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POLICY DEPARTMENT
STRUCTURAL AND COHESION POLICIES **B**

Agriculture and Rural Development

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Regional Development

Transport and Tourism

**THE IMPACT OF
OVERTAKING BANS FOR
HEAVY GOODS VEHICLES**

NOTE



DIRECTORATE GENERAL FOR INTERNAL POLICIES
POLICY DEPARTMENT B: STRUCTURAL AND COHESION POLICIES

TRANSPORT AND TOURISM

THE IMPACT OF OVERTAKING BANS FOR HGVs ON TWO-LANE HIGHWAYS, ON TRAFFIC FLOWS AND ROUTES OF TRANSPORT

NOTE

This document was requested by the European Parliament's Committee on Transport and Tourism.

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Abstract

Delays on 2-lane divided highways can be caused by HGVs overtaking each other. This Note presents details of the research carried out and schemes introduced in EU countries to ban HGV overtaking movements. A cost benefit analysis concludes that annual benefits of up to 1500 million euro could be realised by introducing such schemes at optimal locations.

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LIST OF ABBREVIATIONS

AADT Annual Average Daily Traffic

BAST Bundesanstalt für Straßenwesen – German traffic research institute

DfT Department for Transport – government department in the United Kingdom responsible for transport

GDP Gross Domestic Product

HGV Heavy Goods Vehicle

SISTM Simulation of Strategies for Traffic on Motorways – a micro-simulation software package owned by the UK Highways Agency

TRL Transport Research Laboratory

UNECE United Nations Economic Commission for Europe

VMS Variable Message Sign

VoT Value of Time

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EXECUTIVE SUMMARY

A large proportion of the European road network consists of 2-lane divided highways, which are constructed to a high standard and enable higher speeds to be maintained by all vehicle types. A common source of frustration for drivers of cars and other light vehicles is the delay caused by HGVs using the offside lane in order to overtake one another. HGVs travel at lower speeds because of speed limiting devices or uphill gradients and one HGV overtaking another can take a significant amount of time, which can lead to cars behind being delayed. The purpose of this study was to review the research carried out on banning overtaking by HGVs on these roads and to estimate the monetary effect of a rollout of the scheme throughout the European Union.

Many European countries have HGV overtaking bans in place; schemes have been introduced in the UK, the Netherlands, Germany, France, Denmark, Belgium, Austria and Italy. They vary in terms of the length of road covered (from 2.4 km up to 229 km), the HGV weight categories included and the times of operation (some are permanent, most are fixed time, a few are dynamic, i.e. traffic responsive). Dynamic overtaking bans are activated when total traffic flow and HGV proportion both exceed thresholds (2,600 veh/h and 9.6% HGV in the Netherlands and 3,200 veh/h and 25% HGV in Germany). Studies in the Netherlands suggest that dynamic bans are more effective with greater user acceptance. Compliance with all the schemes was considered to be very good, although one scheme reported that compliance was reduced when HGVs represented more than 15% of all traffic. Only a few schemes evaluated the journey time benefits; in the UK journey times for non-HGVs were between 2 and 13 seconds lower, whereas HGV journey time changes ranged from an 8 second decrease to an 8 second increase.

Using the results from existing schemes, it is estimated that an HGV overtaking ban rolled out across the 15 of the EU countries (for which data was available) could produce annualised benefits of up to 1500 million euro. This is based on scaling up the observed benefits to a typical upper limit for each country's road network that could be suitable for overtaking bans.

A modelling exercise has been carried out to evaluate under what conditions (total flow, HGV proportion and gradient) benefits are produced. Increases in overall speed (when averaged for both light and heavy vehicles), were found in most of the situations where there was an uphill section (+2% gradient). On a level motorway and on a downhill section the results were mixed. When averaged over all combinations of gradient and HGV proportion, the overall changes in average speed were a 0.5% reduction with high traffic flow and a 0.3% increase with a medium traffic flow level. Results showed greater sensitivity to gradient and HGV proportion at the higher flow level, but the largest improvements in journey time were recorded with higher flows on uphill gradients and with 25% HGVs.

No study found any significant change in the number of accidents. A European Commission study of a sample of accidents involving HGVs found that overtaking manoeuvres accounted for 11.3% of all HGV accidents. In 53.6% of these cases the HGV was changing lane. Although it might be expected that an HGV overtaking ban would result in a reduction in accidents, the results relate to accidents on all roads, not just 2-lane divided highways. This would be expected to substantially over-estimate the maximum potential effect of an overtaking ban. Furthermore, it is concluded that although the effect of an overtaking ban

could not be measured based on the data available, the maximum influence that it could have on National or European casualty reduction targets is likely to be very small, particularly if only applied at specific congestion spots rather than to the whole network.

There were, however, reported changes in traffic behaviour that could affect accident risk. For example, less frustration for car drivers and more homogenous traffic flow could result in a lower accident risk. On the other hand, HGV drivers may suffer increased frustration when following a slow vehicle and higher speeds in the offside lane could lead to a higher accident risk. There was also some evidence of increased HGV overtaking in the section of road following a ban.

Operational issues are also discussed in the report. Long platoons of HGVs could cause problems for drivers at junctions where traffic has to leave and enter using the nearside lane. There could also be some obscuration of traffic signs and more frequent maintenance of the nearside lane may be needed because of the increased quantity of heavy traffic; this could lead to increased delays to drivers when the road works are being carried out. In the UK concern at traffic behaviour in junctions resulted in the cancellation of one scheme where junctions were 1 km apart, but in the rest of Europe the schemes include intervening junctions although the junctions are further apart than in the UK abandoned scheme.

Overall the conclusion from this study is that HGV overtaking bans have been applied successfully in many European countries with dynamic bans having the greatest acceptance. Further rollout of schemes is likely to bring benefits especially on sections of road with uphill gradients and with junctions spaced at least 3 km apart.

1. INTRODUCTION

The transport of goods and people by road is an essential component of 21st century economies throughout the European Union. Individual countries have developed networks of roads constructed to high standards to expedite movement in a safe and speedy manner. The interaction of Heavy Goods Vehicles (HGVs) with passenger cars and other lighter vehicles presents a potential form of conflict because of their different performance characteristics and physical dimensions.

A large proportion of the national and international road network consists of 2-lane divided highways, commonly referred to as dual carriageways and motorways. These roads are constructed to a high standard; they have limited joining and leaving points, are often equipped with advanced driver information systems and as a result, enable higher speeds to be maintained by all vehicle types. A common source of frustration for drivers of cars and other light vehicles is the delay caused by HGVs using the offside lane, intended for faster moving traffic, in order to overtake one another. HGVs travel at lower speeds, either because of speed limiting devices or uphill gradients. One HGV overtaking another on a 2-lane divided highway can take a significant amount of time and may lead to cars behind being delayed. For example a 12m long HGV travelling at 90 km/h overtaking another at 88 km/h will take 79.2 seconds and 1980 metres to complete the manoeuvre. If the two HGVs are 18.75m long, the manoeuvre will take 103.5 seconds and 2587.5 metres¹.

This Elaborated Note describes the research carried out on banning overtaking by HGVs on 2-lane divided highways. Information on schemes from across the European Union has been obtained and a modelling exercise has been carried out to provide further data that has been used to quantify the benefits/disbenefits if the HGV overtaking ban were rolled out across the EU. The principal means of assessing the success of the schemes have been changes in journey time and safety. However, there are many other variables that need to be assessed when considering a scheme and these are also discussed in this Note. This Note also includes material presented in other recent reviews of HGV overtaking bans (Bereni, 2008 and Neumann *et al*, 2009).

¹Assuming a headway of 10m between the HGVs and that the faster vehicle is already travelling at the higher speed.

2. SCHEMES IN OPERATION

KEY FINDINGS

- Many European countries have HGV overtaking bans in place; they vary in terms of the length of road covered (2.4 km to 229 km), the HGV categories included and the times of operation (some are permanent, most are fixed time, a few are dynamic, i.e. traffic responsive)
- Only a few schemes have evaluated the journey time benefits; in the UK journey times for non-HGVs were between 2 and 13 seconds lower, whereas HGV journey time changes ranged from an 8 second decrease to an 8 second increase
- No study found any significant change in the number of accidents

2.1 United Kingdom

There are two HGV overtaking ban schemes in place in the UK: on the M42 J10-11 northbound and on the A14 in Northamptonshire (both directions). The schemes have many similarities. They are all on uphill gradients and apply over relatively short sections with no intervening junctions. The locations were selected because there were congestion problems associated with HGVs in the offside lane and the construction of a climbing lane at these locations was not economically justified. For both schemes, there was an 18-month trial period during which the effects of the HGV overtaking ban were assessed (Optima, 2007 and Carillion, 2008). At the end of the trial period, the schemes showed an overall benefit and were made permanent.

The schemes were effective in reducing the number of HGVs using the offside lane. Prior to the overtaking ban, 12% of HGVs used the offside lane. This reduced to 4% when the ban was in place. The schemes were assessed in the same way: journey times were measured for HGVs and non-HGVs during the busy morning and afternoon periods and also during the day. There were small reductions in journey times for non-HGVs (between 2 and 13 seconds). The effects on HGV journey times were broadly neutral, varying between a gain of 8 seconds and a loss of 8 seconds, depending on the site. A summary of the results and characteristics of the three UK sites is presented in Table 1.

Table 1: Details of established HGV overtaking bans in UK

SCHEME	LENGTH (km)	HOURS OF OPERATION	HGV WEIGHT	JOURNEY TIME EFFECT (s)		DAILY FLOW (VEHICLES)	HGV PERCENTAGE
				NON-HGV	HGV		
A14 (east)	3.2	06:00 to 20:00	> 7.5 t	-2	+8	22,000	25%
A14 (west)	2.4	06:00 to 20:00	> 7.5 t	-13	-8	22,000	25%
M42 (north)	4.8	07:00 to 19:00	> 7.5 t	-2	-1	29,000	23%

The small number of accidents on the affected road sections meant that it was not possible to detect any significant change in the accident rate because of the introduction of the schemes. On the A14, some drivers could not see nearside signage, due to obscuration from convoys of HGVs. The Police have expressed concerns about slow-moving abnormal loads on the A14 causing long convoys of HGVs.

A further location in the UK (on the A1) was considered for an HGV overtaking ban in 2009. The proposed section contained two junctions about 1 km apart. The Highways Agency and the Police considered that the implications of an HGV overtaking ban at junctions were not well enough understood, and that the risks and uncertainties outweighed the potential journey time savings. Therefore, the scheme did not go ahead.

New schemes have been introduced in the UK (on the A1) in early 2010 following the success of the A14 and M42 bans. These are shown in Table 2.

Table 2: Details of HGV overtaking bans in UK introduced in 2010

SCHEME	LENGTH (km)	HOURS OF OPERATION	HGV WEIGHT	DAILY FLOW (VEHICLES)	HGV PERCENTAGE (approx)
A20 (west)	3.2	Not known	> 7.5 t	13,000	20%
A1(M) (south) – 2 locations	Not known	07:00 to 19:00	> 7.5 t	26,000	20%
M11 (north)	4.0	07:00 to 19:00	> 7.5 t	70,100	20%
M11 (south)	1.5				
A34 (north)	1.6	06:00 to 20:00	> 7.5 t	47,000	20%

2.2 Netherlands

The Netherlands first trialled HGV overtaking bans in 1997 on 185 km of 2 lane dual-carriageway roads (Sétra, 2007). This was extended to 750 km in 1999 and then further extended by 400 km in 2003. Each section was an intermittent, time-based ban during the peaks. This has varied over time, with all bans now in force from 06:00 to 19:00. The static, intermittent bans were implemented to increase road capacity by up to 3% depending on location. It is assumed that it was the success of the initial trials in delivering this increase in capacity that drove the wider implementation of HGV overtaking bans.

Since 2005, trials of a dynamic overtaking ban have been carried out, where the term 'dynamic' means that the ban on HGV overtaking is based on the actual traffic flow and the flow composition rather than being permanent or based on arbitrary time periods. The thresholds are shown in Table 3.

Table 3: Thresholds for HGV dynamic overtaking ban in the Netherlands

	TOTAL FLOW (veh/h)	HGV FLOW (veh/h)	HGV PERCENTAGE
Activation	2600	250	9.6 %
Deactivation	2300	230	10.0 %

Junctions are located at about 3 to 4 km intervals. Evaluation of the dynamic ban (based on the 2 lane dual-carriageway trial above) in comparison to the intermittent ban showed the following:

- The dynamic ban at Limburg was in force for an average of 1.5 hours less per day than the previous intermittent ban.
- The dynamic ban came into force 3-4 times a working day on average, with some weekend operation.
- Compliance was in line with intermittent bans at between 97% – 99%.

- Average speeds rose by 1-2 km/h in the offside lane and fell by the same amount in the nearside lane, but both lanes had a more homogenous flow.
- Accident rates were unaffected by the ban; year on year variations were not statistically significant.

In a user acceptance survey, 90% of HGV and private car users preferred the dynamic ban to the intermittent ban.

It should be noted that while the dynamic ban is potentially more efficient and can foster greater user acceptance, the traffic management infrastructure required to implement such a ban is usually only available where variable speed limits and similar traffic management measures are enforced with gantries and VMS.

2.3 Germany

HGV overtaking bans are currently in place on more than 1,500 km of Autobahn in Germany, mostly in Bavaria and Baden-Württemberg, using a mixture of fixed time bans or permanent bans. Trials of HGV overtaking ban sections were originally carried out on 75km of 2-lane dual carriageways spread over 12 sections (Sétra, 2007).

Work by Drews (1999) attempted to quantify the benefits of implementing HGV overtaking bans with a cost benefit calculation to aid in identifying appropriate sections of Autobahn where HGV bans could be rolled out. This is based on total flows, HGV flows and gradient.

It was found that HGV overtaking bans on uphill sections were highly beneficial because car speeds both increased and became more uniform, while HGV speeds changed little. It was also found to be beneficial (using the cost benefit analysis developed by Drews) on some flat sections and some downhill sections when traffic flows reached 2,000 veh/hr.

Analysis of accident data before and after the implementation of HGV overtaking bans showed no convincing safety benefits or dis-benefits except in specific circumstances such as the number of lanes reducing from 3 to 2 or directly before or after junctions.

In conclusion, the findings from the German trials indicate:

- More “homogenous” traffic flow.
- Increase in passenger car speeds and a relatively small reduction in HGV speeds.
- Good compliance with the ban (figures not stated).
- No marked increase in accidents in sections upstream and downstream of the ban.

Nationally, there is no overall view on the implementation of scheme and it has been left to individual Länder to decide. However, research work carried out for the German Research Institute (BAST) has recommended default thresholds for dynamic overtaking bans. These are shown in Table 4 (values also exist for 3- and 4-lane motorways).

Table 4: Thresholds for HGV dynamic overtaking ban in Germany

	TOTAL FLOW (veh/h)	HGV FLOW (veh/h)	HGV PERCENTAGE
Activation	3200	800	25 %
Deactivation	2900	435	15 %

2.4 France

Three sites have been evaluated (Bereni, 2008). Trials started in 1997 on the A4 autoroute and the results (De Gonneville, 2001) showed that speeds increased between 10 and 15 km/h in both nearside and offside lanes following the introduction of the ban. Compliance was good, but it was lower when the proportion of HGVs increased to more than 15% of all traffic. On the Route Nationale 83, which has had an HGV overtaking ban since 2001, the measure is considered to have had positive impacts though it has been reported there is excess speeding in the offside lane and there have been dangers with platoons of HGVs in the nearside lane. No overall increase in average speed was recorded. At the third site, on the route from Poitiers to the Spanish border (12 sections in total), trials started in 2003 and the evaluation also found that platoons of HGVs could cause problems. A general reduction in average speeds of HGVs was balanced by a slight increase (0.4%) for passenger cars. Other points noted in the study were that there were increases in the proportion of vehicles (both cars and HGVs) with unsafe headways.

A summary of the operational aspects of the three French sites is presented in Table 5.

In January 2010 a new section of autoroute had an overtaking ban applied. This was for the 20 km section of A25 between Bailleul and Englos and applied to HGVs of more than 3.5 tonnes in both directions. The main reason given for the ban was to improve safety and reduce congestion. 2-way Annual Average Daily Traffic (AADT) flows on this section range from 52,000 to 83,000, approximately 12% of which are HGVs.

Table 5: Details of HGV overtaking bans in France

SCHEME	LENGTH (km)	HOURS OF OPERATION	HGV WEIGHT	JOURNEY TIME EFFECT		DAILY FLOW (VEHICLES)	HGV PERCENTAGE
				NON-HGV	HGV		
A4	7	07:00 to 19:00	> 3.5 t	Overall neutral effect		25,000	13%
RN83	20	permanent	> 19.0 t	Overall neutral effect		22,000	14%
Poitiers – Spanish border	150	06:00 to 22:00	> 12.0 t	Favourable	Unfavour- able	12,500	32%

2.5 Denmark

The Danish road directorate currently employ HGV overtaking bans on 229 km of their road network based on a trial of more than 100 km which was evaluated in 2004 (Ágústsson, 2004). The bans cover vehicles in excess of 3.5 tonnes, buses, vehicles with trailers and caravans and are applicable from 06:00 to 18:00 each day in most sections, with 06:00 to 22:00 or permanent bans at some locations. Junctions are approximately every 5 km.

The initial trial consisted of stretches approximately 10km long where the AADT flows were more than 20,000 vehicles and HGVs accounted for at least 10% of the traffic. Compliance varied between sections of the ban from 98% to 99.6%. Overtaking was more prevalent when HGVs accounted for more of the traffic.

Traffic speeds for vehicles not affected by the ban showed a smaller spread indicating smoother journeys in the offside lane than prior to the ban. It was also found that the increased stability in non HGV traffic flows also had no significant impact on the average speeds and flows of HGVs and vehicles affected by the bans.

Studies comparing accident rates and severities both before and after the introduction of the HGV overtaking bans proved inconclusive. However, it was found that in the 2 – 3km following the overtaking bans, overtaking by HGVs was increased significantly compared with normal stretches of road. This so called “elephant race” was found to subside after 3 km and overtaking then returned to normal levels.

2.6 Other countries

Austria has an HGV overtaking ban on several sections of the country’s 2-lane Autobahn network. The longest section is on the A12 between Innsbruck and Kufstein (part of an important transit route between Germany and Italy) where for an 80 km length in both directions there is a permanent ban for HGVs in excess of 7.5 tonnes (ASFiNAG, 2005).

Since 2008, Belgium has introduced an overtaking ban on HGVs in excess of 3.5 tonnes on many sections of 2-lane highway outside built-up areas (DGAR, 2008). On some sections the ban is permanent; on others it applies from 07:00 to 19:00. Additionally the A15 (E42) autoroute between Liège and Namur has dynamic control of the overtaking ban.

Finally, Italy has HGV overtaking bans on the A22 (Austrian border to Modena) which has junctions approximately every 10 km:

- A permanent restriction on an 85 km section for vehicles over 7.5 tonnes and also vehicles towing caravans and trailers.
- A fixed time restriction from 06:00 to 22:00 on a 229 km section for vehicles over 12 tonnes and also vehicles towing caravans and trailers.

3. SIMULATION STUDY

KEY FINDINGS

- A traffic model has compared average speeds on a 2-lane hypothetical motorway with and without an HGV overtaking ban
- Increases in overall speed (when averaged for both light and heavy vehicles), occurred in most of the situations where there was an uphill gradient
- Changes in overall speed on a level motorway and on downhill gradients were mixed with some very small increases in speed in some situations balanced by large reductions in speed in a few specific cases
- When averaged over all combinations of gradient and HGV proportion, the overall changes in average speed were a 0.5% reduction (high demand) and a 0.3 % increase (medium demand)

3.1 Scenarios

TRL conducted a study of HGV overtaking bans using the UK Highways Agency's SISTM micro-simulation traffic model² (Hardman, Lunt and Smith, 2008). Hypothetical sections of 2-, 3- and 4-lane motorways were modelled with and without HGV restrictions. Simulation runs were performed with different HGV proportions (7½%, 15% and 25%) and three gradients (level, 2% downhill and 2% uphill). Two traffic demand levels (medium and high) were used and a peak period flow profile (containing a rise and fall in the flow levels) was applied; overall the input flow was 2480 veh/h for the medium demand level runs and 3360 veh/h for the high demand level runs. The modelled section included two junctions 8 km apart, with the proportions joining and leaving set at 20%.

It was considered that results from these SISTM runs would provide useful data for this study. A traffic model has the advantage over on-the-road results in that conditions can be carefully controlled and extraneous effects (e.g. higher flows in the “after” period, changes in HGV proportion or occurrence of incidents) can be eliminated.

3.2 Results

The changes in average speed from the simulation runs are shown in the Annex (pages 35-36): Table 6 (individual results) and Table 7 (summary results).

Changes in average speed were found to be highly dependent on the demand level, the HGV proportion and the gradient. Furthermore, the results were more sensitive to HGV proportion and gradient at the higher flow level. As might be expected, increases in car average speeds were recorded in most of the situations, whilst HGVs generally had lower average speeds. The only cases where car speeds declined were at the higher flow level on a downhill gradient (with 25% HGVs) and a level gradient (with 15% and 25% HGVs). HGV speeds were lower in nearly all of the 18 situations studied, though in most cases the reductions were small, at between 1% and 3%. Larger reductions of up to 27% occurred with 15% HGVs on a level road (high demand) and 25% HGVs (all gradients for high demand, and an uphill gradient for medium demand).

² A micro-simulation model is one where individual vehicles are represented

When the results for light and heavy vehicles are combined, there were overall benefits when the gradient was uphill (except for medium demand, 25% HGVs); average speeds increased by between 1% and 11%, with the greatest benefits occurring at high demand levels and 25% HGVs. On level motorways, the results were mixed with speed reductions of 10% predicted for 15% and 25% HGVs at high demand, and only very small changes (less than 1%) in other cases. On downhill gradients, all changes were less than 1% except for 25% HGVs at the high demand level where a 13% fall in speeds occurred.

If the results from all 18 situations are combined, the net changes are a 0.5% reduction in average speed at the high demand level and a 0.3% increase at the medium demand level.

The speed changes predicted by the simulations occur because of:

- queues of HGVs forming behind a slower moving HGV (particularly on the uphill gradients).
- higher car speeds in the offside lane at all gradients.
- difficulties in traffic joining and leaving the motorway due to queues of HGVs. It is therefore likely that if the proportion of this traffic was lower than the 20% value used in the simulations, this would have presented less of a problem.

More detailed analysis of the simulation output would be needed to understand changes in lane utilisation and lane changing rates and how they impact on the simulation results.

4. IMPACTS ON SAFETY

KEY FINDINGS

- Evaluations of existing schemes have not shown any change in accident rates, which is to be expected given the low number of accidents likely to occur within schemes
- Some changes in observed driving behaviour resulting from HGV overtaking bans could lead to an increased accident risk; other changes could lead to a decrease
- Overall, widespread implementation of overtaking bans could, at most, have only a very small influence on overall numbers of accidents

According to a study of a sample of accidents involving HGVs (European Commission, 2007), accidents after an overtaking or lane changing manoeuvre accounted for 11.3% of all HGV accidents. In 53.6% of these cases the HGV was changing lane. It might therefore be expected that an HGV overtaking ban would result in an approximately 6% reduction in accidents. However, using these results in such a simplistic manner could be highly misleading. In particular, this total includes accidents on all roads, not just 2-lane divided highways. This would be expected to substantially over-estimate the maximum potential effect of an overtaking ban, though this would be offset slightly because the total excludes collisions between two light vehicles as a consequence of an overtaking HGV.

However, none of the research monitoring existing schemes has been able to show any significant change in accident frequency or severity as a result of the introduction of HGV overtaking bans. This is not surprising when the following statistics from Great Britain³ are considered as an example. In 2008, there were approximately 231,000 casualties from accidents (DfT, 2009a) that occurred on approximately 394,500 km of public road (DfT, 2009b). Table 1 (page 13) showed that there was 10.4 km of overtaking ban in the UK so even if the risk of accidents was equal on all road sections, it would be expected that in one year the areas subject to the ban would experience only about 6 casualties per year. In reality, 2-lane divided highways tend to be safer than single carriageway roads so the expected number could be lower still. Given that this includes all accident types, not just those that could potentially be affected by an overtaking ban, it is easy to see why no statistically valid conclusions could be drawn. Enabling statistically significant results would be likely to require that a large proportion of the relevant road network was subject to a ban, preferably implemented simultaneously, with monitoring of the overall effects.

Similar techniques allow the maximum possible benefit of an overtaking ban to be scoped out. For example, in Great Britain there are approximately 11,500 km of motorway and dual carriageway (approximately 2.9% of the entire network). So, if it was assumed that the risk of injury is the same on all roads, overtaking bans were implemented on the entire length of these roads, bans eliminated all overtaking accidents and 11.3% of all accidents involved overtaking and/or changing lane then the expected casualty reduction would be approximately 0.3% of all casualties. In reality, 2-lane highways and motorways are considerably safer than more minor roads and an overtaking ban would only influence a small proportion of overtaking and changing lane accidents such that 0.3% is likely to be a substantial over-estimate. It is, therefore, reasonable to state that although the effect of an overtaking ban could not be measured based on the data available, the maximum influence

³ United Kingdom excluding Northern Ireland

that it could have on National or European casualty reduction targets is likely to be very small, particularly if only applied at specific congestion spots rather than to the whole network.

From the review of the schemes that have been implemented, there is qualitative evidence of the following:

- Removal of frustration of car drivers when driving behind an HGV in the offside lane, potentially leading to a reduced accident risk.
- Increased frustration of HGV drivers as they are forced to travel at the speed of the slowest HGV at the front of a platoon leading to a higher accident risk.
- An increase in the accident rate in the section of road following the overtaking ban as HGVs make their lane changing manoeuvres.
- Similarly there could potentially be an increase in HGV overtaking rate in the section of road before the overtaking ban, but this has not been reported to be a problem in any of the schemes.
- Higher speeds and reduced headways (i.e. less distance between vehicles) in the offside lane. This could lead to an increased accident risk and greater severity of the accident.
- More homogeneous traffic flow (i.e. reduced speed differentials between vehicles) and overall reduction in lane changing could lead to a reduced accident risk.

5. COST BENEFIT ANALYSIS

KEY FINDINGS

- Using results from existing schemes, it is estimated that an HGV overtaking ban rolled out across the EU could produce annualised benefits of 1500 million euro

5.1 Aim of analysis

An analysis of the scope of potential benefits of HGV overtaking bans was undertaken. The aim was to explore the high level case for HGV overtaking bans across Europe. Benefits were estimated based on available evidence to produce an annual economic measure.

5.2 Background

In order to provide a benefit baseline, two sources of evidence were used. The first source was the results of the example schemes where HGV overtaking bans have been used in Europe. The other was the results of modelling work where the impact of a ban was simulated. By using both sets a range of benefits was estimated.

From the example schemes there was evidence of impact on traffic flows (both general vehicles and HGVs). There was insufficient evidence to support any claim of either benefits or disbenefits for road safety.

The benefits to traffic from improved journey times were calculated. In some cases the benefit to HGVs was negative.

5.3 Method

The benefits were calculated in terms of the Net Present Value (NPV) in Euros. This was achieved by scaling the benefits from one scheme to represent the benefits that would be achieved by using HGV overtaking bans at all the suitable locations in each country.

The economic benefits were scaled for each EU country (15 of 25 were considered plus Norway and Switzerland) taking account of the length of state controlled highways, the total traffic volumes (in vehicle kilometres) and the associated economic value of delay for each nation. The data was sourced from UNECE statistics, individual national road authority annual reports and peer reviewed journal papers. The countries considered are shaded in Map 1 shown below.

Map 1: Countries where results were scaled



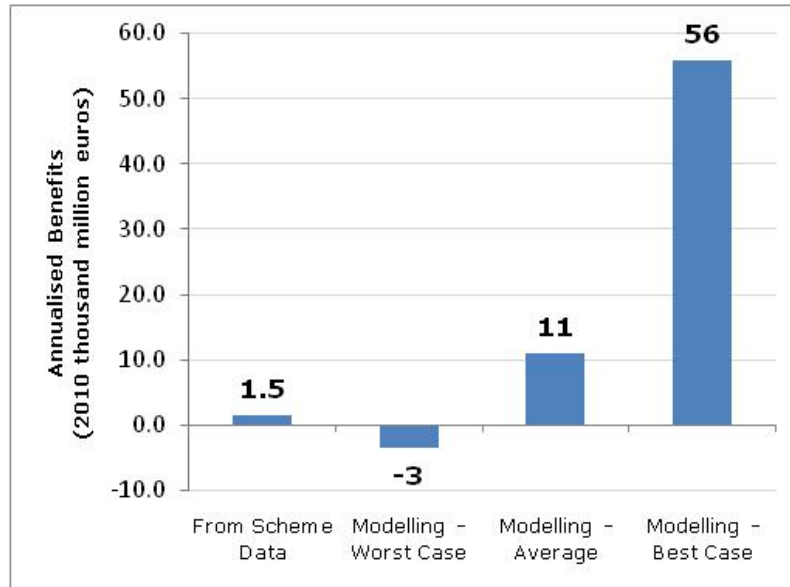
The benefits were calculated as follows:

1. The typical vehicles travel time saved (reduction in congestion) by HGV overtaking bans were calculated by averaging values obtained in example scheme studies. The values found were 1.6 seconds per vehicle kilometre for non HGVs and 0.1 seconds per vehicle kilometre for HGVs.
2. The average length of national road networks suitable for HGV overtaking bans was found by averaging the amount of network used in Denmark, Germany, the Netherlands and the UK. It was found to be 22 %.
3. Typical Value of Time (VoT) figures were sourced (HEATCO, 2006; RAND Europe and ITS Leeds, 2004) for 9 countries in the sample and then scaled across all countries using values of Gross Domestic Product (GDP) for 2010.

Steps 1 through 3 were multiplied to produce the overall economic benefit for each country. These individual benefits were then summed for the whole sample (15 countries).

5.4 Results

The calculations showed that an HGV overtaking ban rolled out at all suitable locations across the EU could produce annualised benefits of 1500 million euro, based upon the sample schemes considered. The simulated results indicated that the overall benefits could potentially be higher or lower, as shown in the figure below.

Figure 1: Annualised Benefits of HGV overtaking ban

The modelling best case shown here is unrealistic for an EU wide roll out because it requires a sufficient number of sites where the conditions are perfect for a ban. Similarly, the worst case scenario assumes that all sites are only partially suitable (low HGV traffic volumes, negative inclines and insufficient traffic demand). The range of results provided by the modelling therefore serves only to support the findings based on example schemes.

This analysis has made no account of the suitability of each country to an HGV overtaking ban. It is likely that mountainous countries would benefit more from such bans. However when this was examined no correlation was found between the current prevalence of bans and the countries' level of hilliness.

6. OPERATIONAL ISSUES

KEY FINDINGS

- HGV overtaking bans will result in platoons of HGVs in the nearside lane
- This will have consequences for traffic entering and exiting the main carriageway
- For traffic in the offside lane, traffic signs could be obscured by platoons of HGVs
- Alternatives exist to HGV overtaking bans, but these involve infrastructure changes and will be costly to implement

In addition to traffic demand levels, HGV proportions and gradients, there are many other factors that need consideration when implementing a scheme.

6.1 Platoons of HGVs

The introduction of an HGV overtaking ban will result in bunches or platoons of HGVs in the nearside lane as they are forced to travel at the speed of the slowest HGV at the front. The length of these platoons will depend on the traffic flow and the proportion of HGVs. In free flow conditions, HGVs travel at different speeds because of differing performance on uphill gradients and because of tolerances and inaccuracies in the setting of speed limiting devices (which can vary due to tyre wear). Furthermore, speed limits for HGVs vary across Europe depending on their weight, whether they are towing a trailer and their length. In addition abnormal load movements, particularly those involving the transport of the widest or heaviest loads, are made at even lower speeds and very slow agricultural vehicles are sometimes permitted on 2-lane divided highways. The presence of a slower moving vehicle is likely to lead to frustration by other HGV drivers. Despite this, the reaction of freight companies to the HGV overtaking bans in France has been general acceptance on the basis that other traffic will be speeded up.

The platoons of HGVs may affect traffic behaviour at junctions. Vehicles joining a 2-lane motorway enter the nearside lane and similarly those leaving the motorway have to exit from this lane. A platoon of HGVs in the nearside lane could make it more difficult for:

- Non-HGVs in the offside lane to move into the nearside lane in order to exit.
- All traffic (but especially HGVs) to join the main carriageway from an entry slip road. On a motorway without overtaking restrictions, HGVs on the main carriageway frequently move out to the offside lane in order to make it easier for HGVs on the entry slip road to join the main carriageway.

As mentioned earlier, in the UK a scheme that was under consideration did not go ahead because of concerns about junctions which were about 1 km apart. In other schemes, junctions were further apart (ranging from 3 to 4 km for the Netherlands to 10 km in Italy).

Another potential problem with the platoons of HGVs is that of sign obscuration. Traffic signs placed on the verge next to the nearside lane may not be visible to drivers in the offside lane if there are large vehicles in the nearside lane. This can be a problem without an HGV overtaking ban, but it is more likely to occur if an overtaking restriction results in long platoons of HGVs.

Finally, increased use of the nearside lane by heavy vehicles may result in increased road wear and hence an increase in maintenance activity. The works necessary to resurface the lane will require lane closure and hence may well result in delays to all vehicles.

6.2 Types of ban

In applying a HGV overtaking ban, consideration needs to be given to the categories of HGV to be restricted. In some countries it is vehicles in excess of 7.5 tonnes, in others 3.5 tonnes and in two of the French schemes the weight threshold is higher than 7.5 tonnes. There may also be cases for extending the overtaking ban to include other vehicle categories that are not permitted to travel at the maximum speed limit, for example, buses and cars with trailers.

The duration of the HGV overtaking ban varies in the different schemes. Some schemes have a permanent ban in place, for others it is fixed time (07:00 to 19:00 being the most common) and in a few schemes a traffic responsive system is in place so that the ban is only in operation when HGV proportions and traffic flows exceed specific thresholds. The latter demands an advanced traffic control infrastructure (e.g. VMS) and this would usually be introduced along with other traffic control measures such as variable speed limits.

Compliance has been reported as being very good in the countries reporting on their schemes. It is not known whether enforcement has been carried out using police patrols or through an Automatic Number Plate Recognition system.

6.3 Traffic signing

Results from a survey for the EU funded IMPROVER project (Horberry and Mitchell, 2006) showed that the regulatory 'no overtaking by goods vehicles' sign (shown in Figure 2) is part of the official traffic collection in a number of EU countries.

Figure 2: Vienna Convention sign C13ba: No overtaking by goods vehicles



However, it was established that this regulatory sign is not adopted in Finland nor in the United Kingdom. In addition, in a few EU countries where this sign has been adopted, the official meaning is different to that specified by the Vienna Convention. For example, in France, the sign does not prohibit HGVs overtaking two wheeled vehicles.

6.4 Alternatives to an HGV overtaking ban

The following measures, which provide additional road capacity, are possible alternatives to the introduction of an HGV overtaking ban:

- Construction of crawler lanes (also known as climbing lanes). This is particularly applicable on uphill gradients and has been applied in many locations. This can be a costly option and in some locations there may not be space for its provision.
- Use of hard shoulder. Several trials across Europe (notably the UK and Netherlands) have converted the motorway hard shoulder into a running lane to provide additional capacity, usually at peak times when traffic demand is highest.

- Use of a lane in opposite direction (tidal flow). On sections of motorway where there is strong directionality in the traffic flow within the day, it may be possible to switch lanes according to the direction with the higher demand.

In all cases implementation costs are likely to be higher than for implementing a static or intermittent HGV overtaking ban because additional infrastructure is required.

7. CONCLUSIONS AND RECOMMENDATIONS

Overtaking bans have been implemented in several EU countries with wide variation in the locations, HGV weight categories and hours of operation:

- Fixed daytime bans applying to HGVs in excess of 3.5 or 7.5 tonnes are the most common type. Compliance is generally considered good, though one French scheme reported a decline in compliance where the proportion of traffic that was HGV exceeded 15%. The attitude of HGV drivers to such bans was found to be mixed.
- Dynamic overtaking bans are only activated when total traffic flow and HGV proportion both exceed thresholds (2,600 veh/h and 9.6% HGV in the Netherlands and 3,200 veh/h and 25% HGV in Germany). Studies in the Netherlands suggest that dynamic bans are more effective with greater user acceptance.

Very few schemes quantified the effect on journey time but where reported the following effects were found:

- –2 to –13 seconds for cars
- –8 to +8 seconds for HGVs

No scheme reported a change in accident rate. Using these results it is estimated that HGV overtaking bans could lead to a net benefit across the European Union (plus Norway and Switzerland) of 1500 million euro annually. Simulation runs from a traffic model confirm the general increase in HGV journey times and reduction for car journey times in most situations. Overall, the model showed benefits on uphill gradients (+2%), but on level sections and downhill gradients there were many situations with overall disbenefits for both light and heavy traffic. Averaged over all the situations modelled, the net change was:

- a 0.5% decrease in average speed at the high traffic flow level (3360 veh/h)
- a 0.3% increase in average speed at a lower flow level (2480 veh/h)

Results showed greater sensitivity to gradient and HGV proportion at the higher traffic flow level, but the largest improvements in journey time were recorded at the higher level on uphill gradients and with 25% HGVs.

There are many other factors that need to be considered when introducing a HGV overtaking ban. Platoons of HGVs can lead to problems at motorway junctions where entering and exiting traffic needs to use the nearside lane. These can also lead to difficulties in drivers in the offside lane not seeing traffic signs due to obscuration and to greater road wear in the nearside lane requiring additional maintenance. In the UK concern at traffic behaviour in junctions resulted in the cancellation of one scheme where junctions were 1 km apart, but in the rest of Europe the schemes include intervening junctions although the junctions are further apart than in the UK abandoned scheme.

Overall the conclusion from this study is that HGV overtaking bans have been applied successfully in many European countries with dynamic bans having the greatest acceptance. Further rollout of schemes is likely to bring benefits especially on sections of road with uphill gradients and with junctions spaced at least 3 km apart.

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ANNEX

Table 6: Average speeds from SISTM simulation runs with and without HGV overtaking ban⁴

OVERALL TRAFFIC DEMAND LEVEL	PERCENTAGE OF HGV	GRADIENT	VEHICLE TYPE	SPEED (km / h)		% CHANGE
				NO BAN	BAN	
High	7.5 %	-2.0 %	Light	97.4	98.0	0.6 %
			Heavy	89.9	88.4	-1.7 %
			Overall	96.9	97.3	0.4 %
		0.0 %	Light	97.3	97.9	0.6 %
			Heavy	89.7	88.2	-1.7 %
			Overall	96.7	97.2	0.5 %
		+2.0 %	Light	89.5	95.8	7.0 %
			Heavy	80.0	82.2	2.8 %
			Overall	88.8	94.8	6.7 %
	15.0 %	-2.0 %	Light	95.6	96.4	0.9 %
			Heavy	88.2	85.6	-3.0 %
			Overall	94.5	94.8	0.3 %
		0.0 %	Light	93.2	84.8	-9.0 %
			Heavy	85.9	73.1	-14.9 %
			Overall	92.1	83.1	-9.9 %
		+2.0 %	Light	67.4	75.2	11.5 %
			Heavy	61.3	60.6	-1.1 %
			Overall	66.5	73.0	9.8 %
	25.0 %	-2.0 %	Light	84.5	76.3	-9.6 %
			Heavy	78.2	58.5	-25.2 %
			Overall	82.9	71.9	-13.3 %
		0.0 %	Light	74.7	71.3	-4.5 %
			Heavy	69.6	50.5	-27.4 %
			Overall	73.4	66.1	-9.9 %
		+2.0 %	Light	56.3	68.6	21.7 %
			Heavy	53.4	41.8	-21.7 %
			Overall	55.6	61.9	11.3 %
Medium	7.5 %	-2.0 %	Light	100.1	100.4	0.3 %
			Heavy	91.4	90.0	-1.5 %
			Overall	99.5	99.7	0.2 %
		0.0 %	Light	100.1	100.4	0.3 %
			Heavy	91.2	89.9	-1.4 %
			Overall	99.4	99.6	0.2 %
		+2.0 %	Light	99.1	100.5	1.4 %
			Heavy	87.4	85.9	-1.7 %
			Overall	98.2	99.4	1.2 %
	15.0 %	-2.0 %	Light	98.8	99.6	0.8 %
			Heavy	90.5	88.4	-2.3 %
			Overall	97.5	97.9	0.4 %
		0.0 %	Light	98.7	99.5	0.8 %
			Heavy	90.3	88.3	-2.2 %
			Overall	97.5	97.9	0.4 %
		+2.0 %	Light	96.2	99.6	3.5 %
			Heavy	85.9	84.0	-2.2 %
			Overall	94.7	97.3	2.8 %
	25.0 %	-2.0 %	Light	97.5	99.2	1.8 %
			Heavy	89.3	86.7	-2.9 %

⁴ Speeds have been rounded to 1 decimal place; percentage changes have been calculated using the original speeds before rounding.

OVERALL TRAFFIC DEMAND LEVEL	PERCENTAGE OF HGV	GRADIENT	VEHICLE TYPE	SPEED (km / h)		% CHANGE
				NO BAN	BAN	
		0.0 %	Overall	95.5	96.1	0.7 %
			Light	97.4	98.2	0.9 %
			Heavy	89.0	83.7	-5.9 %
			Overall	95.3	94.6	-0.7 %
		+ 2.0 %	Light	91.4	93.4	2.1 %
			Heavy	82.4	66.5	-19.4 %
			Overall	89.2	86.7	-2.8 %

Table 7: Summary of changes in average speed in SISTM simulation runs with introduction of HGV overtaking ban

OVERALL TRAFFIC DEMAND LEVEL	PERCENTAGE OF HGV	GRADIENT	% CHANGE		
			LIGHT VEHICLES	HEAVY VEHICLES	OVERALL
High	All	-2.0 %	-2.7 %	-9.9 %	-4.2 %
		0.0 %	-4.3 %	-14.7 %	-6.4 %
		2.0 %	13.4 %	-6.7 %	9.3 %
		Overall	2.1 %	-10.4 %	-0.5 %
	7.5 %	All	2.7 %	-0.2 %	2.5 %
	15.0 %		1.1 %	-6.3 %	0.1 %
	25.0 %		2.5 %	-24.8 %	-4.0 %
	Overall		2.1 %	-10.4 %	-0.5 %
Medium	All	-2.0 %	1.0 %	-2.2 %	0.4 %
		0.0 %	0.7 %	-3.2 %	0.0 %
		2.0 %	2.4 %	-7.8 %	4.0 %
		Overall	1.3 %	-4.4 %	0.3 %
	7.5 %	All	0.7 %	-1.5 %	0.5 %
	15.0 %		1.7 %	-2.2 %	1.2 %
	25.0 %		1.6 %	-9.4 %	-1.0 %
	Overall		1.3 %	-4.4 %	0.3 %

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