Corridor name	length in km rail	length in km road
C1I	Tallinn - Riga - Kaunas - Warszawa with a branch Riga - Kaliningrad - Gdansk	1655	1630
C2I	Berlin - Warszawa - Minsk - Moskva - Niznij Novgorod	2313	2200
C3	Dresden/Berlin - Wroclaw - Lviv - Kiev	1650	1700
C4	Dresden/Nürnberg - Praha - Bratislava/Wien - Budapest - Arad - Sofija - Istanbul the branches Arad - Bucuresti - Constanta and Sofija - Thessaloniki	4340	3640
C5	Venezia - Trieste/Koper - Ljubljana - Budapest - Uzgorod - Lviv with three branches Rijeka - Zagreb - Budapest, Ploce - Sarajevo - Budapest, Bratislava - Zilina - Uzzgorod	3270	2850
C6	Gdansk - Grudziadz/Warszawa - Katowice - Zilina with two branches Grudziadz - Poznan and Katowice - Ostrava - Breclav/Brno	1800	1880
C7I	Danube	inland waterway: 2415 km	
C8II	Durres - Tirana - Skopje - Sofija - Varna/Burhas	1270	960
C9	Helsinki - St. Petersburg - Pskow/Moskva - Kiev - Ljubasevka - Chisinau - Bukuresti - Alexandropoulos with two braches Klaipeda/Kaliningrad - Vilnius - Minsk - Kiev, Ljubasevka - Odessa	6500	5820
C10	Salzburg - Ljubljana - Zagreb - Beograd - Nis - Skopje - Veles - Thessaloniki with four branches Graz - Maribor - Zagreb, Budapest - Novi Sad - Beograd, Nis - Sofija, Veles - Florina	2528	2300
	Pan-European transport areas		
	Barents Euro-Arctic		
	Black Sea Basin		
	Adriatic/ Ionian Seas		
	Mediterranean Basin		

2.3.3.1. The new high-level group "A wider Europe for transport"

After the decision at the ministerial meeting "Wider Europe for Transport" in Santiago de Compostela in June 2004, a high-level group was set up by the European Commission in October 2004 with the task of agreeing on the extension of the major trans-European axes of the TENs to the neighbouring countries including the new Motorways of the Sea, and on the identification of priority projects on these axes. The final recommendations to the Commission are expected to be presented in October 2005. They will include a proposal to the Commission on a limited number of five to seven major axes for the connection of the EU with its neighbours with a focus on international exchanges and freight movements and promoting regional integration and cohesion. Furthermore, tight budgets require a highly selective approach for the identification of feasible priority projects on these axes.
In addition to the proposals on transport axes and projects, the High Level Group will also identify important horizontal priorities dealing with regional co-operation, technical and administrative interoperability, safety and security measures as well as the implementation of new technologies like traffic management systems. These measures are important for the creation of an efficient transport system as well as for the completion of transport infrastructure and in particular for the traffic flows at border crossings.

Based on studies on the Pan-European corridors implementation, the TEN-STAC study covering the EU27, the MEDA[5] project and traffic forecasts covering the neighbouring regions, five geographical subgroups will compile recommendations for all PANEuropean transport areas. To integrate all relevant stakeholders, a public consultation on the extension of the major trans-European transport axes to the neighbouring countries and regions was carried out in the beginning of 2005. The results of the consultation were presented at a meeting in April 2005.

2.3.4. Progress and financing of the TEN-T

Roughly estimated, the cost of the whole trans-European network as defined in the Community guidelines from 2004 averages EUR 600 billion until 2020. Only EUR 170 billion or less than 30% have been invested until the end of 2001. The overall investment for the 26 priority transport projects of European interest that have not been completed yet, amounts to EUR 220 billion up to the year 2020.

More than 10 years after the launch of the trans-European networks programme at the Essen council in 1994, progress of works along the identified major transport axes is unsatisfactory. Many projects are facing delays, because of reductions in national public investments which are, on average, now well below 1% of GDP for the EU-25. In the EU-10, higher rates of economic growth compared to the EU-15, the deterioration of the infrastructure networks especially for rail during the years before 1990 and high accumulated needs for additional road infrastructure to cope with increasing vehicle ownership and road transport demand have resulted in a higher share of investments of about 1.5% of GDP compared to about 0.75% in the EU-15. This different investment pattern reflects the high relevance of improving the transport networks for the continuation of successful economic development in these countries. Nevertheless, increasing transport volumes call for action. If the policy's aim of shifting the modal balance between road and rail can not be reached because of too low investments in crucial rail infrastructure, most of the predicted traffic increases will take place on the roads. While current congestion costs are estimated to represent about 1% of GDP, this ratio might double by the year 2020 with further negative consequences for the environment, safety and the quality of life. The completion of the TEN-T network by 2020 is expected to be possible, only if additional funds are found. This is necessary in order to tap into the potential for businesses and people resulting from better transport connections. This untapped potential is estimated to amount to about 0.23% of GDP.

However, this objective can only be achieved if the outcome of negotiations between the Commission and Member States over the future EU budget provides the Union with the necessary financial means to co-finance infrastructure investments. With the revision of the guidelines the Commission has set a framework that allows for a better co-ordination of investments between Member States.

The tighter focus on the defined priority projects allows for setting precise dates. For instance, the interconnection of national highspeed rail networks for passenger transport shall be completed by 2012. The time horizon for the construction works on the European core freight rail network is set to 2015, while important measures for improved connection between ports with land transport are aimed to be completed by 2010. According to these dates, the peak of funding is expected to occur between 2007 and 2013, so decisions guaranteeing sufficient public financing are of utmost importance. Without sufficient financial incentives by the Union it will prove difficult to stimulate participation by the private sector.

2.3.4.1. Investing in bottlenecks at border crossings

Investments in transport infrastructure not only improve the performance of the national networks of the investing countries. By improving interconnectivity between them, the return on investments transcends national borders. For this reason, the definition of priority projects of European interest in the new 2004 TEN-T guidelines and the co-financing of projects through the EU budget line are essential to guarantee that the limited financial means are allocated to those parts of the transport system yielding the highest benefits for the Union as a whole. This is especially true for border crossing transport links and for the development and deployment of advanced technological solutions that boost the performance of the transport system by providing new tools for the management of traffic flows. Consequently, the Commission has put special emphasis on projects that are at the cutting edge of advanced technology or with high impact on interregional connectivity:

- Galileo is the first satellite positioning system designed specifically to serve civil purposes. As a European core infrastructure it provides possible applications for transport but also for the energy, agriculture and financial sectors of the economy. It also provides high incentives for the involvement of private funds and the establishment of public/private partnerships

- Innovative and intelligent transport systems (ITS) increase the efficiency of the transport system by helping to make better use of existing infrastructure and thus reducing congestion with its negative impacts on the economy and the environment.

[5] *MEDA*

- The two planned transalpine rail crossings with the Mont-Cenis rail tunnel between Lyon and Turin and the Brenner base tunnel at the section Kufstein-Verona will more than double the current capacity on these links and better connect some of the most dynamic regions in Europe with the core of the new Member States. A comparably positive effect is expected from the construction of the new rail link between Perpignan and Figueras crossing the Pyrenées.

- The concept of Motorways of the Sea promises to take significant amounts of freight off the roads, thereby reducing congestion on road bottlenecks and reducing the environmental impacts of freight transport.

In January 2005, the European Commission granted EUR 620 million to major transport infrastructure projects, with a share of 65% to rail projects and 20% to innovative IT-systems concerning the interoperability in the railway and aviation sectors. Significant support is given to Galileo, the Perpignan-Figueras rail link and the transalpine rail crossings. While EUR 515 million have been granted to the 30 priority projects defined in the revision of the guidelines, EUR 105 million are allocated for smaller projects open for public and private promoters. However, for some of the planned projects the respective countries still have not come to a decision about the construction. This pertains to the two transalpine rail crossings Mont-Cenis and Brenner, the Fehmarn belt bridge between Germany and Denmark and the planned bridge crossing the straight of Messina connecting the Italian peninsula with Sicily. Since budget restrictions are tight for all countries, the building decisions also heavily depend on the most recent traffic forecasts on these links.

2.3.4.2. Co-ordination of national infrastructure programs

Infrastructure planning has traditionally fallen under the responsibility of national authorities, so the co-financing of construction for the TEN-T by the EU is key to create incentives for planning authorities to give greater emphasis to essential interconnections with the international transport corridors of Europe. The co-financing incentive is necessary as national master plans often lack adequate references to the plans of neighbouring countries. Although most countries recognise the growing share of international transport in total transport volumes, the total benefit of improving cross-border sections on the trans-European axes is sometimes underestimated as a result of a predominantly national perspective. With the introduction of new financial rules that include an increased co-financing level of up to 20% (the Commission has additionally proposed to boost the co-financing level up to 50% for exceptional cases of cross-border projects) and the reinforcement of co-ordination instruments for these projects in the new 2004 guidelines, the EU has introduced a mechanism to overcome this problem. With increased co-financing, the financial burden pertaining to these projects of high European relevance is spread among all Member States.

In the EU-10 and in the integration of Candidate Countries, funding is increasingly receiving attention and is often a major element for the prioritisation of infrastructure projects. EU-15 countries, on the other hand, rarely consider the TEN-T network as a whole in their national plans. This shows that the EU-10 not only recognise European transport policy as a possible source of funding for specific international projects, but that they treat it as an important element complementary to their national transport policies.

Beyond these differences, national concerns for transport infrastructure investments also differ between the central and peripheral European countries. Investment plans of the central countries are more concerned with the amount of transit traffic through their territory and focus on increasing capacity or building bypasses of high-density areas. The more peripheral countries deal particularly with the accessibility of their network and the capacity of their cross-border points, with transit traffic playing only a minor role in the planning process.

Table 2-6: Total investments in TEN-T infrastructure of the EU-15 in the period 1998-2001 per mode and country

	in million EUR					
	Road	Rail	Inl. Waterway	Ports	Airports	Total
Austria	639	2973	3	30	182	**3827**
Belgium	555	1507	320	1044	940	**4365**
Denmark	2050	3476	-	122	193	**5840**
Finland	469	501	16	397	229	**1612**
France	8373	9002	0	486	2139	**20000**
Germany	7567	9303	1460	2054	3522	**23906**
Greece	2223	1044	-	134	1904	**5305**
Ireland	1886	137	-	136	286	**2446**
Italy	1015	16114	-	204	915	**18249**
Luxembourg	62	18	-	-	89	**169**
Netherlands	1550	7154	283	1395	2393	**12775**
Portugal	1376	1249	-	331	629	**3586**
Spain	3889	3998	-	2423	509	**10818**
Sweden	625	1472	-	356	201	**2654**
United Kingdom	1697	11121	-	647	327	**13793**
Total	33975	69068	2083	9759	14456	129342

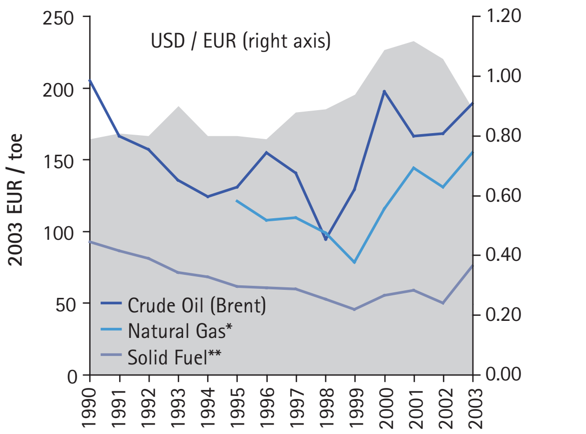
Source: European Commission, TEN-T implementation report 1998-2001

3. COSTS AND ACCESSIBILITY OF ENERGY AND TRANSPORT

- Although energy prices had been falling steadily over the 1990s, the trend has reversed from 2000-2001 onwards, driven principally by rising oil prices. Even coal, whose market is largely independent of the oil market, has experienced increases due to shipping constraints.
- Despite ongoing harmonisation efforts, energy taxes and network access charges continued to vary significantly across Member States.
- Automotive fuel process also exhibit wide variability within Member States, with petrol being on average more costly than diesel.
- TEN-T projects will significantly increase the accessibility of peripheral countries.

The following sections assess the performance of the energy and transport markets and their impact on companies operating in the sector and the respective end-users.

Figure 2-9: Average wholesale real fuel prices in the EU



** German border **ARA*
Source: Global Insight

3.1. Cost drivers and comparative costs for users

3.1.1. Common cost drivers : Wholesale fuel prices
International oil prices are directly reflected by European wholesale fuel prices which, in turn, affect transport activities through the prices of automotive fuels and oil products. Through their effect on natural gas prices, international oil prices also affect the costs of power generation, which are passed on to electricity prices. Despite recent moves towards other types of indexation, European gas prices continue to be mainly indexed on oil prices (with a lag of around 6 months). As a result, the effect of movements in gas prices into the power sector is magnified by nearly 100% given that the average efficiency of gas plants is around 50%.

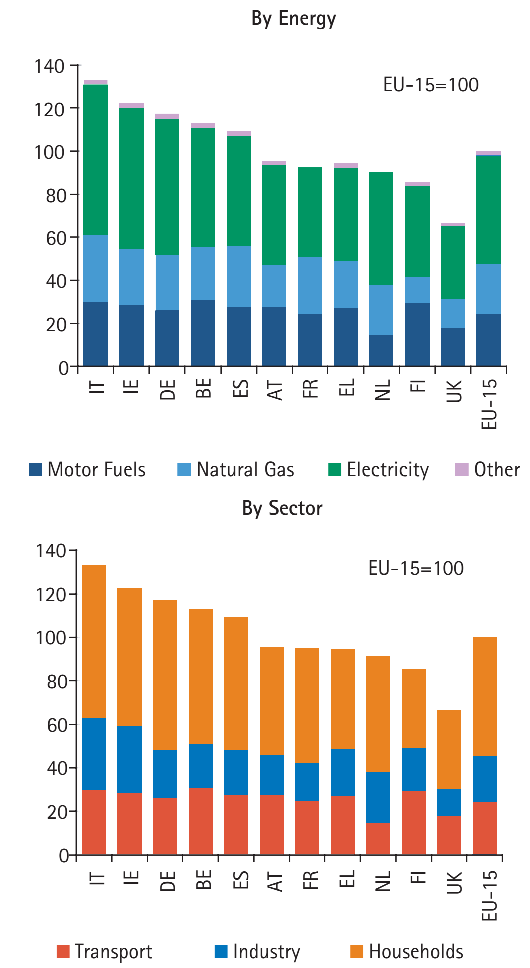
Since 2001, the effects of higher international oil prices (which are traded in US dollars) has been partially buffered by the falling value of the dollar against the euro. Prior to that date, the dollar had experienced the inverse trend, rising in value against the single currency. Figures for 2004 confirm the trends of growing international oil prices and a falling USD/EUR ratio. The evolution of these indicators between 1990 and 2003 is presented in Figure 2-9.

European coal wholesale prices also depend on the world market price for that commodity. Although coal prices declined between 1990 and 2000, the tendency has been unclear since 2000, when an inflection in the price trend occurred. Between 2002 and 2003 prices experienced a sharp rise due to a tight shipping market.

3.1.2. Sector-specific cost drivers

3.1.2.1. Retail energy prices
A first assessment of the competitiveness of the retail price structure across Member States can be made by comparing the value of an energy basket at each Member States' retail pre-tax prices. Figure 2-10 presents the ordering of this value for selected EU Member States using the distribution by fuels and by sectors of the EU-15's final energy demand in 2003 as the energy basket and normalising its total value at EU-15 average prices to 100. The basket's cost is highest in Italy, Ireland, Germany, Belgium and Spain, and is lowest in Finland and the U.K., with the remaining countries exhibiting intermediate values[6]. The basket's higher price in the first set of countries is mainly a result of their higher electricity prices. The Netherlands, despite exhibiting a similar value for electricity is at the lower end of the spectrum due to low motor fuel and gas prices.

Figure 2-10: Comparison of the value of the EU-15's energy basket valued at selected Member States' real prices (2003)



Source: Eurostat and Global Insight

[6] *The same exercise was carried out in the EC 2003 Annual Energy and Transport Review and revealed that the basket was most costly in Italy, Belgium, Germany and Spain.*

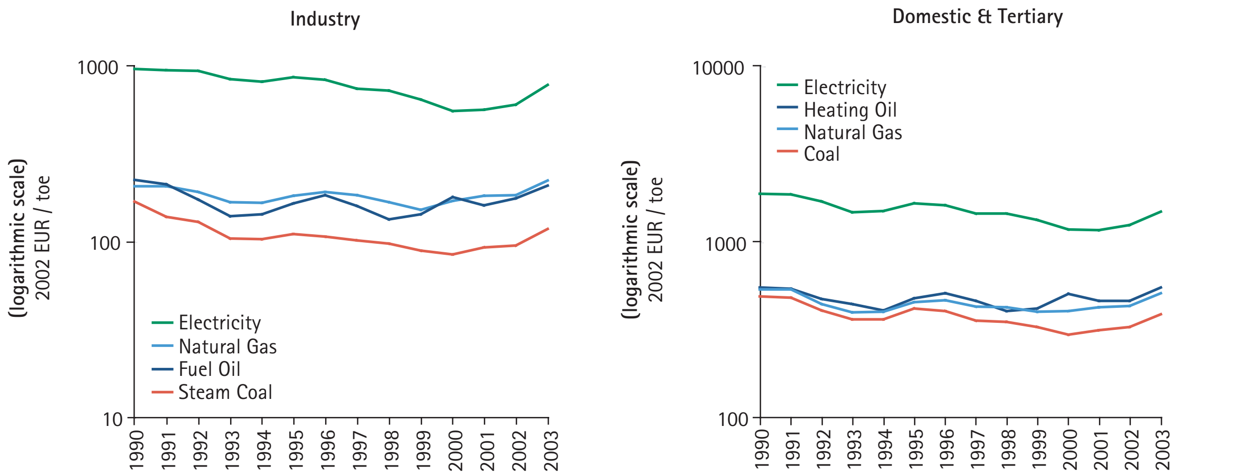
The exercise also reveals that energy prices to different sectors of the economy vary widely across Member States. Italy's price structure means that the same basket is relatively more costly to its residential and industrial sectors, even if the value for the transport sector is not the highest among the selected countries. The basket is cheapest in the U.K. and the Finland, given that their markets exhibit low prices to transport in the former country and low prices to households, in the latter.

Whilst retail electricity prices followed a generally decreasing trend for all energies over the 1995-2001 period in real terms, that changed from 2000 onwards with electricity prices in 2003 reaching their 1997 levels. Prices of the other energies also followed a more or less decreasing trend until 2001, from where a clear growth in prices was observed. The price of steam coal, which dropped uninterruptedly since 1996, rose for the third consecutive year, although it continued to be the cheapest energy source. Higher international oil and gas prices as well as tightness in the coal shipping markets are largely responsible for the recent surge in coal price levels.

A grade has been given to each country ranging from 1 to 21[7] according to its 2003 retail price relative to other countries, for each fuel. By averaging the four grades, the average price position for each country was obtained. As observed in Table 2-7, the ranking for prices to residential and commercial customers shows that Slovakia, the Czech Republic and Poland exhibited the best average fuel price positions, whereas Portugal, Italy and Denmark presented the least favourable price positions. All of the EU-10 and candidate countries considered were in the half of the list containing the lowest energy price rankings.

In the industrial sector, the countries ranked with the lowest overall prices were Poland, Czech Republic and Austria. At the other end, highest overall energy prices to industrial customers were found in Switzerland, Turkey and Denmark. Contrary to that observed in prices to the domestic sector, prices to industry in the selected EU-10 and candidate countries were not systematically among the upper half of the ranking.

Figure 2-11: Average* Retail Fuel Prices in the EU-25



**Non demand-weighted*
Source: IEA and Global Insight

Table 2-7: Ranking of 2001 prices by fuel in the EU-15

Residential and Commercial Customers 2003 EUR/ toe	Heating oil		Natural gas		Coal		Electricity		Average rank
Slovakia	130	3	253	1	225	1	745	1	1.5
Czech Republic	118	2	412	7	312	5	846	3	4.3
Poland	171	4	437	8	331	6	935	4	5.8
Finland	206	5	448	11	246	2	946	5	6.0
Greece	252	7	465	12	380	8	857	4	7.8
Hungary	272	9	799	16	263	4	801	2	7.8
United Kingdom	374	11	325	3	337	7	1168	10	8.0
Turkey	117	1	837	18	256	3	1101	9	8.0
Spain	462	16	355	4	588	16	1079	8	11.3
Norway	246	6	791	15	715	17	968	6	11.3
France	445	15	439	9	480	10	1190	12	11.8
Germany	661	19	400	6	503	11	1357	13	12.8
Switzerland	1181	21	306	2	549	14	1324	12	12.8
Belgium	570	18	362	5	514	13	1446	15	13.3
Austria	494	17	444	10	426	9	1446	16	13.5
Ireland	441	14	523	13	558	15	1190	11	13.5
Sweden	369	10	846	19	794	18	1024	7	13.8
Netherlands	423	13	672	14	511	12	1724	17	14.5
Portugal	404	12	804	17	862	20	1413	14	16.3
Italy	265	8	959	21	880	21	1736	18	17.5
Denmark	860	20	854	20	861	19	2325	19	20.0

[7] *Only countries for which full data series for 2003 were available are compared.*

Industrial Customers

2003 EUR/ toe	Fuel oil		Natural gas		Steam coal		Electricity		Average rank
Poland	69	3	143	3	171	2	545	11	4.8
Czech Republic	61	2	134	2	198	4	545	12	5.0
Austria	85	9	205	8	204	6	467	3	6.5
Belgium	77	6	204	7	183	3	523	10	6.5
Slovakia	97	12	127	1	214	10	523	9	8.0
Spain	83	8	236	16	205	7	478	4	8.8
France	178	19	199	6	210	9	412	2	9.0
Finland	136	17	254	18	155	1	478	5	10.3
Netherlands	77	7	222	14	201	5	690	15	10.3
Sweden	113	14	220	11	295	19	200	1	11.3
United Kingdom	115	15	208	10	208	8	579	13	11.5
Germany	228	20	181	5	285	18	490	6	12.3
Greece	131	16	221	13	229	14	512	8	12.8
Hungary	148	18	157	4	233	15	668	14	12.8
Ireland	53	1	278	20	219	12	834	19	13.0
Norway	73	4	460	21	421	21	501	7	13.3
Portugal	73	5	245	17	238	16	768	16	13.5
Italy	87	10	220	12	228	13	1257	21	14.0
Switzerland	92	11	206	9	315	20	823	18	14.5
Turkey	99	13	231	15	218	11	1046	20	14.8
Denmark	285	21	276	19	276	17	779	17	18.5

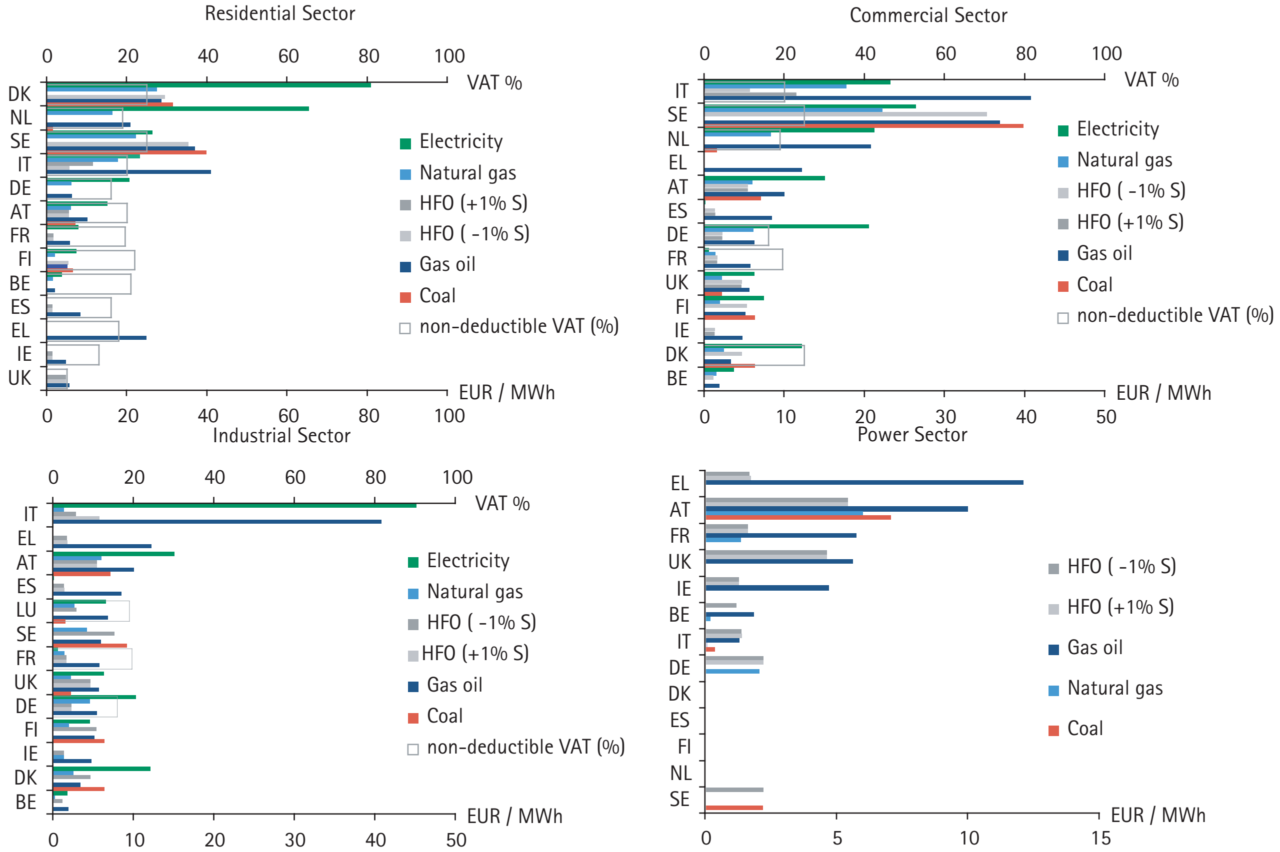
Source: Global Insight

3.1.2.2. Energy taxes (EU-15 only)

One of the main barriers to a single energy market in the EU is the difference in the tax levels that Member States levy on different energy sources. These divergences arise from a combination of factors within each Member State and the Commission has set out to harmonise energy tax systems. Indeed, the EU Council of Ministers adopted in 2003 a Directive which widened the scope of the EU minimum rate system, previously limited to mineral oils, to all energy products including coal, natural gas and electricity. Although some progress has been made, energy taxes still vary widely across the EU-15 (and to an even greater extent in the EU-25, but insufficient data was available for this analysis).

On average, the Member States considered levy the highest energy taxes on residential customers, followed by commercial customers, industrial sector customers and power sector

Figure 2-11: Average* Retail Fuel Prices in the EU-25



Source: Eurogas Annual Report

customers. However, there are no clear taxing patterns across all countries. Some impose high energy taxes on residential and commercial customers (e.g. Italy, Netherlands, Sweden), while others prefer to levy energy taxes in the industrial and power sectors (e.g. Austria, Greece).

Austria, Germany, France, Belgium and Italy are the sole countries to have applied taxes on natural gas sales to the power sector, although the levies are not in excess of EUR 6/MWh. Taxes on fuel oil sales to the power sector were more frequent and probably the most homogeneous among the EU-15 Member States, with the highest having been levied by Austria and the U.K.

Table 2-8: Electricity network access charges (2003)

Estimated networks charges (/MWh)			
	Medium Voltage	Low Voltage	Estimated Average
Belgium	14.00	50.00	58.00
Cyprus	n.a.	n.a.	n.a.
Czech Rep	13.00	34.00	27.00
Denmark	n.a.	23.00	42.00
Germany	9.00	55.00	62.00
Greece	n.a.	n.a.	n.a.
Spain	7.00	36.00	35.00
Estonia	-	-	-
Finland	16.00	32.00	40.00
France	12.00	40.00	48.00
Hungary	9.00	30.00	40.00
Ireland	17.00	44.00	50.00
Italy	11.00	52.00	36.00
Latvia	18.00	42.00	38.00
Lithuania	n.a.	n.a.	n.a.
Luxembourg	n.a.	n.a.	n.a.
Malta	n.a.	n.a.	n.a.
Netherlands	11.00	31.00	36.00
Austria	11.00	56.00	61.00
Poland	13.00	34.00	27.00
Portugal	6.00	42.00	38.00
Slovakia	22.00	33.00	32.00
Slovenia	10.00	45.00	29.00
Sweden	11.00	22.00	44.00
UK	15.00	35.00	30.00

Source: Commission Annual Report on the Implementation of the Gas and Electricity Internal Market

3.1.2.3. Network access charges for third party access (TPA) to electricity and gas infrastructure

The annual survey performed by the Commission on the implementation of the gas and electricity internal markets showed that here too, there was wide divergence across Member States. For TPA to gas networks, average charges in 2004 ranged from EUR 1 to EUR 9/MWh to industrial customers and from EUR 3 to EUR 21.5/MWh to residential customers. Overall, the highest charges occurred in Spain, Austria and France, while the Netherlands, Hungary and the UK exhibited the lowest overall charges. Significant variance in TPA charges to electricity networks prevailed in 2004, with average charges ranging from EUR 27 to EUR 62/MWh. The highest charges were levied in Germany, Austria and Belgium, while the lowest charges were levied in Poland, the Czech Republic and Slovenia. Out of the EU-10 countries considered, only Hungary was not in the lower half group of countries.

Caution must be taken when comparing gas and electricity tariffs, as other factors such as quality of service, technical characteristics and the environment of the networks are not taken into account by the above analysis.

Table 2-9: Gas network tariffs (2003)

Estimated networks charges (/MWh)			
	Eurostat category I4 (Industrial)	Eurostat category I1 (Industrial)	Eurostat category D3 (Domestic)
Belgium	2.00	4.50	10.50
Czech Republic	n.k		
Denmark	2.00	6.00	n.k.
Spain	2.50	11.00	21.50
Estonia n.k.			
France	1.00	9.50	13.00
Germany	2.50	10.50	n.k.
Hungary	2.50	5.50	5.50
Ireland	4.50	14.00	
Italy	2.50	n.k.	8.00
Latvia	3.50	4.00	4.00
Lithuania	4.20	6.20	8.70
Luxembourg	1.00		
Netherlands	1.00	2.50	3.00
Austria	2.50	10.00	13.00
Poland	5.00	8.00	8.00
Slovakia	6.50	8.00	
Slovenia	1.10		
Sweden	5.00		
UK	2.50	4.50	6.50

Source: Commission Annual Report on the Implementation of the Gasand Electricity Internal Market

3.1.2.4. Automotive fuel prices and taxes

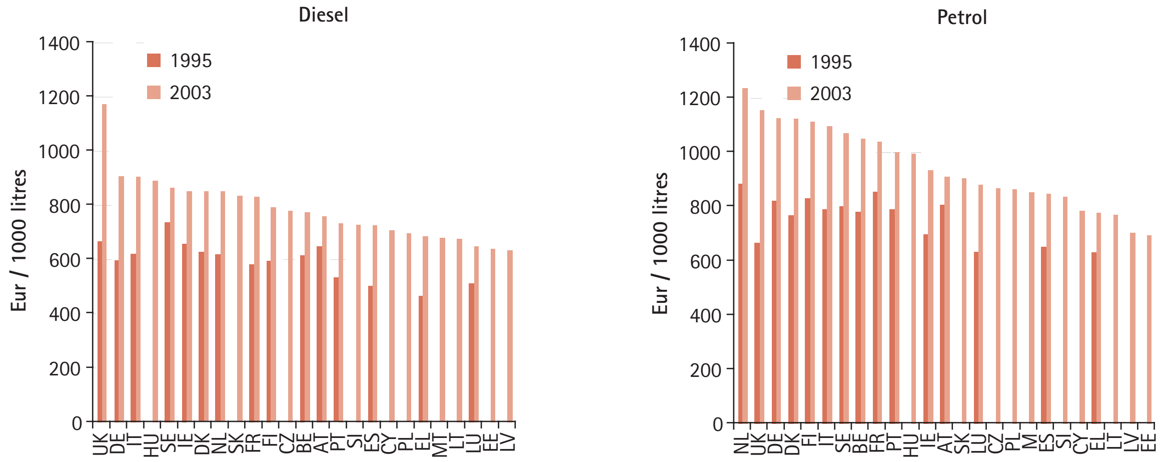
With the provisions of Council Directive 2003/96/EC from the 1st January 2004 (adopted in October 2003), new common rules for the harmonisation of fuel taxes came in force with higher minimum excise duty rates for oil products. The current minimum level for unleaded petrol has been fixed at EUR 359 per 1000 litre while for diesel a minimum rate of EUR 302 per 1000 litre applies. Although this is a further step in the direction of greater harmonisation, prices for diesel in November 2004 still varied between EUR 0.72 / litre in Latvia and EUR 1.24 / litre in the UK, by far the highest value for diesel across the Member States. Prices for unleaded petrol varied between EUR 0.72 / litre (again in Latvia) and EUR 1.25 / litre in the Netherlands. Final prices including excises and taxes in the EU-10 are in general lower than in the EU-15 because of different levels of taxation. Table 2-10 presents an overview of the final and net prices as well as total taxation of petrol and diesel in the EU-25. The countries with the highest prices are given the lowest ranks.

With the exception of the UK, all countries taxes levy a lower tax on diesel fuel than on unleaded petrol. Taking into account the net prices for both diesel and petrol without excises and VAT, the picture becomes somewhat more complex. Prices are still very low in the Baltic States but also in Luxembourg, France and in Slovenia, while the highest net fuel prices are found in Italy and Hungary.

The significantly lower net prices in some countries suggests greater competition in the fuel market, even if differences in other cost components may also add to the price differences.

Nevertheless, the net fuel price differences are, in general, comparably low and clearly dominated by the different tax rates applied. Consequently, the highest final prices can be found in the countries with the highest excise duties (UK, Italy, Germany, Netherlands).

Figure 2-13: Final prices of automotive fuels in the EU (incl. excises and VAT)



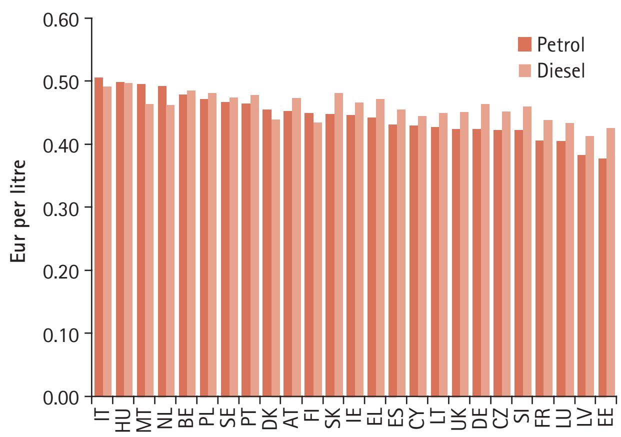
Source: Energy and transport in figures

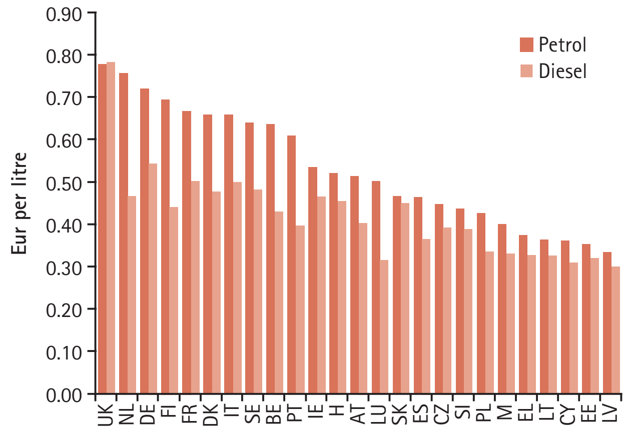
Table 2-10: Petrol prices , excises and taxes for diesel and petrol (November 2004)

	Values for diesel in EUR per litre					Values for Petrol in EUR per litre				
	Final Price		Excises + VAT	Net price without excises and VAT		Final Price		Excises + VAT	Net price without excises and VAT	
Country	Price	Rank	Value	Price	Rank	Price	Rank	Value	Price	Rank
Belgium	0,92	11	0,43	0,49	3	1,12	6	0,64	0,48	5
Cyprus	0,76	22	0,31	0,45	19	0,79	23	0,36	0,43	16
Czech Rep	0,85	16	0,39	0,45	16	0,87	19	0,45	0,42	20
Denmark	0,92	10	0,48	0,44	20	1,12	7	0,66	0,46	9
Germany	1,01	2	0,54	0,47	11	1,15	4 0,7	2	0,43	19
Greece	0,80	19	0,33	0,47	9	0,82	21	0,38	0,44	14
Spain	0,82	17	0,37	0,46	15	0,90	18	0,46	0,43	15
Estonia	0,75	24	0,32	0,43	24	0,74	24	0,36	0,8	1
France	0,94	6	0,50	0,44	21	1,08	10	0,67	0,41	22
Hungary	0,96	5	0,46	0,50	1	1,02	11	0,52	0,50	2
Ireland	0,93	7	0,47	0,47	10	0,99	12	0,54	0,45	13
Italy	0,99	3	0,50	0,49	2	1,17	3	0,66	0,51	1
Latvia	0,72	25	0,30	0,41	25	0,72	25	0,34	0,38	24
Lithuania	0,78	21	0,33	0,45	18	0,79	22	0,37	0,43	17
Luxembourg	0,75	23	0,32	0,43	23	0,91	15	0,50	0,41	23
Malta	0,80	20	0,33	0,46	12	0,90	17	0,40	0,50	3
Netherlands	0,93	9	0,47	0,46	13	1,25	1	0,76	0,49	4
Austria	0,88	12	0,40	0,47	8	0,97	13	0,52	0,45	10
Poland	0,82	18	0,34	0,48	5	0,90	16	0,43	0,47	6
Portugal	0,88	13	0,40	0,48	6	1,08	9	0,61	0,47	8
Slovakia	0,93	8	0,45	0,48	4	0,92	14	0,47	0,45	12
Slovenia	0,85	15	0,39	0,46	14	0,86	20	0,44	0,42	21
Finland	0,88	14	0,44	0,44	22	1,15	5	0,70	0,45	11
Sweden	0,96	4	0,48	0,47	7	1,11	8	0,64	0,47	7
UK	1,24	1	0,78	0,45	17	1,21	2	0,78	0,43	18

Source: Energy and Transport in Figures (2004) Compound Average Annual Growth Rate*

Figure 2-14: Breakdown of automotive fuel prices (2004)





Source: Energy and transport in figures

3.1.2.5. Infrastructure charging

Charges for the use of transport infrastructure are, alongside fuel prices and vehicle taxation, another key driver of transport costs, influencing the mobility of people and the provision of freight transport services. Given the natural monopoly nature of rail and road network infrastructure, public regulation of charges for the use of infrastructure is necessary to enable effective third party access to networks, and to allow for a fair and efficient competition in the road and railway markets. However, like in the energy sector, the fundamental goal of creating an internal transport market with non-discriminatory market access for all users is hampered by heterogeneous charging systems and policies across the EU, which have resulted from specific historical developments within the Member States. In respect of railways, rail track access is charged by different national systems depending on time slots, type of infrastructure and transport distances. Road-pricing systems exist generally in the form of vignette solutions independent of actual travel distances, distance-related road pricing systems on motorways, separate passage tolls for the use of bridges and tunnels e.g. for alpine crossings and urban congestion charges. There is a long tradition of road pricing on motorways in France, Italy, Spain and Portugal as well as on Alpine passes. After overcoming technical problems, Germany successfully introduced a new electronic charging system for heavy goods vehicles in January 2005, one year after the implementation of the new Austrian system, which includes both goods vehicles and passenger cars.

In Europe, the diversity of road charging systems can be explained by a variety of motivations resulting from country-specific pressures. These range from raising of funds for financing infrastructure, the wish to adequately charge foreign trucks for the use of national roads in countries with volumes of transit traffic, to the management of chronic congestion and environmental improvement. Some countries are planning or have begun to use distance-dependent network charging systems, aimed at substituting fixed charges on vehicle possession for a variable charge that depends on the actual distances travelled on the network. Motivations for such as system include the reduction of distortions in international competition, the provision of more predictable relationships between road and rail costs by substituting fuel taxes and the improvement of the efficiency of the tax system as a whole by substituting taxes on labour and capital with taxes on external costs.

> Reform of the Eurovignette Directive

As a result of complex and heterogeneous national developments, the issue of infrastructure charging in the road and railway markets has been high on the European political agenda over the past few years. In order to move forward to the goal of a common implementation of the user pays and polluter pays principles, the Commission presented in July 2003 a proposal amending the existing 'Eurovignette' Directive (1999/62/EC) on charging of heavy goods vehicles on motorways. After the differences of national interests stirred controversy for almost two years, opposing peripheral countries and central countries with high transit volumes, the European transport ministers finally agreed on April 2005 on a compromise that allows to apply tolls in a flexible manner. The key elements of the Council's decision are as follows:

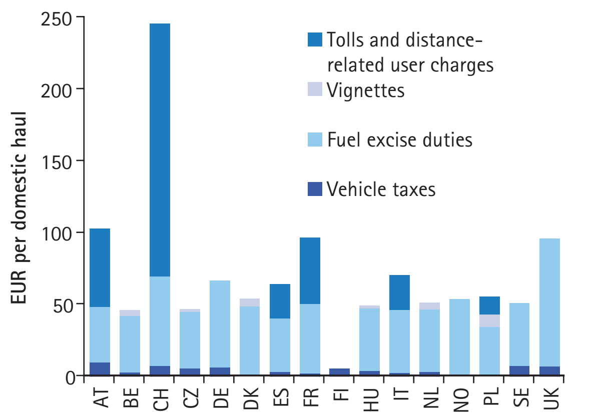
- Weight: All goods vehicles above 3.5 tons maximum weight can be included into the charging system.
- Network: The scope of the Directive covers all roads that are part of the TEN-T.
- Construction costs can in general be included for the last 30 years.
- Mark-ups can be levied up to 15 % in sensitive regions and up to 25% for cross-border sections in mountainous regions to crossfinance alternative transport infrastructure projects.
- Variation: Charges can be doubled or lowered to zero to fight congestion or to promote the use of clean vehicles.
- Use of revenues: Member states are allowed to use revenues for public budget purposes. However, it is recommended that they are used for transport infrastructure.

> Charging levels

Like with fuel and vehicle taxation, the charging levels for the use of motorway and for railway infrastructure continue to differ significantly within Europe. This is a result of the variety of different systems for infrastructure funding that are in place.

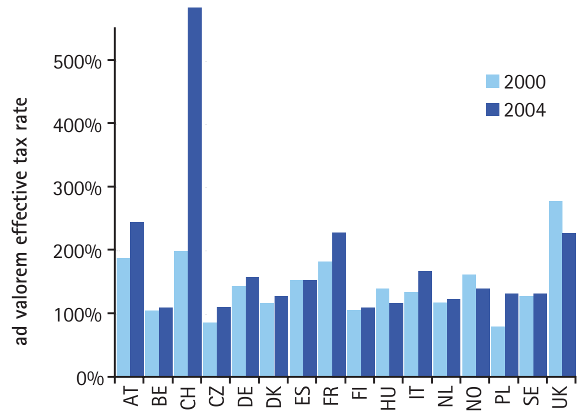
Road user charges for heavy goods vehicles vary not only with respect to the average price per vehicle-km but also according to

Figure 2-15: Structure of taxes and charges for domestic standard hauls* on roads for selected European countries in 2004



** 400 km, 1 fiscal day, 1 year = 276 fiscal days, tolled highways = 60% of total trip (=240 km)*
Source: European Conference of Ministers of Transport (ECMT)

Figure 2-16: Ad valorem effective taxation* for domestic standard hauls for selected European countries



** net charges (EUR/ trip) / diesel consumption (litres) / pre-tax price of diesel (EUR/ litre) x 100*
Source: European Conference of Ministers of Transport (ECMT)

vehicle sizes and emission standards. Additional charges for the use of tunnels and bridges, mainly levied at the cross-border sections of mountainous regions, make the comparison of charges even more complex. In order to achieve a meaningful picture, Figure 2-15 reduces this complexity by presenting an overview on the level and structure of taxes and charges for a standard domestic haul with a heavy goods vehicle in 16 European countries, including Switzerland and Norway. The values have been calculated by the European Conference of Ministers and Transport (ECMT) for the beginning of the year 2004. A standard haul is defined as a trip of 400 km with a share of 60% on motorways that may be, depending on the country, subject to a distance-related charge. Yearly taxes for vehicle use as well as costs associated with the purchase of a motorway Vignette are translated into costs per haul, using the assumption of 276 hauls per year. Fuel excise duties refer to an average fuel consumption of 32 litres per 100 km. The figure shows that the highest total charges are levied in countries with a distance-related road pricing system in place. The high total costs in Switzerland are a result of the introduction of heavy vehicle fee (LSVA) in 2001 with the explicit objective to cross-finance new trans-alpine rail transport links. Other countries that show comparatively high total costs as a result of their national road pricing systems are Austria, France, Italy, and Spain, while for Germany and the UK, the higher fuel excise duties on diesel are noticeable. To catch the effect of the introduction of the new electronic road pricing system in Germany in January 2005, some EUR 30 have to be added to the 2004 value, thus resulting in total costs of approximately EUR 100 per haul, which is comparable to that in Austria and France. Despite significant differences in single cost elements like vehicle tax and the price of a Vignette for motorway access, the cost values for the remainder of the countries considered varies only moderately between EUR 46 and EUR 60. The outcome is that the different cost structures within countries provide countervailing incentives and impede the development non-discriminatory international competition, i.e. the development of the internal market. Figure 2-16 presents the evolution of the ad valorem effective taxation, defined as the sum of taxation of road charges for a domestic standard haul per fuel consumption per net fuel cost. The noticeable reduction of overall charges in the UK correspond to a significant 50% reduction of the vehicle excise duty in 2001 together with the exchange rate development of the British pound.

Railway access charges vary even more than motorway charges across the Member States. According to calculations provided by the European Conference of Ministers of Transport, tariffs ranged from some EUR 0.50 per train-kilometre for a 1000 gross tonnes freight train in Sweden and the Netherlands to more than EUR 8 per trainkilometre in Slovakia. The charges for freight trains in the EU-10 include tariffs above EUR 4 per tkm and are, in most countries, higher than in the EU-15. The highest access charges in the EU-15 were levied in the UK, in Austria and Denmark with values slightly above EUR 3/train km. In contrast, average charging levels for inter-city and suburban passenger trains were highest in France, Germany and the UK. The lower average values in the EU-10 countries were due to lower charges for suburban trains compared to those countries.

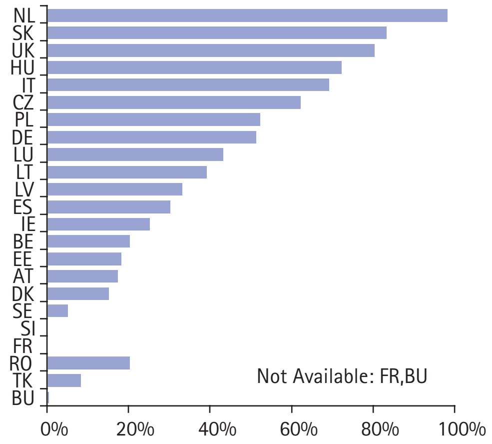
With some exceptions, motorway tolls for passenger cars are levied in most European countries. Motorways in Germany and the Benelux countries as well as in Sweden and Denmark are generally free of charge. However, tolls are charged for two motorway sections in the Netherlands as well as for the Oeresund link between Copenhagen and Malmö and for the crossing of the Great Belt in the Denmark passage. The average motorway charges were highest in Spain with some EUR 8 /100 vehicle-kilometres, followed by France, Italy and Portugal with tariff levels around EUR 5 /100 vehicle-kilometres. Austria, the Czech republic, Slovakia and Hungary have implemented time-dependent Vignette solutions for the use of their motorways. Vignettes can often be purchased for periods of a week, a month and a year.

3.2. Public service and vulnerable customers

3.2.1. Energy

Under EU law, public service obligations are understood as those that an energy company might not cover in part (or at all) based on a normal commercial consideration, such as continuity of supply or nondiscriminatory supply to all citizens and regions. Under a recent Commission white paper (COM (2004) 364) on services of general interest, Member States can impose public service obligations on gas and electricity utilities. The electricity and gas Directives in force include provisions for vulnerable customers, such as special tariffs, prepayment meters, a free amount of supply (for electricity), and restrictions on disconnection.

Figure 2-17: Households connected to the gas grid (2003)



Source: EC – Third benchmarking report on the implementation of the gas and electricity internal markets, 2004

In respect of universal service, nearly all households in the EU-25 were connected to the electricity grid in 2003. Nonetheless, the Commission reported that in 2003 there was an "increasingly delicate" supply and demand balance in certain regions, especially in the Nordic countries and in Greece, Ireland and Italy, which increases the chances of service interruptions.

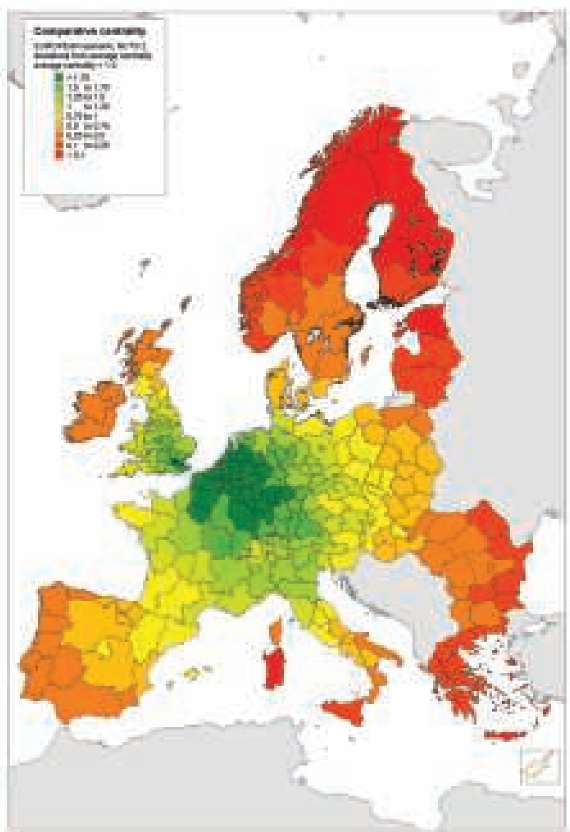
Contrary to electricity, gas is a non-essential and substitutable fuel. This, along with historical, political and geographical factors explain the differences in the degree of penetration of natural gas networks in each of the Member States. Indeed, despite advances in the single market and ongoing penetration of networks, the percentage of households connected to the gas grid varied widely. In 2003, the figure respectively ranged from 98% and 83% in the Netherlands and Slovakia, to 15% and 5% in Denmark and Sweden. No information was available for France and Bulgaria.

One recent source of concern highlighted in the latest Commission report on the implementation of the electricity and gas markets (SEC (2004) 1720) was the difficulty of price comparisons and informed customer choice, especially among household and small business customers.

3.2.2. Regional accessibility transport

Geography, population density, the quality of transport connections (as measured by travel times between European regions) as well as the costs of transport determine the accessibility of the European regions within the European internal market. Clearly, people and industries in central and densely populated regions like the Netherlands, Belgium and in the western parts of Germany have transport connections with lower travel times and costs to other European regions than the more peripheral regions in Scandinavia, Greece, southern Italy, the Baltic states, Ireland and the western parts of the Iberian peninsula. Nonetheless, the provision of high-quality transport infrastructure in the centres of economic activity of the peripheral countries is able to significantly reduce these differences caused by the geographical location of the regions within the European Community. Improving the accessibility of European regions is a central goal of European infrastructure policy laid down in the guidelines for the TEN-T networks, and a necessary condition for developing the internal market and increasing social cohesion among Member States. Figure 2-18 illustrates the estimated differences of accessibility across Europe in 2020 if all 14 priority projects of the 'Essen-list' and major corridors of the TINA network for the CEEC countries are completed. This is done by calculating an index of centrality that takes into account travel times (for passenger transport) and generalised transport costs (for freight transport) respectively of every region to all other regions. The values for travel times and costs are weighted with the population (passenger transport) and GDP (freight transport) of the respective destination regions. After this calculation is performed for every region, the average centrality for all regions of the EU-25, Switzerland, Norway, Romania and Bulgaria can be determined. The comparative centrality is then obtained by dividing the absolute value of each region by the average for all regions under consideration. The diagram shows that the gravitational centre of the area considered spans from the south-eastern part of England and the Île-de-France across the Benelux countries to the western regions of Germany. While the sparsely populated peripheral regions such as the middle and northern parts of Scandinavia retain a low comparative centrality, the relatively low accessibility of more densely populated regions in Greece, the Baltic States or Sicily indicates that several key areas will continue to suffer from poor access to European markets by land-borne or air transport modes. The western peripheral countries of Ireland, Portugal and Spain, on the other hand, show relatively good accessibility (up to 50% of the average value), indicating the effectiveness of the planned trans-European network for these regions. The growing importance of air transport hubs is visible by the high comparative centrality values for Madrid, London or Berlin. It is worth noting that the figures presented in this context do not contain information on sea transport and the accessibility of regions overseas.

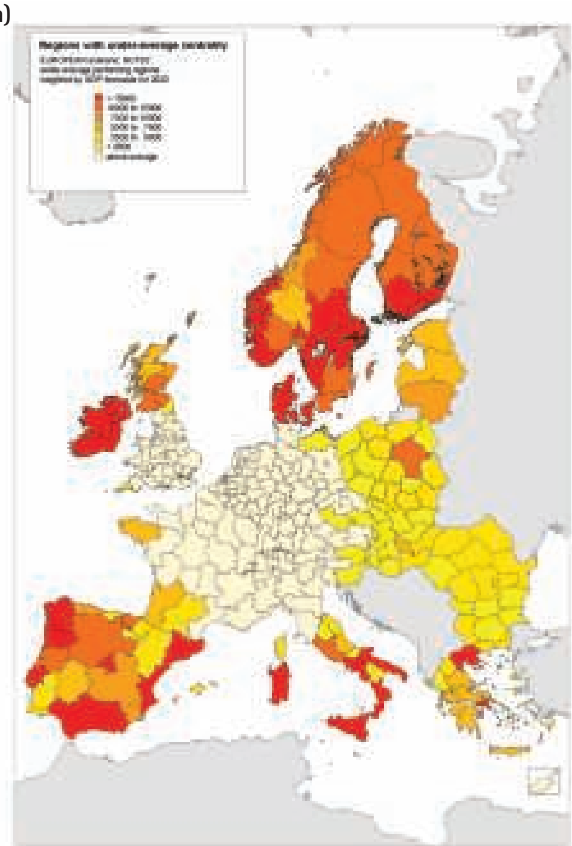
Figure 2-18: Estimation of comparative centrality of European regions with respect to travel times and generalised costs for passenger and freight transport on roads and railways until 2020



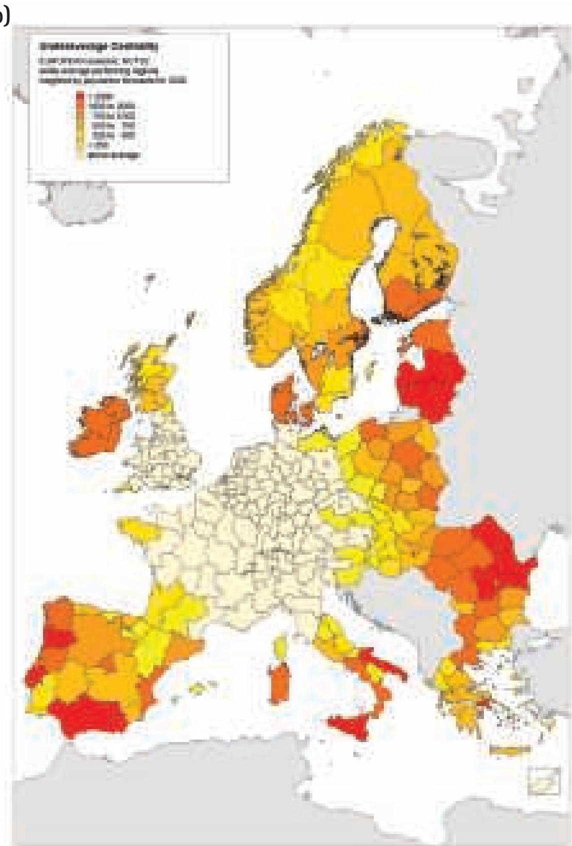
In order to identify more clearly which regions will continue to suffer from a low centrality compared to their relative importance in the European context, the index values for the comparative centrality can be weighted by the regional population and by GDP. Figure 2-19 (a) shows the comparative centrality weighted by the estimated GDP in 2020. Now it becomes visible that the peripheral regions with a strong economy but relatively poor accessibility will be Ireland, Denmark, the southern part of Finland around Helsinki, the Salonika and Athens regions in Greece, Warsaw and coastal regions in Spain and southern Italy. It is worth noting that since sea transport is not considered in the diagram, some coastal regions that would otherwise have a higher centrality index, exhibit in this exercise a relatively poor indicator. However, as sea transport is of only minor importance for passenger transport, a closer examination of the centrality values weighted by population in Figure 2-19 (b) sheds more light on the issue of identifying regions with under-average centrality. The most prominent differences are, that for the whole of Scandinavia as well as for Ireland, and to a lesser degree for Italy and Spain, the relative centrality is significantly higher. In contrast and because of their low GDP per capita in comparison with the European average, the situation in the Baltic States, Poland, Slovakia and especially in the candidate countries Romania and Bulgaria turns up to be a good deal worse when taking into account the number of inhabitants affected by lower accessibility. Altogether, it can be concluded that, while the construction of the trans-European transport networks will effectively moderate the restraints for the access to the internal market for many regions, the accessibility of the candidate countries, the Baltic states, Portugal and the very South of Italy and Spain will remain limited.

Figure 2-19: Regions with under-average centrality with respect to regional GDP and to regional population

(a)



(b)



Source: NEA, COWI, IWW, NESTEAR, PWC, TINA, IVT, Herry, Mkmetric. TEN-STAC:

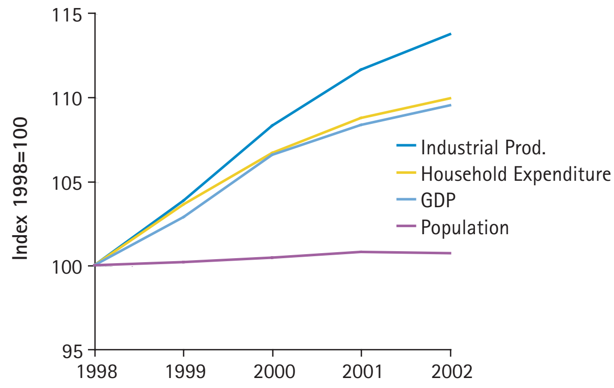
4. LINKS BETWEEN THE ECONOMY, TRANSPORT AND ENERGY

- The EU-25's GDP has grown steadily since 1996 although output has significantly slowed down from 2001 onwards. Average yearly growth between 1995 and 2003 was 2.2%.
- Growth in primary and final energy demand was less than proportional to economic growth as a result of ongoing restructuring of the economy coupled with power sector reform and, to a lesser extent, efficiency-increasing measures.
- Freight transport is significantly driven by increasing trade volumes. Furthermore, modern production processes demand for more frequent deliveries, which has augmented the number of trips.
- Determinants for passenger transport differ significantly across Member States. Income, petrol prices and tax-regulations can be considered the most important economic drivers. However, socio demographic drivers such as an increasing number of households, ageing of societies and changing life styles are equally important.

4.1. Socio-economic trends

The levels of energy and transport activity are mainly determined by overall economic performance, industrial production and structure, the volume and patterns of consumer expenditure, climatic conditions and demographics. To a certain extent, the evolution of energy and transport activities is also sensitive to the wholesale price of primary energy, especially oil, which is an important source of energy for both industries.

Figure 2-20: Principal economic drivers in the EU-25



Source: Eurostat

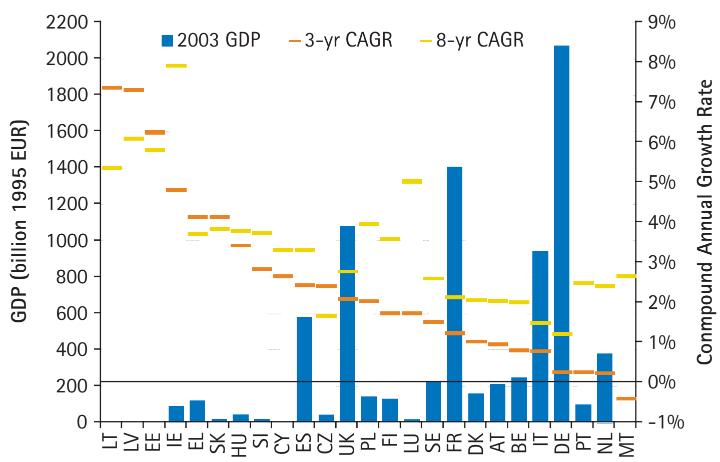
Figure 2-20 illustrates the relative evolution of the principal drivers common to energy and transport activities. Between 1998 and 2003, the EU-25's GDP grew by over 10% in real terms, passing from EUR 7.3 trillion to EUR 8.1 trillion (at 1995 market prices and exchange rates). However, the EU-25's aggregate compound annual growth rate (CAGR) has been slowing down over the years. Whereas the EU-25's economy grew by an average 2.7%/year between 1995 and 2000, it dropped to 1.4%/year between 2000 and 2003. Over the 2002-2003 period, it grew by a 0.9%, its lowest annual growth rate since 1995.

Industrial production in the EU-25 has been growing steadily since and more than proportionally to GDP since 1998. Nonetheless, industrial production slowed down in 2002, growing by 1.9% (down from 3.1% in the previous year). Although the decoupling if industrial production to economic output is related to the growth of high added value industrial sectors in the EU, it is also partly a consequence of the falling dollar, through which many of the EU's exports are traded. Household expenditure was conservative over the period, closely following the evolution of GDP. Population in the EU-25 expanded by a mere 0.7% over the 1998-2003 period.

Underlying the EU-25's aggregate performance were mixed performances by individual Member States (see Figure 2-21). The majority of the less developed economies of the EU-10 presented the highest growth rates (with the exception of Malta), while most of the more developed EU-15 economies grew at a slower pace (with the exception of Ireland, Greece and Spain). Among the best performers were the three Baltic states whose with 3-year and 8-year CAGR was over 6.5%, and Ireland, Greece and Slovakia, with 3-year and 8-year CAGR exceeding 3.5%. The slowest growing economies over the period between 2000 and 2003 were Germany, Portugal, the Netherlands and Malta, all with three year averages under the 1% mark, although the 8-year average for the three latter countries was greater than 2%. The EU's larger economies also presented differences in performance. Between 2000 and 2003, France and Italy grew near the EU-25's average of 1.2%/year, while the UK grew by more than 2% and Germany's economy grew by only 0.3% over the same period.

Figure 2-21 also illustrates some accelerations and decelerations in the development of economic activity in the 3-year period between 2000 and 2003 compared to the 8-year period between 1995 and 2003. The fastest deceleration occurred in Luxembourg and Ireland, whose 8-year CAGR respectively slowed down from 5.0% and 7.9%, to 1.7% and 4.8% between 2000 and 2003. Other important slowdowns were observed in Malta, Portugal and the Netherlands. Conversely, economic growth in the short term accelerated with respect to the longer term in the Baltic States, Greece, Czech Republic and Slovakia.

Figure 2-21: EU GDP in 2003 and compound annual growth rates (CAGR) by Member State



Source: Eurostat

4.2. Determinants and trends of energy and transport activity

4.2.1. Energy drivers and indicators

Energy consumption is principally determined by overall economic performance, structural characteristics and weather. At constant structural conditions, expanding economic activity inherently requires more energy. The EU has nonetheless undergone significant structural shifts over the past decade: A significant portion of heavy industry has relocated to other countries, its economies have become increasingly more serviceoriented and the level of productivity has grown. It has also passed from being a relatively homogeneous group of 15 countries to a less homogeneous group of 25. Advances in thermal efficiency have played an important role too, though mainly in the power sector, where there has been significant replacement and growth through new more efficient gasfired units. In the EU-10 countries, important behavioural changes owing to the transition to market economies have had a major impact on the consumption of energy, particularly in the households and tertiary sectors.

Weather is another fundamental driver of energy consumption: Colder years require more energy for heating in the winter. More recently, energy consumption has also increased in warmer years from the increased use of air conditioning and refrigeration, particularly in the Mediterranean. Heating Degree-days (HDD) is the measure used to reflect the impact of climate on energy demand[8]. The correlation between FED and climate variations is shown in Figure 2-22. Colder years (peaks) are clearly associated with a higher FED. Due to changing climate conditions, FED can therefore only be accurately compared to actual economic fluctuations if corrected for the effects of weather. Once weather effects are adjusted for[9], the true relation between economic activity and energy demand become apparent (see Figure 2-23). From the figure, it is clear that in the EU-15, FED has approximately followed the trend of economic performance, while in the EU-10 the two indicators are clearly decoupled. The main reason explaining the decoupling is that economic growth in the latter group of countries has occurred simultaneously to the replacement or shut down of older production units and major changes in consumer behaviour following the transition to market economies, meaning that economic output was able to grow without requiring a proportionally equivalent amount of energy. As shown in Table 2-11 FED has in some cases even dropped, while economic output has grown.

Table 2-11: Relative evolution of GDP and energy activity in the EU-25

					CAGR	
		1995	2002	2003	2003/1995	2003/2002
Belgium	GDP (1995 EUR billion)	212	245	248	2.0%	1.1%
	GIC (Mtoe)	47	55	56	2.2%	2.0%
	Electricity demand (TWh)	68	78	80	1.9%	1.6%
	Final energy demand (Mtoe)	34	36	38	1.3%	6.4%
Czech Republic	GDP (1995 EUR billion)	40	44	45	1.7%	3.1%
	GIC (Mtoe)	47	42	41	-1.8%	-3.5%
	Electricity demand (TWh)	48	51	52	1.1%	3.1%
	Final energy demand (Mtoe)	26	24	26	0.1%	9.0%
Denmark	GDP (1995 EUR billion)	138	161	162	2.1%	0.5%
	GIC (Mtoe)	18	21	21	2.0%	-1.6%
	Electricity demand (TWh)	31	33	32	0.5%	-0.4%
	Final energy demand (Mtoe)	15	15	15	0.1%	1.3%
Germany	GDP (1995 EUR billion)	1880	2075	2072	1.2%	-0.1%
	GIC (Mtoe)	356	345	344	-0.4%	-0.3%
	Electricity demand (TWh)	453	499	509	1.5%	2.1%
	Final energy demand (Mtoe)	222	226	230	0.4%	2.1%
Estonia	GDP (1995 EUR billion)	3	4	5	5.8%	5.1%
	GIC (Mtoe)	10	6	5	-7.7%	-5.2%
	Electricity demand (TWh)	4	5	6	2.8%	5.7%
	Final energy demand (Mtoe)	2	3	3	0.8%	2.7%
Greece	GDP (1995 EUR billion)	90	115	120	3.7%	4.5%
	GIC (Mtoe)	22	26	27	2.4%	5.0%
	Electricity demand (TWh)	34	47	49	4.5%	4.4%
	Final energy demand (Mtoe)	16	19	20	3.3%	4.9%
Spain	GDP (1995 EUR billion)	447	566	580	3.3%	2.4%
	GIC (Mtoe)	89	106	111	2.8%	4.8%
	Electricity demand (TWh)	141	207	220	5.7%	6.5%
	Final energy demand (Mtoe)	64	85	90	4.4%	5.1%
France	GDP (1995 EUR billion)	1188	1401	1407	2.1%	0.5%
	GIC (Mtoe)	226	247	255	1.5%	3.1%
	Electricity demand (TWh)	343	393	408	2.2%	3.8%
	Final energy demand (Mtoe)	141	154	158	1.4%	2.5%
Ireland	GDP (1995 EUR billion)	51	92	94	7.9%	1.4%
	GIC (Mtoe)	10	12	13	2.9%	6.2%
	Electricity demand (TWh)	15	22	23	5.6%	5.5%
	Final energy demand (Mtoe)	8	11	11	4.6%	0.8%

[8] A HDD is defined as 18° C minus the daily average temperature. The number of HDD in a year is simply the sum of the daily HDD's. [9] Corrected by dividing demand by (HDD of the year / Average HDD between 1990-2001)^0.5

Table 2-11: Relative evolution of GDP and energy activity in the EU-25

					CAGR	
		1995	2002	2003	2003/1995	2003/2002
Italy	GDP (1995 EUR billion)	839	942	945	1.5%	0.3%
	GIC (Mtoe)	153	164	169	1.2%	3.1%
	Electricity demand (TWh)	238	282	291	2.6%	3.1%
	Final energy demand (Mtoe)	114	125	130	1.7%	4.0%
Cyprus	GDP (1995 EUR billion)	7	9	9	3.3%	2.0%
	GIC (Mtoe)	2	2	2	3.1%	12.0%
	Electricity demand (TWh)	2	3	4	6.3%	7.4%
	Final energy demand (Mtoe)	1	2	2	3.1%	5.5%
Latvia	GDP (1995 EUR billion)	4	6	6	6.1%	7.5%
	GIC (Mtoe)	4	3	3	-2.8%	-2.3%
	Electricity demand (TWh)	4	5	5	1.9%	6.8%
	Final energy demand (Mtoe)	4	4	4	-0.3%	2.4%
Lithuania	GDP (1995 EUR billion)	5	7	7	5.4%	9.0%
	GIC (Mtoe)	16	8	9	-6.5%	11.5%
	Electricity demand (TWh)	6	7	7	1.5%	6.7%
	Final energy demand (Mtoe)	5	4	4	-1.5%	2.5%
Luxembourg	GDP (1995 EUR billion)	14	20	20	5.0%	2.1%
	GIC (Mtoe)	4	3	3	-1.0%	-2.3%
	Electricity demand (TWh)	5	6	6	2.3%	6.0%
	Final energy demand (Mtoe)	3	4	4	2.9%	5.7%
Hungary	GDP (1995 EUR billion)	34	45	46	3.8%	2.9%
	GIC (Mtoe)	28	25	25	-1.4%	-0.9%
	Electricity demand (TWh)	28	31	31	1.6%	-0.3%
	Final energy demand (Mtoe)	16	17	18	1.5%	3.2%
Malta	GDP (1995 EUR billion)	2	3	3	2.7%	-0.1%
	GIC (Mtoe)	0.8	0.8	0.8	6.7%	5.1%
	Electricity demand (TWh)	1.3	1.9	1.9	5.0%	0.0%
	Final energy demand (Mtoe)	0.4	0.4	0.4	0.3%	0.0%
Netherlands	GDP (1995 EUR billion)	317	387	384	2.4%	-0.7%
	GIC (Mtoe)	67	75	75	1.5%	-0.2%
	Electricity demand (TWh)	83	100	100	2.4%	0.6%
	Final energy demand (Mtoe)	48	51	52	1.1%	2.8%
Austria	GDP (1995 EUR billion)	180	210	212	2.1%	0.7%
	GIC (Mtoe)	25	28	29	1.8%	1.2%
	Electricity demand (TWh)	46	55	61	3.5%	10.5%
	Final energy demand (Mtoe)	20	25	26	3.3%	7.3%
Poland	GDP (1995 EUR billion)	104	137	142	4.0%	3.8%
	GIC (Mtoe)	100	103	98	-0.3%	-5.5%
	Electricity demand (TWh)	90	96	98	1.2%	3.0%
	Final energy demand (Mtoe)	63	54	57	-1.4%	4.1%
Portugal	GDP (1995 EUR billion)	83	102	101	2.5%	-1.2%
	GIC (Mtoe)	17	21	22	3.5%	7.2%
	Electricity demand (TWh)	29	41	43	5.2%	4.1%
	Final energy demand (Mtoe)	13	18	18	4.3%	-0.2%
Slovenia	GDP (1995 EUR billion)	15	20	21	3.7%	2.5%
	GIC (Mtoe)	6	6	6	1.9%	-0.9%
	Electricity demand (TWh)	9	12	13	3.7%	6.3%
	Final energy demand (Mtoe)	4	5	5	2.3%	2.6%
Slovakia	GDP (1995 EUR billion)	15	19	20	3.8%	4.2%
	GIC (Mtoe)	21	17	17	-2.5%	-1.5%
	Electricity demand (TWh)	22	23	23	0.7%	1.1%
	Final energy demand (Mtoe)	10	11	11	1.1%	-2.9%
Finland	GDP (1995 EUR billion)	99	129	132	3.6%	1.9%
	GIC (Mtoe)	29	33	33	1.8%	1.4%
	Electricity demand (TWh)	65	80	81	2.7%	1.5%
	Final energy demand (Mtoe)	22	26	26	1.9%	0.5%
Sweden	GDP (1995 EUR billion)	190	229	233	2.6%	1.6%
	GIC (Mtoe)	47	50	51	0.9%	0.9%
	Electricity demand (TWh)	125	131	130	0.5%	-1.1%
	Final energy demand (Mtoe)	34	34	34	0.1%	0.5%

Table 2-11: Relative evolution of GDP and energy activity in the EU-25

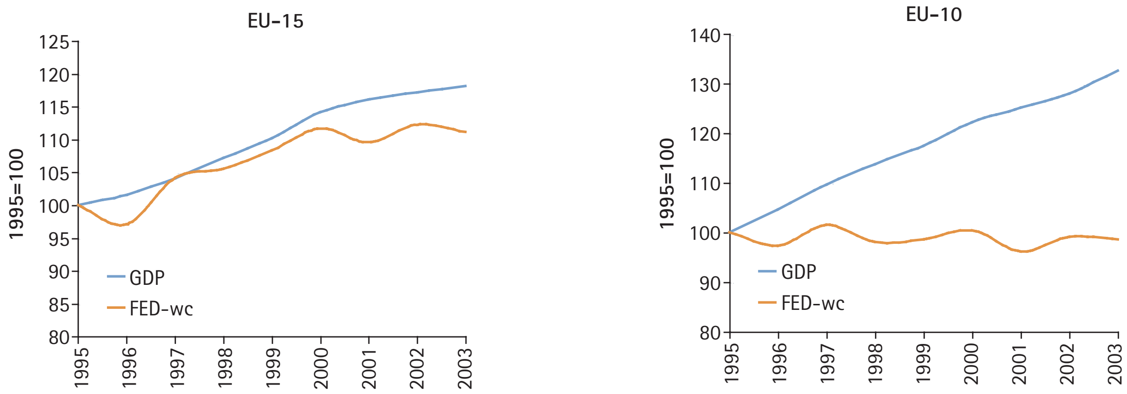
		1995	2002	2003	CAGR 2003/1995	CAGR 2003/2002
United Kingdom	GDP (1995 EUR billion)	867	1055	1079	2.8%	2.2%
	GIC (Mtoe)	211	223	230	1.1%	3.4%
	Electricity demand (TWh)	294	333	337	1.7%	1.2%
	Final energy demand (Mtoe)	142	148	150	0.7%	1.2%
EU-25	GDP (1995 EUR billion)	6822	8024	8092	2.2%	0.9%
	GIC (Mtoe)	1556	1625	1648	0.7%	1.4%
	Electricity demand (TWh)	2184	2541	2612	2.3%	2.8%
	Final energy demand (Mtoe)	1027	1100	1132	1.2%	2.9%

Source: Eurostat

Figure 2-22: Correlation of FED and climate in the EU

Source: Global Insight and Eurostat

Figure 2-23: Coupling and decoupling of energy (weather-corrected) and economic indicators in the EU



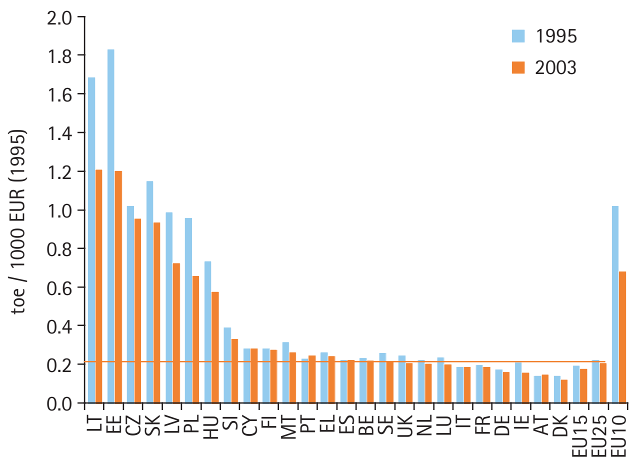
Source: Global Insight and Eurostat

4.2.1.1. Intensity

Energy intensity is measured in the number of energy units consumed per unit of economic output (GDP). This broad indicator reflects a series of factors, including changes in the technical efficiency of energy use, productivity increases and structural changes such as re-location of production or sector re-composition.

Between 1990 and 2003, the most significant intensity reductions occurred in the EU-10, mainly in the three Baltic States, Poland Slovakia; not surprisingly though, as these countries also happened to exhibit the highest intensities in absolute terms. Their large reductions, which in the cases of Lithuania, Estonia, Latvia and Poland averaged an impressive 4-5%/year between 1990 and 2003, occurred mainly from the combination of growing economic output, the rationalisation of consumption by the transition to market economies, and the shut down / replacement of inefficient soviet-era coal power plants. Within the EU-10, the only country that did not experience significant improvement is its intensity was the Czech Republic. For the aggregate EU-10, energy intensity passed from 1.02 toe/1000 EUR (1995) to 0.67 toe/1000 EUR (1995), a 33% decrease.

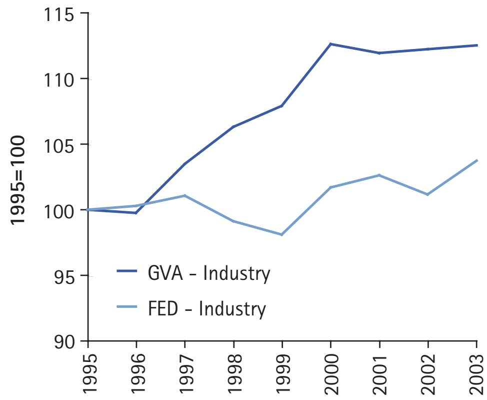
Figure 2-24: Energy intensity in the EU-25



Source: Eurostat

In 2003, aggregate intensity for the EU-15 countries was 0.18 toe/1000 EUR (1995), down by 7.8% from 0.20 toe/1000 EUR (1995) in 1990. The largest intensity enhancements among this group of countries occurred in Ireland, the UK and Sweden, which reduced their intensities by more than 2.0%/year over the period. Indeed, energy intensity was much lower in the more modern EU-15 relative to the EU-10, reflecting both higher efficiency levels as well as a more services-orientated, less manufacturing-intensive economy.

Figure 2-25: Decoupling of gross value added (GVA) and FED in the EU-25's industrial sector



Source: Global Insight and Eurostat

Contrary to the EU-10, where all countries witnessed reductions in their energy intensity, some Member States in the EU-15 actually saw their intensity grow between 1990 and 2003. Such is the case for Austria, Portugal, Spain and Greece. Especially in the latter three countries, economic growth fuelled by the expansion of energy intensive industries and manufacturing contributed to the increase in intensity.

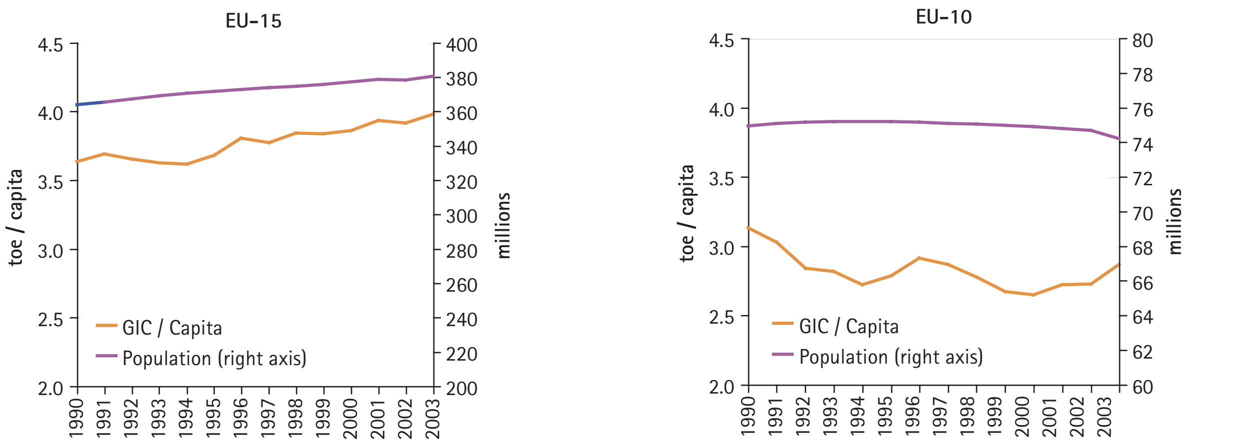
The decoupling of industrial activity and energy consumption in the EU-25, which contributes to the reduction of intensity, is shown in Figure 2-25. The figure presents the relative evolutions of gross value added (GVA) of industry and final energy demand from that sector.

4.2.1.2. GIC per capita and behavioural changes

Very distinct demographic trends were observed between the EU-10 and the E-15. In the former set of countries, the number of deaths have been outpacing births, contributing to a net decrease in population of about 0.1%/year between 1990 and 2003. The trend has accelerated in recent years and between 2002 and 2003 population in the EU-10 contracted by 0.6%. This demographic trend, along with GIC declining at a slightly faster rate (0.8%/year) resulted in a generally decreasing GIC per capita over the period, However, the trend seems to reverse from 2000 onwards, where increases in energy demand are more than compensating the slump in population growth.

In the EU-15 on the contrary , the demographic trend was upward sloping, with population expanding by 0.3%/year between 1990 and 2003. With GIC growing slightly faster (1.0%/year), the EU-15 has seen its per capita GIC expand over the period.

Figure 2-26: Per capita energy consumption in the EU-25



Source: Global Insight and Eurostat

4.2.2. Transport drivers and indicators[10]

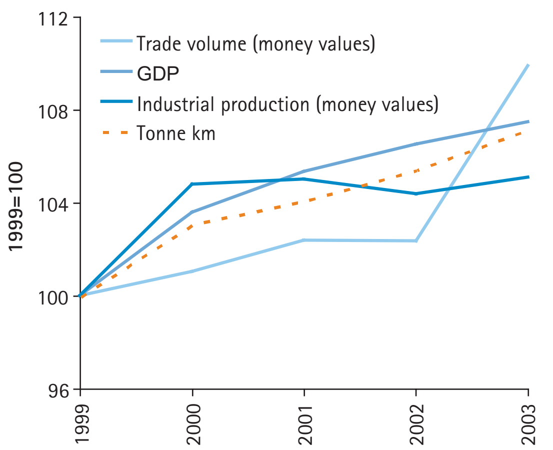
4.2.2.1. Freight transport

Freight transport plays a key role in modern production processes. The concept of 'just-in-time production' replaces the requirement for storehouses on site. 'Day-to-day deliveries' guarantee high flexibility while low transport costs support continuing international diversification of production. In general, new production processes that demand more flexibility, have developed alongside an increased number of light goods vehicles. Net effects in terms of tonne-km are not clear. In one respect longer distances and more frequent trips point to increases in freight transport, whilst, decreasing volumes per trip partly offset this.

These effects differ significantly by industry, and so transport trends are often related to more general economic indicators. Most prominent examples are GDP, industrial production and trade volumes. Figure 2-27 gives a first overview of these indicators' trends within the enlarged EU between 1999 and 2003.

> The key role of GDP

Figure 2-27: Recent trends of GDP, industrial production, trade volume and tonne-km, EU-25, 1999-2003



Interestingly, freight transportation follows trends in GDP rather than industrial production or trade volumes. However, this general rule does not apply for all Member States. Figure 2-28 shows, that some countries experienced relatively strong increases in freight transportation but comparably low increases in GDP (or vice versa) in recent years. In order to illustrate these trends, transport and economic performance are each subdivided into three groups – low, average and high growth between 2000 and 2003.

Blue coloured countries experienced reduced tonne-kilometres between 2000 and 2003. However, these trends are weak and might be not be continued. Over a period of ten years, tonne-kilometres clearly increased for all EU-15 Member States. Due to limited data availability concerning road haulage, the longer-term trend is not clear for most of the new Member States.

With the exception of Belgium, Denmark and The Netherlands, Member States listed alongside or above the diagonal, show clear correlation between real GDP growth and transport performance.

Figure 2-28: Development of GDP and freight transport performance between 2000 and 2003.

Increase of transport performance (tkm)			
High	Portugal	Czech Republic, Spain, Luxembourg	Greece, Estonia, Ireland, Latviz, Lithuania
Average	EU 15, Austria, Germany, Italy	EU 25, Sweden, United Kingdom	Cyprus, Slovak Republic
Low	Belgium, Denmark, Malta, The Netherlands	Finland, France, Poland	Slovenia, Hungary
Growth of GDP	Low	Average	High

[10] *The source for this section is EC, Energy and transport in figures 2004, unless otherwise stated.*

In contrast, decoupling trends can be identified for countries listed in the three boxes below the diagonal, as well as for Belgium, Denmark and The Netherlands. Again, the stability of these trends is not yet evident.

Coupling trends are particularly evident for the EU-15 member States. However when compared to the EU-25, some of these countries show relatively small growth rates in terms of GDP. Therefore, coupling does not necessarily point to large increases in transport performance. Current transport intensities, measured in tkm per 1000 Euro GDP, are clearly higher for the majority of the new Member States. This allows for more significant gains in efficiency, which may lead to decreasing intensities over time. Figure 2-29 gives an insight into current transport intensities. While data on inland transport was available for all countries, necessary estimations concerning sea transports are based on intra-EU trade flows.

Intensities appear to be independent of country size. Although France and Germany take the lead, the economies of Denmark and Austria are also characterised by low intensities. Instead intensities relate to the countries' industrial structure, the hauliers' logistic concepts and the structure of trade flows.

> International trade flows

As well as GDP and industrial production, trade flows have become more and more important in recent years. Figure 2-30 shows that trade volumes (exports plus imports) of smaller countries easily exceed domestic production (GDP). The trade volumes of France, Italy, Germany, Spain and the United Kingdom are reviewed in more detail later in this document.

Due to relatively good data availability, trade flows as measured by their monetary value are often used as a first indicator for transport developments. However, effects on freight transports in particular derive from the physical flows. Figure 2-31 shows that the parameter used is of particular importance for the derivation of modal shares.

When considering trade volumes in monetary values, road transport is clearly most important. Maritime transport have a share of about 30% and interestingly, air transport clearly exceed rail transport. When measuring physical trade flows, maritime and rail transport as well as inland waterways increase in importance. The significant difference in modal shares, points to the different markets served by the each mode. While air and road transport focus on high value goods, inland waterway, maritime and rail transports primarily serve the market of comparably low value, bulk and intermediate goods. This in turn leads to relatively small transported values per tonne or per tonne-kilometres, especially as inland waterway, sea and rail transports cover on average higher distances compared to road services. Figure 2-32 compares modal shares of trade volumes measured in monetary value with related tonne-kilometres for France, Germany, Italy and Spain. Due to limited data availability of average distances of air transport, the comparison focuses on road, rail, sea and inland waterway transports. Due to its geographical character, trade flows of the United Kingdom relate exclusively to sea shipping or air transports. Road, rail and inland waterway transports are not important in this context. In monetary value air transport is only slightly behind sea shipping. However, in physical terms maritime transports are far ahead.

Figure 2-29: Freight transport intensities in the EU-25, 2003

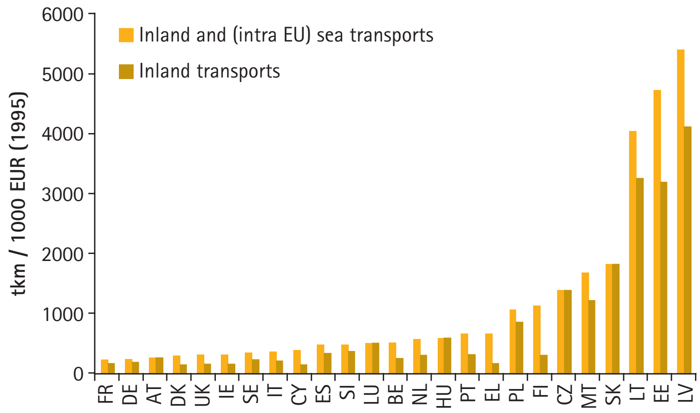


Figure 2-30: GDP and trade flows in the EU-25 (2003)

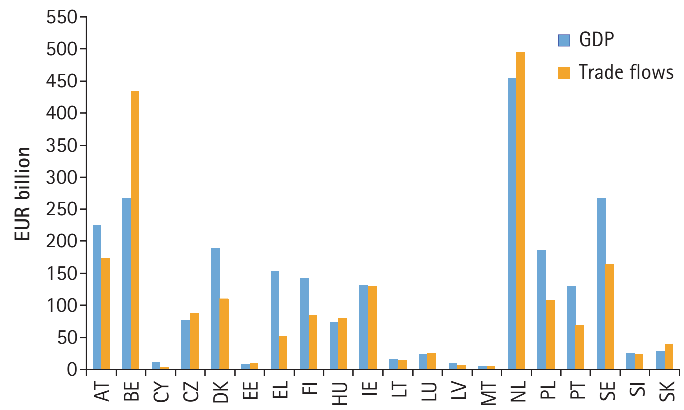


Figure 2-31: Trade flows in physical and in monetary terms, intra and extra EU trade in the EU-25 (2003)

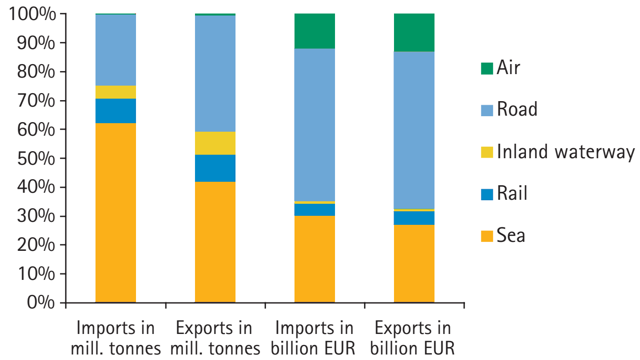
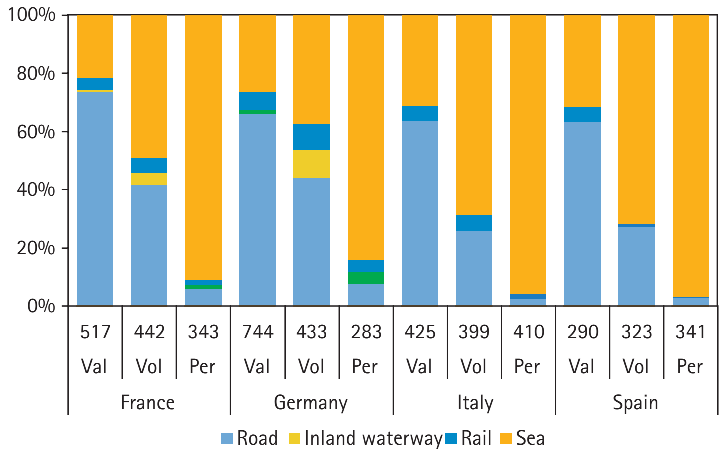


Figure 2-32: Trade flows in values, volumes and transport performance (2003)*



** Values in EUR billion, volumes in million tonnes, performance in billion tkm*

It can be concluded that increasing trade flows certainly stimulate freight transport. But in order to estimate the effects on transport performance, trade flows as measured in monetary value as well as volume, modal split and average distances must be taken into account.

4.2.2.2. Passenger transport

While freight transport is mainly analysed in relation to economic trends, passenger transport is much more related to population. Therefore variables such as population growth, ageing of the society or changing life styles are of higher relevance than increases in industrial production. In contrast to the industrial production, where limits to growth have been regularly overcome by technological changes, the "production" of daily activities is strictly limited by a constant time budget of 24 hours. With regard to transport activities, personal mobility time has remained stable at about 80 minutes per person per day since the 1960s. This in turn highlights the fact that increases in passenger transport performance are not driven by increases in travel time but rather by higher travel speed which allows for covering longer distances in the same time.

Though the limitations on time available for mobility can be considered the most important constraint on passenger transport demand, other constraints need to be considered. In particular, economic and biological factors become more significant. Since transport demand from senior citizens differs significantly from the demand from younger generations, the ageing of the European population - the biological factor - will affect passenger transport in the future. However, net effects are not yet clear. On the one hand, commuting transport will decline but on the other hand transport related to leisure activities is expected to increase. Also, economic factors affect people's mobility pattern. In general greater wealth stimulates transport demand. In contrast, higher energy prices which are transferred to the consumer hamper transport activities.

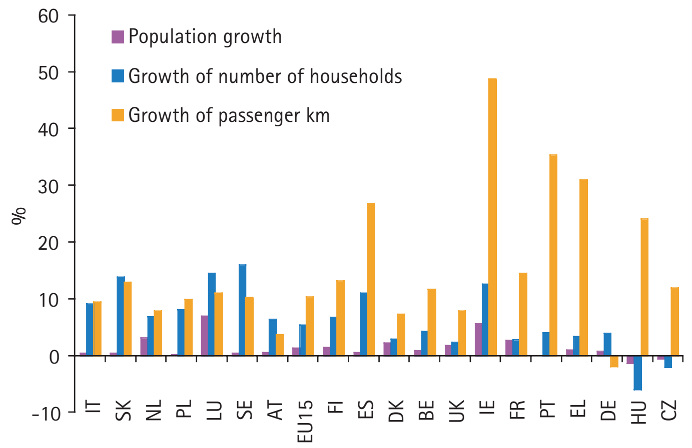
> Demographic drivers

Population growth generates increasing passenger transport demand. In fact, strong population growth, which can be observed in several metropolitan areas within the EU-25, results in constraints on transport supply, which in turn leads to severe congestion and air pollution. Consequently various incentives are adopted by the public authorities to decrease demand for transport or at least to shift demand to public transport.

At a national level, however, the relevance of population growth has been limited in recent years. In fact hardly any member state has experienced major increases in population. However, there was significant growth in the number of households, which can be considered a strong driver of passenger transport. Figure 2-33 compares the growth of population, number of households and transport passenger performance for 19 member states.

For seven members, namely Italy, Slovak Republic, the Netherlands, Poland, Luxembourg, Sweden and Austria, changes in the number of households can be identified as an important driver of passenger transport. Positive impacts, to a lesser extent, can be identified for Finland, Denmark, Belgium, United Kingdom, Ireland, France, Portugal and Greece. In contrast, Germany, Hungary and the Czech Republic have shown opposite trends of passenger transport performance and household structure.

Figure 2-33: Growth of population, number of households and passenger transport performance in the EU-25

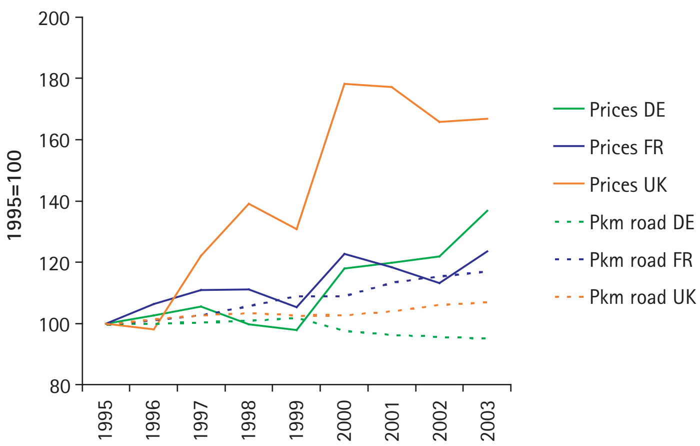


In fact small positive or even negative correlations point to the existence of other important drivers.

> Economic drivers

The population's mobility patterns are firstly limited by time constraints. However, economic factors, such as personal income or petrol prices, can further intensify or lessen time restrictions.

Figure 2-34: Development of petrol prices and road transport performance between 1995 and 2003



Many factors, including geopolitical instability (e.g. the Iraq war and the threat of terrorism), supply bottlenecks (e.g. in US refineries) and lack of spare capacity in the main producing countries have contributed to shortages in global oil and petrol production. Simultaneously, the economic awakening of Asia's largest countries – China and India – has further increased demand for oil. As a result, oil and petrol prices have strongly increased. National tax regulations, such as eco-taxes, have strengthened that trend. Despite that, the trend of growing individual road transportation continues in most Member States. This points to low price elasticities, at least in the short run. Figure 2-34 shows the development of petrol prices and of road passenger transport in the Union's largest economies: France, Germany and United Kingdom.

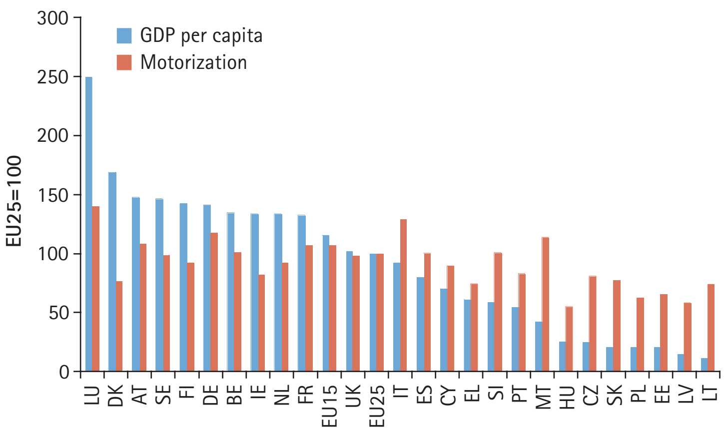
In France and the United Kingdom road transport performance has increased in spite of higher fuel prices. In fact, a parallel increase of petrol prices and individual road transport has been observed for most Member States. For some countries, namely Austria, Denmark, Hungary and Slovenia, stagnating road transport performances can be found. Only Germany and Italy show clear opposite trends. Due to weak data availability, the situation for the Baltic States is not clear.

Increasing petrol prices clearly affect consumers from a psychological point of view. Prices above 1 Euro or even 1.50 Euro per litre make people angry – regardless of their income. Changing mobility patterns, however, can only be expected if a) real income increases cannot compensate for price increases and b) changes can be performed easily.

The ease with which changes can be performed is difficult to measure. When analysing the performance of public transport, the development was similar for France, Germany and the United Kingdom, which all showed slightly increasing trends in terms of bus and rail transportation. However, the very recent trend in Germany was negative for rail transport as well, i.e. there is hardly any shift between modes.

In fact, real income increases, measured in GDP per capita, have been quite different for EU members in recent years. Figure 2-36 clusters Member States and the aggregates EU-25 and EU-15 according to their income increases and their passenger transport performance (road and rail). The development of the Baltic States' transport performance is based on data on rail passenger km and trends in motorization (number of cars per 1000 inhabitants). Countries in red were characterised by income decreases in real terms. "Blue" countries showed decreasing passenger transport performances.

Figure 2-35: GDP per capita and level of motorization (number of cars per 1000 inhabitants)



All countries listed alongside the diagonal boxes show very similar trends of passenger transport performance and real income increases. Small increases in terms of passenger-km, for example, can be explained by relatively small increases in real income for Austria, Denmark, Germany, Luxembourg and The Netherlands. In contrast Portugal and France show relatively strong increases in passenger transport, despite modest development of real incomes. Greece and Ireland can be considered outstanding performers in both categories. Starting from relatively low level of GDP per capita, Eastern and Central European countries have experienced strong increases in GDP per capita. However, increases in transport performance are average or even low.

In summary, increases in transport performance can be explained by the aim to reach a certain level of mobility. While countries above this level react rather sensibly to economic trends (e.g. "low-low" country group in Figure 2-36), countries below this level might want to catch up rapidly, regardless of their economic performance. This behavioural pattern can particularly be observed in terms of motorization. Figure 2-35 shows that the highest and lowest GDP per capita among Member States differs by a factor of 15. In contrast the highest and lowest level of motorization only vary by a factor of 2.5. (Both factors refer to the second highest performance and do not account for the levels found in Luxembourg).

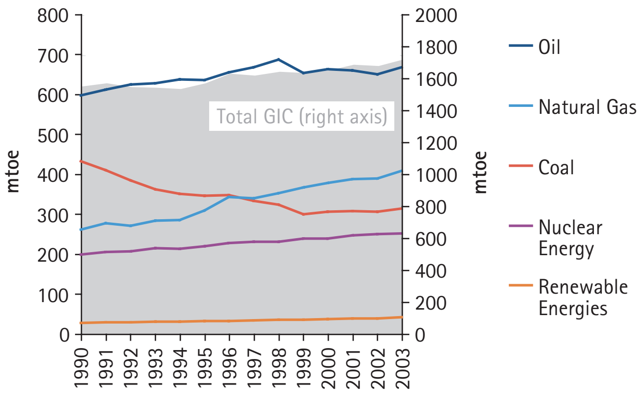
Figure 2-36: Development of income increases and passenger transport performance between 2000 and 2003.

Increase of transport performance (pkm)			
High	France, Portugal	Finland, Poland, Spain, Sweden, United Kingdom	Greece, Ireland
Average	Belgium, Malta	EU 25, EU 15, Cyprus	Czech Republic, Hungary, Latvia, Slovak Republic
Low	Austria, Denmark, Germany, Luxembourg, The Netherlands	Italy	Estonia, Lithuania, Slovenia
	Low	Average	High — Growth of GDP/capita

4.3. Activity trends

4.3.1. Gross inland consumption (GIC)
With the expansion to 25 members in 2004, the EU has confirmed its place as the second largest energy-consuming region in the world, after the United States. In absolute terms, the demand for primary energy (GIC) in the EU-25 grew at an average annual rate of 0.8% between 1990 and 2003, with the volumes consumed accelerating in recent years: The CAGR of total GIC rose to 1.4% between 2000 and 2003, and GIC reached a volume of 1726 Mtoe in 2003, a 2.5% increase with respect to the previous year.

Figure 2-37: GIC by source in the EU-25



Source: Eurostat

Oil remains the EU-25's main source of primary energy, for which demand continued to expand as a result of the ever-growing use of road transport and despite a move away from oil and towards natural gas in other sectors. In 2003, the EU-25 consumed 666 Mtoe of oil, representing more than 38% of its total primary energy requirements. Although average demand for oil had been relatively flat over the past few years, growing at around 0.8% per year between 1990 and 2003, and by a mere 0.3%/year between 2000 and 2003, it surged in 2003, growing 2.6% with respect to the previous year. Natural gas continues to be the second largest and one of the fastest growing components of the EU's primary energy portfolio. GIC of gas reached 408 Mtoe in 2003, a 4.9% increase relative to 2002 and representing almost 24% of total GIC in that year. Primary demand of natural gas has grown by an average 3.5%/year since 1990 and by an average 2.7%/year since 2000. The third largest component of GIC in 2003 was nuclear energy, which at 251 Mtoe represented less than 15% the EU-25's total primary energy requirements. Higher utilisation rates, better efficiency and growing capacity in the nuclear sector (see section 5.2.1.2) has allowed consumption to rise in 2003 by 1.0% with respect to previous year. Primary demand of hard coal and lignite (represented as "coal" in the figure) rose to 314 Mtoe in 2003, or 18.2% of the EU-25's total GIC. Although the intake of these fuels had declined steadily over the decade, the demand for hard coal grew in 2003 for the first time since 2000 (4.1% relative to 2002).

The highest growth rates of GIC of primary energy were observed in renewable sources (hydropower, wind & solar energies and bio-mass & wastes). Between 1990 and 2003, primary consumption of these energies grew by an average 3.4%/year. More recently, consumption has been accelerating: Whereas the CAGR between 2000 and 2003 was 3.6%, that rate more than doubled between 2002-2003 (8.4%). At 103 Mtoe, primary consumption of renewable energies represented in 2003 some 6.0% of total GIC.

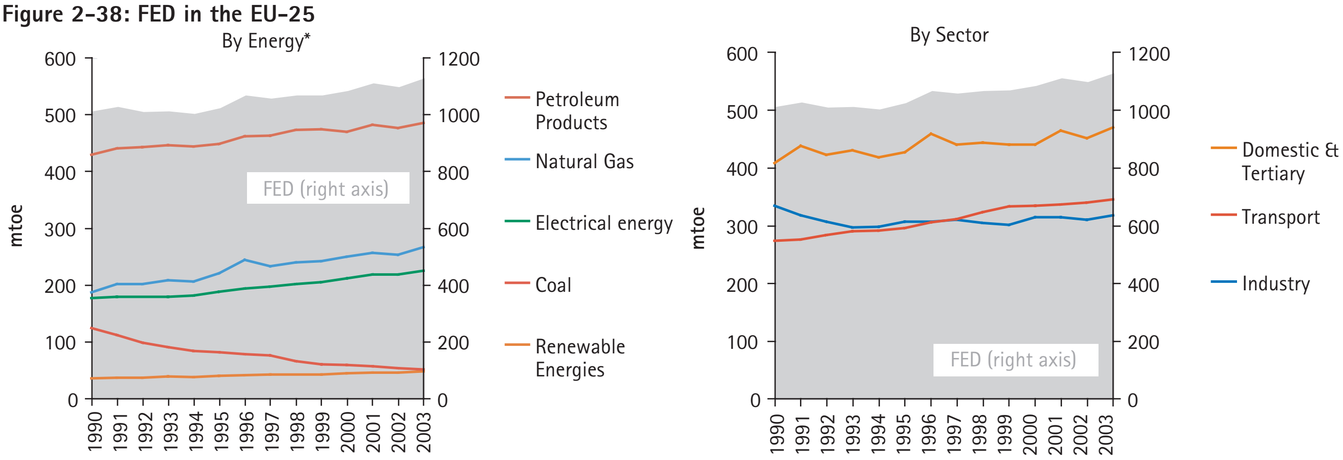
At a Member State level, the breakdown of primary energy consumption varied widely. The most significant extremes were France and Lithuania, which derived more than 40% of their primary energy supplies from nuclear energy in 2003; the oil-intensive economies of Greece, Lithuania, Netherlands and Croatia, where that fuel represented more than 60% of their total GIC for the same year; and the Netherlands and the U.K., where natural gas covered over 37% of their primary energy requirements in 2003. Austria, Latvia, Austria, Finland and Sweden shone by the high share (20% or more) of renewable energies in the primary energy mix –due in most cases to their natural endowment of hydraulic power.

4.3.2. Final energy demand (FED)
The households, commerce and tertiary sector represents the bulk of final energy demand in the EU-25. FED from the domestic and tertiary sector rose to 470 Mtoe, or more than 41% of total final demand in 2003. The second major component of FED was final demand from transport, which represented 30% of the total in the same year (344 Mtoe). FED from industry, which was 317 Mtoe in 2003, accounted for 28% of the EU-25's total. An additional 101 Mtoe were consumed by industry for non-energy uses such as feedstock.

The share of petroleum products in the final energy demand energy is largely dependent on the importance of road transport and the degree of motorization within the economies. As such, FED for petroleum products in the more developed EU-15 Member States represents more than 40% of total FED, with the exception of the Netherlands, Finland and Sweden. In contrast, the share of demand for oil products in EU-10 Member States only exceeds the 40% mark in Cyprus and Malta (due to their large maritime freight industries) and in Slovenia. Indeed, the share of petroleum products in the EU-15's FED in 2003 was 44.7%, while it was 28.5% for the EU-10. At the aggregate EU-25 level, oil products accounted for almost 43% of FED in 2003.

Segmented by energies, the second major component of FED was natural gas, whose share in 2003 was 24.3% (272 Mtoe) of the EU-25's total. In Italy, Hungary, the Netherlands, Slovakia and the U.K., FED of natural gas presented a market share above 30%. At the other end of the spectrum, gas's share of FED was less than 5% in Greece, Cyprus, Malta, Finland and Sweden. FED of electricity ranked third in the EU-25's FED mix, representing nearly 20% (225 Mtoe) of total FED in the same year. FED of electricity accounted for more than 15% of the total in all of the EU-25's members, with the exception of Latvia, Luxembourg, Poland and the Netherlands. Electricity's share of FED was highest in Malta, Finland and Sweden, where it respectively attained more than 25% of the total in 2003. Taken together, the remaining sources of energy (solid fuels, renewable energies, derived heat and industrial wastes) accounted for around 13% of final energy demand in the EU-25 in 2003, although this share was 10% in the EU-15 and 33% in the EU-10. Their high share in the latter group of countries is largely a result of the significant share of coal (15%) and derived heat (11%) in the final energy mix. In Poland and the Czech Republic, some of the heaviest consumers of solid fuels in the EU-25, the share of that energy in their FED exceeded 17% in 2003. Estonia, Latvia, Finland, Sweden stood out by the high share of renewable energies in the FED mix (15%). The share of renewables was under 1% in Luxembourg, Malta, the Netherlands and the UK.

Figure 2-38: FED in the EU-25



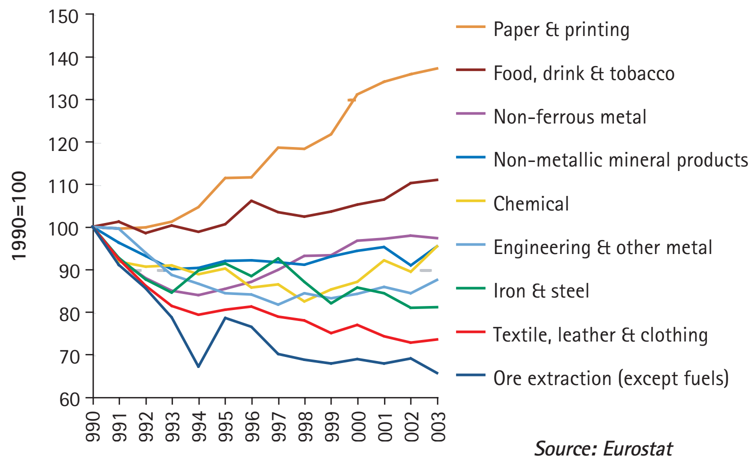
** due to their small volumes, industrial wastes have been purposely left out.*
Source: Eurostat

4.3.3. FED: Industry

FED from the industrial sector has experienced two countervailing trends over the past few years. In the EU-15, industrial FED has grown less than proportionally to GDP, at an average 0.6%/year between 2000 and 2003. On the other hand, final demand from industry in the EU-10 has been declining by around 0.8%/year, on average, with GDP growing faster here than in the EU-15 (see section 4.1). The structural changes that took place in the EU-10 following the post-Soviet era are particularly striking in this sector: FED from industry declined by 4.2%/year between 1990 and 2003, making industry's share in total FED drop from 44% in 1990 to just under 31% in 2003. In the EU-15 the share of industry in FED also fell, albeit less impressively, respectively passing from 31% to 28% in 1990 and 2003.

The evolution of FED from the EU's different industrial sectors exhibits a wide range of paths, clearly indicating the region's move towards a more services-orientated economy through relocation of certain industries outside the EU, through the growth of higher value added, less energy intensive industry, but also increases in technical efficiency. For instance, the highest demand growth came from the paper and printing, and the food and tobacco industries, with consumption growing by almost 40% over the period in the case of the former. On the other hand, heavy and labour-intensive industries such as ore extraction, iron and steel and textiles have been reducing their demand for energy.

Figure 2-39: Final energy demand in the EU-25's industrial sectors



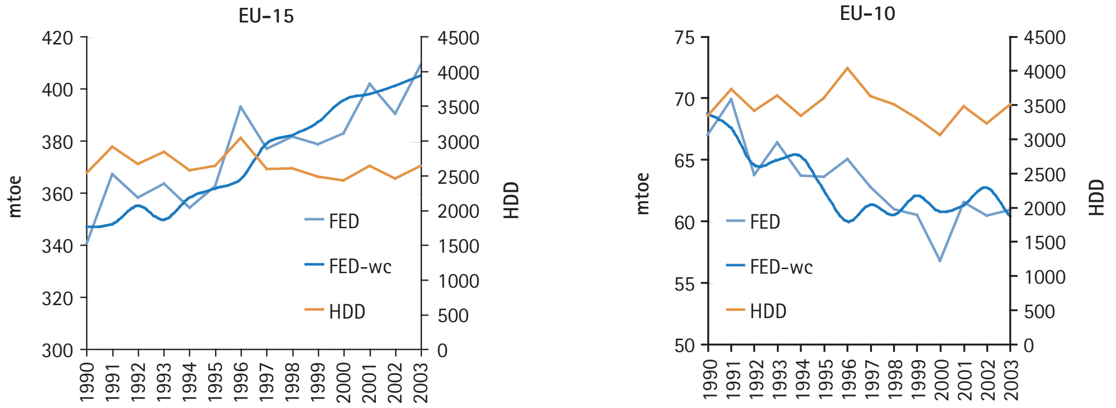
Source: Eurostat

With regard to the fuel mix, the use of solid fuels and crude oil and petroleum products in the industrial sector declined steadily between 1990 and 2003, with average annual reduction rates of -4.7% and -0.9%. Conversely, final industrial demand of gas and electricity each grew over the same period by about 1.1%/year, with industrial demand for these energies passing from respectively accounting for 9.2% and 7.8% of total FED in 1990 to 9.5% and 8.2% in 2003.

4.3.4. FED: Households and tertiary

Since a large part of its demand is driven by energy consumption for space heating, FED from the households and tertiary sectors is directly linked to weather conditions. Their high correlation is illustrated in Figure 2-40, where the peaks and troughs of heating degree days (HDD) accurately correspond to those in FED. Thus, in weather-corrected terms, two distinct trends of FED (FED-wc in the figure) from this sector arise in the EU-15 and the EU-10. In the former, FED from the households and tertiary sector presented a clearly upward sloping trend. Indeed, the flat demand, in absolute terms, over the 1997-2000 period was actually expanding, in weather corrected terms, as warmer than average temperature (i.e. lower HDD) required less heating. Similarly, the absolute demand spike in 2001 in the EU-15 was actually the result of a slightly colder year. In the EU-10 on the contrary, demand from the households and tertiary sectors presented a less clear trend. In the period between 1990 and 1996-97, demand was clearly declining, as expected from the rationalisation of consumption that followed the major reforms of the first half of the 1990s in those countries. From 1996-1997 onwards, FED from the domestic and tertiary sectors in the EU-10 has been relatively flat, with variations owing more likely to other drivers such as economic conditions. The largest component of FED from this sector was natural gas, which at 103 Mtoe represented in 2003 almost 15% of total FED in the EU-25. Gas demand from this sector has been growing healthily, averaging 3.1%/year between 1990 and 2003. That rate grew to 3.5%/year from 2000 onwards. Roughly the same trends were observed between the EU-15 and the EU-10 over the period, although gas demand has been growing much more rapidly in the latter group over the past few years (around 5.7%/year since 2000 compared to 3.3%/year for the EU-15) as a result of higher penetration rates and from the relative price effect of substitutable fuels (mainly electricity).

Figure 2-40: Households & tertiary final energy demand



Source: Eurostat

Electricity and oil products were the second and third largest components of demand from this sector, with 11% and 9%, of total FED, respectively. Their average annual growth rates between 1990 and 2003 were 2.4% for electricity and -0.5% for oil products. It is worth noting at this point that the trends of demand from this sector were similar in the EU-15 and the EU-10 for all fuels except oil products. Indeed, whereas demand for gas, electricity, solid fuels, renewable energies and heat moved in the same direction in the two groups of countries, demand for oil products receded in the EU-15 whilst in expanded in the EU-10. In the case of the EU-15, this is due to the replacement of heating oil for gas and electricity in many places. In the EU-10, where gas networks have reached less penetration, the demand for petroleum products from this sector continues to grow.

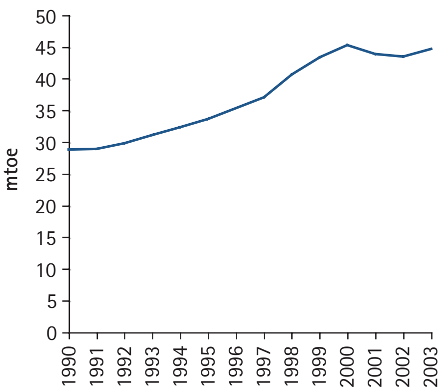
Good growth was also observed in demand for renewable energies, which represented 2.4% and 5.0% of total FED in the EU-15 and EU-10,respectively. In fact, demand for these sources in the EU-25's domestic and tertiary sector grew between 2000 and 2003 at the same annual growth rate as the highly dynamic gas demand (i.e. 3.5%/year).

4.3.5. FED: Transport

Due to growing motorization and a net population increase in the EU-25, the transport sector presented the most dynamic growth of final energy demand. Between 1990 and 2003, the average annual growth rate for both the EU-25 and the EU-15 was 1.8%, and was an impressive 2.5% for the EU-10. The different speeds of growth are partly explained by differing degrees of motorization and road freight performance in the economies. In the EU-10, final demand for transport use in 2003 only represented 22% of total FED whilst that share was 32% in the EU-15. FED for transport accounted for 30% of the EU-25's total in that same year.

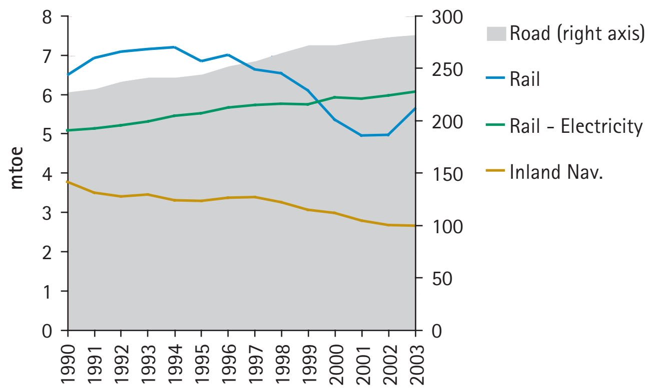
On a fuel by fuel basis, petroleum products are the single largest component, representing 97.5% of FED from the transport sector and almost 30% of total FED in the EU-25. As a result of the recent introduction of bio-fuels and other renewable energies in the transport sector, the share of petroleum products has very slowly started to recede: It passed from 97.9% in 2000 to 97.5% in 2003. Indeed, demand for renewable energies for the transport sector grew considerably by an impressive 73.2%/year between 1990 and 2003, although demand for this type of energy is still very low, representing only 0.6% of total FED from transport in 2003. Electricity demand was the second largest component in 2003, representing 1.8% of total FED for transport and used mostly in the rail sector. Demand growth for this energy has been modest, averaging 1.4%/year between 1990 and 2003. Despite a very small share of the total (0.1%) gas has also presented good growth levels, averaging 6.1%/year over the period.

Figure 2-41: FED of oil products for air transport in the EU-25



Source: Eurostat

Figure 2-42: FED of oil products and electricity for land transport in the EU-25



Source: Eurostat

4.4. Energy and transport in the context of the economy

- On a pre-tax bases, FED represented an estimated 4.2% of the EU-25's GDP in 2003. When taxes are accounted for, FED's share of GDP rises to 6.2%.
- Growing fuel prices have contributed to increase the share of FED in GDP.
- Estimates suggest that the transport sector represented between 6% to 8% of GVA.
- Transport services account for approximately 4.5% of the overall GVA including auxillary transport services in former EU-15 Member States. With regard to the EU-10 shares are significantly higher and range between 6% and 15%.
- The total number of employees in the transport services sector and auxillary transport services amounts to approximately 7.5 million persons.

As fundamental contributors to the economy, energy and transport demand are strongly correlated to the level of economic activity. This section highlights this relationship, and presents other factors that may induce demand to develop either faster or slower than developments in GDP.

4.4.1. Value of final energy demand and energy taxes in the EU-15[11]

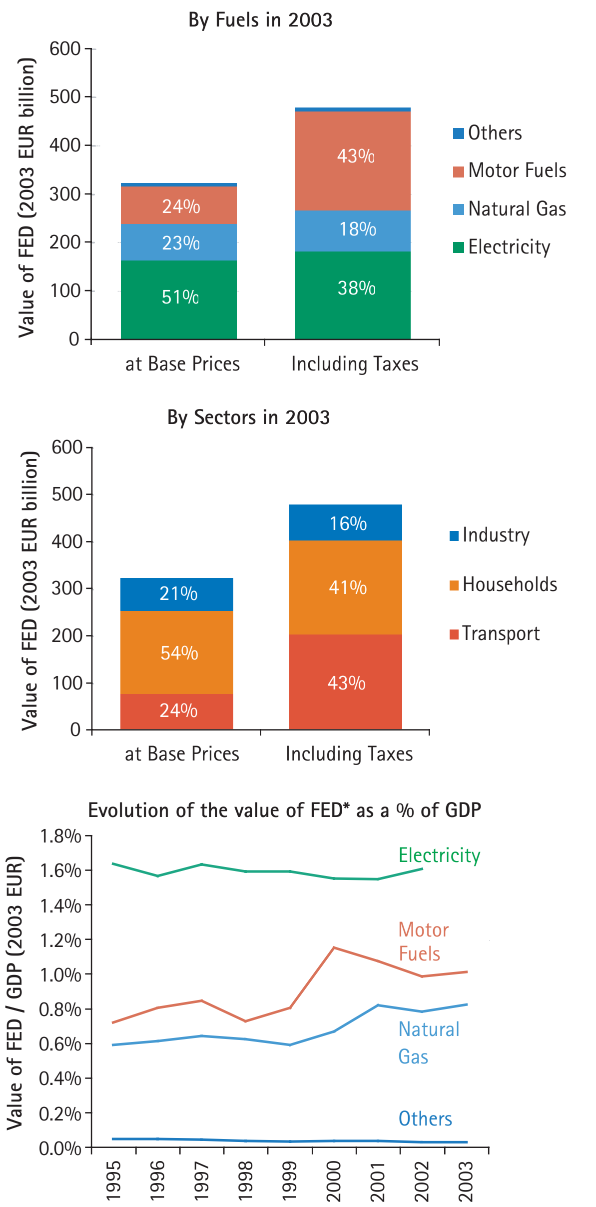
As the European economy becomes more services orientated, as motorization grows, and with the surge in fuel and electricity prices, the value of FED as a percentage of the EU-15's GDP has been growing. When evaluated at demand-weighted base prices (i.e. excluding taxes and VAT), the value of FED rose from 3.1% of GDP in 1995 and 3.7% in 2000, to 4.2% in 2003. Indeed, the value of final energy demand in the EU-15 was more than EUR 323 billion, the larger part of which was attributable to consumption of electricity, which represented a growing proportion (50.5% compared to 48% in 2001) of the total value of FED. The remaining half was nearly evenly distributed between the value of demand for motor fuels –gasoline and diesel–stable at 24% and natural gas with 23%.

Once taxes and VAT are included, the value of FED represented about 6.2% of the EU-15's GDP in 2003, or some 480 EUR billion. Mainly as a result of the high excise taxes levied on motor fuels across Member States (nearly 60% of the value of FED of motor fuels at final prices corresponded to taxes), the share distribution varied significantly compared to the pre-tax level. Taxes boosted the value of motor fuels to 43% of the total value of FED on a final price basis, with electricity dropping to 38% and natural gas to 18%. In fact, the value of taxes on motor fuels represented 81% of the total taxes levied on final energy consumption in the EU-15 in that year. Taxes on electricity were up to 12% of total taxes levied whilst taxes on natural gas were just under 7%. Taken together, levies on final energy demand rose to EUR 156 billion or 2.1% of the EU-15's GDP in 2003.

The evolution of FED value as a percentage of GDP across different energies was mixed. Declining fossil fuel prices over the 1995-1999 period, accompanied with good economic growth saw the value of FED for electricity and gas as a percentage of GDP remain relatively stable. From 2001 onwards, however, the deceleration of economic activity combined with the upwards trend in energy prices resulted in an increasing share of the value of electricity and gas FED in GDP. On the contrary, the share of the value of FED for motor fuels exhibited a generally upward sloping trend.

The value of FED at base-prices as a percentage of GDP also varied significantly across Member States. Among the countries considered, Italy was the country with the highest ratio in 2003, with FED representing 6.6% of GDP. In the same year, the indicator took the lowest value in Austria and France, where it failed to exceed the 4% mark.

Figure 2-43: Value of final energy demand in the EU-15



** excluding all taxes, weather corrected*
Source: Global Insight, Eurostat and IEA

[11] Due to data gaps in fuel prices for several EU-10 countries, analysis has been limited to the EU-15.

Table 2-12: Value of final energy demand in the EU-15 (2003)

2003 EUR million	FED at Base Prices (1)	% of Total Value	Excise Taxes & VAT (2)	% of Total Value	FED at Final Prices (1)+ (2)	% of Total Value
Electricity	163341	50.5%	18120	11.6%	181461	37.8%
Households	115956	35.8%	12733	8.2%	128688	26.8%
Industry	47386	14.6%	5387	3.5%	52773	11.0%
Motor Fuels for Transport	78622	24.3%	126310	81.0%	204933	42.7%
Gasoline	35665	11.0%	67766	43.4%	103431	21.6%
Diesel	42958	13.3%	58544	37.5%	101502	21.2%
Natural gas	75147	23.2%	10413	6.7%	85559	17.8%
Households	58789	18.2%	9057	5.8%	67845	14.1%
Industry	16358	5.1%	1356	0.9%	17714	5.5%
Others	6598	2.0%	1172	0.8%	7770	1.6%
Households	1510	0.5%	284	0.2%	1793	0.6%
Industry	5088	1.6%	888	0.6%	5976	1.8%
Total Value of FED	323708	100.0%	156015	100.0%	479723	100.0%
% of GDP	4.2%		2.0%		6.2%	

Table 2-13: Value of FED (excluding taxes) as a % of GDP in selected EU-15 countries

	1995		2000		2003	
2003 EUR	Value of FED	% of GDP	Value of FED	% of GDP	Value of FED	% of GDP
Austria	5410	3.01%	6170	3.00%	7754	3.66%
Belgium	8517	4.03%	12082	4.99%	13054	5.26%
Finland	4087	4.12%	5452	4.36%	6967	5.29%
France	36736	3.09%	50246	3.71%	54164	3.85%
Germany	58917	3.13%	71460	3.48%	87675	4.23%
Greece	2630	2.93%	5090	4.78%	6175	5.14%
Ireland	1974	3.88%	3552	4.37%	4553	4.87%
Italy	32601	3.89%	52022	5.64%	62178	6.58%
Netherlands	10450	3.29%	14346	3.76%	17209	4.48%
Spain	17217	3.85%	27190	5.04%	32618	5.62%
United Kingdom	30774	3.55%	35996	3.55%	38408	3.56%
EU-15	205767	3.12%	277585	3.69%	323708	4.16%

4.4.2. Transport's share of GDP

Economic growth stimulates transport activities. Conversely, economies rely on a smooth functioning of the transport system. This holds for passenger transport but is particularly true for freight transport. High transport infrastructure standards enable time savings, which in turn lead to productivity increases and the strengthening of a region's competitiveness. In contrast infrastructure bottlenecks cause congestion and hamper economic growth. In the following section, the contribution of the transport sector to overall Gross Value Added and its role as employer is discussed in further detail.

4.4.2.1. GVA of the transport sector

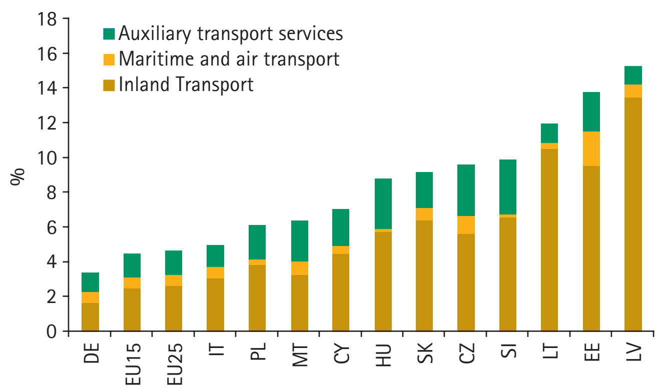
The economic output of the transport sector accounts for approximately 4.5% of GVA including auxiliary transport services in the EU-15 Member States. Adding the output of transport-related industries such as car manufacturing leads to an additional contribution of approximately 2%. Thus direct contributions amount to around 6.5% of the gross economic value.

With regard to the new Member States, shares are significantly higher and range between 6% and 15% (excluding transport-related manufacturing). However, due to the new Member States' relatively low GDP, the average shares for the enlarged Union rise by no more than 0.2%.

Based on national input-output tables, Figure 2-44 shows the contribution to GVA of inland transport, maritime and air transport as well as auxiliary transport services, with particular focus on the new Member States. Shares of EU-15 members range between the German and the Italian shares, which are also shown.

Direct contributions are particularly high in the Baltic States. However, the relatively high shares point to below-average efficiency rather than to economic importance, especially as

Figure 2-44: Transport's share of GVA (2003)



Source: IWW

transport intensities are very high as well. Thus it can be assumed that ongoing structural changes will be accompanied by decreases in these shares in the near future.
In addition to the transport sectors' direct contributions diverse indirect effects point to the key role of transport. In this context, productivity increases of other sectors as well as transport-related manufacturing industries and construction work is of particular importance.

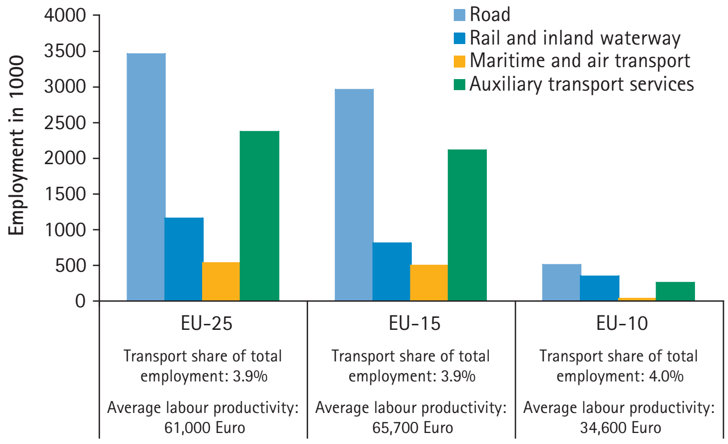
It can be concluded, that the development of the transport sector strongly affects the path of economic growth, which is widely dependent on the finalisation of the internal market and thus the functioning of international trade. In the context of European transport policy, the realisation of priority infrastructure projects can be considered a key element.

4.4.2.2. Employment in the transport sector
The production of transport services requires enormous capital investments. This is particularly true for rail, sea and air transports, but also for modern road transport services. However, the smooth functioning of the transport system also relies on its workforce. With regard to the EU-25, the total number of employees in transport and auxiliary transport services amounts to approximately 7.5 million according to Eurostat. Figure 2-45 shows that the majority of these are within the road transport sector.

The transport share of total employment which amounts to 3.9% for the EU-25 is slightly lower compared to transports contributions to the overall GVA. This in turn points to slightly above average labour productivity. While the GVA shares increase significantly if the new Member States are analysed separately, the share of employment is about the same. Since a similar share of employment leads to significant higher shares of total GVA, labour productivity seems to be higher in the new Member States. Obviously this is only true in relative terms, i.e. in comparison to other sectors' productivity. Therefore the results point to relatively low labour productivities of other sectors rather than to international competitiveness of transport services, especially as absolute transport labour productivity of former EU-15 countries is almost double that of the New Members' productivity. Nevertheless, the New Members have successfully increased their competitiveness in some fields of transport services. In this context road freight transports should be given a particular mention.

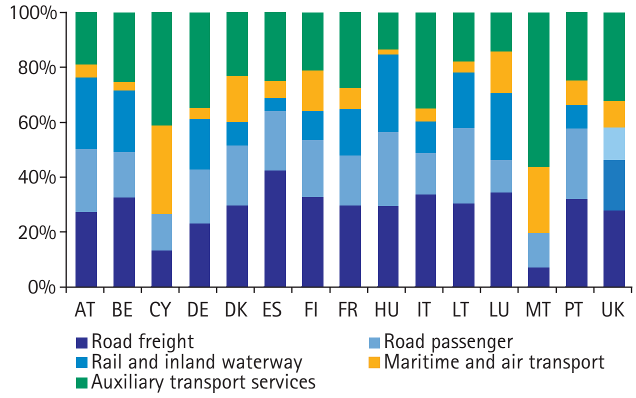
Passenger and freight road transport accounts for about 3.5 million employees (46% of employees in total transport sector). Rail transport accounts to more than 30% in the new Member States. In contrast employment related to railway activities in the EU-15, add up to no more than 13% of total employees in the transport sector. Employment in maritime and services are strongly

Figure 2-45: Employment in the transport sector in the EU-25 (2003)



Source: Eurostat

Figure 2-46: Distribution of transport-related employment



Source: Eurostat

related to the members' geography and the existence of major airports. The Netherlands, for example, shows high employment shares in these fields. Auxiliary transport services have become more and more important in recent years. On the one hand, the services account for cargo handling, storage and logistics, which has gained in importance alongside with increasing transport volumes. On the other hand, auxiliary services include tourist services, such that popular tourist destinations, e.g. Cyprus or Malta, have experienced strong growth in this field. Figure 2-46 gives some insight into the distribution of transport-related employment at country level.

5. ENERGY DEVELOPMENTS[12]

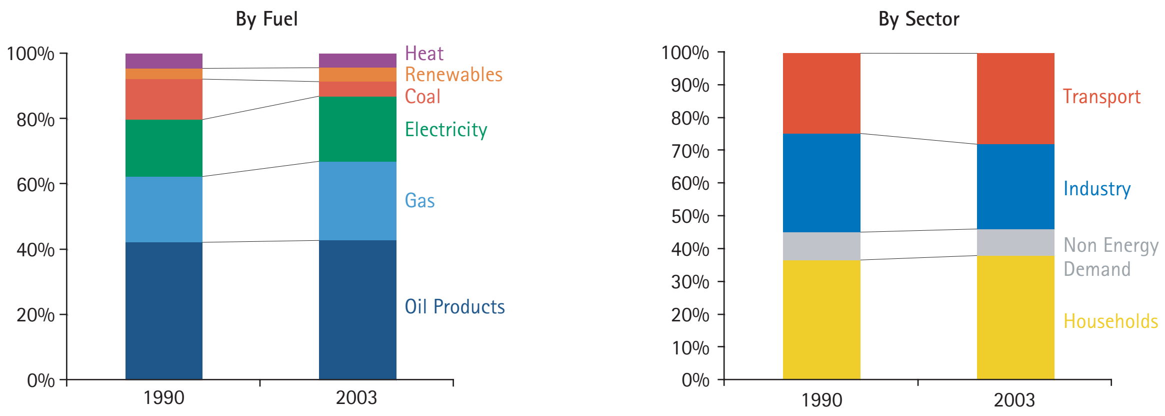
5.1. Changes in the structure of final energy demand

- The structure of FED continues to change along two main axes: on the one hand, a declining coal demand offset by increased gas and electricity demand. On the other, growing demand from households and transport in the face of reducing demand from industry.

The evolution in the structure of FED in the EU-25 between 1990 and 2003 continues to be characterised by two major trends. On the one hand, it presents an ongoing change in the fuel mix, where demand for coal is being displaced by gas and electricity. Coal demand has followed a downwards trend during the past decade, passing from more than 12% of FED in 1990 to about 4.5% in 2003, being replaced mostly by gas, whose share in FED over the period rose from 20% to 24% and electricity, whose share grew from 17% to 20%. Renewable energies also increased their share of total FED, from 3.5% in 1990 to 4.3% in 2003. The share of oil products – the main component of FED– was slightly higher in 2003 (44.0%) relative to 1990 (42.3%).

The second major trend continued to be the restructuring of final energy demand by economic sectors. The households and tertiary sector represented in 2003 the bulk of FED with over 41.5% of the total, up from 40.2% in 1990. But the main evolution has undoubtedly been the increase of the transport sector's share of FED, which passed from 27% in 1990 to more than 30% in 2003. The share increase of the above two sectors was compensated by a drop in the share of the industrial sector, which passed from 33% to 28% over the period.

Figure 2-47: Change in the structure of FED in the EU-25



5.2. The energy transformation sector

- Major changes in the structure of the EU-25's power generation sector took place between 1990 and 2003. In the EU-15 the number of CCGTs continued to grow, making capacity as well as generation decreasingly coal-intensive and more gas-intensive. In the EU-10, the share of coal also dropped, replaced by gas, hydro and in some cases, nuclear.
- Across the entire EU, Utilisation rates, capacity and output of nuclear stations was also on the rise.
- More than 74% of total refining capacity remains within the EU-25's 6 largest economies. The share of lighter fuels in total refinery output continued to increase.

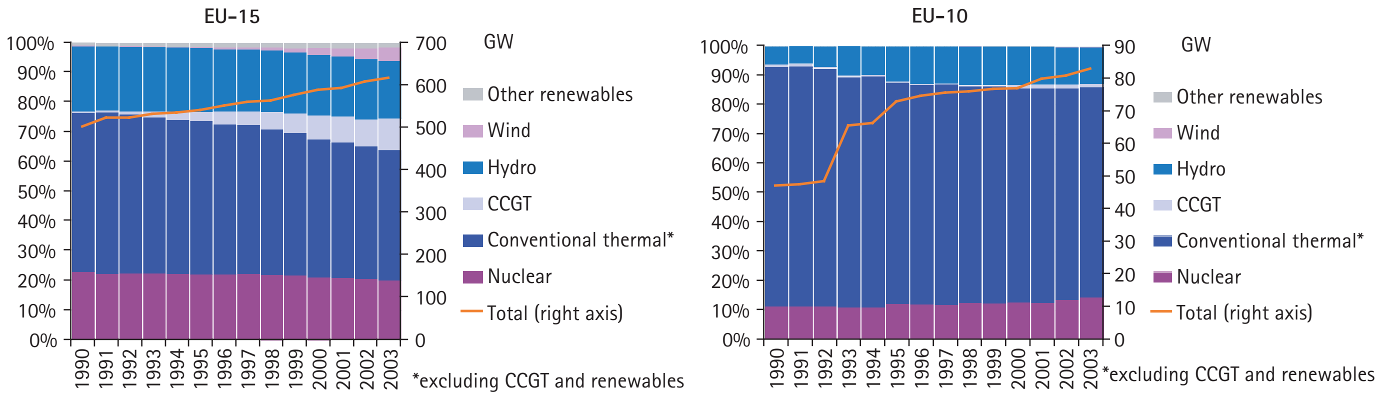
5.2.1. Electricity generation

5.2.1.1. Installed capacity

Aggregate installed capacity for electricity generation in the EU-25 was 697 GW, up by 28% from the 546 GW available in 1990. Conventional fossil fuel-fired thermal power stations continue to have the highest share of capacity, with almost 57% of the total in 2003. Despite significant decommissioning and replacement of old coal and oil plants, the installation of more efficient and environmentally-friendly combined cycle gas turbines (CCGT) has actually seen the share of thermal power stations grow over the period, up from 56% in 1990. Also on the rise were wind power, whose share grew from a negligible 0.1% in 1990 to nearly 4% in 2003, as well as other renewables (mainly bio-mass-fired stations), up from 0.9% to 1.4% over the same period. The above increases displaced nuclear capacity, whose share of total capacity declined from 22% in 1990 to 19% in 2003 and hydraulic stations, whose share respectively fell from 21% to 18%.

[12] *Unless stated otherwise, all data presented in this section is produced by Eurostat.*

Figure 2-48: Electricity generation capacity by technology in the EU



In general terms, several factors contributed to changes in the structure of installed capacity over the period considered: (1) the introduction of CCGT technology (2) the modernisation of some of the EU-10's obsolete generation capacity, (3) developments in the world natural gas markets and technologies and (4) tighter environmental regulations. However, as illustrated in Figure 2-48, developments in the EU-15 and the EU-10 were not the same. In the former group of countries, the main trends were the growth of the share of CCGT, wind and other renewables in the aggregate generation mix, whilst the shares of nuclear remained relatively stable, and other conventional thermal and hydro declined. In the EU-10, on the other hand, there was a large share increase of hydro (especially in the first half of the 1990s) and, to a lesser extent, of nuclear capacity[13], accompanied by reductions in the share of conventional power stations. There, the share of CCGT technology is still marginal, but is expected to rapidly grow as markets develop.

The most spectacular increase has to be the very rapid growth of CCGT power capacity in the EU-15, which passed from 3.6 GW in 1990 (<1% of the total) to an estimated 69 GW in 2003 (nearly 10% of the total).

Table 2-14: Changes in net nuclear generation capacity (1995-2003)

	Change in %	Change in MW
France	8.3%	4848
Czech Republic	113.6%	2000
Slovakia	50.0%	880
Spain	7.3%	513
Finland	15.6%	361
Belgium	2.3%	129
Hungary	1.4%	26
Lithuania	0.0%	0
Slovenia	-1.2%	-8
Netherlands	-11.1%	-56
Sweden	-6.1%	-614
United Kingdom	-5.2%	-664
Germany	-5.6%	-1274
EU-15	2.7%	3243
EU-25	4.8%	6141
EU-10	32.1%	2898

Source: Commission Annual Report on the Implementation of the Gas and Electricity Internal Market

Member States' position over nuclear power continues to be a controversial issue within the EU. Several member states have increased their nuclear capacity since 1995, mainly through expansions of existing reactors, and 4 new plants were built in the Czech Republic and Slovakia between 1998 and 2003. The large capacity increase in France as well as the all the other smaller expansions have mainly occurred through ongoing increases of existing reactor capacity. These augmentations were partly offset by decommissioning or capacity reductions in Slovenia, the UK, Germany, Sweden and the Netherlands. In all, the EU-25's nuclear capacity grew by 5% (6.1 GW) between 1995 and 2003.
The volume of hydraulic capacity remained relatively stable between 1995 and 2003, with additions of more than 0.75 GW occurring only in Spain, Italy and the Czech Republic. In all, about 4.8 GW of hydropower was added during the period. That increase did not prevent the share of hydropower in the plant mix to fall, however, from 20.6% of the total in 1990 to 18.4% in 2003. Hydropower is a clean and renewable source of energy, but such projects are often confronted with strong local opposition.

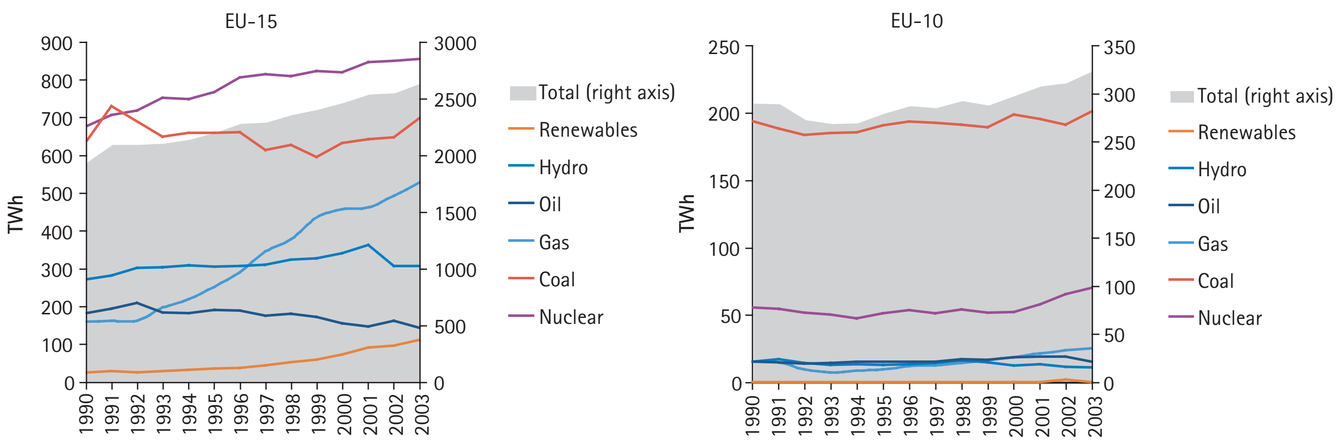
Highly significant to European energy supply security and tackling environmental emissions has been the outstanding growth of electricity generation capacity from renewable energy sources (excluding large hydro). Growth has been nearly exponential, passing from 5 GW in 1990 to 37 GW in 2003, an increase of more than seven-fold. The bulk of the growth has come from the construction of wind turbines (also called aero-generators), principally in Germany, Spain, Denmark, Italy and the Netherlands, whose joint capacity represented in 2003 almost 93% of the EU-25's total. Wind capacity in the EU-25 passed from less than 1 GW in 1990 to more than 27 GW in 2003. All of this growth has taken place in the EU-15; the capacity of wind power in the EU-10 in 2003 was negligible.

5.2.1.2. Generation

Dispatching of power plants is driven by the merit order of each generation technology, which is in turn a function both of short-term marginal cost and the technical flexibility of the plant. Power is first dispatched from base load plants – typically from the noninterruptible nuclear, coal, wind and (more recently) CCGT, and from low-cost hydro – while other types like conventional gas and oil plants, are called to generate power only at peak demand periods.

[13] *Under accession agreements, some of the Soviet-era nuclear plants in the EU-10 are scheduled for decommissioning in the very near future.*

Figure 2-49: Net generation of electricity by technology in theEU



In 2003, total net generation in the EU-25 rose to 2964 TWh, 32% higher than the level observed in 1990. On average, power generation grew by 2.2%/year between 1990 and 2003. Of the total, 89% of generation came from the EU-15 while the remaining 11% was produced in the EU-10. Like in capacity, the evolution of generation presents different trends in the EU-15 and the EU-10. In the former group of countries, the most significant evolutions were the increase in the shares of gas and renewables in the total generation mix. Electricity generated from gas-fired stations witnessed a 232% increase between 1990 and 2003, mainly from use of highly-efficient CCGTs, whilst growth in the production of electricity from renewable energies was even more impressive, expanding by more than 360% over the period. Production from nuclear power grew by 26%.

Generation of electricity from gas was also the fastest growing segment in the EU-10, albeit at a much slower pace than in the EU-15. Production from that energy source increased by 68% between 1990 and 2003, with the second most rapid increase being production of electricity from nuclear energy, which grew by 26% over the same period. Generation from coal plant grew only slightly and in 2003 was only 3.7% above 1990 levels. These increases have more than offset the reductions in electricity generated from oil-fired plants, which dropped by 28% over the period.

In the EU-15, the larger part of electricity generation continues to come from nuclear plants, which in 2003 represented more than 32% of the total. Despite their lower share in total capacity, their share in the capacity mix and the fact that they operate nearly uninterruptedly make them the largest source of electrical energy in that group of countries. Indeed, not only has the capacity of nuclear plants grown (c.f. previous section), but as shown in Figure 2-50, their utilisation rate (i.e. the number of hours they run per year) has also increased. But more impressive still is the evolution of the share of gas-fired generation in the aggregate mix, which passed from a mere 8% in 1990 to more than 20% in 2003. Although the absolute volume of power generated from coal has remained relatively stable, its share fell from 33% to 27% between 1990 and 2003.

The EU-10 remains heavily dependent on coal for its power generation needs. Although its share in the generation mix has fallen slightly, it still accounted for 62% of total generation in 2003. (down from 67% in 1990). Nuclear power constituted the second major source of generation, providing the EU-10 with 22% of its domestic power generation in 2003. Gas, oil and renewables all contributed with less than 8% of total generation.

Generation from the renewable energies has also increased significantly although its share in the aggregate mix, both in the EU-15 and the EU-10 remains modest. In the former group of countries generation from renewables (excluding large hydro) represented just over 4% in 2003. For the EU-10, that figure was 0.1%.

Figure 2-50: Utilisation rate of nuclear capacity: EU-15

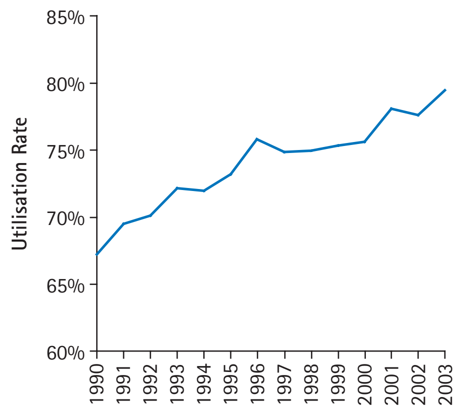
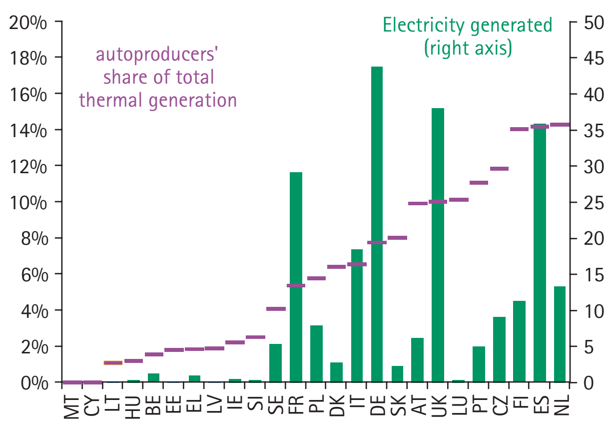


Figure 2-51: Share of generation from auto-producer facilities in total thermal generation



It is worth noting that the larger part of power produced both within the EU-15 and the EU-10 is generated from fossil fuels (oil, gas and coal). In the EU-15, the combustion of fossil fuels produced 52% of total generation. Their share in the EU-10 was 73%. The high share of fossil fuels combustion for power generation explains why the sector is a major source of emissions, including CO_2, acidifying compounds (SOx and NOx) and particulate matter, although emissions vary significantly by fuel and plant type. Also, most fossil fuels are imported (even as the EU has significant coal reserves, imported coal is less expensive and often less polluting) which underline the importance of supply security to the sector.
The development of cogeneration (also known as CHP: Combined heat and power) facilities is one of the Commission's policy objectives. Figure 2-51 shows the relative shares of thermal generation and the volumes produced by auto-producer facilities (many of which are CHP) in the EU-25.

5.2.1.3. Refining capacity
The EU-25's refining capacity is mainly concentrated within the larger economies (Germany, Italy, France, UK, Spain, and Netherlands), which together represented more than 74% of the EU-25's total in 2003. In that year, refining capacity rose to 14,831 million tonnes per year, which represented a 0.1% increase over the previous year but only a 4.0% increase with respect to the 1994 level, reflecting structural change within the sector. Indeed, although final demand for oil products grew by 13% between 1990 and 2001, net imports grew by 21% over the same period, which offset some refining capacity within the EU-15.

5.2.1.4. Refining output
Both in the EU-15 and the EU-10, refinery output of the heavier oil products has declined whereas production of lighter fuels has increased as a result of the promotion of cleaner fuels by the Commission. The move has been made possible by technological developments in the refining industry, plant replacement (particularly in the EU-10) and the use of lighter crudes. In 2003, total refinery output in the EU-25 was 696 Mtoe of which more than 93% was produced within the EU-15. Total output in 2003 was 12% above the 1990 level.

Growing demand for road fuels has generated a rapid increase in the production of gas diesel oil and, to a lesser extent, of gasoline. Output of gas diesel oil increased by an average 1.9% per year between 1990 and 2003, surpassed only by the average growth rate of LPG, which was 2.1%/year. The share of diesel in the total output mix also increased, passing from 32% in 1990 to 37% in 2003. Production of gasoline grew by an average 0.5%/year over the same period, but its share declined, going from 23% in 1990 to 22% in 2003. The share of residual fuel oil also decreased, in particular from the shutting down of some older refineries in the EU-10.

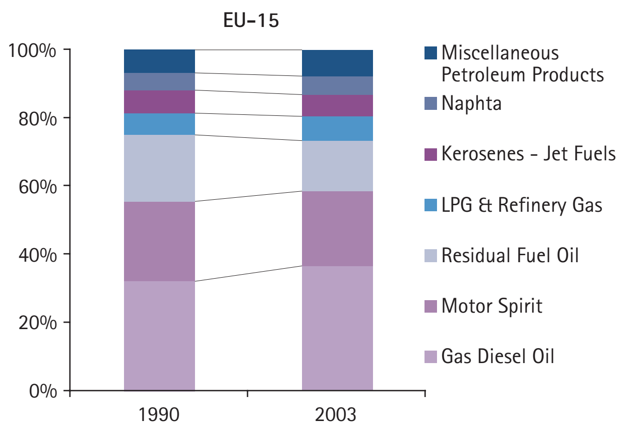
Other products with increasing shares were naphtha (up from 5.1% of the total in 1990 to 5.4% in 2003) and miscellaneous petroleum products (respectively up from 6.8% to 7.7%).

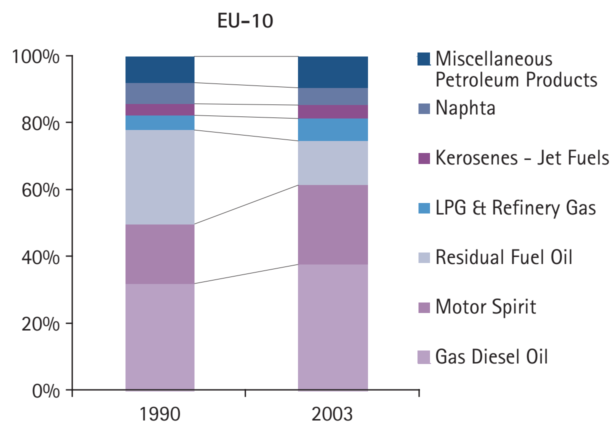
Table 2-15: Refining capacity in selected EU Member States and the EU-25

Tonnes/yr	1994	2001	2002	2003	CAGR 2002/2000	CAGR 2003/1994
Belgium	692	785	803	805	1.49%	1.69%
France	1697	1961	1967	1967	-0.29%	1.65%
Germany	2272	2274	2286	2304	0.62%	0.16%
Greece	385	412	412	412	0.74%	0.76%
Italy	2272	2294	2294	2294	0.00%	0.11%
Netherlands	1197	1233	1237	1237	0.68%	0.37%
Spain	1205	1247	1333	1333	2.25%	1.13%
Sweden	422	422	422	422	0.08%	0.00%
United Kingdom	1866	1769	1785	1813	0.65%	-0.32%
EU-25	14255	14533	14810	14831	0.76%	0.44%

Source: BP World Energy Review

Figure 2-52: Evolution of refinery output in the EU





5.3. Electricity and gas infrastructure

5.3.1. The EU's electricity network

Electricity utilities have been co-operating since the post-war period, mainly in order to maximise the system's reliability and quality of supply, while optimising the use of primary energy and capacity resources. Four regional Transmission System Operator (TSO) organisations emerged from this co-operation:

- TSOI, the association of TSOs in Ireland
- UKTSOA, the United Kingdom TSO association
- NORDEL, the Nordic countries' TSOs
- UCTE, the Union for the Co-ordination of Transmission of Electricity, an association of CENTREL (TSO organisation of central European countries), TSOs of the Continental countries of Western and Central Europe. UCTE is the largest of these, and coordinates the operation and development of the electricity transmission grids across continental Europe, grouping transmission system operators from 23 countries.

Table 2-16 presents the evolution in the length of transmission circuits in the EU.

Table 2-16: Length of electricity transmission circuits in selected EU countries (km)

km		1991	2002	2003
Belgium	High Tension	854	1476	1298
	Medium Tension	266	388	415
Czech Republic	High Tension	n.a.	3367	3422
	Medium Tension	n.a.	1904	1923
Denmark	High Tension	1076	n.a.	n.a.
	Medium Tension	247	n.a.	n.a.
Germany	High Tension	12064	18600	19600
	Medium Tension	16822	19800	16700
Greece	High Tension	1857	2623	4459
	Medium Tension	6783	8146	11078
Spain	High Tension	12883	16213	16269
	Medium Tension	15018	16066	16591
France	High Tension	19609	20866	20966
	Medium Tension	25596	26289	26256
Italy	High Tension	8434	9880	9891
	Medium Tension	13341	12005	11705
Luxembourg	High Tension	0	0	0
	Medium Tension	190	236	236
Hungary	High Tension	n.a.	1956	2090
	Medium Tension	n.a.	1488	1188
Netherlands	High Tension	792	2003	2003
	Medium Tension	388	683	683
Austria	High Tension	1986	n.a.	n.a.
	Medium Tension	3901	n.a.	n.a.
Poland	High Tension	n.a.	4660	4830
	Medium Tension	n.a.	8112	7887
Portugal	High Tension	1072	1301	1403
	Medium Tension	2178	2705	2692
Slovenia	High Tension	n.a.	510	n.a.
	Medium Tension	n.a.	328	n.a.
Slovakia	High Tension	n.a.	1753	1753
	Medium Tension	n.a.	962	962
Finland	High Tension	10565	n.a.	n.a.
	Medium Tension	4763	n.a.	n.a.
Sweden	High Tension	10565	n.a.	n.a.
	Medium Tension	4763	n.a.	n.a.

(*) Compound annual growth rate *Source: UCTE and National TSO's*

5.3.2. Gas transmission network, storage and import terminals

The EU-25's high-pressure gas transmission grid connects Member States to domestic production sources as well as to external production sources in North Africa, Norway, Russia and the Caspian though land and underwater pipelines, but also to more remote sources via LNG import terminals. The system also serves to transport gas imports and indigenous production to final consumption destinations and distribution systems. The European gas grid spanned over 1.8 million km in 2003, of which some 220,000 km were high pressure (transport) pipelines.

In 2004, 10 LNG import terminals and regasification plants were operational across the EU-25, taking gas mainly from Egypt, Oman, Qatar, Nigeria, Trinidad & Tobago and even Australia. France and Spain, which respectively have 2 and 4 LNG terminals, are the largest importers of gas in this form. The remaining LNG import terminals are located in Greece, Italy, Portugal and Belgium.
Due to supply security concerns, but also to flexibility considerations in seasonal demand, gas storages have increasingly become a key element of the supply chain. The larger part of storage capacity is concentrated in Germany, Italy and France, which together hold 65% of the EU-25's total storage capacity.

Table 2-17: Gas network in the EU (2003)

	High Pressure (km)	Low Pressure (km)	Total (km)
Belgium	3693	51117	54810
Czech Republic	3638	67481	71119
Denmark	1439	17000	18439
Germany	61000	314000	375000
Spain	10691	37457	48148
Estonia	–	2148	2148
France	35750	176340	212090
Finland	1000	1440	2440
Greece	961	2751	3712
Hungary	5278	72409	77687
Italy	31220	197000	228220
Ireland	1850	8400	10250
Lithuania	1600	6400	8000
Latvia	1244	3675	4919
Luxemburg	320	1750	2070
Netherlands	11600	123500	135100
Austria	5400	26000	31400
Portugal	1402	9359	10761
Poland	15451	219720	235171
Slovenia	961	n.a.	961
Slovakia	6196	23837	30033
Sweden	530	2000	2530
UK	19424	262000	281424
EU-25	220648	1625784	1845471

Source: Eurogas Annual Reports

Table 2-18: Gas storage capacity in the EU-25 (2003)

	Number of facilities	Max working volume (million m3/day)	Max withdrawal capacity (million m3/day)
Germany	43	18599	462
Italy	10	16800	295
France	15	11000	195
UK	9	3855	131
Netherlands	3	3500	146
Hungary	5	3380	44
Czech Republic	9	3150	52
Austria	4	2820	33
Latvia	1	2255	24
Slovakia	3	2018	25
Spain	2	1500	12
Poland	6	1365	26
Denmark	2	700	20
Belgium	2	655	22
Greece	1	75	5
Sweden	1	10	1
EU-25	116	71682	1494

Source: Eurogas Annual Reports

5.4. Changes in the structure of gross inland consumption

- The share of fossil fuels in the EU-25's GIC declined from 83% in 1990 to 81% in 2003. In the EU-15 and the EU-10 those share were respectively, 82% to 80% and 90% to 85%.
- The greatest share increase was by natural gas, which passed from 17% to 24% of total GIC between 1990 and 2003.
- Growing generation from gas, increased penetration of gas networks and environmental regulations on other fuels were responsible for the shift.

Crude oil is the EU's main source of primary energy. Oil's share in the primary energy mix has been stable, passing from 38.4% in 1990 to 38.6% in 2003. However, the EU-25's GIC of oil in absolute terms continues to grow, and rose from 597 Mtoe in 1990 to 666 Mtoe in 2003.

The most fundamental change in the structure of the EU's GIC continues to be the shift away from solid fuels and towards natural gas. The share of solid fuels in primary consumption between 1990 and 2003 passed from 28% to 18% and was mainly replaced by gas, whose share increased from 17% to 24%. In absolute terms, consumption of solid fuels declined rapidly in the first half of the 1990s following the restructuring of the ex soviet republics and the commissioning of new CCGT plants, but stabilised from 2000 onwards, with primary consumption of coal and lignite floating around the 300 Mtoe mark. As a result, the EU's growing primary demand has been countered by increased demand for natural gas, which rose from 260 Mtoe in 1990 to 408 Mtoe in 2003, a 57% increase. The sharp rise is explained not only by increased demand for power generation but also to the higher demand from the domestic and tertiary sectors as gas network penetration progresses in most Member States.

As a result of capacity increases in many plants, higher utilisation rates, as well as the commissioning of new plants in the Czech Republic and Slovakia, the share of nuclear energy in the EU-25's primary energy mix increased from 13% to 15% between 1990 and 2003. Primary consumption of nuclear energy in the latter year was 251 Mtoe, 26% more than in 1990.

Consumption of renewable energy, such as bio-mass and wind, also increased its share in the primary energy structure. Although the demand for these fuels represented in 2003 just 6.0% of the EU-25's total GIC, that represents a major increase from the 4% in 1990. Primary demand of renewable energy has been increasing at an average rate of 4%/year since 2000.

Increases in the demand for nuclear energy and renewables have decreased the EU's level of exposure to fossil fuels, whose prices are linked to world prices of oil and which are, in many cases, produced in politically unstable regions. Indeed, the share of fossil fuels in the primary energy mix passed from 83% in 1990 to 80.5% in 2003. This is also a welcome move in favour of the environment, as greenhouse gas emissions and acid rain precursors both emanate from the combustion of fossil fuels.

Individual Member States exhibited slightly different patterns. Between 1990 and 2003, only Estonia, Cyprus, Lithuania and Finland increased their share of either hard coal or lignite in their primary energy mix. Cyprus, Malta, Latvia, Lithuania, the Netherlands and Slovenia, on the other hand, were the only Member States to have seen the share of natural gas in their GIC decline. The share of nuclear energy only grew in the Czech Republic, Germany, France, Lithuania, Slovakia and the UK; while the share of renewable energies decreased only in France (where bio-mass combustion has an important share).

Figure 2-53: Change in the structure of GIC in the EU-25

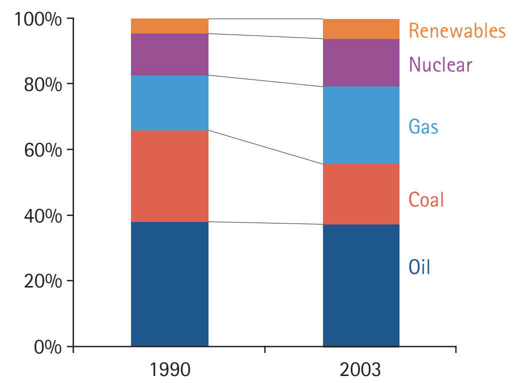


Table 2-19: Gross inland consumption by source in the EU-25

Mtoe		1990	2000	2002	2003	CAGR 03/90	CAGR 03/00	CAGR 03/02
Belgium	Hard coal & derivatives	10.2	8.1	6.5	6.1	-3.8%	-9.0%	-6.7%
	Lignite & derivatives	0.1	0.1	0.1	0.1	2.2%	1.1%	-7.7%
	Crude oil & feedstocks	26.2	32.7	30.1	33.2	1.8%	0.5%	10.1%
	Petroleum products	-8.5	-10.8	-11.5	-12.0	2.7%	3.6%	4.3%
	Natural gas	8.2	13.4	13.4	14.4	4.5%	2.5%	7.7%
	Nuclear energy	10.7	12.4	12.2	12.2	1.0%	-0.5%	0.0%
	Renewable energies	0.6	0.7	0.8	1.1	3.8%	12.3%	28.9%
	Total GIC	47.3	57.2	52.6	55.8	1.3%	-0.8%	6.1%
Czech Republic	Hard coal & derivatives	29.4	21.6	20.4	20.7	-2.7%	-1.5%	1.1%
	Lignite & derivatives	0.5	0.0	0.0	0.0	-30.1%	-49.3%	-76.7%
	Crude oil & feedstocks	7.7	6.0	6.2	6.6	-1.2%	3.2%	5.7%
	Petroleum products	1.2	1.8	2.1	2.0	3.7%	3.4%	-4.7%
	Natural gas	5.2	7.5	7.8	7.8	3.1%	1.5%	1.0%
	Nuclear energy	3.2	3.5	4.8	6.7	5.7%	23.9%	38.1%
	Renewable energies	0.1	0.6	0.9	1.2	19.2%	23.1%	33.2%
	Total GIC	47.4	40.4	41.4	43.7	-0.6%	2.7%	5.4%
Denmark	Hard coal & derivatives	6.1	4.0	4.2	5.7	-0.6%	12.2%	35.3%
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Crude oil & feedstocks	8.1	8.5	8.1	8.4	0.3%	-0.2%	4.4%
	Petroleum products	0.1	0.6	0.7	-0.1	-197.1%	-151.4%	-111.8%
	Natural gas	1.8	4.4	4.6	4.7	7.5%	1.6%	0.7%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	1.2	2.1	2.4	2.7	6.6%	9.2%	12.1%
	Total GIC	17.9	19.7	19.8	20.7	1.1%	1.7%	4.3%
Germany	Hard coal & derivatives	55.0	47.8	44.7	45.7	-1.4%	-1.5%	2.4%
	Lignite & derivatives	78.1	36.0	40.0	39.3	-5.2%	3.0%	-1.8%
	Crude oil & feedstocks	91.8	108.5	108.6	110.9	1.5%	0.8%	2.2%
	Petroleum products	32.3	21.4	18.8	14.3	-6.1%	-12.5%	-24.1%
	Natural gas	55.0	71.9	75.6	79.2	2.8%	3.3%	4.8%
	Nuclear energy	37.7	43.8	42.5	42.6	0.9%	-0.9%	0.1%
	Renewable energies	5.7	9.7	10.6	11.6	5.6%	6.0%	9.2%
	Total GIC	356.1	340.2	342.8	344.5	-0.3%	0.4%	0.5%
Estonia	Hard coal & derivatives	0.2	0.1	0.0	0.0	-21.5%	-45.5%	-55.6%
	Lignite & derivatives	5.7	2.9	2.8	3.4	-4.0%	4.8%	19.6%
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-	-	-
	Petroleum products	2.9	0.5	1.1	1.0	-7.5%	26.9%	-1.3%
	Natural gas	1.2	0.7	0.6	0.7	-4.4%	0.9%	14.1%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	0.5	0.5	0.5	0.5	0.9%	1.2%	-0.5%
	Total GIC	9.9	4.6	5.0	5.5	-4.5%	6.1%	10.2%
Greece	Hard coal & derivatives	1.0	0.7	0.6	0.5	-4.5%	-9.3%	-13.4%
	Lignite & derivatives	7.1	8.3	8.7	8.4	1.3%	0.2%	-3.8%
	Crude oil & feedstocks	15.8	20.6	20.1	20.6	2.0%	-0.1%	2.2%
	Petroleum products	-3.0	-4.7	-3.2	-3.1	0.3%	-13.0%	-3.2%
	Natural gas	0.1	1.7	1.8	2.0	23.0%	5.9%	12.5%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	1.1	1.4	1.4	1.5	2.6%	3.4%	11.0%
	Total GIC	22.2	28.1	29.7	30.2	2.4%	2.4%	1.5%
Spain	Hard coal & derivatives	16.1	19.5	20.0	18.6	1.1%	-1.6%	-7.2%
	Lignite & derivatives	2.9	1.2	1.7	1.6	-4.3%	10.9%	-5.1%
	Crude oil & feedstocks	53.5	57.8	57.4	57.1	0.5%	-0.4%	-0.5%
	Petroleum products	-8.0	5.4	8.2	9.9	-201.7%	22.5%	20.6%
	Natural gas	5.0	15.2	18.8	21.4	11.9%	11.9%	13.9%
	Nuclear energy	13.7	16.0	16.3	16.0	1.2%	-0.2%	-1.8%
	Renewable energies	6.3	7.1	7.3	9.4	3.2%	9.9%	29.2%
	Total GIC	89.4	122.8	130.1	134.1	3.2%	3.0%	3.1%

Table 2-19 (continued)

						CAGR		
Mtoe		1990	2000	2002	2003	03/90	03/00	03/02
France	Hard coal & derivatives	19.2	15.1	13.7	13.8	-2.5%	-2.9%	0.8%
	Lignite & derivatives	0.7	0.1	0.1	0.0	-24.1%	-47.9%	-72.8%
	Crude oil & feedstocks	78.6	86.0	82.7	87.0	0.8%	0.4%	5.2%
	Petroleum products	9.0	2.8	9.7	5.0	-4.4%	21.9%	-48.2%
	Natural gas	26.0	35.8	37.5	39.4	3.2%	3.3%	5.1%
	Nuclear energy	81.0	107.1	112.7	113.8	2.6%	2.0%	1.0%
	Renewable energies	15.7	17.6	16.5	17.3	0.8%	-0.5%	4.8%
	Total GIC	226.4	258.5	266.2	270.6	1.4%	1.5%	1.7%
Ireland	Hard coal & derivatives	2.2	1.8	1.7	1.7	-1.8%	-2.0%	-1.1%
	Lignite & derivatives	1.4	0.7	0.8	0.8	-4.3%	2.8%	-2.5%
	Crude oil & feedstocks	1.8	3.3	3.2	3.3	4.5%	-0.8%	0.8%
	Petroleum products	2.9	4.6	5.3	5.5	4.9%	6.1%	2.3%
	Natural gas	1.9	3.4	3.7	3.7	5.3%	2.3%	0.0%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	0.2	0.3	0.3	0.3	3.5%	0.4%	-9.4%
	Total GIC	10.4	14.2	15.1	15.3	3.0%	2.5%	0.9%
Italy	Hard coal & derivatives	14.4	12.7	13.7	14.9	0.3%	5.7%	8.8%
	Lignite & derivatives	0.2	0.0	0.0	0.0	-29.9%	-35.6%	-20.0%
	Crude oil & feedstocks	88.0	94.2	95.5	97.1	0.8%	1.0%	1.7%
	Petroleum products	1.8	-5.3 -	7.2	-8.7	-212.9%	17.7%	20.6%
	Natural gas	39.0	57.9	57.7	63.4	3.8%	3.0%	9.8%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	6.5	9.0	9.1	10.8	4.0%	6.0%	18.0%
	Total GIC	153.1	172.5	173.6	182.0	1.3%	1.8%	4.9%
Cyprus	Hard coal & derivatives	0.1	0.0	0.0	0.0	-4.2%	2.2%	1.5%
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	6.3%	0.0%
	Crude oil & feedstocks	0.8	1.2	1.1	1.0	1.9%	-6.2%	-10.7%
	Petroleum products	1.0	1.1	1.3	1.5	3.3%	10.0%	19.7%
	Natural gas	0.0	0.0	0.0	0.0	-	-	-
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	0.0	0.0	0.0	0.0	15.6%	-6.2%	-17.2%
	Total GIC	1.8	2.4	2.4	2.5	2.6%	2.3%	5.2%
Latvia	Hard coal & derivatives	0.6	0.1	0.1	0.1	-15.0%	-1.3%	-3.4%
	Lignite & derivatives	0.0	0.1	0.0	0.0	-3.7%	-37.7%	-8.1%
	Crude oil & feedstocks	0.0	0.1	0.0	0.0	17.8%	-44.1%	-39.8%
	Petroleum products	0.6	1.2	1.1	1.2	5.3%	2.5%	9.5%
	Natural gas	2.1	1.1	1.3	1.3	-3.5%	7.2%	4.3%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	0.4	1.1	1.5	1.5	10.8%	11.3%	0.4%
	Total GIC	4.1	3.7	4.2	4.4	0.5%	6.0%	4.4%
Lithuania	Hard coal & derivatives	0.9	0.1	0.1	0.2	-12.0%	25.6%	27.0%
	Lignite & derivatives	0.0	0.0	0.0	0.0	1.5%	16.0%	60.3%
	Crude oil & feedstocks	9.6	5.1	6.8	7.3	-2.0%	12.8%	7.9%
	Petroleum products	-2.7	-2.7	-4.2	-4.9	4.8%	21.6%	16.5%
	Natural gas	4.8	2.1	2.2	2.4	-5.3%	4.5%	8.6%
	Nuclear energy	4.4	2.2	3.6	4.0	-0.7%	22.5%	9.5%
	Renewable energies	0.0	0.6	0.7	0.7	25.8%	2.8%	1.7%
	Total GIC	16.0	7.2	8.7	9.0	-4.3%	7.5%	3.8%
Luxembourg	Hard coal & derivatives	1.1	0.1	0.1	0.1	-18.9%	-14.7%	-16.5%
	Lignite & derivatives	0.0	0.0	0.0	0.0	-8.1%	-12.6%	0.0%
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-	-	-
	Petroleum products	1.6	2.3	2.5	2.7	4.0%	5.4%	7.8%
	Natural gas	0.4	0.7	1.1	1.1	7.2%	16.6%	1.0%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	0.0	0.1	0.1	0.1	1.9%	1.9%	6.4%
	Total GIC	3.6	3.6	4.0	4.2	1.3%	5.0%	5.4%

Table 2-19 (continued)

						CAGR		
Mtoe		1990	2000	2002	2003	03/90	03/00	03/02
Hungary	Hard coal & derivatives	2.2	1.0	0.9	1.0	-5.6%	-0.2%	10.5%
	Lignite & derivatives	3.8	2.9	2.7	2.7	-2.6%	-2.6%	1.6%
	Crude oil & feedstocks	8.6	7.4	6.8	7.4	-1.1%	-0.1%	8.3%
	Petroleum products	0.1	-0.5	-0.2	-0.7	-213.7%	8.2%	167.6%
	Natural gas	8.9	9.7	10.8	11.9	2.2%	7.2%	10.0%
	Nuclear energy	3.5	3.7	3.6	2.8	-1.7%	-8.1%	-21.1%
	Renewable energies	0.0	0.4	0.9	0.9	37.0%	28.2%	3.4%
	Total GIC	28.1	24.9	25.9	26.7	-0.4%	2.4%	3.4%
Malta	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-	-	-
	Petroleum products	0.6	0.9	0.8	0.8	2.7%	-4.3%	0.0%
	Natural gas	0.0	0.0	0.0	0.0	-	-	-
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	0.0	0.0	0.0	0.0	-	-	-
	Total GIC	0.6	0.9	0.8	0.8	2.7%	-4.3%	0.0%
Netherlands	Hard coal & derivatives	9.1	8.0	8.4	8.7	-0.3%	3.1%	4.3%
	Lignite & derivatives	0.1	0.0	0.0	0.0	-9.4%	-3.1%	-23.1%
	Crude oil & feedstocks	52.0	62.4	58.0	60.5	1.2%	-1.0%	4.2%
	Petroleum products	-27.6	-33.9	-28.4	-29.3	0.5%	-4.7%	3.0%
	Natural gas	30.8	34.7	35.8	36.0	1.2%	1.2%	0.4%
	Nuclear energy	0.9	1.0	1.0	1.0	1.3%	0.8%	2.6%
	Renewable energies	0.8	1.6	1.7	2.0	7.8%	8.0%	17.1%
	Total GIC	66.8	75.7	78.2	80.5	1.4%	2.1%	2.9%
Austria	Hard coal & derivatives	3.2	3.2	3.4	3.5	0.7%	3.0%	4.1%
	Lignite & derivatives	0.8	0.3	0.4	0.4	-4.8%	6.6%	6.2%
	Crude oil & feedstocks	9.1	8.7	9.2	8.9	-0.2%	0.5%	-3.8%
	Petroleum products	1.5	3.1	3.6	4.9	9.8%	16.5%	38.1%
	Natural gas	5.2	6.5	6.6	7.6	2.9%	5.0%	14.3%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	5.0	6.5	6.7	6.7	2.2%	1.1%	-1.0%
	Total GIC	24.9	28.5	30.2	32.7	2.1%	4.8%	8.4%
Poland	Hard coal & derivatives	62.0	44.2	42.7	45.3	-2.4%	0.8%	6.2%
	Lignite & derivatives	13.4	12.1	12.1	12.3	-0.6%	0.6%	1.9%
	Crude oil & feedstocks	12.8	19.6	18.6	18.2	2.7%	-2.4%	-1.8%
	Petroleum products	0.6	1.1	1.9	2.2	10.9%	24.7%	18.3%
	Natural gas	8.9	10.0	10.1	11.3	1.8%	4.2%	11.3%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	1.6	3.8	4.1	5.1	9.3%	10.1%	22.6%
	Total GIC	100.0	90.8	89.4	94.1	-0.5%	1.2%	5.3%
Portugal	Hard coal & derivatives	2.6	3.8	3.5	3.3	1.9%	-4.8%	-5.6%
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Crude oil & feedstocks	11.1	12.2	12.4	13.3	1.4%	2.9%	7.1%
	Petroleum products	0.5	2.9	3.6	1.6	9.6%	-17.8%	-54.7%
	Natural gas	0.0	2.0	2.7	2.6	-	9.0%	-3.4%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	2.7	3.1	3.6	4.3	3.7%	11.4%	18.0%
	Total GIC	16.9	24.1	26.0	25.3	3.2%	1.7%	-2.4%
Slovenia	Hard coal & derivatives	0.5	0.2	0.3	0.3	-3.5%	10.0%	5.6%
	Lignite & derivatives	1.1	1.1	1.3	1.2	0.2%	3.1%	-7.7%
	Crude oil & feedstocks	0.6	0.2	0.1	0.1	-12.4%	-15.6%	-15.4%
	Petroleum products	1.2	2.2	2.3	2.4	5.6%	2.2%	1.8%
	Natural gas	0.8	0.9	0.8	0.9	1.3%	1.4%	10.6%
	Nuclear energy	1.2	1.2	1.4	1.3	0.9%	3.0%	-5.8%
	Renewable energies	0.3	0.7	0.8	0.7	8.5%	-0.4%	-3.5%
	Total GIC	5.5	6.5	6.9	6.9	1.8%	2.5%	0.6%

Table 2-19 (continued)

						CAGR		
Mtoe		1990	2000	2002	2003	03/90	03/00	03/02
Slovakia	Hard coal & derivatives	4.0	3.1	3.1	3.5	-1.1%	4.2%	11.8%
	Lignite & derivatives	3.5	1.2	1.1	1.1	-8.7%	-2.3%	-4.0%
	Crude oil & feedstocks	6.0	5.0	6.0	6.1	0.1%	7.0%	0.5%
	Petroleum products	-1.5	-2.5	-2.4	-2.5	3.9%	-0.4%	5.4%
	Natural gas	5.1	5.8	5.9	5.7	0.9%	-0.5%	-3.2%
	Nuclear energy	3.1	4.3	4.6	4.6	3.1%	2.7%	-0.5%
	Renewable energies	0.3	0.5	0.7	0.6	5.1%	8.0%	-12.6%
	Total GIC	21.0	17.0	18.8	18.9	-0.8%	3.6%	0.3%
Finland	Hard coal & derivatives	4.1	3.6	4.5	5.9	2.8%	17.7%	31.8%
	Lignite & derivatives	1.0	1.4	2.0	2.4	7.0%	17.7%	15.5%
	Crude oil & feedstocks	9.4	11.8	12.5	12.4	2.1%	1.5%	-1.3%
	Petroleum products	0.5	-2.6	-2.4	-2.0	-211.5%	-8.3%	-14.8%
	Natural gas	2.3	3.4	3.7	4.1	4.7%	6.1%	10.9%
	Nuclear energy	5.0	5.8	5.8	5.9	1.2%	0.4%	2.0%
	Renewable energies	5.5	7.8	7.8	7.9	2.8%	0.3%	0.8%
	Total GIC 28.7	32.5	35.1	37.1	2.0%	4.5%	5.6%	
Sweden	Hard coal & derivatives	2.5	2.2	2.5	2.3	-0.4%	1.8%	-6.7%
	Lignite & derivatives	0.2	0.2	0.3	0.4	4.0%	15.3%	3.9%
	Crude oil & feedstocks	17.0	20.3	18.7	19.8	1.2%	-0.7%	6.3%
	Petroleum products	-2.4	-5.9	-2.9	-4.4	4.7%	-9.4%	51.2%
	Natural gas	0.5	0.7	0.8	0.8	3.4%	4.6%	-0.3%
	Nuclear energy	17.8	14.8	17.6	17.4	-0.2%	5.6%	-1.0%
	Renewable energies	11.7	15.1	13.9	13.4	1.0%	-4.0%	-4.0%
	Total GIC	47.1	47.9	51.4	50.9	0.6%	2.1%	-1.1%
United Kingdom	Hard coal & derivatives	64.3	35.7	35.7	38.4	-3.9%	2.4%	7.7%
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Crude oil & feedstocks	88.7	90.1	87.5	87.2	-0.1%	-1.1%	-0.3%
	Petroleum products	-7.8	-8.7	-8.8	-7.9	0.1%	-3.2%	-10.7%
	Natural gas	47.2	87.5	85.9	85.9	4.7%	-0.6%	0.0%
	Nuclear energy	16.6	21.9	22.7	22.9	2.5%	1.4%	1.0%
	Renewable energies	1.1	2.6	2.8	3.1	8.7%	6.1%	10.4%
	Total GIC	211.1	230.4	226.4	229.8	0.7%	-0.1%	1.5%
EU-15	Hard coal & derivatives	211.1	166.3	163.1	169.2	-1.7%	0.6%	3.8%
	Lignite & derivatives	92.6	48.5	54.2	53.3	-4.2%	3.2%	-1.6%
	Crude oil & feedstocks	551.3	617.1	604.0	619.6	0.9%	0.1%	2.6%
	Petroleum products	-7.1	-28.8	-12.0	-23.4	9.6%	-6.6%	95.5%
	Natural gas	223.4	339.3	349.6	366.1	3.9%	2.6%	4.7%
	Nuclear energy	183.3	222.8	230.6	231.7	1.8%	1.3%	0.5%
	Renewable energies	64.1	84.7	85.2	92.1	2.8%	2.8%	8.1%
	Total GIC	1321.9	1455.6	1481.2	1513.6	1.0%	1.3%	2.2%
EU-10	Hard coal & derivatives	99.8	70.4	67.7	71.1	-2.6%	0.3%	5.0%
	Lignite & derivatives	28.2	20.4	20.1	20.7	-2.3%	0.6%	3.3%
	Crude oil & feedstocks	46.0	44.5	45.7	46.7	0.1%	1.6%	2.2%
	Petroleum products	4.0	3.1	3.7	3.1	-2.0%	-0.2%	-16.7%
	Natural gas	37.1	37.6	39.5	42.0	0.9%	3.7%	6.4%
	Nuclear energy	15.5	14.8	18.1	19.5	1.8%	9.5%	7.3%
	Renewable energies	3.2	8.4	10.1	11.3	10.2%	10.4%	11.4%
	Total GIC	234.5	198.3	203.5	212.6	-0.8%	2.3%	4.4%
EU-25	Hard coal & derivatives	310.9	236.8	230.8	240.4	-2.0%	0.5%	4.1%
	Lignite & derivatives	120.8	68.8	74.2	74.0	-3.7%	2.5%	-0.3%
	Crude oil & feedstocks	597.4	661.7	649.7	666.3	0.8%	0.2%	2.6%
	Petroleum products	-3.1	-25.7	-8.3	-20.4	15.5%	-7.5%	145.1%
	Natural gas	260.5	376.9	389.0	408.1	3.5%	2.7%	4.9%
	Nuclear energy	198.8	237.7	248.8	251.2	1.8%	1.9%	1.0%
	Renewable energies	67.3	93.1	95.3	103.4	3.4%	3.6%	8.4%
	Total GIC	1556.4	1654.0	1684.7	1726.1	0.8%	1.4%	2.5%

** Compound average annual growth rate*

5.5. Primary energy production

- Steady growth in the production of nuclear and renewables characterised the EU's domestic production between 1990 and 2003.
- Gas production, which had been growing throughout most of the period, began to stabilise, while oil production continued the reduction started in the late 1990s.
- The rate of decline of coal production slowed down in the latter part of the period.
- Nuclear energy remains the EU's most abundant energy source.

Primary energy production of energy in the EU-25 rose to 885 Mtoe, representing around 51% of the region's total GIC. Out of the total, 84% came from the EU-15 while the remaining 16% came from the EU-10. Production in 2003 dropped by 0.7% with respect to the previous year and has fallen by an average 0.2%/year between 2000 and 2003, mainly as a result of falling indigenous oil production in the North Sea. However, the compound annual growth rate of primary energy production between 1990 and 2003 was 0.1%, attributable to production increases that began around 1992 and peaked in 1996.

In the EU-15, the major output of primary energy in 1990 was coal and lignite (29.6%), followed by nuclear energy (26%) and natural gas (18.8%). In 2003, the structure of production was quite different, with coal and lignite accounting for only 12.7% of total production, nuclear energy 31% and natural gas 24.7%. Between 1990 and 2003, the share of oil passed from 17% to 19%, whilst the share of renewable energies passed from 9 to 12%.

In 1990, coal and lignite were by far the dominant energies of the production mix in the EU-10, representing over 83% of total output, whilst nuclear energy accounted for 9.2%, gas for 4% and oil 1.5%. Those shares had experienced considerable change by 2003: Solid fuel production was down to 71%, while nuclear energy production had increased to 14% and gas slightly to 4.3%. Oil production increased marginally to 2.2% The large increase however, was in the production of renewable energies, mainly bio-mass, whose share passed from 1.9% in 1990 to 8.3% in 2003.

Since 1998, nuclear energy has been the most abundant energy source in the EU-25, showing a steady increasing trend. Although at a much lesser level, this trend has been followed by renewable energies, mainly in the forms of bio-mass and wind. The volumes of gas and solid fuel production have remained roughly equivalent since 2000, although production of the former exhibits an increasing tendency, while production of the latter continues to decline. Oil production seems to be falling from 1999 onwards.

The United Kingdom is the EU-25's main source of domestic energy production, accounting in 2003 for more than 27% of the Community's total primary output. Indeed, the UK contributed in that year to 74% of the EU-25's total oil production as well as with 49% of the total gas produced. Other important producers of hydrocarbons in the EU-25 included the Netherlands (28% of total gas production), Germany (8% of total gas) and Denmark (4% of gas and 13% of oil). The bulk of nuclear power production came from France, whose output in 2003 was more than 43% of the EU- 25's total, along with Germany (17%) and the UK (9%). The production of solid fuels came mostly from Poland and the Czech Republic, which together accounted for more than 66% of hard coal production, and Germany which contributed to 54% of lignite production and 15% of coal production. The UK, Estonia, Hungary, Spain and Greece are also significant producers of solid fuels.

Figure 2-54: Primary energy production in the EU-25

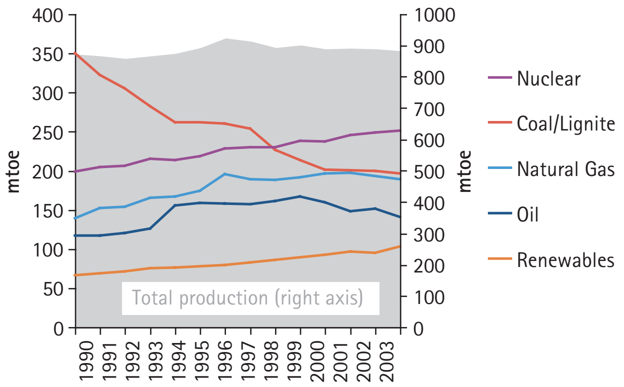


Figure 2-55: Primary energy production in the EU-25 (2003)

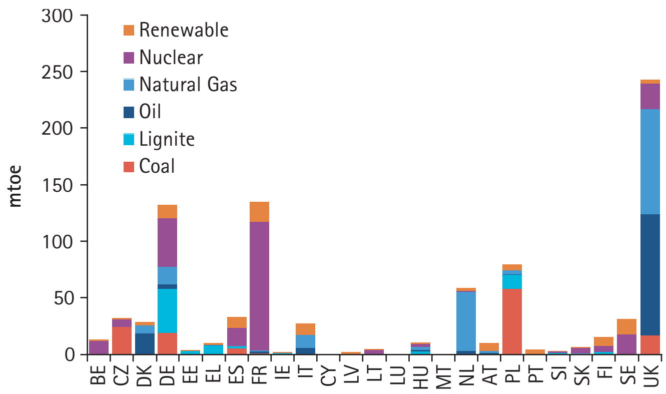


Table 2-20: Production of primary energy in the EU-25

						CAGR		
Mtoe		1990	2000	2002	2003	03/90	03/00	03/02
Belgium	Hard coal & derivatives	0.6	0.0	0.0	0.0	-100.0%	-	-
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-	-	-
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	0.0	0.0	0.0	0.0	-100.0%	-100.0%	-
	Nuclear energy	10.7	12.4	12.2	12.2	1.0%	-0.5%	0.0%
	Renewable energies	0.6	0.6	0.7	0.9	2.5%	11.8%	31.2%
	Total Production	12.0	13.1	12.9	13.1	0.7%	0.1%	1.7%
Czech Republic	Hard coal & derivatives	34.2	24.9	24.1	24.1	-2.6%	-1.1%	0.0%
	Lignite & derivatives	0.5	0.1	0.1	0.1	-12.4%	0.3%	-10.7%
	Crude oil & feedstocks	0.0	0.2	0.3	0.3	15.1%	21.8%	20.3%
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	0.2	0.2	0.1	0.1	-3.2%	-8.2%	14.2%
	Nuclear energy	3.2	3.5	4.8	6.7	5.7%	23.9%	38.1%
	Renewable energies	0.1	0.6	0.9	1.2	19.4%	24.3%	33.3%
	Total Production	38.3	29.5	30.3	32.6	-1.2%	3.3%	7.3%
Denmark	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Crude oil & feedstocks	6.1	18.1	18.5	18.5	8.9%	0.7%	0.1%
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	2.8	7.4	7.6	7.2	7.6%	-0.9%	-5.3%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	1.2	2.0	2.3	2.6	6.1%	8.2%	10.4%
	Total Production	10.1	27.6	28.5	28.3	8.3%	0.9%	-0.5%
Germany	Hard coal & derivatives	49.9	24.2	18.9	18.7	-7.3%	-8.2%	-1.0%
	Lignite & derivatives	75.1	35.4	39.9	39.3	-4.9%	3.5%	-1.5%
	Crude oil & feedstocks	3.7	3.2	3.6	3.7	0.1%	5.3%	5.3%
	Petroleum products	0.0	0.0	0.2	0.1	-	-	-59.5%
	Natural gas	13.5	15.8	16.0	15.9	1.3%	0.3%	-0.4%
	Nuclear energy	37.7	43.8	42.5	42.6	0.9%	-0.9%	0.1%
	Renewable energies	5.7	9.7	10.6	11.6	5.6%	6.0%	9.2%
	Total Production	185.6	132.1	131.6	131.9	-2.6%	-0.1%	0.2%
Estonia	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	5.0	2.7	2.8	3.2	-3.3%	6.7%	15.4%
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-	-	-
	Petroleum products	0.0	0.0	0.3	0.3	-	-	7.2%
	Natural gas	0.0	0.0	0.0	0.0	-	-	-
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	0.5	0.5	0.5	0.6	2.4%	6.8%	12.4%
	Total Production	5.5	3.2	3.6	4.1	-2.1%	9.3%	14.4%
Greece	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	7.1	8.2	8.9	8.2	1.1%	-0.2%	-8.3%
	Crude oil & feedstocks	0.8	0.3	0.2	0.1	-13.0%	-21.2%	-27.6%
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	0.1	0.0	0.0	0.0	-10.8%	-9.8%	-26.9%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	1.1	1.4	1.4	1.5	2.6%	3.4%	11.0%
	Total Production	9.2	9.9	10.5	9.9	0.6%	-0.2%	-6.1%
Spain	Hard coal & derivatives	8.9	6.5	5.8	5.4	-3.8%	-6.4%	-6.7%
	Lignite & derivatives	2.7	1.2	1.7	1.6	-3.9%	10.3%	-5.1%
	Crude oil & feedstocks	0.8	0.2	0.3	0.3	-6.8%	12.2%	1.3%
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	1.3	0.1	0.5	0.2	-13.4%	10.0%	-57.9%
	Nuclear energy	13.7	16.0	16.3	16.0	1.2%	-0.2%	-1.8%
	Renewable energies	6.3	7.1	7.3	9.4	3.2%	9.9%	29.2%
	Total Production	33.6	31.2	31.8	32.9	-0.2%	1.7%	3.4%

Table 2-20 (continued)

						CAGR		
Mtoe		1990	2000	2002	2003	03/90	03/00	03/02
France	Hard coal & derivatives	6.5	1.9	0.9	1.0	-13.2%	-18.2%	16.7%
	Lignite & derivatives	0.8	0.1	0.1	0.0	-34.1%	-68.8%	-93.9%
	Crude oil & feedstocks	3.1	1.7	1.3	1.4	-5.7%	-5.4%	6.6%
	Petroleum products	0.4	0.7	0.2	0.0	-100.0%	-100.0%	-100.0%
	Natural gas	2.5	1.5	1.4	1.3	-5.1%	-5.2%	-11.6%
	Nuclear energy	81.0	107.1	112.7	113.8	2.6%	2.0%	1.0%
	Renewable energies	15.7	17.6	16.5	17.4	0.8%	-0.4%	5.0%
	Total Production	110.0	130.6	133.1	134.9	1.6%	1.1%	1.3%
Ireland	Hard coal & derivatives	0.0	0.0	0.0	0.0	-100.0%	-	-
	Lignite & derivatives	1.4	0.9	0.5	1.0	-2.6%	4.6%	91.8%
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-	-	-
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	1.9	1.0	0.7	0.5	-9.1%	-17.2%	-19.8%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	0.2	0.3	0.3	0.3	3.5%	0.4%	-9.4%
	Total Production	3.5	2.1	1.5	1.8	-4.9%	-4.7%	22.0%
Italy	Hard coal & derivatives	0.0	0.0	0.1	0.2	12.0%	-	53.4%
	Lignite & derivatives	0.2	0.0	0.0	0.0	-100.0%	-100.0%	-
	Crude oil & feedstocks	4.7	4.6	5.6	5.6	1.4%	6.8%	0.8%
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	14.0	13.6	12.0	11.4	-1.6%	-5.8%	-5.0%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	6.4	8.5	8.6	10.1	3.6%	5.7%	17.9%
	Total Production	25.3	26.8	26.2	27.2	0.6%	0.6%	3.9%
Cyprus	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-	-	-
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	0.0	0.0	0.0	0.0	-	-	-
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	0.0	0.0	0.0	0.0	15.6%	-6.2%	-17.2%
	Total Production	0.0	0.0	0.0	0.0	15.6%	-6.2%	-17.2%
Latvia	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	0.1	0.0	0.0	0.0	-22.2%	-57.6%	-94.4%
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-	-	-
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	0.0	0.0	0.0	0.0	-	-	-
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	0.4	1.2	1.8	2.0	13.4%	16.9%	9.8%
	Total Production	0.4	1.3	1.8	2.0	12.3%	16.2%	7.9%
Lithuania	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	0.0	0.0	0.0	0.0	-0.6%	3.1%	-8.0%
	Crude oil & feedstocks	0.0	0.3	0.4	0.4	30.7%	6.5%	-12.1%
	Petroleum products	0.0	0.0	0.0	0.0	-	-4.4%	-59.6%
	Natural gas	0.0	0.0	0.0	0.0	-	-	-
	Nuclear energy	4.4	2.2	3.6	4.0	-0.7%	22.5%	9.5%
	Renewable energies	0.0	0.7	0.7	0.7	25.8%	2.4%	1.2%
	Total Production	4.5	3.2	4.8	5.1	1.1%	17.2%	5.6%
Luxembourg	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-	-	-
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	0.0	0.0	0.0	0.0	-	-	-
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	0.0	0.1	0.1	0.1	1.9%	1.9%	6.4%
	Total Production	0.0	0.1	0.1	0.1	1.9%	1.9%	6.4%

Table 2-20 (continued)

						CAGR		
Mtoe		1990	2000	2002	2003	03/90	03/00	03/02
Hungary	Hard coal & derivatives	0.7	0.0	0.0	0.0	-100.0%	-	-
	Lignite & derivatives	3.3	2.9	2.7	2.7	-1.4%	-2.2%	1.0%
	Crude oil & feedstocks	2.3	1.7	1.6	1.6	-2.8%	-1.1%	1.1%
	Petroleum products	0.0	0.0	0.0	0.1	-	-	-
	Natural gas	3.8	2.5	2.4	2.3	-3.9%	-2.6%	-3.0%
	Nuclear energy	3.5	3.7	3.6	2.8	-1.7%	-8.1%	-21.1%
	Renewable energies	0.0	0.4	0.9	0.9	37.0%	28.2%	3.4%
	Total Production	13.6	11.1	11.1	10.5	-2.0%	-1.9%	-5.7%
Malta	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-	-	-
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	0.0	0.0	0.0	0.0	-	-	-
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	0.0	0.0	0.0	0.0	-	-	-
	Total Production	0.0	0.0	0.0	0.0	-	-	-
Netherlands	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Crude oil & feedstocks	4.0	2.4	3.1	3.1	-1.9%	9.4%	0.1%
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	54.6	51.9	54.3	52.2	-0.3%	0.2%	-3.8%
	Nuclear energy	0.9	1.0	1.0	1.0	1.3%	0.8%	2.6%
	Renewable energies	0.8	1.6	1.7	2.0	7.8%	8.0%	17.1%
	Total Production	60.3	56.9	60.1	58.4	-0.2%	0.9%	-2.9%
Austria	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	0.6	0.3	0.3	0.3	-6.5%	-2.6%	-18.4%
	Crude oil & feedstocks	1.2	1.1	0.9	1.0	-1.4%	-2.1%	6.9%
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	1.1	1.5	1.6	1.8	3.8%	5.0%	11.2%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	5.0	6.5	6.7	6.7	2.2%	0.9%	-1.0%
	Total Production	7.9	9.4	9.6	9.7	1.6%	1.2%	1.2%
Poland	Hard coal & derivatives	80.8	58.5	58.5	57.8	-2.5%	-0.4%	-1.2%
	Lignite & derivatives	13.5	12.1	12.1	12.4	-0.7%	0.6%	1.9%
	Crude oil & feedstocks	0.2	0.7	0.7	0.8	12.8%	5.3%	5.4%
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	2.4	3.3	3.6	3.6	3.3%	2.9%	1.2%
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	1.6	3.8	4.1	5.1	9.3%	10.1%	22.7%
	Total Production	98.5	78.4	79.1	79.6	-1.6%	0.5%	0.7%
Portugal	Hard coal & derivatives	0.1	0.0	0.0	0.0	-100.0%	-	-
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-	-	-
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	0.0	0.0	0.0	0.0	-	-	-
	Nuclear energy	0.0	0.0	0.0	0.0	-	-	-
	Renewable energies	2.7	3.1	3.6	4.3	3.7%	11.4%	18.0%
	Total Production	2.8	3.1	3.6	4.3	3.3%	11.4%	18.0%
Slovenia	Hard coal & derivatives	0.4	0.0	0.0	0.0	-100.0%	-	-
	Lignite & derivatives	1.0	1.1	1.2	1.2	1.1%	3.7%	0.7%
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-10.2%	-9.6%	5.0%
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	0.0	0.0	0.0	0.0	-11.3%	-9.7%	-9.5%
	Nuclear energy	1.2	1.2	1.4	1.3	0.9%	3.0%	-5.8%
	Renewable energies	0.3	0.7	0.8	0.7	8.5%	-0.4%	-3.5%
	Total Production	2.9	3.0	3.4	3.3	0.9%	2.4%	-3.0%

Table 2-20 (continued)

Mtoe		1990	2000	2002	2003	CAGR 03/90	03/00	03/02
Slovakia	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	1.3	1.0	0.9	0.8	-3.4%	-7.0%	-12.3%
	Crude oil & feedstocks	0.1	0.1	0.1	0.0	-2.8%	-3.3%	-7.5%
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	0.3	0.1	0.1	0.2	-4.7%	10.6%	23.9%
	Nuclear energy	3.1	4.3	4.6	4.6	3.1%	2.7%	-0.5%
	Renewable energies	0.3	0.5	0.7	0.6	5.2%	7.7%	-11.7%
	Total Production	5.1	6.0	6.5	6.3	1.6%	1.8%	-2.9%
Finland	Hard coal & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Lignite & derivatives	1.5	1.2	2.1	1.8	1.8%	14.9%	-13.0%
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-	-	-
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	0.0	0.0	0.0	0.0	-	-	-
	Nuclear energy	5.0	5.8	5.8	5.9	1.2%	0.4%	2.0%
	Renewable energies	5.3	7.8	7.8	7.9	3.1%	0.3%	0.8%
	Total Production	11.7	14.8	15.7	15.6	2.2%	1.7%	-0.6%
Sweden	Hard coal & derivatives	0.0	0.0	0.0	0.0	-100.0%	-	-
	Lignite & derivatives	0.2	0.2	0.3	0.4	4.1%	15.6%	3.9%
	Crude oil & feedstocks	0.0	0.0	0.0	0.0	-100.0%	-	-
	Petroleum products	0.0	0.0	0.0	0.0	-	-	-
	Natural gas	0.0	0.0	0.0	0.0	-	-	-
	Nuclear energy	17.8	14.8	17.6	17.4	-0.2%	5.6%	-1.0%
	Renewable energies	11.7	15.1	13.9	13.4	1.0%	-4.0%	-4.0%
	Total Production	29.7	30.1	31.8	31.1	0.4%	1.1%	-2.3%
United Kingdom	Hard coal & derivatives	53.3	18.2	17.5	16.5	-8.6%	-3.3%	-6.0%
	Lignite & derivatives	0.0	0.0	0.0	0.0	-	-	-
	Crude oil & feedstocks	92.8	127.9	117.9	107.6	1.1%	-5.6%	-8.7%
	Petroleum products	0.0	0.0	0.0	0.0	-100.0%	-	-
	Natural gas	40.9	97.7	93.4	92.6	6.5%	-1.7%	-0.8%
	Nuclear energy	16.6	21.9	22.7	22.9	2.5%	1.4%	1.0%
	Renewable energies	1.1	2.6	2.8	3.1	8.7%	6.1%	10.4%
	Total Production	204.6	268.3	254.3	242.8	1.3%	-3.3%	-4.5%
EU-15	Hard coal & derivatives	119.4	50.8	43.2	41.7	-7.8%	-6.3%	-3.3%
	Lignite & derivatives	89.7	47.6	53.9	52.6	-4.0%	3.4%	-2.4%
	Crude oil & feedstocks	117.2	159.4	151.3	141.5	1.5%	-3.9%	-6.5%
	Petroleum products	0.4	0.7	0.3	0.1	-12.1%	-53.8%	-79.6%
	Natural gas	132.8	190.6	187.5	183.2	2.5%	-1.3%	-2.3%
	Nuclear energy	183.3	222.8	230.6	231.7	1.8%	1.3%	0.5%
	Renewable energies	63.7	84.1	84.4 9	1.2	2.8%	2.7%	8.0%
	Total Production	706.4	756.1	751.3	741.9	0.4%	-0.6%	-1.2%
EU-10	Hard coal & derivatives	116.1	83.4	82.6	81.9	-2.6%	-0.6%	-0.8%
	Lignite & derivatives	24.7	19.9	19.9	20.4	-1.5%	0.9%	2.7%
	Crude oil & feedstocks	2.6	2.9	3.1	3.1	1.4%	2.9%	1.7%
	Petroleum products	0.0	0.0	0.3	0.4	-	173.5%	38.8%
	Natural gas	6.7	6.1	6.2	6.2	-0.6%	0.6%	0.4%
	Nuclear energy	15.5	14.8	18.1	19.5	1.8%	9.5%	7.3%
	Renewable energies	3.2	8.6	10.5	11.9	10.7%	11.6%	13.4%
	Total Production	168.8	135.7	140.7	143.5	-1.2%	1.9%	2.0%
EU-25	Hard coal & derivatives	235.5	134.3	125.8	123.7	-4.8%	-2.7%	-1.7%
	Lignite & derivatives	114.4	67.5	73.7	73.0	-3.4%	2.6%	-1.0%
	Crude oil & feedstocks	119.8	162.3	154.4	144.6	1.5%	-3.8%	-6.4%
	Petroleum products	0.4	0.7	0.7	0.5	2.3%	-11.8%	-23.1%
	Natural gas	139.5	196.7	193.7	189.4	2.4%	-1.3%	-2.2%
	Nuclear energy	198.8	237.7	248.8	251.2	1.8%	1.9%	1.0%
	Renewable energies	66.9	92.7	95.0	103.1	3.4%	3.6%	8.6%
	Total Production	875.3	891.8	892.0	885.4	0.1%	-0.2%	-0.7%

** Compound average annual growth rate*

5.6. Renewable energy consumption[14]

- The share of renewables in the EU-25's total GIC represented 6% of the total in 2003.
- Bio-mass & wastes, along with hydropower were by far the most abundant sources of renewable energy.
- The trend of fast growth of wind energy continued. Production from that source has grown by an average 37% per year between 1990 and 2003.

The consumption of renewable energies (including large hydro) has been one of the fastest growing segments of the EU-25's GIC in recent years. In 2003, the share of renewable energies in GIC reached 6.0%, up from 4.3% in 1990. In the EU-15 and the EU-10, their share in that same year was 6.1% and 5.3%, respectively. In absolute terms, GIC of renewable energies was 103 Mtoe in 2003. Indeed, GIC of renewable energies grew considerably between 1990 and 2003, averaging annual growth of 3.4%/year in the EU-25. That rate increased to 3.6%/year between 2000 and 2003 and in 2003, production grew by 8.4% with respect to the previous year.

In the EU-25, the larger part of GIC of renewable energies came from the combustion of bio-mass & wastes, which in 2003 represented 67% of the total, and from hydraulic power, whose share in total GIC of renewable energies was 24%. In comparison, GIC of geothermal and wind energy was quite small, respectively accounting only for 5% and 4% of the total in the same year.

As shown in Figure 2-56, the production of renewable energies within EU-25 Member States varies widely. The largest producers were France, Sweden, Germany, Italy and Spain. The first two countries derived their production from their natural endowment of hydraulic power as well as from the combustion of bio-mass and wastes, mainly from woodlands. Indeed, large forest reserves and exploitation in Sweden and France provide considerable amounts of bio-mass for combustion; in France, that is complemented by the country's policy of power generation from municipal waste incineration.

Figure 2-56: GIC of renewable energy in the EU-25 (2003)

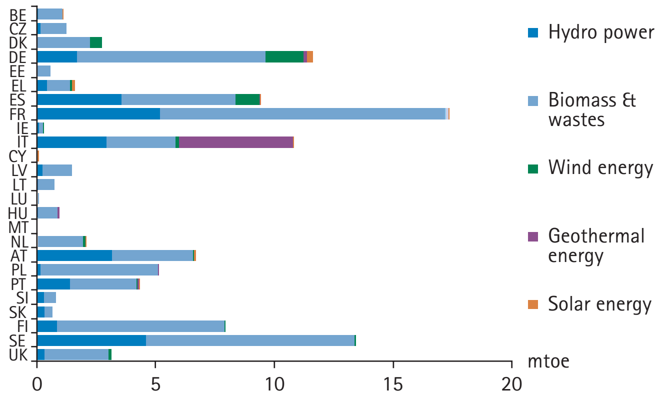


Table 2-21: Gross inland consumption of renewable energies in the EU-25 (2003)

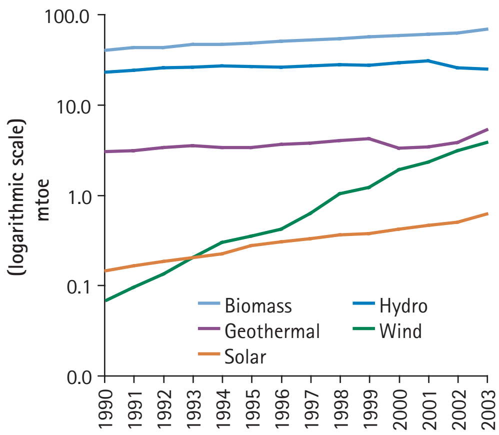
'000 toe	Biomass & wastes	Hydro power	Geothermal energy	Wind energy	Solar energy	Total	% of total GIC
Belgium	1023	21	1	8	2	1056	1.9%
Czech Rep.	1093	119	0	0	0	1212	2.8%
Denmark	2251	2	2	478	9	2742	13.3%
Germany	7932	1656	132	1622	241	11582	3.4%
Estonia	519	1	0	0	0	520	9.5%
Greece	945	410	1	88	105	1549	5.1%
Spain	4788	3530	8	1038	48	9412	7.0%
France	12014	5134	129	29	20	17325	6.4%
Ireland	170	51	0	39	0	261	1.7%
Italy	2918	2905	4810	125	11	10769	5.9%
Cyprus	1	0	0	0	36	37	1.5%
Latvia	1263	195	0	4	0	1462	33.4%
Lithuania	677	28	0	0	0	705	7.8%
Luxembourg	51	7	0	2	0	60	1.4%
Hungary	817	15	86	0	2	920	3.4%
Malta	0	0	0	0	0	0	0.0%
Netherlands	1902	6	0	114	19	2041	2.5%
Austria	3401	3125	19	31	80	6657	20.3%
Poland	4916	144	7	11	0	5078	5.4%
Portugal	2806	1352	78	43	21	4300	17.0%
Slovenia	460	271	0	0	0	731	10.5%
Slovakia	326	299	1	0	0	626	3.3%
Finland	7041	825	0	8	0	7874	21.2%
Sweden	8743	4576	0	54	5	13378	26.3%
UK	2695	278	1	110	20	3105	1.4%
EU-15	58681	23877	5180	3791	581	92110	6.1%
EU-10	10072	1072	95	15	38	11292	5.3%
EU-25	68753	24949	5275	3805	619	103401	6.0%

[14] *Production and primary consumption (GIC) are used interchangeably in this section.*

Wind energy is by far the most dynamic segment, and was mostly concentrated in Germany (43% of total wind), Spain (27%) and Denmark (13%). Italy, the Netherlands and the UK also contributed to wind energy with around 3% each. Though its contribution remains small in respect of the EU-25's total consumption of energy, the production of wind energy grew by an astonishing 36.5%/year between 1990 and 2003. Geothermal energy production is almost entirely concentrated in Italy (93% of total geothermal production).

The main producers of solar energy were Germany (39% of total solar energy production), Greece (17%), Austria (13%), Spain (8%) and Cyprus (6%).

Figure 2-57: Evolution of GIC of renewable energies in the EU-25

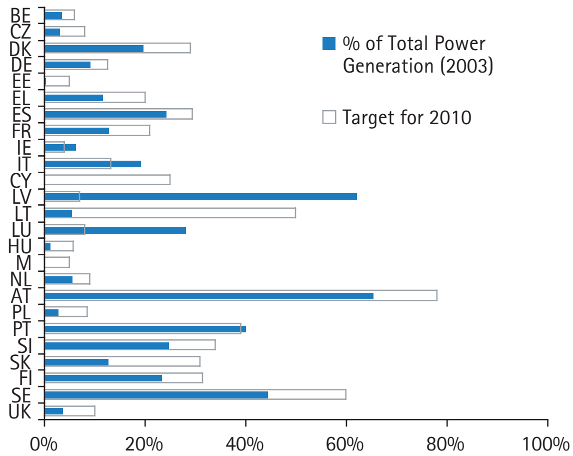


The 0.6 Mtoe produced in 2003 represented a mere 0.6% of total production of renewable energies, that is, only 0.04% of the EU-25's total GIC. But solar production has also been growing rapidly, attaining a 11.8% average annual growth rate between 1990 and 2003.

Increasing the use of renewable energies is one of the Commission's major policy objectives, not only in terms of its potential to contribute to greenhouse gas emissions abatement and ameliorate sustainability, but because they are also an indigenous energy source and, as such, contribute to supply security. A Directive adopted in 2001 to promote the use of renewable energies for the generation of electric power established targets for each Member State relating to the amount of electricity that should be generated from renewable sources by 2010.

Figure 2-58 presents the Commission targets as well as each Member State's position in 2003. High targets are given to Member States naturally endowed with renewable sources such as Austria, the Nordic countries, Portugal and Spain. The Commission has set a target to generate 22% of the EU's electric power from renewable energy sources by 2010. Excluding hydro power, only 2% of the total electricity generated in 2003 came from renewable sources in the EU-25.

Figure 2-58: Actual and projected share of power generation from renewable energies (including large hydro): EU-25



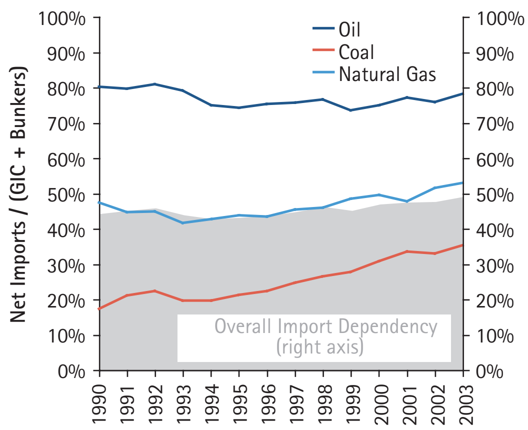
5.7. Import dependency and supply security

- The level of import dependency in the EU-25 is growing. In 2003 it attained over 49% in 2003.
- However, both gas and oil supplies are becoming slightly more diversified. The share of oil imported from OPEC countries continued to decrease as well as the share of Europe's traditional gas suppliers (Algeria and Russia).

Despite abundant energy sources, the EU is a net importer of primary energy. In 2003, the EU-25 imported 876 Mtoe of energy, of which 60% was crude oil, 25% natural gas, 13% hard coal and 3% refined petroleum products.

Import dependency –defined as the ratio of net imports to the sum of gross inland consumption and marine bunkers– was 49.4% for the EU-25 in 2003. The EU-15's import dependency was somewhat higher, attaining nearly 52% in 2003. In contrast, import dependency in the EU-10 was 32% in the same year.

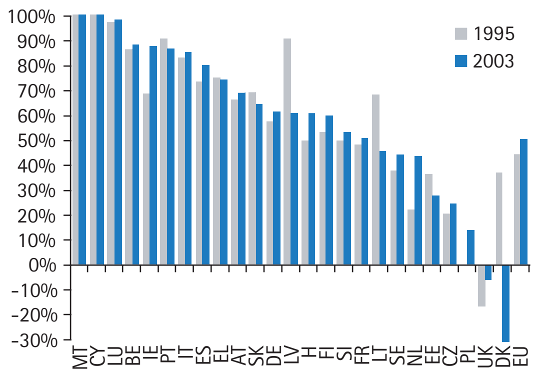
Figure 2-59: Evolution of import dependency by fuel in the EU-25



As production of oil and gas in the North Sea declines, and with Europe's economies consuming less indigenous coal and more imported coal (for environmental and commercial reasons), the EU's import dependency has gradually grown over the years. Import dependency for the EU-25, was 44.6% in 1990, almost five percentage points below the level recorded in 2003. In the EU-10, import dependency in 1990 was 28% (4 percentage points lower than in 2003).

Import dependency is lowest in some of the hydrocarbon-producing countries: For example, dependency was below the 30% mark in the Czech Republic, Denmark, Estonia, Poland and the United Kingdom, which produce important volumes of oil, gas or coal. On the other hand, countries whose import dependency exceeded 85% were Ireland, Italy, Cyprus, Luxembourg, Malta and Portugal. In most of these cases, the high dependency is mainly related to oil and gas. Figure 2-60 compares the level of aggregate import dependency in the EU's Member States between 1995 and 2003.

Figure 2-60: Import dependency by Member State in the EU-25



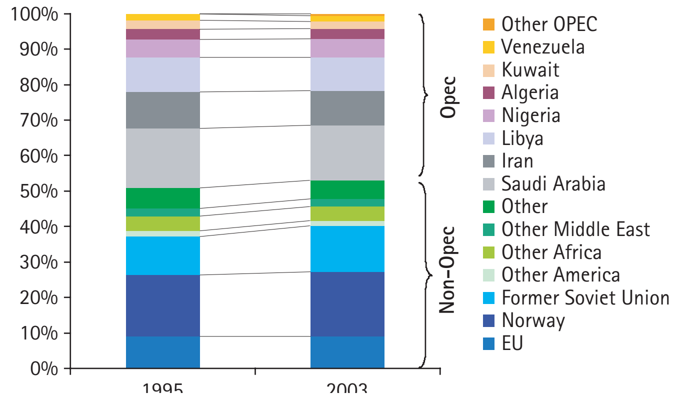
On a fuel basis, dependency on oil continues to be the highest. Although it dropped to just over 72% in 1999, when production from the North Sea peaked, it has been gradually growing ever since, and in 2003 reached 78%, the highest level since 1993. Nonetheless, the level of dependency has remained relatively stable over the period considered.

The same cannot be said about the import dependency of coal and gas. In the EU-25, dependency on the former fuel, which was just above 17% in 1990, more than doubled by 2003, surpassing the 35% threshold. Dependency on imported gas has exhibited a less clear trend, although it has been, in general terms upward sloping since 1993. Import dependency of gas passed from 42% in 1993 to 53% in 2003.

In 2003, 56% of the EU-15's oil supplies came from Norway (18%), the Former Soviet Union (13%), Saudi Arabia (16%) and domestic production (9%). The EU has increased diversification and augmented supply security by increasing the shares of oil imported from the Former Soviet Union (FSU) and Norway –with which it has signed energy security agreements– and by reducing its imports from riskier sources such as Saudi Arabia, Iran and Libya. There is also a clear shift away from OPEC countries towards non-OPEC producers.

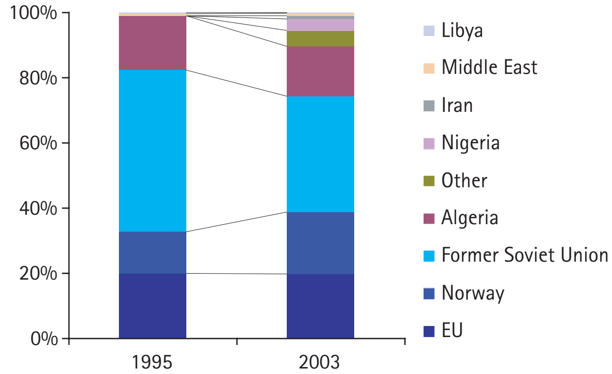
Diversification has been more important in the EU's imports of natural gas. There, the share of gas imported from the two traditional sources –the FSU and Algeria– have been replaced by other imports, mainly from Norway. Nigeria, Iran and other sources (including Trinidad & Tobago, Oman, Qatar and UAE). It is worth noting however, that despite the share decreases between 1995 and 2003, the absolute volumes imported have increased in all cases.

Figure 2-61: Imports of crude oil in the EU-15 by country of origin



Source: IEA

Figure 2-62: Imports of natural gas into OECD Europe by country of origin



Source: IEA

6. TRANSPORT DEVELOPMENTS[15]

- From 1995 to 2003, the enlarged Union's freight transport performance (measured in tonne-km) grew by 24%. In recent years, however, stagnation or decreasing trends were observed in some Member States.
- Growth of freight transport was primarily driven by increasing maritime and road transports.
- Passenger transport performance (measured in passenger-km) increased by approximately 14.5% between 1995 and 2003.
- Air transport experienced highest growth rates, followed by individual motorised transports. However, most recently air transport performance has stagnated. At the same time international and domestic high-speed rail transports have become more important.

The aim to guarantee free movements of persons and goods, which is a central issue in the completion of the internal market, relies heavily on a high-capacity transport system. The smooth functioning of the transport system depends on high quality transport infrastructure and on the sufficient supply of transport services. Since the development of European transport infrastructure is discussed in chapter II.2 in further detail, this section focuses on the development of transport services and activities.

Transport activities can first be analysed in quantitative terms, with transport performances measured in passenger- or tonne-kilometres. Most EU-25 Member States experienced significant increases in this metric in the 70s, 80s and early 90s. However, the late 90s and particularly the beginning of the twenty-first century have been characterised by opposite trends. While performances have still increased in some countries, breaks in these trends were observed in others. This is true for passenger transport, where growth rates generally declined, but also holds for freight transport, where rapidly increasing performances contrast with clearly decreasing trends.

According to the Commission's White Paper on European Transport Policy, the users' interests should be placed at the core of transport policy. Consequently, qualitative issues of transport services can be considered equally important as quantitative indicators - especially as transport performances are partly stagnating indicating that sufficient (quantitative) levels have already been achieved in several Member States.

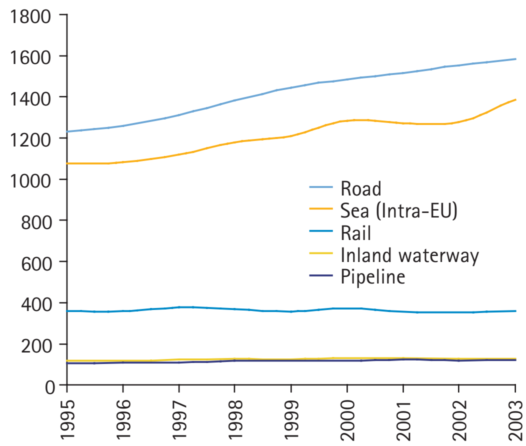
In the main, qualitative issues relate to specific transport modes. Therefore, the development of modal shares will be analysed alongside transport performance. However, quality indicators such as customer satisfaction, travel speed, effects on the environment as well as safety and efficiency of the transport system are discussed in further detail later in the report.

6.1. Freight transport

6.1.1. European trends

Many European economies have experienced rapidly changing industrial structures in recent years. In general structural changes have further strengthened the already dominant role of service sectors. Increases in tonne-kilometres derive not from increasing volumes but from an increasing number of trips and longer distance per trip. Indeed modern manufacturing processes are characterised by international diversification, which requires the application of modern logistic concepts allowing for "just-in-time production", "day-to-day deliveries", etc. In addition to the transportation of intermediate products, the private householders' final demand is largely satisfied by goods manufactured abroad. Consequently, trade flows have increased strongly. In monetary value some Member States' trade flows have even exceeded domestic production in recent years.

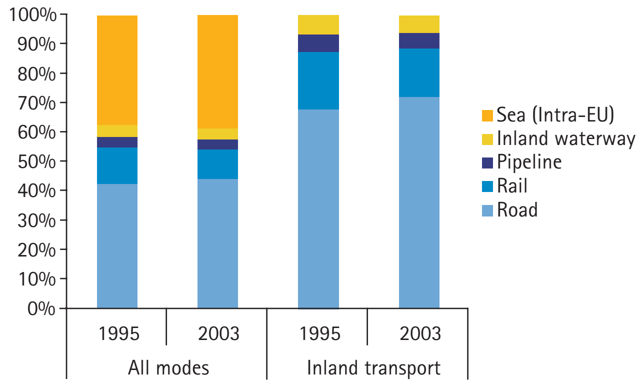
Figure 2-63: Freight transport performance by mode in the EU-25



During the period 1995 to 2003, net effects on freight transport were positive for the majority of the EU Member States. Accumulated growth for this period and all modes amounted to approximately 24%.

The growth is mainly driven by road haulage and (intra-EU) sea transports. In contrast rail, inland waterways and pipelines have shown rather constant levels which in turn has lead to a further decline of the respective modal shares.

Figure 2-64: Modal split of EU-25 freight transport 1995 and 2003



[15] *Unless stated otherwise, all data in this section was produced by Eurostat and in the EC Energy and Transport in Figures 2004 publication.*

When we consider all modes of transport, sea and road transport dominate both in 1995 and 2003. Road transport increased its share from 42.5% to 44.2%, and sea transport from 37.3% to38.7%. In contrast railway shares declined from 12.4% to 10% and inland waterway from 4.1% to 3.6%. The share of pipelines remained more or less constant at approximately 3.5%.
Often modal shares refer to inland transports only. In this context road transport accounted for about 68% in 1995 and further increased its share to more than 72% in 2003 at the expense of all other modes. Rail dropped from about 20% to 16%, inland waterway from around 7% to 6% and pipelines show decreasing trends at a level of slightly less than 6%.

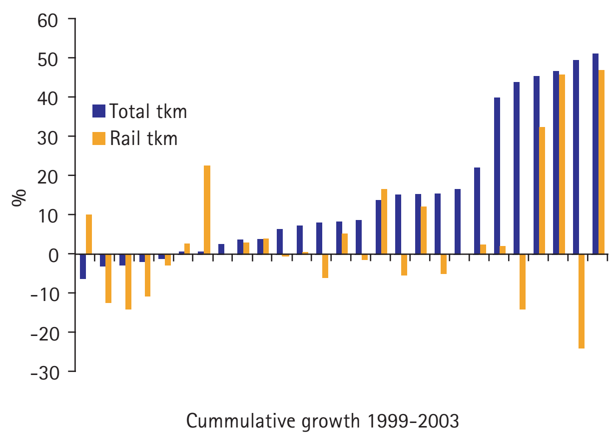
6.1.2. National trends

The overall Union trend of increasing tonne-kilometres does not hold for all Member States, with trends differing significantly. This is especially true in recent years. Figure 2-65 shows the accumulated growth between 1999 and 2003, with total growth rates referring to inland transport. In addition the figure provides information about the growth of rail transport. The latter does not exist in Cyprus and Malta.

Countries are ranked according to their relative increases of total tonne-kilometres. A decreasing inland transport performance can be identified for the Netherlands, France, Poland, Hungary and Denmark. However, with the exception of the Netherlands rail transports also declined at above average rates in these countries. Due to the low level of rail transports in the Netherlands and Greece, relative increases hardly affect the modal split. The converse is true for Ireland and Luxembourg.

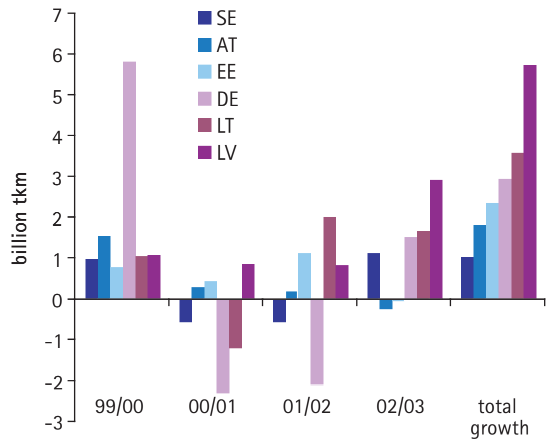
In the case of the United Kingdom, Slovenia and Germany relative growth was higher for rail transport than other modes. This in turn points to (slightly) increasing rail shares. Growth rates were slightly smaller than overall growth of inland transport in Denmark, Finland, Sweden, Austria, Lithuania and Latvia. Thus rail shares can be considered more or less stable.

Figure 2-65: Freight transport development by country, accumulated growth 1999-2003



Due to the high starting level, absolute increases have been significant in Sweden, Austria and Germany. However, the Baltic States clearly outperformed these countries. Figure 2-66 shows the annual increases in tkm for these countries.

Figure 2-66: Most significant absolute growth of rail transport performance

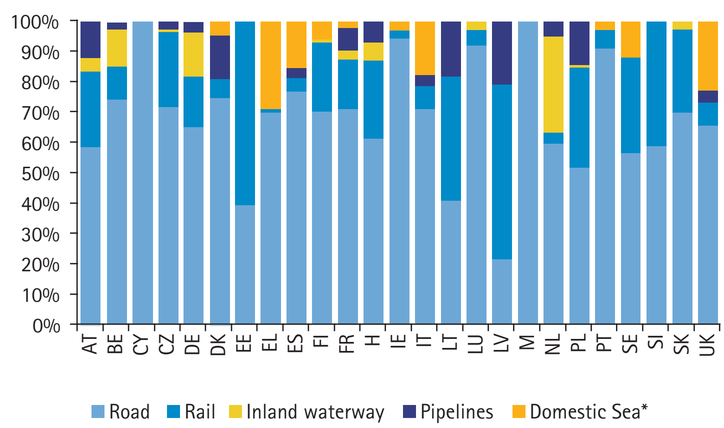


For the remaining countries growth of rail transport was significantly lower compared to overall increases in freight transport. This is true for countries with positive trends such as the Slovak Republic or Spain, but also holds for France, Poland and Hungary which experienced negative growth rates. With regard to modal shares, the discrepancies point to a major shift towards road haulage.

Figure 2-67 gives an overview of the modal shares at country level. The shares relate to the transports on national territory. Thus domestic sea transports are (if available) included.

With the exception of the Baltic States, road shares clearly dominate freight transport. On the one hand, the dominating role of road haulage results from higher flexibility at lower costs - neglecting external costs. On the other hand, the picture is incomplete since data on domestic sea transports is missing for the new Member States.

Figure 2-67: Modal shares of Member States, inland transport, 2003



**Domestic sea transports only known for former EU-15 Members*

A more complete picture can be given with regard to shares of international trade volumes when measured in tonnes (instead of tonne-kilometres). For countries without access to maritime ports modal shares are similar to the shares above (Austria, Czech Republic, Hungary, Luxembourg, Slovak Republic). However, due to higher average loads, rail transports show slightly higher shares. Vice versa sea shipping obviously dominates international freight transport for islands. This is particularly true for Cyprus and Malta, where maritime transport shares amount to 100%, but also holds to a lesser extent for Ireland, the United Kingdom and (though not being islands) Greece and Denmark. Maritime shares account for slightly less than 100% in these countries. Figure 2-68 provides the shares of international trade volumes that can be observed for the remaining countries.

With regard to trade volumes, maritime transports can be considered even more important than road transports. Interestingly, country shares differ significantly between imports and exports.

Figure 2-68: Share of international trade volumes in volume (2003)

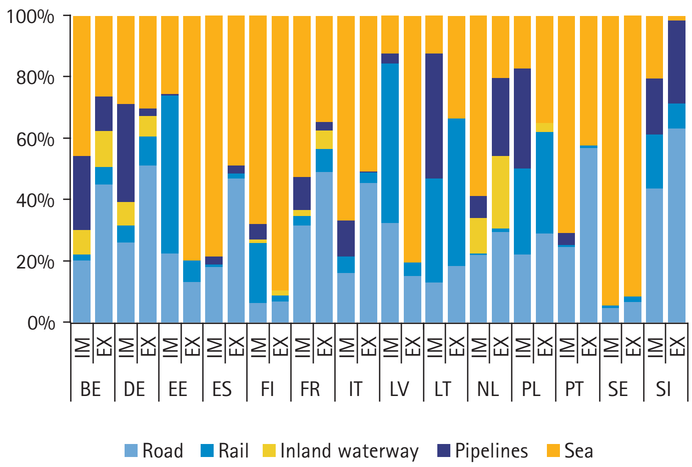
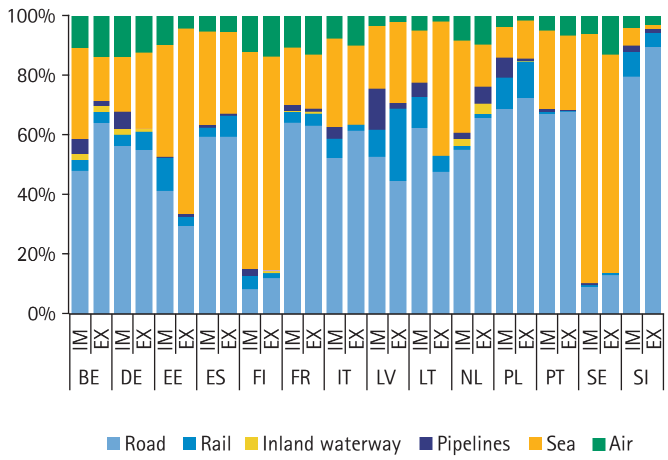


Figure 2-69: Share of international trade volumes in value (2003)



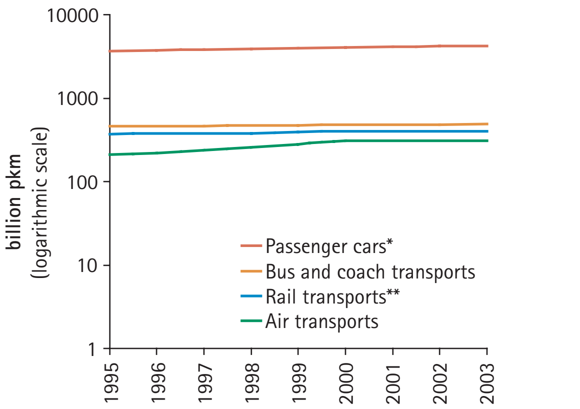
This points to the different structure of trade flows. With the exception of Estonia, Latvia and Sweden, all Member States show higher volumes related to imports. Trade with the rest of the world is still characterised by imports of raw materials and intermediate products and exports of final goods. The analysis of trade flows in monetary value, given by Figure 2-69 further strengthens the assumption of different structures.

With the exception of Sweden and Finland, road transport clearly dominates international trade flows in monetary value. Sea and rail transport, however, reduce in importance. This shows the dilemma of rail transport. While road hauliers transport relatively high-valued goods, rail transports serve, in most cases, markets of comparably low-value goods (e.g. mass products). Subsequently, transport costs make up for higher shares in rail transport, which in turn leads to relatively small margins.

Conversely, air transport is insignificant in volume terms, but serves the high value market or time-sensitive goods. Therefore, clients are willing to accept higher costs for transportation.

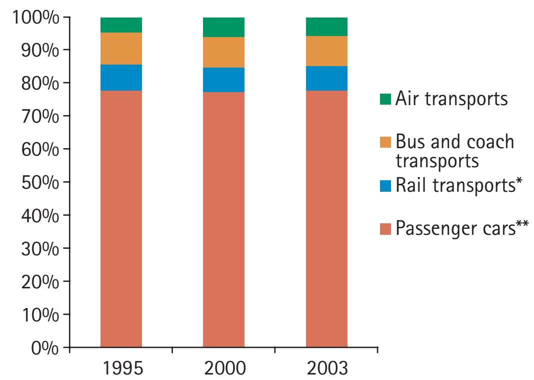
6.2. Passenger transport

Figure 2-70: Development of passenger transport performance in the EU-25 between 1995 and 2003



**Including motorised bikes; **Including tram and metro*

Figure 2-71: Modal split of European passenger transport, EU-25 in 1995, 2000 and 2003



**Including tram and metro; **Including motorised bikes*

6.2.1. European trends

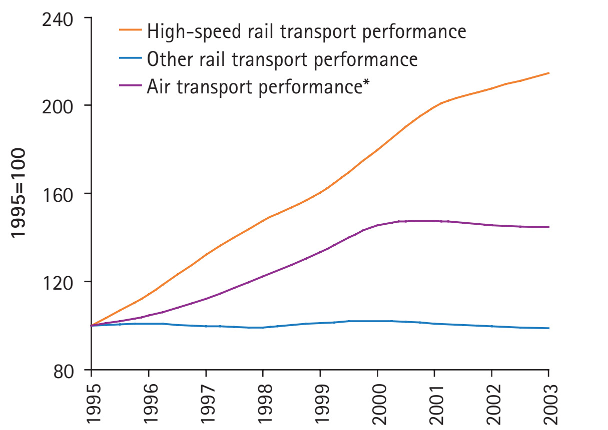
During the period 1995 to 2003, tonne-kilometres increased by approximately 24%. The Member States' growth rates in passenger transport, generally measured in terms of passenger-kilometres, have been significantly smaller. Nevertheless, accumulated average growth came up to about 14.5% in this period. Passenger transport experienced average growth (+14.4%), with bus (+5.7%) and rail (+9.2%) showing positive trends as well. However, the modal shares of these sectors slightly decreased. The air transport market turned out to be the most dynamic passenger transport market. In total, air transport performance (intra-EU plus domestic flights) increased by 44.6%. Figure 2-70 gives an idea of European passenger transport development.

In recent years (e.g. 2000 to 2003), rail and air transports have been stagnating. In contrast, bus transports and specifically passenger road transport have been characterised by continuously increasing performances. In the case of individual road transport, growth is largely driven by an increasing motorization of Central and Eastern European Member States. Figure 2-71 provides a first overview of the modal shares of European passenger transports.

Individual road transports account for approximately 78% of total passenger-kilometres and clearly dominate the sector. Marginal shifts can be observed for the other modes. While the late 1990s were characterised by the increasing relevance of the aviation sector at the cost of rail transport, the trend came to an end in the first years of the new century. In fact, the high passenger volume for European high-speed connections points to the fact that the Commission's aim to revitalise European railways could gain greater significance in the near future. Existing high-speed connections such as Frankfurt-Cologne-Brussels, Brussels-Paris, Paris-Lyon have already increased their shares at the cost of domestic or intra-EU flight connections. Figure 2-72 compares the development of highspeed rail performance with other rail and air transport trends.

The trend clearly points to the attractiveness and consequently the competitiveness of high-speed rail transports. Thus the ongoing promotion and encouragement on the part of European transport policy to further extend the European highspeed network can be seen as a policy measure of utmost importance to revitalise European railways.

Figure 2-72: Growth of European high-speed rail transports in the EU, 1995-2003



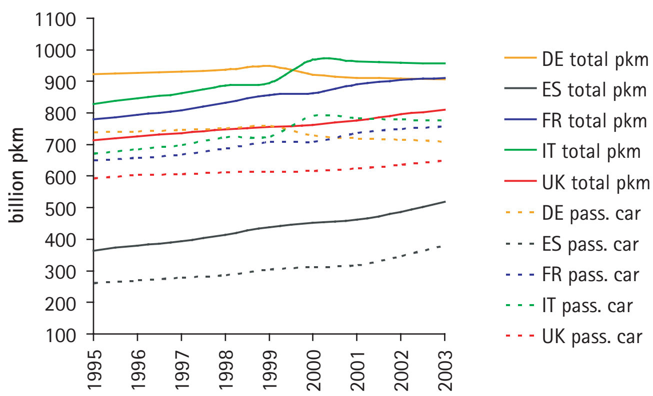
6.2.2. National trends

The aggregated trends give an overview of the general passenger transport sector development. However, a more detailed analysis at national level reveals a diversity in trend.

While some countries just follow the overall European trends, others have either experienced much stronger increases in terms of passenger-kilometres or in some cases, even decreasing passenger transport performances. If we consider the five biggest economies of the Union, passenger-kilometres continuously increased between 1995 and 2003 in France, Spain and the United Kingdom. Italy experienced rapidly increasing performances until the year 2000, stagnating afterwards. In contrast, decreasing passenger-kilometres can be observed for Germany, the most populous Member State. Thus Germany, which clearly outperformed the other Member States in terms of absolute passenger-kilometres in 1995, dropped behind Italy and France in 2003. Figure 2-73 shows the development of passenger-kilometres for these countries. The illustration of total passenger-kilometres and individual road transport performances confirms the high relevance of passenger cars (and motorised bikes which are included). In fact, trends for both indicators run more or less parallel for all countries.

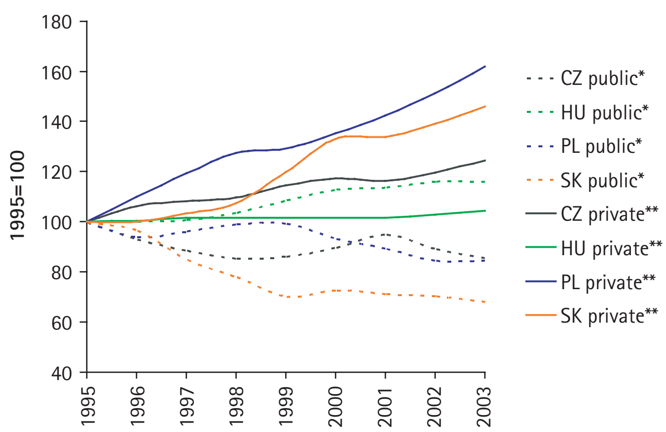
Between 1995 and 2003, the EU-15 Member States mainly experienced passenger transport growth of around 15% (+/-3%). This is true not only for the illustrated performances of Italy, France and the United Kingdom, but also for Belgium, Denmark, Finland, Luxembourg, the Netherlands and Sweden. Significantly higher growth was observed for Greece (+46%), Ireland (+66%), Portugal (+48%) and Spain (+42%). In contrast, passenger transport grew at below-average rates in Austria (+5%) and Germany (-2%).

Figure 2-73: Development of passenger transport performance in France, Germany, Italy, Spain and the UK



Due to the high relevance of passenger cars, trends of overall passenger-kilometres more or less follow trends in individual motorised transports. Though shares slightly shift towards individual road transports, EU-15 Member States, with the exception of Portugal, show constant or even increasing trends for public transports in absolute terms. In contrast, individual transports often replace public transports in the Eastern Member States. Figure 2-74 compares the development of private and public transport in the case of Hungary, Poland, and the Czech and Slovak Republic.

Figure 2-74: Growth of private and public transport in selected Eastern European Member States



**Public: Rail and bus transports; **Private: Individual motorised transports*

The converse can be identified for Poland, the Czech and particularly the Slovak Republic. In contrast, Hungary shows increasing trends for public and private transports. Interestingly, growth is even stronger with regard to public transports. While public transport performance was, compared to former EU-15 Member States, relatively high in 1995, the opposite trends in growth of private and public transport performance came along with significant shifts of modal shares.

Figure 2-75 illustrates the development of modal shares for 20 Member States. Due to limited data on individual motorised transport performance and intra-EU aviation, the figure does not include Cyprus, Malta nor the Baltic States.

The highest share of individual transport performance can be observed in France. In contrast Hungary makes up for the lowest share. Greece, Poland, Portugal, Slovenia, and the Czech and Slovak Republic experienced the highest increases of individual transport shares. In contrast, decreasing shares of individual motorised transport can be identified for Austria, Germany, Hungary and Sweden. Rail transport shares amounted to more than 10% in six countries in 1995. However, in 2003 only three countries – Austria, the Czech Republic and Hungary – exceeded this level. Bus transport often accounts for the second highest shares. This is particularly true for the Slovak Republic and Hungary, where these transports came up to 22% and 24% respectively. Not surprisingly air transport is particularly relevant for the rather peripheral Member States Greece, Ireland, Spain and Sweden.

The rapid increases in individual motorised transport have been brought about by increasing levels of motorization (measured in number of passenger cars per 1,000 inhabitants). Consequently, people aim to use their cars and avoid public transport. Figure 2-76 shows these opposite trends that can particularly be observed for the new Member States. In this analysis smaller economies are chosen for illustration.

Due to the relatively low starting level of motorization, increases are hardly surprising. However, increases are not just observed for Member States with a relatively low starting level. Some countries show consistently growing levels of motorization despite high absolute levels. Conversely, stagnating trends can be observed at relatively low levels. Reasons are manifold and some of them are discussed briefly in the chapter on transportspecific drivers (household structures and incomes). Figure 2-77 compares the level of motorization for the EU-25 Member States (excluding Estonia, Latvia, Lithuania and Slovenia whose level of motorization is already shown in Figure 2-76).

Figure 2-76: Development of public transport (in km per person) and motorisation (in number of passenger cars per 1,000 inhabitants)

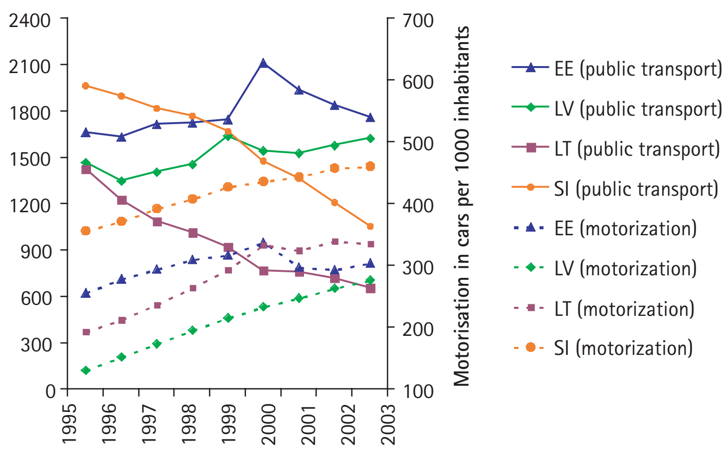


Figure 2-77: Motorization in the EU Member States (2003)

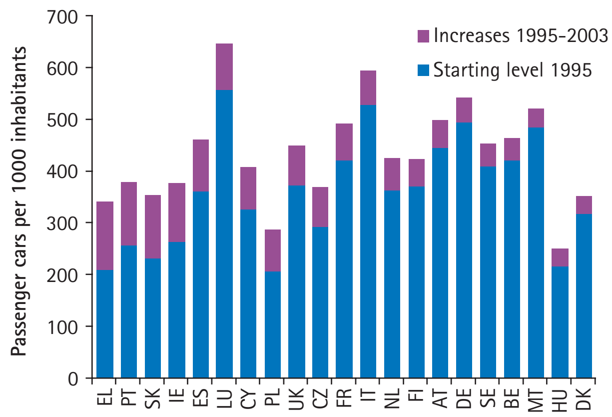
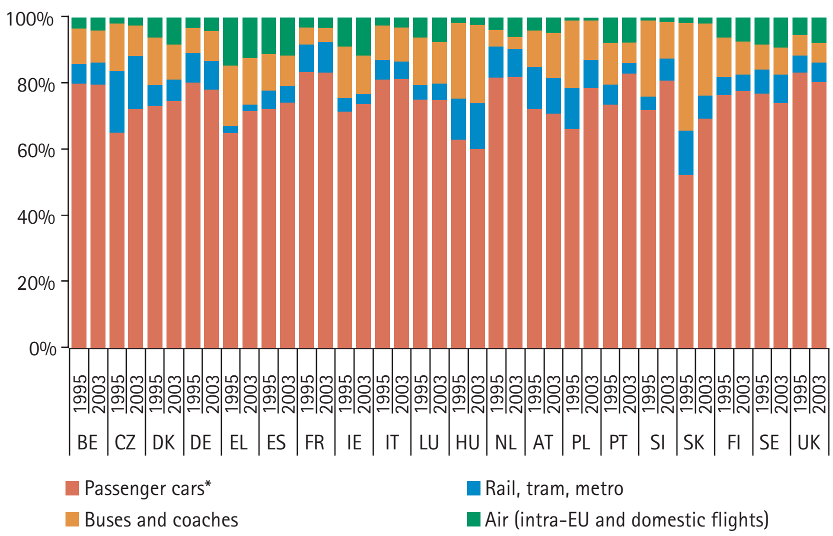


Figure 2-75: Modal shares of Member States, 1995 and 2003



The level of motorization in 2003 is a function of both the starting level in 1995 and the absolute increases between 1995 and 2003. The countries are ordered according to the growth rates, i.e. Greece experienced the highest and Denmark the lowest increases. Some countries with a high level of motorization show rather modest increases (Austria, Belgium, Germany, Malta, Sweden). This in turn would strengthen the assumption of stagnating trends once the country realised a certain level of motorization. However, there is hardly a general rule. Increases in Luxembourg and Italy are significantly stronger compared to growth in Denmark or Finland which started at lower level and have high levels of disposal household income.

7. ENVIRONMENT

- Emissions come mainly from the power generation and transport sectors, responsible for 64% of CO_2 emissions and the larger part of acidifying emissions.
- The largest CO_2 emissions increases came from the transport sector, which have grown by an average 1.8% between 1990 and 2002.
- The establishment of emission standards has lead to substantial reduction of NOX emissions. However, reductions in road transport have been partly offset by growing emissions from maritime transports.
- Policy efforts have lead to significant decreases in fatalities.

7.1. Overview

The energy transformation sector (which includes power generation and refining) and the transport sector are the greatest sources of anthropogenic emissions within the EU-25. The two sectors account for more than 64% of total CO_2 emissions and are the major source of other pollutants including other greenhouse gases, acidifying compounds, particulate matter and noise. Indeed, energy transformation and transport were also responsible for the larger part of acidifying gases that cause acid rain: Combustion of coal and oil for power generation is the main source of sulphur compounds, whilst road traffic is the main source of nitrogen oxides. Their huge environmental impact underlines the importance of the Commission's approach of producing EU-wide coordinated and integrated policies for the two sectors.

7.2. CO_2 emissions[16]

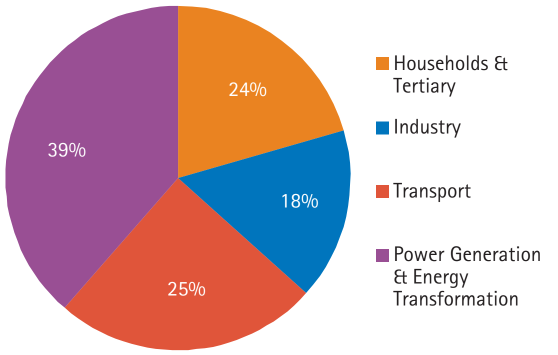
Carbon dioxide (CO_2) emissions from human activities represent more than 80% of greenhouse gas (GHG) emissions, the group of compounds responsible for global warming. In 2003, CO_2 emissions in the EU-25 rose to 4028 million tonnes, a 0.2% increase with respect to the previous year. Emissions from the EU-15 represented almost 86% of the total, with the EU-10 accounting for the remaining 14%.

The larger part of CO_2 emissions came from the power generation and energy transformation sector. In 2003, emissions from that sector contributed to 39% of total CO_2 emissions. Second in line were the transport and the households & tertiary sectors, each contributing about a quarter to the total. Emissions from the industrial sector came last with an 18% share.

Although emissions in the EU-25 dropped over the 1991-1994 period, their volume has been growing ever since (with the exception of 1999, a particularly rainy year, which allowed for high production levels from hydro electric stations). In fact, CO_2 emissions have been increasing at an average annual growth rate of 0.7%, from 1994 to 2002. In 2002, emissions for the EU-25 were 1.6% above the 1990 level.

Figure 2-79 shows that emissions from the households and industrial sectors have been stable to declining. Emissions from the power generation sector, present a rather "u-shaped" path, having initially declined in the early 1990s but regaining an upwards sloping trend from 1997 onwards. It is the transport sector that has most contributed to aggregate emissions growth by increasing uninterruptedly since 1990, and overtaking in 1996 the household sector as the EU's second largest source of emissions. On average, emissions from the transport sector have grown by an annual rate of 1.8%. This increase has come about mainly from growing traffic volumes and higher motorization, as there have been only modest improvements in the average energy use per vehicle kilometre.

Figure 2-78: Distribution of CO_2 emissions (2002)

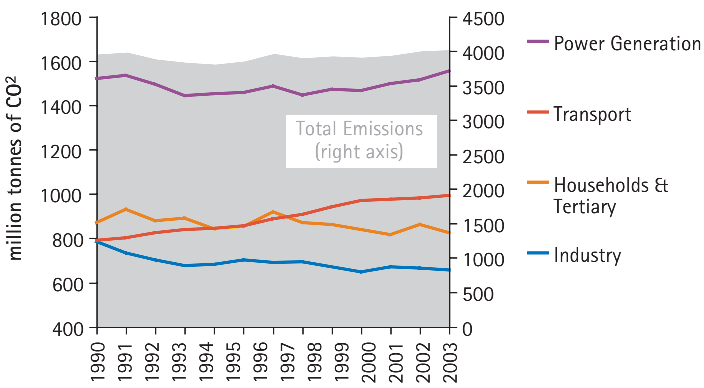


**Source: Eurostat*

Table 2-22: Total inland CO_2 emissions in the EU-25

Million tonnes of CO_2	1990	2002	CAGR 2002/90	% of Total in 2002
Households & Tertiary	871	825	-0.4%	20.5%
Industry	784	657	-1.4%	16.3%
Transport	791	992	1.8%	24.6%
Power Generation & Energy Transformation	1519	1554	0.2%	38.6%
Coal	1664	1207	-2.4%	30.0%
Oil	1557	1670	0.5%	41.5%
Natural gas	555	866	3.5%	21.5%
Bio-mass & Wastes	189	285	3.2%	7.1%
Industrial wastes	7	14	4.9%	0.3%
Total CO_2 Emissions	3965	4028	0.1%	100.0%
% over 1990 level (total emissions)	0.0%	1.6%		

Figure 2-79: Total inland CO_2 emissions by sector in the EU-25



[16] *This section, and all other references to CO_2 levels, present Eurostat data for total inland emissions calculated through the sectoral approach.*

Significant progress, on the other hand, has been achieved in tackling CO_2 emissions from the power generation and energy transformation sectors. The fact that generation of electric power and the FED of electricity grew by more than 27% while CO_2 emissions from that sector grew by a mere 2.3% between 1990 and 2003 are evidence of the decoupling of production, consumption and emissions. This has been achieved through the use of less CO_2-intensive generation technologies, through the substitution of oil and coal by gas, and through the increasing use of alternative fuels and technologies for power generation.

Under the Kyoto Protocol, the EU agreed to reduce its aggregate greenhouse gas emissions to 8% below 1990 levels by 2008-2012. To this end, the Member States agreed to individual targets under what is called the EU "burden-sharing" scheme. As evidenced in Table 2-23, Member States' compliance has been varied: Whereas there are some countries that are on track to achieve their targets, that is with emissions in 2002 less than 10 percentage points from their target (in blue in the table), others (in red) presented emissions in 2002 more than 25 percentage points above their target for 2008-2010.

Although CO_2 emissions in the EU-25 had grown by 1.6% relative to emissions in 1990, the EU Emissions Trading Scheme launched in January 2005, is expected to lead the EU to meeting its Kyoto objectives by 2010. The ETS is the first major trans-national CO_2 flexible abatement mechanism to be implemented in the world. The Commission hopes other countries will follow Europe's example and efforts, and work together to curb global CO_2 emissions.

7.3. Acidifying emissions

The main anthropogenic precursors of acid rain are sulphur dioxide (SO_2) and nitrogen oxides (NOX), two compounds that are mainly emitted from the combustion of fossil fuels such as coal, oil, petroleum products and natural gas. SO_2 and NOX emissions have dropped substantially in the EU, due to European legislation forcing the installation of desulphurisation systems, reductions in coal use and the use of low-sulphur coals, and major economic restructuring (especially in the new German Länder and the EU-10), but also from the installation of catalytic converters, which has helped to reduce NOX and volatile organic compound (VOC) emissions from motor vehicles. Figure 2-80 and Table 2-24 show the evolution of these emissions in the EU-25.

Figure 2-80: Total acidifying emissions in the EU-25

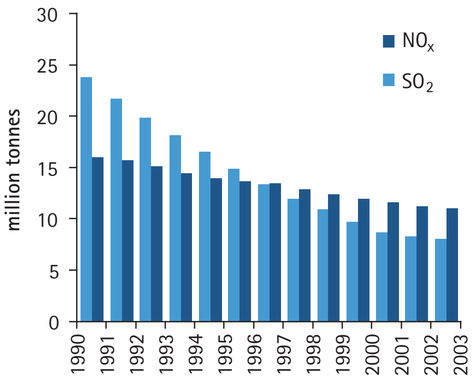


Table 2-3: CO_2 emissions by Member State, EU-ETS targets and compliance

Million tonnes of CO_2	1990	2000	2002	2003	% over 1990 level in 2002	EU Burden Sharing Target*
Belgium	109.3	118.9	111.5	120.7	10.4%	-7.5%
Czech Republic	155.1	119.8	115.1	122.2	-21.2%	-8.0%
Denmark	56.6	60.0	61.7	66.8	18.2%	-21.0%
Germany	964.2	856.1	874.2	n.a.	-9.3%	-21.0%
Estonia	39.1	16.1	16.3	17.9	-54.2%	-8.0%
Greece	75.0	93.4	98.1	98.6	31.4%	25.0%
Spain	221.1	301.7	323.7	n.a.	46.4%	15.0%
France	401.1	421.8	422.2	434.8	8.4%	0.0%
Ireland	30.9	42.1	44.2	43.5	40.9%	13.0%
Italy	391.0	430.8	441.5	461.5	18.0%	-6.5%
Cyprus	5.5	7.1	7.2	7.6	38.5%	-8.0%
Latvia	12.0	11.5	12.4	12.7	5.8%	-8.0%
Lithuania	34.1	13.1	14.2	14.3	-58.1%	-8.0%
Luxembourg	10.8	9.0	10.4	11.0	1.7%	-28.0%
Hungary	67.0	55.6	58.4	60.8	-9.2%	-8.0%
Malta	1.8	2.7	2.6	2.6	44.7%	-8.0%
Netherlands	155.2	173.1	180.0	182.9	17.8%	-6.0%
Austria	62.9	69.6	77.7	84.1	33.6%	-13.0%
Poland	341.9	307.9	298.6	312.5	-8.6%	-8.0%
Portugal	47.3	67.4	74.5	69.7	47.5%	27.0%
Slovenia	13.2	16.1	17.1	16.9	28.3%	-8.0%
Slovakia	52.4	35.3	38.3	39.4	-24.8%	-8.0%
Finland	73.1	83.7	92.5	102.2	39.9%	0.0%
Sweden	74.3	87.7	85.5	89.2	20.0%	4.0%
United Kingdom	569.9	553.5	550.1	573.7	0.7%	-12.5%
EU-25	3964.5	3954.1	4027.8	n.a.	1.6%	-8.0%

(*) % of emissions in 2008-2010 exceeding 1990 levels

Source: Eurostat

Table 2-24: Inland acidifying emissions in the EU-25 (2002)

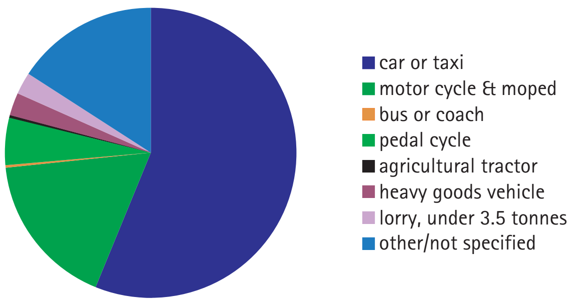
'000 tonnes	Total acid equivalent	SO_2	NOX	% acid equivalent 1990 level
Belgium	15.81	283.72	82.74	-35.2%
Czech Republic	18.58	318.23	72.16	-76.7%
Denmark	11.08	200.33	100.92	-43.2%
Germany	87.81	1499.50	614.26	-67.7%
Estonia	4.15	40.06	9.09	-61.5%
Greece	26.65	331.00	73.00	1.1%
Spain	102.04	1444.71	382.31	-11.3%
France	91.91	1352.01	777.63	-28.5%
Ireland	12.73	125.26	118.97	-15.0%
Italy	76.78	1316.57	441.85	-36.8%
Cyprus	2.46	22.21	6.63	5.6%
Latvia	1.94	41.48	11.38	-72.6%
Lithuania	5.46	51.26	51.26	-64.3%
Luxembourg	0.89	17.03	7.23	-35.5%
Hungary	18.97	179.75	65.06	-56.9%
Malta	n.a.	n.a.	n.a.	n.a.
Netherlands	19.08	406.12	136.44	-40.8%
Austria	8.69	204.47	53.00	-17.2%
Poland	85.70	805.38	328.43	-45.8%
Portugal	18.55	278.52	97.80	0.1%
Slovenia	4.65	59.63	19.36	-47.8%
Slovakia	7.10	102.00	28.80	-72.0%
Finland	9.06	208.21	33.27	-46.3%
Sweden	10.28	242.30	54.51	-24.2%
United Kingdom	83.10	1581.54	295.56	-58.0%
EU-25	**723.46**	**11111.30**	**3861.67**	**-47.0%**

7.4. Safety and environment in the transport sector

7.4.1. Safety

Road mobility still comes at a high price in terms of lives lost and health impacts, although road safety has substantially improved in the past years. In 2004, road accidents caused 43700 fatalities in EU-25. Given the growing concern for road safety by EU citizens, the topic has become a priority of European transport policy.

Figure 2-81: Road fatalities by user categories in the EU-15 (2002)



Numerous initiatives to reduce the number of road accident victims have been produced. Indeed, accident rates have declined, proving the effectiveness of technical efforts by the industry and of enforcement through public safety regulations. To reinforce this positive trend, the Commission proposed in its White Paper of 2001 that the EU should reach the ambitious target of halving the number of road fatalities within the decade until 2010. In particular, more than 50 technical standardisation Directives (e.g. vehicle safety standards, improvement of road infrastructure etc.) are in place now and will contribute – together with better infrastructure, extended traffic regulation and improved education of drivers as well as enforcement of alcohol regulations – to a decrease of fatal accident rates.

Figure 2-83 illustrates the positive trend with regard to road fatalities. While passenger cars' and buses' transport performance grew significantly between 1995 and 2002 (a 13.5% increase), road fatalities were reduced by approximately 20% over the same period. Although this positive trend was observed in all Member States, the relative risk of fatal road accidents still varies significantly. Relative to its population, Malta shows the lowest rate in fatalities, followed by Sweden, the UK and the Netherlands.

Based on more detailed 2002 data, available only for the EU-15, road fatalities can further be differentiated by user categories. While safety problems are most severe on roads, other transport modes show much lower accident risks. However, single accident events on the railway, air or maritime sectors often take a catastrophic dimension, which influences people's perception of traffic safety (for instance the rail accident of Eschede in Germany 1998, when a high speed train derailed and 101 passengers lost their lives). With respect to railways, the casualties reported are 121 for 2002 and 91 for 2003. Infras and IWW (2000, 2004) conclude that the economic costs of accidents per 1000 passenger km is EUR 35.7 for cars and EUR 0.9 for rail. In aviation the average safety performance is similar to that of railways, although not directly comparable because of the much longer average distance of flights.

In maritime transport, the spectacular accidents of ferry boats (Estonia in 1994) or oil tankers (Aegean Sea, Brear, Erika, Prestige) have lead to dedicated action programmes in the EU, which are still at the core of the EU's maritime safety policy to prevent fatalities and spills. The Erika I and Erika II packages have introduced technical regulations (e.g.: Elimination of single-hull oil tankers), tighter inspections and biting enforcement rules for companies and countries. The new Regulations allow for a significantly better surveillance of ships in coastal zones, especially for "risk" vessels. A European Maritime Safety Agency (EMSA) was established (see next section), which will provide technical and scientific advice to the Commission in the fields of maritime safety and prevention of pollution by ships.

Figure 2-82: Road fatalities related to population, EU Member States

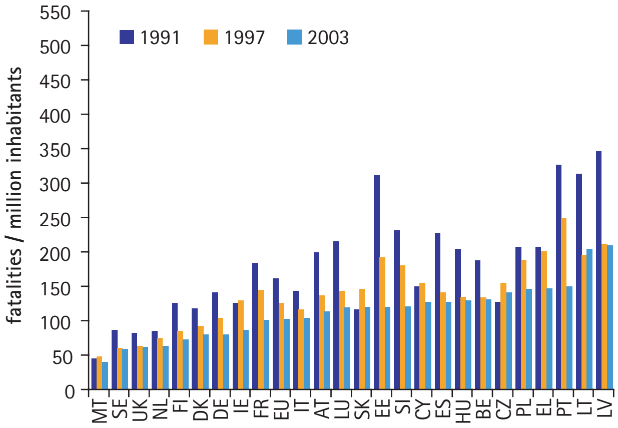
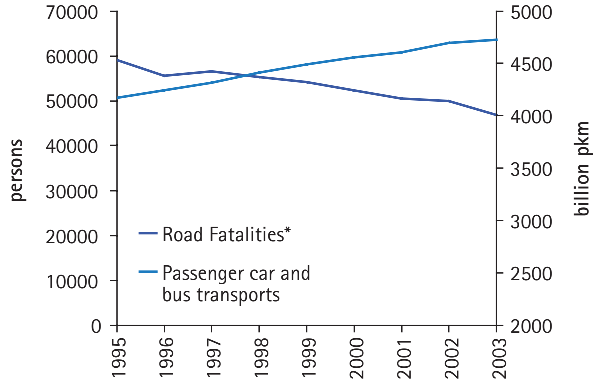


Figure 2-83: Development of road transport performance and road fatalities, EU-25, 1995-2003



**Road fatalities for Belgium in 2003 estimated according to trend in Belgium*

7.4.2. Maritime safety

Due to the increasing importance of sea transports, maritime safety has become an important issue of the European transport policy. Poor safety standards cause loss of life, environmental pollution and destruction of natural habitats. In order to define clear standards and strategies to face these challenges the European legislation approves, and sometimes reinforces, ship safety standards established by conventions of the International Maritime Organisation (IMO). Furthermore, diverse packages have been developed in this area (e.g. Erika I and II, Directive 1999/32/EC).

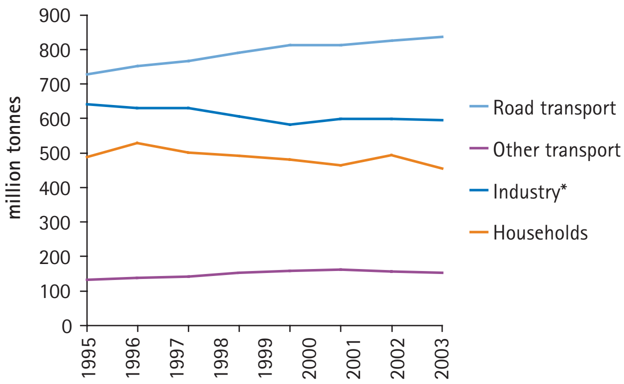
In 2002, the Commission established the European Maritime Safety Agency (EMSA), which should contribute to the enhancement of the overall maritime safety system in the Community. The objective of this agency is to reduce the risk of maritime accidents, pollution from ships and the loss of human lives at sea. The Agency will provide technical and scientific advice to the Commission in the field of maritime safety and prevention of pollution by ships, by developing new legislation, monitoring its implementation and evaluating the effectiveness of the measures in place. Agency officials will closely co-operate with Member States' maritime services and the international maritime organisation (IMO).

In the same year, the Commission presented a proposal (COM (2002) 780) that aimed to ban the transport of heavy fuel-oil in single hull tankers, and speeded up the phase-out of single-hull tanker for the transport of all types of oil at the European level. However, the Prestige accident led the European Parliament and the Council to opt for an even faster rate of phasing-out single hull tankers. This resulted in Regulation EC No 1726/2003 of the European Parliament and the Council of 22 July 2003, amending Regulation No 417/2002 on the accelerated phasing-in of double-hull or equivalent design for single-hull oil tankers. The European Parliament adopted the Regulation at the end of 2003.

7.4.3. Environment

Environmental policy in transport has yielded substantial achievements in the past decades. In the EU-15, the problems with carbon monoxide, acidifying emissions and lead from this sector have practically vanished as a consequence of technical changes provoked by regulations. In the first instance, the EURO emission standards for road vehicles, beginning with EURO-0 in 1988 and developing periodically through EURO I-IV (presently obligatory for new vehicles) and EURO V (forthcoming), have contributed to achieve this result, and, furthermore, have reduced the emissions of nitrogen oxides and particulate matter. The latter are, together with the emissions of greenhouse gases like carbon dioxide, a major challenge for the next decade.

Figure 2-84: Development of CO_2 emissions in the EU-25 (1995-2002)



**Excluding power and heat generation*
Source: Eurostat

7.4.3.1. CO_2 emissions

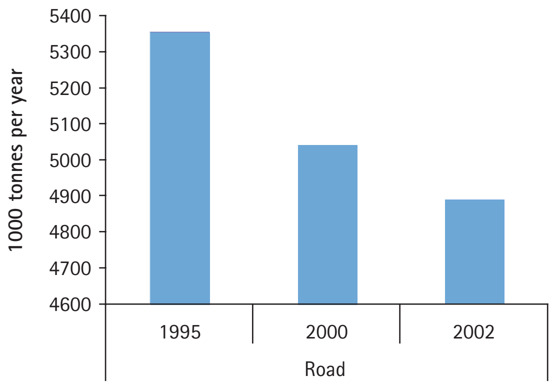
With a share of some 25%, the transport sector is one of the most important drivers of growth of CO_2 levels. Figure 2-84 shows the recent development of emissions caused by road and other transport modes. For comparison purposes, emissions from industry and households emissions are presented as well.

7.4.3.2. Nitrogen oxides (NOx)

Nitrogen oxides (NOx) consist of nitric oxide (NO), nitrogen dioxide (NO2) and a number of other gaseous oxides containing nitrogen. One of the main sources of these gases are motor vehicle exhausts, especially in urban areas.

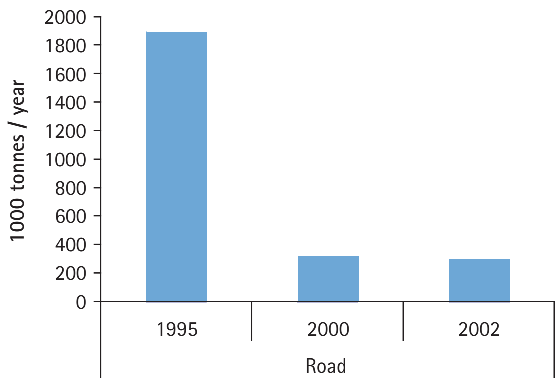
In the transport sector, the larger part of NOx emissions is caused by road freight transport while rail, aviation and inland waterways produce negligible amounts of NOx. Between 1995 and 2000, NOx-emissions in EU-25 dropped from ca. 5.35 to 5.04 million tonnes (estimation based on results calculated in UIC external cost study 2004 for EU-17). This indicates that the progress which has been achieved with new technology has only partly penetrated the market, mainly as a result of the high share

Figure 2-85: NOx emissions by road in the EU-25



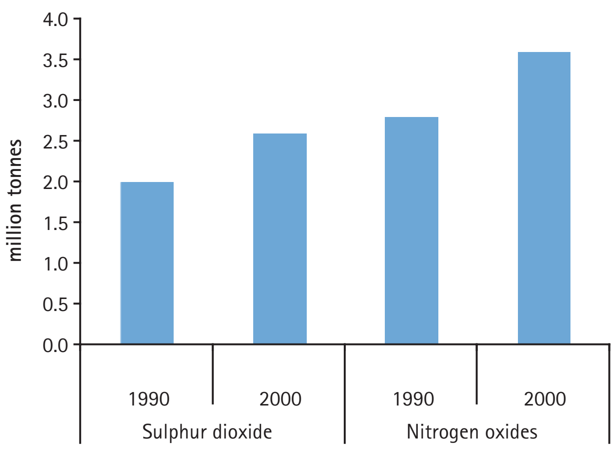
Source: UIC external costs study 2004 / estimation for EU-25 based on developments in transport performance

Figure 2-86: PM-10 emissions by road in the EU-25



Source: UIC external costs study 2004 / estimation for EU-25 based on developments in transport performance

Figure 2-87: Development of SO_2 and NOx emissions in EU-15 maritime transport



Source: Swedish NGO Secretariat on Acid Rain.

of outdated technology and the growth of traffic activity. Specific NOx emissions of newly licensed passenger cars could be reduced by about 96% comparing EURO-IV with pre-Euro standard (ECE-1504). The evolution of these emissions is presented in Figure 2-85.

7.4.3.3. Particulate matter (PM)

According to the European Environmental Agency, emissions of particulate matter from all modes of transport decreased by 24% between 1990 and 2001 in the EU-15. Most of this reduction is due to better engine technologies such as catalytic converters and electronic combustion control. Figure 2-86 shows PM10 emissions produced by road transport.

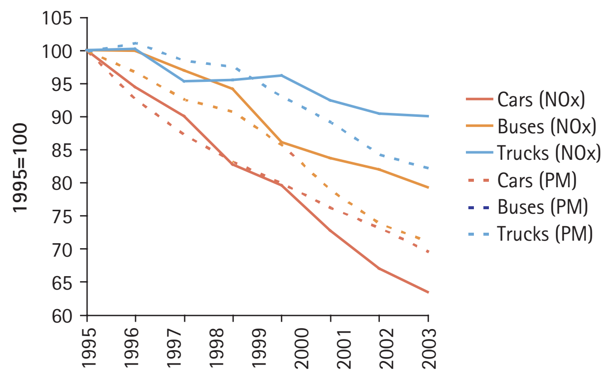
7.4.3.4. Emissions related to maritime transport

One of the goals of the White Paper on European Transport Policy was to reduce nitrogen and sulphur oxide emissions from maritime transport. Reductions of sulphur dioxide emissions, which depend on the sulphur content of fuels, can be obtained by burning lower sulphur fuel. A significant reduction has already been achieved by this means.

Besides acid emissions, sea transports also produced considerable amounts of CO_2, although nowhere near the levels produced by road transport. Nonetheless, international maritime transport caused more than 200 million tonnes of CO_2 in 2002, corresponding to about 1.2% of all GHG emissions in the national Greenhouse Gas Inventories (cf. UN).

Interestingly, rather different developments can be observed for Europe, Japan and the United States, which are together responsible for 95% of maritime CO_2 emissions. Reported data from the EU-15 and the United States show that the EU-15's emissions from maritime transports increased by about 35% between 1990 and 2002, while emissions from the United States were reduced by almost 60% over the same period.

Figure 2-88: Total reduction of NOx and PM emissions related to road transports



**Based on growth of transport performance (tkm or pkm) and reduction of specific emissions (NOx/tkm, NOx/pkm, PM/tkm, PM/tkm) or pkm)*

7.4.3.5. Nitrogen oxides and particulate matter in an international perspective

The improvement of ecological standards (strongly pushed by political goals) has lead to decreasing specific emissions –measured in NOx/tkm, NOx/pkm, PM/tkm or PM/pkm. However, strong increases of transport performances have partly offset these favourable technological improvements. Fortunately, the net effect has been positive and overall emissions decreased for passenger cars, buses and trucks over the period considered.

European emission standards concerning NOx and PM for the near future are less severe with respect to diesel engines compared with Japanese or Californian target values. Concerning PM, for instance, the European target level for diesel engines is set at 0.025 g/km while the Californian limit value is 0.006 g/km, to be achieved by phases steps starting in 2004 (see WCTRS and ITPS, 2004). In Japan, the corresponding limit is 0.013 g/km for small cars which entered into force in 2005. The European argument for a less restrictive target setting for diesel technology is the advantage of the latter with respect to CO_2-emissions. After the implementation of Directive 1999/30/EC however, which sets maximum concentrations of PM beginning in 2005 (the same will follow for NOx in 2010), a new discussion about a further reduction of PM emissions in the EURO standards has begun. This debate is reinforced by active policies in Japan and parts of the US against diesel technology. As a result, a number of car manufacturers have followed the example of the French PSA Group to equip diesel driven cars with a particle filter, which brings PMemissions down almost to the standards of gasoline engines and neutralises most of the arguments against diesel.

Figure 2-89: Changes in road-transport-related NOx emissions between 2000 and 2020 (based on results from European Project TEN-STAC)

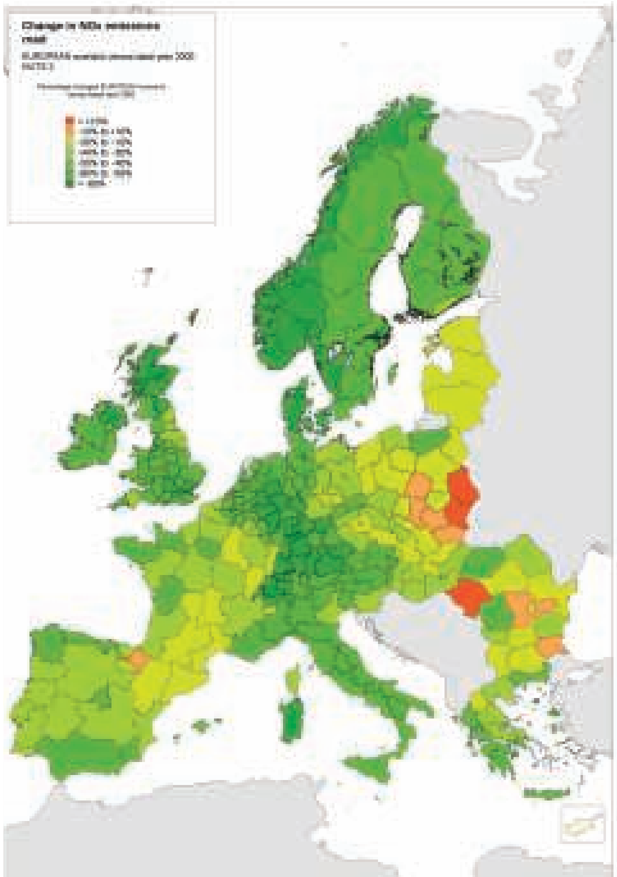
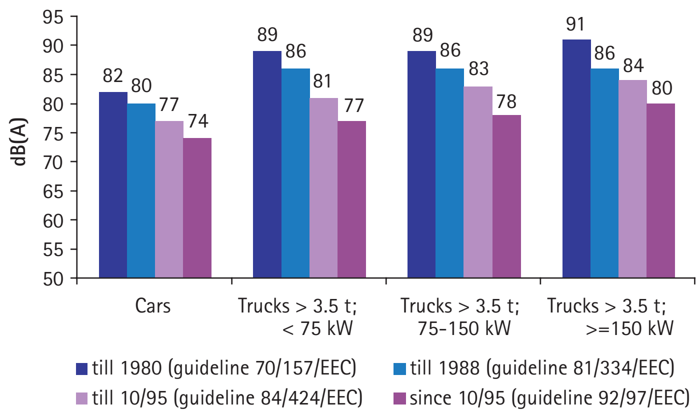


Figure 2-89 compares road-transport-related NOX emissions forecasted for the year 2020 with base year data (2000). Values were calculated within the European project TENSTAC and were based on models because actually no harmonised data for transport-related emissions exists for the EU-25. The figure shows that NOX emissions in some of the EU-10 countries will slightly increase while NOX emissions in EU-15 countries will be reduced by nearly 60%.

7.4.3.6. Noise

The rapid growth in transport – particularly caused by road and air transport – has resulted in over 120 million people in the European Union being exposed to noise levels above 55 dB(A) on the front facade of their houses (cf. EEA 2005). Daily average levels above 40 dB(A) can already affect people's well-being while levels above 60 dB(A) can seriously affect physical and psychological health. By tightening the limit values within the past two decades, significant reductions in noise exposures were achieved. Figure 2-90 presents the development of noise emission standards differentiated by vehicle type.

Figure 2-90: Development of noise emission limit values differentiated by vehicle type



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Trading partners’ energy and transport developments

1. ACCEDING COUNTRIES, CANDIDATE COUNTRIES AND EUROPEAN TRADING PARTNERS

1.1. Policies and industry structure

1.1.1. Acceding and candidate countries (ACC)

The European Union grew in 2004 from 15 to 25 members. Two additional countries, Bulgaria and Romania (henceforth, the acceding countries) are expected to join in 2007. Croatia and Turkey are candidate countries. Much of the four countries' recent energy and transport policies have been directed towards the implementation of the corresponding segments of the Community Acquis –the body of Community legislation– necessary condition to be invited to join the EU.

1.1.1.1. Energy

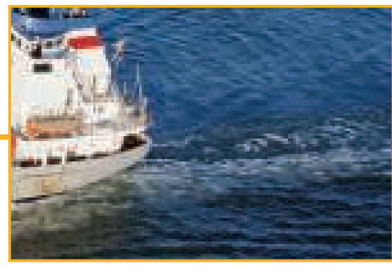
Main energy policy objectives in the acceding and candidate countries (ACC) include the dismantling of state-owned monopolies, price deregulation, energy management, emissions abatement and nuclear safety, and the development of energy interconnections with the EU and neighbouring countries.

Among the four countries, Bulgaria is perhaps the one that has made the most significant efforts to bring gas and electricity sectors in line with EU legislation. The government is in process of overhauling its gas and power sectors in order to align them with the Community Acquis, including a gradual liberalisation of the market, ending state monopolies in gas and power distribution and opening up the sectors to competition. The government has also launched a plan to privatise power generation and distribution assets as well as power market liberalisation. Significant progress in terms of privatisation has been made, with the sale of 67% stakes in each of the seven regional electricity-distribution companies completed in 2004. Moreover, the sale of three power plants, accounting for 20% of the country's installed capacity, should be completed in 2005. Bulgargaz, the state-owned gas monopoly may also be privatised in the near future. Bulgaria is expected to be granted accession to the EU in 2007.

After several years of setbacks, the Romanian government is moving quickly to privatise state-owned power and gas assets in an effort to meet loan conditions set by the IMF. As such, the government restructured the former state power utility, then unbundled it into separate generation, transmission and distribution companies. Gas sector responsibilities have already been parcelled out to separate production, distribution, and transportation companies. In 2004, the government made substantive progress by selling stakes in regional gas and power distribution companies. Romania is hoping to bring its utility sectors in line with EU guidelines in time for accession to the EU in 2007.

Turkey's plans to liberalise and privatise the energy sector have been accelerated under a recovery programme supported by the international community and the regulatory framework for the liberalisation of the gas and power sectors is slowly developing. Three main objectives for its power and gas industries have been set out. The first is the privatisation of power generation and distribution: The electricity distributor is expected to be privatised in 2006, and power distribution will be sold off to investors between 2005 and 2007. Opening of the gas sector is the second priority, although privatisation is moving forward much more slowly, and a definitive time framework is pending. The government also aims to reduce the volume and cost of power imports. Romania, Bulgaria and Turkey's location in south-eastern Europe makes them a key transit point for Russian and Caspian gas exports to the Balkans and Europe. Several international oil and gas pipelines are under consideration that would cross these countries, these pipelines geared to carry Caspian oil en-route from the Black Sea to Romanian refineries and gas to European consumers.

Croatia was the last of the four countries to become a candidate for EU accession and, to this end, has made some progress in bringing its energy markets in line with the EU gas and power directives. In this respect, the government has established four goals for its gas and electricity sectors: First, to partially privatise its state-owned electricity and gas utility assets while maintaining ultimate control – at least for the near-term future. Second, it plans to rehabilitate installed generating capacity, which has been undermined by war damage and years of under-investment. Third, the government has begun to deregulate prices, although Croatia lags behind other Central and Eastern European countries in opening up its energy markets to competition. Finally, to expand its existing gas distribution network to all regions of the country –many of which were formerly not connected internally or not served at all. A nationwide gasification programme is being implemented to extend Croatia's gas transportation and distribution networks and to build further international links with its neighbours.



1.1.1.2. Transport

Transport is a key sector in the ACC, especially in view of their objectives of increasing international competitiveness and preparing for EU accession. Freight transport, in particular, has acquired great importance as a result of ongoing growth in international trade. In Bulgaria, for example, international trade flows amounted to more than 90% of the country's GDP in 2003. Turkey's growing role as an international trade bridge between Central Asia, the South Caucasus and Europe, as well as Croatia's successful reestablishment of profitable transit traffic underline the key role of freight transportation.

Rapidly growing passenger transport performance, driven mainly by increasing levels of motorisation have resulted in high congestion and air pollution in certain metropolitan areas such as Sofia, Bucharest, Istanbul or Zagreb. Tourism is a key economic driver for several ACC countries: International passenger transportation is specifically relevant for Turkey, Croatia and, to a certain extent, Bulgaria.

The ACC face the challenge of transposing and implementing a substantial body of Community transport law, which represents about 10% of the total Community Acquis. The parts of the Acquis pertaining to road transport covers a vast area of social, technical, fiscal, safety and environmental requirements. Bulgaria's transport policy, for example, is primarily geared towards EU membership by the development of free transport markets. Its main priorities are the harmonisation of national legislation and transport regulations with those of the European Union, the development of transport infrastructure and the implementation of structural reforms and privatisation. Based on the Railway Law of 2002, the Bulgarian government separated the infrastructure and rail service segments into two independent companies, complying with the main EU railway regulations. The law also created the base for opening the railway infrastructure to competing rail service suppliers. Moreover, a powerful Railway Administration Executive Agency has been created to regulate the railway sub-sector. The former national Romanian Railways (SNCFR) organisation has also been recently restructured and disintegrated into four companies owned by the states. Market access is also granted to some private operators. Bulgaria is currently developing a strategy to privatise the national carrier Bulgaria Air, although Romania does not yet have plans for privatising its national airline.

In Turkey, key outstanding issues range from the harmonisation of infrastructure, vehicles, environmental and other standards, the development of logistic networks, to the improvement of border crossings and trade facilitation policies. Transport policy and planning suffers from some administrative inefficiencies, and certain planning decisions have lent priority to large politically motivated projects and have caused a substantial fiscal burden. Road investment is spread among various projects with exceptionally long completion times and is dominated by construction works for an over-designed motorway programme. The country's accident rates are well above those of the EU level, so the issue of road safety has been gradually moving up the policy agenda. Railways contribute significantly to the fiscal deficit and are among the least profitable public sector enterprises. The Turkish state railway company TCDD (Türkiye Cumhuriyeti Devlet Demiryolları) manages the seven largest ports, the railways and the rolling stock manufacturers and repair workshops. In fact, cross subsidies from Turkey's ports are used to help run the railways. A major reform of the TCDD is thus one of the main transport policy targets.

The social and economic difficulties suffered by Bulgaria and Romania coupled with a lack of finance for road infrastructure has brought about a deterioration of the roads in general. In Bulgaria however, significant progress has been made in the past ten years. The road transport industry has been almost entirely privatised and operates under a satisfactory regulatory framework with strong competition. Nevertheless, some portions of the main roads in Bulgaria are still in poor condition. Transport infrastructure in Romania still fails to meet current needs due to insufficient investment, maintenance and repair. In order to support the development of their transport infrastructure, the ACC receive financial aid from the Community under the pre-accession financial instruments PHARE (administration, institutions), ISPA (transport and environment) and SAPARD (agriculture, rural development). While Romania and Bulgaria obtained funds for building their transport infrastructure from the PHARE budget (until 1998) and from ISPA (since 1999), Turkey benefited from separate pre-accession funding. Both the ISPA and the PHARE programme aim at promoting the economic and social cohesion of Candidate Countries. Since 1999 ISPA has been the programme responsible for environmental and transport infrastructure measures. From the total ISPA resources allocated over the 2000-2006 period, Bulgaria will receive an 8-12% share while Romania's share will be about 20-26%. For Bulgaria, financial support is focused on rail infrastructure (more than 60%), followed by financial aid for measures improving airports and roads. In Romania on the other hand, the bulk of resources is aimed at improving road infrastructure (64%), while the remaining part is destined for railways. Between 2004 and 2006, some EUR 4.5 billion of preaccession aid will have been allocated to Bulgaria and Romania. Turkey is due to obtain EUR 1.05 billion over the same period.

1.1.2. European trading partners (ETP)

This section considers the EU's two most important trading partners within Europe: Norway and Switzerland. Like the preceding set of countries, Norway and Switzerland have, to a significant degree, aligned their energy and transport policies and legislation with those of the EU.

1.1.2.1. Energy

Norway possesses the largest hydrocarbon reserves in Western Europe. It is the world's second largest oil exporter, as well as the largest supplier of gas to the EU. The country is a member of the European Economic Area (EEA) and has secured access to European markets by a partial aligning of its own energy legislation with the EU's Directives on electricity and gas market opening. Norway is also the largest supplier of gas to north-west Europe, currently making up 11% of Europe's gas consumption, and is set to increase with future market penetration, provided that the necessary infrastructure is put in place. Three main policy priorities govern oil and gas production: The first is to restructure gas and oil industry to match changes in the markets and from competition. In particular, the government is considering further reducing its stake in the national oil company, Statoil. Its second objective is to make production from mature fields more profitable, although the government remains averse to handing out tax breaks for oil companies. Finally, there are aims to increase oil and gas exports to Europe. Norway is already Europe's main gas supplier after Russia, and is keen to protect that position as the EU becomes more dependent on imported gas. Norway is also the largest producer of hydropower in Europe, which explains the government's concerns about over-reliance on that energy source, since it conveys weather risk from dry winters. Norway's largest electricity producer generates just under one-third of Norwegian electricity, 99% of which is generated from hydropower. Gas-fired power generation has been extremely contentious for environmental reasons. With investments in the power sector dropping for the past 15 years, particularly in the construction of new electricity generation plants, the government is moving to ensure sufficient generation capacity and that Norway is served by a number of transmission links. Transmission system operators (TSOs) from Denmark, Finland, Sweden and Norway decided in May 2004 to develop cross-border systems to reduce bottlenecks and increase the security of power supply in order to prevent blackouts. The Norwegian government is also aiming to significantly increase wind capacity by 2010.

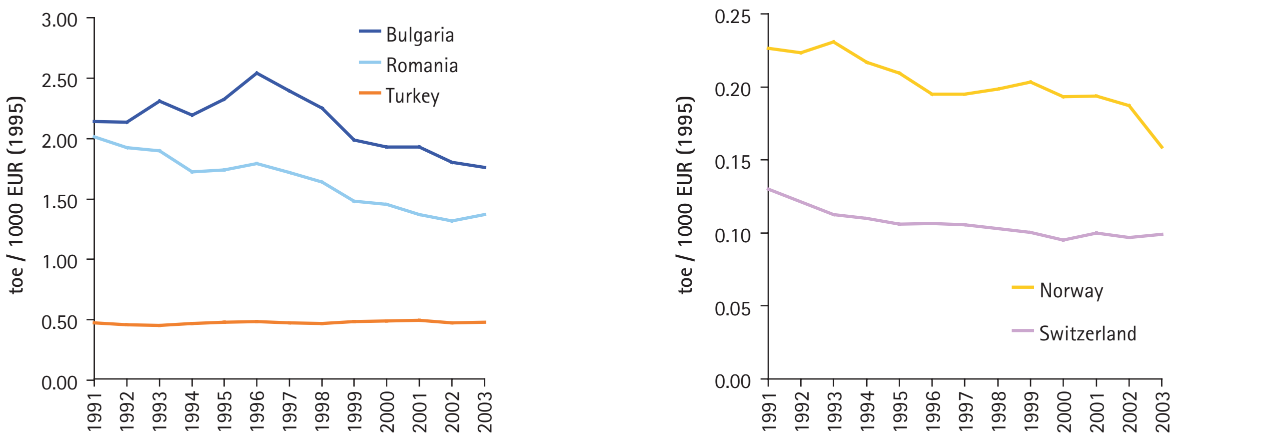
Like in Norway, energy policies in Switzerland have sought to guarantee that the country's energy markets are not isolated from the rest of Europe, in particular the electricity market. In response to the rapid integration of European energy markets promoted by the Commission, Switzerland has been working on ways to introduce some harmonisation of its markets with those of its neighbours. Over the past 15 years, Switzerland has pursued a consistent energy policy through framework programmes, but it is still a long way from achieving its goal of securing a sustainable energy supply. Authorities consider that the problem is not so much a technical one, but rather concerns the need for more effective implementation of political and economic strategies. Although the harmonisation of its energy markets with the rest of the EU has advanced, the Swiss electricity and gas industries continue to be highly regulated markets. All industrial and residential customers, independently of their level of consumption, are obliged to purchase electricity and gas directly from the regional distributor at a price fixed by the government. Distribution is a regional monopoly: The distributor has only a passive role as an intermediary between traders and consumers and has no 'power' in the market. Traders and generators are vertically integrated. They are the only players permitted to import and export electricity from and to neighbouring countries. Although the government has been under pressure to speed up liberalisation of the electricity market, it is still perceived that whilst electricity market opening may help ensure the competitiveness of Swiss companies, it may also threaten the viability of many.

1.1.2.2. Transport

As part of the EEA, Norway is a full participant in the internal market in the fields of transport and communications. Norway has accepted the same legal obligations as the EU Members and has supported the main initiatives taken by the European Union. Subsequently, the main aim of its transport policy is to comply with EU transport policy. Although there are strong specificities in the Norwegian transport industry as a result of the country's size, the importance of short-sea shipping and its peripheral geographic position within Europe, Norway shares a great deal of common views on transport policy with the EU and is involved in several transport programmes (e.g. the Marco Polo Programme for combined transport). Besides contributing to major European initiatives in the transport sector, Norway is also providing financial aid for candidate and neighbouring countries of the EU.

Switzerland, on the other hand, does not belong to the EEA, but key elements of its transport policy are also oriented towards EU policy. Examples include the common aim to establish the Galileo satellite navigation system or safety issues, which are being implemented in the light of the EU's safety programmes. The central element of the Swiss European transport policy however, is the bilateral agreement on land-borne transport, which entered into force in June 2002. It amends the transit agreement from 1992 to 2005 and replaced it from 2005 onwards. The agreement is valid for seven years and comprises the harmonisation of maximum vehicle weights, vehicle norms (EU standards) and social provisions, mutual granting of access to the railway network and the coordination of an environmental policy for the protection of the alpine environment. Allowable rest and driving times are to be the same in Switzerland and the EU, and market access to road haulage is clearly regulated. Of special importance is the agreement with respect to the introduction of the Swiss system on road pricing for heavy goods vehicles in January 2001. It is designed not only for refinancing the full costs of road transport but also for collecting the necessary funds for cross-financing the New Alpine Transversale (NEAT) for rail transport in order to shift transport flows from the road to railways and to reduce environmental impacts of transport in the alpine region. The European Union committed itself to provide the necessary infrastructure for securing good access to the NEAT.

Figure 3-1: Energy intensity in the candidate countries and EEA trading partners



Source: Eurostat and IEA

1.2. Energy indicators

1.2.1. Energy intensity

Following the economic slowdown of 2001, the ACC experienced good economic growth between 2002-2003. Turkey in particular, which had suffered a serious crisis in 2001, recovered by growing by an average of nearly 7.0%/year over the period. Within this more favourable climate, different trends relative to the decoupling of economic growth and energy consumption were observed: In Bulgaria, a compounded annual rate of economic growth rate of 4.1% (since 1997) combined with a negative growth rate in primary energy demand (-1.1% over the same period) resulted in rapidly falling energy intensity. In Romania, the same overall trend was observed, although a 9.0% rise in GIC in 2003 combined with a lesser economic growth rate saw intensity rise for the first time since 1996. On the other hand, Turkey's energy intensity continued to gradually increase (around 0.1%/year on average between 1997 and 2001).

As is the case in other Western European countries, the developed, less industry-intensive economies of Norway and Switzerland exhibited much lower energy intensities, vis-à-vis the emerging ACC. In Norway, a 2.0% average annual growth rate in GDP between 1997 and 2003 combined with an average 1.4%/year reduction in primary energy demand to produce a sharply falling intensity, especially between 2002-2003. The same was not true for Switzerland, where a slowly falling economic output (-0.6%/year between 2000-2003) combined with growing energy demand have resulted in a slight increase in energy intensity.

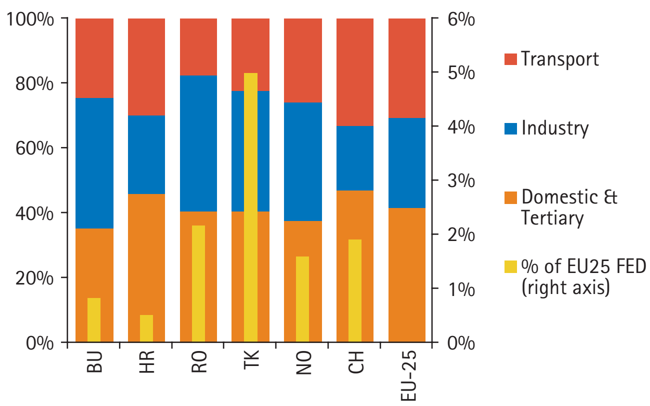
1.2.2. Structure of final energy demand

The structure of FED in the ACC is relatively similar to that of the EU-25 and that of Norway. The structure in Croatia and Switzerland more closely resemble that of the EU-15, where high levels of motorisation imply that final demand from transport takes a larger share of total FED. Figure 3-2 also depicts the relative sizes of FED in the ACC and ETP relative to that of the EU-25. Taken together, FED in the 6 countries represented in 2003 the equivalent of 12% of the EU-25's FED in the same year.

1.2.3. The energy transformation sector

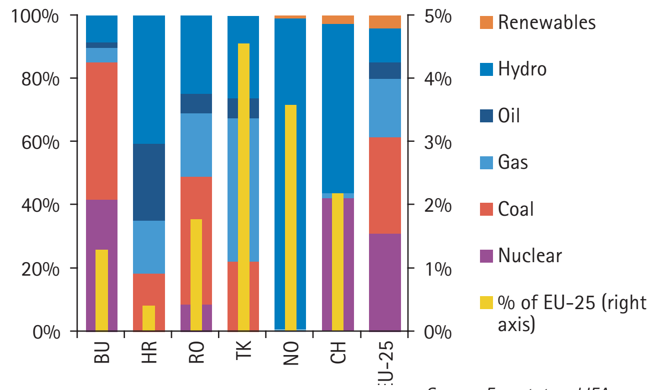
Norway and Switzerland's topographical and hydrological characteristics allow them to generate most of their electrical power from water, giving these countries a major competitive advantage in terms of electricity costs to industry and commerce. Like the EU-25, coal remains an important source for power generation in all the ACC. Bulgaria, which in 2003 produced over 40% of its generation needs from nuclear energy, is set to close down its old nuclear plants but is considering the construction of a new one. The high use of oil for power generation in Croatia (around 20%) is also worth noting. Electricity produced jointly by the ACC and the ETP amounted to 410 TWh in 2003, or just below 13% of the total electricity output of the EU-25.

Figure 3-2: Structure of FED in the EU-25, the candidate countries and the EEA trading partners (2003)



Source: Eurostat and IEA

Figure 3-3: Electricity generated per technology and total generation in the EU-25, candidate countries and EEA trading partners (2003)

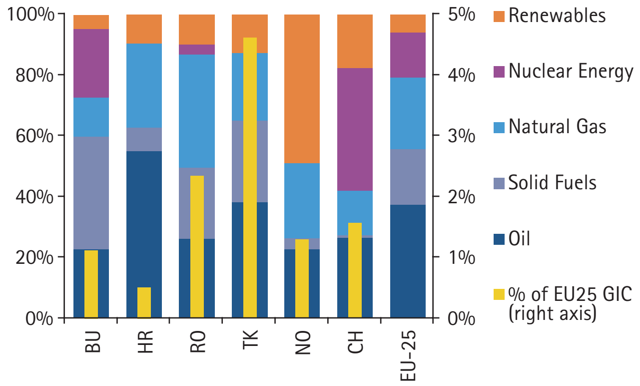


Source: Eurostat and IEA

1.2.4. Structure of gross inland consumption

Coal was the major source of primary energy only in Bulgaria, while Romania's primary source of energy was gas, as was oil in Croatia and Turkey. Norway and Switzerland stood out as having the highest shares of renewable primary energy (mostly in the form of hydro power). The latter country also exhibited a sizeable consumption of nuclear energy. GIC in the group of six countries in 2003 rose to 198 Mtoe, or around 11.5% of GIC in the EU-25.

Figure 3-4: Structure of GIC in the EU-25, the candidate countries and EEA trading partners (2003)

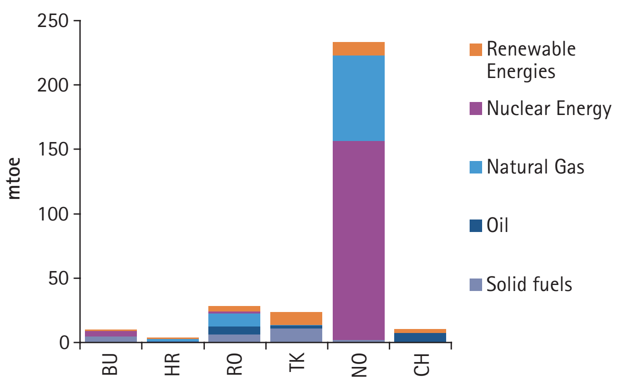


Source: Eurostat and IEA

1.2.5. Production of primary energy

Norway clearly stands out as the principal producer of primary energy, not only by virtue of its large hydrocarbon reserves, but also as one of the major producers of hydroelectric power. Next to Norway, the still significant production of indigenous primary energy in the ACC and Switzerland seems small. Rising to 233 Mtoe in 2003, Norway's production represented more than a quarter (26.3%) of the EU-25's total primary production. Taken alone, Norway's oil production exceeds that of the entire EU by more than 6%. Romania is also one of the larger producers –albeit on a very different scale– and holds the largest proven oil and gas reserves in Eastern Europe. However, the country's oil and gas output is on the decline, widening the gap between gas and oil production and consumption. Together, the six countries produced in 2003 some 310 Mtoe or over 35% of the total produced by the EU-25 in the same period.

Figure 3-5: Production of primary energy in the candidate countries and the EEA trading partners (2003)



Source: Eurostat and IEA

1.3. Transport indicators: Accession and candidate countries

1.3.1. Infrastructure

Bulgaria has extensive transport infrastructure, although major portions are in poor condition. According to a study performed by the World Bank in 2004, one third of the main and secondary roads are in a "bad" state. Accessibility to rural regions is particularly insufficient. This significantly hampers the development of agriculture, which is of great importance to most of the rural population. The length of railway lines amounts to more than 4,300 km, of which approximately 2,800 km are electrified. Maritime and inland waterway transports have been strengthened by a reform of the port and shipping sector. The reform aims to enhance the commercial efficiency of ports and foresees a gradual privatisation of maritime and river fleets. Similar reforms are planned for the aviation sector, which includes plans to partly privatise major (seaside) airports.

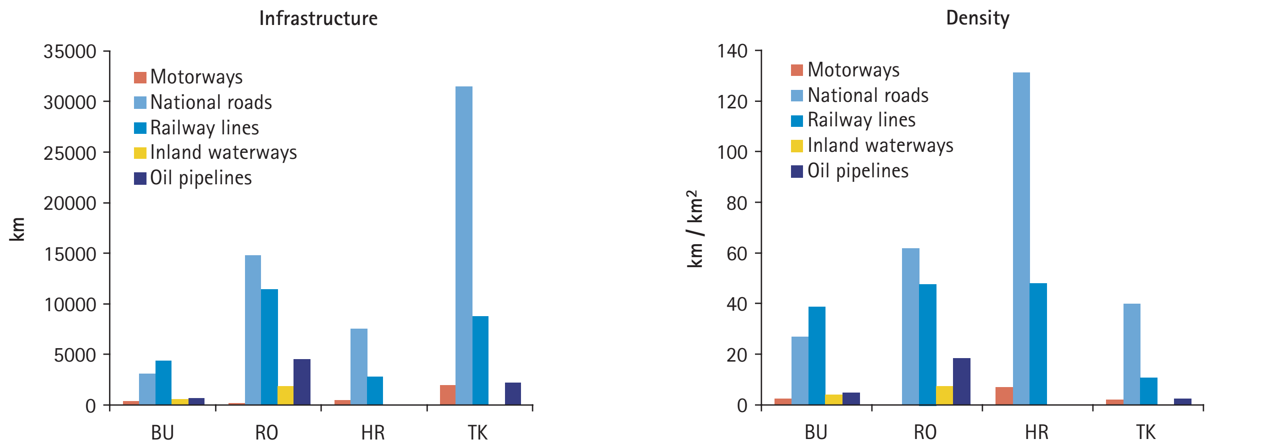
Romania's road network is dominated by regional and municipal roads that principally serve farming-related activities. Like in Bulgaria, roads are generally in poor condition and large investments are needed to allow a smooth functioning of the transport system. In the rail sector, tracks add up to more than 11,300 km, of which 35% are electrified. In addition to road and rail infrastructure, Romania disposes of almost 1,800 km of inland waterways. Within the EU-25, only Germany, Finland, France and Poland possess longer inland waterway networks. Oil pipelines also play an important role in Romania.

Since its independence, Croatia has successfully repaired its war-damaged transport infrastructure. The transport system now comprises approximately 18,000 km of classified interurban roads. The rail network amounts to more than 2,600 km, of which 1,000 km are electrified and 250 km are double track. During, and shortly after, the Kosovo crisis, maritime, port and river transport fell dramatically. The re-establishment of several sea and river ports aims to counter this trend. The crisis affected tourism as well, although the number of tourists has increased significantly over recent years. Its seven international airports ensure sufficient passenger capacity.

Turkey's rail tracks add up to some 8,700 km. Subsequently, network density, measured in km of track / km2, is considerably smaller than in any other ACC or EU state. With respect to road infrastructure, Turkey's motorways total about 1,900 km. Other interurban roads add up to approximately 60,000 km. Turkey's geographical position as a link between Asia and Europe makes freight transport, and particularly maritime transport, crucial for the economic development of the region. In this context, the Bosporus transit and Turkish sea ports play a key function. In international passenger transport, the increasing importance of tourism has spurred the continuous upgrade of international airports.

Figure 3-6 shows the ACC's endowment of transport infrastructure and infrastructure densities. Roads are subdivided into motorways and national roads. Regional and local roads are not included.

Figure 3-6: Transport infrastructure and infrastructure density in the ACC (2001)



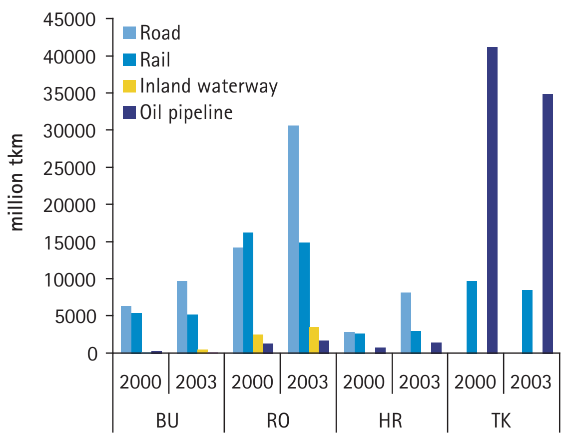
Source: Energy and transport in figures

1.3.2. Freight transport

Bulgaria's freight transport market is mainly composed of road and rail transport. In the past, road transport had largely complemented rail transport, focusing on short-distance and time sensitive transports. More recently, road transport (which has been almost entirely privatised) is increasingly competing with rail transport in other market segments as well. Significant investments in rail infrastructure and rolling stock, as well as efficiency improvements have averted major decreases in rail performance. Railway shares have nonetheless declined due to the growth in overall performance.

In Romania, the freight transport market is characterized by the dynamic growth of the privatised road sector and slightly decreasing performances of the rail sector. The latter was restructured recently, whereby the former national Romanian Railways organisation was subdivided into four companies, of which the "Freight Rail Transport Company" is responsible for goods transportation. This State-owned company licensed ten private freight operators, which share approximately 10% to 15% of the rail freight market. Inland waterway and maritime transports were restructured as well. While State-owned bodies are in charge of infrastructure, concessions for river and seaport operation were given to private companies. This has led to an increase in the performance of sea and inland waterway transportation.

Figure 3-7: Freight transport performance in the ACC



Source: Energy and transport in figures

The Kosovo crisis had important effects on Croatia's freight transport performance. This is true both for absolute performance (tkm) as well as modal shares. The national railway now carries less than a third of its pre-war traffic volume. The main port of Rijeka, which has a capacity of 11 million tons per year, handled approximately 2.7 million tons in 2002. Although the important shift towards road transport is partly due to the war, it is also largely an effect of the country's economic transition. The aim to rebalance the modal share towards environmentally friendly modes has been addressed by several national and international programmes. The main goal is to increase the efficiency of rail and port operations and to improve the financial standings of Croatian railway and seaports.

Turkey's freight transportation market is clearly dominated by road transport. Although very limited official data on road transport performances are available for national and international transports, it is estimated that the share of road transport in the combined road and rail freight market is about 95%. With respect to other modes, sea transports and, particularly, oil pipelines play an important role. Estimates suggest a performance between 155,000 and 165,000 million tkm for both years.

1.3.3. Passenger transport

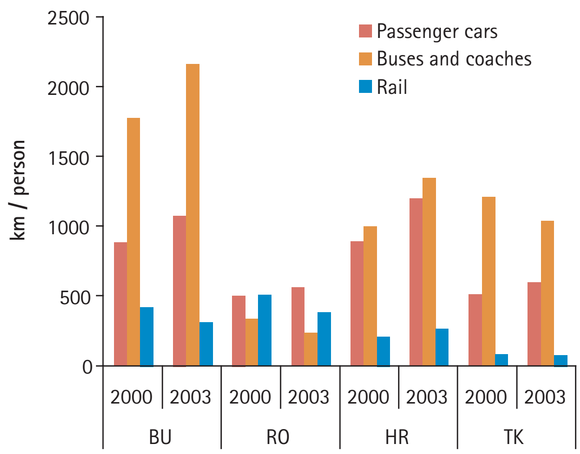
Passenger transport in Bulgaria is determined by increasing road transportation, which has offset rail performance. Even as performance of the latter mode already dropped by half between 1990 and 2000, the negative trend continues. In contrast, road transport performance has continued to increase. On the one hand, Bulgaria's increasing level of motorisation, which is already higher than that of Slovakia or Hungary, strengthens the trend towards greater road passenger transport; on the other, interurban buses and coaches have become increasingly popular relative to railways.

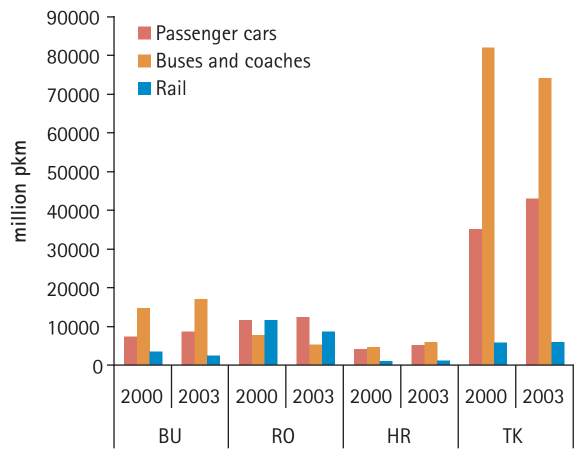
In contrast to Bulgaria, the level of motorisation is relatively low in Romania. Also, buses and coaches are not as popular, which means that railways continue to enjoy a high share of the market. Contrary to what occurred in rail freight transportation, the Passenger Rail Transport Company has not yet awarded concessions to private operators.

Crisis in the 1990's significantly affected Croatia's passenger transport performance. Tourist traffic fell sharply and motorisation growth stalled during and shortly after the war. However, the number of tourists and the level of motorisation have increased rapidly in recent years. In turn, this has led to growing national and international performance. Like in other transition economies, the general trend of growing passenger-kilometres has been accompanied by a clear shift from rail to road.

Buses and coaches dominate passenger transport in Turkey. However, individual passenger transportation has become more important in recent years. In particular, the level of motorisation in metropolitan areas is clearly above the country-wide average of approximately 70 cars per 1,000 inhabitants, and has induced significant levels of congestion and air pollution. Railway performance is stagnating at a low level.

Figure 3-8: Passenger transport performance in the ACC





Source: Energy and transport in figures

1.4. Transport indicators: European trading partners

1.4.1. Transport infrastructure

International transport projects in Switzerland clearly focus on Alpine transit, where bilateral agreements are often used to enhance capacities for passenger and freight transport. In 2004, for example, Switzerland and Italy jointly agreed to increase the capacity of the Simplon tunnel ("Piattaforma Sempione") and the Luino-Line ("Piattaforma Luino"). The realisation of New Railway Alpine Crossings (NEAT) includes further capacity increases of Gotthard and Lötschberg tunnels.

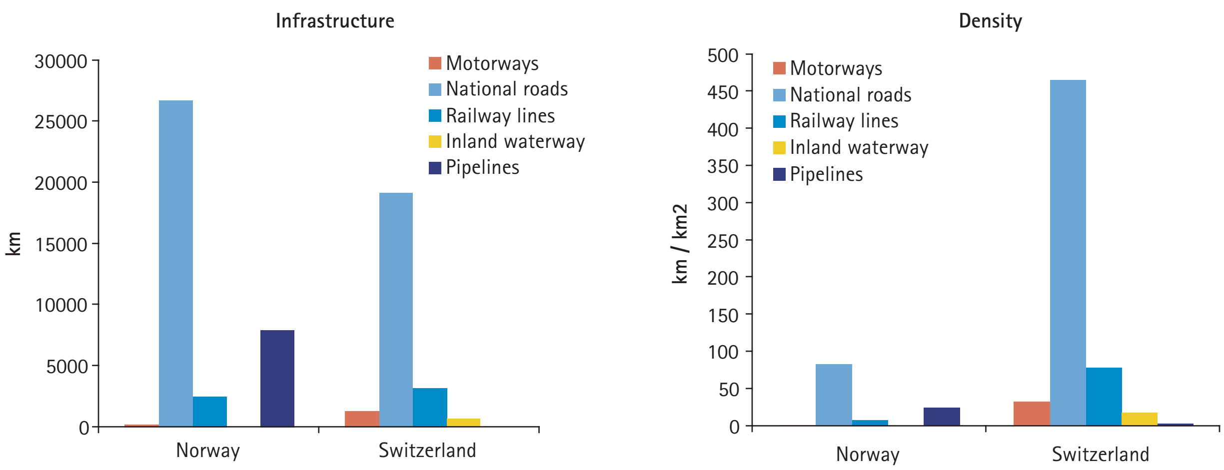
Norway has, together with Sweden and Finland, put an emphasis on the establishment of "The Nordic Triangle". The project consists of the Oslo - Gothenburg - Malmö, the Oslo - Stockholm - Malmö, and the Helsinki - Stockholm – Malmö corridors, and consists of both road and railway connections, including ferries and harbours. The triangle connects the three Nordic capitals through the Øresund link, acquiring increased importance as Norway becomes more economically integrated with the EU. In general, the Norwegian government aims to develop infrastructure that includes the most important transport corridors abroad and the most important corridors for Norwegian industry. In doing so, transport policy focuses on good connections and co-ordination between land-based transport and sea transport. Figure 3-9 shows the two countries' transport infrastructure endowment and infrastructure density.

1.4.2. Freight transport

Despite the ETP's efforts to rebalance the modal shares towards more environmentally friendly modes, the performance of road transport has grown recently. However, Figure 3-10 shows that these increases have been rather modest, especially compared to the trends in the ACC. Rail transport, which has received significant support through Swiss transport policy, decreased slightly over the same period.

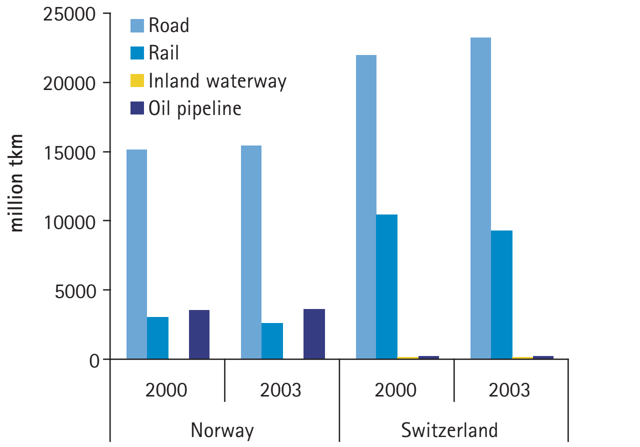
In Switzerland, international freight transport is mainly determined by Alpine transit, whilst it is determined by maritime transports in Norway. Figure 3-11 shows the development of Alpine transit volumes through Switzerland and recent developments of port handling in Norway.

Figure 3-9: Transport infrastructure and infrastructure density in the ETP (2002)



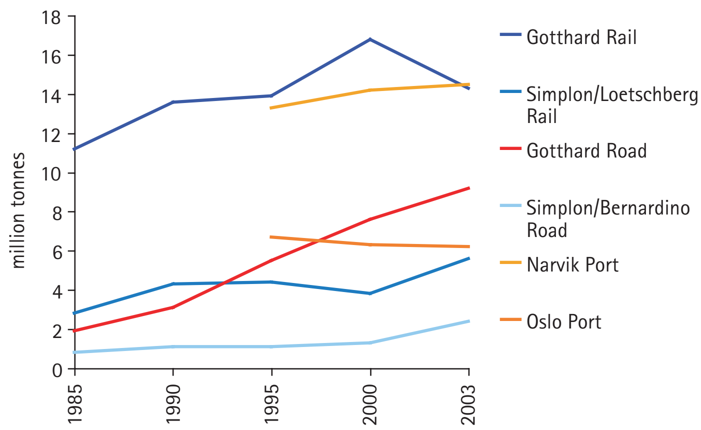
Source: Energy and transport in figures

Figure 3-10: Freight transport performance in the ETP



Source: Energy and transport in figures

Figure 3-11: Alpine transit between 1985 and 2003, port handling between 1995 and 2003



Source: Energy and transport in figures

1.4.3. Passenger transport

Individual road transport clearly dominates public passenger transport in the ETP. This is true for Norway, despite a level of motorisation significantly below EU-15 and EU-25 averages, but particularly holds for Switzerland, which exhibits a level of motorisation clearly above the EU-15 average.

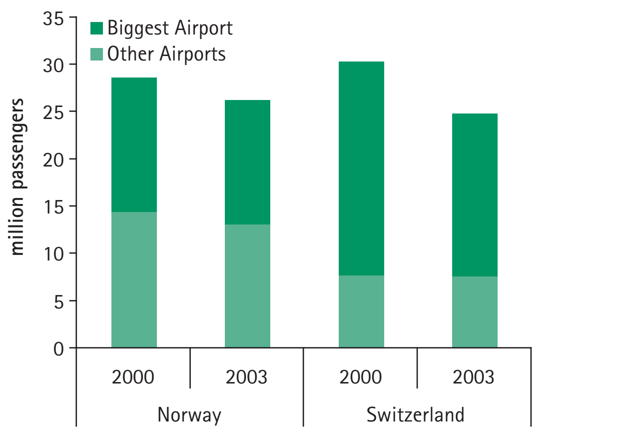
With regard to other inland modes, there is a clear preference for rail transport in Switzerland, although buses and coaches play, at a much lower scale, an important role in interurban transport. The situation is the opposite in Norway, where bus transports are more popular than rail transport.

Road and rail transport are complemented by air transportation. Due to Switzerland's relatively small area, aviation is mainly a function of international transport, with the major international airports located in Zurich and Geneva. Norway, approximately eight times larger than Switzerland, has approximately 10 major airports. In contrast to the former country, domestic traffic plays a much more important role. Interestingly, the total number of passengers arriving and departing at major airports is about the same. Following a more global trend, the dynamic growth of the aviation sector has declined dramatically in both countries. Only one airport (Sandefjord in Norway) out of the 12 airports considered showed an increasing number of passengers between 2000 and 2003.

1.5. CO_2 emissions

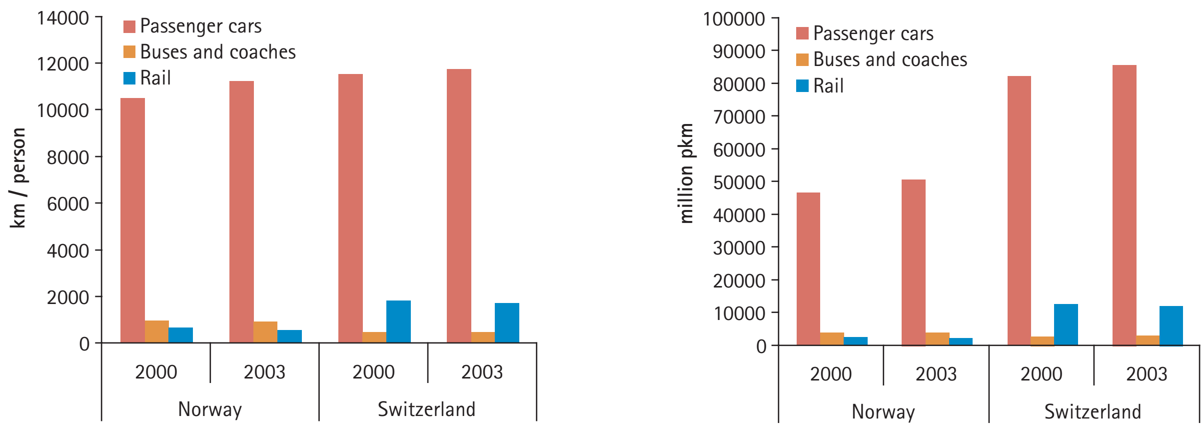
Relative to their levels in 1990, carbon dioxide (CO_2) emissions from the ACC and the ETP increased in all countries except Bulgaria and Romania. The highest proportional increase was in Croatia, whose emissions grew almost four-fold over the period in question. In Norway and Turkey, emissions in 2003 were 22% and 80% above their level in 1990, respectively. The latter country deserves particular attention as its CO_2 indicators have seriously deteriorated over the years: It presents the highest emissions volume and growth rate of the group, and is the only one whose CO_2 intensity has grown since 1990. On the other hand, Bulgaria and Romania presented a net decrease of their CO_2 emissions with respect to their 1990 levels, respectively reducing their emissions by 32% and 36%. Their efforts must be put into context, however: The two countries also happen to be the most CO_2-intensive of the group.

Figure 3-12: Traffic at major airports in the ETP



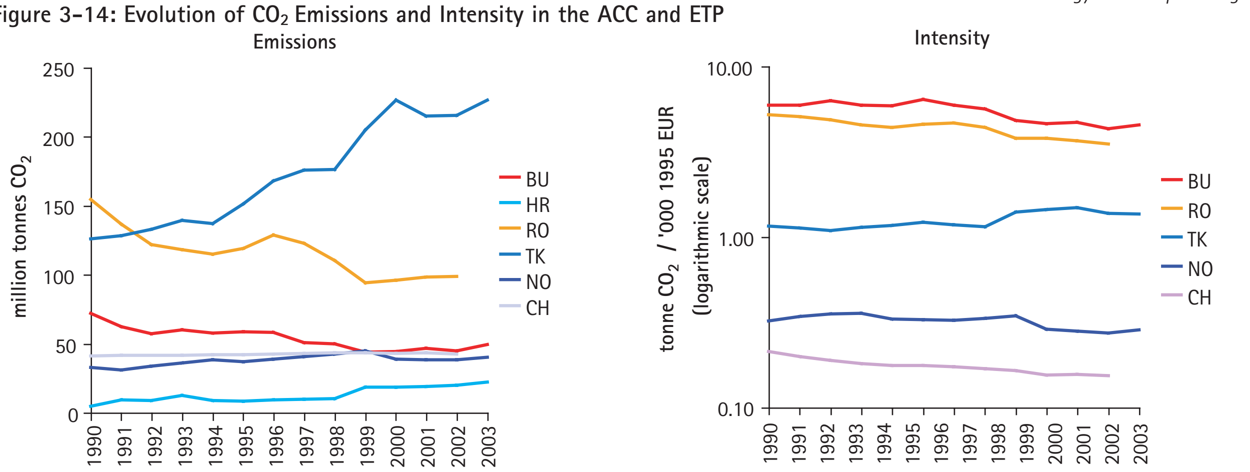
Source: Energy and transport in figures

Figure 3-13:Passenger transport performance in the ETP



Source: Energy and transport in figures

Figure 3-14: Evolution of CO_2 Emissions and Intensity in the ACC and ETP



Source: Energy and transport in figures

2. PRINCIPAL TRADING PARTNERS

2.1. Common interests, policies and industry structure

2.1.1. Energy

2.1.1.1. China

In 2003, China was the second largest consumer of energy in the world. Its oil and gas policy is dominated by its growing dependence on imported oil, whose share in primary energy demand has been expanding rapidly, passing from 13% of GIC in 1990 to nearly 20% in 2003. Previously a net energy exporter, China became a net importer of petroleum products and crude oil in the early 1990s. The change prompted increased exploration for oil within its territory, but that has not shown significant results: over the past three years there have only been modest new oil and gas discoveries. China's growing energy needs are bound to have profound impacts on a geopolitical scale, especially since Chinese energy policy focuses on managing rather than reducing its import requirements, mainly through supply diversification, but also through direct investments in oil and gas producing states.

Downstream, the Chinese government formulates energy policy and regulates fuel and electricity markets. The government is also able to exert considerable influence over the sector through its ownership of national oil and power companies. At the national level, energy strategy is guided by targets for production and consumption set out under the Communist Party's five-year and twenty-year economic plans. Key objectives affecting the energy sector include extending development to the country's western regions, improving environmental standards and managing oil import dependence. There are also plans to construct a national petroleum reserve, which was approved in late 2003. Electricity policy continues to emphasise affordability to the end user, suggesting that heavy restrictions and regulations will continue to dictate retail pricing. This is an important issue, given that China is the largest consumer of electricity in the Asia-Pacific region and the world's second-largest single consumer, surpassed only by the USA. Indeed, low energy prices contribute significantly to the competitive advantages of China's enormous manufacturing industry. Coal remains the dominant fuel both for power generation and industry use; China is one of the largest producers as well as the largest consumer of coal in the world. Indeed, China's economy is highly coal-intensive (58% of GIC in 2003), which explains international pressure to reduce CO_2 and acidifying emissions levels and improve the environment in industrial areas. To that end, the government has chosen to favour turning away from coal towards oil, gas and hydropower.

2.1.1.2. Japan

Japan is the world's third-largest energy consumer, but also one of the most resource-scarce countries in the world relative to its size, population and overall wealth. This means that more than 80% of its oil, gas, coal and uranium requirements are imported, with the only significant domestic sources of energy derived from geothermal and hydroelectric power (there are practically no domestic oil or gas reserves). Thus, one of the central aspects of Japanese energy policy has been to ensure energy security, diversify supplies and limit dependence on imported hydrocarbons from the Middle East. Nonetheless, 83% of Japan's oil imports in 2003 came from just five countries: Saudi Arabia, the UAE, Kuwait, Qatar and Iran. Japan has renewed discussions about sourcing more oil from other regions, such as Russia, South-East Asia and West Africa.

In order to stimulate a sustainable economic growth, another recent policy objective has been to reduce Japan's high average energy costs, which rank amongst the highest in the world. Indeed, Japan's high per-unit energy costs are not only a result of its high dependence on imports, but are also attributed to the lack of a national gas network, to high operational and labour costs and to the lack of competition amongst power suppliers, who control most generating capacity and monopolise regional power grids. Yet high energy prices have forced Japanese industries and consumers to be highly efficient in their consumption, and have lead the government to consider introducing more competitive market structures, although progress has been slowed by the entrenched interests of privately owned regional gas and power companies. The Ministry of Economy, Trade and Industry established the Energy Development Organization to advise on the promotion of energy conservation and new energy technologies. Targets have been set for increasing the use of new energy sources. Research and development funding has focused on fuel-efficient cars and fuel cell technology.

2.1.1.3. Russia

Russia is becoming one of the largest suppliers of gas and oil in the world and is, by far, Europe's leading supplier of natural gas. The relationship is symbiotic however, as revenues from oil and gas extraction and export are a key component of the Russian government's budget, and the hydrocarbons industry is one of the main drivers of the country's economy. As such, the Russian government is interested in maintaining and increasing both production and exports in order to maximise revenue and keep the economy in good health. Since 2000, Russia and the EU have established a dialogue to develop an EU-Russia energy partnership. Objectives include increasing supply security, investments in infrastructure and co-operation on numerous fronts across the energy supply chains. The Russian government's main energy policy objectives include increasing production and exports, attracting foreign investment, reasserting state control over the oil and gas sector, and maintaining low gas prices for the domestic market. In respect of the latter point, the government's policy of making cheap, affordable gas available to domestic consumers is designed to ensure payment and maintain domestic stability, since gas supplies are necessary for home heating in much of Russia and any cut-off for nonpayment would have significant socio-political ramifications. Nevertheless, the government has permitted the national gas company to gradually raise prices for the domestic market in line with the continued development of the Russian economy. As part of a deal signed with the EU in May 2004, Russia committed to effectively double its average domestic gas price by 2010, although this means that prices will still remain significantly below the European average.

Although a divestiture of numerous state assets in the oil sector took place in the early 1990s, the ownership of the majority of the country's gas assets remains with Gazprom, the partially state-owned gas monopoly. In 2003, the Russian parliament passed a package of laws geared to overhaul the country's ageing power sector, with provisions in the legislation for unbundling the dominant utility, the liberalisation of electricity prices, the introduction of competition, and the eventual privatisation of power-generating assets. Plans are to liquidate the state-owned power company that controls much of the power sector, with the federal government taking ownership of Russia's electricity transmission grid. By contrast, efforts to reform Gazprom, which also controls gas transmission and distribution, as well as the majority of gas production, have stalled. Gas sector reform has lost much of its urgency with Gazprom's improved operational and financial performance. Nevertheless, the company is undertaking some substantive internal reforms, and the Russian government has pledged to implement several important reforms as part of its agreement with the EU. However in 2004, the state revealed its intentions to take a majority share in Gazprom. The state also maintains control over Russia's crude oil exports via its control of Transneft, the crude oil pipeline monopoly operator. Government intervention has been stepped up in recent years, taking a more proactive role in the operation of both the oil and gas sectors, and increasing extraction and export tariffs to raise additional revenue from the energy sector. At the downstream level, the state-run gas and power utilities are awaiting reform.

2.1.1.4. United States

The United States is the world's largest consumer of energy. In 2003, it absorbed about 25% of the world's total oil output. Although the USA is still one of the world's largest oil and gas producers, domestic production has been declining since the 1970s. This, combined with growing demand, has made the country increasingly dependent on imports. The USA's upstream policy is complex and can be seen as having multi-layered objectives. At the highest level, oil and gas policy has been consistent since the 1970s and focuses on the central objective of ensuring that oil flows plentifully into the USA's market at a low price. This first objective is not up for debate, and both political parties are committed to it. With oil still a major driver for the USA's economic engine, the government has always been concerned with ensuring a steady flow of oil at a low price so that the economy can continue to grow. Oil security objectives have always meant that the USA has sought to be without restraint in its ability to consume oil; this focus on the supply side of the equation has meant that the taxation of oil and gas has been far lower than in Europe. Increasing taxes on oil and oil products would now mean political suicide for any party considering it, and as such it is not even considered as a policy tool. There has been interest in improving fuel efficiency, but the carrot approach has been preferred over the stick. Ensuring cheap oil also means keeping the international market free from interference to guarantee a steady, uninterrupted flow of imports. This has been a key geopolitical objective for all US administrations. A strategic petroleum reserve to stockpile oil for use in the event of any supply disruption has also been created to ensure that any temporary disruptions will not result in supply shortages. The USA's second major policy objective is to maximise domestic oil and gas production. Whereas the specifics of how this is to be achieved continue to be debated and discussed domestically, the country's commitment to open up reserves to private oil and gas producers is not being questioned. Rather than attempting to curb output in order to conserve domestic reserves, further exploration and production has been encouraged. Initially endowed with some of the world's largest oil and gas reserves, continuous production has transformed the USA into the world's most mature oil and gas producer. However, there is still potential for oil discoveries and the government continues to encourage companies to explore for oil and gas in new areas.

The United States is also the world's largest producer and consumer of electricity. Although power is produced from all the main technologies, the largest share of output comes from coal-powered stations. However, like in Europe, the largest demand growth has come from the commissioning of numerous gas-fired CCGTs. Regulation varies significantly from state to state but overall the federal government has been eager to deregulate electricity generation and distribution while introducing a market element.

2.1.2. Transport

2.1.2.1. China

The strong economic growth experienced by China over many years was able to transform the country into one of the major exporting nations for industrial products while simultaneously creating a strong need for the import of commodities. The value of China's international trade has more than quadrupled over the past decade; more than 20% of world container trade now involves China. However, this growth has been concentrated in coastal provinces, with an especially dynamic development of the Shanghai region, and industrial production in many inland provinces is lagging far behind. In order to catch up with increasing transport demand in the booming regions and to trigger economic development in the inland provinces, Chinese transport policy gives high priority to investments in transport infrastructure. Yet despite substantial investments in new transport infrastructure in the past, future growth in the inland provinces as well as China's overall economic growth could be curtailed by the country's still inadequate transport infrastructure. Indeed, the Government regards the promotion of future economic growth by the construction of a modern transportation system as a key aspect of social security for future generations. Consequently, the government intends to modernise and expand road, rail, inland waterway and coastal shipping infrastructure with a focus on creating multi-modal transport hubs and regional distribution centres. Since the maturing economy and growing levels of industrial and retail outsourcing with a rising transfer of international cargo to and from the ports and inland provinces call for sophisticated supply chain management solutions, the improvement of logistics sits at the core of China's tenth five-year plan. Today, the share of transport costs of total costs in China is much higher than in Western economies. It can cost 50% more to transport goods inland than in Europe or North America, while the quality of service is poor. The nation's total spending on logistics amounts to 20% of GDP.

Traditionally, public and freight transport in China have been regulated by the government. However, a progressive opening up of China's freight transport sector to foreign investment appears be a catalyst for future modernisation and innovation. Up to date, the coastal provinces in the south have attracted most of these investments, with well over 40% of projects concentrated in the Shanghai region. However, interest in the interior is increasing and the Chinese Government's 'Go West' policy may encourage further activity in the inland provinces. Increasing motorisation in Chinese cities means a new way of life for the residents of the world's most populous country; which simultaneously offers one of the biggest markets in the world for car manufacturers. On the other hand, China's growing demand for oil and its rising greenhouse gas emissions create major uncertainties for the global environment and is easily the largest driver of growing oil prices.

2.1.2.2. Japan

Transportation systems of industrialised countries are in general a mixture of common and specific factors that depend on geography, history and the socio-political environment. Being a long archipelago with a very high population density relative to that of Europe or the USA), Japan's most important cities and industries are concentrated along the coasts of the main islands, a land use structure that is ideal for railways and coastal shipping. Also, the mountainous areas in the centre of the islands contributed to the rapid progress of civil aviation in the past. Population is concentrated around large metropolitan areas, the largest being greater Tokyo, with almost a quarter of total population, followed by the Osaka region in the south. The last decades showed a strong growth of population in the suburbs of metropolitan areas, which made the construction of efficient regional transport systems indispensable for those urban agglomerations. The central element of Japanese transport policy is the adjustment of the growing regional disparities by shifting from a centralised to a more multi-polar distribution. Transport policy thus includes various measures to consolidate the rapid passenger transport systems (Shinkansen), airports and motorways on a nationwide scale. Passenger transport in Japan is characterised by its sizeable share of rail transport. Since 1964, when the first of the famous Shinkansen high-speed train began operations, Japan has constructed a highly efficient and profitable high-speed railway system with high supply frequencies and an outstanding quality of service. In regional rail transport, private railway companies in large cities play a predominant role. Their local train networks are often well connected with the publicly operated subways serving the inner city areas. Private railway companies do not only carry commuters to and from the suburbs, they are also heavily engaged in value-added services including housing projects and the management of supermarkets at the railway stations. Thus, they also play an important role in regional development.

Until late into the twentieth century, the Japanese road system was underdeveloped compared to other Western industrial economies. Motorway construction made good progress over the last decades, but substantial work remains to be done for the envisioned network to be completed. Thus, road congestion as well as environmental issues continue to be a concern. A central aspect of the motorway construction scheme is the pooled toll system. The construction of motorways is financed by government loans and repaid over a 30-year period using toll revenues. In addition, some large cities operate their own urban motorway network using tolls not only to create revenues but also to manage traffic flows and fight congestion. Freight transport of railways dropped dramatically since the middle of the last century and its performance is now below 5% of total tonne-kilometres. The decrease of rail transport shares was related to the change of the economic structure with a strongly increasing production of high added-value small lightweight goods. These changes and the extension of the motorway network together with other infrastructure improvements also led to significant increases of road transport by trucks by enabling door-to-door delivery and just-in-time production. However, the largest share of all freight transportation modes is handled by coastal shipping between the large coastal cities. Because of the limited motorway density and Japan's mountainous geography, the modal share of civil aviation in passenger transport in Japan is high. The deregulation of air transport started in 1987 and major airports are now run both publicly and through public-private partnerships. Good competitiveness of many Japanese airports has caused growing congestion, so the further development of the international air transport network remains an important part of transport policy.

Japan's current road transport policy promotes the renewal of roads, the wide usage of intelligent transport systems (ITS) as well as a more efficient and transparent road administration. But because Japan is still lagging behind the US and Europe in terms of highway development, there are also ongoing efforts to extend the motorway system. The trunk railway network, on the other hand, is almost completed. Thus, railway policy concentrates on the further development of service quality, operating speed and the improvement of railway facilities, although the railway system is still in the process of enlargement. New Shinkansen lines are being constructed to extend the system to all regions. Railway policy also includes measures to speed up conventional trunk railways. These infrastructure projects are often financed jointly by the government, the municipalities and the private sector. The lines are then operated by the successors of the former Japan National Railways (JNR) and other private railway companies. Further elements of the Japanese transport policy contain the development of a marine highway network similar to the European concept of the motorways of the sea, the promotion of multi-modal transport systems and measures to improve safety for all modes of transport.

2.1.2.3. Russia

Like in China, the transport market in Russia has strongly different characteristics with respect to Europe. There, railways still play an important role, not only for connecting its European regions, but also and to a high degree to connect the spacious and sparsely populated (and at some points, highly industrialised) Asian regions, as well as its ports on the Pacific coast with the European parts of Russia. The trans-Siberian railway is still an important transport axis in the huge country that possesses few sea ports, especially because the road network in Russia is still much less developed than that of Western economies.

Although its transport sector's history has largely determined Russia's economic and spatial development and facilitated the country's integrity, Russia has yet to deal with enormous challenges of transforming the former national centrally planned system into a modern and efficient transport system. Since 1990, operating conditions and demand patterns in the transport sector have dramatically changed. After a slump of transport activities in the aftermath of the political changes in the beginning of the 1990s, the demand for freight and passenger transport has been constantly growing in recent years. However, the absence of a baseline transport network for the whole country prevents the development of a single economic market and hampers economic growth. Significant interregional disparities exist, especially between European Russia and the Asian part of the country. Like in China, the share of transport costs in total production costs is very high and amounts to almost 20%, resulting from large travel distances and the under-developed transport system.

A primary goal of the Russian transport policy is the establishment of a baseline network without gaps and bottlenecks. With respect to individual transport it is the growing gap between increasing motorisation and the insufficient status of the road network that calls for action. With respect to international freight transport, policy seeks to diversify the export-related transport infrastructure with a view to enhancing the country's global competitiveness and enabling access to international markets. Further goals include the promotion of a better utilisation of the transit potential, for instance, by increasing the competitiveness of container transport with the trans-Siberian railway compared to maritime transport from Chinese ports, the reduction of unit transport costs and increasing the sustainability of the transport sector in terms of cost effectiveness, safety and environment. With respect to infrastructure funding, the Russian government regards public-private partnerships and the implementation of the "user pays" principle by levying road user charges as viable tools to mobilise private funds for road and railway construction as well as for urban public transport. For Russia, air transport is of special significance in passenger transport because of the long travel distances. Thus, the development of the internal air service market (which is protected from unregulated access of foreign air companies) as well as the reform of air traffic management systems are also important elements of Russia's transport policy.

2.1.2.4. USA

The main characteristic of the United States' transport structure is the long travel distances between the main centres of economic activity on its coasts. Central transport axes in the US are the north-south connections on the East coast, which still exhibit significant passenger rail transport performance and the trans-continental axes, linking the East coast via the Midwestern states with the centres of economic activity on the West coast. Traditionally, railways played an important role not only for the transport of goods but also for passenger transport between the regions. However, with the opening of the Panama canal, the formidable increases in motorisation and road transport volumes, and the emergence of air transport as the major passenger transport mode for long-distances, the importance of railway transport started to decline, especially for passenger transport. Consequently, parts of the railway network have progressively been shut down over the years. However, the remaining network is used in a highly efficient way for long-distance rail freight transport, predominantly with freight trains powered by Diesel locomotives and thus needing no electrification. Railway lines designated for high-speed passenger transport exist virtually only on the East coast, e.g. connecting Boston with New York and Washington. Plans exist for constructing a high-speed train system in California but are still in early planning stages. The road and motorway network in the USA is very sophisticated and individual mobility plays a key role in American society. Until 1991, federal funds for transport were available predominantly for motorways. Since then, legislation also allows support for public transport.

In the USA, the deregulation and market opening of network industries started well before most European countries. Deregulation started with the air transport sector with the Airline Deregulation Act of 1978. In recent years, the high level of competition, increasing fuel prices and the emergence of low-cost carriers has forced several of the traditional airlines into insolvency. The railway market, which has been deregulated since 1980, means primarily freight transport. It consists of a high number of regional railway companies (more than 200) that are vertically integrated and possess their own regional railway infrastructure. Passenger transport, on the other hand, falls under the responsibility of a single, publicly owned railway company (AMTRAK), which pays for the use of infrastructure owned by the freight transport companies. Not surprisingly, freight transport is, in contrast to Europe, prioritised to passenger transport with the consequence of low average speeds for passenger transport in general. In April 2005 however, the Bush administration introduced the Passenger Rail Investment Reform Act, an initiative that aims to increase competition in rail passenger transport market by enabling private rail operators to enter the passenger rail transport market. In this context, Amtrak will be exempted from paying for the maintenance of the rail infrastructure and stations. That deregulation shows many similarities to the European rail policies introduced from 1994. Regional authorities will be empowered to design their local rail transportation system and are eligible to apply for federal grants for passenger rail infrastructure projects.

2.2. Energy indicators

2.2.1. Energy intensity

Energy intensity is defined as the ratio between the gross inland consumption (GIC) and the gross domestic product (GDP) at a specified year's market prices and exchange rates. In general term, the energy intensity of the EU's trading partners has been falling almost steadily since 1990. However, two specific trends can be identified. On the one hand, rapid economic growth in China and, to a lesser extent in Russia, has been accompanied by less than proportional growth in primary energy demand (or gross inland consumption - GIC). Those developments have resulted in a sharp drop in the energy intensities of those two countries: Between 1990 and 2002, the indicator fell by 34% in China and by 17.5% in Russia, although for different reasons. In China's case, fast economic growth was accompanied by a very flat energy demand curve over the period (achieved in part by replacement of older production units in the energy transformation sector). Russia's intensity decrease, on the other hand, resulted from a more moderate economic growth, a contraction of its heavy industry and manufacturing sectors, and the replacement of its older power stations, which combined to produce negative growth of energy demand over the period.

In the USA, energy intensity fell by 12.4% over the period, mainly due to good economic performance of its less energy-intensive sectors. Intensity decreases were much more moderate in the EU and Japan, driven by higher relative energy prices (from taxes and other structural conditions), and a less dynamic growth of their economies. For instance, whereas GIC in the EU and the USA rose by nearly the same amount (in the vicinity of 9.3%) between 1990 and 2003, the USA's economy grew by 28.7% over the period, while the EU's only grew by 18.6%. Japan's energy demand grew even less over the period (3.5%), while its total growth between 1990 and 2003 barely exceeded 10.5%. Figure 3-15 illustrates these trends.

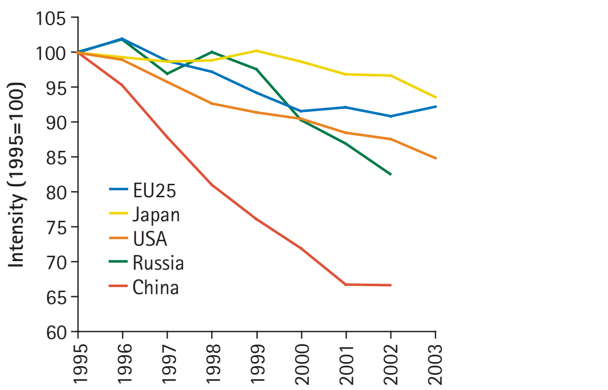
The reductions of energy intensity in Japan and the EU were also lower because their intensities are already the lowest among the countries considered; both in absolute and in Purchasing Power Parity-adjusted terms (see Figure 3-16). Purchasing power parity allows to more accurately compare the incomes of different countries by adjusting GDP levels to account for the differences in price levels (typically a basket of goods and services) across different countries.

2.2.2. Structure of final energy demand

The USA and Japan exhibited similar shares for their household and tertiary sectors, but in the former country, where the use of public transport is much more limited and where private cars are larger and performance is higher, demand from the transport sector takes a much larger share of total final consumption.

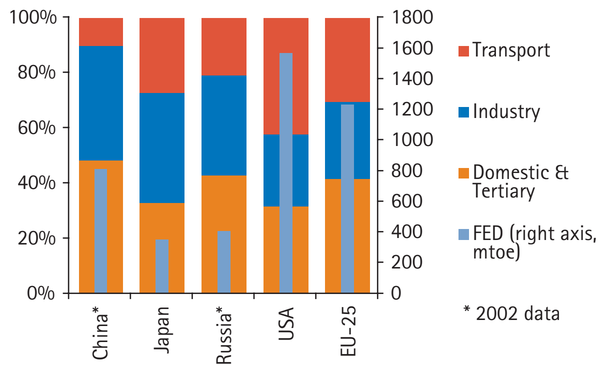
China and Russia's emerging economies present similarly structured demand, where the bulk of final consumption goes to the domestic and industrial sectors, and where transport represents less than 20% of the total demand. The larger share of heavy and energy-intensive industries, combined with lower

Figure 3-15: Evolution of energy intensity in the EU and its principal trading partners



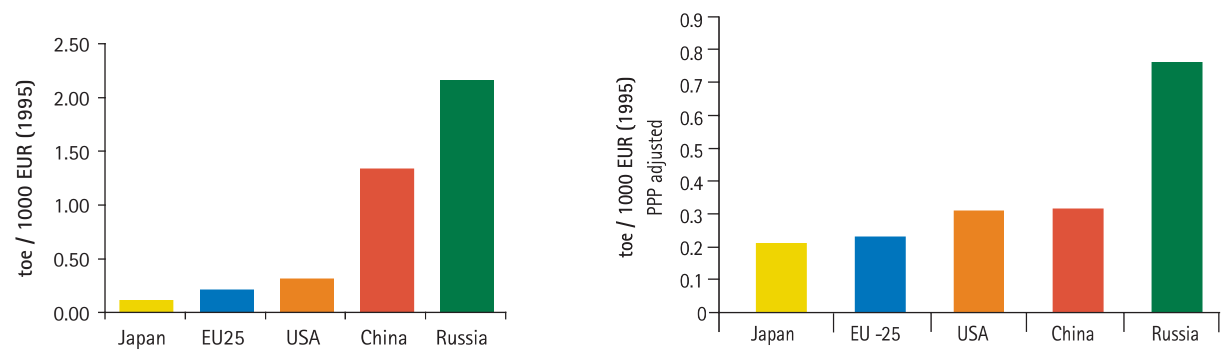
Source: Eurostat and IEA

Figure 3-17: Structure of FED in the EU-25 and its principal trading partners (2003)



Source: Eurostat and IEA

Figure 3-16: Energy intensity in the EU and its principal trading partners (2003)



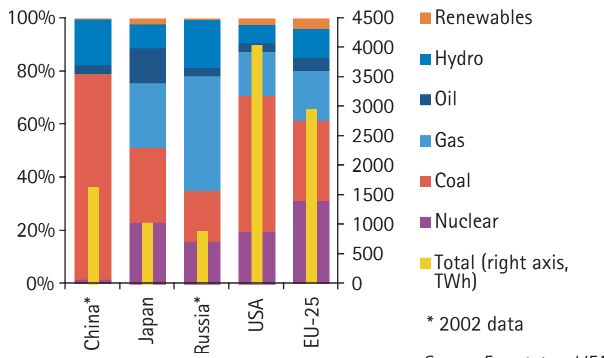
Source: Energy and transport in figures

motorisation levels, also means that industry takes a much larger share of FED in those countries, relative to the more developed economies of the USA, Japan and the EU. Figure 3-17 also illustrates the impressive volume of China's FED which, still a long way to reach the EU's level of development, is not far from that of the EU.

2.2.3. The energy transformation sector

With some 4000 TWh produced each year, the USA is by far the largest generator of electricity in the world. In 2003, production of electric power continued to come primarily from coal and, to a lesser extent, from nuclear and natural gas. The United States' large production of electricity must be put into perspective by recalling that the EU is larger in terms of surface, population and GDP.

Figure 3-18: Electricity generation mix in the EU-25 and its principal trading partners (2003)



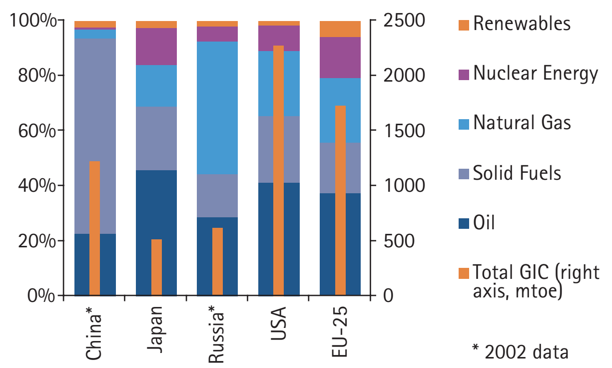
Source: Eurostat and IEA

Nuclear energy is the predominant source of electricity in Japan, who relies heavily on imports of fossil fuels, whereas high domestic availability of energy resources allow Russia to be gas-intensive and China to be overwhelmingly coal-intensive. The EU has (perhaps along with Japan) the more balanced generation mix. However, the importance of nuclear in the EU is likely to decrease in favour of gas in the upcoming years as several old nuclear plans in the EU-10 are, or will be, decommissioned.

2.2.4. Structure of gross inland consumption

Partly as a result of the predominance of the internal combustion engine, modern economies are easily recognisable by the structure of their GIC. There, oil invariably occupies the leading position, because developed countries are characterised not only by high motorisation and performance levels, but also by the consumption

Figure 3-19: Structure of GIC in the EU-25 and its principal trading partners (2003)



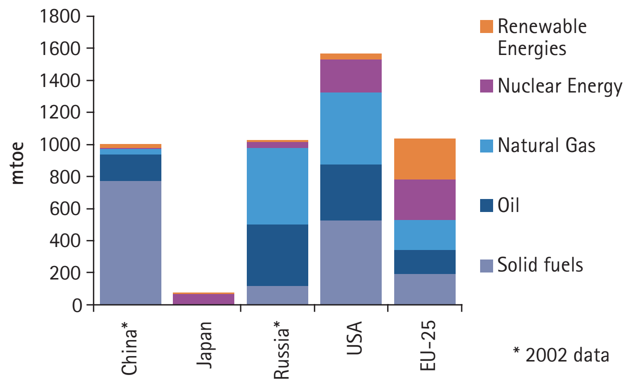
Source: Eurostat and IEA

of other petroleum products used mainly for transport. It is worth noting that whereas the share of primary oil demand is similar in the USA and the EU, final demand for oil and oil products for transport is much lower in the latter region. Figure 3-19 also shows the importance of renewable energies in the EU's primary energy mix. Mainly as a result of the structure of their electricity generation sector, China is a predominantly coal-intensive economy whilst Russia is gas-intensive.

2.2.5. Primary energy production and self-sufficiency

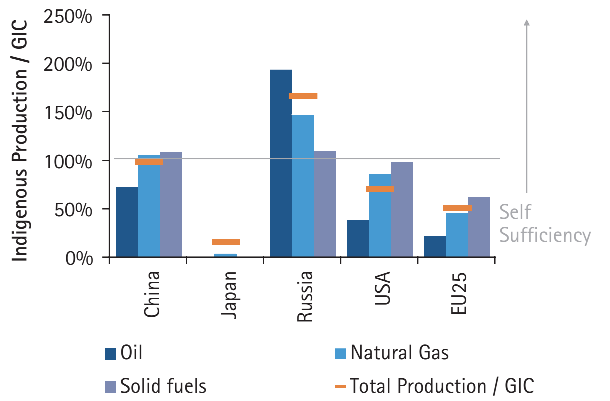
Despite the fact that the USA is, by far, the largest producer of primary energy among the EU's main trading partners, its large energy demand means that its overall self-sufficiency –defined as the ratio of indigenous production to GIC– is around the 72% mark. Although the USA is nearly self-sufficient in terms of its solid fuel (99%) and gas (86%) demand, the USA relies heavily on oil imports, even as it is still among the largest producers in the world. Japan, on the other hand, has negligible production of hydrocarbons or coal, and its only significant output of primary energy is in the form of nuclear and renewable energies. At 16%, the country's self-sufficiency is the lowest of the EU's trading partners.

Figure 3-20: Production of Primary Energy in the EU-25 and its principal trading partners (2003)



Source: Eurostat and IEA

Figure 3-21: Primary energy self-sufficiency in the EU and its principal trading partners (2003)



Source: Eurostat and IEA

On the other end of the self-sufficiency spectrum are Russia and China. Russia possesses abundant hydrocarbon and coal reserves and is not only entirely self-sufficient in the three fuels, but is also the only net exporter of energy (principally oil and gas) among the EU's trading partners. Indeed, in 2003 the country produced almost 2 times its consumption of oil and nearly 1.5 times its consumption of gas. Until recently, China was, like Russia, a net exporter of the three fuels. Yet fast economic growth has changed that, making China dependent on oil imports and producing just enough gas to cover its demand. In 2003, only 73% of its primary energy demand of oil was covered by indigenous production, a share that is expected to continue to fall rapidly in the coming years. Among the trading partners, China is also the largest producer of solid fuels, most of which are consumed internally.

In comparison with its trading partners, the EU has one of the most balanced production portfolios, with its output roughly equivalent to that of China and Russia. Nonetheless, indigenous production covers only 51% of its primary energy needs. The EU's dependency on imported oil is the highest among the group of trading partners considered: In 2003 it produced only 22% of its GIC of that fuel. Coal and gas are relatively more abundant, with self-sufficiency of those fuels attaining 63% and 46% respectively in 2003 .

2.3. Transport indicators

2.3.1. Infrastructure

Differences in the structure and density of the national transport infrastructure of the non-European trading partners reflects differences in geography, population density, historical developments and the structure of industrial production. With the exception of China, network densities are, in general, strongly correlated with population density.

Japan's rail transport system is famous for its high-speed-train Shinkansen and the highly efficient commuter lines that serve the suburbs surrounding the main urban agglomerations. The high share of electrified lines reflects the importance of this kind of passenger transport. Japan's railway companies continue to build new lines and increase capacity by adding tracks to existing lines. Railway system expansion is also being promoted through system diversification, with the addition of monorails and other types of railway technology. Compared to Europe, the dense road network shows a relatively small share of motorways, which is due to Japan's specific geography and the lower modal share of long-distance road transport. Having peaked in the mid-nineties, investments in road infrastructure still remain significant. Under the "Interaction Network Initiative", the network is being extended with the goal of creating a multi-polar, decentralized road transport system.

Despite its considerable population density (second only to Japan), China possesses one of the lowest network densities among the EU's trading partners. While infrastructure supply in the booming cities (e.g. Shanghai or Beijing) has strongly grown in recent years, the dynamic economic development of the urban centres has yet to reach most of the poor rural regions of the country, which often lack transport infrastructure altogether. Notwithstanding, a significant extension of the networks has taken place in recent years. The length of motorways has more than doubled over the 1999-2003 period with a total increase of the road network of more than 400,000 km over 1999-2003. In the same period, 4,500 km of railroads were built. Significant efforts have been made to construct a high-speed train connection between Shanghai and its Pudong airport. As part of the vast process of transforming China into a highly industrialised economy, the government has given investments in transport infrastructure top priority.

The situation in Russia is very different. The total extension of the road and rail network has been stagnating for more than a decade. Moreover, the length of local roads has even dropped in recent years. Only the lengths of subway lines, quality roads with hard surfaces and pipelines have increased slightly.

Taking into account the different population densities, the scope of the road and rail networks in the USA is comparable to that of the EU-25. The main difference between the two is the former's low share of electrified railway lines, explained by its low levels of passenger rail transport. The total length of the inter-urban road network has been increasing only slowly, while the rail networks for freight transport remained more or less constant. The length of the Amtrak network for rail passenger transport has even slightly decreased in recent years.

2.3.2. Modal split

The different structures of transport systems in the EU, Russia and the main non-European trading partners are reflected by differences of the modal shares of the alternative inland transport modes for both freight and passenger transport.

Inland freight transport in the EU-25 and Japan is strongly dominated by road freight transport, whose respective shares in 2002 were 72% and more than 90%. In contrast, rail freight transport in China and the USA plays the predominant role, although road freight transport is also significant in those countries. No data on road freight transport was available for Russia. In absolute terms, the volume of rail freight transport in

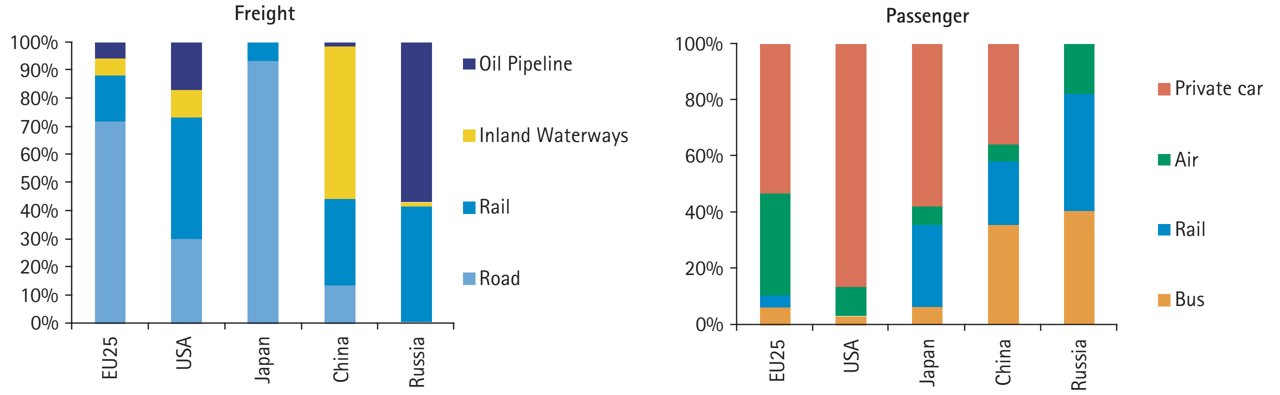
Table 3-1: Rail networks of Russia and non-European trading partners compared to EU-25

Year 2001	Russia	China	Japan	USA	EU25
Total rail network (1000 km)	86,1	70,1	23,7	315,3	199,7
Share of electrified lines	46,8%	26,7%	69,6%	< 5%	50,2%
Network density (m/sqkm)	5	7	63	33	50

Table 3-2: Road infrastructure of Russia and non-European trading partners compared to EU-25

Year 2001	Russia	China	Japan	USA	EU25
Total road network (1000 km)	585	1698	1172	7173	4800
Motorways (1000 km)	n.a.	19,4	6,9	90	55,6
Network density (m/sqkm)	35	180	3100	750	1210

Figure 3-22: Modal split for freight and for passenger transport in the EU and its principal trading partners (2002)



Source: National statistical offices

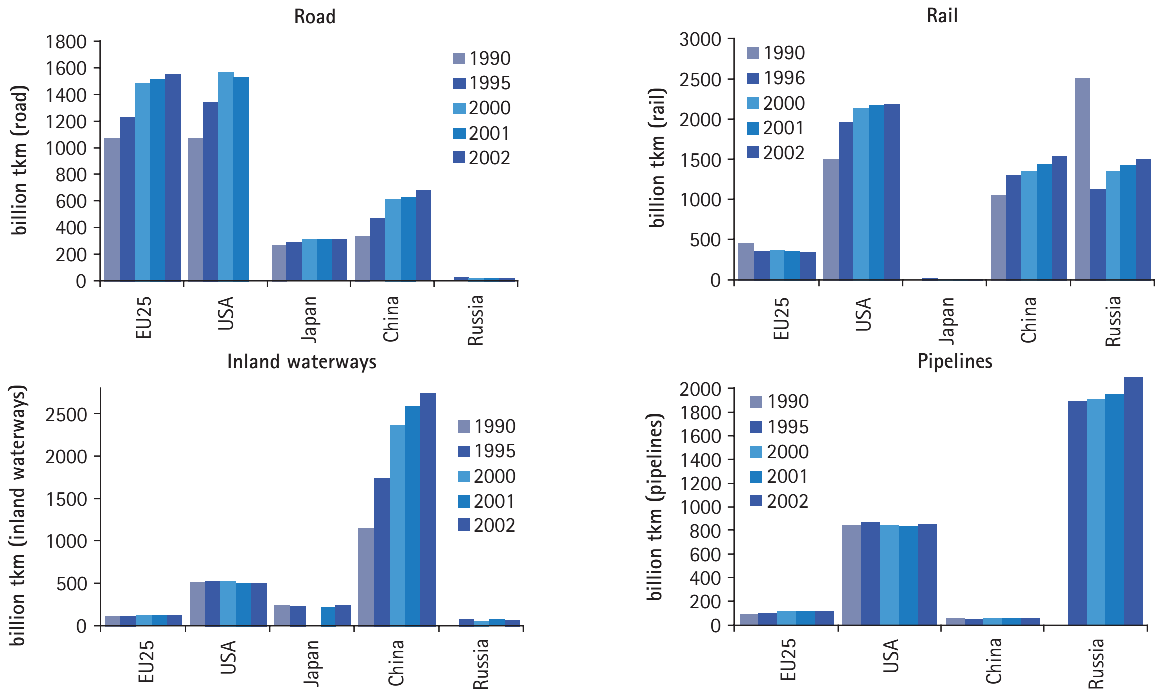
Russia was comparable to China, where the share of inland waterways is by far the highest among the countries considered. It is followed by the USA, the EU-25 and Russia, while in Japan there is virtually no freight transport by that mode. Short-sea shipping is not included in the diagrams. Nevertheless, its modal shares are significant in the EU-25, USA and Japan, while it is almost irrelevant in Russia.

With respect to passenger transport, each country exhibits a specific modal structure. The share of individual transport by private vehicles is by far highest in the USA, while the share of railways is very low (with the only significant traffic volumes along the East Coast between Boston, New York and Washington). Conversely, the share rail passenger transport in Japan is high as a result of the efficient high-speed train and commuter systems, both with outstandingly high levels of service. Although motorisation in China is growing rapidly, public transport by bus and rail still retain a higher modal share than individual transport. The situation in Russia is similar with an even higher share of rail passenger transport. However, data on individual transport with private vehicles was not available. The share of air transport is highest in the EU, followed by the USA, Japan and China.

2.3.3. Freight transport

Growing economic output and the growing integration of global production processes have resulted in increasing freight transportationin every one of the EU's main trading partners with the exception of Japan, whose stagnating economic performance was reflected by stable freight transport volumes. China presented the most dynamic development of transport performances with increases in every transport mode, including very high growth in inland waterway performance. Contrary to what occurred in the EU-25 and Japan, rail transport performance increased in the remaining trading partners. Following the slump from the aftermath of the transition to a market economy in the early 1990s, rail transport volumes in Russia grew steadily since the mid 1990s. In the USA, the growth of road freight transport stalled in 2002. Freight transport volumes on inland waterways and oil transport through pipelines remained fairly constant for most of the countries, except in China where there was the aforementioned growth of inland waterway performance, and the slightly increasing pipeline conveyance in Russia.

Figure 3-23: Development of freight transport performances in the EU and its principal trading partners



Source: Energy and transport in figures, national statistical offices

[1] Longer distances have a direct impact on transport performance, which is measured in tonne-kilometres.

Relative to Europe, rail freight transport plays a major role in the USA's transport sector, largely due to the longer distances travelled[1] and higher efficiencies. High priority has been given to this transport mode as it guarantees high speed and reliability of deliveries.

2.3.4. Passenger transport

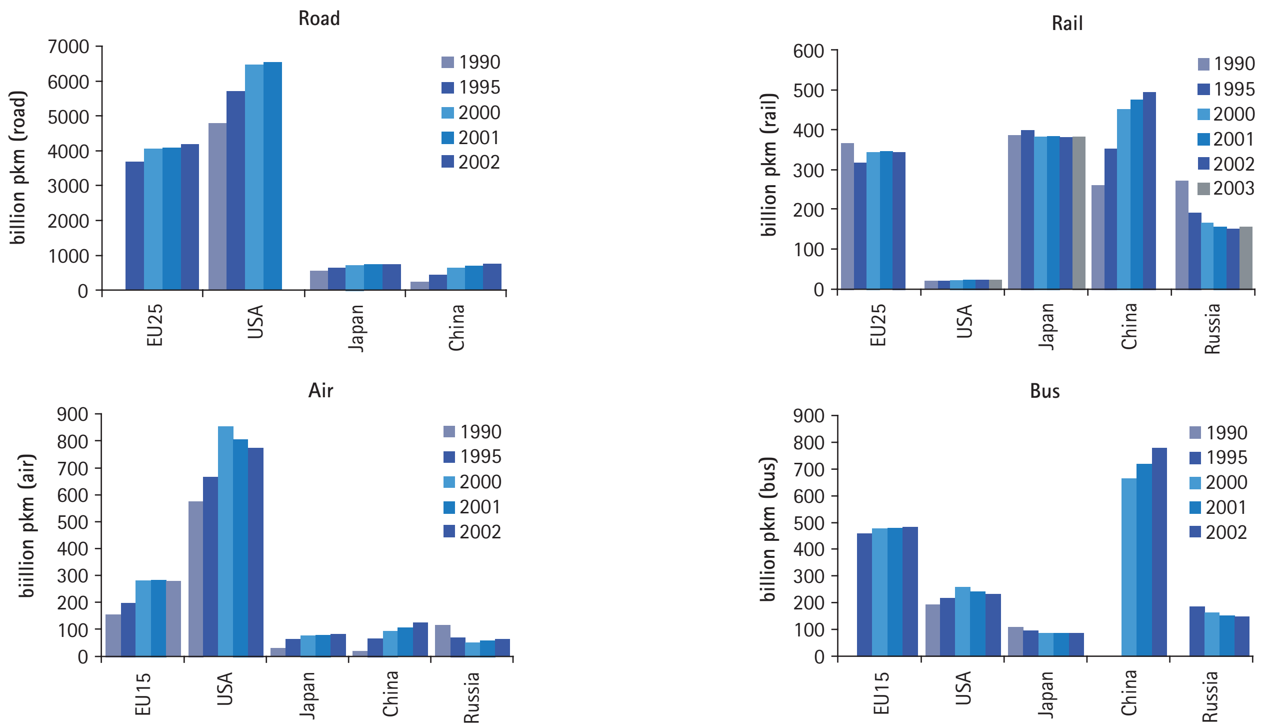
Performance of individual private vehicles in the USA and the EU largely exceeds that of China, Japan or Russia. In the USA, individual road transport has always been of great importance, where comparatively longer distances, deficient or no public transports in smaller and medium-sized cities and low gasoline prices have resulted in high motorisation and performance levels across the entire territory. The recent move away from automobiles and towards Sports Utility Vehicles confirms that country's strong taste for large cars with low relative fuel efficiencies. However, some states (e.g. California) have moved against this trend and have introduced regulations to limit environmental pollution from transport. Initiatives include the establishment of a green vehicle market or taxes related to cars' weights. While individual road transport in China is still low in absolute terms (particularly in relation to its population), the rising level of motorisation has led to significant and stable performance growth over recent years. In contrast, passenger transport volumes in Japan have remained nearly constant for all modes.

The USA presents the lowest rail passenger transport performance, where frequent delays and modest comfort contribute to make passenger rail transport unattractive. However, some high-speed links on the east coast have successfully been established in the last years, where occupation rates are relatively high. This shows that modern rail transportation systems attract passengers regardless of their former habits. Significant railway performance growth took place in China, as well as in all other passenger transport modes in its fast growing economy. With respect to its evolution over time, the amount of rail passenger-kilometres in the USA and the EU-25 remained more or less constant. In Russia, rail performance volumes decreased until 2001.

The dynamic development of air passenger transport is a global trend that can in general be observed in each of the countries considered. However, air transport volumes in Europe and in the USA peaked in 2000 and began a slow decrease after that, partially owing to the effects on passenger preferences following the September 11 terrorist attacks.

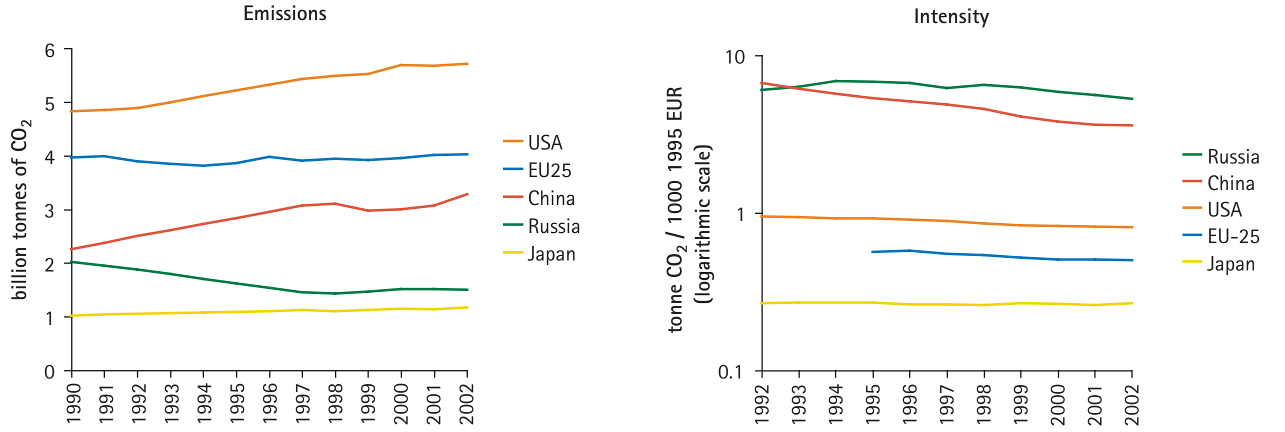
Public road transport by bus slightly grew in the EU-25 and, until 2000, in the USA. Growth was even faster in China, where in 2002 bus transport performance almost matched the volumes of the EU-25, the USA and Japan combined. In Japan and Russia public road transport by bus decreased slightly but steadily over the period considered.

Figure 3-24: Development of passenger transport performances in the EU and its principal trading partners



Source: Energy and transport in figures, national statistical offices

Figure 3-25: Evolution of CO_2 emissions and intensity in the EU and its principal trading partners



Source: Eurostat and IEA

2.4. CO_2 emissions

Several elements combine to make the USA the greatest source of CO_2 emissions in the world: Its comparatively large use of road vehicles for passenger transports the principal form of individual transport as measured by motorisation and performance, a power generation sector based mainly on coal-fired stations and the sheer size of its economy. Moreover, annual CO_2 emissions in the USA have been growing at a much faster pace relative to the EU's main trading partners, which partly explains why the US administration is unwilling to sign the Kyoto protocol on greenhouse gas emissions control. At the other end of the scale, Japan is the country with the lowest CO_2 emissions, although Russia has closed in on that level in recent years, mainly due to a combination of economic restructuring, reduced energy demand, and the decommissioning of inefficient power generation and industrial plants.

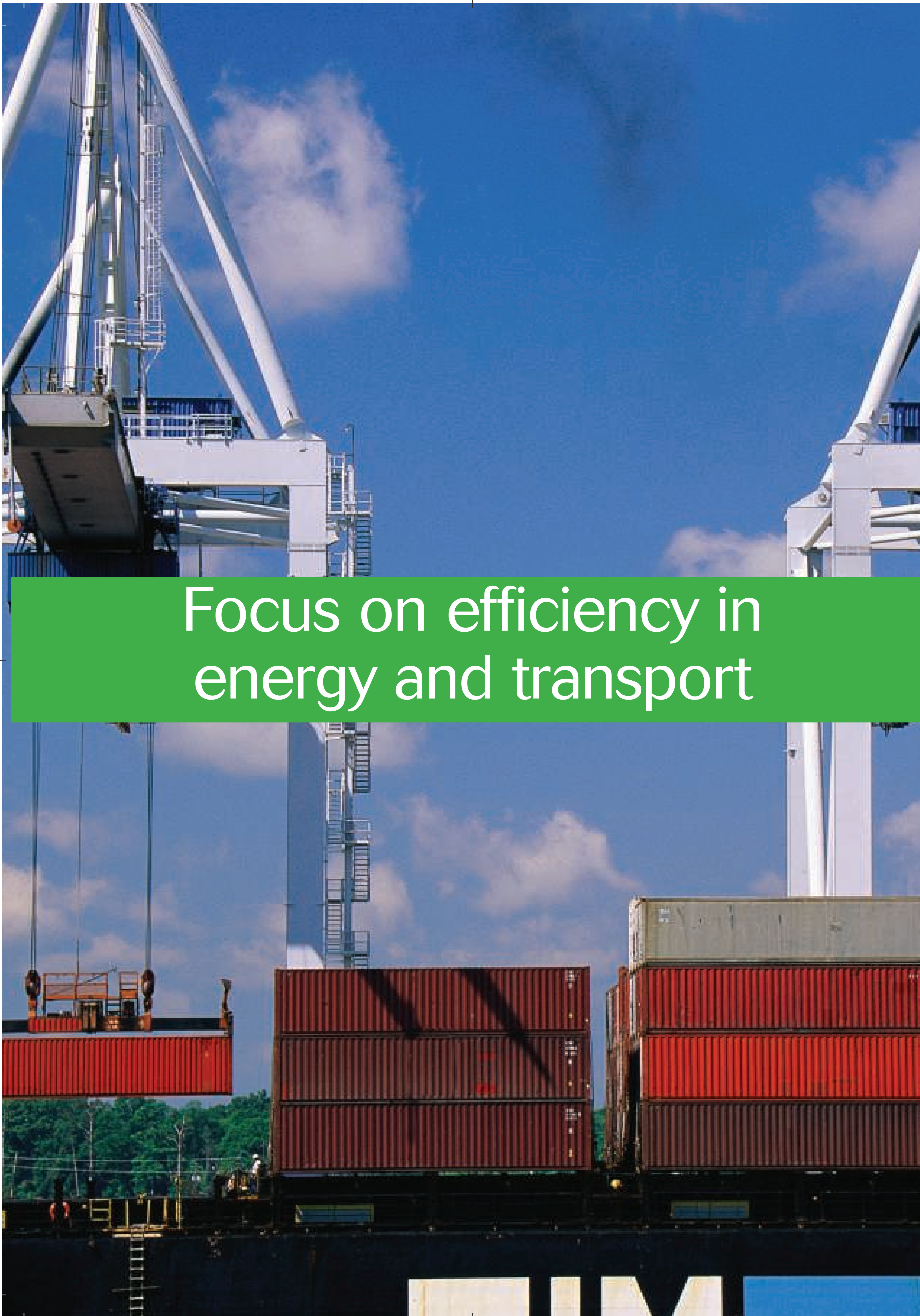
The fastest growth has been in China, whose emissions in 2002 were up by 45.6% relative to the 1990 level, representing a 3.2% average annual growth rate.

In mid 2005, the USA, China, India, Australia, Japan and South Korea surprised the world by signing the Asia-Pacific Partnership on Clean Development. The agreement does not impose obligations to decrease GHG emissions but rather stipulates reductions through the development and sharing of existing and new technologies.

The evolution of CO_2 intensity shows that there is ample room for improvement: In the USA, emissions per unit of GDP were consistently higher than those observed in Japan or the EU, although well below the intensities of the developing economies of China and Russia. In general, emissions intensity of all trading partners fell over the 1990-2002 period, although the largest reductions took place there where the intensity was highest, namely China and Russia.

MORE DETAILED STATISTICS, TABLES AND GRAPHS FOR ACC, ETP AND EUROPE'S MAIN TRADING PARTNERS CAN BE FOUND IN THE CD-ROM ATTACHED TO THIS DOCUMENT.

Focus on efficiency in energy and transport



1. INTRODUCTION

Improving the efficiency of Europe's energy and transportation industries and systems is of overriding economic and social importance for three reasons. First, it directly contributes to the international competitiveness of Europe by minimising the cost of energy and transport for manufacturing and distribution of goods including the daily journeys of the workforce. Second, it reduces the energy use and transport movements per unit of output, which reduces emissions and other environmental footprints. And third, through lower oil consumption it reduces Europe's dependence upon the oil exporting countries and contributes to longer-term availability of the fuel.

Increases in energy efficiency have been realised mainly through improvements in the specific energy consumption of transformation and final consumption facilities (power stations, refineries, internal combustion engines, factory boilers and domestic boilers) together with attention to a reduction in transmission losses and thermal insulation of building properties. Very great strides have been made with, for example, the thermal efficiency of power stations, which rose by almost 20 percentage points with the introduction of modern combined cycle gas turbines in the early 1990s. In the transport sector,

specific consumption enhancements have been modest over the past decade, and the savings achieved therein have been largely offset by rapidly growing demand.Despite good progress in the efficiency of household appliances, an enormous potential for savings in the domestic and tertiary sectors (e.g. through better insulation and the rationalisation of energy supply and consumption) remains largely untapped.

Another major prospect for efficiency enhancements lies within the transport sector. Given that oil use for transport represents some 30% of total final energy consumption in the EU-25 and that it is a large and rapidly growing sector, improving its efficiency requires much more than simply reducing the specific consumption of vehicles. In fact, the challenge of enhancing not only specific energy efficiency, but also social, economic and organisational efficiency (which are discussed below) in Europe's energy and transport industries requires a fully integrated approach. Indeed, the over-riding aim is to minimise the unit cost of transport (of which energy is only a part) consistent with adequate quality and flexibility, and recognising the trade-offs with other dimensions such as security and environment. The fusion of the Commission's Energy and Transport Directorates in 2000 constituted a step towards that objective. This chapter explores the increasingly important role of efficiency in Europe's energy and transport industries and presents the steps taken so far, current trends, as well as the future objectives and policies in this crucial area.

1.1. Efficiency: a multi-pronged concept

It is important to start with a precise definition of efficiency in order to correctly work through the ideas which follow. We begin with two main concepts of efficiency, applicable to both energy and transport:

Specific or technological efficiency refers to the simple input-output ratio which measures, for example, the energy efficiency of a plant, that is, the proportion of useful energy output (heat, electricity or motive power) relative to energy input.

System or organisational efficiency refers to how well the resources of a system (e.g. an economy) are deployed in terms of overall objectives (e.g. policy goals). Although there is no unique indicator for measuring system efficiency, several dimensions of the concept can be considered:

- The load or utilisation of capital assets of various kinds: average utilisation of any form of transport – trucks, buses, trains, aeroplanes; utilisation of networks – passengers or tonnes of freight carried per km of main road or railway track; KWh transmitted per km of gas or electricity transmission/distribution network; average utilisation of energy production or transformation plant. Loads are mainly determined by market forces, which may or may not be influenced by sectoral regulations.
- The adequate provision of infrastructure according to the current and future volume and structure of demand for transport and energy products. Public infrastructure planning processes play a predominant role in this field.
- The organisational efficiency of energy and transport production processes in respect of industrial structure, degree of competition or level and quality of public service within the sectors. Here, adequate regulation may significantly contribute to improved efficiency.
- User behaviour, consumption patterns and public awareness: determined in turn by the socio-economic and cultural environment. Consumer characteristics are also drivers of change in demand structures and can be influenced by incentives, education and public campaigns.

However, efficiency also refers to the economics of supplying energy and transport services, but the concept varies depending on the decision-maker. Governments ideally want to maximise welfare while minimising total social costs. Efficiency for producers means operating with the lowest private costs of production. Efficiency for users refers rather to relative quality and cost effectiveness. There is also a societal and political challenge to use energy economically in order to give future generations the opportunity to enjoy economic prosperity and a high quality of life. Thus, three additional dimensions of efficiency can be identified:

Economic efficiency means minimizing the full social cost (i.e. market costs plus the cost of externalities such as pollution or accidents) of overall policy goals. This may include the correction or regulation of market failures such as market concentration, asymmetric information or natural monopolies and to the minimisation of inter-temporal social costs.

Commercial efficiency refers to the relation between the supply of a given level of goods or services and the private costs that must be incurred to obtain it. The highest economic efficiency is attained when the prices of goods equals the marginal cost of producing or obtaining them. Commercial efficiency is a key driver of competitiveness.

User efficiency refers to the cost-effectiveness and quality of goods and services as measured by the ratio of variables such as regularity, punctuality or security to their price. Increases in user efficiency enhance welfare.

Also, it is important to recognise that there are sometimes unavoidable trade-offs between the flexibility that different systems offer and their efficiency. A transport system which offers a relatively high degree of spatial flexibility and a high frequency of service will not achieve the same efficiency as less flexible, lower frequency systems. Similarly an energy supply system that is able to supply energy flexibly as needed to accommodate a wide range of climatic conditions together with other demand variations (e.g. due to changing levels of industrial activity) will be less efficient than a less flexible system. In the case of transport there is a further set of trade-offs to be made – between average speed, energy efficiency, and capital asset efficiency: trains or cars travelling at high speeds will deliver a more valuable service to consumers, will reduce energy efficiency, but may also increase utilisation of capital assets. In order to make these trade-offs transparent and to allow for the well-informed appreciation of conflicting policy objectives, it is important that all relevant costs, including externalities, are reflected in the prices.

Finally, the multiplicative nature of efficiency improvements is worth noting. As energy efficiency of any system is the product of the efficiencies of individual components, it follows that material (as opposed to merely incremental) improvements in several sections simultaneously will have a multiplicative, rather than merely additive effect. Two examples would be:

- In households, heating using gas three factors can jointly improve overall efficiency – reduction in transmission losses, improvements in thermal insulation and improvements in boiler efficiency.

- In transport, improved utilisation of trucks (i.e. reduced empty return journeys) coupled with improved engine efficiency leads to significant reduction in diesel/tkm of freight moved. It simultaneously leads to a higher efficiency of capital – both trucks and road space.

1.2. Main drivers of efficiency

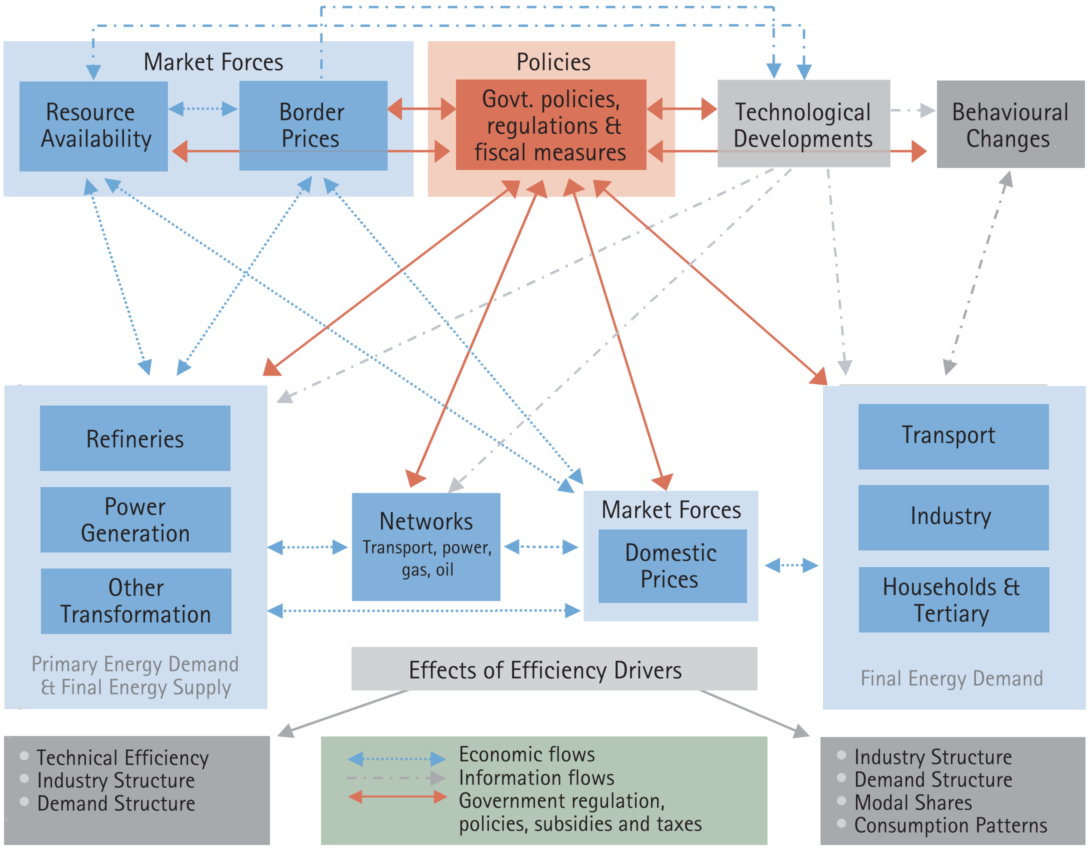
Two main types of efficiency drivers can be identified: market forces and government policies. Market forces, starting with energy prices and competition, are a powerful and continuous driver towards efficiency-enhancing actions. Markets are imperfect, however, and do not always reflect the totality of issues which governments wish to see recognised in economic decisions to develop and utilise different forms of energy and transport. The full cost of the externalities associated with energy and transport activities (environmental damage, injuries/deaths) is seldom captured by the pricing mechanism and therefore needs policies that internalise it, such as command and control regulations (e.g. standards or quotas), market-based instruments (e.g. taxes or tradable permits), voluntary agreements or government aid. In addition, the government may wish to meet other policy objectives such as avoiding excessive energy import dependency (in total or from certain regions) or increasing overall competitiveness, and may therefore look to induce certain actions (e.g. reduce energy consumption or stimulate modal shifts) to help meet such objectives.

Market forces and government actions are the main drivers for efficiency but other, less direct drivers exist, such as technological developments and social and individual behaviour. Whilst technological advancements are frequently driven by market incentives and/or stimulated by government policies, resources or actions, they may also develop independently. At all levels, from major breakthroughs to small incremental improvements of existing technologies, technological advancements affect energy efficiency.

Behaviour, used here as a broad term which refers to individual and social consumption patterns, preferences and other psychological and social values, can also have an impact on the system and user efficiency with which energy and transport are consumed. Like technological developments, it may be influenced by market forces and government actions, but also evolves independently of those factors. In passenger transport, for example, behaviour affects the modal shares of the different types of transport. As a result, improved user information on costs and modal alternatives can steer user behaviour, resulting in higher system efficiency. This includes buying cars with lower fuel consumption or making better use of public transport services. Also, the use of information technology services (ITS) helps to make better use of existing infrastructure and thus increases overall capacity and reduces congestion.

Figure 4-1 shows how different drivers interact to improve transport and energy efficiency, and the complexity of their interactions. For example, improvements in transport system efficiency can generally lead to multiple benefits – (i) improved utilisation of the infrastructure (network and mobile units) leading to lower unit costs, (ii) reduced energy consumption, (iii) an improved competitive position for the country as a result of the first two factors, (iv) reduced environmental impact including that achieved through lower energy consumption, (v) reduced energy imports (particularly oil) to the extent that the road transport system is made more efficient and/or a modal shift to rail/water is achieved. These considerations highlight the overriding importance of addressing efficiency in the energy and transport sectors in an integrated manner.

Figure 4-1: Energy demand and efficiency drivers



1.3. The importance of efficiency in European energy and transport policy

One the greatest challenges faced today, and perhaps one of the strongest drivers towards increased efficiency, is rising energy costs. Since 2002, real oil prices have been growing rapidly. Moreover, there is increasing consensus among experts that this is not a temporal shift, and that oil prices have in fact risen to a new price band, implying that that the return to the low prices of the late 1980s and 1990s is increasingly unlikely. Whilst Europe's modern economies are much less dependent on oil than they were in the 1970s and have weakened the linkage between economic growth and oil consumption, oil still remains the largest component of our energy supply. As such, rising oil prices may perhaps not spark a world recession as in 1973-1974, but they will undoubtedly have a pronounced impact on the rate of economic growth. It is thus simple to see why more efficient use of oil is of crucial importance to European economies.

Rising oil prices are bound to be major a driver and incentive towards greater efficiency in the energy and transport sectors (as occurred for example in automobile production and heating technologies following the price hikes of the 1970s), but three more fundamental reasons explain why efficiency is called to play a determinant role in Europe's future:

- Competitiveness and the Lisbon agenda: a high potential for energy savings in Europe and its leadership in new energy efficient equipment and energy services make the promotion and development of energy efficiency an ideal means for enhancing the European economy in terms of job creation and in becoming the most competitive economy in the world, as proposed by the Lisbon agenda.

- Environmental protection and the EU's Kyoto obligations: Energy saving is one of the fastest, most effective and most cost-effective means for reducing greenhouse gas emissions, as well as improving air quality. It will therefore not only help Member States in meeting their Kyoto commitments, but will also constitute a major contribution to the longer term EU efforts in combating climate change through further emissions reductions.

- Security of energy supplies: Forecasts suggest that in less than three decades, the EU will be 90% dependent on imports for its requirements of oil and 80% dependent regarding gas. Enhanced energy efficiency is thus one of the key methods to deal with this challenge.

Following this three-tiered objective, the Commission has set out to make efficiency increases the way forward for Europe's energy and transport markets. In June 2005, it launched a discussion on the role that efficiency will play in Europe's future through the adoption of the Green Paper "Energy Efficiency or Doing More with Less" (COM(2005) 265). The paper addresses the numerous aspects of efficiency in the energy and transport markets and sets forth a series of questions and proposed initiatives that will be discussed and commented by stakeholders from all sectors of society. The Commission expects active participation from all stakeholders in order to produce a new policy framework document on the tools for augmenting energy and transport efficiency in Europe.

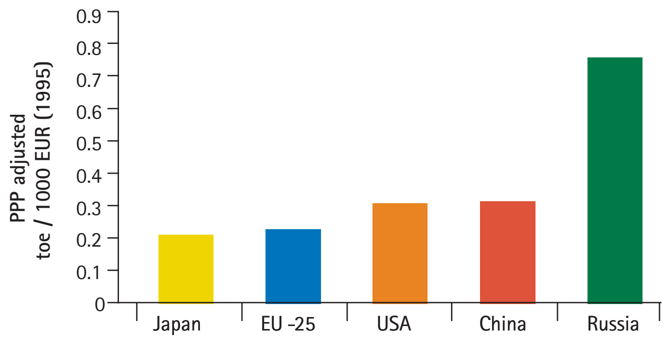
1.4. Europe's position and the potential for efficiency increases

The first measure of overall efficiency that can be made is the ratio of final energy demand (FED) to gross inland consumption of primary energy (GIC). In 2003, GIC in the EU-25 rose to 1726 Mtoe while final energy demand (FED) rose to 1131 Mtoe, meaning that only 65.6% of the total energy taken by the economy was actually used by final consumers, with the remainder being lost or used in the processes of transformation[1] and distribution. In 1990, that ratio was only slightly lower, at 65.1%.

Another very broad indicator of efficiency is energy intensity (energy consumed per unit of GDP output). An economy with low energy intensity is not necessarily more efficient than one with a higher intensity, as there could be a number of reasons explaining the difference, none of which need be a function of technical or system efficiency. These include climatic conditions, the chosen level of heating comfort, size and type of industrial manufacturing base, geography (which determines the extent to which both citizens and goods need to travel) or living standards (which affect the level of white goods consumed or the propensity to travel for pleasure purposes). However, without losing sight of a given country or region's specificities, it is still valuable to compare how well different countries convert energy into economic output and there are unmistakeable patterns between developed and less developed countries. As shown by Figure 4-2, the EU stands out as one of the regions with the lowest energy intensity in the world, second only to Japan. Energy intensity in the EU-25 was 0.204 toe/1000 EUR (1995) in 2003. Since 1995, intensity in the EU-25 has fallen on average by 1.4%/year. In comparison, energy intensity in the USA for 2003 was 0.313 toe/1000 EUR (1995) and only fell by an average 0.8%/year over the same period.

As in most developed countries, Europe's economy is oil-intensive. In 2003, GIC of oil represented 39% of total GIC in the EU-25. In

Figure 4-2: Energy intensities of the EU and its principal trading partners (2003)

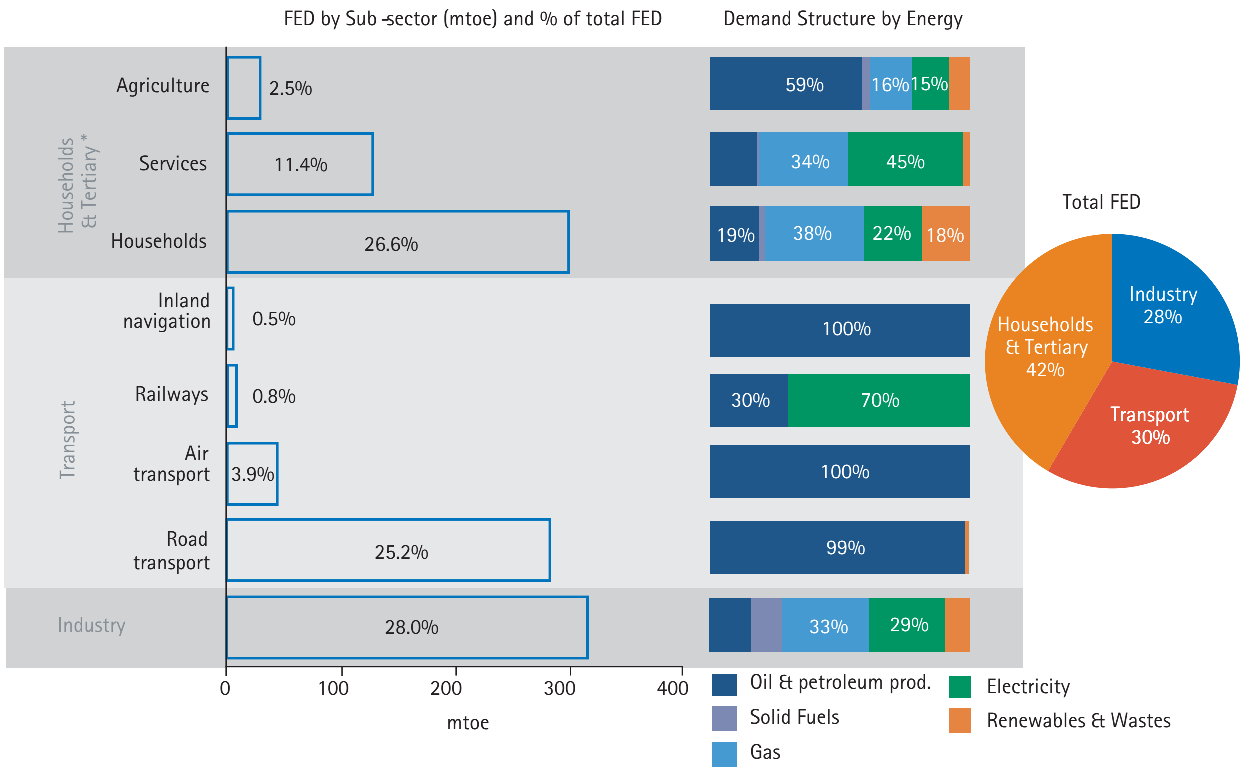


Source: Eurostat and IEA

that year, the share of oil and oil products in FED was even larger, accounting for 43% of the total. As shown in Figure 4-3 transport is undoubtedly the most oil-intensive sector: oil and oil products represent close to 100% of final demand in air, road and inland navigation and about a third in rail transport. Agriculture also depends largely on oil for its energy needs. The figure also shows the breakdown of FED by sectors and sub-sectors, together with their demand structure and confirms those sectors that should be given proportionately greater attention.

The Commission has identified the households, services and road transport sub-sectors – which together represent more than 63% of final energy demand – as the focal points of its new efficiency-enhancing policies. Industry, which represents 28% of FED, is already subject to numerous efficiency-enhancing policies, regulations and agreements and has covered much ground in increasing its efficiency. Most new initiatives for the latter sector will take the form of voluntary agreements or will be related to emissions abatement policies such as the ETS (emissions trading scheme) and the IPPC (integrated pollution prevention and control) Directive.

Figure 4-3: Structure of final energy demand (FED) in the EU-25 (2003)



(*) Does not include "other" sector which in 2003 represented 1.1% of FED Source: Eurostat

[1] *Through losses, own use and technical efficiency thresholds in generating electricity and refining fuels.*

2. LEGISLATION IN FORCE AND PROPOSALS FOR EFFICIENCY IN THE ENERGY AND TRANSPORT SECTORS

2.1. Energy sector

2.1.1. Efficiency in buildings

The aim of improved energy efficiency in buildings sector has already been the subject of many earlier legal instruments. Among the main Community legislation for the sector are the Boiler Directive (92/42/EEC), the Construction Products Directive (89/106/EEC) and the buildings provisions in the SAVE Directive 93/76/EEC). The Directive on the energy performance of buildings in force since January 2003 builds on those measures with the aim to provide for an ambitious step-ahead to increase the energy performance of public, commercial and private buildings in all Member States.

2.1.2. Efficiency in energy using products

> Framework on eco-design requirements

In July 2005, a Directive establishing a framework for the setting of eco-design requirements for Energy Using Products (2005/32/EC) was adopted. The requirements (such as energy efficiency requirements) apply for all energy using products in the residential, tertiary and industrial sectors. It also lays down coherent EU-wide rules for eco-design, ensuring that disparities among national regulations do not become obstacles to intra-EU trade. It does not introduce directly binding requirements for specific products, but rather defines conditions and criteria for setting requirements regarding environmentally relevant product characteristics (such as energy consumption) and allows them to be improved quickly and efficiently. This new Directive will be followed by implementing measures that will establish the eco-design requirements. In principle, the Directive will apply to all energy using products and cover all energy sources.

> Domestic appliances

The following table presents the main legislation concerning efficiency in household appliances.

2.1.3. Promotion of end-use efficiency & energy services

In 2003, the Commission set forth a proposal for a Directive on the promotion of end-use efficiency and energy services (COM/2003/739). The proposal established mandatory targets for annual energy savings at Member States' level and for the share of energy-efficient public procurement for the period 2006-2012. For the same period, strong incentives to Member States are given through the Directive to ensure that suppliers of energy offer a certain level of energy services. The proposal is still under discussion and some requirements might be changed.

Table 4-1: Legislation in Force for Domestic Appliances

Energy Labelling of household appliances	
Household electric refrigerators, freezers and their combination	Commission Directive 2003/66/EC of 3 July 2003 amending Directive 94/2/EC implementing Council Directive 92/75/EEC with regard to energy labelling of household electric refrigerators, freezers and their combinations,
Electric ovens	Commission Directive 2002/40/EC of 8 May 2002 implementing Council Directive 92/75/EEC with regard to energy labelling of household electric ovens,
Air-conditioners	Commission Directive 2002/31/EC of 22 March 2002 implementing Council Directive 92/75/EEC with regard to energy labelling of household air-conditioner (Text with EEA relevance)
Lamps	Commission Directive 98/11/EC of 27 January 1998 implementing Council Directive 92/75/EEC with regard to energy labelling of household lamps (Text with EEA relevance)
Dishwashers	Commission Directive 97/17/EC of 16 April 1997 implementing Council Directive 92/75/EEC with regard to energy labelling of household dishwashers (Text with EEA relevance)
Combined washers-driers	Commission Directive 96/60/EC of 19 September 1996 implementing Council Directive 92/75/EEC with regard to energy labelling of household combined washer-driers,
Electric tumble driers	Commission Directive 95/13/EC of 23 May 1995 implementing Council Directive 92/75/EEC with regard to energy labelling of household electric tumble driers,
Washing machines	Commission Directive 95/12/EC of 23 May 1995 implementing Council Directive 92/75/EEC with regard to energy labelling of household washing machines,
Electric refrigerators, freezers their combination	Commission Directive 94/2/EC of 21 January 1994 implementing Council Directive 92/75/EEC and with regard to energy labelling of household electric refrigerators, freezers and their combinations,
Household Appliances	Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances,
Minimum efficiency requirements	
Fluorescent lighting	Directive 2000/55/EC of the European Parliament and of the Council of 18 September 2000 on energy efficiency requirements for ballasts for fluorescent lighting,
Household electric refrigerators, freezers and combinations	Directive 96/57/EC of the European Parliament and of the Council of 3 September 1996 on energy efficiency requirements for household electric refrigerators, freezers and combinations thereof
Hot-water boilers boilers	Council Directive 92/42/EEC of 21 May 1992 on efficiency requirements for new hot-water fired with liquid or gaseous fuels

2.1.4. Combined heat and power
Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market (amending Directive 92/42/EEC) is a recently adopted legislative measure that concentrates on providing a framework for the promotion of this efficient technique in order to overcome existing barriers, to advance its penetration in the liberalised energy markets and to help mobilising unused potentials. The Directive defines high efficiency cogeneration as cogeneration providing at least 10% energy savings compared to separate production. As the indicative target value from the 1997 strategy is out-dated, the Directive does not include targets but instead urges Member States to carry out analyses of their potential for this highly efficient technology.

2.1.5. Office equipment – Energy Star programme
Office information and communication technology equipment (computers, monitors, printers, fax machines, copiers, scanners and multifunction devices) is responsible for a growing share of electricity consumption in the EU. The European Energy Star Programme is a voluntary energy labelling programme for office equipment. The programme started in 2000 as an Agreement between the Government of the USA and the European Community, whose goal was to co-ordinate energy-efficient labelling programmes for office equipment in these two major global markets for office products. The Agreement is intended to stimulate international trade of office equipment, by facilitating the procedures for economic operators to participate in the Energy Star programme. It is managed by the US Environmental Protection Agency and the European Commission and it will remain in force for an initial period of five years.

The Energy Star logo helps consumers identify office equipment products that save them money and help protect the environment by saving energy. Manufacturers, assemblers, exporters, importers and retailers are invited to register with the European Commission allowing them to place the Energy Star label on products that meet or exceed energy efficiency guidelines. The participation in the programme is voluntary.

2.2. Transport sector
In its recent Green Paper on energy efficiency, the Commission suggested the introduction of additional specific policies to foster energy efficiency in road transport. One is the establishment of a market for clean vehicles. Buyers of clean vehicles could be encouraged, for example, by tax incentives; public administrations could be obliged to spend a part of their vehicle investments on clean vehicles. Furthermore, limited access to central areas for polluting vehicles could be seen as an appropriate incentive to purchase cleaner cars. But while reducing CO_2 emissions is important, there can be a goal conflict with another important objective, the reduction of other polluting emissions and particulates in order to reduce the negative impacts on human health and the local environment. An example is the respective environmental benefits and drawbacks of petrol and diesel engines. Diesel engines emit less CO_2 than petrol engines. On the other hand, diesel engines produce more fine particles than petrol engines, a type of emission often associated with cancer. Thus, measures to reduce CO_2 emissions have to be combined with measures to reduce other pollutants. Of special importance in this field is the harmonisation and improved co-ordination in the fields of fuel and vehicle taxation.

Another proposed policy aims to reduce the friction between road and tyres, which estimates suggest accounts for up to 20% of fuel consumption. Friction could easily be reduced if drivers checked the pressure of their tyres more regularly. The Commission thus aims to work with industries to install pressure sensors. Alternatively, air could be replaced by nitrogen. Nitrogen-filled tyres (already used in Formula 1 and aircrafts) have the advantage of constantly self-regulating their pressure.

Community actions also include the organisation of air traffic management and the promotion of the use of intelligent information systems based on the Galileo project for the optimisation of traffic management for all modes of transport. Another element of the Commission's strategy for enhancing energy efficiency in transport is the induction of behavioural changes by providing users with better and more transparent information on the energy efficiency of transport modes.

2.2.1. CO_2 emissions from passenger cars
The Community's aim is to reach average CO_2 emissions of 120 g/km for all new passenger cars marketed in the EU by 2010. This objective is to be achieved by three main instruments:

1) Agreements committing automobile manufacturers to reduce CO_2 emissions from passenger cars mainly by means of improved vehicle technology

2) Improvements of consumer information on the fuel-economy of cars

3) Market-orientated measures to influence motorists' choice towards more fuel-efficient cars

> Agreements committing the automobile manufacturers to reduce CO_2 emissions from passenger cars mainly by means of improved vehicle technology

Car makers have signed voluntary agreements to reduce CO_2 emissions from passenger cars. The Association of European Automobile Manufacturers (ACEA) made a voluntary commitment to achieve a target of 140g CO_2/km for their fleet of new passenger cars sold in the EU by the year 2008. This would translate into a reduction of fuel consumption of 25 % compared to 1998 levels. Progress towards this commitment is reviewed annually by the Commission. Similar agreements have been made by JAMA (Japan Automobile Manufacturers Association) and KAMA (Korea Automobile Manufacturers Association), with a target date of 2009. The CO_2 target is to be mainly achieved by technological developments and market changes linked to these developments. Up to now, the strategy of voluntary commitments has proved to be successful, and the interim target range foreseen for 2003 has been met by ACEA already in 2000.

> Improvements of consumer information on the fuel-economy of cars

Directive 1999/94/EC on availability of consumer information on fuel economy and CO_2 emissions in respect of the marketing of new passenger cars stipulates that consumers are to be provided with information on the CO_2 emissions of cars that are offered for sale or lease. This mandatory "car labelling" is aimed to enable consumers to make an informed choice. However, the fashion for lowefficiency SUVs shows that consumers are still either not ready to change their behaviour or are not sufficiently aware of the problem. The demand for such cars makes it difficult for car-makers to make more commitments towards the production of greener cars. On the other hand, it can be expected that with higher oil prices, mandatory car labelling will prove to be more effective. The Commission is currently studying other measures to improve the effectiveness of car labelling.

> Market-orientated measures to influence motorists' choice towards more fuel-efficient cars: taxation

In the Green Paper on energy efficiency, the Commission advocates using taxation to encourage the use of more fuel-efficient cars. By arguing that the taxation of energy products, in the form of duties, falls under EU competence, moves toward harmonising tax regimes could be used to support the development of vehicles that use cleaner and less fuels. The Commission is also seeking to encourage fiscal incentives for greener cars and to review the whole area of vehicle taxation. A central element of a restructured vehicle taxation system is to link tax levels to CO_2 emissions. This would encourage the consumers to buy low consumption vehicles and penalise 'gas guzzlers' such as sport utility vehicles (SUVs). In April 2000, an expert group was set up in order to assist the Commission in its work on developing a fiscal framework for measures to reduce CO_2 emissions from passenger cars. This work resulted in a Commission Communication in 2002[2], which was subject to a wide public consultation, followed by the adoption on 5 July 2005 of a proposal from the Commission for a Council Directive on passenger-car related taxes[3] that aims at introducing a CO_2 element in the calculation of car taxes for those Member States that have such taxes. Favourable tax treatment of alternative fuels with the potential for CO_2 emissions avoidance is offered by the Directive on the taxation of energy products[4]. It allows, among other things, lower tax rates for bio-fuels, natural gas, LPG, and hydrogen.

2.2.2. Opening up public purchasing
It has been observed that, despite the existence of various technologies for improving transport energy efficiency, markets have not proved large enough to off-set the growth in consumption, nor to reduce production costs by increasing returns to scale through higher sales volumes. An example is the low market penetration of the vehicles with enhanced environmental performance. In order to enlarge the market for these vehicles, the Commission promotes kick-starting demand through public procurement. The Green Paper states that if the public authorities could collectively acquire more clean and energy-efficient vehicles, this would provide an important contribution to the reduction of pollution and energy consumption, and encourage motor manufacturers in their efforts to produce these cars by making the market more stable and predictable and by reducing production costs. The Commission has carried out a wide stakeholder consultation on this approach and received a generally favourable response. A proposal for a legislative action is presently under preparation by the Commission Services.

2.2.3. Communication on climate change and aviation
In order to promote economic instruments for increasing energy efficiency and reducing greenhouse gas emissions such as fuel taxation, emission charges or emission trading in the field of aviation the Commission plans to present a Communication on this topic in the near future.

2.2.4. Community research and technical development
Within the 6th Framework Programme for Research and Development, the EU is funding the Cooperative Air Traffic Management (C-ATM) project for the large-scale validation of the future concept of air traffic management using new information, communication and navigation technologies. Parts of the project serve as a basis for the system under the SESAME project. SESAME is a large industrial initiative aimed to lead to substantial savings of kerosene aviation fuel by reducing air congestion around the major European airports. It is part of the 'Single Sky' initiative for the development of a single European system for air traffic control.

In the Clean Urban Transport for Europe (CUTE) programme, the potential offered by hydrogen has been demonstrated by putting into circulation 27 fuel-cell powered buses in nine European towns. In the CIVITAS initiative, 19 European towns have acted together around four large projects dealing with the use of alternative fuels and easier access to urban transport in urban areas.

With respect to funding future research in the development of clean vehicles, the further development of alternative fuels and vehicle technologies such as biofuels, hydrogen and fuel cells have been proposed for the 7th Framework Programme for Research and Development.

2.3. Intelligent Energy for Europe: an integrated initiative
Intelligent Energy - Europe (EIE) is the Community's support programme for non-technological actions in the field of energy efficiency and renewable energy sources. The programme was adopted in June 2003 and its duration is from 2003-2006. EIE supports the EU's policies in the field of energy as laid down in the Green Paper on Security of Energy Supply, the White Paper on Transport and other energy-related Community legislation. Its aim is to support sustainable development in the energy context, making a balanced contribution to achieving the general objectives of security of energy supply, competitiveness, and environmental protection. EIE is structured in four fields:

- SAVE - Improvement of energy efficiency and rational use of energy, in particular in the building and industry sectors.

- ALTENER - Promotion of new and renewable energy sources for centralised and decentralised production of electricity and heat, and their integration into the local environment and energy systems.

- STEER - Support for initiatives relating to all energy aspects of transport, the diversification of fuels through new and renewable energy sources, and the promotion of renewable fuels (bio-fuels) and energy efficiency in transport.

- COOPENER - Support for initiatives relating to the promotion of renewable energy sources and energy efficiency in the developing countries, in particular in the framework of the Community cooperation with developing countries in Africa, Asia, Latin America and the Pacific.

[2] *COM (2002) 431*
[3] *COM (2005) 261*
[4] *2003/96/EC (27.10.2003)*

Actions or projects supported in the framework of the EIE programme will be committed to remove market barriers to the increased use of energy efficiency and renewable energy sources. They will equally have a significant impact at European level, a high profile and the broadest possible relevance to European citizens and policies. In this context, preference will be given to proposals of outstanding quality that present cost-effective arrangements and a significant dimension.

Generally the actions will be "promotional activities" in the very broad sense. In contrast to the 6th Framework Programme for Research and Technological Development the EIE programme will not support costs related to investments in technologies. However many of the actions will have a link to one or more energy efficiency and/or renewable energy technologies.

3. THE KEY ROLE OF ENERGY PRICES

3.1. Energy prices and their effects on the economy and the energy and transport sectors

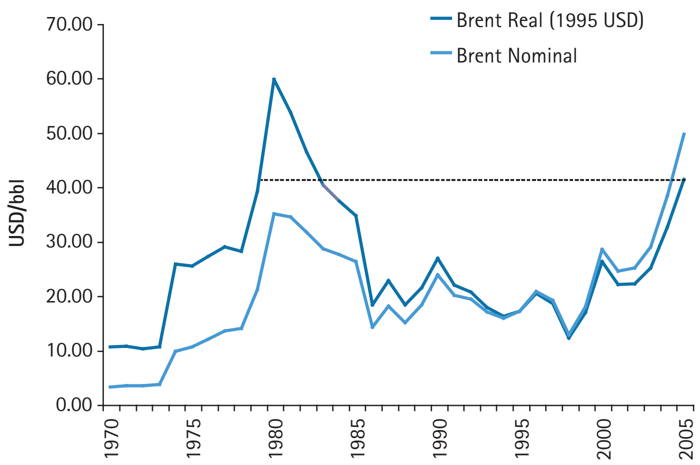
Quantum increases in energy prices have been seen to have a decisive impact on energy use – a direct manifestation of the price elasiticity of demand's effect. Between 1973 and 1974, the oil embargo imposed by the OPEC on western economies prompted a step jump in oil prices. The Brent oil price, the standard for European oil markets, passed in that period from from 3.63 USD/bbl to 9.72 USD/bbl, a 168% increase in nominal terms. Although that price went on to rise by a further 51% and 67% in 1979 and 1980, respectively, the 1973 increment alone prompted a world-wide economic recession. This world slowdown was a direct result of the very high depedence on imported oil that was characteristic of the developed economies of the USA, Japan and Western Europe.

High oil prices in the late 1970s and early 1980s sparked major policy and technology changes throughout the developed world. Cars became smaller, new fuels such as natural gas began being developed, and national energy policies were redefined in order to diversify the sources and types of energy consumed.

Today, and after some 15 years of floating around the $20/bbl mark (in real terms), a series of factors, including limited spare production capacity, high demand growth from Asian markets (China and India) and refinery bottlenecks in the USA have caused a sharp rise in oil prices. Although nominal oil prices passed the peak of the early 1980s in 2004, Figure 4-4 shows that, in real terms, prices are still quite below those prevailing in 1980. Industry experts agree that, all else equal, oil prices should not continue to rise as sharply as they have over the past couple of years and may stabilise around a new, much higher, longer term average. Nonetheless, political and meteorological uncertainties in many producing areas and the threat of international terrorism make further increases in the price of oil a very real possibility.

Today, modern economies are much less dependent on oil than they were in the 1970s, with much of the demand concentrated in the transport sector. Natural gas has replaced a good deal of the former oil demand, but whilst the price continues to be indexed on oil, it has not relieved the consuming economies from exposure to the oil price. Nuclear power and renewable energy have also played a role. However oil substitution is a long-term process. In fact, short term demand in developed nations is highly inelastic, meaning that demand does not significantly respond to price changes, even if the latter are significant. The same, however, is not true for long-run demand, which may be rather more elastic. Indeed, if the new range of high oil prices prevails, we can expect important changes all across European (and world) economies to take place, not only in terms of demand patterns, but also in tems of technology and structural change. Moreover, the oil price still pervades most economies through the price indexation effect on gas prices, and in some countries through gas into power prices.

Figure 4-4: Evolution of Brent oil prices 1970-2005



Source: Global Insight

3.2. Effects on demand: demand elasticity and demand structure

In the short term, demand for oil is found to be inelastic, whilst long term demand is more elastic. Recent figures show that the average short run price elasticity of oil in the EU-15 averaged about -0.34 over the period 1990-2003. Conversely, the long run price elasticity of average demand between 1985 and 1994 and 1995 and 2003 is estimated at -1.9, implying that oil demand is significantly more sensitive to price changes over the longer term. The effects of higher oil prices will be felt in a number of economic sectors, mainly in:

- Freight and haulage
- Household transport
- Sea shipping and inland navigation
- Power generation (due to the indexation of gas prices to oil)
- Energy-intensive industries.

In many cases, increased costs from higher energy prices will be passed on to the consumer, ultimately reducing her or his purchasing power and thus depressing demand.

Figure 4-5 shows final demand for oil and oil products in the EU-25 by sector of demand, clearly illustrating the reduced dependence of households and industry on those fuels – mainly as a result of their higher relative price and the restructuring of industry – and the higher share of demand for transport resulting from increased motorisation and performance. Indeed, industry's share of oil demand has fallen from 14% in 1995 to almost 12% in 2003, whilst the share of demand from the domestic and tertiary sectors respectively fell from 28% to 23%. Conversely, the

Table 4-2: Crude oil price demand elasticity in the EU-15

	Real Oil Price (Brent, 1995 USD/bbl)	Crude oil demand in the EU-15 (Mtoe)	Short-run Price elasticity of Demand[5]
1985	34.63	459.8	
1986	18.22	491.8	-0.15
1987	22.72	481.8	-0.08
1988	18.18	501.7	-0.21
1989	21.39	506.8	-0.06
1990	26.74	518.2	-0.09
1991	21.78	533.9	-0.16
1992	20.59	553.8	-0.68
1993	17.71	558.8	-0.06
1994	16.13	572.1	-0.27
1995	17.04	574.5	-0.07
1996	20.27	596.1	-0.20
1997	18.44	603.7	-0.14
1998	12.17	626.3	-0.11
1999	16.82	597.6	-0.12
2000	26.15	605.7	-0.02
2001	22.00	596.8	-0.09
2002	22.10	587.8	-3.37
2003	25.06	606.0	-0.23

Source: Eurostat and Global Insight

share of final oil demand from road transport grew slightly from 64% in 1995 to 64.5% in 2003, and the share of marine bunkers and inland navigation grew from 11.2% in 1995 to 11.9% in 2003.. The largest share growth occurred in the demand for air transport, which passed from 8.9% to 10.3% over the same period.

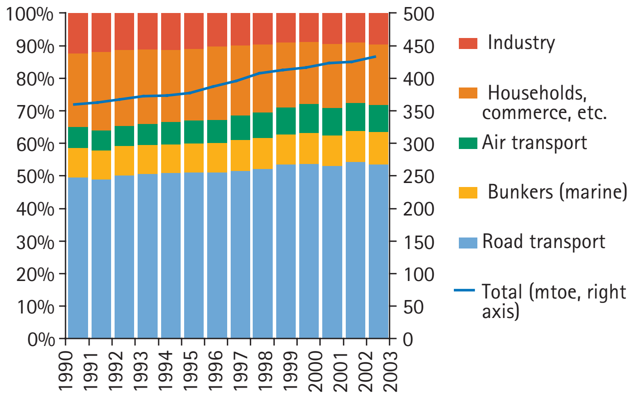
Higher oil prices are a critical issue, particularly for the transport sector, of which modern economies are highly dependent.

In the power generation sector, the relative demand for oil between 1990 and 2003 fell as environmental constraints were tightened and new, more efficient combined cycle gas turbines replaced older oil and coal-fired generation plants. This is clearly shown in Figure 4-6. Indeed, the share of natural gas in fuel consumption for power generation nearly tripled, passing from 11.1% in 1990 to 27.8% in 2003, whilst oil's share dropped from 14.2% to 8.7% over the same period. Despite the industry's move away from oil, the price risk related to oil was not removed, as gas prices continue to be linked to oil prices in the vast majority of supply contracts. Increases in oil prices thus have a very direct effect on cost of power generation and ultimately on the cost of electrical energy to final industrial and domestic consumers, especially as the share of electricity in final demand has been growing steadily over the past decade. Therefore oil price increases provide a strong incentive for more efficient use of energy outside the direct oil-consuming sector.

Calculations indicate that, despite the reduced demand for oil, Europe's exposure to oil price volatility has indeed increased. In 1990, the share of oil, gas and electricity – the energies that are affected by oil price variations – was 84.8%, but due to important reductions in the use of coal, combined with increased use of gas and electricity across all sectors, that share had gone up to 89.8% in 2003.

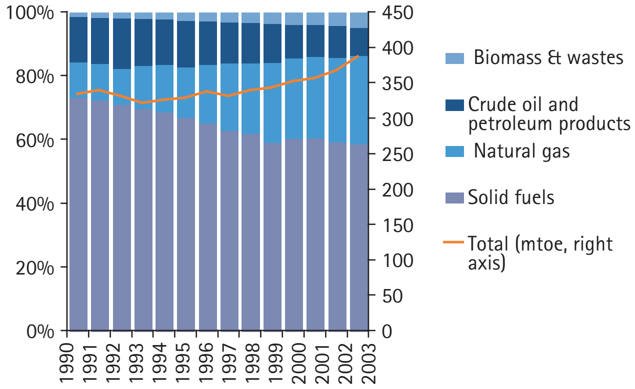
[5] *Defined as Elasticity = – Absolute Value [(% change in Quantities) / (% change in Prices)]. The negative sign is a convention indicating the inverse relationship between price and demand. A figure close to zero indicates inelasticity, a figure of 1.00 and below indicates elasticity.*

Figure 4-5: Final demand for oil and oil products in the EU-25



Source: Eurostat

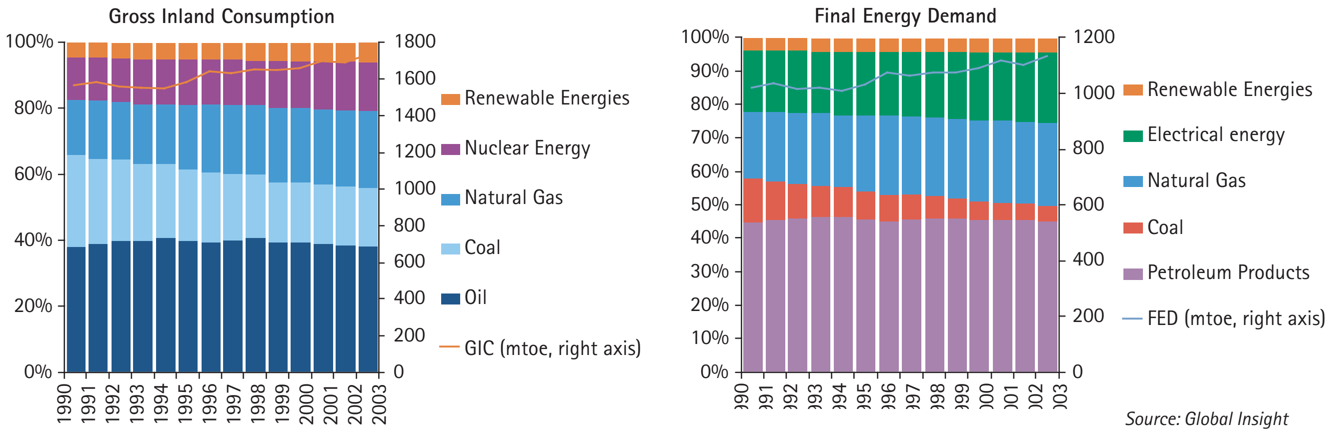
Figure 4-6: Inputs to power generation in the EU-25



Source: Eurostat

4. EFFICIENCY IN THE ENERGY SECTOR

Figure 4-7: Primary and final energy demand in the EU-25



Source: Global Insight

High efficiency in the energy sector has several important benefits for the economy. The main direct effects are expected to be a more competitive economy, lower environmental emissions and increased supply security, all of which ultimately result in higher living standards for European citizens.

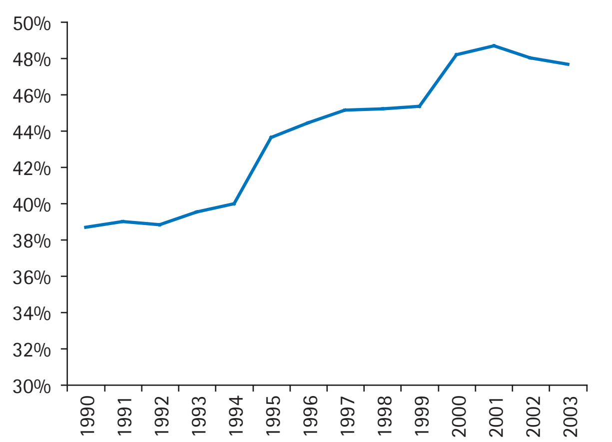
4.1. Main trends in energy demand and efficiency

Between 1990 and 2003, gross inland consumption (GIC) of primary energy grew by an average 1.1% per year, increasing by nearly 150 Mtoe over the period. Nonetheless, it is the structure of GIC which has experienced the most marked changes, with gas' share rising significantly to the detriment of coal and oil. However, oil's share of GIC in 2003 remained close to 38%. The same structural shift occurred in the final demand for energy (FED), where electrical energy and natural gas have increased their shares of the total, mainly offsetting final demand for coal and, to a much lesser extent, of petroleum products. Although the share of petroleum products in final demand has somewhat stabilised, it still represents almost half of FED.

4.2. Power generation

One area where significant progress has been made since the early 1990s has been the power generation sector. The development and introduction of CCGT (combined cycle gas turbines) technology by European firms, which has largely displaced older coal and oil-fired power plants, has dramatically improved the overall technical efficiency with which fossil fuels are converted into electrical energy. Figure 4-8 shows how the aggregate output to input ratio of all fuels into conventional thermal power plants (coal, oil, gas and biomass) has risen from 37.9% to 47.6%, between 1990 and 2003 (around 0.75% per year).

Figure 4-8: Output to input ratio of conventional thermal power stations in the EU-15



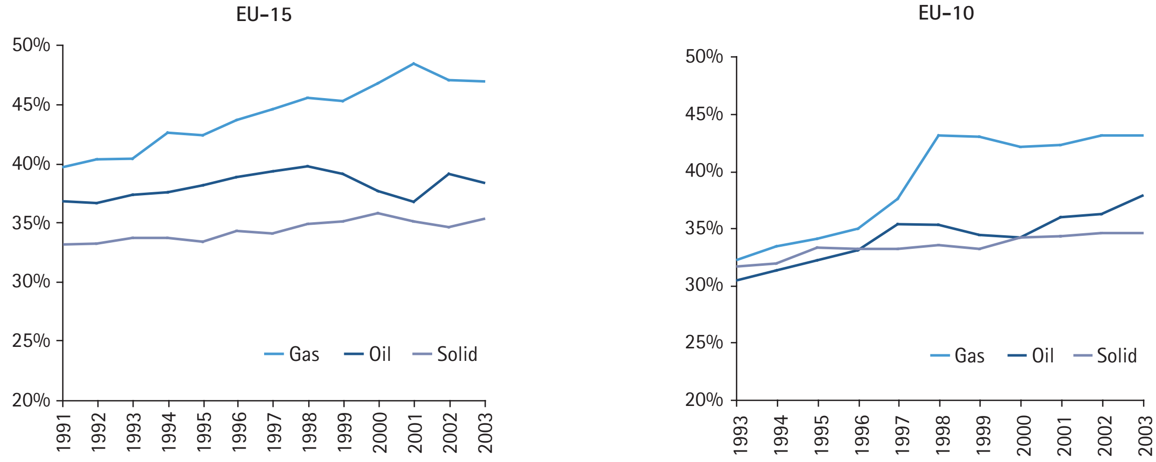
Source: Global Insight

The ongoing replacement of older power stations with more efficient CCGTs is expected to continue to significantly improve the efficiency of power generation in the short and medium term. The peaks and troughs in the trend are mainly due to climatic variations (rain and temperature) over the years that affect both the load structure as well as the dispatching order of the different generation technologies.

Figure 4-9 presents the evolution of thermal efficiency for individual generation technologies, in the EU-10 and the EU-15. In both cases, it is clear that gas-fired plants exhibit the highest thermal efficiency, which in 2003 averaged 46.7% for the EU-25. As mentioned above, gas-fired generation technology is also the one who has seen the largest increases in efficiency, growing at an average annual rate of 1.1% for the EU-15 and 2.9% for the EU-10. The efficiency of oil-fired plants has also increased considerably, passing from an average 36.2% in 1990 to 38.2% in 2003 in the EU-25. Over the periods depicted in Figure 4-9, oilplant efficiency respectively grew by an average 2.2% per year in the EU-10 and by 0.3% per year in the EU-15. Coal plant efficiency grew on average by 0.5% per year in the EU-25. Efficiency increases have also taken place in the generation sector's own consumption of electricity (that used in the power plants themselves). Figure 4-10 shows the ratio of own consumption in electricity production and distribution to total electricity output in the EU. While the EU-15 has exhibited a slowly decreasing trend throughout the 1990-2003 period, efficiency increases in the EU-10 only started to occur in the late 1990s.

Although no aggregate data are yet available, the EU has also made significant advancements in power generation efficiency as a result of the increased penetration of combined heat and power systems (or CHP, also known as cogeneration).

Figure 4-9: Efficiency of thermal power stations by technology in the EU

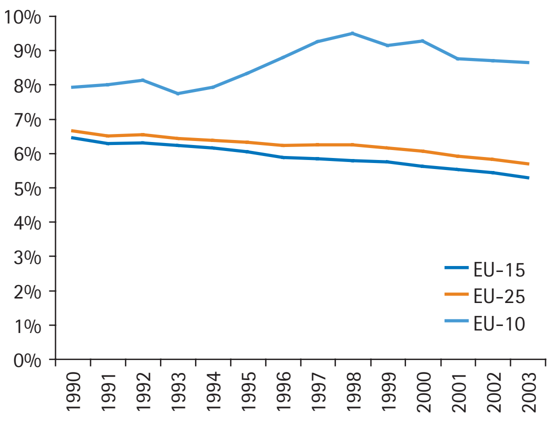


Source: IEA and Global Insight

4.2.1. Power transmission and distribution

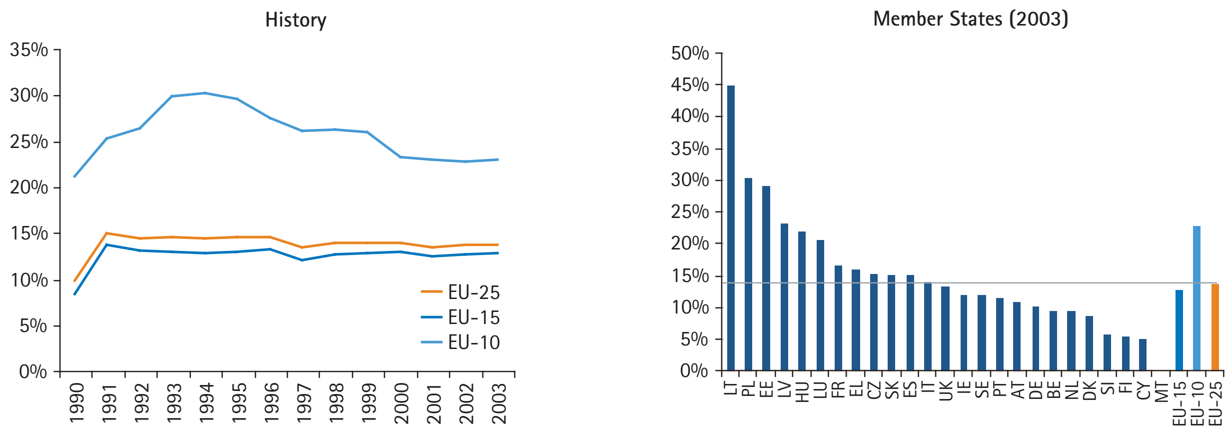
Total electricity losses are defined by net electricity available[6] minus total electricity available for final consumption, divided by total electricity available for final consumption. This indicator captures both transmission losses (energy lost in high voltage lines that transport power from the production units to the distribution networks) as well as losses in distribution (losses in the low voltage distribution network). Figure 4-11 illustrates the evolution of electricity losses over the 1990-2003 period. Losses in the EU-15 have floated between the 12% and 13% mark over the period. Although a small improvement is visible over the later years, the relatively constant level suggests that the industry is operating at its technological barrier and that structural changes may be required in order to further reduce losses. As for the EU-10, there have been significant reductions in the volume of losses from 1993 onwards; declining from over 30% in 1994 to 23% in 2003, but there is still ample room for improvement. The second graph in Figure 4-11 compares electricity losses in the EU Member States with averages for the three groups of countries.

Figure 4-10: Own consumption of electricity as a percentage of total generation



Source: Eurostat

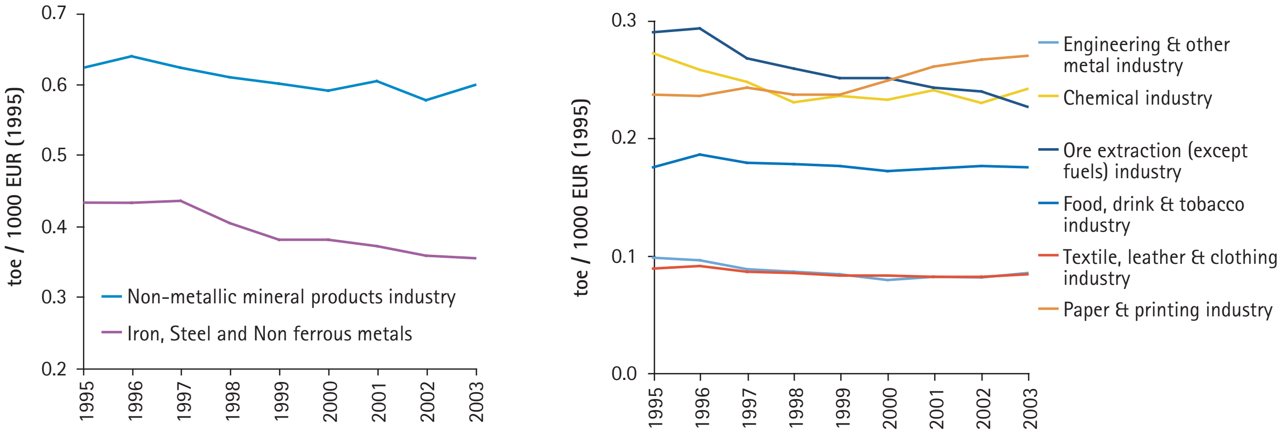
Figure 4-11: Total electricity losses as a percentage of electricity available for final consumption



Source: Eurostat

[6] *Net generation plus net electricity imports.*

Figure 4-12: Specific energy demand in selected industries in the EU-25

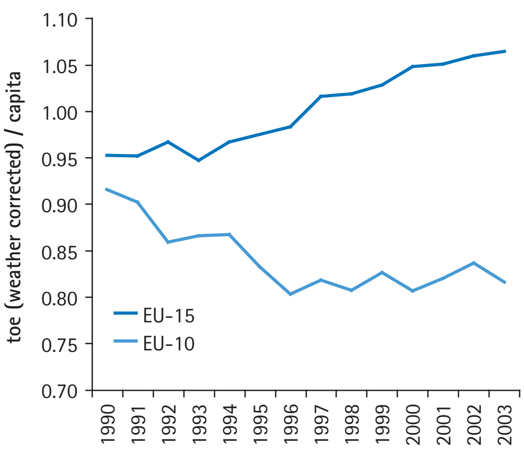


Source: Global Insight, Eurostat and IEA

4.2.2. Energy efficiency of industry
Over the 1995-2003 period, Europe's industrial sector achieved significant efficiency increases. Although heavy industry such as non-metallic minerals and iron, steel and non-ferrous metals remained the most energy-intensive segments, they respectively reduced their specific energy[7] by 0.5%/year and 2.5%/year. The largest improvement, however, was achieved in the ore-extraction industry, which reduced its specific energy by 3.1%/year, followed by engineering and others metals (-1.8%/year) and chemicals (-1.5%/year). The only segment to have increased its specific energy over the period was the paper and printing industry, which grew at an average 1.7%/year.

4.2.3. Domestic sector demand
The importance of consumption patterns and the potential for savings are illustrated by the per capita final energy consumption of households. Between 1990 and 2003, two very different trends were observed in the EU. On the one hand, rapid demand growth (owing to wealth and price effects) along with a slowly increasing population in the EU-15 combined to make per capita FED of households grow by 11.2% between 1990 and 2003, in weather-corrected terms. On the other hand, a decreasing population and the rationalisation of household energy consumption brought by the transition to market economies in the EU-10 resulted in a sharp decline of FED per capita (10.9% over the same period). At the aggregate EU level, FED per capita in the households sector has grown at a compound annual growth rate of 0.8% between 1990 and 2003.

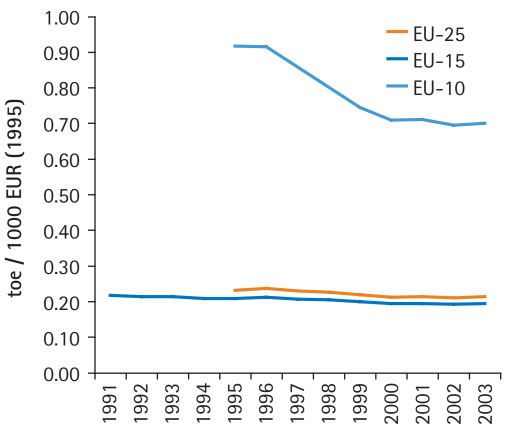
Figure 4-13: Final energy demand per capita in the EU's domestic sector



Source: Eurostat

4.2.4. National energy intensity
The broadest indicator of the economic efficiency of energy consumption is energy intensity. Europe's economy is one of the least energy-intensive economies in the world, second only to Japan. The aggregate energy intensity of the 25 Member States has been declining since 1990, passing from 0.21 toe/1000 EUR (1995 prices) to 0.19 toe/1000 EUR (1995 prices). The picture is altogether different when the intensity of the 15 older Member States (EU-15) is compared to that of the 10 new Member States (EU-10). Whilst the latter group of countries has exhibited a larger reduction of its energy intensity, it is still a long way from the low intensity levels of the more modern EU-15. In 2003, the energy intensity of the EU-10 was 3.6 times higher than that of the EU-15[8]. As cautioned before, this broad indicator must be read with care however, as it simultaneously captures many aspects, including the structutral composition of the economy, economic performance, as well as several technological aspects of the energy transformation chain.

Figure 4-14: Energy intensity in the EU



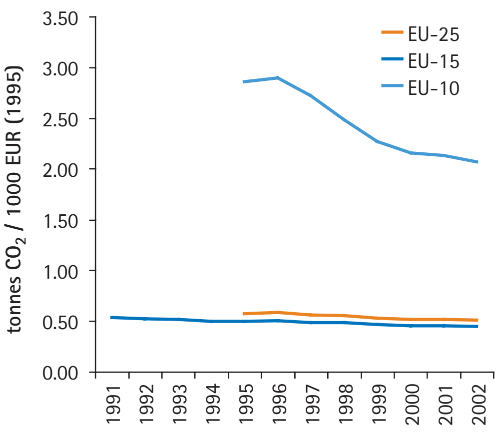
Source: Eurostat

[7] Here specific energy is measured by final energy demand per unit of gross value added (GVA), in 1995 prices.
[8] To a large extent, this reflects the differences in purchasing power between the two groups of countries.

4.2.5. CO_2 intensity

Carbon intensity, which can be used as a measure of environmental efficiency in the EU's economy, declined between 1995 and 2002 at an annual average growth rate of 1.7%, passing from 0.57 tonnes CO_2 / 1000 EUR (1995 prices) to tonne 0.51 CO_2 / 1000 EUR (1995 prices). Intensity declined as a result of lower emissions from the industrial and households sectors (which declined by an average 1.0%/year and 0.5%/year, respectively) coupled with constant GDP growth (2.3%/year on average). Emissions reductions in the latter two sectors, which represented in 2002 nearly 37% of the total, were enough to compensate for growth in emissions from the power industry (34% of the total) which rose by yearly average of 0.9%. Figure 4-15 illustrates these trends.

Figure 4-15: CO_2 Intensity in the EU



Source: Eurostat

Carbon intensity in the EU-10 dropped significantly over the period (4.5%/year), owing mainly to an average GDP growth of 3.6% per year, coupled with an average yearly reduction of emissions of 1.1% in the power sector (which represented in 2002 over 46% of total emissions). Most of these reductions were achieved through the decommissioning and/or replacement of old Soviet-era coal and oil power stations for more modern plants. Significant reductions in the households and industrial sectors (which together accounted for 34% of total emissions in 2002) also contributed to the trend, with yearly reductions of 2.3% and 4.1%, respectively. Like in the power sector, many of the reductions from the industrial sector were achieved through the renewal of production installations. Reductions from the households sector, on the other hand, resulted from the rationalisation of consumption arising from the transition to market based economies. In all, these important improvements only marginally contributed to the trend in the EU-25 since emissions from EU-10 represented in 2002 only 15% of the total.

Indeed, the EU-15 accounts for 85% of the EU's emissions and contributes to 96% of total GDP, which explains why the EU-15 closely follows the trend in the EU-25 in terms of carbon intensity. Between 1995 and 2002, the largest emissions reductions in the EU-15 occurred in the industrial and households sectors (37% of total emissions), which fell by 0.4% and 0.1% per year respectively, mainly due to fuel switching and the relocation of production sites. Emissions from the power sector (32% of total emissions), on the other hand, rose by 1.5% per year over the same period, driven by rapidly growing demand and despite the introduction of more efficient CCGT plants to replace older coal- and oil-fired power stations. As a result, aggregate emissions grew by 0.9% per year, which combined with an annual GDP growth of 2.3%/year, resulted in a slight decline of carbon intensity (1.4% per year).

4.3. The potential for savings

Following the adoption of the Green Paper on Supply Security in 2000, the Commission made the political decision to tackle energy supply security through demand-side measures, rather than solving the problem by increasing its supplies (as is the case in the USA). The Commission's new Green Paper on Energy Efficiency has identified a series of sectors and indicated a series of potential measures in/by which energy efficiency could be enhanced/addressed. This potential arises from existing obstacles to enhanced efficiency and which include lack of information, countervailing incentives, price distortions, technical barriers and regulatory failures. In what follows, we present the identified sources of savings as discussed in the Green Paper.

4.3.1. Efficiency in buildings

In 2006, a Directive on the energy performance of buildings will come into force, in a sector that represented almost 42% of final energy demand in 2003 and where studies suggest that there exists an enormous potential for savings. The implementation of the Directive will require the Commission to provide Member States with the necessary tools for developing the methodology required to calculate a building's energy performance. Among the main provisions of the Directive is the requirement of buildings of over 50 m2 to obtain an energy performance certification when they are built, rented, or sold. Major savings can also be attained through more efficient lighting[9].

4.3.2. Domestic appliances

Since the early 1990s, several pieces of EU legislation addressed the issue of energy consumption by household appliances, but much remains to be done in this sector, not only in terms of scale (increase the number of appliances concerned by legislation), but also in terms of scope (wider mechanisms involving other actors concerned, including consumers). In addition to promoting behavioural changes in consumption patterns, there are two complementary ways of reducing the energy consumed by products: labelling to raise awareness of consumers on the real energy use in order to influence their buying decisions, and energy efficiency requirements imposed to products from early stages of the design phase.

The production, distribution, use and end-of-life management of energy-using products is associated with a considerable number of important impacts on the environment, stemming from energy consumption, consumption of other materials/resources, waste generation and release of hazardous substances to the environment. It is estimated that over 80% of all product-related environmental impacts are determined during the design phase of a product. Through eco-design, the environmental performance of the entire life-cycle of a product can be improved by the systematic integration of environmental aspects at a very early stage in the product design.

[9] The Green Light Programme is aimed in this direction.

4.3.3. Public information campaigns
A large potential for saving exists by merely changing the way people use energy. To this end, several public information campaigns have been launched at the European, national and regional levels. The Europe-wide programme is the Sustainable Energy Europe 2005-2008 campaign, designed to bring about a genuine change in consumption behaviour across the players concerned. A large potential for savings also exist by informing those that work in the energy sector, including architects, heating system installers, among others.

4.3.4. Transmission and distribution efficiency
On average, up to 13% of the total net electricity generated is lost in electricity transmission (2.6%) and distribution (10.4%), with significant variations across Member States. While it may, in some cases, be relatively easy and cost effective to reduce these losses, regulations determining the revenues of transmission and distribution system operators are such that they do not provide incentives for these companies to make the appropriate investments. Thus, there is great potential for improvements by introducing incentive-based regulation such that the necessary investments are made.

4.3.5. Generation
As explained in section 4.1, generation technologies have seen significant efficiency improvements over the past decade or so. Greater competition in the increasingly liberalised European energy markets as well as environmental constraints introduced by the IPPC Directive and, more recently, the EU ETS (Emission Trading Scheme) have spurred the construction of a large number of CCGTs. This process is expected to continue, at least throughout the remainder of the decade. As this will imply huge investments, the Commission intends to act on three major fronts:

- Ensure that new generation plants are of the highest fuel efficiency
- Promote distributed generation and cogeneration where applicable
- Promote new district heating systems and upgrade existing ones.

4.3.6. Energy services
The opening-up of markets has had a positive effect on energy efficiency (mainly through the adoption of more technically efficient generation) and has had an impact on electricity prices (e.g. prices to industrial users have dropped by an average of 10-15% in real terms between 1995 and 2005). Yet falling prices for energy do not encourage either careful consumption or investments in energy efficiency in themselves. There are a number of companies that supply efficiency solutions ("ESCO") and that are getting paid by the energy savings realised through their efforts. These companies still need policy support in the form of help for the dissemination of their activities, quality standards, and access to finance, as they are still in their infancy stage. The further development of the ESCO industry could greatly contribute to the implementation of many additional cost-effective projects, and can play an important role in bridging the gap between different actors on the energy and technology supply side and among energy consumers. A Directive on the promotion of energy services was presented by the Commission in 2003, and intends to oblige distributors and suppliers to offer consumers energy services, meaning an integrated package such as thermal and lighting comfort and not bound to a given quantity of energy consumed. As the cost of energy is expected to remain a large part of the cost of the service, it is expected that price competition between such providers will ultimately lead to their investment in efficiency enhancing measures.

4.3.7. Efficiency certificates
Italy and the UK have had positive experience with certification systems, whereby suppliers or distributors are obliged to undertake energy efficiency measures for final users. Certificates confirm the amount saved, giving both energy value and lifetime. Such certificates can, in principle, be exchanged and traded. If the contracted parties cannot submit their allocated share of certificates, they can be required to pay fines that may exceed the estimated market value.

4.3.8. Incorporate efficiency into the ETS
The European emissions trading scheme was launched in January 2005. This system is aimed at creating a market for environmentally harmful CO_2 emissions originating from large productions sources (mainly industry and power generation). The Commission has asked if and how efficiency considerations could be included within this system.

* * *

As a result of the Commission's and Member States' policy efforts, but also as a response to market forces, efficiency in Europe's energy industry has been increasing on most fronts. Thermal efficiency of power generation has grown impressively; transmission and distribution losses are stable, and the EU's energy intensity continues to decline.

Undoubtedly, the new era of high oil prices will contribute to increase not only the efficiency with which energies are produced but also the choices citizens make in consuming them. This specific situation presents a unique opportunity to permanently alter the way in which Europe produces and consumes energy. The Commission's initiatives and the discussion expected to ensue from its recently adopted Green Paper will hopefully provide the means to reach this ambitious goal.

5. EFFICIENCY IN THE TRANSPORT SECTOR

The challenge of increasing energy efficiency has acquired particular relevance in European transport markets, given its development into one of the largest energy-consuming sectors and by far the fastest growing. Improvements in transport efficiency will therefore not only lead to a smoother functioning of the transport system, but will also contribute to other sectors' gains in terms of productivity and efficiency, for example through lower unit costs, among other gains. This makes the need for a more efficient transport system an important goal for the completion of the internal market. Although transport has potentially significant indirect effects for the efficiencies of all industries, the following analysis focuses primarily on the transport sector. Section 5.1 below provides a first insight into the transport system as a whole and compares efficiencies in the different transport modes. This overview is followed by a more detailed analysis of the different modes in Section 5.2.

5.1. Efficiency of the transport system

The efficiency of the transport system as a whole is measured by transport intensities. An important measure of the efficiency of individual transport modes, is their load factors, whilst a first indicator for assessing energy efficiency and externalities is the share of modes with low energy consumption.

5.1.1. Transport intensities

Transport intensity is measured by tonnes-km per unit of GDP for freight transport. Figure 4-16 shows that freight intensity is low and practically stable in the EU-15, whereas it is comparatively high in the EU-10. Two reasons explain this divergence: on the one hand, the EU-10 still carries momentum from its formerly centrally planned economies, which encouraged the overuse of transportation through very low State-imposed prices, for freight in particular. Second, the industrial structure of the EU-10 exhibits higher shares of agriculture and industrial production relative to the EU-15, whose economy is more service-orientated.

With respect to passenger transport intensity, passenger-km/EUR has been declining since the mid 1990s, indicating that there has been a gradual decoupling of passenger transport from GDP growth. In the EU-10, passenger transport intensity was higher than in the EU-15 over the first half of the 1990s, but the transition to market economies resulted in an increase in the relative prices of passenger transportation, making transport intensity for that group of countries drop below that of the EU-15.

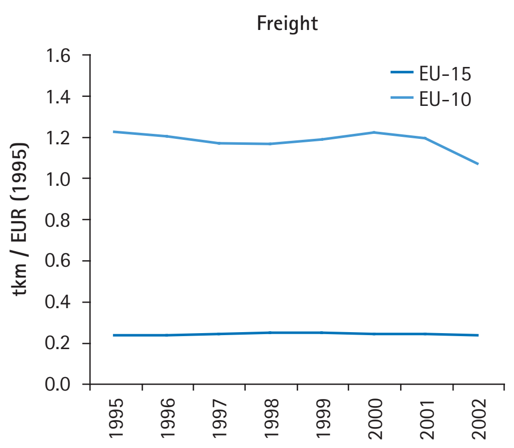
5.1.2. Modal shares

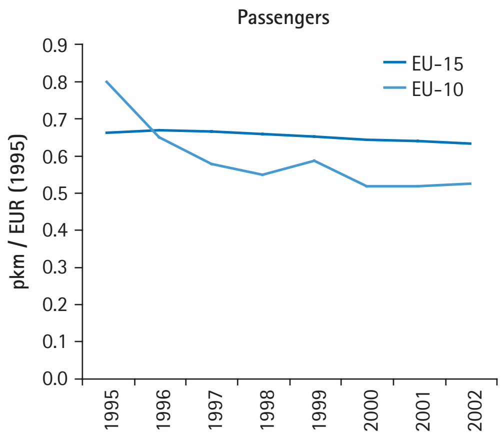
Modal shares are a second general indicator for the energy and social cost-efficiency of the transport system. The rail and inland waterway transport modes are, in general, more energy-efficient and environmentally favourable than road and air transport. This explains general strategies to strike a better balance between modal shares. In the Transport White Paper published in 2001, the European Commission set out its intention of taking measures to reverse the trend towards ever-increasing reliance on road transport and to achieve in 2010 the modal split of 1998. This involves targeted actions to improve the attractiveness and competitiveness of more environment-friendly modes of transport, notably by revitalising the railways and promoting maritime and inland waterway transport.

Figure 4-17 shows the differences in energy consumption of the different transport modes in the freight and passenger segments (measured in tkm/toe and pkm/toe, respectively). Railways for both goods and passenger transport not only have much lower specific fuel consumption per unit of transport, but this has recently been improving. Further improvements are expected from the on-going revision of the road charging framework for heavy goods vehicles. This would allow Member States to vary road use charges for goods vehicles over 3.5 tonnes according to a number of factors, including distance travelled, exhaust emissions and the level of congestion on the road.

The Pilot Action Programme for Combined Transport launched more than 160 projects on inter-modal services between 1992 and 2000. The establishment of a new rail/sea link between Sweden and Italy via Germany and Austria is an example. Due to a significant improvement of travel time (up to 48 hours in some cases), combined transport has taken off approximately half a million tonnes of freight from roads. This substantial energy-saving potential of inter-modal transport is highlighted in the Green Paper on energy efficiency adopted in 2005. The Marco Polo programme, established in 2003, grants financial assistance to improve the environmental performance of freight transport across the EU. The current programme, running to 2006, has a budget of some 100 million. For 2007-13, the Commission has proposed new ambitious targets, including new actions such as traffic avoidance measures and motorways of the sea, with an increased budget of 740 million.

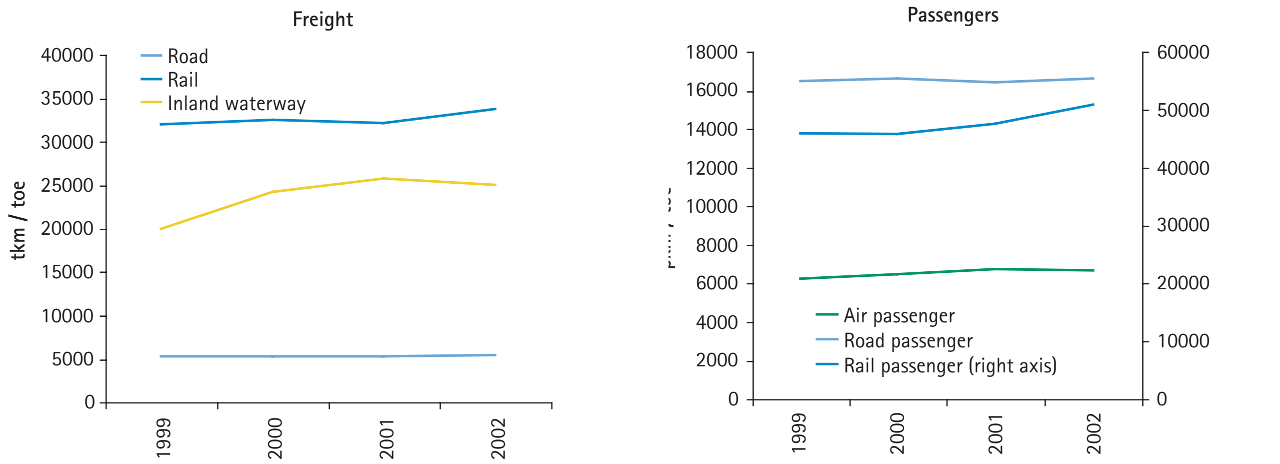
Figure 4-16: Transport intensities in EU-15 and the new Member States





Source: Eurostat (2004), DIW (1999 and 2003)

Figure 4-17: Energy consumption of transport modes (EU-15)



Source: Eurostat (2004), DIW (1999 and 2003)

Inter-modality will be further strengthened through the Galileo satellite navigation system. The system offers reliable and precise positioning of cars and trucks on roads, but also of railcars and containers within the railway and waterway networks. In addition, Galileo will simplify maritime and coastal navigation. These modern traffic management systems will help optimise traffic flows in all fields of transportation, thus considerably reducing costs of congestion and energy consumption.

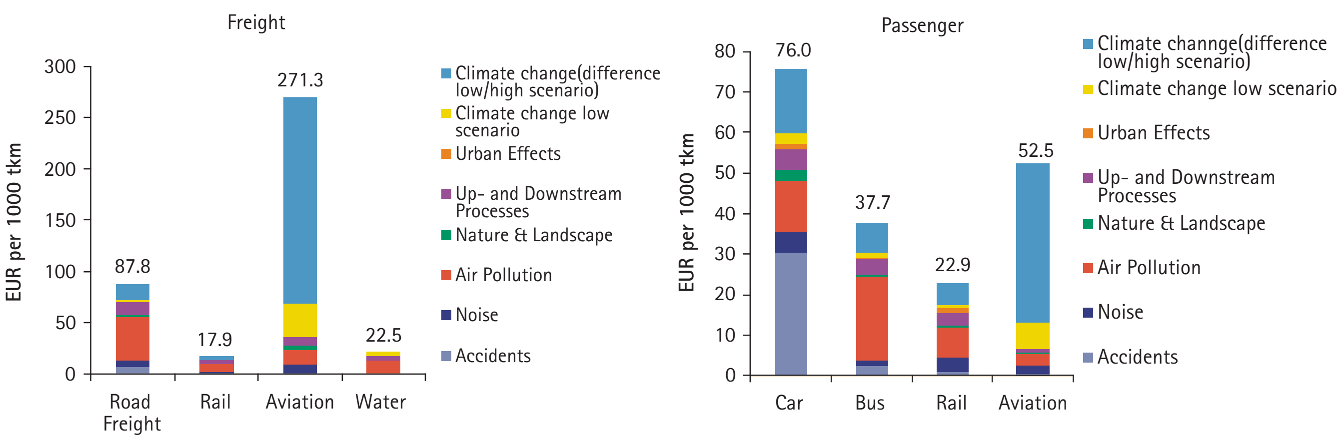
Despite good political efforts, there are three reasons why the relative energy efficiency and external cost advantages of rail and inland waterway transport are not reflected by their market shares. First, because in the case of rail, the transport mode entails heavy investments in infrastructure and requires centrally scheduled operations, which limit the extent to which they can follow the spatial spread of transport activities and meet the quality required by different market segments. Second, their advantages vis-à-vis other modes in terms of external costs are not relevant to markets as long as those costs are not internalised through taxes or other regulatory instruments. Third, the railway industry is still lagging behind other modes in terms of market opening and consequent commercialisation. Therefore, it is less competitive compared with other modes and has difficulties following the rapidly developing requirements of the market, e.g. in the field of logistics.

5.1.3. Social cost efficiency

The transport generates high external costs in terms of accidents, air pollution, climate change, noise, and deterioration of landscape, habitats and the urban environment. Some of these effects like external costs of congestion, infrastructure, air pollution, CO_2 emissions, noise and accidents can be measured in economic terms, with studies suggesting that these externalities could sum up to nearly 7% of GDP10. Indeed, very few of the external costs produced by the transport sector are reflected by market prices.

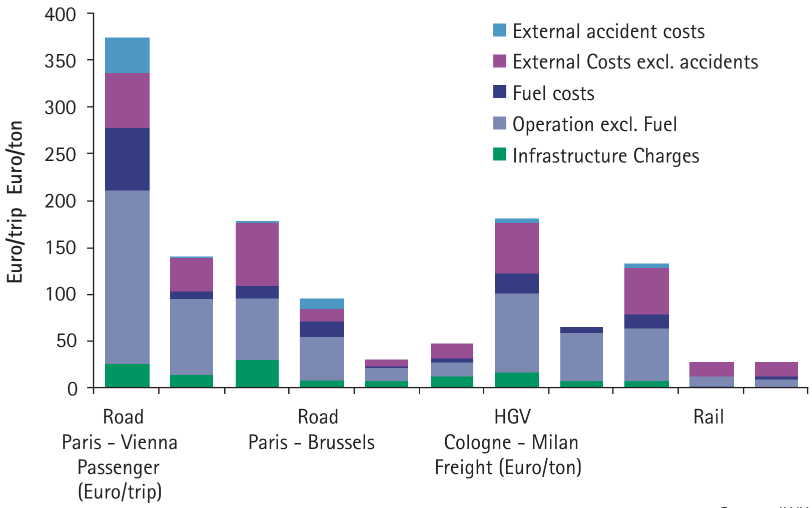
Whilst the figures show that the rail and inland waterway and coastal shipping transport modes generate the lowest social cost, this does not mean that transport tasks should be primarily allocated to these modes: They are not competitive in many market segments. It is, however, possible to identify important market segments in which the environmentally-friendly and energy-saving transport modes could increase their market share if the externalities were internalised by all modes. Figure 4-19 gives examples for some corridors in which transport by rail and inland waterways could be significantly developed.

Figure 4-18: External costs in transport



Source: INFRAS/IWW (2004)

Figure 4-19: Operating and external costs by corridor



Source: IWW

5.2. Efficiency of transport modes

One of the aims of transport policies is to increase both economic and energy efficiency, thus simultaneously achieving economic and external benefits. Win-win situations, however, are difficult to achieve and increases of economic efficiency are often associated with decreases in energy efficiency, and vice-versa. The trade-off must therefore be analysed carefully.

Figure 4-20 gives an overview of the main determinants of energy efficiency, general economic efficiency and business efficiency in the transport sector. Driving forces of a political or institutional nature are shown in black type. Green type indicates technological issues and red type stands for behavioural changes.

5.2.1. Air transport

The European and international air transport sector in general is characterised by a dynamic growth of transport volumes and a high level of competition. Boosted by the emergence of low-cost carriers, this has brought forth an extensive exploitation of potentially untapped efficiency by airlines. Further improvements of business efficiency in air transportation can thus be expected mainly from technological progress, from the reduction of congestion by extending airport infrastructure that has reached saturation levels for many airports, and by fighting the capacity overload of European air traffic control. The Community is tackling these tasks by including the extension of congested airports into their infrastructure policy, by the initiative of the single European sky adopted in March 2004 and by the creation of the future European Agency for Aviation Safety, which is laid down in Council Regulation (EC) No 1592/2002. These policy measures are explicitly aimed to reform the architecture of European air traffic control in order to meet future capacity and safety needs and to improve the cost efficiency of regulatory processes.

In respect of airplane technology, the new generation of wide-bodied aircrafts, such as the new Airbus A380, will significantly improve energy and economic efficiency. Energy efficiency, measured by energy input per passenger-km, will increase because the high number of passengers more than compensates for the additional consumption of kerosene. This will be particularly true for long-distance flights.

Long-distance flights with fully occupied wide-bodied aircrafts between major airports will increase efficiency, but the number of (less efficient) short-distance connection flights is expected to increase as well. Hence, the net efficiency outcome in the aviation sector is not clear.

From a political point of view, taxes on kerosene could be an appropriate measure to increase energy efficiency. Such a policy would provide the correct incentives for the development of more efficient aircraft engines. It would also increase the competitiveness of high-speed railways, resulting in increased energy efficiency for the transport system as whole.

If airlines discontinued some of the less profitable short-distance connections, kerosene taxes could even lead to higher commercial efficiency in the long run. However, horizontal and vertical integration plays a more important role in terms of commercial efficiency. While horizontal integration is characterised by airline alliances and recently also airline mergers, vertical integration is reflected by the co-operation of airlines and airports. On the one hand, it can be argued that both trends decrease the level of competition, which in turn would affect commercial efficiency negatively. But, on the other hand, synergies are comparatively high, meaning that gains in efficiency can be realised. With regard to freight transportation, vertical integration is of particular interest since EU international logistic companies co-operate closely with a small number of airports. These co-operations come along with large investments into logistics infrastructures within the airports.

5.2.2. Rail transport

In the railway sector, the Community's efforts to open the market and to establish competition will have a positive effect on its economic efficiency. This is true for international passenger transport, but particularly holds for freight transport. In turn, the fostering of interoperability, especially for freight transport, will further increase efficiency. In this context, the establishment of freight corridors can be expected to raise the average travel speed, hence commercial efficiency. With the ongoing market opening, especially through the opening of all networks in 2006 by broadening infrastructure access rights to encompass domestic freight services including the introduction of cabotage transports

Table 4-20: Main determinants of transport efficiency

	Air transport	Rail transport	Road transport	Sea transport, inland waterway
Driving forces of energy efficiency	Introduction of kerosene taxes	Unified fuel/ecological taxation	Internalising externalities through taxes, regulation and incentive compatible instruments	Unified fuel/ecological taxation; environmental regulation
	New generation of wide bodied aircrafts	Modernisation of propulsion technology; refeeding of energy	Development of EURO V and EEV a); increase safety	Larger vessels (container shipping); improvement of container processing
	Organisation and management to increase occupation	Organisation and management to increase occupation	Improved fleet management; use of telematics	Better port management
Driving forces of socioeconomic efficiency	Kerosene taxes; noise regulation / pricing	Fostering combined transport; fair and efficient infrastructure charging	Cost-based pricing of public road infrastructure	Unified port regulation, infrastructure charging
	Wide bodied aircrafts; new turbines	Improve control systems to increase capacity	Application of telematics	Port deepening and technology for automatic container processing
	Concentration on larger distances	Concentration on rail affine market segments	Modern logistics: Just-intime or in-sequence production	Global networking, coordination of production and distribution
Driving forces of business efficiency	Open sky policy	Market opening	Technology policy; road pricing	Establishment of "Motorways ohe sea", sea port liberalisation policy
	Aircraft development; improvement of air traffic control	Use of telematics; unified control systems, electronic toll collection	New propulsion technology (e.g. hybrid)	Modern port facilities, large container vessels
	Alliances, vertical integration low cost carriers	New co-operation, alliances, mergers	Improvement of loading and occupancy factors	Improvement of navigation (GALILEO)

a) EEV: Enhanced Environmentally friendly Vehicles and engines

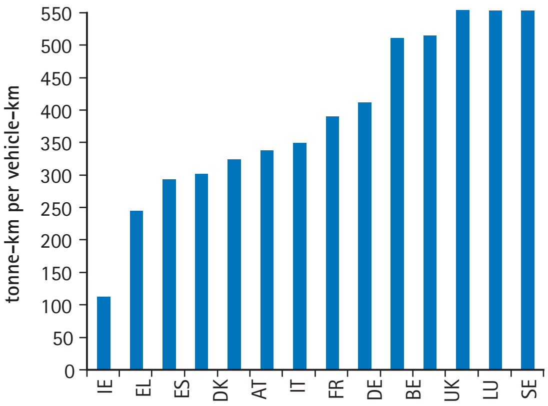
Source: IWW

in 2007, railways will be able to better use their capacities and comparative advantages. Increasing competition on the networks will lead to a better usage of the existing railway infrastructure. Also, the removal of major European infrastructure bottlenecks within the framework of the TEN-T will be another key element to unleash the still untapped potential for efficiency increases, particularly in international transport.

Due to the considerable volume of electricity consumed, the energy efficiency of the railway sector is mainly determined by the efficiency with which electricity is supplied. However, as a result of its passive role, the influence of the rail sector on the efficiency of electricity supply is quite limited. There are however, more direct ways by which efficiency increases take place. In rail passenger transport, occupancy rates are a key determinant of efficiency. Increasing occupancy rates improves system, commercial and economic efficiency (respectively measured by energy inputs per passenger, higher margins and foregone emissions). In turn, these rates are mainly determined by quality of service, which depends on the reliability, safety, comfort and punctuality of the system. The Commission's aim to place the user at the heart of transport policy clearly addresses these issues and therefore contributes to increase the efficiency of the sector at several levels. High speed trains are a good example: Despite the high energy inputs necessary to reach speeds above 300 km/hour and the large costs associated to the operation of the trains and the maintenance of the networks, high occupancy rates have increased company margins and have avoided emissions from other transport modes, such as airplanes or private vehicles.

There are other means by which railways can directly contribute to enhance energy efficiency. Technical developments like recapturing energy help railways to be both less energy intensive and more environmentally friendly. Further development of diesel and electric engines can help save energy as well, but such measures need to be integrated at the development and construction phases of the engine. Indeed, due to the long life cycles of the rolling stock, new developments require a long time to be implemented. For instance, the lack of modern rolling stock combined with low utilisation rates in the EU-10 are the main determinants of its comparatively low energy efficiency.

Figure 4-21: Load factors in rail freight transports



Source: IWW

Load factors are a broad indicator that helps measure the economic and environmental efficiency of different modes of transport. They are defined as the ratio between tonne kilometres per vehicle kilometres. Figure 4-21 shows the average load factors of freight trains in selected EU countries. It is worth noting that longer trains increase the load factors. The figure is also an indicator for the structure of freight volumes in Member States. For example, a large number of long container trains leaving the Netherlands or the long haul ore-trains in Sweden contribute to high load factors.

The barriers for efficiency improvements in freight railway transport can be grouped into technical, organisational and cultural barriers. Technical barriers to interoperability result form the different standards of national railways, e.g. signalling systems, loading gauges, electrification, axel loads or train lengths. In turn, inefficient organisational processes may arise from the lack of technical interoperability. Sometimes, they also stem from cultural gaps or differing commercial philosophies, which result in problems for the approval of locomotives, rolling stock and driving staff. National railways have to perform a balancing act between cooperation in the field of single wagonloads and competition in the fields of full-trains, logistic trains and container trains. In order to increase transport efficiency on railways, policy must take into account these three dimensions of interoperability.

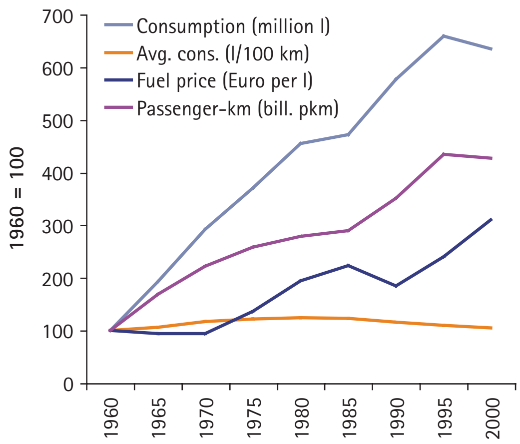
5.2.3. Road passenger transport

Two main factors determine the efficiency of passenger transport by private cars: Vehicle technology and user behaviour. If the efficiency of industrial production processes (e.g. vehicle production) is excluded, the most important cost elements of individual transport by private cars are fuel and external costs. The latter include effects on climate change, health impacts by air pollutants and noise, accidents and damage to habitats and landscape. While fuel costs and emissions per passengerkilometre are directly determined by the energy efficiency of individual passenger transport, the evolution of the other cost categories also depends on technical progress as well as on behavioural changes.

Fuel prices, but also disposable income, regulations and progress in information technology are the key drivers of individual transport behaviour. In turn, changes in user preferences and behaviour affect and promote technological developments in the highly competitive field of vehicle construction. On the other hand, the utilisation of road infrastructure can be increased by smoothing the traffic flows and by reducing congestion. At the European level, this goal is addressed within the framework of the TEN-T by removing bottlenecks in road infrastructure and identifying important transport corridors. A promising development in this field is the development of Intelligent Transport Systems (ITS) that make use of satellite-based geo-positioning systems (Galileo) together with mobile communication technology and modern road pricing systems. Whilst the system information flow currently ends when the information is displayed in the vehicle, future generations of feed-back systems will allow for a dynamic optimisation of traffic flows by providing user-specific information generated with the help of real-time data that the system receives from the vehicles themselves.

Energy efficiency in passenger transport can be measured by the ratio of transport performance (pkm) to fuel consumption (litres). Figure 4-22 provides an overview of the development of passenger performance, fuel consumption, and fuel prices between 1960 and 2000. The data refers to the situation in Germany but, with the exception of the inflection at the end of the period considered, most European countries present similar trends.

Figure 4-22: Fuel consumption, fuel prices (in current prices) and passenger performance in road transport (Germany)

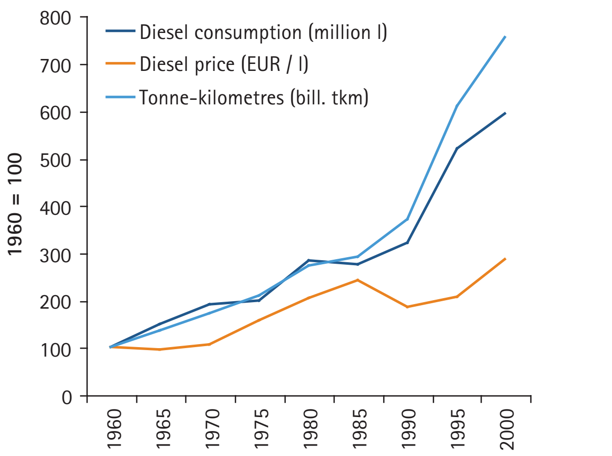


Source: IWW, based on BMVBW / DIW

Passenger transport performance increased significantly between 1960 and 1995, but fuel consumption increased proportionally more, resulting in decreasing energy efficiency. That trend, however, changed in the late 1990s, when both performance and fuel consumption receded. As a result of stronger relative decreases of fuel consumption, energy efficiency increased over that part of the period. The decreasing trends in performance and fuel consumption in some Member States can partly be explained by increases of fuel prices. However, similar price movements after the oil shock of the 1970s were followed instead by slightly increasing road transport performance, thus implying the existence of performance drivers other than fuel price. Indeed, in addition to fuel prices, the share of transport costs in total disposable income is a major determinant of performance. Additional drivers include increased individual mobility levels, occupation rates and technological changes. Higher occupation rates increase energy efficiency and, in the long run, also reduce the costs of mobility per passenger-km and therefore have a positive impact on economic efficiency as well. To this end, policies such as the establishment of reserved lanes for high occupancy cars in peak traffic hours or the introduction of eco-taxes could encourage people to carpool more.

The effects of technological changes move in two directions. On the one hand, the development of more efficient engines reduces fuel consumption per vehicle km. On the other, these developments are partly offset by other trends, such as higher safety standards, which imply higher weights, and passenger comfort (e.g. air conditioning), which reduce a car's fuel efficiency. Figure 4-22 shows that the net effect has only been a slight decrease of the average fuel consumption per 100 km for passenger cars in recent years.

Figure 4-23: Fuel consumption and freight performance in road transport



Source: IWW, based on BMVBW / DIW

5.2.4. Road freight transport

In contrast to passenger transport, Figure 4-23 shows slightly stronger increases in freight transport performance compared to fuel consumption from the mid 1980s onwards. As a result, energy efficiency (measured in tonne-km per litre diesel) augmented over that period. Though increasing diesel prices have been an incentive for more efficient engines for heavy goods vehicles (HGV's) other determinants are equally important. This is true for HGV tolls - which partly depend on emission standards– and is particularly true for the implementation of modern logistics. Conversely, new production processes require more flexible delivery schedules (just-in-time production, day-to-day deliveries), which reduce the gains from improvements in logistics. In general, however, modern logistics contribute to gains in energy, commercial and economic efficiency, and are expected to be further enhanced by the use of telematics (ITS).

HGV tolls can be accompanied by congestion charging in order to reduce urban congestion. Already, charges in metropolitan areas, such as London and Madrid, have led to significant congestion decreases.

5.2.4.1. Trends with implications on efficiency

The network characteristic of transport markets necessitates high communication capabilities and flexibility. In road transport, flexibility is guaranteed by a high number of relatively small but flexible carriers. These small transport companies are specialising on specific markets and clients, and are coexisting with large, integrated logistics service providers. The tendency is to concentrate on core competencies and to collaborate in order to provide high-quality logistics services.

Logistic concepts depend heavily on the considered freight market. Own-account transports, for example, are characterised by specific routes (and often specific transports). In contrast partial load transports carry loads for several clients, which in turn require a high level of flexibility. Since impacts on transport efficiency can vary significantly for different freight transports, the analysis below considers the following market segments are discussed in further detail:

- Full-load long-distance transports with general cargo
- Partial-load transports with general cargo
- Mixed cargo transports
- Specialised transports
- Own-account transports

> Full-load long-distance transports with general cargo

Here, the term "full" does not refer to vehicle capacity but to the number of owners of the vehicle's load (if the load belongs to one client only, the trip is classified as a full-load transport). General cargo refers to a wide range of products which have no special handling requirements (mainly palletised cargo). In this market, carriers perform fully-loaded trips with an average transport distance of 350 to 400 kilometres. In contrast, the average distance of empty trips amounts to approximately 50 km. Due to the relatively low share of empty trips, full-load transports are considered to be relatively efficient market segments from a commercial and energy efficiency perspective. However, transport of goods for which a shipper has a significant commodity flow to the recipient could be carried out by railway carriers. Such a change in the logistics regime would lead to increased warehouse costs and require an access to the railway network. For larger distances, inter-modal transports also emerge as an alternative.

> Partial-load transport with general cargo

In contrast to full-load transports, partial-load transports simultaneously carry loads for several clients. Two reasons explain why this market has become increasingly important in recent years. First, there has been a clear trend to decreasing lot sizes. This is true for intermediate movements, but holds for the distribution of consumption goods as well. The average distance of these transports amounts to slightly more than 300 km. Second, efficiency in this market segment varies significantly and depends on the distances between different pick-ups of partial loads. Due to the smaller lot sizes, partial-load transports (especially consumer distribution transports) are less likely to be replaced by other modes.

> Mixed cargo transports

Like partial-load transport with general cargo, mixed cargo transports have also gained importance in recent years. This segment is characterised by internationally operating alliances of haulers which set up hub and spoke systems interconnected with line operations between the partners. In particular, interconnection trips with consolidated shipments exhibit high utilisation ratios, which have a positive impact on commercial and energy efficiency. In contrast, final distribution is characterised by short-distance trips, delays from re- and up-loading procedures and a significant contribution to congestion in metropolitan areas. This market segment could in principle foster inter-modal transports. Hubs could be located next to maritime and inland ports and they could partly be connected by railway. In doing so, energy efficiency could increase.

> Specialised transports

Specialised transports are characterised by a high degree of specificity, often requiring special equipment (transportation of cars, fuels or fresh food). What is more, these transports are associated with a much higher share of empty runs, given that the flows are uneven. Depending on the strength of the commodity flow between shipper and recipient as well as transport distance, this market segment could equally be served by railways (i.e. bulk cargo logistics). However, due to the trend in industry to decentralise and accelerate all processes, such strong microscopic transport relations become more and more scarce.

> Own-account transports

The share of transports operated on own-account has been continuously decreasing in recent years. High dynamics in the road haulage market, which lowered transport costs, have spurred a trend of outsourcing transport services, especially since average distances in distribution have also increased significantly. However, own-account transports persist in industrial distribution, consumer goods distribution, in the construction industry and in garbage collection (when movements take place in local areas). Due to the relatively short distances and the significant share of deadhead trips, economic and energy efficiency is relatively low.

5.2.4.2. Efficiency indicators and possibilities for efficiency improvement

Table 4-3 presents road load factors for selected Member States. As was the case with freight, the indicator must be regarded with care. Here, the different characteristics of different freight transport markets (such as retailer distribution, long-distance haulage with general cargo or local transports undertaken by artisans) are merged into the indicator, making it impossible to distinguish, for example, whether a small load factor corresponds to a certain industrial structure or, rather, a poor performance of transport companies. In fact, small countries with a significant share of local transports such as Austria, Ireland or Denmark have low load factors. Load factors express both the organisational efficiency of transport companies as well as the structure of freight transport demand.

Table 4-3: Load factors for road

Country	tonne-km/ vehicle-km	values from
Austria	1.5	1992
Denmark	2.2	1998
Finland	4.3	1998
Germany	4.6	1997
Ireland	2.7	1996
Italy	3.7	1992
Netherlands	2.3	1997
Portugal	4.8	1998
Spain	3.2	1994
Sweden	3.8	1998
UK	5.0	1998

Source: Eurostat 2002

In order to assess the efficiency of the transport sector and to identify areas with room for improving it, load factors of the freight transport submarket can be compared. As an example, Table 4-4 presents several profiles of German transport markets. It shows that nearly 50% of the transport performance is generated by long-distance transports, with two-thirds of the trips in this segment are carrying cargo. The average distance of trips with cargo on board largely exceeds that one of the empty transfer

Table 4-4: Efficiency profiles of German transport markets for 2002

	Travelled distance (bn km)	Travelled distance, cargo on board (bn km)	distance share of empty runs	trip-share of empty runs	average distance, cargo on board	average distance, empty runs	average cargo weight, cargo on	average loading capacity	capacity use of volume constrained
General Cargo, long distance	10.7	8.9	16%	36%	327 km	115 km	13 t	24 t	60%
Distribution	3.0	2.2	27%	41%	76 km	40 km	11 t	16 t	76%
General Cargo, local transports	3.6	2.6	26%	37%	76 km	45 km	10 t	16 t	65%
Specialised trans-ports, long distance	3.5	2.8	21%	37%	264 km	114 km	14 t	23 t	63%
Specialised transports, local	3.0	1.9	37%	45%	33 km	23 km	14 t	18 t	84%

Source: IWW

trips. The high proportion of trips with cargo on board is due to line-operations in mixed cargo networks and partial load tours. Enhancing the cooperation among transport companies could further reduce the share and the average distance of empty trips. Internet-based spot market trading platforms are a way to find return cargo; platforms for awarding transport contracts support the establishment of efficient collaboration structures. At a first glance, the capacity use of trips with cargo on board seems to be rather low (13 tonnes vs. 24 available). However, this is mainly due to volume constraints: There, the volume capacity is completely exhausted, and "only" 60% of the weight capacity is used. Changing the size of packaging boxes might be a good strategy for freight transport efficiency gains. The table further shows that most empty runs are generated by local transport activities (industrial own-account transports, retailer distribution, agricultural products, construction-site supply). In these segments, it is difficult to achieve additional efficiency gains by combining shipments and finding return cargo. Large generators of distribution trips (mainly distribution centres, wholesalers) can slightly improve their efficiency by introducing software for journey optimisation.

5.2.5. Sea transport and inland waterway

The role of coastal shipping and maritime transport has become increasingly important in recent years. The accession of Malta, Cyprus and the Baltic States in 2004, which almost led to the doubling of the EU fleet, further strengthened the role of sea transports within the enlarged EU. Consequently, the question of efficiency in this sector is of major importance. The main driving forces of commercial and energy efficiency are the standardisation of container loads and the increase of vessel size. Reinforcing this trend requires the upgrading of inland waterways and (maritime and inland) ports. EU transport has addressed this issue by the establishment of the so-called "motorways of sea". From an economic point of view, additional gains in efficiency can be expected when free access to port services is guaranteed. Since ferry operators would then belong to the beneficiaries, free access to port services would affect the efficiency of sea passenger transport as well.

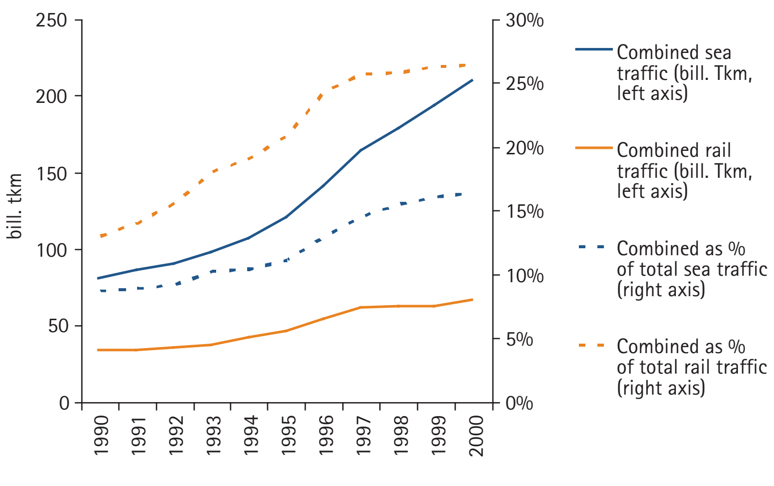
Combined transport was not explicitly illustrated in Figure 4-20, but inter-modal transport should also lead to higher energy efficiency of the transport system. In particular, combined rail/sea and rail/air services remove significant loads from the road. However, gains in efficiency are expected not only from increasing shares of inter-modal transports, but also from the improved operation of the entire inter-modal chain. In this context, the standardisation of container and "swap bodies" is of particular interest. Swap bodies are easily transferable from rail to road (and vice versa) and are specifically adapted to the European palette size. On the other hand, they are more fragile than containers and not stackable. The Commission is thus strongly promoting the development of new standardised loading units that offer the advantages of containers and swap bodies plus optimum inter-modal transhipment. Standardising loading units will, in particular, minimise time and costs related to un- and reloading. This, in, turn increases commercial and economic efficiency. If the new generation of containers allows for higher loads, a growth in energy efficiency can be expected as well. Figure 4-24 gives an insight into the recent trends in combined transport.

* * *

The establishment of modern aircrafts, road vehicles, rail and maritime fleets and new logistic concepts that come along with the renewal of fleets can be considered the major determinants of increasing transport efficiency. The new generation of wide-bodied aircrafts, the establishment of EURO V and EEV11 standards, the modernisation of propulsion technology and higher interoperability as well as the improvement of container processing can be mentioned as some examples.

However, the time span for fleet renewal and establishment of modern logistic concepts is strongly affected by external incentives – determined by either markets or policies. Significant gains in efficiency can be expected if market and political incentives complement rather than compete with each other. The Commission's aim to establish a market for green vehicles, for example, might very well come along with an increasing demand for these cars (from high petrol prices). With regard to rail transport, the political process of market opening and the push for interoperability clearly conforms to the rail carriers' aim to provide efficient (and thus competitive) transport services at international level.

Figure 4-24: Development of combined transport



Source: Energy and Transport in Figures

European Commission

The Annual Energy and Transport Review for 2004

Luxembourg: Office for Official Publications of the European Communities

2006 — 142 pp. — 21 x 29.7 cm

ISBN 92-79-00652-5

Price (excluding VAT) in Luxembourg: EUR 65.00