european regions airline association

Air and rail: Setting the record straight

environment, investment, mobility and political bias

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Foreword

The interaction between air and rail as transport modes for Europe has been the subject of considerable political debate for many years. It has been characterised by a continued leaning towards rail (especially high speed rail) at the expense of air as a solution to many of the problems facing intra-European transport including congestion, environmental impact and investment programmes.

However it is evident that, too often, this debate has been undertaken in the absence of objective assessments and comparative data for each mode. That high speed rail is seen by key European decision-makers as a preferred alternative to air transport is more a result of doctrine than rational and transparent analyses. This study attempts to set the record straight on many of these issues and in particular from a financial, environmental and policy perspective. It is based on extensive research and relies on work done by independent entities.

For the first time we have an objective study that looks at the merits of both modes and examines the case for each. The conclusion is clear – both modes offer a solution to providing intra-European transport, but the case for rail as the "preferred" mode by policy-makers and transport planners can no longer be justified.

I hope this study will lead to a more objective and constructive debate on the future of air and rail in Europe and provide policy-makers with the evidence they need to promote air transport as an equal (and in some cases better) means of delivering enhanced future mobility for European citizens.

Mike A Ambrose, Director General

Executive Summary

The interaction between air transport and High Speed Rail (HSR) is a key strategic issue for the future of transport in Europe. European Regulators, including the European Commission (EC), have generally favoured high speed rail ahead of air transport in the policy and funding choices they have made. In many European policy documents (including the 2011 EC White Paper on the future of transport in Europe) it is regularly stated that substitution of regional aviation by HSR is a means to solve Europe's congestion and environmental problems caused by aviation.

Few of these actions and arguments have been supported by hard facts.

The aim of this study is to present facts and well researched arguments that underline both the essential role played by air transport in Europe but also the bias shown towards rail across Europe. Such bias results in distortions of competition between air and rail with the competitive balance loaded in favour of rail. Equally importantly, it results in reduced freedom of choice for the citizens of Europe. The study looks at current networks and the contributions of the two modes in addition to their environmental impact, the return on investment, competition and substitution, and the different regulatory approaches taken by policy makers for each mode.

The conclusions of the study are clear: both air and high speed rail offer a solution to providing intra-European transport, but the case for rail as the "preferred" mode by policy-makers and transport planners cannot be justified.

In the past 15 years, in contrast to the rail industry, air transport has met the challenge of providing more mobility for Europe, through competition and in response to consumer demand, whilst paying the full cost of its infrastructure without relying on taxpayers' money. Air transport in Europe moves over 750 million people annually, creates over 3 million indirect jobs and has steadily grown its market share compared to other modes. The industry is a true European transport success story.

By contrast, the continued massive public investment in the semi-monopolistic rail industry has proved an inefficient means of delivering mobility in Europe. On average each year the rail industry requires over

"The case for rail as the "preferred" mode by policy makers and transport planners cannot be justified."

€40 billion of taxpayers' money just to survive, it has steadily lost its market share of passengers transported compared to other modes and the fares charged to passengers (if subsidies were removed) can be up to 270% higher than an equivalent air fare.

The study tackles the on-going debate on the environmental impact of rail and air by using a different approach to the traditional "emission at source" approach and looks instead at the full "life-cycle" impact of each mode. Under this scenario, the green credentials of rail can no longer be maintained. For example, the huge cost of dismantling and waste management for nuclear power and the "nuclear footprint" of HSR can no longer be ignored. The study shows that when analysing the full life cycle of emissions, rail produces far higher levels of emissions than aviation. For example, for various HSR routes, the CO and NOx emissions from rail are up to 150% and 50% higher than for an equivalent air route.

The study has examined the return on investment from various HSR projects and has concluded that they are rarely justified from either a financial perspective or in terms of the social disruption that they cause. Despite the huge amount of taxpayers' money involved, European HSR projects are undermined by fundamental shortcomings in long-term demand fluctuation, fares, environmental costs, social impact due to higher taxation, price competition from conventional rail and other modes, the cost of over-crowding and higher fares on existing services in the years leading up to HSR becoming operational, and the value of time to consumers. In general, major HSR projects show rail to provide a positive social and economic return only when connecting very highly populated areas that are poorly served by air and when other cheaper solutions, for example the construction of new airports, are not duly considered.

The study looks closely at competition between modes and the case for substitution of air by rail. It concludes that the most effective solution for European citizens is to allow the market to determine the best solution for providing mobility based on fair competition, freedom of consumer choice and sound business cases rather than on modal substitution through regulatory intervention.

The final area examined by the study is the regulatory approach taken by policy makers to each mode and the approach by governments to funding each mode. The bias towards rail is clearly demonstrated through the allocation of EU funding to transport. Of the 30 priority EU transport projects earmarked for public funding just one is dedicated to air transport and 19 to rail. Equally, the approach taken by policy makers on regulations governing security and the rights of passengers is disproportionate and distorts competition. For example, governments can indefinitely exclude urban, suburban and regional rail services from providing basic rights to passengers whereas the air industry is not granted such an exemption.

Overall the study points towards the need for a radical rethink on how rail and air are perceived by consumers, politicians and industry.

Chapter 1: The existing air and rail network in Europe

Air transport is an essential part of Europe's transport network

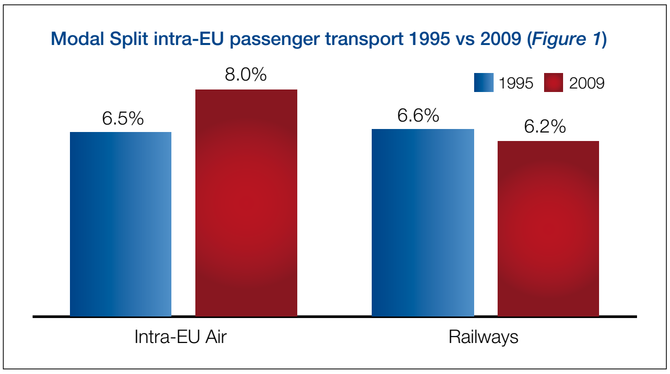
Air transport is an innovative industry that drives economic and social progress, connects people and cultures, provides access to global markets and generates trade and tourism. Air transport also remains the only transport mode capable of connecting underdeveloped and underserved regions to the international transport network as advocated as a key element in The Lisbon-strategy[1] .

According to the most recent Facts and Figures on air transport released by the European Commission (EC)[2], in December 2010, 4,105 commercial aircraft were in service in Europe. In 2009 some 320 air operators provided a total of 3.2 million indirect jobs (3% of the EU workforce)[3] transporting 751 million passengers[4] on 9.41 million flights[5].

The air transport market leads the way in European free trade and innovation

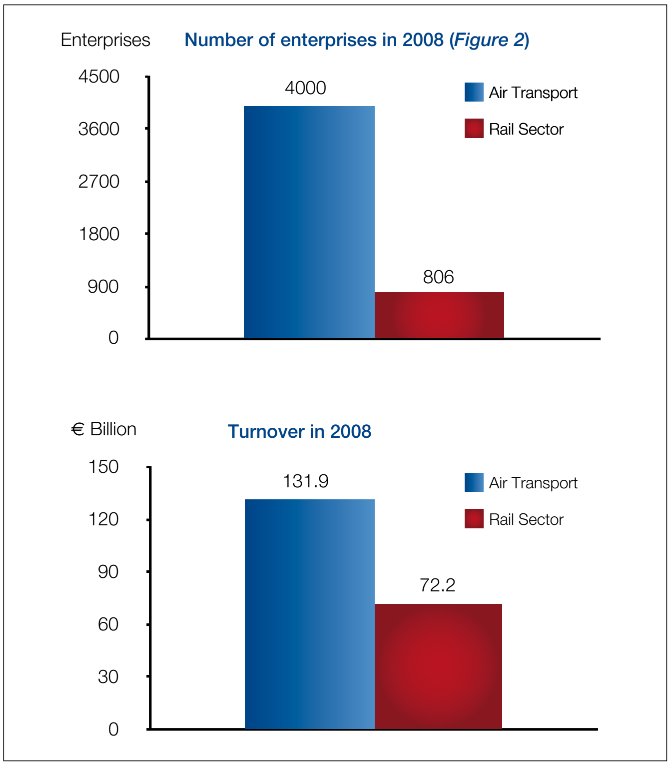
The process of introducing competition and liberalisation in the air transport market that took place over the last 15-20 years within the EU has resulted in an efficient network driving trade and mobility. Within the 27 EU Member States (EU-27), air transport accounts for 26.74% of total export value, compared to rail at 1.6% and road at 21.5%[6].

In terms of intra-EU passenger transport, air has captured a market share rising from 6.5% in 1995 to 7.3% in 1999 and 8.0% in 2009 compared to a rail industry which has decreased its market share from 6.6% in 1995 to 6.2% in 2009[7] *(see Figure 1).*



Based on the official EU Eurostat data[8], the number of enterprises in the EU-27 air transport market is 5 times higher than the number of enterprises in the railway sector (4000 versus 806), while the turnover of the EU-27 air transport market is almost twice that of the railways (€131.9 billion versus €72.2 billion) *(see Figure 2).*

> **"In 2009 some 320 operators provided a total of 3.2m indirect jobs (3% of the total EU workforce)."**



Air transport pays its own way and is a major tax generator for EU Member States

The air transport industry pays ('user charges') to cover the costs of the infrastructure it uses for both airport operations and air traffic management (for example runways, airport terminals, air traffic control). The latest data available shows that total worldwide 'user charges', paid by airlines and their customers, exceeded €39.5 billion in 2007, representing about 11% of total operating revenues[9].

Net Contribution of each transport mode						
	Germany		France		United kingdom	
	€ million per annum	€ per journey	€ million per annum	€ per journey	€ million per annum	€ per journey
Aviation	764	7.5	726	8.4	659	4.6
Road (+Bus)	15,540	0.2	21,507	0.3-0.4	31,255	0.5
Rail	-12,048	-6.2	-6,179	-7.4	-2,146	-2.4
Light Rail	-3,689	-0.5	-5,154	n/a	-2,175	-2.3

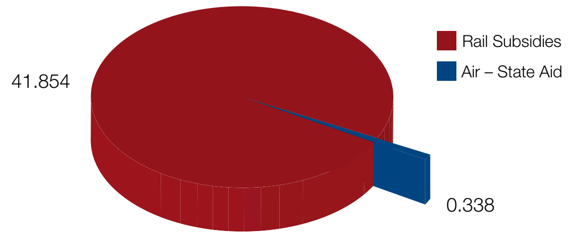
Table 1 Source: IATA Economics Briefing no 2, 2005: NET CONTRIBUTION = Taxes paid net of subsidies received + User Charges net of infrastructure costs

It is often asserted that airlines are under-taxed relative to other modes as, in many instances, they do not pay fuel duties or ticket taxes on their international services. However, according to the European Commission's UNITE data[10] comparing rail and aviation in terms of fiscal net contribution, aviation provides a net surplus in Germany, France and the United Kingdom. The study also shows *(see Table 1)* that both rail and light rail are fully reliant on massive and continuous annual public subsidies in order to cover their continued deficit scores.

Air transport does not rely on tax payers' money to survive

According to the most recent data published on the EC's website[11], the yearly average amount of subsidies[12] to the rail sector in 2007-2009 was €41.85 billion, which represents almost 125 times more than the amount of state aid granted to air transport (€338 million) *(see Figure 3)*.

Subsidies to rail sector vs State Aid to air transport (yearly average 2007-2009 in € billion) (*Figure 3*)



Subsidies to rail are 125 times higher than State aid granted to aviation. Is this fair competition?

Even if aviation's fuel and VAT exemptions are considered as 'subsidies', rail's share of subsidy in the period 2007-2009 is very high compared to the total share of passenger transport volume (27% versus 6%). Conversely, air's share of subsidies is lower than the share of passenger transport (10% versus 12%)[13].

Air transport pays for all of its infrastructure unlike the rail industry where data show that, for example, on the Rome-Milan rail route the indirect infrastructure subsidy granted by the State is equivalent to 1275% of charges actually paid by the train operator. On Paris-Marseille the subsidy is equivalent to 66% of charges actually paid by the operator, Frankfurt-Cologne is 65%, Madrid-Seville is 46% and Madrid-Barcelona is 43%. Such significant subsidised "cost reductions" of rail infrastructure directly affects and undeniably distorts competition against short-haul air services that pay the full costs for their infrastructure[14].

Air transport provides an affordable solution to Europe's transport needs

The EC's liberalisation of air transport stimulated innovative business practices and pricing policies in the industry. These have revolutionised European mobility and introduced a new affordable way to travel for millions of citizens, thereby fulfilling the EC's liberalisation objectives. For example, the average cost of travelling by rail between Madrid-Barcelona is 100% higher by train than air. Rome-Milan is some 214% higher, London-Manchester is 273% higher, London-Paris is 188% higher and Paris-Marseille some 152% higher[15]. In each of these examples, the rail comparison is based on published fares based on the true costs of rail, i.e. if the annual subsidies were to be removed.

Air transport has met the challenge of providing mobility for Europe in a competitive environment

As mobility represents a European priority for the next decade[16], it is worth analysing the current role of aviation in meeting this fundamental goal. Between 1992 and 2009 intra-EU air routes increased by 120%[17] and intra-EU routes with more than two competitors achieved an impressive +310% growth, showing the benefits of an open, competitive and liberalised business environment.

In this regard, *Figure 4* presents a map of routes and air services currently provided by the airline members of the European Regions Airline Association (ERA) compared with the High-Speed Rail network in Europe. Air transport is a fundamental asset for European mobility and is often the only means of transport available in the highly densely populated but outlying regions of Europe.

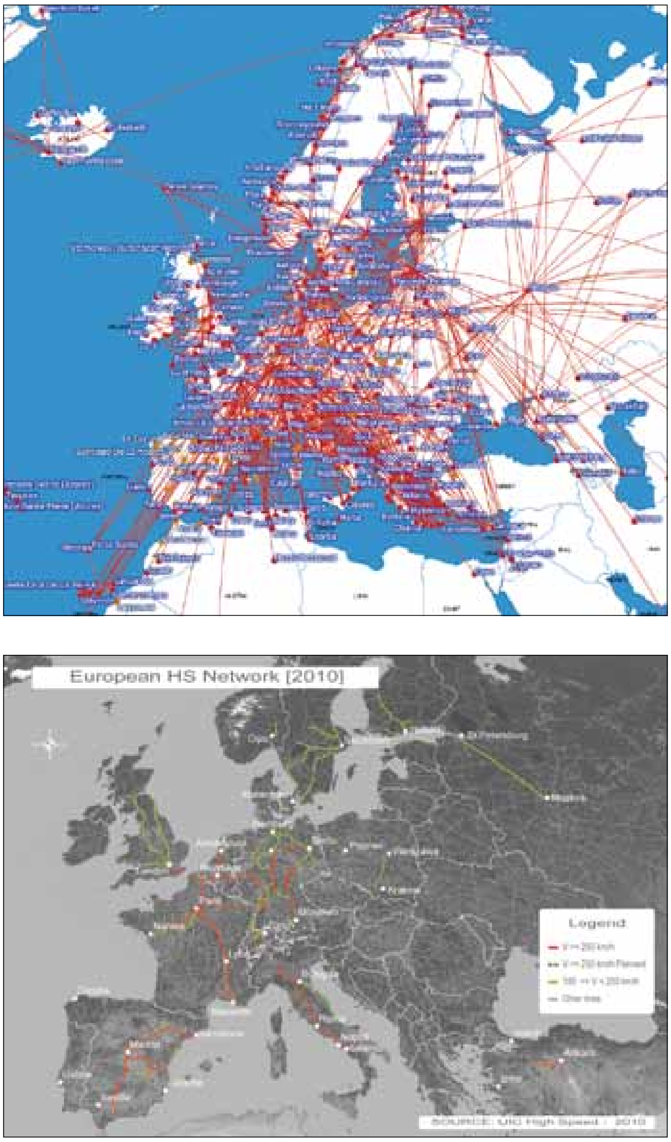


Figure 4: City pairs offered by Air and by High Speed Rail (Source: INNOVATA)

"Subsidies to rail are 125 times higher than State aid granted to aviation. Is this fair competition?"

For many regions air transport is the only option

In a recent EC-funded project, it is acknowledged that "Regional airports constitute an important element in regional economic development, as they contribute added value to local economies located in peripheral regions; regional airports provide the crucial infrastructure necessary to ensure a region's accessibility to and from national and international economic centres, facilitating the EU policy objectives of social and economic cohesion, spatial development, improvement and regional competitiveness[18]".

In many cases, aviation is the only transport mode for remote regions. For example Norway has more than 50 airports with scheduled air services and around 9 million passengers on domestic air services per year[19]. PSO (Public Service Obligation) routes[20] serve 29 regional airports and carry each year 1.5 million passengers at the cost of approximately €50 million[21]. Likewise, the Greek Islands, Canary Islands, the Azores are similarly dependent on efficient inter-regional air services both for inter-island business and social purposes and for connectivity for their access to international markets.

Air transport is a European success story unlike the rail industry

The 1992 regulatory package that created the Single European Aviation Market[22] resulted in the generation of an incremental 44 million passengers. This traffic expansion spurred development of both the travel and tourism sector and other industries, 1.4 million full-time jobs resulted from liberalisation and European GDP grew by €64.4 billion[23].

In stark contrast, the rail industry across Europe is still a monopolistic-driven and nationally-fragmented market. In its 2011 White Paper and Impact Assessment, the European Commission acknowledges that legislation prescribing market opening in rail freight (2007) and in rail passenger (2010) has been implemented slowly and incompletely in the large majority of Member States. National passenger markets are still largely closed, the crossing of national borders continues to cause inefficiencies and additional costs in rail, while the lack of competition and residual administrative barriers held back the quality and efficiency of the service.

These monopolistic, state-owned and highly subsidised companies have social and long-lasting economic costs and impacts on taxpayers. For example, the French rail operator (SNCF) group made a loss of almost €1 billion in 2009. Under arrangements to separate SNCF's operations from the infrastructure manager (RFF), the French government recently accepted future responsibility for infrastructure finance and €25.6bn of national railways' debt[24].

Despite the EU's attempts at increasing integration between Member States, international rail passenger services are still very modest and 90% of them consist of routes between neighbouring countries for distances of less than 300 kilometres. The poor environmental efficiency in international mobility is also confirmed by the low occupancy level of 43 passengers per train at the borders between EU-15 and EU-12[25].

Air transport continues to be a growth industry but is heavily reliant on good infrastructure

In total, the capacity of the air transport system in Europe is expected to increase by around 40% between 2011 and 2030. This marked increase in air services is due to the responsiveness of the business to changing market conditions. According to a survey[26] conducted by EUROCONTROL on 138 European airports, by 2030 an 18% growth in investments at 27 airports will be aimed at new runway capacity and a 17% increase in investment at a further 79 airports is expected to improve the air-side (taxiways, aprons, etc.) or ground-side (passenger terminals) infrastructure.

In its recently published White Paper, one of the priorities of the EC is to implement the Single European Sky (SES) initiative. The EC acknowledges that the creation of a SES is one of the main measures to address the rising density of air traffic and to rationalise air traffic management (ATM) in Europe. Once established, it is expected to triple air traffic capacity, increase safety by a factor of ten, halve ATM costs and reduce the environmental impact of each flight by 10%.

Propping up the rail industry will not deliver an efficient European transport network

One of the most frequently asserted remedies to reducing air transport congestion and delivering additional mobility to Europe is to increase investment in the European High-Speed Rail network and deliberately divert passengers from air to rail. Putting to one side the principle of freedom of consumer choice, the EC's White Paper makes clear assertions

that the majority of medium distance passenger transport should go by rail by 2050[27].

However, experience has shown that this is not the most efficient way of delivering mobility in Europe. For example, in France, one of the most cited examples of successful investments in HSR, the modal share of air transport passengers has increased from 8% in 1994 to 12% in 2005, while rail's share has remained unchanged at 9%[28]. This change occurred despite the fact that public investment in the rail infrastructure in 2005 amounted to €1.42 billion (7% for HSR only), compared to just €0.6 billion invested in air transport infrastructure.

Continued massive public investment in rail is an inefficient means of delivering mobility for Europe

It is unlikely that massive investment in high speed rail will ever bring about significant modal shift. A recent (2010) EUROCONTROL study[29] examined the impact of expanding the HSR network to link all major city-pairs of less than 500km currently connected by at least 10 flights a day. It concluded that it would lead to a reduction of just 4.2%-4.9% in demand for flights by 2030.

Achieving this type of expansion of the rail network would mean a 600% increase in the HSR network compared to current expansion plans to only achieve a very modest modal shift. The economic case for such expansion, leaving aside the other challenges such as financing and environmental impact, would be difficult to justify.

"It is unlikely that massive investment in high speed rail will ever bring about significant modal shift."

Air transport delivers mobility to Europe

Having seen the development of air transport and the rail industry over the last decade, it can be seen that air transport has delivered on many fronts. By contrast the rail industry still operates in a semi-monopolistic environment and is heavily supported by State subsidies and preferential taxation policies.

With financial constraints on both business and governments it is vital that Europe invests smartly in the future of transport. Air transport can deliver a cost effective, efficient, competitive and affordable solution for Europe.

Chapter 2: The environmental consequences of air and rail transport

Addressing the environmental impact of two different modes is a difficult task. The purpose of the arguments and data presented in this chapter is to reset the balance in the on-going debate between the two modes on their respective environmental impact and allow for a debate based on fact rather than doctrinal assertion.

Air transport takes its environmental responsibility seriously and has a proud record of continuous improvement

Climate change is an important policy concern and all transport modes, including air and rail, produce external environmental impacts including noise, pollution and greenhouse gas (GHG) emissions. European aviation accounts for 0.5% of worldwide CO_2 emissions[30] and civil aircraft generate only 2% of global CO_2 emissions and are claimed to be responsible for just 3.5% of the overall climate change effects resulting from man-made activities[31]. Nevertheless, the civil aviation industry (airlines, airframe and engine manufacturers) continues to self-fund efforts into further reducing its CO_2 and GHG emissions[32].

The result has been that the aviation industry has continuously decreased its impact on the environment: fuel efficiency[33] and associated emissions reductions have improved by more than 70% over the last 40 years and today's newest aircraft are as or more fuel efficient than the average car[34]. Aircraft entering the fleet today are typically 20 decibels (dB) quieter than comparable aircraft of 40 years ago: this equates to a noise annoyance reduction of 75%. In order to put this noise annoyance in context, air transport in the European Union contributes only 1% to the standard threshold of nuisances[35] that affect 80 million people, while cars are responsible for 90%[36].

Looking further forward, in Europe, the EU Advisory Council for Aeronautics Research (ACARE) has set challenging targets of a 50% reduction in CO_2 (per passenger km) and 80% reduction in NOx (oxides of nitrogen)

emissions by 2020[37]. The main technology policies should lead to step changes in airframe and engine design and alternative fuels, as well as ATM improvements. From 2012, aviation is included in the EU Emissions Trading Scheme and the EU is committed to cutting its emissions by 8% from 1990 levels by 2012 under the Kyoto Protocol. Aviation is therefore bearing the costs of its CO_2 emissions.

The purpose of the facts and figures presented in this chapter is not to attack rail or to make a case for promotion of air. It simply attempts to reset the balance in the debate between the two modes and allows for an environmental debate based on fact rather than allegation, bearing in mind that 80% of aviation Greenhouse Gas emissions are related to passenger flights exceeding 1500 km (900 miles), for which there is no practical alternative transport mode[38].

High speed rail's "nuclear footprint" cannot be ignored by responsible policy makers

One of the main statements to justify European policies for modal shift from aviation to rail relates to the claimed "greenness" of High-Speed Rail (HSR) compared to air transport. For example, in a 2010 EC publication[39], HSR is described as a "safe, fast, comfortable and ecological mode of transport, assuring low environmental impact". It states that "high-speed trains are powered by electricity" and, consequently, that "CO_2 emitted during electricity generation does not need to be taken into account", as "this rate varies depending on the primary energy source used to generate electricity consumed by the HSR" (coal or nuclear).

As seen in this quotation, electricity generation from nuclear power is often presented as a cheap, safe and CO_2-free energy source. However, past events, underlined by the 11th March 2011 tragic nuclear meltdown at the Japanese Fukushima Nuclear Power Plant, have shown its green credentials to be highly questionable. It has to be noted that public opinion in Germany has caused the Government to officially commit to abolish nuclear power generation by 2022[40]. Despite the known risks, the future of HSR in Europe will largely depend on nuclear sources for power. For example, in France, 78% of electricity is produced by nuclear energy at its 59 plants[41]. Leaving aside the risk of catastrophic accidents[42] and dangers posed to global security, the problem of radioactive waste and disposal is also still unresolved.

The International Atomic Energy Agency (IAEA) estimates that, every year, nuclear energy produces the equivalent of about 50,000 barrels (10,000 m3) of High-Level Waste (HLW)[43] that includes highly-radioactive elements that need to be reliably stored for hundreds of thousands of years[44]. Reprocessing spent nuclear fuel is conducted on a commercial scale by very few countries; consequently, dangerous nuclear waste is repeatedly transported across oceans and borders and through towns and cities.

The real cost of High Speed Rail's "nuclear footprint" must be objectively assessed and taken into account

Before embarking on a debate about which mode is greener, policy makers should examine the real cost of producing and decommissioning nuclear power stations in the pursuit of "green energy". The cost of building a nuclear reactor is consistently two to three times higher than the nuclear industry

estimates and the difference is normally bridged by State subsidies[45]. Commercial insurance companies generally do not accept liability for nuclear reactors as one major accident could bankrupt them. For example, the total Chernobyl accident cost is estimated at €358 billion.

In a recent publication, the French Court of Auditors estimated that the cost to industry for dismantling and waste management of the French nuclear industry would be €60 billion, although the Court admits that the figure could be very conservative[46]. The cost of waste management is also highly uncertain: in 2006 French waste authority ANDRA estimated the cost for deep geological disposal of nuclear material at between €16 and €58 billion[47]. A more recent example for decommissioning and waste disposal in the UK has seen estimates of the cost rise in less than two years from €80 billion to €100 billion[48].

It is essential that the known risks and decommissioning costs associated with nuclear energy are taken into account when rail's "green" credentials are considered. Rail should bear its fair share of these costs and liabilities.

Land use and noise impact are also a problem for high speed rail

The noise impact of HSR operations is also a factor to consider. At a distance of 100 metres from a rail track, a typical European High-speed train creates 93.5 dB, 17% higher than the noise level of an ATR 72-500 aircraft at an equivalent distance from the runway. Similarly, in a report prepared by ERA, it was shown that at sideline distances where typical non-transport land use will start (30m laterally from a TGV high-speed train and 280m from a runway) the sideline peak noise observed can be as much as 12% greater in dB for rail travel than from a regional jet (Embraer 145) at take-off[49].

Moreover, regional airports are mostly built and ready to use, while huge financial investments, land expropriations and legal actions are needed for a new HSR line. For example, infrastructure for the 410 km long Paris-Lyon TGV line required 2,250 hectares of ground surface to be taken which is 21.5 times more than the land required for a typical regional airport[50]. On average, the infrastructure investment required to build a new runway, funded by industry, could build a mere 30 kilometres of High Speed Rail track[51].

Examining the full life cycle costs shows rail to be a questionable green alternative to air

Any objective comparison between modes of transport must look at the full "life-cycle" impact of each mode. A typical life-cycle environmental analysis of HSR captures not just the energy used to move the train but also the emissions from power plants, vehicle manufacturing and maintenance, the energy inputs and emission outputs for vehicles, raw material extraction, infrastructure construction, fuel production components as well as end of life treatment of vehicles[52].

Taking an example of the 1,100 km HSR line between San Diego and Sacramento in the USA and looking only at energy use at the point of use shows the route to be some 35% more environmentally friendly than aviation. However when considering the full life-cycle impact, it paints a very different picture where for example, in a low-occupancy scenario[53], air and rail's energy consumption[54] is similar[55].

Looking in more detail at the life-cycle impact shows that (under a low-occupancy scenario which is common on rail journeys) GHG emissions[56] on the rail route are 50% higher than by air and SO_2 emissions are ten times higher. If CO, NOx, VOC and PM_{10} emissions are considered[57], the life-cycle assessment shows that rail has consistently higher emissions than air by 150%, 50%, 500% and 150% respectively. (See reference 52).

Two recent studies in the UK, the first by Booz Allen and Hamilton[58], estimate that taking into account the impact of construction alone in a life-cycle analysis adds around 35% to the CO_2 that results from direct operations.

The second study, by the UK's infrastructure provider Network Rail, estimated that life-cycle GHG emissions[59] for a Eurostar Class 373 train could be split as follows with 80% resulting from direct train operations, 18% from infrastructure and 1% from train production.

Looking deeper into these studies shows some even more startling results for specific HSR projects. If the modal split on the proposed UK London-Manchester HSR route[60] moved from a 50%-50% air-rail split (which is approximately the current split) to 100% HSR and 0% air, GHG emissions emitted by building and operating the new HSR route would be larger than the entire quantity of carbon emitted by the air services over a period of 60 years[61] were the current 50-50 split to be maintained.

An often overlooked aspect of the impact of HSR is its effect to move passengers away from conventional express passenger trains[62], thus causing them to incur a much higher carbon footprint. For example, HSR CO_2 emissions on the UK London-Manchester corridor are expected to be 35-40% higher than emissions from conventional rail lines[63] for the same quantity of passenger-kilometre. Given the kinetic energy[64] required to accelerate the train and energy to overcome aerodynamic resistance to motion in order to maintain speeds, reductions in journey times of 25% would lead to an increase in energy consumption of 90%[65]. Promoters of the proposed HS2 Project in the UK, connecting London to the West Midlands and then to the North of England, estimate that by 2043 65% of demand will be shifted from the existing conventional rail services to the new high speed service.

Examining alternative and cheaper options may be a better solution

The result of these projections will be to increase the environmental impact of rail whereas the alleged capacity constraints could be reached through alternative low-cost solutions such as longer trains, reduced proportion of first-class carriages or the introduction of fares that reflect demand[66].

Similar conclusions are drawn in a 2006 transport study submitted to the British Government stating that "Given that domestic aviation accounts for 1.2 per cent of the UK's carbon emissions, it is unlikely that building a high-cost, energy-intensive high-speed train network is going to be a sensible way to reduce UK emissions"[67]. A new high-speed rail line between two cities would not offer the economy significant new connectivity or trading opportunities if those cities were already a day-trip away from each other by existing rail, road or air links. Increasing ports and aviation capacity can offer strong economic benefits, including under carbon pricing scenarios"[68]. Transport demand in the UK is predominantly local and is concentrated within urban areas: 69% of business journeys and 84% of commuter journeys are shorter than 15 miles[69].

Looking more closely at other emissions, a 2004 EUROCONTROL case study on air pollution, comparing the impact of aviation and HSR travel on London-Paris[70], showed that air transport resulted in more emissions in HC, CO and NOx, while a journey by HSR was characterised by higher emissions in SO_2 and PM_{10}. As these gases have different impacts on air pollution, the study concludes that "it is impossible to determine which mode is preferable". The report goes on to state very clearly that "evaluating the impact of each mode is not obvious since results can vary according to the chosen unit of comparison and due to the difficulty of measuring the air pollution and of evaluating the social cost per pollution unit".

High speed rail generates its own demand which in turn has an environmental impact

Within Europe, the last decade's shift of transport demand from air to HSR has been limited in its effects. However, what cannot be ignored is the additional demand that has been "generated" by the construction of new HSR routes. According to different estimates[71], induced demand on the Paris-Lyon route accounted for 29% of total HSR traffic (1980-1985); in the Madrid-Seville route it was 50% (1991-1996), Madrid-Barcelona 20%, Paris-Brussels 11% and on the London-Paris it was 20%. The share of newly generated demand for the UK London-Midlands-North England HS2 project is expected to reach 22%[72].

Clearly additional demand is good news as far as mobility and tourism, business and economy are concerned, but greater mobility does have an environmental cost.

It's time for a more balanced debate on the environmental impact of rail versus air

It is unquestionable that all transport modes have environmental effects. Traditionally the debate around rail versus air has been typified with unsubstantiated claims of the "greenness" of rail. This has led to a blatant bias amongst policy makers when considering future transport policy in Europe. The information presented above is just a snapshot of the real data which exist to compare the two modes and hopefully goes some way to show that an objective analysis provides some different results from the widely held perceptions of air and rail.

What is clear is that when a full life-cycle emissions approach is undertaken and when noise, and land take are considered, it is difficult to conclude whether, and under what circumstances, air or rail has an environmental advantage[73]: this alone is further proof of the need for a more balanced debate amongst policy-makers on the future of rail and air in Europe.

Chapter 3: Investing in air and rail – what makes the best economic sense?

In an age of reducing public budgets and an increasingly price sensitive population, the cost effective delivery of transport services and the infrastructure to support them will become a key requirement for transport planners, providers of investment funding and governments. The application of policies such as "polluter-pays" and the "user-pays" principles[74] will become more common, adding pressure to seek "smart" investment solutions for transport. With this trend in mind, and having clarified the environmental impact of each mode in Chapter 2, it is essential that planners and policy makers clearly understand the relative position of rail and air in a financial context.

The purpose of this chapter is to objectively examine the economic cost benefit case for investment in High Speed Rail (HSR). In common with Chapter 2, while it is not the intent to criticise rail, the figures and case studies speak for themselves and are at odds with the political message continually used to justify more investment in HSR.

High speed rail requires massive investment at a time when policy makers and States are looking for more cost effective returns

HSR requires huge investment[75]. For example, the French TGV infrastructure cost (in 2009 values) for the 250 km long Méditerranée line was €3.1 billion, for the 327 km long Hanover-Wurzburg it was €5.06 billion and for the 621 km long Madrid-Barcelona line it was €7.06 billion. Despite these massive investments HSR does not appear to attract advanced services companies, which show no greater propensity to locate in areas neighbouring rail stations. Whilst HSR does improve accessibility between city centres, it has the effect of disarticulating the space between the connected cities (the so called tunnel effect) and promotes territorial polarisation rather than increasing inter-territorial cohesion[76]. Other costly effects, normally not factored in the cost-benefit analysis for HSR projects, are: disruption to travellers during the construction of the new lines, adverse impact on private property values near the planned route and dispersion of communities and loss of "social capital" due to compulsory purchase, loss of development rights when property is safeguarded along the route and additional road congestion to reach new stations[77].

This centralisation of investment can even have the effect of further worsening depressed and peripheral areas and reduce the secondary benefits of transport links[78]. For example, the opening of the Shinkansen line in Japan caused a dramatic fall in employment of 30% in Nagayo, a city located between Tokyo and Osaka, in the first years of operation[79]. Similarly, after the Paris-Lyon HSR was opened, the percentage of train passengers staying at least one night at their final destination fell from 74% to 46%.

Looking at other European case studies, the rationale for initial investment in the Spanish HSR (AVE) was to promote the country's poorer regions and to favour cohesion for territorial equity purposes. Despite this intent, the line has neither increased economic dynamism around its railway stations, nor led to new firms establishing themselves within their vicinity[80]. In Italy, the rationale for construction of new HSR lines was to increase the extremely low share of rail passenger traffic on the total passenger transport (in 2007 5.7% versus a 7.1% average of the EU-27). Private shareholders' reluctance to engage in the projects on the new Milan-Naples, Turin-Venice and Milan-Genoa routes forced the State-owned rail Company[81] to acquire 60% of the private share on the HSR Company[82] in 1998, just seven years after it was formed. Delays and a new strategy aimed at integrating conventional and high-speed networks led to a huge increase in projected costs from €15.5 billion in 1992[83] to €32 billion in 2006, while competition mainly with cars and road transportation has not changed the pre-existing market share of these modes. The capital cost to build a HSR in the UK from London to the Midlands and to the North of England is expected to be €34 billion[84] (in 2011 prices).

By contrast, the building of Frankfurt airport's new runway and an additional terminal, due to be opened in November 2011, is estimated to have cost €4 billion[85] and will increase the available capacity at Frankfurt by 50%[86]. The project is expected to increase the number of jobs in the Frankfurt/Rhine-Main region and throughout Germany by around 97,000[87]. Frankfurt airport currently serves a total of 298 destinations[88] and the mobility return from the €4 billion investment will be to allow even more destinations to be served as well as increasing the services of destinations already served.

Even the European "flagship" HSR projects don't deliver a good return on their investment

One of the most well-known examples of high speed rail connections is the Channel Tunnel linking the UK to France. Total construction costs of the project were approximately €11.2 billion[89] (in 2011 prices)[90] while some additional €6 billion (also in 2011 prices) were incurred for the development of both its freight and passenger international services[91]. The project came in 80% over its predicted budget[92]; both the freight and passenger traffic forecasts that led to the construction of the tunnel were largely overestimated: total cross-tunnel passenger traffic volumes peaked at 18.4 million in 1998, then dropped to 14.9 million in 2003, mainly due to the loss of duty free privileges and growing competition. Passenger numbers rose again to 17 million in 2010, thanks to the completion of the HSR connection from London St Pancras station to the Channel Tunnel terminal, an ambitious project that cost an additional €6.5 billion[93]. Despite this massive investment (a final total of almost €24 billion), in 2008 the share of Eurostar on total passenger transport connections[94] between UK and Europe was just 6%.

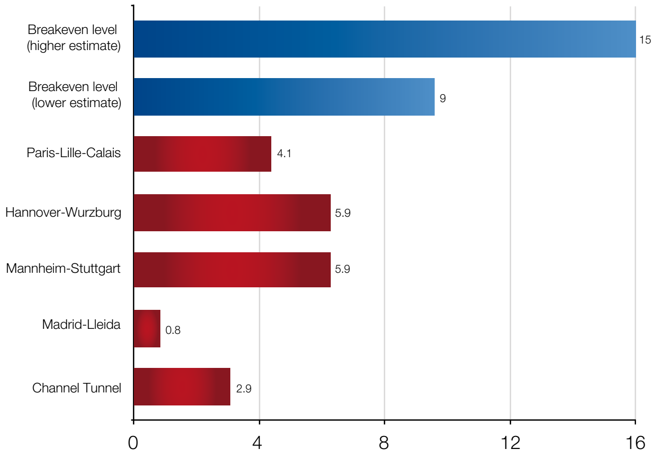
At the time of the decision to build the tunnel, 15.9 million passengers were predicted for Eurostar trains in the opening year. In 1995, the first full year, actual numbers were a little over 2.9 million, growing to 7.1 million in 2000, then dropping again to 6.3 million in 2003. In 2008, Eurostar carried 9.1 million passengers in cross-Channel-Tunnel traffic. Cost benefit analysis[95] of the Channel Tunnel indicated that there were few impacts on the wider economy and few developments associated with the project, and that the British economy would have been better off if the tunnel had not been constructed, as ferry and Tunnel operators' losses outweighed the users' benefits by more than 100%.

The future HSR line in the UK connecting London to the Midlands and North of England is already expected to result in a €19.1 billion net financial loss, thus increasing the burden on taxpayers, should the project go ahead as planned. This is despite fundamental shortcomings in initial assumptions on: long-term demand fluctuation, fares, environmental costs, social impact due to higher taxation, price competition from conventional rail, cost of over-crowding and higher fares on existing services in the 15 year run-up to HSR becoming operational, value of time, distributional effects and the assurance strategy to address risks[96]. Other major HSR projects show rail to provide a positive social and economic return only when connecting very highly populated areas that are poorly served by air.

There are relatively few published cost-benefit analyses of HSR projects, although a variety of studies have suggested that 9-15 million passengers per year are needed for any HSR to be worthwhile economically[97]. One of the few published studies on the Madrid-Seville route shows that, with its initial 2.8 million passengers, the investment was not justified as the social benefits (time savings, modal shift from more polluting modes, road congestion relief) do not even cover the costs of operation[98].

Other "first year" passenger figures show very low demand: Paris-Lille-Calais: 4.1 million; Hannover-Wurzburg: 5.9 million; Mannheim-Stuttgart: 5.9 million; Madrid-Lleida: 0.8 million[99] (*see Figure 5*). The clear conclusion is that building an HSR line will, in general, only benefit routes connecting densely populated metropolitan areas, with severe road congestion problems, a deficient air connection and where expansion of alternative modes proves extremely difficult or expensive.

High Speed Rail Passengers on first year of operations (million) (*Figure 5*)



Even over the long term the case for major public investment in HSR in order to deliver European mobility is weak

Taking another case study of the cross-border section of the projected HSR line connecting Turin to Lyon, on which work is expected to start in 2013. The estimated €16 billion project (which includes 50 km of tunnelling) is extensively supported by the European Commission, and by the Italian and French governments. The project has been launched despite no published factual and ex ante cost-benefit appraisal justifying its economic, social and environmental returns. In a recent essay[100], the project was extensively analysed and, even taking into account the most optimistic assumptions, the conclusion across all scenarios is that throughout the entire HSR life, socio-economic costs are far higher than the benefits even if the investment was assumed to be "for free".

Based on a detailed economic cost benefit analysis[101] the overall conclusion is that the project will provide a very negligible net economic benefit but only when spread over the full 50-year life of the project and excluding the investment needed for the tunnelling work[102]. The figures amount to a €1.7 billion net benefit to consumers and a €0.6 billion benefit in reduction of external costs. Opposing this, the negative impacts appear much higher by way of a €1.2 billion reduction in highways operator revenues and a €2 billion loss of fuel-related taxes. If the overall investment costs of the Lyon-Turin tunnel are included, the socio-economic costs during the entire duration of the project will always be higher than the benefits. The analysis shows that despite using very favourable assumptions for investment in the HSR tunnel works, the project will ultimately result in approximate losses of €19 billion.

Globally, the rail industry is a massive financial burden on tax payers and governments

Aside from the poor economic return, the rail industry continues to be propped up by massive public subsidy. Looking at the United States rail network, the federal passenger subsidy per 1000 rail passenger miles is estimated at €166.43[103] compared to just €2.96 for commercial aviation[104]. However, these figures are small compared to Europe. As outlined in Chapter 1, according to the most recent data published on the EC's website, the yearly average amount of subsidies to the rail sector in 2007-2009 was €41.9 billion, which represents almost 125 times more than the amount of State aid granted to air transport (€338 million). Arguably, one of the most forward looking EU States with respect to rail privatisation is the UK, where its privatisation process started in 1993 by way of concessions to private rail operators. Despite passenger numbers and ticket prices increasing, rail subsidies for the period 2009-2010 totalled €7.7 billion[105], which is 3.8 times more than (inflation-adjusted) pre-privatisation levels[106]. It is notable that this annual subsidy is 27% of the annual receipt to the UK provided by Air Passenger Duty in the financial year 2009-2010[107].

Government annual rail subsidies are also extremely high in France (€7 billion)[108] and in Germany (€15.96 billion).

Investment in air transport will provide quicker economic returns as well as clear mobility and social benefits

The case for investment in new HSR routes as a means of delivering a positive economic and social return is clearly weak. However, it does remain an option for certain European routes which will bring greater mobility benefits and more consumer choice. Nonetheless, to conclude a fair economic appraisal it is important to complete this analysis with a comparison of other cheaper actions to deliver benefits such as the upgrading of conventional railway lines, the construction of new airports or road capacity.

Investment in air transport brings important "catalytic" benefits arising from the introduction of new air services. New services allow regions to compete for economic opportunities throughout the world. For example, empirical evidence shows that a 10% increase in the supply of intercontinental flights creates around a 4% increase in the number of headquarters of large firms located in the corresponding area[109].

There may also be other methods for mitigating the effects of airport congestion and meeting mobility demand. Past studies from EUROCONTROL[110] proved that schedule smoothing, accelerated shift to larger aircraft and extension of high-speed rail networks have limited benefits as mitigation actions for the air traffic network as a whole. More could be gained from use of alternative (regional) airports and further SESAR improvements, each reducing un-accommodated demand by up to 40%.

In a 2006 report submitted to the UK Department for Transport, it is claimed that the same mobility, environmental, investment and social benefits that would be achieved through the construction of a new HSR line in the UK could be obtained at a much lower cost. The report argues that, for example, the expansion of South East UK airport capacity would ensure direct economic benefits of €21.4 billion[111] over the period to 2060, with construction costs of only €6.25 billion and other external costs valued at €3.68-4.46 billion (cost of carbon emissions, noise and air quality impacts)[112].

As shown in Chapter 2, the environmental benefits of HSR are not a significant driver to justify investment on the basis of it being a "green" alternative to air.

The overall economic case for shifting passengers from rail to air does not add up

The continual political message from the European Commission and many EU States that the future mobility of Europe should focus on HSR does not stand up to scrutiny when the real economic facts of HSR investment are analysed. This chapter shows that it is time for a far more fact based debate on the future of rail and air in Europe on the basis of economics, financial returns and positive cost benefits to European citizens.

HSR clearly has its place as an enabler for mobility in Europe, but it cannot continue to be sustained by a political belief that HSR represents a good investment for mobility in Europe. Equally, the argument for replacing air routes with HSR requires far more reasoned debate than is currently the case.

Chapter 4: Rail versus Air – is the consumer better served by complementarity, competition or substitution?

Historically, airlines and railway companies have operated as competitors but at the interconnection of their networks, for example, at airport railway stations, they have increasingly cooperated in expanding the catchment area around airports and feeding traffic to each other. Equally rail and air can be complementary, connecting passengers at hub airports to regional destinations and at the same time competing in certain markets for point-to-point services.

The debate about whether rail and air are best suited as competitors or as complementary modes has been a source of discussion amongst regulators for some time. In recent years a third option has been introduced, namely substitution. Substitution occurs when, instead of leaving market forces to decide which mode best serves a route, a policy decision is taken to favour one mode over another.

In Europe, the political debate has traditionally favoured rail over air. The objective of this chapter is to debate the 'pros' and 'cons' of each of these options on the basis of the evidence presented so far in this study.

According to the 2011 White Paper on Transport published by the European Commission[113], airports, ports, railway, metro and bus stations should increasingly be linked into multimodal platforms by greater use of online information, electronic booking, smart intermodal ticketing and payment systems. An appropriate set of common passengers' rights will have to integrate all means of transport in a uniform, effective, harmonised interpretation and their actual enforcement must ensure a level playing field for the industry across Europe.

With this perspective in mind it follows that air and HSR complementarity and competition should be based on fair competition and freedom of consumer choice in order to ensure overall benefits in terms of economic return on investment, environmental impact and mobility.

Rail and air can exist alongside each other offering more choice and convenience to consumers

The AIRail agreement between DBahn (the German railway company) and Lufthansa in Frankfurt is an example of complementarity. It provides, on average, 31 daily seats by train in 2nd class for economy class passengers and 6 seats in 1st class for business/first class passengers connecting to or from an air service in Frankfurt and travelling from or to Cologne or Stuttgart. AIRail offers a seamless journey to the passengers both with regards to luggage (full luggage check-in and processing at the railway stations) and to the ticketing and booking processes.

The cost of the infrastructure of the automatic luggage system has been shared equally between Lufthansa, Fraport and DBahn. However Lufthansa bears the related cost of handling the actual service, which has to be compliant with ICAO standards. Trains are allocated a flight number and information is shared between the Lufthansa reservation system and the DBahn booking system. Approximately 170,000 air passengers use this service each year and although the main objective of Lufthansa was to relieve slot capacity constraints at Fraport and replace domestic flights with rail, Lufthansa still operates 6 daily scheduled flights between Stuttgart and Frankfurt[114].

The example of Frankfurt is a clear case of complementarity at work with benefits to consumers who have a choice to fly or go by train with both modes able to exist alongside each other.

Another example of complementarity is the TGVAir service connecting 20 HSR stations to Paris CDG airport. Tickets can be bought just like any other Air France ticket, but it is composed of at least two coupons: one for the TGV journey and one for the international flight. Luggage check-in is not possible at rail stations and has to be made at the airport. Despite the offering by rail, 30% of the daily passenger services between Paris CDG and Lyon and 50% of total services between Paris CDG and Nantes are still performed by air.In this case both modes coexist and provide a choice to the consumer.

Substitution of air for rail does not suit all markets, the key to success is letting the market decide rather than forcing consumer choice through regulatory intervention

Where both modes exist alongside each other it is appealing for policy makers to attempt to force the substitution of one mode over the other. However, experience has shown this does not always work because the needs and objectives of travellers are different. The link between Lyon airport and Valence in France is a case in point. As the volumes of passengers are quite low, airlines have never been able to commit to buying a significant number of seats on trains, while SNCF wants to remain free to set its schedules and frequencies rather than adapting its product to appeal to both rail and air travellers. The initial French government objective of doubling traffic on the Lyon-Valence route by substituting air for rail has not been achieved. Only a 20% increase has been experienced and intermodal passengers at Lyon airport are less than 1% of total point-to-point traffic[116].

A good example of effective substitution is the link between Brussels and Paris. In 2001 Air France and Thalys International signed an agreement that Air France would stop operating flights between Paris CDG and Brussels and that all Air France passengers would be transported via Thalys HSR trains on the same route. Thalys reserves at least one carriage for Air France passengers and it agreed to increase its train frequencies. Travellers can check-in at Brussels station for the whole (train+air) journey including luggage. In 2005, 1.8 million passenger journeys used HSR services to travel to CDG, 88% of these passengers used two separate tickets rather than a joint air/rail one. 4% used joint Thalys airline tickets and 8% a common TGV-airline ticket[117].

In general, the conclusion of the above examples is that the potential market for substitution between air and rail depends on the size of the market in terms of passenger throughput and economic activities in the catchment area. Some estimates indicate a threshold of 7 million

air passengers a year as the minimum volume to make a connection profitable and viable[118]. Despite this, actively removing the air option still reduces consumer choice. Regulatory 'forcing' of modal use is contrary to the fundamental principle of freedom of consumer choice and is unlikely to work in practice.

Dealing with the problem of security

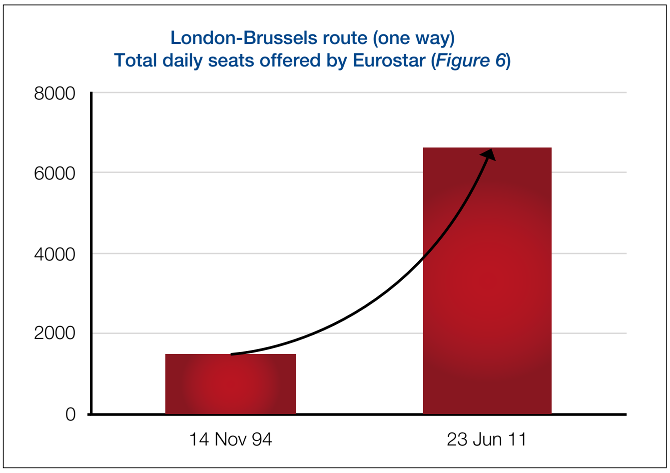
Aviation security has had a high profile for many years and this has resulted in a well-developed international framework of protection. Until the 2004 and 2005 terrorist attacks on commuter trains in Madrid and London, rail has not been considered as facing the same level of threat[119] and, with the exception of Eurostar services, they are largely or wholly open access systems.

The security threat posed by transport in general will continue to be a major factor in decisions taken by transport planners. It is inevitable that over time the differences in level of protection given to air and HSR users in terms of security screening and protection will need to be levelled with rail greatly increasing the protection it offers. This will lead to considerable costs and investment in security for HSR (HSR is risk-exposed throughout its entire journey length) that needs to be factored into transport planning decisions.

Substitution generates demand – is that what planners want?

There is no question that greater mobility, on whatever mode, is good for social and economic development. However, both co-modality and modal substitution can be seen to generate demand for travel amongst society. HSR, by definition, is a mass transport mode and transport planners can influence traffic flows through their choice of mode. Air transport continues to provide a service that cannot be replicated on many low volume routes. HSR by definition is a high volume transport mode.

For example, on the London-Brussels route (see *Figure 6*), the amount of daily seats offered by High Speed Rail has increased by 350% since the start of Eurostar operations (14th November 1994)[120], resulting in exponential generation of demand, despite a poor average load factor (59% compared to 75% of aviation[121]).



Experience shows that transferring or substituting between modes is relatively unsuccessful

The conclusions from the above analyses on intermodality show that the difficulties with communication and consolidating information between the respective air and rail computer systems cause confusion with potential customers. The marketing is often unclear and presentation of the product misleading. In principle, all these issues can be resolved, but the investment costs in physical infrastructure and IT networks are often too high to be commercially justified[122] or the passenger demand simply does not exist on the route in question.

The European Commission[123] has already admitted the narrow benefits of this transport approach to airport congestion because of the large gap between demand for airport slots and supply. Over the last few years major airlines have transferred many short-haul routes to regional airlines that, being more cost effective, generally manage to operate profitable short-haul flights on behalf of the major airlines. For example, in 2010 Air France, through its subsidiary regional airline VLM, re-introduced 54 monthly air services on the Nantes-Paris route. A 50-seat aircraft is used to feed passengers to its Caribbean final destinations as a competitive response to the British Airways partnership with TGV in the framework of its Open skies programme[124]. According to evidence and views collected by IATA, "the impact of high-speed rail connections will free up a limited number of slots at key airports"[125].

Political decision making on the future of air and rail must be balanced and reflective of the strength of each mode to deliver benefits to consumers

It is critical that politicians adopt a neutral approach towards different transport modes. Demand and the markets of air, rail, cars and buses would appear differentiated enough that complementarity, rather than mode substitution, would be a more efficient response to actual transport and consumer demand[126].

The recent approach by the EC[127] is unacceptable when it states that, whenever possible, air services should be transformed into rail services, thus freeing capacity for other air routes: "We can no longer think of maintaining air links to destinations for where there is a competitive high speed rail alternative. In this way capacity could be transferred to routes where no high speed rail service exists." This interventionist approach, unsupported by published business cases, does not reflect the reality of the market (i.e. what EU citizens want), the promotion of free market policies and the demand of the consumer.

Equally, the attractiveness of intermodality requires considerable improvement with regards to many elements, namely price, journey time, schedule coordination, seamless security checks, compatibility of IT infrastructure and booking systems, air/rail coordination in case of missed connections, passenger rights, frequencies of trains for efficient and short connecting times between both air and rail modes[128]. As and when consumer demand forces these changes, they will happen; in the meantime regulatory intervention will achieve little.

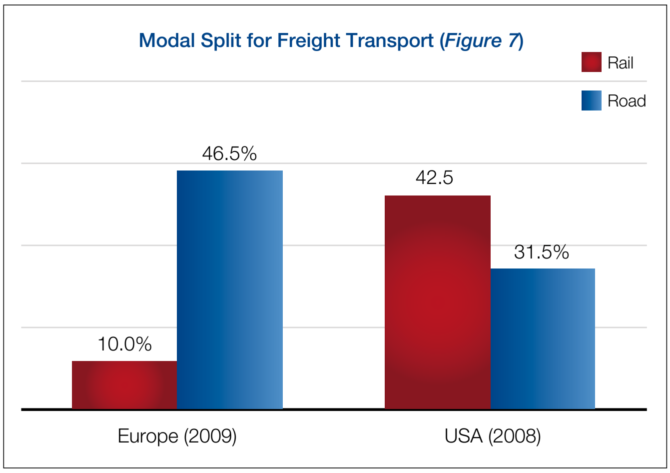
The implications of the differing door to door journey times for air and rail are also an important factor for consideration. The implication of moving passengers from air to rail for business is to effectively reduce the working time available to employees at their destination. Equally the effect will be

to increase the overall working time of a typical business employee if travel time is included.

For example, an equivalent door to door journey that takes 1 hour by air and takes 2 hours by rail for a business person taking a day trip will mean an extra 2 hours travelling in a day when travelling by rail rather than by air. This extra travelling time will be reflected in either a shorter working day at the destination or overall an extra 2 hours of door to door travelling including the meeting time at the destination. The first of these two outcomes results in a less effective mode of transport for businesses wanting their employees to spend productive time at a destination, the second option results in employees spending more time "working" (ie including travel) overall and potentially breaching the EU Working Time Directive.

Regulators should focus less on passengers and look instead at the "quick win" of using rail to tackle Europe's growing freight shipment demands

The EU's emphasis on trying to move more passengers to rail has been at the expense of freight travelling by rail. A greater focus on moving freight off the roads and onto rail would be a "quick win" for the EU yet it is not a policy priority. For example, while a little more than 30% of U.S. freight goes by road and more than 42% goes by rail, nearly 47% of European freight goes on the road and just 10% goes by rail[129]. Moreover, rail's share of freight movement is declining in Europe, but increasing in the United States *(see Figure 7).*



Rail's poor performance at carrying freight in Europe suggests that spending €70 billion a year on passenger rail might get a small percentage of cars off the road – but one possible consequence is to greatly increase the number of trucks on the road, therefore increasing congestion.[130]

A true complementarity approach that would decrease congestion across Europe and have environmental benefits would be to improve the existing infrastructure in order to transport more freight by rail.[Ibid]

Chapter 5: The regulatory and political approach to air and rail transport

Despite the competitive and complementary nature of the two modes, the regulatory and political approach to air transport and high speed rail has been significantly different over the last 10 years.

In many cases, it could be argued that there appears to have been a clear bias amongst policy makers towards high speed rail. Much of that bias has been driven by a series of misconceptions on the environmental, economic and competitive performance of air against rail that this study has tried to explore and correct.

Nonetheless, to illustrate the bias that seems to have existed it is worth highlighting some recent examples of where policy makers have favoured high speed rail against air transport.

European tax-payer money earmarked for transport development has overwhelmingly been given to rail projects

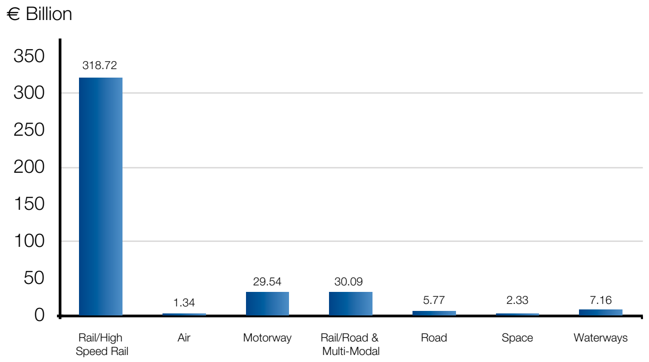
The Maastricht Treaty in 1992 gave the Community the powers and instruments to establish and develop the Trans-European Transport Networks (TEN-T) in order to contribute to the smooth functioning of the internal market and the strengthening of economic, social and territorial cohesion. The TEN-T policies promote the interconnection and the interoperability of national networks and support projects of common European interest.

The funding of TEN-T projects[131] draws mostly from the national budgets of Member States (€196 billion in the period 2007-2013) while the EU contribution is provided through the TEN-T budget (€8 billion) and the Cohesion and Structural Funds (€43 billion). Loans and guarantees from the European Investment Bank reach a value of €65 billion[132].

By 2010 only 5 out of 30 projects had been completed. The total updated cost of these projects is projected at €394.83 billion and, by the end of 2009, around €164 billion had been invested and €79.82 billion is projected for the period 2010-2013[133].

Out of the 30 priority plans, 19 are rail projects, 3 are mixed rail-road projects, 2 are inland waterway transport projects[134] and just one is specifically dedicated to air transport. This allocation shows how aviation and airport infrastructures are massively undervalued *(see Figure 8)*.

Total projected cost of 30 TEN-T Priority projects by mode (*Figure 8*)



As traffic volumes are higher on national than on cross-border sections, States tend to give priority to national transport which links up centres of national interest. The risk is that the TEN-T network remains a badly connected agglomeration of 27 national network plans[135]. Moreover discrepancies among Member States remain strong and are even increasing in the high-speed rail sector, as this represents a transport mode that has developed since 2004 mainly in France, Italy, Germany, Benelux, Spain and the United Kingdom[136].

Governments urgently need to devote more European funding to developing infrastructure to support a growing and essential air transport industry

Air traffic growth will be affected by the available capacity at airports. Traffic is expected to increase on average by 1.6% to 3.9% per year overall and, according to a EUROCONTROL forecast, around 2 million flights will not be accommodated by 2030, approximately 10% of demand[137].

With this clear constraint, the TEN-T priority projects should include aviation as a key recipient of EU funding. In particular, the Single European Sky initiative, the SESAR project (it is currently the only wholly trans-European transport project), and projects aimed at improving accessibility to airports. Without this investment, airports and air traffic management will be affected by capacity constraints and this situation needs to be overcome. It should be borne in mind that Europe's airports provide a network of over 150,000 city pairs, while Europe's HSR provides a network of about 100 city pairs[138]. Only 40 new city pairs are expected to be connected by new or improved HSR links by 2030.

Based on these projections, passengers opting for rail will reduce the demand for flights by only about 0.5%[139].

As outlined in Chapter 3, the "smart" means of investing in future European transport is through air.

Passengers are even discriminated against depending on the mode that they choose

As far as EU legislation on passenger rights is concerned[140], discrimination occurs among different modes and with the rights granted to passengers[141]. These regulatory discrepancies are causing unfair competition between air and rail due to additional and unjustified burdens on the airline industry. No case can be made for perpetuation of these distortions which should be speedily corrected by EC action.

Air passengers already enjoy the best protection out of all transport modes with, for example, unlimited obligations on airlines to provide care and assistance to passengers for events beyond the airlines' control (eg. airspace closure due to volcanic ash, or snow disruption at airports) and to financially compensate passengers under certain circumstances.

Examples of the discrepancies which exist include, for example, the right granted to Member States to exclude urban, suburban and regional rail services indefinitely (and domestic inter-city services for up to 15 years) from European rail passenger rights legislation. No such alleviation exists for air passengers.

In the case of rail, obligations for financial compensation are exempted when circumstances are "not connected with the operation of the railway" and if the passenger chooses a refund. For airlines, the regime is more demanding and exemptions are rigidly regulated according to the advance timeframe (number of days) of cancellation or delay of flight. Moreover, a recent case law[142] from the European Court of Justice has further extended the obligation of financial compensation to delays of more than 3 hours.

Other discrepancies are quite visible in the levels of compensation payable depending on the mode chosen by the consumer: €125-€600 for airlines (depending on the amount of delay and distance travelled) and just 25%-50% of ticket price for rail operators. For rail, delays occurring outside the EU are not taken into account in calculating length of delay and compensation; a similar exception is not envisaged for air.

High speed rail remains as much of a target for terrorist activity as air, yet the security standards applied differ hugely

Ensuring the highest possible level of security has always been a priority for the airline business. With the threat of terrorist action always present, the cost and complexity to airlines grows annually. According to ACI Europe[143] in a 2010 report, complex security procedures are draining European airport budgets and adding to the "hassle factor" of airline travel. Security now accounts for 35% of airport operating costs (before 9/11 terrorist attacks the value was 5-8%) and, on average, over 40% of the entire airport staff is security-related.

Events have shown that air transport and high speed rail are each significant terrorist targets. Competition among transport modes is negatively affected by the fact that the air transport industry is bearing the huge costs of security, despite the fact that the ultimate target of any terrorist attack is the Nation, its society and its government. Conversely, policing and security for rail is generally borne by the taxpayer.

Until recently, most rail security within Europe focused on preventing criminal rather than terrorist threats and no significant attempts were made to coordinate a framework of measures to prevent terrorism on rail services[144]. This security gap is not consistent with the tragic terrorist attacks and train bombings that hit Madrid on 11 March 2004 and London on 7 July 2005. Other terrorist attacks have taken place in Paris, where a gas bottle explosion in the Saint-Michel station of the regional train network (RER) killed 8 people and injured 160 on 25 July 1995. About 16 months later a bomb exploded in a carriage of the same Paris regional train network at Port Royal station. It is no surprise then to learn that Al Quaeda was considering a terrorist attack on the US railway system to mark the tenth anniversary of the 9/11 attacks, according to intelligence seized at the Pakistani compound where Osama bin Laden was killed[145].

Rail networks across Europe are largely or wholly open access systems with the exception of Eurostar services, where the process for passenger boarding and luggage screening at terminals is comparable to aviation security standards. The real issue is not to question the strategic security choices of each European State. However, past terrorist actions show that railways and metro lines across Europe, with some 500 billion passengers per km travelled each year[146], may be a valid target as much as air transport. The unbalanced approach on security, and in particular its funding, among different transport modes is therefore another example of the unequal treatment of air and rail.

It is essential that the regulatory and political bias against air transport is corrected in future policy making

This chapter has examined only three issues, European funding, passenger rights and security yet it has shown three clear examples where differing standards are applied to rail and air. These differences in standards have been applied despite the modes being competitors. On the face of it, there is limited justification for these different approaches other than a political bias towards rail driven by misperceptions regarding its environmental and economic performance.

If the previous chapters in this study have attempted to correct these views, then the time must be right for a change in approach by policy makers to promote air and rail equally as important contributors to European mobility.

Conclusions

This study has shown that competition between air and High Speed Rail (HSR) is a key strategic issue for European transport and the future of regional aviation in Europe. Current and past policies demonstrate that European regulatory and political institutions, including the European Commission (EC), are predisposed to favour the development of High Speed Rail whilst simultaneously applying regulatory burdens and taxes on air transport that are not applied to rail.

In many European policy documents (including the recent EC White Paper on the future of transport in Europe) it is regularly stated that substitution of regional aviation by HSR would be a way to solve Europe's congestion and environmental problems caused by aviation: such policy is rarely, if ever, supported by objective business-case analyses. Furthermore, this study demonstrates that such policy will not achieve the declared objectives.

The role of regional aviation and HSR has been comprehensively examined and the study addresses five main sections:

1 the current air and rail network

2 the actual environmental impact of HSR

3 the return on investment for HSR compared to the economic performance of aviation

4 the issue of air and rail competition and substitution

5 the regulatory and political bias against aviation in favour of HSR.

The main findings of the study are:

- the EC policy of mode substitution from air to rail has proved unsuccessful: this is acknowledged in the 2011 White Paper on Transport.

- air transport pays its own way and is a major tax generator for governments, while rail is massively and continuously subsidised. The average amount of subsidies to the rail sector in 2007-2009 was almost 125 times higher than the amount of State aid granted to air transport.

- the on-going granting of massive subsidies to rail unfairly distorts the market between air transport and rail.

- aviation is a fundamental asset for European mobility and is often the only means of transport available in the highly densely populated but outlying areas of Europe. However, air transport's importance to the EU economy is not adequately reflected in EU policies.

- the number of aviation-related enterprises is 5.6 times higher than the number of rail companies, while the turnover of the EU-27 air transport market is almost twice that of the railways.

• HSR is not a viable and realistic alternative solution to air as massive investment in HSR will never bring about significant modal shift. Evidence shows that expanding the HSR network to link all major city-pairs of less than 500 km currently connected by at least 10 flights a day would lead to a reduction of just 4.2%-4.9% in demand for flights by 2030. Achieving such an expansion of the rail network would mean a 600% increase in the HSR network compared to current expansion plans. It is not a sustainable option for government budgets.

• the 'greenness' of HSR is clearly unfounded when assessed from a full 'life cycle' perspective. To date, the only comparisons have been on emissions 'at the point of use' which clearly distort the results. The study's environmental analysis looks at the full 'life cycle' including electricity generation from nuclear power, land use, noise impacts, emissions from power plants providing energy to HSR, the impact of vehicle manufacturing and maintenance, the energy inputs and emission outputs for vehicles, raw material extraction, infrastructure construction, fuel production components as well as end of life treatment of vehicles. The study shows that for various HSR routes the CO, NOx, VOC and PM_{10} emissions from rail would be 150%, 50%, 500% and 150% higher than an equivalent air route.

"It is time for government and policy makers to objectively debate the merits of air and rail, based on fact not preconception."

• HSR requires massive investment at a time when policy makers and governments are looking for more cost-effective returns. Historically, social, financial and economic returns on investment in HSR have been negative (and sometimes disastrous) for taxpayers. HSR does bring positive benefits under some strict and rare conditions, ie when connecting very highly populated areas that are poorly served by air. In terms of returns on investments, some case studies have been examined. As a typical example, the planned Turin-Lyon HSR link will, despite using very favourable assumptions for HSR investment, ultimately result in approximate losses of €19 billion over the life of the project.

• rail and air can exist alongside each other and offer more choice and convenience to consumers as long as their complementarity is based on fair competition eg. TGVAir in France and AIRail in Germany, and on freedom of consumer choice.

• improving the attractiveness of intermodality requires considerable improvements with regards to price, journey time, schedule coordination, seamless security checks, compatibility of IT infrastructure and booking systems, air/rail coordination in case of missed connections, passenger rights, frequencies of trains for efficient and short connecting times between both air and rail modes.

• there has been a clear discriminatory approach against air and in favour of rail in many different policy and funding areas. For example, out of the 30 TEN-T EU priority projects for EU funding, 19 are related to rail and just one to air; unjustified differentiation in Air/Rail passenger rights; unbalanced security standards and funding of security costs.

The cost effective delivery of transport services will become more common, adding pressure to seek 'smart' investment solutions for transport and to avoid financially and socially disastrous 'white elephant' projects, as many of the European HSR initiatives have become.

In an age of reducing public budgets where transport planners and policy makers have to make difficult and important choices, this study aims to set the record straight and it is time for government and policy makers to objectively debate the merits of air and rail, based on fact and not preconception, for the long term benefit of Europe's citizens and their mobility.

Annex 1:
Case study – HSR line connecting Turin to Lyon:

- Works for the cross border section of the HSR line to start in 2013.
- 50 km-long tunnel section.
- Estimated Cost: €16 billion.
- Fundamental shortcomings of the project: no published factual and ex ante cost-benefit appraisal justifying its economic, social and environmental returns[147].
- **Current** yearly highway **traffic** between Lyon and Turin: 2.5 million passengers and 37 million tons of goods through the Fréjus and Mont-Cenis tunnels. After dynamic demand projections for the next decades, the question is: what will HSR traffic figures be for the 40-50 years following the opening of the Lyon-Turin rail tunnel and is the huge investment justified?
- The **initial assumptions** are very favourable towards the HSR project:
  - passengers: the tunnel will capture 50% of current highway traffic with an additional 30% demand;
  - goods: 25% of current freight traffic will be diverted from road and 10% will be newly generated[148];
  - Overall traffic in the next 25 years is expected to grow at 2% per annum, although passenger and freight traffic in the corridor has not increased in the last decade.
- The **result** of these assumptions would be a decrease of 962 million cars per km and 343 million lorries per km in the first year of opening.
- On the **costs** side, it is not clear whether the cost for rolling stocks (which represents 30% of total investment) is included in the €16 billion figure. In a very optimistic view, the assumption is that the value will not increase all along the project duration.
  - The investment will be borne by public finances at European, national and regional level.
  - The so-called opportunity cost[149] of public funds adds some 30% to the total cost, which now stands at €20.8 billion.
  - The expected duration of construction of the Lyon-Turin tunnel is 5 years and no delays are envisaged (again a very favourable starting hypothesis).
  - The time saving for passengers is 2 hours and can be valued at €14 per hour.
  - It has been assumed that operating costs will be fully recovered by fares from the first year of operations[150], which is another favourable assumption for the project. Furthermore, the loss of income resulting from reduced revenue from highway tolls faced by the existing companies that manage the Mont-Blanc and the Fréjus tunnels has been ignored.
  - Public finances will be negatively affected by the new HSR tunnel due to 1300 million cars per kilometre being diverted to rail: the average decrease in fuel tax revenues in the first year is estimated to be worth €84 million.
  - Reduction of external costs in the first year is estimated at: €3.1 million from reduced air pollution, €12.9 million from reduced GHG emissions and €5.7 million from a decrease in road accidents. Congestion benefits have not been considered as relevant in these estimates as the two current highway tunnels are sufficient to meet the traffic demand and future growth expectations.

The **overall conclusion** is that the tunnel does provide real benefits but they are very limited and negligible: spread over the 50-year life of the project, they amount to: €1.7 billion in consumer surplus and €0.6 billion from reduction in external costs. On the other hand, **the negative impacts appear much higher**: €1.2 billion reduction in highways operator revenues and €2 billion loss of fuel-related taxes.
After adding the overall investment costs of the Lyon-Turin tunnel, the **socio-economic costs during the entire duration of the project will always be higher than the benefits.** The investment will ultimately result in €19.35 billion losses. Even taking into account the most optimistic assumptions[151], the conclusion across all scenarios is that, throughout the entire HSR life, even if the investment was for free (which is an absurd hypothesis) the economic costs would far outweigh the advantages.

Annex 2: Case study – HSR connecting Tours to Bordeaux

The French HSR (TGV) is often presented as an example of efficiency and national pride. Nevertheless, in a cross comparison analysis of the TGV experience, it was estimated that:

- on average the amount of public subsidies needed to make the relatively cheap and densely-used Tours-Bordeaux line a reality was 50% of total investment costs, and this is expected to reach 60% and 70% for the majority of future projects[152];
- total access charges that the SNCF operator is supposed to pay for cost recovery is estimated at €3.1 billion for the 1,900 km long HSR network in France. It is therefore interesting to observe that the very same value is currently required in access charges for the entire 30,000 km rail network: the burden on taxpayers is thus very relevant. Only outstanding social and economic returns could be a valid justification for public investments in HSR;
- taking the example of the Tours-Bordeaux route (340 km), social gains for the increased number of passengers travelling between the two regions are mainly time savings (€100 million per year) and CO_2 reductions resulting from the modal shift from air (€2.61 million per year)[153]. For a public investment cost (= subsidy) of €4 billion, social yearly returns are €100 million. However this assumed no regression[154] in passenger demand and the main beneficiaries of the above gains are high level executives and wealthier minorities of the population[155].

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- Capacity limitations were made illegal except in cases of congestion or environmental problems.
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european regions airline association

The Baker Suite, Fairoaks Airport, Chobham, Woking, Surrey, GU24 8HX, UK
Telephone: +44 (0)1276 856495 Fax: +44 (0)1276 857038 E-mail: info@eraa.org Website: www.eraa.org