

CONGESTION: A GLOBAL CHALLENGE

The Extent of and Outlook for Congestion in Inland, Maritime and Air Transport

*Briefing note - Session 1**

KEY ISSUES

The cost of congestion

- *Congestion is a serious economic and political problem. It is worst in and around cities but also afflicts many airports, ports and railways. Land access to international gateways is a particular concern. Time losses for individuals and businesses amount to many billions of dollars, equivalent in the more congested countries to in the order of 1% of GDP.*

The outlook

- *Air traffic and maritime container traffic are expected to more than double in the next 20 years. The resulting onward terrestrial transport will intensify the pressure on road and rail systems. Car ownership and use continues to grow everywhere. In many places capacity is not expanding in pace with demand. The trend is towards more congestion and, without effective policy intervention, much worse congestion. That would undermine quality of life and threaten to arrest the trends in trade that have helped drive economic growth in the last decade.*

THE EXTENT OF CONGESTION

The basic pattern of congestion for many countries can be summarized as follows:

- chronic congestion on roads in cities and on trunk roads near conurbations;
- chronic congestion on a limited number of other strategic roads;
- strained road and rail freight capacity serving ports;
- recurrent congestion in hub airports;
- recurrent congestion in some ports.

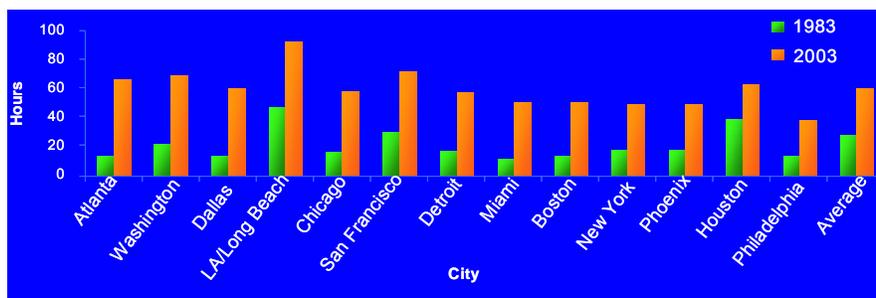
* See Reference document CEMT/ITF(2007)6.

Roads

Congestion is worst on the roads. The proportion of the road network affected, and the intensity and duration of congestion, varies by country. Road congestion is particularly widespread in densely populated regions. In Europe this includes much of England, the German Ruhr-Frankfurt-Stuttgart corridor extending to Zurich and reaching into the Netherlands and Belgium, and also the Milan-Bologna-Padua triangle in Italy. High levels of congestion are encountered on large parts of the urban coastal belt of Japan between Tokyo and Kobe. The problem can be particularly bad in mountainous and other areas of difficult topography that have to absorb high levels of traffic. The US has some of the world’s highest levels of congestion around its car-dependent major cities, and especially Los Angeles. Congestion has grown fastest where infrastructure investment has fallen significantly below traffic growth in rapidly expanding economies, for example in Ireland where congestion in Dublin has now spread across a large part of the country. It has grown most of all in cities where car ownership has risen rapidly – in Eastern Europe and the cities of Latin America and Asia – particularly where demand management measures have been absent.

Congestion has grown in many countries in recent decades. This is not the pattern everywhere but the figures for major US cities illustrate how rapidly congestion can grow when traffic increases faster than road capacity.

Trends in Road Congestion in Very Large US Metropolitan Areas
Annual Hours Lost to Congestion per Peak Hour Driver, 1983-2003

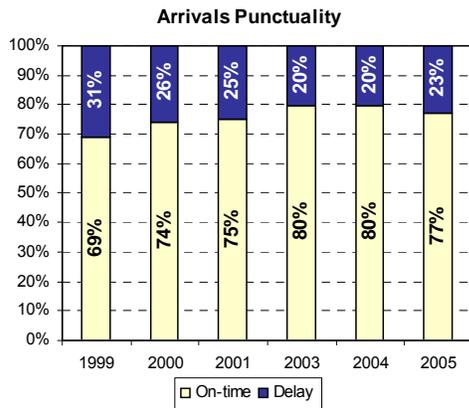


Source Texas Transportation Institute.

Aviation

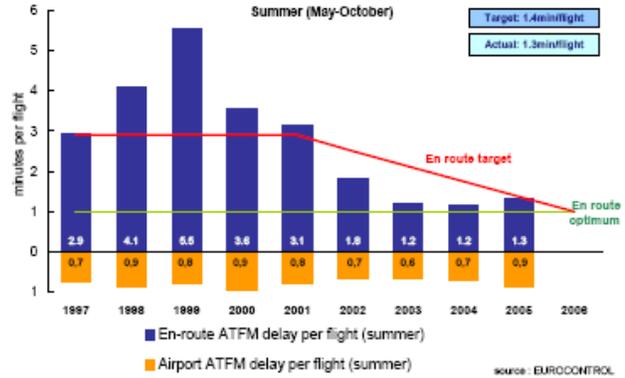
Between 18 and 25 percent of planes depart and arrive late in US and European airports. In Europe there has been a marked improvement in recent years as a result of rationalisation of the air traffic control system. Air traffic control delays now account for only a small part of overall delays. Most of the congestion in the system arises in the airports and is the result of the interaction between air carriers and airport managers rather than the volume of traffic to be managed by air traffic control. Nevertheless air space is congested around the airports in New York, Chicago and Miami. Little data exists on scarcity costs (see below) arising from airlines failing to obtain slots at busy airports.

Passenger Plane Punctuality in Europe



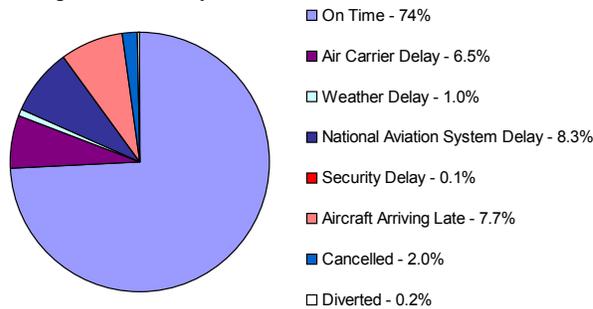
On time = less than 15 minutes delay.
Source: AEA, 2006.

Air traffic flow management (ATFM) delays in Europe

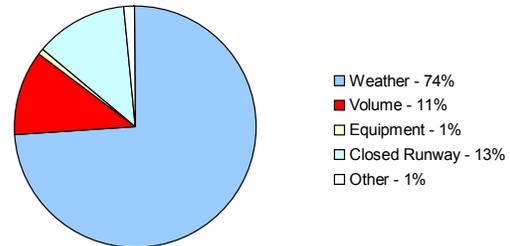


ATFM attributed delays account for 25% of total delays.
Source: Eurocontrol 2005.

USA On-Time Arrival Performance August 2006-January 2007



Causes of US National Aviation System Delays August 2006 to January 2007

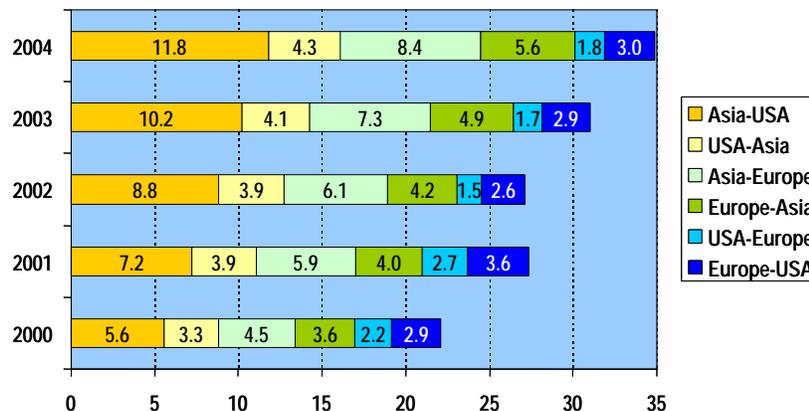


Ports

The situation is most critical on the US west coast, where port expansion is most tightly constrained. Port congestion cost estimates are much lower than for roads or airports but are vulnerable to worsening rapidly because of continued strong growth in traffic coupled with very long lead times for green-field port capacity expansions. City ports are particularly vulnerable to road and rail congestion in their hinterlands and this is where the most intractable problems are usually found, rather than at the port itself. Much has been done to increase throughput in existing terminals in some ports through longer opening hours, week-end operation, automation of container sorting, scheduling truck pick-ups and charging for pick-ups in peak hours. Many more ports could adopt similar measures but those that have led the efficiency drive, such as Los Angeles/Long Beach, are now operating close to capacity limits.

The acceleration of the shift in production of manufactured goods to China over the last five years severely tested the capacity of these ports. Container traffic between Asia and the US west coast grew around 12% in 2004 and in 2005. In China itself capacity has been expanded rapidly, sufficient to match trade volumes.

Containerized Cargo Flows along Major Trade Routes, 2000-2004
(in millions of TEUs)

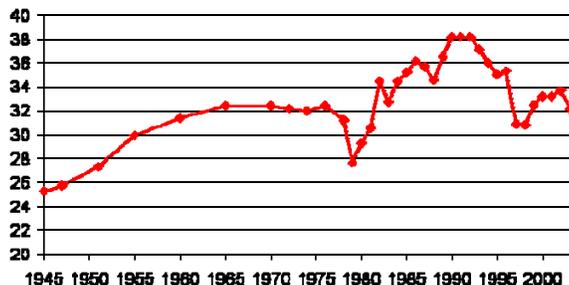


Source: Rodrigues, Hofstra University, 2005

Rail

Among the major rail networks only Russia has spare capacity. Congestion is a chronic problem in China and is an impediment to growth. Chinese railways have not expanded in step with demand, unlike the country’s ports, roads and airports. Declining end-to-end speeds suggest the US rail system has also reached its capacity limits. This is critical to the economy as rail carries 50% of all surface freight ton-kilometres. In Western Europe the figure is only 15% so rail congestion, although exacerbated by the interaction with passenger services that generally take priority over freight, is less significant in total, and an order of magnitude lower than for roads.

Average U.S. freight train speed (km/hr)



MEASURING CONGESTION

Congestion is difficult to quantify. For roads it is usually measured on the basis of time lost in delays, in relation to free-flow, for drivers and their passengers. For business travel and freight transport, wage rates are the basis for valuing lost time. For commuting and leisure travel a variety of approaches exist for valuing time spent in congestion.

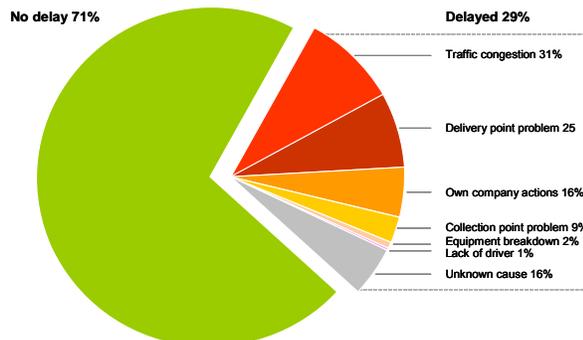
Most estimates of the cost of congestion ignore its effect on the reliability of travel time, measuring only the increase in average journey time. But unpredictability has the more disruptive impact. The UK Department of Transport included reliability in modeling the

impacts of road pricing and found that, compared to time savings, improved reliability added 25% to the welfare benefits achieved¹.

For freight transport some cost estimates cover the additional capital equipment tied up in delivering goods at lower average speeds. Very few studies attempt to quantify the cost of extra inventory that businesses have to carry and the extra depots they need operate to cope with slower and less predictable delivery times. The importance of these secondary effects varies greatly from business to business. The few empirical studies find high values attached to express package services but much lower values for even relatively high cost goods, and trivial values for bulk transport. Whether the omission of these secondary effects results in significant underestimation of the cost of congestion is not clear. The UK road pricing assessment included these wider economic impacts and found that they added 7% to the welfare benefits achieved.

Congestion on public roads is often less of a problem than congestion within the warehouses and loading facilities of the businesses themselves. A survey of food delivery in the UK found that only 9% of all trips were delayed by congestion. Most delays were attributable to business process breakdowns and inefficiencies. Congestion delays tend to get lost in the “noise” of logistical inefficiencies.

Causes of Delay, UK Food Delivery



Scarcity costs

For scheduled modes of transport – railways and aviation – in addition to congestion on the services operated, scarcity costs arise when train operators and air carriers are denied slots because capacity is fully occupied. Scarcity costs can potentially be much larger than congestion costs (because airport and rail network managers will exclude services once track and runways approach full utilization). Very little data on scarcity costs on the railways is available. More conclusive results have been produced for aviation by estimating the consumer surplus foregone (the net benefits potential travelers would have enjoyed if extra flights could have been operated) when airport capacity fails to match growth in demand.

Congestion targets

As already noted, road congestion is generally measured against free flow conditions. Whilst this has the virtue of simplicity it should not be taken to imply that the policy objective is always to eliminate congestion. Building road capacity to accommodate free flow at all times, including the rush hour, would be a wasteful use of resources and impossible in some of the places congestion is worst. The target is instead to reduce

1. *Transport Demand to 2025 and the Economic Case for Road Pricing and Investment*, supporting analysis for the *Eddington Transport Study*, UK Department for Transport 2006.

congestion to the point where the cost of achieving further reduction begins to exceed the benefits that result. Eurocontrol has taken this approach to setting targets for air traffic control (see figure above) and the UK national transport model has been used to assess road congestion in this way (see Outlook section below).

Operational targets can be also be set in other ways. For example the current UK target for mitigating congestion on strategic roads is improved journey time reliability measured by looking at the 10% worst daytime journeys on each road. The average delay associated with the worst 10% of journeys in 2004/5 was 3.5 minutes per 10 vehicle miles compared to free flow (this corresponds to a 35% reduction in speed on motorways where the speed limit is 60mph for HGVs). The target will be met if the worst 10% of journeys for each road and each time of day are quicker in 2007/8 than they were in 2004/5.

THE COST OF CONGESTION

Drivers are frustrated by hours lost in traffic jams – nearly 4 billion hours a year in the USA alone – eating into both work and family time. Business sees congestion as a threat to competitiveness. In the world's biggest economy, the government estimates the overall cost of congestion on roads, railways, ports, airports and airspace at around \$200 billion a year². Congestion wastes time, fuel and money, exacerbates the health and environmental costs of traffic and is the most prominent complaint of the traveling public.

These average figures – that equate for example to 5 minutes spent in congestion per road user a day in the USA or \$2 per person per day – do not tell the whole story because congestion is highly concentrated by location and time of day. The average for Los Angeles is three times the national average, and the worst affected LA road users will suffer much higher exposure to delay again. What matters most is the congestion suffered in the worst affected areas and corridors. Transport for London estimated the cost of congestion to be around \$15 a day per vehicle when it introduced a congestion charge for entering the City. This corresponds to between \$4000 and \$5000 a year per peak driver – well above the average for the whole city of Los Angeles cited in the accompanying table.

Cost of Road Congestion in Time and Fuel in Largest US Cities

Metro Area	Total Cost (\$ millions)	Cost per Peak Traveler (\$)
Los Angeles	10 686	1 598
San Francisco	2 604	1 224
Washington DC	2 465	1 169
Atlanta	1 754	1 127
Houston	2 283	1 061
Dallas	2 545	1 012
Chicago	4 275	976
Detroit	2 019	955
Miami	2 485	869
Boston	1 692	853
Phoenix	1 295	831
New York	6 780	824
Philadelphia	1 885	641

Texas Transportation Institute, 2006 Urban Mobility Trends

2. *National Strategy to Reduce Congestion on America's Transportation Network*, Department of Transportation, Washington May 2006.

ECMT research estimates,³ on the basis of 2000 data for the three biggest economies in Europe (Germany, France and the UK), that by reforming prices for inland transport and even without expanding infrastructure, net gains for society of 30 billion Euros could be achieved through improved efficiency. The changes in prices modeled would yield 100 billion Euros of additional revenues that could be used to cut taxes or invest in infrastructure inside the transport sector or elsewhere in the economy. The largest part of the economic gains would come from reducing congestion to optimal levels on the roads (with the rest related to improved environmental performance and better use of rail and public transport). The foregone revenues give a broad indication of the cost of not addressing congestion in these countries.

The UK's national transport model has been used to estimate the costs of road congestion to business and freight traffic¹ and these were found to be the equivalent of 0.5% of GDP in 2003. Including all road users roughly doubles this cost to 1% of GDP. In the rapidly growing economies of China, India and Brazil there is a potential for congestion costs to increase well above these levels through severe, even if temporary, mismatches between demand to ship goods and infrastructure capacity – this appears currently to be the case in India.

EU research⁴ estimates road congestion costs (including commuting and leisure traffic as well as business and freight traffic) to average 1% of GDP in the Union, with the UK and France at 1.5%, Germany and the Netherlands at 0.9%. The work found congestion costs in rail and aviation to be an order of magnitude smaller than for roads, however, it did not measure scarcity. As noted above, scarcity affects only scheduled modes of transport and though little data exists, scarcity costs can exceed congestion costs.

Eurocontrol estimates the costs of congestion for aviation in Europe to have been 6 billion Euros in 2005 (0.06% of GDP), of which 4 billion arose in airport operations and 2 billion in air traffic management. For air traffic management this is thought to be at the optimal level of congestion. The airport estimates are partial because they cover costs only to air carriers, underestimating costs to passengers themselves. They also ignores scarcity costs for services that fail to obtain slots at crowded airports. The Rand Corporation has investigated scarcity costs at the main US airports⁵. By comparing demand forecasts with airport capacity expansion plans and airport management improvement potential it foresees \$30 billion of lost consumer surplus a year by 2025 as a result of flights that can not be accommodated but which would have found paying passengers. This ignores any scarcity cost in current operations and the figure would rise to \$65 billion if planned runway additions were to be delayed beyond 2025.

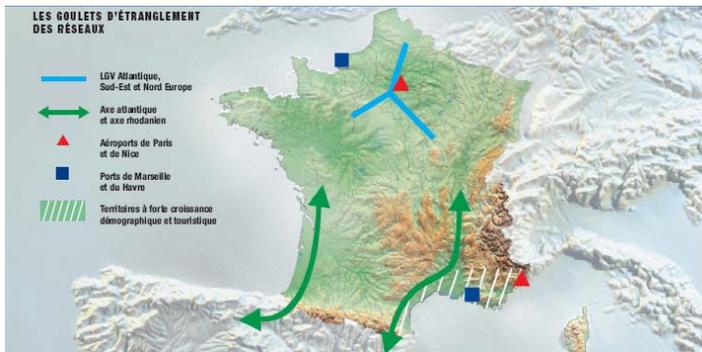
3. See *Reforming Transport Taxes*, ECMT 2003.

4. UNITE project of the Framework Research Programme of the European Commission <http://www.its.leeds.ac.uk/projects/unite/> .

5. Air Traffic Quarterly Volume 10 (3) 2002.

OUTLOOK FOR CONGESTION

France has recently assessed the extent of congestion nationally across all modes, as part of its transport outlook to 2050. The pattern of congestion foreseen is an extension of the existing road bottlenecks, saturation of high speed rail capacity around the capital and congestion emerging in the main ports and in the country's largest airport that almost uniquely among major hubs currently has significant spare runway and terminal capacity. Congestion is also expected to affect Nice airport in the part of the country with the fastest growing population.



Bottlenecks in the French Network

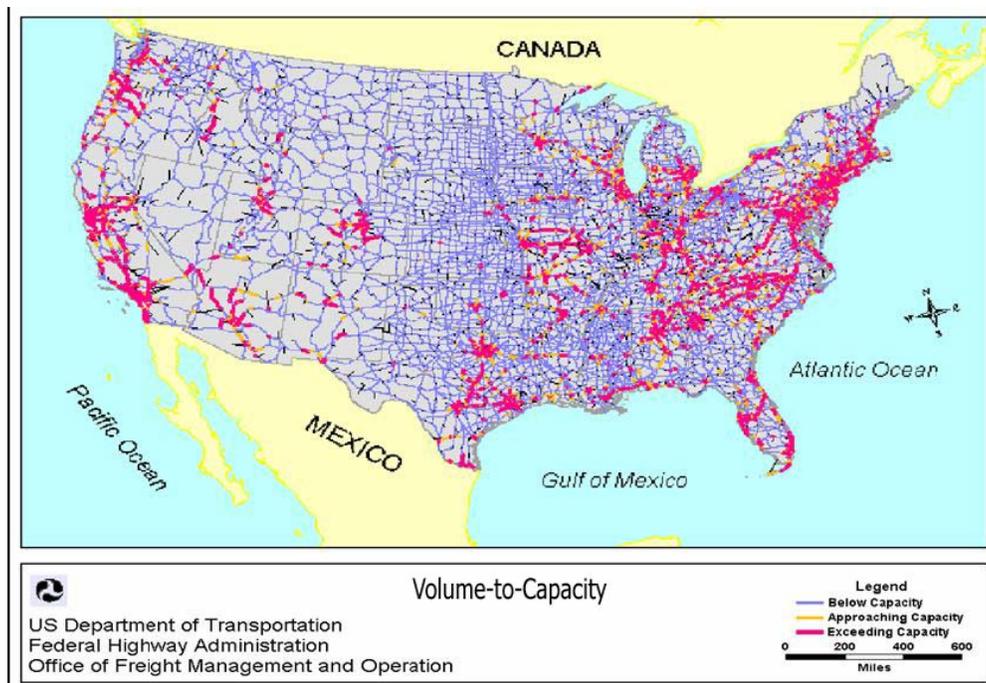
- high speed rail
- ↔ road axes
- ▲ airports
- ports
- ▨ areas of strong population and tourism growth

CGPC 2006.

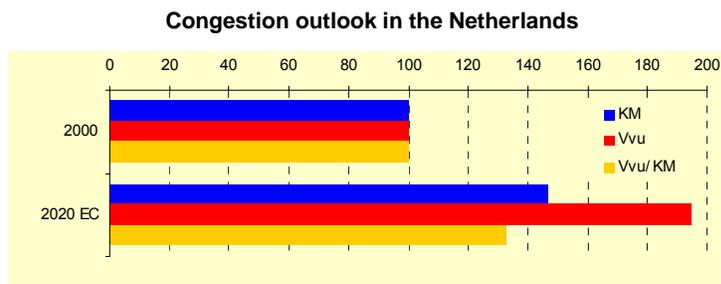
Road outlook

For the USA, the Federal Highway Administration's has examined expected growth in total road traffic to 2020. Superimposing this on today's infrastructure indicates where the greatest pressure from congestion is likely to be felt (see figure) although it takes no account of potential road capacity expansion.

Pressure on US Roads: Projected Traffic Volumes in 2020 Compared to Current Capacity



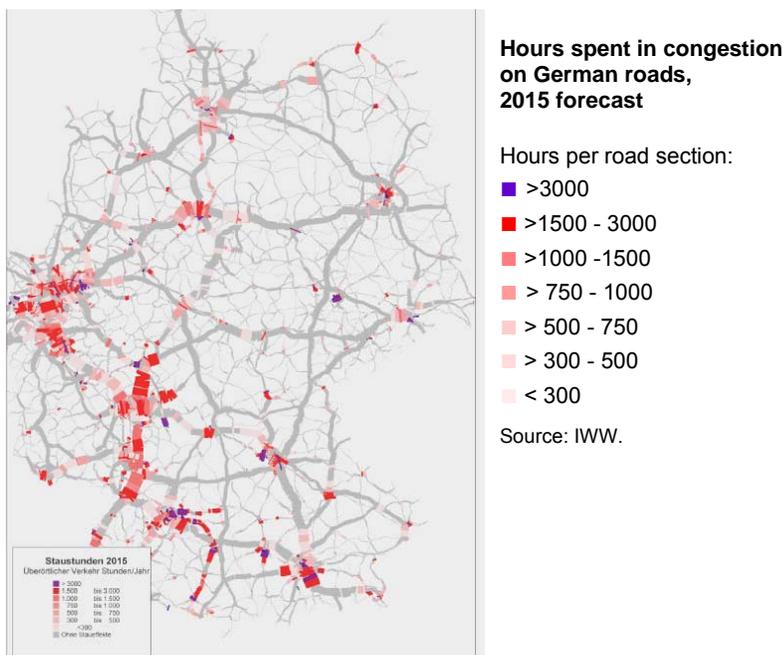
The Dutch government projects an underlying 30% increase in congestion on the country's motorways by 2020, taking into account investment plans but in the absence of any new mitigation measures



VVU= lost vehicle hour; KM = vehicle kilometre on the motorway network.

The UK's National Transport Model has been used to estimate the costs of road congestion to 2025. It foresees the proportion of all road traffic exposed to severe congestion rising from 8% in 2003 to 13% in 2025. The direct cost of congestion to business and freight traffic (in comparison to free flow and omitting reliability impacts) is estimated to rise from £7 to £18 billion (10 to 26 billion Euros) an increase of 16 billion Euros. Including non-business traffic roughly doubles these cost estimates. From modeling the potential impact of national road pricing the research suggests that achieving an optimal level of congestion would involve cutting congestion by half⁶.

For Germany the forecast for congestion on its strategic roads road section on the assumption that the current long term plan for road investment is implemented in full. The situation expected in 2015 is illustrated here and is very similar to that in 2006. Congestion remains concentrated around the big cites and on the Ruhr-Rhine corridor, with little increase in intensity.



6. Road Pricing Feasibility Study, UK Department for Transport, 2004.

Rail outlook

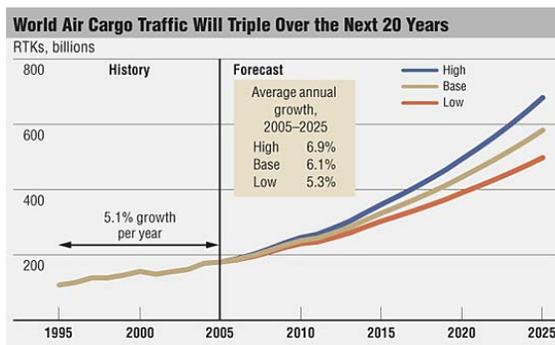
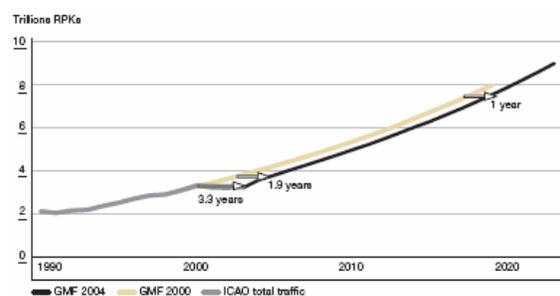
Where rail freight services are provided fully commercially and where governments do not unduly support highway or water competition, the market-driven needs for freight infrastructure and operating investment should be able to be met from resources generated from revenues in the freight sector. However, most governments do support highway competition by failing to charge trucks the marginal costs of road use. The effect of this is to make it impossible to achieve a sufficient financial return on new investment. Until this is corrected congestion can be expected to worsen in the USA and Europe, particularly on lines serving ports. The situation is more critical in China and compounded by the difficulty of attracting investment in an environment of poorly defined property rights. In China and Europe, the priority accorded to subsidised passenger services adds to the difficulty of cutting congestion costs for freight traffic.

Aviation outlook

Demand for air passenger traffic is expected to double over the next 20 years and air freight traffic forecast to triple. Congestion in US airports is currently estimated to cost around 0.07% GDP. Costs could grow to match road costs if scarcity costs are included and the rapid expected growth of air traffic is not matched by expansion of airport capacity. The situation is reported to be similar in the UK. Environmental impacts and long planning processes constrain expansion and this will increase pressure to get more out of existing facilities, through creating incentives for the companies operating at airports to cut delays they impose on each other.

World Air Traffic Outlook

Revenue Earning Passenger Kilometres



Sources: Airbus for passengers, Boeing for freight

Away from airports, improved air-traffic management has been successful in reducing en-route delays over the last decade and generally promises to keep pace with growing air traffic in most parts of the world.

Ports outlook

Ports exemplify the play of forces that will determine the way in which congestion will develop on all modes of transport:

- *Demand.* The outlook for seaborne trade is continued growth, albeit at slightly more moderate rates than in the last decade. World-wide container trade, for example, is expected by most forecasts to grow between 4% and 6% a year over the next 20 years – an overall increase of 150%. Part of this growth reflects the huge adjustment in China's economic output which will eventually run its course and will translate into lower growth towards the end of the period.
- *Infrastructure capacity.* This includes wharf length, crane capacity, storage space and sorting capacity, and the capacity to load and unload land-side transport.
- *The efficiency with which capital equipment is used,* which depends on labour flexibility, operating hours and application of automation and information technology to improve logistics management.
- *Pricing and other demand management policies.* This is extremely useful for managing port gate congestion. For example Southampton container port, which experienced the UK's worst congestion, cut average truck waiting time from 4 hours to 30 minutes by deploying port gate pricing coupled with a pick up reservation management system using mobile phones to make adjustments up to the last minute.

Volumes of containers handled by all the USA's big ports are expected to rise to new record levels this year. Scope for expansion is limited at the biggest ports – Los Angeles and Long Beach – until significant cuts in air pollution from port operations and trucking can be demonstrated. Europe's biggest ports do not yet face these constraints despite equally long consultation periods before expansion plans are approved. Capacity here seems set to keep pace more or less with demand.

North European Ports Forecast

