Impact Assessment

The potential cost and benefits to the United Kingdom of the measures outlined in the proposal for a Regulation of the European Parliament and of the Council on the approval and market surveillance of two or three wheel vehicles and quadricycles

Version 2

1 Background

On 4th October 2010, the European Commission (EC) published a proposal[1] to alleviate a range of concerns associated with the provisions for the type-approval of new L category vehicles. This group comprises mainly two and three-wheeled motor vehicles, but also includes four-wheeled quadricycles and "mini-cars" (see Appendix B for further details of the types affected). The EC proposal includes measures to:

- Simplify the legal framework by replacing Directive 2002/24/EC and its separate directives with a single Regulation and a number of delegated and implementing acts;
- Improve the technical requirements with the aims of reducing emissions, increasing the level of safety, dealing with new technologies and strengthening market surveillance. These technical requirements include:
  - More stringent emission levels and additional evaporative emission controls to strengthen the emission measures for L category vehicles, in particular for Hydrocarbons, Carbon Monoxide, Nitrogen Oxides and Particulate Matter;
  - Mandatory advanced braking systems for specific groups of motorcycles aligned with the European Road Safety Action Plan 2011-2020 and the European Road Safety Charter (ERSC) 2000-2010, which aimed to reduce the number of road fatalities by 50% by the year 2010. Riders of L-category vehicles have the highest fatality and injury rates of all road users and braking technologies exist which have proven benefits in test conditions and are predicted to confer safety benefits, yet are currently fitted to a relatively small proportion of the fleet;
  - Improving the ability to approve vehicles that are fitted with new technologies not covered by the existing legal framework;
  - Measures to prevent selling and registration of certain vehicles, systems, components or separate technical units imported into the EU market which do not comply with the current type-approval requirements, thereby ensuring a high level of vehicle safety and/or environmental protection.

The purpose of this impact assessment is to estimate, based upon the best available evidence available at the time of writing, the potential cost and benefits to the United Kingdom of the measures outlined in the EC proposal. This evidence base is intended to be a 'live' document, which will be updated by the Department for Transport as more robust information becomes available, or more specific details of the EC proposal are developed which allow the consequent costs and benefits to be identified with greater accuracy. In many instances, the estimates are sensitive to subsequent development or changes to the detail of the proposal and on improved stakeholder information should this become available, since the time available for information gathering for this assessment was limited. The costs and benefits estimated should be considered interim assessments and should be reviewed to ensure that they accurately reflect the technical detail of the EC proposal as this is developed and clarified.

[1] http://ec.europa.eu/enterprise/sectors/automotive/files/com-2010-542_en.pdf

2 Problem under consideration

The European Commission (EC) has identified a number of key safety and environmental concerns associated with L-category vehicles;

- the complexity of the legal framework;
- the level of emissions and the increasing L category contribution to total road transport emissions;
- the fitment rate of advanced braking systems, and;
- lack of a legal framework for new technologies.

2.1 Complexity of legal framework

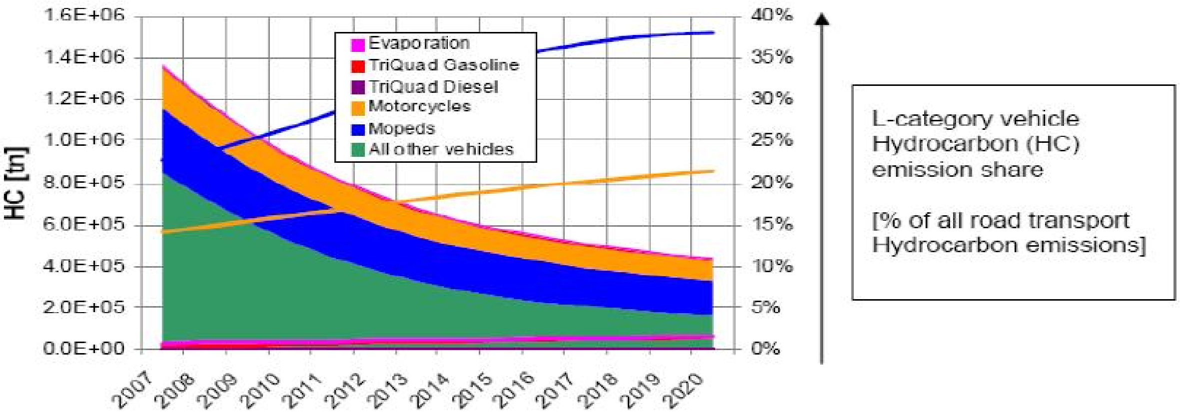
In line with recommendations from CARS21[2], the EC have identified that the existing system for L-category vehicles is too complex and that there is scope for simplification and international harmonisation. The EC's impact assessment indicates that national authorities responsible for applying the Framework Directive incur unnecessary additional costs in operating this complex regulatory framework.

Currently, L-category vehicles must comply with a series of requirements found in a number of separate directives. The Framework Directive is linked to another 13 detailed technical directives, which themselves have been amended by 21 amending directives reflecting technical progress. In addition, many directives contain references to regulations and standards applied worldwide, such as those adopted by UNECE, which are also subject to amendment. Ultimately, the disparate nature of the regulations governing type-approval for L-category vehicles has led to a perceived lack of legal and regulatory clarity. Constantly updating these texts can be a burdensome process and lead to additional costs for both Government and industry.

2.2 Environmental protection

Emissions (both from the exhaust system and evaporative emissions from the fuel system) are known to have negative environmental and health impacts. Improved standards for passenger cars (Euro 5 and 6) and Euro VI heavy-duty emission standards mean that, in future, L-category vehicles are predicted to account for an increasing proportion of all road transport emissions. The EC's impact assessment predicted that the proportion of total evaporative and exhaust hydrocarbons (THC) emitted by L-category vehicles will increase from 38% of those emitted by all road vehicles to 62% by 2021 if no additional measures are implemented. In particular, mopeds are already one of the most significant contributors to hydrocarbon emissions and are expected to account for 38% of total hydrocarbon emissions from road transport by 2020 (see figure below).

[2] http://ec.europa.eu/enterprise/sectors/automotive/competitiveness-cars21/cars21/



L-category vehicles are responsible for a very small proportion (less than 3%) of total European road transport mileage, so their pollutant emissions are considered disproportionately high. In response, the European Commission has proposed measures to control the future emission levels.

The present legal framework governing emissions by L-category vehicles was adopted in 2002. Since then, technology has evolved rapidly. Given the wide diversity of vehicle construction, design and propulsion technologies now on the market, the current legal framework is considered by the EC to be out of date.

The EC propose including measurements of CO_2 emissions and fuel consumption in type-approval demonstration testing. This data is intended to inform the consumer on fuel efficiency and CO_2 emissions in a similar way to the current situation with passenger cars.

The Framework Directive contains no durability requirements and according to the EC's impact assessment, emissions by older vehicles may significantly exceed the limits after only 20,000km. Other published data suggests that in some cases, emission limits may be exceeded after only a few thousand kilometres. Similar requirements to those proposed (emission testing for vehicles after 50,000km) already exist in other parts of the world and other road vehicle categories in the EU (for example for cars and trucks), albeit with the use of deterioration factors.

Finally, an initially emission-compliant vehicle may deteriorate in emission performance if an emission-relevant component or system fails or degrades. Similarly, a vehicle may be at increased safety risk if a system or component important for safety fails or deteriorates such that performance is significantly impaired. The EC proposal includes measures to introduce On Board Diagnostic (OBD) systems. These are intended to alert the rider via a malfunction indicator that an essential vehicle system or component has either failed (OBD1), or is not operating according to the required technical specification (OBD2). This proposal also provides requirements intended to standardise the interface for access to diagnostic information, so that it can be made available to the rider and servicing centres. This may lead to the vehicle being repaired more effectively and efficiently. Also proposed are obligations to provide repair and maintenance information developed by the manufacturer of the vehicle. Technical information is, in some cases, currently not accessible to independent garages or vehicle owners (only franchised dealers) and the opening of the market is predicted to confer benefits to consumers though lower prices and society in general from more timely and effective vehicle maintenance.

2.3 Safety

L-category vehicle users have a higher risk of fatal or serious accidents than other vehicle users. The fatality rate per million kilometres travelled is, on average, approximately 18 times greater than for passenger cars. In 2006, L category vehicles accounted for 2% of the distance travelled but 16% of road deaths in the EU-25 (ETSC, 2007). In Great Britain, L-category vehicles accounted for just over 1% of road traffic mileage in 2009, but over 21% of road user fatalities (DfT, 2010). Furthermore, while other vehicle types have demonstrated significant decreases in the numbers of fatalities and serious injuries over recent years, the figures for L-category vehicles have not shown the same rate of improvements and have remained approximately static. In Great Britain the number of fatally injured motorcyclists in 2009 decreased 4% compared to the previous year and was at a level 1% greater than the 1994-1998 average (DfT, 2010).

In 2008, 5,520 riders of powered two-wheelers (PTW) died in European road accidents. In addition, the number of serious injuries is estimated to be between 5.5 to 13 times greater than the number of fatalities (30,000 – 72,000 riders). The number of slight injuries is even more difficult to estimate but might be between 12 to 28 times higher (66,000 – 155,000) in the EU-27. In Great Britain there were 472 fatalities, 5,350 serious injured, and 14,881 slightly injured motorcycle users in 2009 (DfT, 2010). Advanced braking systems have been shown via predictive and retrospective accident studies to reduce the risk of fatal and serious injury, yet are fitted to a relatively small proportion of the fleet. Some uncertainty exists in the percentage of the fleet equipped with ABS[3] or CBS[4]. This is because the number of machines with optional uptake of anti-lock braking systems (ABS) or combined braking systems (CBS) is largely unrecorded and that the industry commitment for ABS/CBS relates to new vehicles, not the existing fleet. EC measures are designed to increase the fitment of ABS/CBS in order to realise the predicted safety benefits available with these technologies.

Tampering of the vehicle's powertrain may improve engine performance at the cost of pollutant emissions and fuel consumption. Furthermore, higher engine performance may increase the maximum vehicle speed beyond the design limits of some vehicle components, thereby creating a safety risk. There are also safety implications for a rider licensed for a low powered machine riding a modified vehicle which has greater power and/or top speed. However, because of the shift from mechanical to electronic engine control, combined with the increasing use of other types of propulsion (e.g. electrical or hybrid powertrain), the current anti-tampering measures intended to mitigate these concerns may be ineffective or even obsolete in some cases. Research is currently being conducted by the EC on the recommended measures for anti-tampering requirements.

Mini-cars are defined as four-wheel vehicles that have limitations on performance and mass. The perceived problem with these vehicles is that consumers may assume the same level of active and passive safety as modern passenger cars because of their superficially similar appearance. However, their design concept, lower maximum speeds and less strict type-approval requirements mean that this assumption is not necessarily correct. The possibility that mini-cars may offer reduced safety performance compared with passenger cars was therefore identified as a concern by the EC, although there are no specific requirements in the EC proposals at this stage, it is likely technical measures will be included in the delegated acts associated with the Regulation.

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[3] Anti-lock Braking System –prevents wheel lock during emergency braking.

[4] Combined Braking System – automatic distribution of the braking force between the two wheels, thereby reducing the risk of, but not necessarily preventing, wheel lock.

Another area of concern for safety is that quadricycles designed to be used off-road (ATVs: All-Terrain vehicles) are currently able to be approved and can subsequently be registered and driven on public roads. These vehicles are intended to be used off-road and using them on the road has implications for safety because of their high acceleration capability and high centre of gravity. The latter can result in the vehicle rolling while cornering. In order to perform well in off-road conditions, these vehicles are not equipped with a differential on the powered axle, a basic safety feature for driving on hard-surfaced public roads.

There is some interest in the deployment of gaseous fuels, for example CNG, LPG and hydrogen, in L-category vehicles in view of perceived or potential environmental benefits. Adoption of specific requirements for such fuel systems may be appropriate to ensure their safety.

2.4 Other considerations

L-category vehicle technology has evolved rapidly over recent years. The development of associated legislation has lagged behind design developments, with the effect that certain vehicles can no longer be allocated to the correct vehicle category and a number of current measures are no longer appropriate. On-road quads, off-road quads and mini-cars currently all come under the same category, L7e, and are all subject to the same requirements. However, quads and mini-cars are inherently different in design and each require specific legal requirements for safety and to comply with appropriate environmental standards.

Low-power electric bicycles (less than 250 W, up to 25 km/h) currently fall outside the legal framework. In addition, more powerful bicycles of up to 1,000 W are also becoming more popular throughout the EU. At the present time, these more powerful electric bicycles (over 250 W, more than 25 km/h) are classified as mopeds. These bicycles must therefore comply with the type-approval requirements for vehicles with combustion engines, which is not appropriate for an electric vehicle.

This proposal will be discussed by Member States, the European Commission and the European Parliament and will inevitably be subject to amendments before being finalised. The UK needs to decide its negotiating position with respect to the proposal. All of the Commission's analyses supporting the proposal are based on the EU as a whole so there is a need to assess their likely effects in the UK specifically.

3 Rationale for intervention

The EC consider that their proposal to simplify the legal framework is in line with CARS21 findings and has potential cost savings across the EU. In parallel with these changes, and with respect to the current road safety and predicted environmental emission data for L category vehicles, a range of technical requirements have been proposed with the rationale to increase the market penetration of proven safety technologies, as well as reducing emissions, providing approval routes for new technologies and strengthening market surveillance. This impact assessment aims to, where the information allows and using the best available information, scope the likely cost benefit of the technical changes for the UK.

4 Policy objective

The objectives of the proposal are to simplify the current legal framework, to contribute to a lower, more proportionate share of overall road transport emissions, and to increase vehicle safety for new vehicles entering the market. The specific objective of the proposed changes to the rules applicable to L-category vehicles are to:

- Simplify and clarify regulation to ensure greater efficiency; lower administrative time costs and less burdensome adaptation to technical progress, eliminating duplication of international standards, thereby minimising administrative costs, improving the understanding of the requirements and ensuring that technical changes are implemented with no time delay.
- Reduce the tailpipe and evaporative emissions for new L category vehicles such that their share of total road transport emissions remains at least at current levels, or preferably reduced in proportion to actual use/total mileage compared to other road vehicle categories.
- Restrict modifications that may be detrimental to safety or pollutant emissions (anti-tampering).
- Increase the fitment of advanced braking systems to improve safety and reduce the number of road casualties from accidents involving L category vehicles. The proposal aims to achieve similar reductions seen for other transport modes, with the falling trend in passenger car fatalities since 2000 as the benchmark.
- Requirements to assure the environmental and functional safety requirements for vehicles over their useful life and fitment of on-board diagnostic systems to alert and efficiently diagnose system failures which may have negative effects on emissions and safety.
- Allow regulation to reflect current and future technology so that the requirements are appropriate for the vehicle type and that technological development is allowed to continue.
- Ensure the competitive functioning of the market for vehicle repair services via uniform access to vehicle repair and maintenance information.
- Introduce measures to strengthen existing regulations on Market Surveillance to ensure that products placed on the market are compliant and safe.

5 Description of Options

Each of the European Commission (EC) options has been compared against the "do nothing" situation. The latter case is the prevailing situation expected should the EC proposal not be implemented. The assumptions made for the "do nothing" (option 0) and the EC proposal (option 1) have been defined in Table 1.

Table 1. Details of Option 0 and Option 1

Topic	Option 0	Option 1 (EC proposal)
Simplification of EU legislation	Do nothing; current situation	Repeal Directive 2002/24/EC and its separate directives and replace with one Regulation and a small number of delegated and implementing acts from 1st January 2013.
Responsibilities of economic operators	Do nothing; current situation	Responsibilities of importers and distributors aligned with manufacturers with respect to approval to technical requirements and conformity of production. Additional requirement to designate a representative within the EU to liaise with type approval authorities
Market surveillance	Do nothing; current situation	Implement existing Market Surveillance Regulation, (EC) 765/2008, which Increases "market surveillance" responsibilities for economic operators to report non compliant systems, components or technical units and for Member States and their approval authorities to monitor compliance
Provision of anti-tampering measures	Do nothing; current situation	L category vehicles shall be equipped with designated measures to prevent tampering of a vehicle's powertrain to prevent modifications which have negative safety and environmental impacts.
On-board diagnostic (OBD) systems	Do nothing; current situation	Malfunction monitoring (e.g. circuit integrity check) "OBD stage 1" for new vehicles: • in L1Be, L3e, L5e. L6Ae and L7Ae from 1st January 2017; • in L6Be and L7Be from 1st January 2019; • all new L category vehicles from 1st January 2021; Second stage "OBD II" which monitors not only failures, but also deterioration of systems, components or separate technical units[5] for new vehicles in L1Be, L3e, L5e. L6Ae and L7Ae from 1st January 2021. The specific test procedures have not been defined.
New emission limits	European Industry (ACEM) commitment to 2017	To introduce M1 Euro 5 equivalent tailpipe emission limits for new types from 2020 and existing types from 2021, with two prior stages for Euro 3 (new types 2014, existing types 2015) and Euro 4 (new types 2017, existing types 2018).
Use of a revised World Motorcycle Testing Cycle (WMTC) for all L category vehicles:	Do nothing; current situation	Use of ECE R47 and ECE R40 test cycles for some vehicle categories (WMTC[6] for L3e – L7Ae) for the first two emission stages and modified World harmonised Motorcycle Testing Cycle (WMTC) for all L-category vehicles from 2020.

[5] Subject to confirmation after the results of a planned cost-effectiveness study
[6] World Motorcycle Test Cycle

Topic	Option 0	Option 1 (EC proposal)
Type-approval requirement for CO_2 measurement and fuel consumption determination and reporting:	Do nothing; current situation	Actual introduction of type-approval requirements for CO_2 measurement and fuel consumption determination and reporting.
Evaporative emissions test and limit:	Do nothing; current situation	Evaporative emissions test and limit ensuring evaporative emission control for all L-category vehicles.
New or revised measures for the type-approval of new vehicles, continued Durability requirements:	Do nothing; current situation	Deterioration reduced to 10% over useful life and linear extrapolation for higher mileages.
In-use conformity (IUC) testing and limits	Do nothing; current situation	New checks for in-use conformity testing (not further specified in the proposal)
Mandatory fitting of advanced brake systems to new vehicles:	European Industry (ACEM) commitment	From 1st January 2017: • New L3e-A1 sold, registered and entering into service shall be equipped with ABS and/or CBS. • New L3e-A2 and L3e-A3 sold, registered and entering into service shall be equipped with ABS
Power limit	Do nothing; current situation	Repeal of 74Kw power limit
Repair and Maintenance information	Do nothing; current situation	Requirement for repair and maintenance information to be provided to all repair garages.
Daytime running lights	Do nothing; current situation	Mandatory daytime running lights

6 Analysis of impacts for the UK

6.1 Groups and Sectors

The main groups affected by the changes proposed by the EC will be manufacturers, of L category vehicles, importers and distributors, component manufacturers, approval authorities, Government, motorcycle users and wider society. In 2008, the UK motorcycle industry was reported to have turnover of £5.9 billion (£5.2 billion after removing double counting of turnover within the market) and involved an estimated 65,500 jobs and 6,350 businesses (GHK, 2010). There were a total of 194 different brands registered in the UK in 2010 (MCIA[7] data).

6.1.1 Motorcycle manufacturers

The motorcycle manufacturers affected include those based in the UK and all other manufacturers of L category vehicles who sell models in the UK. GHK (2010) estimated that UK manufacturers (including manufacturers of components and related products) accounted for 8.3% of UK net sales in 2008. The largest domestic manufacturer is Triumph Motorcycles accounting for almost 8% of the UK two-wheeler market in 2010. Other important UK-based companies are Norton and CCM, along with two smaller manufacturers identified: AJS and Megelli Motorcycles. The main impacts to motorcycle manufacturers include:

- Technical developments required to comply with new or improved technical requirements
- Additional costs associated with new technical requirements. Small reductions in costs associated with regulatory simplification (from fewer technical meetings).

6.1.2 Importers and Distributors

Information supplied by MCIA indicated that companies operating in the UK who import major motorcycle brands account for 76% of the UK market. Importers of other motorcycles accounted for approximately 16% of the market in 2010. GHK (2010) estimated that "distribution and retail" accounted for 51.8% of total UK motorcycle industry turnover in 2008. Imports were estimated to account for £555 million and included imports from Europe, Japan, the US and China. Importers and distributors will be affected by additional costs and record management associated with the proposal to align their responsibilities more closely with those of manufacturers. MCIA data identifies around 49 importers, but these relate to the main UK operations; there are estimated to be many more (perhaps up to 4,500) distributors in the UK.

6.1.3 Maintenance and servicing

Information supplied by MCIA showed that this sector accounted for 4.9% of turnover and comprised 1,237 businesses (20.9% of identified businesses). It should be noted that GHK (2010) included the turnover related to spare parts in "distribution and retail" and the turnover for maintenance and servicing businesses is therefore greater than suggested by these figures. The division between franchised and independent operators in the UK is

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[7] Motorcycle Industry Association – http://www.mcia.co.uk

unknown, but based on information that in Europe[8], that single franchise businesses account for 50% of turnover, estimates of 50% single and 10% multi franchise business were made for UK situation, with the remaining 40% assumed to be independent operators.

6.1.4 Component manufacturers

These are companies who manufacture components in the UK for the UK or other markets, or manufacturers who manufacture components elsewhere for use within the UK. No specific information was found to quantify the size of the UK market. However, these companies would be affected by the approval requirements for important safety and environmental components.

6.1.5 Government and approval authorities

The Government is responsible for the application of the EC Regulation in national approval processes and ensuring that changes in the EC regulation are updated. The impact expected as a result of the proposals are that less administrative burden will be spent transposing technical requirements into UK law. An increased burden is also expected associated with implementing existing "market surveillance" requirements, (EC) 765/2008. However, the additional effort for approval authorities is difficult to quantify because the extent to which industry notifications of non-compliance, which require investigation, will increase is difficult to estimate.

Approval authorities are those bodies with delegated responsibility for the approval of vehicles (VCA) and the monitoring of compliance in use (VOSA). The impacts on these bodies may include:

- Increased cost to approve components, (although these costs are likely to be recovered from the manufacturer).
- Increased costs with monitoring importers and distributors (market surveillance) to ensure that they are upholding their responsibilities to only sell type-approved products into the UK market.

6.1.6 Motorcycle Users

In 2009 there were 1.3 million registered motorcycles in the UK (DfT, 2010). The impacts expected on this group are:

- Improved safety
- Controls on modifications which may affect safety or environmental performance
- Increased retail price to consumers
- Potentially improved competition for vehicle maintenance, leading to reduced servicing and repair costs.
- Improved durability

6.1.7 Wider Society

Impacts on society are anticipated to include:

- Improvements in air quality which has important health and quality of life impacts as well as effects on a wider scale to the global environment.

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[8] FIGIEFA presentation to EC MCWG December 2009 - http://circa.europa.eu/Public/irc/enterprise/automotive/library?l=/mcwg_motorcycle/meeting_december/figiefa_20091214pdf/_EN_1.0_&a=d

- Lower casualty numbers associated with L category vehicle accidents. This has implications for Governments, but ultimately means less resources are required to deal with the consequences of accidents
- Better quality of life and contribution to reducing man-made impacts on global environment

6.1.8 Stakeholder information

6.1.8.1 EC Consultation

The European Commission (EC) conducted a public consultation in 2009 on the policy principles they were intending to follow in the drafting of the proposed Regulation[9].

6.1.8.2 UK information gathering

Additional information gathering has also been undertaken by TRL, both under contract to the EC (Robinson *et al.*, 2009) and as part of this impact assessment. As part of this impact assessment study, an email questionnaire was distributed to 15 stakeholders, including vehicle manufacturers, component manufacturers and industry associations. From this exercise, responses representing the views of nine of these stakeholders were received. Further information was obtained via personal communication and follow up questions to participating stakeholders. A summary of the information gathering questionnaire along with details of the response are provided in Annex A and B. Whenever appropriate, information from these responses have been used when making assumptions in this impact assessment.

7 Costs, Benefits, Risks and Assumptions

A large number of different measures have been proposed, ranging from alterations to existing limits to completely new requirements and tests. Each aspect of change identified in Table 1 has been assessed separately. The costs, benefits, risks and assumptions have been described for each identified change. However, the overall impact for the UK has been quantified based on the combined effects of the changes outlined in the EC's proposal. The information below should be referred to in conjunction with the accompanying spreadsheet.

7.1 Simplification of EU legislation

L category vehicles are currently approved under a framework Directive that contains reference to 13 separate technical Directives. Each time that one of the current technical Directives is amended the UK Government is required to make changes to their own National Legal Framework in order to enforce these changes.

7.1.1 Costs

Information supplied by the Department to previous consultations[10] (Dodd, 2009) estimated that a combination of legal and technical resources as well as policy advisors are usually required to implement such a change, costing approximately £15,687 per amendment.

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[9] http://ec.europa.eu/enterprise/sectors/automotive/files/consultation/2_3_wheelers/results_report_en.pdf

[10] Note that the previous consultation was on a European basis so the Department supplied cost estimates in Euros

Table 2. Estimated staff cost per amendment

DfT Staff Area	Daily Rate (€)	Daily rate (£) using 1.2 exchange rate	Staff time (days)	Total cost
Legal	€550	£478	20	£ 9,565
Technical	€264	£230	20	£ 4,591
Policy	€352	£306	5	£ 1,530
				£ 15,687

The European Commission's website provides a chronological list of Directive and Regulations[11]. This list was used as a source to estimate that, over the ten year period from 1996, there were on average approximately two amendments or adjustments to EC Directives relevant to category L vehicles per annum (Robinson et al., 2009). On this basis, the annual administrative cost to maintain the type approval system in its current format, using a lower limit of 1 and upper limit of 3 amendments, is estimated to cost between £15,687 and £47,061, with a best estimate cost of £31,374.

Table 3. Estimated cost for 1-3 annual amendments

	Lower estimate	Central estimate	Upper estimate
Cost per amendment	£15,687	£15,687	£15,687
N° of amendments per year	1	2	3
Current annual cost for amendments	**£15,687**	**£31,374**	**£47,061**

If the new proposal was implemented then the existing Framework Directive would be replaced by an EC Regulation. The technical requirements would be replaced by a small number of implementing Regulations which would refer to equivalent international standards and regulations (e.g. UNECE Regulations) wherever possible. If the proposal was adopted then there would be an initial administrative investment to the UK Government to replace the current type approval framework, followed by a regular annual cost to adapt the new Regulations to technical progress.

Figures previously supplied by the Department (Dodd, 2009) estimate that, replacing the current framework is likely to incur a one off cost, approximately 5-10 times greater than the current cost to amend a single directive. This equates to a cost of between £78,435 and £156,870, with an average of £117,652.

Table 4. Estimated investment cost of replacing current framework

	Lower estimate	Central estimate	Upper estimate
Current cost per amendment	£15,687	£15,687	£15,687
Implementation costs 5-10 times more…	5	7.5	10
Investment cost to replace Framework	**£78,435**	**£117,652**	**£156,870**

[11] http://ec.europa.eu/enterprise/automotive/directives/motos/index.htm

The adoption of a new Framework would still require regular amendments to be made to reflect technical progress. However, the use of Regulations instead of Directives is expected to reduce the administrative burden of transposition. It has been estimated that regular amendments under the new Framework are likely to require half the effort compared to updating current Directives (Dodd, 2009; Robinson *et al*., 2009). Therefore, it has been estimated that an annual saving of between £7,843 and £23,530 could be achieved.

Table 5. Estimated annual costs for amendments for Option 0 and Option 1

	Lower estimate	Central estimate	Upper estimate
Current annual cost for amendments	£15,687	£31,374	£47,061
Annual cost to amend new Regulation	£7,843	£15,687	£23,530
Change to annual cost for amendments	(£7,843)	(£15,687)	(£23,530)

In addition to the cost of setting up a new framework, there is also a cost for a UK Government representative to attend regular meetings, such as EC and ECE meetings, to discuss and negotiate proposed changes and other issues. Information from the DfT indicated that the cost of a single meeting at around £1,200, with £400 of this relating to Travel and Subsistence expenses. This estimate was used for the central estimate, with values 20% higher and 20% lower for the upper and lower estimates respectively. Assuming 4 ECE meetings and 6 EC meetings per annum (with Travel and Subsistence costs refunded for EC meetings), the estimated annual cost for a single DfT attendee was between £7,680 and £11,520.

On the basis that simplification could reduce the effort required to attend regular meetings by up to 10% (Robinson *et al*., 2009) it has been estimated that an annual saving of up to £4,930 could be achieved for Government representatives assuming a single government representative attends the relevant meetings.

Table 6. Estimated Government costs for meeting attendance for Option 0 and Option 1

	Lower estimate	Central estimate	Upper estimate
Current annual cost to attend meetings	£7,501	£24,074	£49,304
Estimated saving from reduced effort	0%	5%	10%
Change to annual cost for meetings	£0	(£480)	(£1,152)

Industry also attends such meetings and also ISO/CEN meetings and Robinson *et al.* (2009) estimated that between one and three UK industry representatives currently attend each meeting. Assuming this situation is maintained, a further additional annual saving of up to £14,791 could be expected, providing reduced annual costs for Industry.

Table 7. Estimated Industry costs for meeting attendance for Option 0 and Option 1

	Lower estimate	Central estimate	Upper estimate
Current annual cost to attend meetings	£7,501	£48,148	£147,913
Estimated saving from reduced effort	0%	5%	10%
Change to annual cost for meetings	£0	(£2,407)	(£14,791)

Table 8. Estimated overall costs for Option 0 and Option 1

	Lower estimate	Central estimate	Upper estimate
Option 0 annual cost	**£30,868**	**£89,122**	**£206,494**
Option 1 one-off cost	**£78,435**	**£117,652**	**£156,870**
Option 1 annual cost	**£23,024**	**£70,547**	**£167,020**
Option 0 - Total cost 2013-2025	£352,400	£1,017,450	£2,357,419
Option 1 – Total cost 2013-2025	£337,929	£918,008	£2,056,918

7.1.2 Non-monetised impacts

The findings of the EC Impact assessment to which the UK contributed found simplification was generally considered to lead to greater transparency and harmonisation as well as reduced administrative costs. TRL's consultation found that most respondents were generally in favour of the principle of simplification and felt that it would make it easier for technical changes to be followed. However, some stakeholders raised the view that the planned administrative benefits would, in their opinion, not be realised, indicating that the benefits to Industry were perceived to be negligible.

Due to multiple technical changes with varying implementation dates, information gathering responses suggested that this may result in compliance problems for unsold or unregistered stock. One stakeholder commented that end of series approval might be required between 2013 and 2021 as a result of the many, staggered technical changes proposed by the regulation.

7.1.3 Risks and assumptions

Assumptions have been made regarding:

- Number of technical changes – a range has been estimated based on the number of changes made over the period 1996-2006 (Robinson *et al.*, 2009).
- Costs of meeting attendance – values obtained from European responses to previous consultations (Dodd, 2009) have been applied to the UK situation.

Furthermore, no allowance has been made for the fact that ECE Regulations may not cover the full scope of current technical requirements. Therefore, no costs were included for adding ECE Regulations or for any additional changes implemented during this process which would result in an additional administrative burden for UK Government.

7.1.4 Estimated effect of Option 1

The estimated effect of Option 1 was calculated by comparing the costs associated with Option 0 with those anticipated for Option 1. It was assumed that future years requiring more technical amendments would also result in meeting costs at the higher end of the estimated range. Therefore the lower estimate reflects anticipated costs with one amendment per year, the central estimate two amendments per year and the upper limit three amendments per year; the methodology is described in more detail in Appendix C. The cumulative estimated benefits (inflated at 2% per annum and discounted at 3.5% per annum) are presented below.

Table 9. Estimated net benefit of Option 1 (EC proposal) compared with Option 0 (current situation)

Year	Lower estimate	Central estimate	Upper estimate
2013	-£67,566	-£94,832	-£112,365
2014	-£60,168	-£77,311	-£75,131
2015	-£52,876	-£60,045	-£38,436
2016	-£45,691	-£43,028	-£2,272
2017	-£38,609	-£26,258	£33,367
2018	-£31,630	-£9,731	£68,489
2019	-£24,753	£6,556	£103,103
2020	-£17,975	£22,608	£137,215
2021	-£11,295	£38,426	£170,833
2022	-£4,712	£54,016	£203,963
2023	£1,776	£69,379	£236,613
2024	£8,170	£84,520	£268,790
2025	£14,471	£99,442	£300,501

Negative values indicate increased cost – i.e. a net disbenefit

7.2 Advanced Braking

The fitment of ABS to motorcycles is increasing and ACEM have reiterated their pledge to increase the fitment of advanced braking systems[12,13]. This has been used as the (Option 0 – "do nothing") situation expected to prevail if the EC proposal to mandate ABS/CBS on new vehicles from 1st January 2017 (Option 1), is not implemented.

However, there is a lack of clarity regarding whether the ACEM commitment relates to percentage of vehicles *offered* or *fitted* with ABS. Published information from ACEM differs in this respect with some statements indicating the commitment relates to *"vehicles offered with"*, or more explicitly *"as an option"*, although the most recent official statements refer to "equipped vehicles". Moreover, there are some discrepancies between the values reported from ACEM and the numbers observed from other sources. For example, ACEM stated that in 2008, 35% of European new registrations were equipped with ABS, whereas unpublished information from VOSA indicated that fitment rates in the UK may be lower. In an unpublished 2008 UK survey of eight manufacturers (six of which were in the top ten in terms of UK sales), VOSA found that only 5% of new vehicles had ABS fitted as standard with a further 10% having ABS as an option.

7.2.1 Costs

System costs (to end users) were estimated using data gathered by TRL for the EC impact assessment, with consideration of subsequent ACEM comments at MCWG[14] that the costs used were too low System costs for the Option 1 situation were difficult to estimate because the extent to which future costs are expected to reduce because of economies of scale is subject to some debate. Previous published research for mandatory fitment scenarios (Baum *et al.* 2007) incorporated large economies of scale in the expected future system price. In the light of ACEM feedback to the EC impact assessment that the motorcycle industry will not achieve these economies of scale because of the smaller number of units , the Option 1 costs were revised upward from the values used in the EC impact assessment. These were based on 50% of the Option 0 cost. Despite this increase in Option 1 cost (in relation to EC impact assessment), there is a risk that the unit costs estimated in Option 1 are still too low. If increased confidence in these estimates is required, further information gathering would be necessary.

Costs (in Euro) from Robinson *et al.* (2009) were up-rated to 2010 estimates using inflation at 2% per annum and converted to GBP using a Euro exchange rate of 1.15. Table 10 shows the costs assumed for Option 0.

Table 10. Option 0 system costs

System	Lower (£)	Central (£)	Upper (£)
ABS cost	**£138**	**£488**	**£729**
CBS cost	**£92**	**£325**	**£486**

These costs are 'end-user' costs: what the purchaser of a new motorcycle would have to pay. For Option 0, the central value for ABS systems was taken from the estimate made by

12 http://www.acem.eu/media/d_ACEM_Braking_Commitment_21346.pdf

13 http://www.acem.eu/cms/det_news.php?det=1263

14 EC Motorcycle Working Group

Kebschull and Zellner (2008) for a dual ABS system (€539). This estimate was considered to be the best estimate since it was a recent industry estimate and also broadly consistent with the median market costs obtained by TRL for optional ABS on Yamaha and BMW motorcycles. The minimum cost was taken from the difference between four models of Yamaha motorcycles with ABS and non-ABS versions, or the costs of ABS as an option (€150). These models were: Yamaha FZ1 Fazer, FZ6 Fazer, XJ Diversion and XJ6. The maximum cost of €822 was taken from information on the highest price for ABS as an optional extra on BMW motorcycles (from data on ten current BMW models). The costs for CBS were estimated because no objective evidence was forthcoming; these were set at two-thirds of the ABS cost because the rationale of requiring this system on smaller bikes is that it is a lower cost system than ABS.

Table 11. Option 1 system costs

System	Lower (£)	Central (£)	Upper (£)
ABS cost	**£92**	**£244**	**£365**
CBS cost	**£92**	**£163**	**£243**

For the Option 1 situation, the central and upper estimates for ABS and CBS were set at 50% of their respective Option 0 values to account for expected economies of scale from mandatory fitment of ABS/CBS. This resulted in a cost estimate of more than double that used by Baum *et al.* (2007). The lower estimate for ABS was set at 33% lower than Option 0. For the lower CBS estimate the same value as ABS was used; this lower estimate was considered to represent the lowest price, even at high unit volumes.

A review of more recent literature and specific cost questions in the stakeholder consultation yielded no further information. One Industry stakeholder commented "*In the time available for research, we have been unable to obtain figures*".

Multiplying the estimated number of annual registrations by the system cost ranges gives the following annual costs:

Table 12. Estimated annual costs for Option 0 and Option 1

Option	System	Annual registrations	Lower (£)	Central (£)	Upper (£)
0	ABS L3e b,c (>125cc)	75,890	£10,504,575	£37,006,313	£55,329,749
	CBS L3e a (>50cc<125cc)	41,211	£3,802,908	£13,397,173	£20,030,696
	All advanced braking	*117,101*	£14,307,483	£50,403,486	£75,360,445
1	ABS L3e b,c (>125cc)	75,890	£7,002,980	£18,503,157	£27,664,875
	CBS L3e a (>50cc<125cc)	41,211	£3,802,908	£6,698,586	£10,015,348
	All advanced braking	*117,101*	£10,805,888	£25,201,743	£37,680,223

Three different market penetration scenarios for new L category vehicles equipped with advanced braking were examined:

- Market penetration A – based on information from an unpublished VOSA survey to estimate the likely percentage of new vehicles fitted with advanced braking.

- Market penetration B – based on the Industry (ACEM) commitment milestones for percentage of new vehicles with ABS, assuming these milestones include bikes to which ABS is optional equipment.
- Market penetration C – based on the Industry (ACEM) commitment milestones for percentage of new vehicles with ABS, assuming these milestones relate to standard ABS fitment.

Using these market penetration scenarios, the percentage of new registrations equipped with advanced braking systems in each year for Option 0 and Option 1 was assumed to be as follows:

Table 13. Estimated percentage of new registrations with ABS/CBS for three fleet penetration scenarios

Year	Option 0 - A	Option 0 - B	Option 0 - C	Option 1
2013	16%	40%	65%	65%
2014	18%	45%	70%	70%
2015	20%	50%	75%	75%
2016	22%	55%	80%	80%
2017	24%	60%	85%	100%
2018	26%	65%	90%	100%
2019	28%	70%	95%	100%
2020	30%	75%	100%	100%
2021	32%	80%	100%	100%
2022	34%	85%	100%	100%
2023	36%	90%	100%	100%
2024	38%	95%	100%	100%
2025	40%	100%	100%	100%

The annual costs for fitment of advanced braking was calculated by multiplying the annual cost for fitment to all new registrations (the low, central and high estimates) by the percentage of new registrations in the table above.

Repair costs were not included because suppliers that responded to the information gathering exercise considered this cost to be negligible and that the reliability of ABS and CBS components was high (Robinson *et al.* 2009). However in the recent information gathering, some responses were received which raised concerns about both reliability and greater servicing costs. No further information was found on reliability. Stakeholder information suggested that servicing times will be increased because of the increased time required to bleed the brake systems. For a complex system, this component of time is estimated to increase from 0.5 hours to 2 hours. The assumption has been made that an increase of 0.5 hour (low), 1 hour (central estimate) and 1.5 hours will be required for a service, and that one service will be required per annum.

No information was available for CBS systems and servicing times were assumed to be unchanged using the rationale that the lower cost vehicles to which they are fitted means that the systems are expected to be relatively simple. Hourly rate for labour costs were obtained from local garages and an average value of £72 per hour (including VAT at 20%) was used.

Table 14. Estimated additional annual servicing cost for Option 1

Servicing cost	*Lower*	*Central*	*Upper*
Additional servicing cost per annum per vehicle	£36	£72	£108
Annual cost for 75,890 new registrations with ABS	£2,732,040	£5,464,080	£8,196,120

This component was also multiplied by the percentage of new registrations shown in the Table 13, and the annual servicing cost added to the system cost.

7.2.2 Benefits

Effectiveness estimates for ABS and CBS were taken from Smith *et al*. (2009) and were as follows:

Table 15. Effectiveness values used for different casualty severities

System	Casualty severity	Lower estimate	Central estimate	Upper estimate
ABS	Fatal	9%	18%	36%
	Serious	3%	10%	17%
	Slight	0%	4%	7%
CBS	Fatal	6%	8%	25%
	Serious	3%	10%	17%
	Slight	2%	14%	21%

A review of more recent literature found that these estimates remained appropriate. It should be noted that some recent studies have found fatality effectiveness estimates (expressed in various different ways) which exceeded the upper end of the range used. Further information on ABS effectiveness is provided in Appendix G.

The casualty population which could be influenced by the fitment of advanced braking systems was estimated using a similar approach to Robinson *et al*. (2009). Accident data from STATS19 for 2005-2009 inclusive was examined to obtain a 5-year average for the number of casualties. The selection criteria used was all casualties (whether motorcycle, pedestrian or occupants in other vehicles) in accidents involving at least one motorcycle and up to one other vehicle. Accidents involving more than two vehicles were excluded because they were considered too complex for conclusions to be drawn concerning the implication of changes to the safety equipment fitted to the motorcycle. The following annual casualty estimates were used:

Table 16. Number of annual casualties

Motorcycle type	Fatal	Serious	Slight
Casualties in accident with L3e A1(>50cc<125cc)	54	1,368	5,225
Casualties in accident with L3e A2/A3 (>125cc)	376	3,556	8,943

The application of the effectiveness values to these casualty populations gives estimates for the numbers of annual casualties prevented by ABS:

Table 17. Estimated number of annual casualties prevented by ABS

Casualty severity	Lower estimate	Central estimate	Upper estimate
Fatal	33	68	134
Serious	107	356	605
Slight	0	358	626

The application of the effectiveness values to these casualty populations gives estimates for the numbers of annual casualties prevented by CBS:

Table 18. Estimated number of annual casualties prevented by CBS

Casualty severity	Lower estimate	Central estimate	Upper estimate
Fatal	3	4	14
Serious	41	137	233
Slight	110	732	1097

Casualty valuations (2009 values) for fatal, serious and slight casualties (DfT, 2010) were used. These were inflated to 2013 estimates at 2% per annum and were as follows:

Table 19. DfT casualty valuations

Severity	Casualty valuation (£)
Fatal	£1,716,207
Serious	£192,846
Slight	£14,873

Multiplying the estimated number of casualties by the casualty valuations gives an estimate for the annual casualty benefit of advanced braking, assuming every bike on the road is equipped with an advanced braking system (i.e. 100% fleet penetration). For ABS, the casualty benefit is predicted to be:

Table 20. Estimated annual casualty benefit for ABS

Casualty severity	Lower estimate	Central estimate	Upper estimate
Fatal	£56,785,858	£116,152,891	£230,369,900
Serious	£20,572,823	£68,576,078	£116,579,333
Slight	£0	£5,320,233	£9,310,408

For CBS, the annual benefit is predicted to be:

Table 21. Estimated casualty benefit for CBS

Casualty severity	Lower estimate	Central estimate	Upper estimate
Fatal	£5,838,536	£7,135,989	£23,539,495
Serious	£7,914,405	£26,381,348	£44,848,292
Slight	£1,631,898	£10,879,320	£16,318,980

Overall, the estimated annual benefit (for 100% fleet penetration) is predicted to be:

Table 22. Estimated annual casualty benefit for ABS and CBS

System	Lower estimate	Central estimate	Upper estimate
ABS	£77,358,681	£190,049,202	£356,259,640
CBS	£15,384,839	£44,396,657	£84,706,768
All Advanced braking	£92,743,520	£234,445,859	£440,966,408

The benefits in each year were multiplied by the percentage of the fleet equipped with advanced braking. This was calculated assuming the total fleet size remained at 1,290,661 vehicles (DfT, 2010) and that there were the same numbers of new registrations each year (117,101; DfT, 2010).

Three different assessments were made for the percentage of motorcycles in the entire fleet fitted with ABS or CBS before the assessment period (2012): 10% (fleet 1), 20% (fleet 2) and 40% (fleet 3). The "start values" represented the current uncertainty over how many current bikes are actually equipped with advanced braking systems in the current fleet. Three rates of market penetration for *new registrations* (market penetration A, B and C) were applied to these initial fleet assumptions to generate estimates for the percentage of the entire fleet fitted with ABS or CBS.

7.2.3 Non-monetised impacts

Information gathering for this assessment identified multiple concerns that have not yet been satisfactorily quantified: unit cost, replacement parts cost, how unit cost varies with order sizes. The Regulation will set minimum requirements; however, systems with greater complexity may be required to satisfy the needs of specific rider sectors which may cost considerably more in all these areas and therefore the specifications of the system fitted by manufacturers in response to the requirements are important.

Low volume manufacturers may be disproportionately affected because the cost of a development programme for a single model would be more difficult to recoup and would result in an increase in the retail price, affecting competition. Speculative estimates show that a low volume manufacturer producing around 100 vehicles of one model per year over a four year model cycle would need to add £275 per vehicle to recover the estimated £110,000 development costs for an ABS system. For a high volume manufacturer producing around 3,000 vehicles per year, the extra cost equates to £9 per vehicle over the same four year model life. This suggests that ABS on a low volume bike is likely to be more than £400 per vehicle when parts are included and means that the effect on low volume manufacturers is likely to be a disproportionately high as not all costs may be able to be passed on to the consumer in increased retail price.

7.2.4 Risks and assumptions

In this assessment, assumptions have been made to enable analysis of the likely future effects. The main assumptions are as follows:

- Both the size of the motorcycle fleet (1,290,661 vehicles; DfT, 2010) and the number of new registrations per annum (117,101; DfT, 2010) were assumed to remain at 2008 levels throughout the period under assessment. It is known that the current economic situation has led to a short-term decrease in new registrations (MCIA pers. comm.), but is not expected to persist. Predicting future market trends is difficult and therefore the best estimate was considered to be the most recent fleet data available (2008 data).
- ABS equipped vehicles travel the same annual distances as unequipped vehicles. Thus, it is assumed that ABS and non-ABS bikes are exposed to the same accident risk.
- All vehicles of the same L category travel the average annual distance (DfT, 2010).
- Effectiveness values for the systems were based on existing data; a review of recent literature found these values were appropriate. However, values for CBS especially are based on estimated values. No further information was forthcoming in the information gathering stage of the project.
- The ACEM commitment has been assumed to cover all manufacturers however there are a small number of non-ACEM manufacturers, mainly from China and India, who import into the UK. Numbers are likely to grow in the future and these would not be bound by the ACEM commitment.

Sensitivity analysis was included in the assessment by examining ranges (representing the extremes for the estimates) for:

- System cost (low, medium, high)
- System effectiveness (low, medium, high)
- New registration fitment rate (three scenarios reflecting the available information)
- Fleet penetration rate (three scenarios reflecting the available information on the "start value" for fleet penetration of advanced braking systems)
- Servicing cost (low, medium, high)

7.2.5 Estimated effect of Option 1

The effect of Option 1 was compared to Option 0 over the period 2013 to 2026 (to cover a period of 10 years from the 2017 introduction of the requirements for advanced braking) by comparing like for like estimates (low, central, or high). In each case the comparison estimate for Option 0 was subtracted from the corresponding Option 1 estimate. Low, central and high estimates for the cost saving and benefit associated with Option 1 were produced. These were combined to provide an estimate for the net benefit of Option 1 compared to Option 0. Three Option 0 penetration rates were assessed, as well as three different fleets with differing proportions of equipped vehicles in 2012.

The fleet assumptions for the lowest net effect were that in the baseline situation, advanced braking was fitted to the highest proportion of the fleet (40% in 2012) and that the systems penetrated into the fleet at the greatest rate in the Option 0 situation (penetration rate C, fleet 3; see Figure 1). The initial baseline fleet assumptions for the highest net effect were that for the initial situation, advanced braking was fitted to the lowest proportion of the fleet (10% in 2012) and penetrated at the lowest rate compared with the proposed mandatory fitment (penetration rate A, fleet 1). The central estimate was assessed using the mid-point estimate for both the percentage of vehicles fitted with advanced braking at the start of the assessment period and the rate at which they were expected to penetrate into the fleet in Option 0 (i.e. penetration rate B, fleet 2).

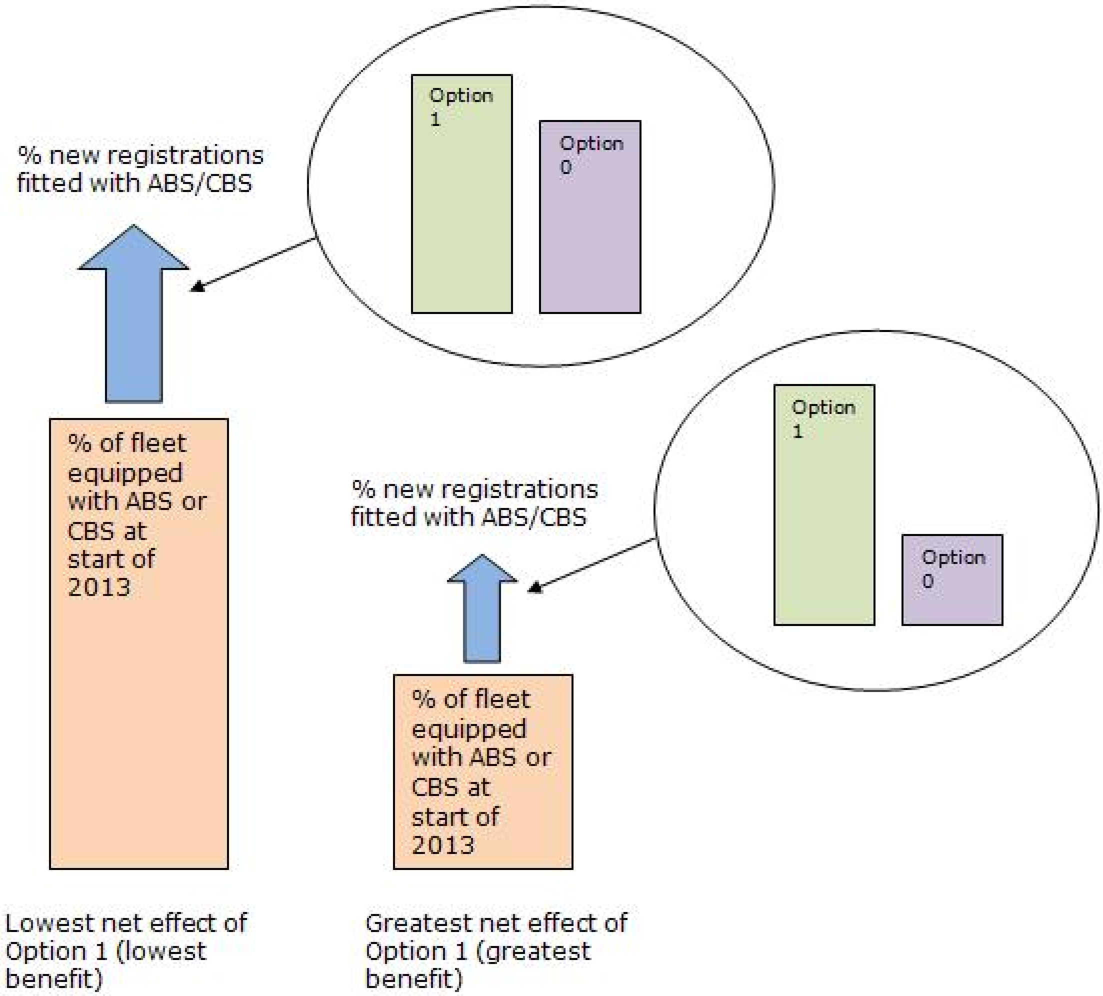

Figure 1. Diagram to show differences between assumptions for lowest and greatest net benefit of Option 1

The estimated net effect of Option 1 (compared with Option 0 in each case) is presented in Table 23. All values were inflated at 2% per annum and discounted at 3.5% per annum. This assessment used the central estimate values from each of the fleet scenarios described above to estimate the low, central and high net effect estimates.

Table 23. Estimated cumulative net effect (benefit) for Option 1

Year	Lower estimate for cumulative effect	Central estimate for cumulative net effect	Upper estimate for cumulative effect
2013	£0	£0	£0
2014	£0	£0	£0
2015	£0	£0	£0
2016	£0	£0	£0
2017	£18,115,546	£29,469,287	£40,064,306
2018	£39,634,095	£65,685,031	£90,847,921
2019	£63,761,770	£107,754,061	£151,755,154
2020	£84,555,087	£154,817,698	£222,209,334
2021	£104,614,808	£206,050,798	£301,652,331
2022	£124,383,808	£259,302,365	£389,544,080
2023	£143,866,302	£297,608,345	£485,362,118
2024	£163,066,440	£320,748,000	£571,739,547
2025	£181,988,315	£333,085,635	£648,218,291

7.3 Responsibilities of economic operators

<u>Option 0 – "Do nothing"</u>

The responsibility to ensure type approval would remain only with the manufacturer who is currently responsible for obtaining the necessary approvals and ensuring conformity of production obligations.

<u>Option 1 – Additional responsibilities of economic operators</u>

Manufacturers outside the EU are required to appoint a representative within the EU to represent their interests with the Type Approval authority. Furthermore, the manufacturer is required to appoint a representative in the EU responsible for market surveillance

Distributors and importers will have the same specific responsibilities with respect to approval and market surveillance as do manufactures. Market surveillance ensures that vehicles, systems, components and separate technical units on the market comply with the regulation. Manufacturers and importers and distributors who re-badge or modify vehicles, systems, components or technical units are responsible for approval.

7.3.1 Costs

Those economic operators from outside the EU who operate in the UK will incur additional cost in relation to the appointment of a representative to liaise with the type approval authority and undertake market surveillance. No information was found directly from this group in the information gathering process. MCIA information identifies 49 importers, but it is considered that this includes only the main operators. The number of UK distributors might be as many as 4,500.

Large operations should have few difficulties with the proposed requirements but smaller importers, particularly those importing from China and India, may have significantly increased costs in relation to a representative to liaise with type approval authorities, assuming one representative for all 27 Member States. A large company may be in a position to appoint an existing member of staff who is already dealing with type approval as the company's representative. However, in the case of a manufacturer with no staff currently in the EU, a consultant may need to be appointed or an existing member of staff relocated to the EU. In these cases, the additional costs may be considerable for wages, office space, and expenses. It may be possible to minimise costs, for example by basing a member of the manufacturer's staff with an importer into one of the EU markets. The potential cost range were speculatively estimated by one stakeholder to be between a few hundred pounds annually to £250,000 per annum for employing a type approval representative, secretary, leasing of an office, car, and expenses.

7.3.2 Market Surveillance

Approval authorities may incur increased costs to ensure that economic operators are satisfying their requirements to ensure only approved products reach the market. With the information available, it appears that the current arrangements may not be sufficient to satisfy the existing Member State requirements for market surveillance. However, the burden of additional work required by the approval authority depends on the increase in notifications from Industry or other Member States compared with the current situation.

With regard to market surveillance responsibilities, requirements to keep approval information and conformity certificates available to authorities for 10 years may not result in change for larger operations. The impact on smaller companies is unclear, although might be reasonably expected to be increased by the EC proposals. Requirements for cooperation with market surveillance and/or approval authorities are considered to result in an increase in cost associated with staff time for this activity, but this cannot be quantified with the information available.

7.3.3 Non-monetised impacts

Improved safety and environmental performance of imported products are expected by clearly defining the responsibilities for approvals and market surveillance. However, it is not possible to quantify these benefits because information on the number of companies and number of vehicles/technical units affected is unknown. It is also unknown whether any such imports are in fact below the type approval requirements and if so, how many and by how much, and what effect does this have on safety. Benefits are expected for the consumer in terms of fewer recalls because of more robust quality requirements.

According to one response from TRL's information gathering, these requirements are likely to lead to a response that at least some importer and distributors might withdraw completely from EU and UK markets due to the increased costs associated with increased responsibilities. Small operations are thought to be disproportionately affected in this respect, whereas some of the larger companies may already be compliant with the new requirements.

7.3.4 Risks and assumptions

There is a lack of information on the number of economic operators in the UK who would be affected by Option 1 and to what extent they would be affected. It is expected that major manufacturers will incur limited additional costs but the impacts for smaller scale operations cannot be estimated because of a lack of information. The short timescale allowed for the information gathering exercise was considered by stakeholders to have limited their ability to contribute information in this area.

The text of Articles 7 and 14 are ambiguous; the former implying a single manufacturer representative will be required for all 27 Member States, the latter imposing the duties of a manufacturer on importers and distributors, where they modify the vehicle before sale, hence the possibility that each importer or distributor should have a type approval representative. .

7.3.5 Estimated effect of Option 1

Costs estimated as between "a few hundred pounds" to £250,000 per economic operator for appointment of an EU representative (with associated office facilities). However, it is not known how many representatives would be required in the UK.

It is likely that the larger companies would already have, or could more easily supply this role, but the cost (between no significant additional cost and £250,000 per annum per economic operator) is dependent on whether or not staff are already based within the EU and whether their job remit already covers the role required.

7.4 Tailpipe emissions

The following scenarios have been evaluated:

- Option 1: the introduction of all of the proposed emission standards.
- Option 2: the introduction of only the first two new standards – Euro 3 & 4 (Euro 4 & 5 for L3 vehicles).

This section deals solely with the change in the emission limits. The following sections are directly related to the emissions and include:

- Evaporative emissions
- Durability requirements
- On-board diagnostics (OBD)

For this assessment, the costs and benefits are presented separately for each element. However, it should be noted that there are some inter-dependencies between them.

7.4.1 Costs

Using the revised WMTC cycle for the second reduction stage should not increase development or test costs. The revised WMTC has only minor changes in part 1 of the cycle by comparison to the version of WMTC that has been optional for testing to Euro 3 since July 2006. Respondents to the consultation were of the opinion that this represented a negligible cost increase.

The cost of additional development to meet the emission requirements (Option 1) compared with the Option 0 situation could not be assessed. – i.e. the amount of development expected in the Option 0 situation is unknown. Respondents to the information gathering request indicated that this could not be estimated at the current time.

Consultation responses indicated that for compliance with Euro 4 and 5 levels, the technical development required for compliance was expected to be achieved by optimisation of the fuel system and combustion chamber design, coupled with adjusting the catalyst loading/positioning. It should be noted that this has not been verified and no associated costs were supplied. For compliance with Euro 6, in addition to the measures for earlier levels, specific items may be required, such as:

- Graded injectors
- Closer tolerance fuel pressure regulation
- Bigger, closer coupled and higher loaded catalysts
- Fuel damper – an accumulator to absorb shocks in the fuel supply pressure due to the opening and closing of the injectors, allowing greater control over the fuelling.
- VVT – variable valve timing to allow the timing to be optimised for emission control at different engine speeds (though it's likely to be a very simple system).

The additional or the increased cost of the parts required for motorcycles were estimated by one respondent. The costs for the various stages are shown in Table 24.

In addition to an increase in the costs of parts, there will also be an increase in test costs. One respondent has indicated that this would be an increase of about £3,000 in the type approval emission tests.

Table 24: Additional part costs per vehicle to meet new emission limits

Description	Cost increment from Euro 3 (£)		
	Euro 4	Euro 5	Euro 6
Catalyst	£15.60	£34.99	£98.76
Graded injectors (+50% of existing cost)	-	£10.00	£10.00
Graded regulator (+50% of existing cost)	-	£1.82	£1.82
Fuel damper	-	£3.64	£3.64
VVT	-	-	£13.29
	£15.60	£50.45	£127.51

The additional costs required to meet the new emissions legislation are shown in Table 25 for Option 1 and in Table 26 for Option 2. The costs include estimates on the additional parts costs and the additional type approval test costs. These have been annualised (based on the expected number of new registrations each year and estimating the number of models requiring type approval each year). As the type approval certification would cover all vehicles sold in Europe, these type approval costs have been factored to estimate the share of the cost that would be attributed to the UK market (UK registrations were 5.6% of the total European registrations for the period 2007-2010, so this figure has been used for all categories). The test costs have also been factored by the average life of the vehicles (assumed to be 5 years for small bikes and 10 years for all other vehicles). The total costs are shown both undiscounted and discounted by 3.5% per year. Investment costs required for either producing the new vehicles or testing to the new regulations are not included in these costs.

Table 25: Annualised costs (£) for Option 1

Year	Parts costs	TA test costs	Total	Inflated	Discounted	Cumulative
2013	£12,980	£4,200	£17,180	£18,231	£16,443	£16,443
2014	£76,193	£4,200	£80,393	£87,020	£75,833	£92,276
2015	£354,912	£4,200	£359,112	£396,489	£333,833	£426,109
2016	£597,580	£4,200	£601,780	£677,702	£551,311	£977,420
2017	£1,360,265	£4,200	£1,364,465	£1,567,341	£1,231,916	£2,209,336
2018	£2,088,999	£4,200	£2,093,199	£2,452,516	£1,862,469	£4,071,805
2019	£2,725,270	£4,200	£2,729,470	£3,261,969	£2,393,408	£6,465,213
2020	£3,538,537	£4,200	£3,542,737	£4,318,577	£3,061,520	£9,526,733
2021	£5,211,811	£4,200	£5,216,011	£6,485,454	£4,442,184	£13,968,917
2022	£6,672,647	£4,200	£6,676,847	£8,467,856	£5,603,886	£19,572,802
2023	£7,950,916	£4,200	£7,955,116	£10,290,791	£6,579,975	£26,152,777
2024	£9,071,967	£4,200	£9,076,167	£11,975,810	£7,398,437	£33,551,214
2025	£10,057,342	£4,200	£10,061,542	£13,541,510	£8,082,801	£41,634,015

Table 26: Annualised costs (£) for Option 2

Year	Parts costs	TA test costs	Total	Inflated	Discounted	Cumulative
2013	£12,980	£4,200	£17,180	£18,231	£16,443	£16,443
2014	£76,193	£4,200	£80,393	£87,020	£75,833	£92,276
2015	£354,912	£4,200	£359,112	£396,489	£333,833	£426,109
2016	£597,580	£4,200	£601,780	£677,702	£551,311	£977,420
2017	£1,360,265	£4,200	£1,364,465	£1,567,341	£1,231,916	£2,209,336
2018	£2,024,883	£4,200	£2,029,083	£2,377,394	£1,805,420	£4,014,756
2019	£2,605,361	£4,200	£2,609,561	£3,118,667	£2,288,263	£6,303,019
2020	£3,113,504	£4,200	£3,117,704	£3,800,464	£2,694,220	£8,997,239
2021	£3,559,331	£4,200	£3,563,531	£4,430,802	£3,034,859	£12,032,098
2022	£3,951,359	£4,200	£3,955,559	£5,016,606	£3,319,906	£15,352,004
2023	£4,296,843	£4,200	£4,301,043	£5,563,858	£3,557,554	£18,909,558
2024	£4,601,967	£4,200	£4,606,167	£6,077,739	£3,754,717	£22,664,275
2025	£4,872,017	£4,200	£4,876,217	£6,562,746	£3,917,242	£26,581,516

7.4.2 Benefits

It is expected that the measure will lead to a reduction in the emissions of CO, HC, NO_x and PM from new vehicles, which will improve the local air quality. Although fitting emission control devices and running at stoichiometric (for the efficient operation of three-way catalytic converters) means that fuel economy cannot be optimised, the likely switch from simple carburettors to more sophisticated fuel control systems (fuel injection *etc.*) is likely to lead to improvements in fuel economy. The estimated change in annual emissions are shown in Table 27 and Table 28 for the two options.

Table 27: Change in the yearly emissions (tonnes) for Option 1

Year	CO	HC	NO_x	PM
2013	- 1.27	-	- 0.10	- 0.09
2014	- 7.41	-	- 0.60	- 0.51
2015	- 49.28	0.26	- 4.61	- 2.17
2016	- 85.31	0.47	- 8.05	- 3.55
2017	- 452.68	5.56	- 50.26	- 4.70
2018	- 782.64	2.85	- 87.91	- 5.68
2019	- 1,076.84	0.48	- 121.01	- 6.49
2020	- 1,351.64	- 29.36	- 152.72	- 7.24
2021	- 1,642.54	- 158.85	- 190.33	- 8.16
2022	- 1,903.03	- 268.67	- 223.64	- 8.92
2023	- 2,136.68	- 361.94	- 253.21	- 9.55
2024	- 2,346.54	- 441.29	- 279.51	- 10.07
2025	- 2,535.32	- 508.91	- 302.95	- 10.51

Table 28: Change in the yearly emissions (tonnes) for Option 2

Year	CO	HC	NOx	PM
2013	- 1.27	-	- 0.10	- 0.09
2014	- 7.41	-	- 0.60	- 0.51
2015	- 49.28	0.26	- 4.61	- 2.17
2016	- 85.31	0.47	- 8.05	- 3.55
2017	- 452.68	5.56	- 50.26	- 4.70
2018	- 779.64	9.79	- 87.27	- 5.66
2019	- ,071.16	13.30	- 119.80	- 6.46
2020	- 1,331.55	16.23	- 148.45	- 7.12
2021	- 1,564.53	18.66	- 173.73	- 7.67
2022	- 1,773.31	20.67	- 196.10	- 8.13
2023	- 1,960.70	22.35	- 215.93	- 8.51
2024	- 2,129.14	23.74	- 233.53	- 8.83
2025	- 2,280.74	24.90	- 249.20	- 9.09

The emissions factors for current vehicles are taken from EMEP/EEA (Ntziachristos & Samaras, 2009) or TRL/DFT (Boulter *et al.*, 2009), as shown in the following tables. For future vehicle types, the Euro 2 values are factored according to the change in type approval emission limits, unless they are already well below the limits. The emissions factors were also adjusted where considered necessary.

Table 29: L1 petrol vehicles

					Emission Factors			
	g/km				**g/km**			
	CO	**HC**	**NO_x**	**PM**	**CO**	**HC**	**NO_x**	**PM**
Pre-Euro 1					13.80	13.91	0.02	0.188
Euro 1	6	1.5	1.5		5.60	2.73	0.02	0.076
Euro 2	1	0.6	0.6		1.30	1.56	0.26	0.038
Euro 3	1	0.6	0.6		1.00	1.56	0.26	0.011
Euro 4	1	0.63	0.17		1.00	1.64	0.07	0.011
Euro 5	1	0.1	0.06	0.0045	1.00	0.26	0.03	0.006

Emissions factors source: Pre-Euro 1 to Euro 2: EMEP/EEA
Euro 3 onwards – factored Euro 2

Table 30: L3, 4, & 5 petrol vehicles – top speed less than 130 km/h

					Emission factors			
	g/km				g/km			
	CO	HC	NO_x	PM	CO	HC	NO_x	PM
Pre-Euro 1					15.07	1.03	0.34	0.020
Euro 1	13	3	0.3		10.94	0.92	0.37	0.020
Euro 2	5.5	1.2	0.3		4.10	0.44	0.28	0.005
Euro 3	2	0.8	0.15		2.26	0.27	0.14	0.005
Euro 4	1.97	0.56	0.13		2.23	0.27	0.13	0.005
Euro 5	1.14	0.38	0.07		1.29	0.27	0.07	0.005
Euro 6	1	0.1	0.06	0.0045	1.13	0.07	0.06	0.005

Emissions factors source: *Pre-Euro 1 to Euro 3: TRL/DfT*
Euro 4 onwards – factored Euro 2

Table 31: L3, 4, & 5A petrol vehicles – top speed greater than 130 km/h

					Emission factors			
	g/km				g/km			
	CO	HC	NO_x	PM	CO	HC	NO_x	PM
Pre-Euro 1					20.71	1.51	0.34	0.020
Euro 1	13	3	0.3		13.06	0.61	0.34	0.020
Euro 2	5.5	1	0.3		3.72	0.34	0.32	0.005
Euro 3	2	0.3	0.15		2.05	0.21	0.16	0.005
Euro 4	1.97	0.25	0.17		2.05	0.21	0.16	0.005
Euro 5	1.14	0.17	0.09		1.19	0.21	0.09	0.005
Euro 6	1	0.1	0.06	0.0045	1.04	0.12	0.06	0.005

Emissions factors source: *Pre-Euro 1 to Euro 3: TRL/DfT*
Euro 4 onwards – factored Euro 2

Table 32: L5B petrol vehicles

					Emission factors			
	g/km				g/km			
	CO	HC	NO_x	PM	CO	HC	NO_x	PM
Pre-Euro 1					41.43	3.02	0.68	0.040
Euro 1	19.5	4.5	0.45		26.12	1.21	0.68	0.040
Euro 2	7	1.5	0.4		7.43	0.67	0.64	0.010
Euro 3	4	1	0.25		4.25	0.67	0.40	0.010
Euro 4	2	0.55	0.25		2.12	0.67	0.40	0.010
Euro 5	1	0.1	0.06	0.0045	1.06	0.12	0.10	0.005

Emissions factors source: *Pre-Euro 1 to Euro 2: L3 emissions * 2*
Euro 4 onwards – factored Euro 2

Table 33: L6 petrol vehicles

					Emission factors			
	g/km				g/km			
	CO	HC	NO_x	PM	CO	HC	NO_x	PM
Pre-Euro 1					41.43	3.02	0.68	0.040
Euro 1	19.5	4.5	0.45		26.12	1.21	0.68	0.040
Euro 2	7	1.5	0.4		7.43	0.67	0.64	0.010
Euro 3	3.5	0.6	0.6		3.72	0.67	0.96	0.010
Euro 4	1.9	0.73	0.17		2.02	0.82	0.27	0.010
Euro 5	1	0.1	0.06	0.0045	1.06	0.11	0.10	0.005

*Emissions factors source: Pre-Euro 1 to Euro 2: L3 emissions * 2*
Euro 4 onwards – factored Euro 2

Table 34: L7 petrol vehicles

					Emission factors			
	g/km				g/km			
	CO	HC	NO_x	PM	CO	HC	NO_x	PM
Pre-Euro 1					41.43	3.02	0.68	0.040
Euro 1	19.5	4.5	0.45		26.12	1.21	0.68	0.040
Euro 2	7	1.5	0.4		7.43	0.67	0.64	0.010
Euro 3	4	1	0.25		4.25	0.67	0.40	0.010
Euro 4	2	0.55	0.25		2.12	0.37	0.40	0.010
Euro 5	1	0.1	0.06	0.0045	1.06	0.07	0.10	0.005

*Emissions factors source: Pre-Euro 1 to Euro 2: L3 emissions * 2*
Euro 4 onwards – factored Euro 2

The emissions have been monetised using two approaches:

- The damage costs for CO, HC & PM. The damage cost is also used for NO_x but only for areas which do not exceed the NO_2 air quality limits – see Table 35.
- For areas which do exceed the air quality limits for NO_2, the abatement costs have been used – see Table 36. For each vehicle category, the percentage of their mileage spent in urban areas haves been estimated. An assumption has also been made about the percentage of urban areas where air quality exceedences occur in order to derive the overall damage plus abatement costs – see Table 37.

Table 35: Damage cost values of various pollutants[15] (£/tonne)

Pollutant	Low	Central	High
CO	*1*	1.64	*2*
HC	*240*	308	*350*
NO_x	681	875	993
PM	34753	**44430**	**50439**

Table 36: Abatement costs for NO_x[16] (£/tonne)

	Abatement costs (£/t)		
Pollutant	**Low**	**Central**	**High**
NO_x	28,669	29,488	73,477

[15] PM & NO_x values taken from:

http://www.defra.gov.uk/environment/quality/air/airquality/panels/igcb/documents/damage-cost-calculator-guidancepaper.pdf

CO & HC values taken from DfT's National Modelling Framework Environment Module

[16] Values supplied by Roald Dickens, Defra, 16 February 2011

Table 37: Abatement plus damage cost values for NO_x for each category (£/tonne) (assuming 50% of urban driving is in areas of exceedance %age Abatement cost = %age Urban driving * 50%)

					Damage + abatement cost (£/t)		
Description			%age Urban driving	%age Abatement cost	Low	Central	High
L1Ae	Powered cycle		100%	50.0%	14,675	15,181	37,235
L1Be	Two-wheel moped		100%	50.0%	14,675	15,181	37,235
L2e	Three-wheel moped		100%	50.0%	14,675	15,181	37,235
L3e L4e L5Ae L7Ae	-Two-wheel motorcycle with/without side-car - Tricycle - Heavy on-road quad	vmax < 130 km/h	50%	25.0%	7,678	8,028	19,114
		vmax ≥ 130 km/h	40%	20.0%	6,279	6,597	15,490
L5Be	Commercial tricycle		50%	25.0%	7,678	8,028	19,114
L6Ae	Light on-road quad		50%	25.0%	7,678	8,028	19,114
L6Be	Light mini-car		50%	25.0%	7,678	8,028	19,114
L7Be	Heavy mini-car		50%	25.0%	7,678	8,028	19,114

7.4.3 Non-monetised impacts

The reduction in emissions is expected to lead to a corresponding reduction in acidification and eutrophication.

7.4.4 Risks and assumptions

Assumptions have been made regarding:

- Both the motorcycle fleet and new registrations were assumed to remain at 2008 levels (DfT, 2010) throughout the period under assessment.
- All vehicles of the same category travel the same annual distance (DfT, 2010) which remains constant throughout the period of the assessment.
- Fleet data for the number of L5, L6 and L7 vehicles has been estimated due to lack of information.
- To estimate the evolution of the fleet as new vehicles are introduced, a scrappage rate has been determined for each class of vehicle, based on the number of total registrations and new registrations, which is applied equally to vehicles of all ages.

7.4.5 Estimated effect of Option 1

The estimated net effect of the introduction of the new emission limits are shown below, for the years 2013 (the first year the new emission limits are likely to affect) until 2025. The gross benefit is based simply on the reduction in the social/abatement cost due to the resulting reduction in exhaust emissions. The net benefit is the gross benefit minus the cost involved in achieving the emissions limits, as detailed earlier. Three cost bands are shown, corresponding to the low, central and high damage cost values.

Table 38. Cumulative gross and net benefits (£) of the reduction in emissions due to the introduction of lower exhaust emissions limits – Option 1

Gross benefit			
Year	**Low**	**Central**	**High**
2013	£3,661	£4,502	£6,095
2014	£24,702	£30,376	£41,124
2015	£130,349	£157,043	£231,578
2016	£304,639	£365,403	£548,494
2017	£853,402	£972,064	£1,767,776
2018	£1,720,826	£1,917,828	£3,754,259
2019	£2,853,254	£3,145,421	£6,379,582
2020	£4,232,531	£4,636,757	£9,594,692
2021	£5,915,712	£6,457,253	£13,516,516
2022	£7,851,194	£8,550,769	£18,026,179
2023	£9,995,533	£10,870,076	£23,023,447
2024	£12,312,097	£13,375,381	£28,423,675
2025	£14,769,953	£16,033,107	£34,155,261
Net benefit			
Year	**Low**	**Central**	**High**
2013	-£12,783	-£11,942	-£10,349
2014	-£67,574	-£61,900	-£51,152
2015	-£295,760	-£269,066	-£194,532
2016	-£672,781	-£612,017	-£428,926
2017	-£1,355,934	-£1,237,272	-£441,561
2018	-£2,350,978	-£2,153,977	-£317,546
2019	-£3,611,958	-£3,319,792	-£85,630
2020	-£5,294,202	-£4,889,976	£67,959
2021	-£8,053,205	-£7,511,664	-£452,401
2022	-£11,721,608	-£11,022,033	-£1,546,624
2023	-£16,157,244	-£15,282,701	-£3,129,330
2024	-£21,239,117	-£20,175,832	-£5,127,539
2025	-£26,864,061	-£25,600,908	-£7,478,754

7.4.6 Estimated effect of Option 2

The benefits of introducing only the first two of the new Euro standards (Euro 3 & 4 or Euro 4 & 5 for L3 category) are shown in Table 39.

Table 39. Cumulative gross and net benefits (£) of the reduction in emissions due to the introduction of lower exhaust emissions limits – Option 2

Gross benefit			
Year	**Low**	**Central**	**High**
2013	£3,661	£4,502	£6,095
2014	£24,702	£30,376	£41,124
2015	£130,349	£157,043	£231,578
2016	£304,639	£365,403	£548,494
2017	£853,402	£972,064	£1,767,776
2018	£1,713,915	£1,910,122	£3,739,152
2019	£2,833,645	£3,123,564	£6,336,679
2020	£4,168,531	£4,565,426	£9,454,650
2021	£5,681,566	£6,196,278	£13,004,211
2022	£7,341,623	£7,982,965	£16,910,562
2023	£9,122,478	£9,897,569	£21,110,638
2024	£11,002,009	£11,916,547	£25,551,185
2025	£12,961,522	£14,020,014	£30,187,169
Net benefit			
Year	**Low**	**Central**	**High**
2013	-£12,783	-£11,942	-£10,349
2014	-£67,574	-£61,900	-£51,152
2015	-£295,760	-£269,066	-£194,532
2016	-£672,781	-£612,017	-£428,926
2017	-£1,355,934	-£1,237,272	-£441,561
2018	-£2,300,841	-£2,104,634	-£275,605
2019	-£3,469,374	-£3,179,455	£33,660
2020	-£4,828,709	-£4,431,813	£457,411
2021	-£6,350,532	-£5,835,820	£972,113
2022	-£8,010,382	-£7,369,039	£1,558,558
2023	-£9,787,080	-£9,011,989	£2,201,080
2024	-£11,662,266	-£10,747,728	£2,886,910
2025	-£13,619,994	-£12,561,502	£3,605,653

7.5 Evaporative emissions

The EC has proposed a new test to control evaporative emissions, although the specific test details have not been developed. This makes it difficult to assess the costs and benefits of this technical requirement.

7.5.1 *Costs*

Costs associated with the new evaporative test can only be considered on a speculative basis because the test method has not been specified in the EC's proposal. The method will determine the cost associated with the test itself and the equipment that needs to be fitted to each motorcycle produced.

Two scenarios have been identified. If the Commission specifies a test aligned broadly with the current California motorcycle evaporative test (one hour diurnal with fixed heat slope/ one hour hot soak), then investment in test equipment could be virtually zero for some UK manufacturers. However, it is likely that some manufacturers who do not sell in US markets would require initial investment to be able to carry out the test.

Assuming the facilities are already in place, consultation responses indicated that the type approval cost is approximately £500 per vehicle type tested for an instrumented fuel tank for the diurnal test which requires thermocouples, heat pads and connectors in addition to the tank itself. The cost of a canister, purge valve, hoses and other associated parts was estimated as being about £20 per vehicle. One respondent provided some costs for individual parts – see Table 40.

Table 40: Additional parts cost per vehicle to control evaporative emissions

Description	Cost increment from Euro 3 (£)		
	Euro 4	Euro 5	Euro 6
Evap system	-	£17.60	£17.60
Evap pressure control valve	-	£3.64	£3.64
Total	-	£21.24	£21.24

The additional costs required to meet the new evaporative emissions legislation are shown in Table 41 for Option 1 and in Table 42 for Option 2. The costs include estimates of the additional parts costs and the additional type approval test costs. As the type approval certification would cover all vehicles sold in Europe but the benefit assessment has considered the benefit only from vehicles sold in the UK, these type approval costs have been factored to estimate the share of the cost that would be attributed to the UK market (UK registrations were 5.6% of the total European registrations for the period 2007-2010, so this figure has been used for all categories). The test costs have also been factored by the average life of the vehicle type (assumed to be 5 years for small bikes and 10 years for all other vehicles). These have been annualised (based on the expected number of new registrations each year and estimating the number of models requiring type approval each year). The total costs are shown both undiscounted and discounted by 3.5% per year. Investment costs required for either producing the new vehicles or testing to the new regulations are not included in these costs.

Table 41: Cost of meeting evaporative emissions - Option 1

Year	Parts costs	TA test costs	Total	Inflated	Discounted	Cumulative
2013	£0	£700	£700	£743	£670	£670
2014	£0	£700	£700	£758	£660	£1,330
2015	£17,672	£700	£18,372	£20,284	£17,079	£18,409
2016	£33,050	£700	£33,750	£38,008	£30,920	£49,329
2017	£382,235	£700	£382,935	£439,872	£345,735	£395,064
2018	£686,145	£700	£686,845	£804,749	£611,135	£1,006,200
2019	£951,252	£700	£951,952	£1,137,671	£834,744	£1,840,944
2020	£1,183,036	£700	£1,183,736	£1,442,968	£1,022,947	£2,863,891
2021	£1,386,146	£700	£1,386,846	£1,724,369	£1,181,099	£4,044,990
2022	£1,564,529	£700	£1,565,229	£1,985,089	£1,313,699	£5,358,689
2023	£1,721,545	£700	£1,722,245	£2,227,908	£1,424,533	£6,783,222
2024	£1,860,055	£700	£1,860,755	£2,455,227	£1,516,795	£8,300,017
2025	£1,982,504	£700	£1,983,204	£2,669,131	£1,593,179	£9,893,196

Table 42: Cost of meeting evaporative emissions - Option 2

Year	Parts costs	TA test costs	Total	Inflated	Discounted	Cumulative
2013	£0	£700	£700	£743	£670	£670
2014	£0	£700	£700	£758	£660	£1,330
2015	£17,672	£700	£18,372	£20,284	£17,079	£18,409
2016	£33,050	£700	£33,750	£38,008	£30,920	£49,329
2017	£382,235	£700	£382,935	£439,872	£345,735	£395,064
2018	£686,145	£700	£686,845	£804,749	£611,135	£1,006,200
2019	£951,252	£700	£951,952	£1,137,671	£834,744	£1,840,944
2020	£1,183,036	£700	£1,183,736	£1,442,968	£1,022,947	£2,863,891
2021	£1,386,146	£700	£1,386,846	£1,724,369	£1,181,099	£4,044,990
2022	£1,564,529	£700	£1,565,229	£1,985,089	£1,313,699	£5,358,689
2023	£1,721,545	£700	£1,722,245	£2,227,908	£1,424,533	£6,783,222
2024	£1,860,055	£700	£1,860,755	£2,455,227	£1,516,795	£8,300,017
2025	£1,982,504	£700	£1,983,204	£2,669,131	£1,593,179	£9,893,196

If the Commission specifies a test more closely aligned with the European car test (24 hour variable temperature diurnal/ one hour hot soak), then a new (additional) shed will be required at a cost of approximately £500,000. A 24-hour diurnal test requires a variable volume shed with climatic control. Consequently, a new shed facility would be required together with a building in which to locate it. Responses from the consultation indicated that it was very difficult to estimate costs per vehicle for this test; they may be similar to the California test, but this is unknown at the present time.

One respondent from Industry indicated that ACEM intend to present the Commission with a proposal for a test method based on the California test.

7.5.2 *Benefits*

An evaporative emissions test should result in a reduction in evaporative emissions – *i.e.* in the emissions of HC. This will also lead to a reduction in various HC species – benzene, toluene *etc.* The estimated annual change in hydrocarbon emissions is shown in Table 43 and Table 44 for the two options.

Table 43: Yearly change in evaporative emissions (tonnes) for option1

Year	HC
2013	-
2014	-
2015	- 2.06
2016	- 3.95
2017	- 44.87
2018	- 83.03
2019	- 117.98
2020	- 152.74
2021	- 194.96
2022	- 233.61
2023	- 269.01
2024	- 301.42
2025	- 331.10

Table 44: Yearly change in evaporative emissions (tonnes) for option2

Year	HC
2013	-
2014	-
2015	- 2.06
2016	- 3.95
2017	- 44.87
2018	- 82.34
2019	- 116.65
2020	- 148.07
2021	- 176.85
2022	- 203.20
2023	- 227.33
2024	- 249.43
2025	- 269.67

7.5.3 *Non-monetised impacts*

If a test more aligned with the European car test is implemented, Industry indicate that this could have a delaying effect on manufacturer development work.

7.5.4 *Risks and assumptions*

The fleet assumptions used are the same as used for the exhaust emissions. There is only a limited amount of data on evaporative emissions from two and three-wheelers. The following rates have been used, which, for existing vehicles types, have been estimated from a graph in the LAT report (Ntziachristos *et al.*, 2009). Three and four wheelers are assumed to have the same evaporative emissions as large motorcycles.

Table 45: Evaporative emissions (g/day)

Emission stage	L1	L3, L4 & L5A <130 km/h	L3, L4 & L5A >130 km/h	L5B	L6e	L7
Pre-Euro 1	0.95	1.50	4.00	4.00	4.00	4.00
Euro 1	0.95	1.50	4.00	4.00	4.00	4.00
Euro 2	0.95	1.50	4.00	4.00	4.00	4.00
Euro 3	0.95	1.50	4.00	4.00	4.00	4.00
Euro 4	0.95	1.50	4.00	4.00	4.00	4.00
Euro 5	0.95	1.50	2.50	2.00	2.00	2.00
Euro 6		1.50	2.00			

According to the LAT the evaporative emissions from mopeds and small motorcycles are already very low – about 0.9 and 1.5 g per day respectively. Therefore, the proposed limits may have very little or no affect on these categories. Ideally, further research needs to be undertaken to see if it in fact worth performing an evaporative emissions test on these vehicles. The damage cost values of HC are the same as for the exhaust emissions.

Relevant information is limited and the required information cannot be fully defined until such a time as the proposed test is better specified.

7.5.5 *Estimated effect of Option 1*

The gross and net benefits estimates of an evaporative emissions test are shown in Table 46, for the years 2013 (as a comparison to the benefits of the new emission limits, although the evaporative emissions don't show a benefit until 2015) to 2025. Three cost benefits are shown, corresponding to the low, central and high damage cost values.

Table 46. Cumulative gross and net benefits (£) of the reduction in emissions due to the introduction of evaporative emission limits – Option 1

Gross benefit			
Year	**Low**	**Central**	**High**
2013	-	-	-
2014	-	-	-
2015	£460	£591	£671
2016	£1,329	£1,705	£1,938
2017	£11,051	£14,182	£16,116
2018	£28,782	£36,936	£41,973
2019	£53,610	£68,799	£78,181
2020	£85,289	£109,454	£124,379
2021	£125,136	£160,592	£182,491
2022	£172,193	£220,981	£251,115
2023	£225,594	£289,513	£328,992
2024	£284,563	£365,189	£414,988
2025	£348,400	£447,113	£508,083
Net benefit			
Year	**Low**	**Central**	**High**
2013	-£670	-£670	-£670
2014	-£1,330	-£1,330	-£1,330
2015	-£17,949	-£17,819	-£17,738
2016	-£48,000	-£47,624	-£47,391
2017	-£384,013	-£380,882	-£378,948
2018	-£977,418	-£969,263	-£964,227
2019	-£1,787,335	-£1,772,145	-£1,762,763
2020	-£2,778,603	-£2,754,437	-£2,739,512
2021	-£3,919,854	-£3,884,398	-£3,862,499
2022	-£5,186,496	-£5,137,708	-£5,107,574
2023	-£6,557,628	-£6,493,710	-£6,454,230
2024	-£8,015,454	-£7,934,828	-£7,885,029
2025	-£9,544,796	-£9,446,083	-£9,385,113

7.5.6 *Estimated effect of Option 2*

The gross and net benefit of the introduction only the first two of the new Euro standards (Euro 3 & 4 or Euro 4 & 5 for L3 category) are shown in Table 47.

Table 47. Cumulative gross and net benefits (£) of the reduction in emissions due to the introduction of evaporative emission limits – Option 2

Gross benefit			
Year	**Low**	**Central**	**High**
2013	-	-	-
2014	-	-	-
2015	£460	£591	£671
2016	£1,329	£1,705	£1,938
2017	£11,051	£14,182	£16,116
2018	£28,634	£36,747	£41,758
2019	£53,183	£68,252	£77,559
2020	£83,894	£107,663	£122,345
2021	£120,040	£154,052	£175,059
2022	£160,971	£206,580	£234,750
2023	£206,100	£264,494	£300,562
2024	£254,897	£327,118	£371,725
2025	£306,889	£393,841	£447,546
Net benefit			
Year	**Low**	**Central**	**High**
2013	-£670	-£670	-£670
2014	-£1,330	-£1,330	-£1,330
2015	-£17,949	-£17,819	-£17,738
2016	-£48,000	-£47,624	-£47,391
2017	-£384,013	-£380,882	-£378,948
2018	-£977,566	-£969,453	-£964,442
2019	-£1,787,761	-£1,772,692	-£1,763,385
2020	-£2,779,998	-£2,756,228	-£2,741,547
2021	-£3,924,950	-£3,890,938	-£3,869,931
2022	-£5,197,718	-£5,152,109	-£5,123,939
2023	-£6,577,123	-£6,518,728	-£6,482,660
2024	-£8,045,120	-£7,972,899	-£7,928,292
2025	-£9,586,307	-£9,499,355	-£9,445,650

7.6 Durability requirements

There are currently no European durability requirements for L category vehicles, although tests are required for some other markets (e.g. US EPA test). The EC has proposed values for durability distance accumulation, but have not yet specified details of the drive cycles used to accumulate these distances. Test costs and whether or not new facilities are required will depend on the drive cycle chosen so it is difficult to assess the UK impact at the time of writing. The various mileage requirements are listed in Table 48.

Stakeholders responding to TRL's questionnaire have suggested it is likely that ACEM will propose to the EC a test based on the US EPA test. Stakeholder responses also indicated that it is expected that the Commission will consider international harmonisation and base their proposal on the current US EPA durability test.

Table 48: Proposed durability requirements: L category vehicles

		Durability distance (km)		
Vehicle category	**Vehicle category name**	**Euro 3(4)**	**Euro 4(5)**	**Euro 5(6)**
L1Ae	- Powered cycle	5,000	5,500	6,000
L1Be L2e L6Ae	- Two-wheel moped - Three-wheel moped -Light on-road quad	10,000	11,000	12,000
L3e L4e L5e L6Be L7Be	- Two-wheel motorcycle, with and without side-car (v_{max} < 130 km/h) - Tricycle - Light mini-car -Heavy mini-car	18,000	20,000	30,000
L3e L4e L7Ae	- Two-wheel motorcycle, with and without side-car ($v_{max} \geq 130$ km/h) - Heavy on-road quad	30,000	35,000	50,000

As an alternative to mileage accumulation, there may be an option to use deterioration factors – emission tests are carried out on a vehicle that has covered 100 km. The emissions are then multiplied by the relevant deterioration factor. The resulting values must still be within the set limits.

However, to be able to use this approach, the manufacturer will have to prove to the type approval authorities the validity of this approach – using both rapidly aged systems (catalytic converter etc.) and also over a full mileage accumulation. It is unclear from the documentation how often this proof testing would have to be undertaken.

7.6.1 Costs

Typically, durability requirements are expected to have little effect on vehicle construction costs, because other markets already impose durability requirements (US) and stakeholders commented that vehicles are designed to be durable. However, according to Industry stakeholders that contributed to this study, there is a significant cost associated with testing a vehicle, mainly because of the time and effort required to accumulate the required mileages; the additional cost of testing will depend on how similar the test that the EC eventually propose is to the existing EPA test.

A durability test for US EPA certification for a large motorcycle type (L3e) reportedly costs approximately £20,000 to complete. Information from Industry also indicates that this can take up to four months, depending on the prevailing weather and associated safety issues. The EPA procedure requires only 50% of the test distance to be run (with the final result extrapolated from half-distance) and therefore this cost is for a 15,000km test distance. This equates to a 2010 cost of £1.33 per kilometre, based on a fuel cost of £1.15 per litre.

Assuming the costs are the same as for the EPA test, a durability distance of 50,000km (Limit proposed by EC for Euro 5 vehicles of category L3e, L4e, L7Ae) and assuming the full distance is driven would result in an estimate that the test would cost approximately £66,650 (£1.333 x 50,000) and would take almost one year to complete. The 50,000 km stage only refers to the larger vehicles at stage Euro 5 (6). The cost of the other durability requirements (factored by the appropriate distance) are shown in Table 49. The actual costs will vary depending on the actual test requirements, including how often emission tests are required during the mileage accumulation. Stakeholders suggest that this would have adverse consequences for manufacturers production schedules, because they state that a typical motorcycle currently has a "drawing board to production" timeline of approximately two years. Respondents to the information gathering exercise indicated this would present a problem because "*a fully developed product would not be available half-way through the design phase and it would be uneconomical to delay the start of volume production*".

Table 49. Cost of the various durability tests

Description	Cost (£)		
	Euro 3 (4)	Euro 4 (5)	Euro 5 (6)
Durability - small	13,330.00	14,663.00	15,996.00
Durability < 130 km/h	23,994.00	26,660.00	39,990.00
Durability > 130 km/h	39,990.00	46,655.00	66,650.00

Should a test of 50,000 km be introduced, the test time is reported to be a significant problem for Industry. At the time of writing, it is uncertain whether an alternative to the full mileage accumulation will be a permitted option. Furthermore, dedicated equipment would also be required to ensure that the test could be run in all climatic conditions and for the maximum period each day (16 hours in 24 according to EPA rules). It was estimated by one Industry stakeholder that the minimum one-off costs for installing the required equipment is £250,000. It is not known if these facilities are already available to the vehicle manufacturer for other worldwide markets, so any additional investment costs has not been included in the overall costs.

Smaller UK manufacturers may not currently undertake the US EPA test if they do not sell into US markets. Therefore the cost effects for them are likely to be considerably greater than for larger exporting companies who already carry out the test. Only one manufacturer provided responses to the information gathering and so the position for other UK manufacturers is unknown. The estimated cost required for meeting the durability requirements are shown in Table 50. From the feedback obtained, modifications required to the vehicle are negligible. However, there is significant costs involved in carrying out mileage accumulation over the full distance.

Table 50: Cost of meeting durability requirements

Year	Parts costs	TA test costs	Total	Inflated	Discounted	Cumulative
2013	£0	£41,952	£41,952	£44,520	£40,154	£40,154
2014	£0	£41,952	£41,952	£45,410	£39,573	£79,727
2015	£0	£48,073	£48,073	£53,077	£44,689	£124,416
2016	£0	£48,073	£48,073	£54,138	£44,042	£168,458
2017	£0	£48,073	£48,073	£55,221	£43,403	£211,861
2018	£0	£68,527	£68,527	£80,290	£60,973	£272,834
2019	£0	£68,527	£68,527	£81,896	£60,090	£332,924
2020	£0	£68,527	£68,527	£83,534	£59,219	£392,143
2021	£0	£68,527	£68,527	£85,205	£58,360	£450,503
2022	£0	£68,527	£68,527	£86,909	£57,515	£508,018
2023	£0	£68,527	£68,527	£88,647	£56,681	£564,699
2024	£0	£68,527	£68,527	£90,420	£55,860	£620,559
2025	£0	£68,527	£68,527	£92,228	£55,050	£675,609

These costs include a number of assumptions. To illustrate this, the durability type approval test costs for 2013 are shown in Table 51. The number of approvals each year is an assumption. Motorcycle manufacturers typically produce a new model every year. Some years, the revisions might simply be changes to the cosmetics, for which a new type approval is not needed. However, a heavily revised model might be produced every two or three years, requiring new approval. Considering the number of different models produced (e.g. Honda has almost 40 different models of 2 wheelers, Suzuki more than 30 etc.), then the numbers presented in the table are considered a reasonable estimate. However, these should be revised if more accurate information becomes available. The cost per test is based upon the stakeholders' response (£20,000 to complete the US EPA test), factored by the varying distances required for the different vehicle classes. The test cost per year is simply the cost per test multiplied by the number of type approval performed each year. Another assumption has been used for the typical life of the vehicles, in order to arrive at an overall annual figure.

This cost figure allows manufacturers to sell their bikes across the EU. However, the corresponding benefits have been based only on the vehicle sold and used in the UK. Therefore for each motorcycle type that is approved, the test cost per year should be divided amongst the total number of bikes sold in the EU each year to get a test cost per bike sold. This test cost per bike should then be multiplied by the number of bikes of that type sold by that manufacturer in the UK. Thus, the test cost per bike sold in the UK would be much greater for bikes produced in small numbers and not sold elsewhere in Europe than it would be for bikes produced in large numbers and sold everywhere in Europe. The total UK cost per year would be the sum of the cost of each manufacturer/type. This data was not available so the annual test costs have simply been multiplied by the proportion of total moped and motorcycle sales across EU-27 that were UK sales (5.6%). This simplifying estimate therefore ignores differences in sales distribution around Europe for different category L sub-categories (e.g. mopeds more popular in southern Europe, larger motorcycles more popular in UK). It also ignores the different effects between large manufacturers selling in Europe such as Honda or Yamaha and smaller niche manufacturers such as Norton.

Table 51: Calculation of the durability testing costs for 2013

Vehicle category	Sub-category	Number of TA's per year	Durability cost per TA (£)	Durability cost per year (£)	Vehicle life (years)	Depreciated cost per year (£)	Depreciated annual cost attributable to UK sales
L1Be		20	13,330	*266,600*	5	*53,320*	2,986
L3e/L4e/L5Ae, L7Ae	PI<130km/h	50	23,994	*1,199,700*	10	*119,970*	6,718
L3e/L4e/L5Ae, L7Ae	PI>130km/h	100	39,990	*3,999,000*	10	*399,900*	22,394
L5Be		20	23,994	*479,880*	10	*47,988*	2,687
L6Ae/L6Be		20	23,994	*479,880*	10	*47,988*	2,687
L7Be		20	39,990	*799,800*	10	*79,980*	4,479
Totals		*230*	*165,292*	*7,224,860*	*55*	*749,146*	41,952

7.6.2 Benefits

This is expected to provide better control of in-service emission levels for vehicles which have travelled up to 50,000km. These benefits are difficult to quantify because only anecdotal evidence exists regarding the deterioration in the current fleet and its environmental effect. Ntziachristos *et al*. (2009) found that in tests on a 1100cc Honda motorcycle that after 30,000km CO emissions were increased by approximately 20% and HC emissions by approximately 25% (although both of these were still at levels under half the Euro 3 limit). For this motorcycle, NOx emissions were reduced slightly. Other results for a 500cc scooter (not designed or tested for US markets) show that CO emissions exceeded the emission standard after 2,000 km of driving and NOx after 5,000km (Ntziachristos *et al*., 2009). No information was forthcoming from the information gathering on this topic and the variability in the available evidence makes an accurate estimation of benefits difficult, although the scale of these is potentially significant.

For indicative purposes, it has been assumed that from Euro 4 (Euro 5 for L3 vehicles) onwards, the standards will cause a reduction in the emissions of new motorcycles. A factor of 0.99 has been used for Euro 4 (Euro 5 for L3 vehicles) and a factor of 0.95 for Euro 5 (Euro 6 for L3 vehicles). These values have been adapted from the values presented by Murrells et al (2010), which assumes current motorcycles will keep their emissions within limits over 30,000km without problem, and will require a 5% reduction in their emissions at new to meet the durability requirements over 48,000km. There is no limit for PM emissions until the final Euro level so it has been assumed that only this standard will affect the deterioration of PM emissions. The benefits are shown together with the introduction of the various emissions standards in Section 7.4.

Table 52: Change in the yearly emissions (tonnes) for Option 1

Year	CO	HC	NOx	PM
2013	-	-	-	-
2014	-	-	-	-
2015	- 0.28	- 0.10	- 0.02	-
2016	- 0.52	- 0.19	- 0.04	-
2017	- 5.99	- 2.16	- 0.41	-
2018	- 11.78	- 3.91	- 0.78	- 0.01
2019	- 16.92	- 5.41	- 1.12	- 0.01
2020	- 25.30	- 6.92	- 1.59	- 0.04
2021	- 47.07	- 9.04	- 2.66	- 0.15
2022	- 66.35	- 10.93	- 3.61	- 0.26
2023	- 83.46	- 12.62	- 4.47	- 0.34
2024	- 98.67	- 14.15	- 5.23	- 0.42
2025	- 112.22	- 15.52	- 5.91	- 0.50

Table 53: Change in the yearly emissions (tonnes) for Option 2

Year	CO	HC	NOx	PM
2013	-	-	-	-
2014	-	-	-	-
2015	- 0.28	- 0.10	- 0.02	-
2016	- 0.52	- 0.19	- 0.04	-
2017	- 5.99	- 2.16	- 0.41	-
2018	- 10.83	- 3.85	- 0.74	-
2019	- 15.12	- 5.31	- 1.04	-
2020	- 18.94	- 6.56	- 1.30	-
2021	- 22.33	- 7.65	- 1.53	-
2022	- 25.37	- 8.58	- 1.75	-
2023	- 28.07	- 9.40	- 1.93	-
2024	- 30.50	- 10.10	- 2.10	-
2025	- 32.67	- 10.72	- 2.26	-

7.6.3 Non-monetised impacts

This is likely to create problems for manufactures in their time planning for new motorcycles and create significant cost pressures, especially for smaller volume manufacturers.

7.6.4 Risks and assumptions

The precise test methodology is not specified by the EC proposal. Therefore the additional testing cost is uncertain; this should be reviewed as further information becomes available. Some manufactures already carry out the US EPA test. Should the final EC test procedure be harmonised with US EPA and include the same "option b" for partial mileage accumulation and subsequent extrapolation of test results, then the additional test cost could actually be zero. However, if the test procedure is different, the additional costs could be significant. The number of models that have to be type approved each year has also been estimated. Currently, there are no vehicle families within the legislation. The use of vehicle families or would reduce the costs significantly.

To evaluate the possible reduction in emissions that may occur, it has been assumed that there has been a reduction in all the gaseous pollutants from new vehicles to enable compliance with additional durability mileage:

- Euro 3 (4) – no change
- Euro 4 (5) – 1% lower emissions
- Euro 5 (6) – 5% lower emissions

Although Euro 3(4) has no change in emissions associated with it (as per the AEA report, motorcycles are already designed for that mileage), there is a cost associated with carrying out the durability test. So, in this case, there is a cost with no real benefit.

The reduction in emission are assumed to occur over the life of the vehicle – e.g. for the Euro 6 motorcycle, the emissions at new are 5% lower than they would have been, and at 50,000 km the emissions are still 5% lower than they would have been without the durability requirements.

For PM emissions, as these will only be measured on Euro 5 (6) vehicles, it is assumed that for these vehicles PM emissions reduce by 5%. These assumptions have been used to provide a first estimate of the benefits. The values used here are considered best estimates but are uncertain; greater benefits would substantially affect the net benefit estimates. It should be noted that the values used were based on a single source (Murrells *et al*., (2010). This was considered, with the available evidence, the most appropriate average value to apply to the entire fleet. Greater values, suggested by some test results on specific vehicles, were considered to apply to a negligible proportion of the fleet; this assumption should be reviewed should further evidence become available.

7.6.5 Estimated effect of Option 1

The gross and net benefits of the inclusion of durability requirements in the new Euro standards are shown in Table 54, for the years 2013 to 2025. Three cost benefits are shown, corresponding to the low, central and high damage cost values.

Table 54. Cumulative gross and net benefits (£) of the addition of durability testing for Option 1

Gross benefit			
Year	**Low**	**Central**	**High**
2013	-	-	-
2014	-	-	-
2015	£156	£169	£366
2016	£446	£482	£1,044
2017	£3,736	£4,036	£8,747
2018	£10,039	£10,875	£23,375
2019	£18,902	£20,504	£43,889
2020	£31,754	£34,579	£73,122
2021	£54,711	£60,121	£123,528
2022	£86,312	£95,473	£192,033
2023	£125,299	£139,212	£275,995
2024	£170,591	£190,110	£373,140
2025	£221,253	£247,109	£481,507
Net benefit			
Year	**Low**	**Central**	**High**
2013	-£40,154	-£40,154	-£40,154
2014	-£79,727	-£79,727	-£79,727
2015	-£124,260	-£124,247	-£124,050
2016	-£168,012	-£167,976	-£167,414
2017	-£208,126	-£207,825	-£203,114
2018	-£262,796	-£261,959	-£249,460
2019	-£314,022	-£312,420	-£289,035
2020	-£360,389	-£357,563	-£319,021
2021	-£395,792	-£390,382	-£326,975
2022	-£421,706	-£412,545	-£315,985
2023	-£439,400	-£425,488	-£288,704
2024	-£449,968	-£430,449	-£247,419
2025	-£454,356	-£428,500	-£194,102

7.6.6 Estimated effect of Option 2

The gross and net benefit of introducing durability requirements, following the introduction of the first two of the new Euro standards (Euro 3 & 4 or Euro 4 & 5 for L3 category), are shown in Table 55.

Table 55. Cumulative gross and net benefits (£) of the addition of durability testing for Option 2

Gross benefit			
Year	**Low**	**Central**	**High**
2013	-	-	-
2014	-	-	-
2015	£156	£169	£366
2016	£446	£482	£1,044
2017	£3,736	£4,036	£8,747
2018	£9,572	£10,340	£22,417
2019	£17,568	£18,976	£41,154
2020	£27,394	£29,587	£64,188
2021	£38,770	£41,869	£90,862
2022	£51,454	£55,562	£120,614
2023	£65,240	£70,442	£152,960
2024	£79,951	£86,318	£187,485
2025	£95,434	£103,025	£223,833
Net benefit			
Year	**Low**	**Central**	**High**
2013	-£40,154	-£40,154	-£40,154
2014	-£79,727	-£79,727	-£79,727
2015	-£124,260	-£124,247	-£124,050
2016	-£168,012	-£167,976	-£167,414
2017	-£208,126	-£207,825	-£203,114
2018	-£263,263	-£262,494	-£250,417
2019	-£315,356	-£313,948	-£291,770
2020	-£364,749	-£362,556	-£327,955
2021	-£411,734	-£408,634	-£359,641
2022	-£456,564	-£452,456	-£387,404
2023	-£499,459	-£494,257	-£411,739
2024	-£540,608	-£534,241	-£433,073
2025	-£580,175	-£572,584	-£451,776

7.7 On Board Diagnostics (OBD)

The EC proposal for On Board Diagnostics is to mandate OBD1 (circuit failure detection) to immediately flag and diagnose failures which have an effect on safety and the environment (see Table 1 for details). Later, OBD2 requirements add functionality of deterioration or total functional failure detection to safety and environmental critical systems.

7.7.1 Costs

Some manufacturers may already comply with OBD1 requirements; a UK respondent indicated that they already have systems compatible with OBD1 principles on all models, and would expect these to require minimal modification to comply with the anticipated initial OBD requirement. However it is unknown whether this is the case for other UK manufacturers or those selling into the UK and the detailed specification for OBD1 has not been defined, therefore making it difficult to assess what specification will be required for compliance.

Information presented by Ntziachristos *et al*. (2009) reported that the industry highlighted two options to implement an OBD system on new vehicle types. Either develop and fit an OBD1 type on existing engines or add OBD1-compliant engine management systems to existing type. The first option requires rewiring and retooling of the ECU by the supplier and the second option, a new calibration of the engine management is required to incorporate the OBD function. The costs in each case were estimated to be approximately 2.0 – 2.1 million Euro per engine type (Ntziachristos *et al*., 2009).

Responses to the information gathering indicated that the motorcycle industry will have difficulty with OBD2 requirements because they considered that car system for misfire detection and catalyst monitoring cannot be directly transferred to motorcycles. This is reported to be because car systems use the crank position sensor at the flywheel to detect missing firing pulses for misfire detection. This option is not open to motorcycles because of the absence of a flywheel. Furthermore, the dynamic range of motorcycle engines are at least double that of a typical car. Therefore very expensive spark ionisation systems, as patented by Delphi, would be required for misfire detection. Speculative initial estimates of the cost of these are somewhere in the region of £30 per bike.

For catalyst monitoring, twin Oxygen sensors must be used. However, unlike cars, many motorcycle exhaust systems do not merge at all and therefore two sensors per cylinder or per separate system may be needed. It should also be noted that a steady state condition is required for accurate catalyst monitoring and there are no steady states in the WMTC cycle and therefore a separate test would also need to be devised. The additional costs for the parts required for OBD are listed in Table 56. This assumes only one additional oxygen sensor is required and also assumes the existing ECU is suitable for storing any fault events and has suitable communication capabilities.

Table 56: Additional parts cost per vehicle for OBD

Description	Cost increment from Euro 3 (£)		
	Euro 4	Euro 5	Euro 6
Extra oxygen sensor for emissions detection	-	-	16.66
Ion detection coil oncost for misfire detection	-	-	30.00
	-	-	46.66

The annualised additional cost for the OBD requirements is shown in Table 57 for Option 1 and in Table 58 for Option 2. It is not known if the OBD requirements will result in additional type approval test costs, so these have been assumed to be zero for now.

Table 57: Cost of meeting OBD - Option 1

Year	Parts costs	TA test costs	Total	Inflated	Discounted	Cumulative
2013	-	-	-	-	-	-
2014	-	-	-	-	-	-
2015	-	-	-	-	-	-
2016	-	-	-	-	-	-
2017	-	-	-	-	-	-
2018	£38,822	-	£38,822	£45,486	£34,543	£34,543
2019	£72,605	-	£72,605	£86,770	£63,666	£98,209
2020	£257,359	-	£257,359	£313,719	£222,401	£320,610
2021	£1,000,580	-	£1,000,580	£1,244,096	£852,138	£1,172,748
2022	£1,647,746	-	£1,647,746	£2,089,740	£1,382,955	£2,555,703
2023	£2,212,549	-	£2,212,549	£2,862,169	£1,830,082	£4,385,785
2024	£2,706,595	-	£2,706,595	£3,571,294	£2,206,281	£6,592,066
2025	£3,139,726	-	£3,139,726	£4,225,657	£2,522,255	£9,114,321

Table 58: Cost of meeting OBD - Option 2

Year	Parts costs	TA test costs	Total	Inflated	Discounted	Cumulative
2013	-	-	-	-	-	-
2014	-	-	-	-	-	-
2015	-	-	-	-	-	-
2016	-	-	-	-	-	-
2017	-	-	-	-	-	-
2018	-	-	-	-	-	-
2019	-	-	-	-	-	-
2020	-	-	-	-	-	-
2021	-	-	-	-	-	-
2022	-	-	-	-	-	-
2023	-	-	-	-	-	-
2024	-	-	-	-	-	-
2025	-	-	-	-	-	-

7.7.2 Benefits

The intended benefit of OBD is that the function provides rapid alerting and diagnosis of system failures so that they can be repaired, minimising the safety and environmental risks. Ntziachristos *et al*. (2009) reported industry information that the failure rate of OBD-monitored motorcycles were below 0.2%. However, these are likely to be newer and better maintained vehicles. The EC's proposed approach is to introduce OBD to alert the rider to failures which have negative safety or environmental consequences because anecdotal evidence (and logic) shows that these events occur in use. Therefore, the EC proposal is being made on a pragmatic basis with the aim of protecting safety and the environment; the scale of the problem in the fleet is not quantifiable with the available information. This means that the benefits of OBD measures are difficult to quantify; this uncertainty is large and has the potential to have significant impact on the overall estimate for both options.

7.7.3 Non-monetised impacts

The benefits for the UK are dependent on:

- the current frequency of failures in the fleet and their effects;
- the rider taking the appropriate action to rectify the failures.

On Board Diagnostics may reduce maintenance costs if the information is made available to everyone undertaking maintenance in a useful format because the diagnosis of the failure has been identified.

In addition, a faulty vehicle may consume more fuel than normal. Having the fault repaired promptly would save money from this excess fuel use.

7.7.4 Risks and assumptions

It has been assumed that the EC will adopt an approach which allows communication to a generic scan tool by the any one of the four protocols allowed by ECE Regulation 83 and using a standardised ISO connector. A UK manufacturer indicated that current systems use the ISO 9141 protocol (which is acceptable for cars in current EC and ECE regulation). If this is not the case, then all current OBD systems would need to be redesigned and a new engine management ECU developed at an estimated cost approaching £2 million.

Industry indicated that ACEM intend to present the Commission with a proposal for OBD1, largely based on ECE Regulation 83 and using the four communication protocols specified in that regulation.

In the emission calculations for the previous sections, it was assumed that 5% of all vehicles would have faults and have emissions the equivalent of pre-Euro 1 vehicles. It has been assumed that with OBD this is reduced to 2.5%, reflecting that the faults are rectified quicker. Note that OBD only affects Euro 5 (Euro 6 for L3 category)

7.7.5 Estimated effect of Option 1

The gross and net benefits of the inclusion of OBD in the new Euro standards are shown in Table 59, for the years 2013 to 2025. As OBD is only included in the last Euro standard, it does not have any effect until 2018. Three cost benefits are shown, corresponding to the low, central and high damage cost values. These costs have been calculated in reference to new tailpipe emission factor including the durability requirements. The effects of OBD on the new emission limits without including durability are very similar.

Table 59. Cumulative gross and net benefits (£) of the addition of OBD for Option 1

Gross benefit			
Year	**Low**	**Central**	**High**
2013		-	-
2014		-	-
2015	£773	£918	£1,448
2016	£2,199	£2,610	£4,124
2017	£18,448	£21,898	£34,560
2018	£48,501	£57,531	£91,047
2019	£90,188	£106,909	£169,623
2020	£146,739	£173,800	£276,629
2021	£234,527	£277,438	£443,614
2022	£348,603	£411,938	£661,360
2023	£484,774	£572,323	£922,023
2024	£639,483	£754,379	£1,218,908
2025	£809,705	£954,527	£1,546,294
Net benefit			
Year	**Low**	**Central**	**High**
2013	-	-	-
2014	-	-	-
2015	£773	£918	£1,448
2016	£2,199	£2,610	£4,124
2017	£18,448	£21,898	£34,560
2018	£13,958	£22,988	£56,504
2019	-£8,021	£8,701	£71,414
2020	-£173,871	-£146,810	-£43,980
2021	-£938,221	-£895,310	-£729,134
2022	-£2,207,100	-£2,143,765	-£1,894,342
2023	-£3,901,011	-£3,813,462	-£3,463,762
2024	-£5,952,582	-£5,837,687	-£5,373,158
2025	-£8,304,615	-£8,159,794	-£7,568,027

7.7.6 Estimated effect of Option 2

The gross and net benefits of OBD for option 2 is shown in Table 60

Table 60. The cost benefit (£/year) of the addition of OBD for Option 1

Gross benefit			
Year	**Low**	**Central**	**High**
2013	-	-	-
2014	-	-	-
2015	£773	£918	£1,448
2016	£2,199	£2,610	£4,124
2017	£18,448	£21,898	£34,560
2018	£47,196	£55,996	£88,546
2019	£86,480	£102,547	£162,501
2020	£134,632	£159,561	£253,374
2021	£190,241	£225,349	£358,560
2022	£252,103	£298,479	£475,831
2023	£319,194	£377,733	£603,276
2024	£390,639	£462,074	£739,256
2025	£465,692	£550,616	£882,359
Net benefit			
Year	**Low**	**Central**	**High**
2013	-	-	-
2014	-	-	-
2015	£773	£918	£1,448
2016	£2,199	£2,610	£4,124
2017	£18,448	£21,898	£34,560
2018	£47,196	£55,996	£88,546
2019	£86,480	£102,547	£162,501
2020	£134,632	£159,561	£253,374
2021	£190,241	£225,349	£358,560
2022	£252,103	£298,479	£475,831
2023	£319,194	£377,733	£603,276
2024	£390,639	£462,074	£739,256
2025	£465,692	£550,616	£882,359

7.8 Access to repair information

The EC proposal is for manufacturers to provide detailed vehicle repair and maintenance information on parts fitted to individual vehicles and information required to ensure compatibility of replacement parts e.g. communication protocols used, expected sensor outputs to independent operators (as well as authorised dealers and repairers) via the internet.

7.8.1 Costs

There is likely to be additional costs for supplying technical information to independent repairers, in providing Article 60(3) information via websites. Initial consultation responses did not report values, and responses were made that adding information to a website would result in relatively minor cost increases. However, subsequent information from industry estimated that the development of an on-line system to allow secure access to the required information represents a significant cost. Estimated costs provided were £0.5 and £3.0 million to establish an RMI compliant website, with approximately 25% of these costs estimated for ongoing annual updates and maintenance. This estimate was made for one UK manufacturer; it is assumed that similar cost burdens will be placed on the other two UK manufacturers identified.

GHK (2008) reported that there were 1,327 "repair, servicing and maintenance" businesses in the UK in 2008. However, the split between franchised dealers and independent operations is not stated, meaning that the number of affected businesses is unknown. Information on a European level provided to the Commission's Motorcycle Working Group by FIGIEFA estimated that 50% of are single franchise, with the remaining 50% multiple franchise or independents. For the purposes of this impact assessment it has been estimated that 10% of business are multiple franchise operations (operations selling more than one brand).

7.8.2 Benefits

The intended benefits include reduced costs to consumers for servicing and repair because of quicker and more effective access to relevant repair information. Estimates were made for the consumer benefit of opening the market up by providing independent operations with RMI information. This was achieved by assuming that provision of RMI could result in any outcome between no impact and a 16% increase in the market share of independent repairers for servicing. This was based on ACEA's estimate of the impact of improved access to information on the replacement parts market for cars. The benefit to consumers was estimated to be £83 per vehicle service based on data on the differential between franchised and independent dealer median car servicing costs from a 2002 DTI survey[17]. There are 1.3 million two-wheeled motor vehicles currently registered in the UK, and for the purposes of this Impact Assessment it was assumed that 30% of these are serviced according to recommended service schedules; a value 10% lower than has previously been assumed for cars because it was considered that a greater proportion of motorcyclists carry out their own servicing and maintenance. The resulting total annual benefit to consumers (£83 per vehicle, multiplied by 30% of 1.3 million vehicles, multiplied by 0 - 16% of market share) is £0 – 5.1 million (with a mid-point estimate of £2.6 million).

[17] Information from Chris Parkin, DfT

Consumers are also estimated to benefit from the increased market share of spare parts provided by independents. It has been assumed that 40% of the market is served by OEM parts and that provision of RMI has the potential to reduce this by between 0% and 40% (20% central estimate). This implies an increase in independent parts suppliers' market share of 16% of the market. The total UK spare parts market is estimated at £255 million per annum (GHK, 2010) and independent parts are assumed to have, on average a 15% lower price than the equivalent OEM part. This implies a total annual benefit to UK consumers in reduced spare parts costs of £0 – 6.1 million (£3.1 million central estimate).

There are also potential benefits for safety and the environment because of more effective repairs resulting from more accurate identification of the correct parts. However, these cannot be quantified because of insufficient information on the current effectiveness of problem diagnosis and repair efficiency. Similarly, any risk associated with differing quality of OEM and non-OEM spare parts has not quantified as insufficient information was found on which to make a judgement.

7.8.3 Non-monetised impacts

Manufacturers may charge for service and repair information (and for training courses) to independent dealers.

7.8.4 Risks and assumptions

No allowance has been made for supplying the system in all official Member State languages. If this was a requirement of the EC proposal then manufacturer costs would be significantly increased.

7.8.5 Estimated effect of Option 1

The overall estimated benefit of option 1, after accounting for inflation at 2% at discounting at 3.5% is presented below.

Table 61. Estimated cumulative benefit of Option 1

			Upper estimate
2013	-£1,500,000	-£370,296	£2,259,408
2014	-£1,869,565	£3,699,557	£11,138,244
2015	-£2,233,774	£7,710,427	£19,888,402
2016	-£2,592,705	£11,663,168	£28,511,746
2017	-£2,946,434	£15,558,623	£37,010,114
2018	-£3,295,037	£19,397,622	£45,385,318
2019	-£3,638,587	£23,180,984	£53,639,141
2020	-£3,977,158	£26,909,514	£61,773,344
2021	-£4,310,822	£30,584,008	£69,789,660
2022	-£4,639,651	£34,205,248	£77,689,797
2023	-£4,963,714	£37,774,006	£85,475,440
2024	-£5,283,080	£41,291,043	£93,148,247
2025	-£5,597,818	£44,757,109	£100,709,854
2026	-£5,907,995	£48,172,941	£108,161,873

7.9 Anti-tampering requirements

Chapter 7 of Directive 2002/24/EC prescribes anti tampering requirements on mopeds and <125cc machines. The EC proposal is to develop anti-tampering measures for all L category machines to reduce environmental damage and preserve safety. There are no measures in place for larger motorcycles, tricycles or quadricycles.

The EC proposal (Article 18) aims to:

- continue effective safety and environmental protection for modification to L-category vehicles;
- cover new engine technologies - electric vehicles, hybrids and all other propulsion concepts that go beyond conventional combustion engine; and
- focus on powertrain/exhaust/tyre issues and not cosmetic modifications or "harmless" alterations.

7.9.1 Costs

These cannot be specified because the anti-tampering measures have not (at the time of this assessment) been defined.

7.9.2 Benefits

Prevention or reduction in tampering events which cause high environmental emissions and/or reduce the level of safety offered. These are difficult to quantify because the frequency of types of tampering is difficult to detect in use and only anecdotal evidence is available on the scale of the current problem, which makes estimating the benefit that could be realised very difficult.

The MAIDS[18] found higher accident involvement of tampering vehicles 71 of 398 (17.3%) compared with 46 of 373 (12.3%) in exposure group:

- Relative risk = 1.38 (95% confidence interval for relative risk calculated as 0.97 to 1.95). This shows that there is a trend for increased accident risk to be associated with tampered bikes, but that the confidence interval includes 1 (no increased risk) and that this is an associative relationship, not a causal one; other rider behavioural factors are probably larger contributors to accident risk.
- 40% of fatal accidents involving L1 vehicles occurred at greater than the 45 km/h (28 mile/h) design speed. This suggests that a large group could be influenced, but the accuracy of accident reconstruction methods means that significant uncertainty is associated with this result.

Information from the consultation indicated that machines subject to an 11kW (category A and B vehicles as defined in current anti-tamper directive) limit are thought most likely to be tampered with. Further responses indicated that because of the transition over the last six or seven years from 2 stroke engines (that were rewarding to tune in terms of increasing power) to 4 strokes that are much less so, this has greatly reduced the frequency of tampering. The technical demands of proposed emission limits are also considered likely to eliminate 2 strokes from the market.

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[18] Motorcycle Accident In-Depth Study - http://www.maids-study.eu/

However, Dittmar *et al.* (2003) found that tampering on higher performance machines can be achieved using the same methods employed on machines subject to 11kW limit and the availability of aftermarket exhausts and devices which interface with the ECU to adjust engine performance suggest that it is at least possible that higher performance machines may currently be tampered with.

7.9.3 Non-monetised impacts

At the time of writing. there were no specific proposals for "anti-tampering" which makes it difficult to assess what this means in terms of maintenance or customisation. However, there are concerns that home servicing in particular will be made more difficult because components will be designed to prevent unauthorised modification (e.g. exhaust header bolts designed to break when loosened with the wrong tools).

It was also noted in the information gathering that respondents were concerned that if the user is not allowed to change any part of the engine and its management system, exhaust system, transmission or rear wheel/tyre, then the options for customisation are severely limited and will have impacts on riders who, if they want to customise, will be required to approve the 'modified' vehicle. However, as with current requirements, approved parts are expected to be allowed (e.g. tyres, exhausts), with the anti-tampering provisions developed to prevent approved parts being easily tampered with such that they have detrimental safety and environmental effects.

7.9.4 Risks and assumptions

The EC's proposed approach is to introduce measures which prevent known tampering events which have negative safety or environmental consequences. Products on the market and anecdotal evidence suggest that such tampering in the fleet does occur and that simple tampering can be just as easily performed on vehicles not covered by the current requirements. However, while some tampering is easy to detect, other types may be difficult without an extensive mechanical inspection. The rate of tampering in the fleet is unrecorded because no such systematic recording scheme exists. The EC proposal has a stated aim of protecting safety and the environment; the scale of the problem in the fleet is unknown and perhaps not 100% detectable, even with specific studies to examine this.

7.9.5 Estimated effect of Option 1

Not monetised.

7.10 Approval of components which affect functional safety or environmental emissions

Article 52 requires systems or components which may have a significant risk to functional safety or environmental emissions, to be authorised by an approval authority.

7.10.1 Costs

Costs are dependent on the type of part being authorised, for which no further information is available from the EC. The main costs in authorising the system or component for an approval authority are time-related and depend on the type of test being carried out. Costs associated with facility hire, which are incurred by the manufacturer, are potentially significant, but again, depend on the type of test carried out and the specific facility and associated instrumentation required for the test.

No specific costs were located in the literature search or the limited information gathering phase, but this was a difficult question to answer because of the uncertain requirements. The list that the EC will populate (referred to in paragraph 2 of Article 52) is currently not further specified. Consequently, it is difficult to estimate associated costs.

7.10.2 Benefits

The use of only authorised parts is expected to ensure only those parts which meet the minimum technical requirements can be fitted. This is expected to enhance safety and environmental effects. However, these are very difficult to quantify with the available information.

7.10.3 Non-monetised impacts

SMEs would be required to obtain authorisation for systems or components on the list, which might deter operations who market products with poor technical performance, therefore conferring a positive impact on safety and the environment.

Depending on the content of the list of parts requiring authorisation, it is possible that consumers may see an increase in retail price as the additional component of cost is passed to the consumer.

7.10.4 Risks and assumptions

Unnecessary costs may be imposed if procedures are not put in place to evaluate whether a system or component should be added to this list. This may include, in each case, an additional Impact Assessment.

7.10.5 Estimated effect of Option 1

Not monetised.

7.11 In-service conformity testing

New checks for in-use conformity testing (not further specified in the proposal)

7.11.1 Costs

Costs cannot be estimated for in service compliance testing other than approximately £2,000 per emissions test.

7.11.2 Benefits

Positive benefits expected from control of in-use emissions and level of functional safety. However, these benefits are very difficult to quantify.

7.11.3 Non-monetised impacts

Significant difficulties are foreseen by Industry associated with locating a representative sample, including: small fleet size and wide geographic distribution and the problems with the ability to trace an owner. The difficulties with locating a representative sample are further compounded by tampering, incorrect maintenance, accident damage, and zero fleet sales (it is known that large-volume car manufacturers source samples from large hire car companies).

7.11.4 Risks and assumptions

None identified.

7.11.5 Estimated effect of Option 1

Not monetised.

7.12 CO_2 and fuel economy

The EC proposal specifies the introduction of type-approval requirements for CO2 measurement and fuel consumption determination and reporting.

7.12.1 Costs

Consultation responses indicated negligible expected additional cost.

7.12.2 Benefits

This requirement will provide the consumer with information on the fuel economy and emission level of the machine. The benefits are difficult to estimate because these are dependent on the user's response to the information.

It is anticipated that for riders purchasing commuter/utility machines (mopeds, scooters and light motorcycles) the availability of $C0_2$ and fuel consumption information may have a significant impact on purchasing decisions and could even encourage transfer of travel mode to motorcycles. However, for larger motorcycles whose purchasers may have different priorities, the availability of fuel consumption and CO2 are considered to have less influence over purchasing decisions.

7.12.3 Non-monetised impacts

Information will allow incentives schemes to be developed which will encourage better performing vehicles to be purchased. In turn, this is expected to encourage manufacturers to produce more fuel efficient and economical vehicles.

7.12.4 Risks and assumptions

One consultation respondent indicated that benefits of the information would not result in realising the intended shift in purchasing decision-making without the addition of applying higher taxes to the poor performers.

7.12.5 Estimated effect of Option 1

Not monetised. This has the potential to influence purchasing choices to more efficient, less polluting vehicles, but insufficient evidence from the riding population to estimate the likely effect.

7.13 Repeal of 74kW power limit

The EC proposal includes measures to repeal 74kW power limit.

7.13.1 Costs

No increase expected. 74kW limit affects only France and is not applicable to the UK.

7.13.2 Benefits

None identified.

7.13.3 Non-monetised impacts

None identified.

7.13.4 Estimated effect of Option 1

Not monetised. However, costs and benefits are expected to be neutral.

7.14 Mandatory daytime running lights

The EC proposal includes measures to require mandatory headlight on or daytime running lights.

7.14.1 Costs

No increase expected. Manufacturer information is that since 2004 model year, the Industry has adopted Automatic Headlamp On which will be accepted as an alternative to daytime running lights. For this reason no additional costs to the UK are expected. No costs were obtained from non-ACEM manufacturers who sell into the UK (China, Korea, Taiwan).

7.14.2 Benefits

Benefits are expected to be improved conspicuity for motorcyclists, which in turn, are expected to reduce accident risk. However because of the voluntary commitment to permanent headlight illumination, the benefits of mandating this requirement are negligible or zero.

7.14.3 Non-monetised impacts

None identified.

7.14.4 Estimated effect of Option 1

Not monetised however costs and benefits are expected to be neutral

8 References

ACEM (2004). *MAIDS final report 1.2.* Available at http://ec.europa.eu/transport/roadsafety_library/publications/maids_report_1_2_september_2004.pdf (accessed December 2010).

Baum H., Westerkamp U. and Geißler T. (2007). *Cost-benefit analysis for ABS of motorcycles.* Institute for Transport Economics at the University of Cologne, Cologne.

Bayly M., Regan M., and Hosking S. (2006). *Intelligent Transport Systems and Motorcycle Safety*. Monash University Accident Research Centre.

Boulter P G, Barlow T J and McCrae I S (2009). *Emission factors 2009: Report 3 - exhaust emission factors for road vehicles in the United Kingdom (2009)*. TRL Report PPR356. TRL Limited, Wokingham.

CARS21 (2005). *CARS 21: a competitive automotive regulatory system for the 21st century final report.* Available at http://ec.europa.eu/enterprise/automotive/pagesbackground/competitiveness/cars21finalreport.pdf (accessed December 2010).

Department for Transport, DfT (2010). *Reported Road Casualties Great Britain 2009: Annual Report*. Available at http://tinyurl.com/3abo3ex

Department for Transport, DfT (2009). Transport Statistics Bulletin. Compendium of Motorcycling Statistics 2009. Available at http://tinyurl.com/yg38tu3.

Dittmar K., Melz M, Baumeister K., Berg M., Braun T., Hartmann S., Leiber M.,and Safarovic H. (2003). *Anti-tampering devices relating to two or three-wheeled motor vehicles. TUV Nord.* http://ec.europa.eu/enterprise/sectors/automotive/files/projects/report_anti_tampering_devices_en.pdf

Dodd M. (2009). *Evaluation of the impact of possible new measures concerning the type approval of agricultural vehicles*. Draft Project Report RPN492. TRL Limited, Wokingham.

ETSC (2007). *News Release: Motorcycle deaths in Europe*. http://www.etsc.eu/documents/News%20release%20Flash%207%20final.pdf

ETSC (2001). *Priorities for EU motor vehicle safety division. European Transport Safety Council, Brussels.*

Gail J., Funke J., Seiniger, P., and Westerkamp U. (2009) *Anti lock braking and vehicle stability control for motorcycles- Why or Why not?* Federal Highway Research Institute, Germany

GHK (2010). *The economic significance of the UK motorcycle industry*. Available at http://www.mcia.co.uk/downloads_temp/f1723bf9-dfe5-4649-89db-8cefc7d77ec4_Imported_File.PDF

Gwehenbereg J., Schwaben I., Sporner A. and Kubitzki J. (2006). *Serious accidents involving motorcycles- analysis of accident structures and effectiveness of ABS* Allianz Centre for Technology, Munich.

Hurt H.H. Jr., Ouellet J.V. and Thom D.R. (1981). *Motorcycle accident cause factors and identification of countermeasures: Volume 1: Technical report, Final Report.* US Department for Transport, Washington DC.

Kebschull S. and Zellner J. (2007 & 2008). *Analysis of cost effectiveness of motorcycle antilock brake systems. Accomplished for International Motorcycle Manufacturers Association, Geneva.* Dynamic Research Inc, California.

McCarthy M. and Chinn B.P. (1999) *ABS and its effect on BMW motorcycle accidents: supplementary report* PR/SE/470/98(supplemental) TRL Ltd, Crowthorne.

McCarthy M. and Chinn B.P. (1998) *ABS and its effect on BMW motorcycle accidents* PR/SE/470/98 TRL Ltd, Crowthorne.

Murrells T., Walker H., Norris J., and Gibson N. (2010) *Modelling of motorcycle emission reductions for proposed Euro 4 and 5 standards*. Ref No: AEAT/ENV/R/3022. AEA Technology, Didcot, UK.

Ntziachristos L., Geivanidis S., Samaras Z., Xanthopoulos A., Steven H., and Bugsel B. (2009). *Study on possible new measures concerning motorcycle emissions. Final Report – Revised Version.* Report No: 08.RE.0019.V4. University of Thessaloniki, Greece.

Ntziachristos L and Samaras Z (2009). *EMEP/EEA emissions inventory guidebook 2009. Section 1.A.*3 *Road Transport*. Laboratory of Applied Thermodynamics, Aristotle University of Thessaloniki, Greece.

Rizzi M., Strandroth J., and Tingvall C. (2009). *The Effectiveness of Antilock Brake Systems on Motorcycles in Reducing Real-Life Crash and Injuries*. University Accident Research Centre, Borlange, Sweden.

Robinson T.L., McCarthy M., Pitcher M., Gibson T., and Visvikis, C. (2009). *Evaluating the impact of possible new measures concerning category L vehicles: Final report*. CPR383. TRL Ltd, Wokingham, UK.

Roll G., Hoffmann O., and Konig J. (2009). *Effectiveness evaluation of Antilock Brake Systems (ABS) for Motorcycles in Real-World accident scenarios*. Continental AG & DEKRA Automobil GmbH. Paper Number 09-0254

Smith T.L., Gibson T. and McCarthy M. (2009). *Development of a methodology for the evaluation of safety systems for powered two-wheelers- final report*. Published Project Report PPR381. TRL Ltd, Wokingham, UK.

Teoh E.R. (2010) *Effectiveness of Antilock Braking Systems in Reducing Motorcycle Fatal Crash Rates.* Insurance Institute for Highway Safety. Arlington, Virginia, USA.

Vavryn K. and Winkelbauer M. (2005). *Braking performance of experienced and novice motorcycle riders- Results of a field study.* Austrian Road Safety Board, Austria.

Appendix A Impact Tests

Competition Assessment Impact Test

This section considers the impact of the new Regulations on competition within the L Category industry. The UK Industry sector is dominated by importers and distributors of motorcycles from Europe, Japan, US and China. Along with other activities classified in this group GHK (2010) estimated that this sectors accounted for over 50% of annual turnover.

For manufacturing, a single manufacturer accounts for approximately 8% of the UK market. A further two companies account a smaller proportion, with a handful of micro-businesses also identified. Importers and distributors account for approximately 16%.

The increased burden of some of the proposals, for example those relating to the responsibilities of manufacturers are likely to be lower for larger companies. The impacts on importers and distributors are potentially very large. The addition of small series and Individual vehicle approval will protect small business to some extent and may even encourage them to enter the market, provided that the measures permit them to operate in an economically viable way.

The introduction of provisions ensuring third party repair organisations have access to repair and maintenance information from vehicle manufacturers is expected to help competition in the aftermarket and may result in reduced consumer prices.

Low volume manufacturers may be disproportionately affected by the advanced braking requirements, since the cost of a development programme for a single model would be more difficult to recoup and would result in an increase in the retail price, affecting competition. Speculative estimates show that a low volume manufacturer producing around 100 vehicles of one model per year over a four year model cycle would need to add £275 per vehicle to recover the estimated £110,000 development costs for an ABS system. For a volume manufacturer producing around 3,000 vehicles per year, the extra cost equates to £9 per vehicle over the same four year model life. This suggests that ABS on a low volume bike is likely to be over £400 per vehicle when parts are included and means that the effect on low volume manufacturers is likely to be a disproportionately higher increase in retail price.

Small Firms' Impact Test

The new Regulations are likely to have an impact on small and medium sized businesses (defined as businesses with fewer than 250 employees) within the industry sub-sectors affected by the Directive.

The "Small Firms Impact Test" is intended to determine the impact of the Regulations on small business and to consider how any adverse or unintentional impacts on small firms might be reduced or avoided.

The initial assessment is that the EC Proposal (Option 1) would have a significant effect on small businesses. The investment needed for compliance with type approval requirements may be prohibitive for the smaller companies. Similarly, all technical requirements have more significant impacts on smaller business since increases in test costs and technical components must be recouped on a smaller number of units.

There may be a positive impact on small firms through repair information being made available to independent repair firms on the same basis as it is for franchised operators.

Appendix B L-category vehicle types

The vehicle types, along with illustrative examples, which are the subject of the proposals, are presented below:

Figure 2. L-category vehicle types (ACEM)

Category & Category Name	Sub category & Sub category name	Example
L1e light two-wheel vehicle	L1Ae powered cycle	
	L1Be Moped	
L2e Three-wheel moped		
L3e motorcycle		
L4e motorcycle with sidecar		
L5e tricycles	L5Ae	
	L5Be Commercial tricycles	
L6e Light quadricycle	L6Ae Light on-road quad	
	L6Be Light mini car	
L7e heavy quadricycle	L7Ae Heavy on-road quad	
	L7Be Heavy mini-car	

Appendix C Regulatory Simplification example

For Option 0, the estimated annual and one-off costs were as follows:

Option 0	Lower estimate	Central estimate	Upper estimate
Implementation cost	£0	£0	£0
Annual amendment cost	£15,687	£31,374	£47,061
Annual meeting costs	£15,180.87	£57,747.83	£159,433.04
Total one-off costs	**£0**	**£0**	**£0**
Total annual costs	**£30,868**	**£89,122**	**£206,494**

Inflating the estimated annual costs by 2.0% each year for the "do nothing" option (Option 0) gives the following annual costs:

Year	Lower estimate	Central estimate	Upper estimate
2013	£32,757	£219,133	£94,577
2014	£33,412	£223,516	£96,468
2015	£34,081	£227,986	£98,398
2016	£34,762	£232,546	£100,366
2017	£35,457	£237,197	£102,373
2018	£36,167	£241,941	£104,420
2019	£36,890	£246,779	£106,509
2020	£37,628	£251,715	£108,639
2021	£38,380	£256,749	£110,812
2022	£39,148	£261,884	£113,028
2023	£39,931	£267,122	£115,288
2024	£40,729	£272,464	£117,594
2025	£41,544	£277,914	£119,946

Discounting these costs by 3.5%, by multiplying each value by a discount factor[19], gives the following estimated costs.

Year	Lower estimate	Central estimate	Upper estimate
2013	£29,545	£197,645	£85,303
2014	£29,117	£194,781	£84,066
2015	£28,695	£191,958	£82,848
2016	£28,279	£189,176	£81,647
2017	£27,869	£186,434	£80,464
2018	£27,465	£183,732	£79,298
2019	£27,067	£181,070	£78,149
2020	£26,675	£178,445	£77,016
2021	£26,288	£175,859	£75,900
2022	£25,907	£173,311	£74,800
2023	£25,532	£170,799	£73,716
2024	£25,162	£168,324	£72,648
2025	£24,797	£165,884	£71,595

[19] Discount factor = $\frac{1}{(1+d)^t}$ where d=discount rate and t= number of years since implementation in the base year (year 0).

After inflating and discounting the estimated costs, the cumulative costs of the Option 0 situation are estimated to be:

Year	Lower estimate	Central estimate	Upper estimate
2013	£29,545	£197,645	£85,303
2014	£58,662	£392,426	£169,369
2015	£87,357	£584,384	£252,217
2016	£115,636	£773,561	£333,865
2017	£143,505	£959,995	£414,329
2018	£170,971	£1,143,727	£493,627
2019	£198,038	£1,324,797	£571,776
2020	£224,713	£1,503,242	£648,792
2021	£251,001	£1,679,102	£724,692
2022	£276,909	£1,852,412	£799,492
2023	£302,441	£2,023,211	£873,208
2024	£327,602	£2,191,535	£945,855
2025	£352,400	£2,357,419	£1,017,450

For Option 1, the estimated annual and one-off costs were as follows:

Option 1	Lower estimate	Central estimate	Upper estimate
Implementation cost	£78,435	£117,652	£156,870
Annual amendment cost	£7,843	£15,687	£23,530
Annual meeting costs	£15,180.87	£54,860.43	£143,489.74
Total one-off costs	**£78,435**	**£117,652**	**£156,870**
Total annual costs	**£23,024**	**£70,547**	**£167,020**

Inflating the estimated annual costs by 2.0% each year gives the following annual costs:

Year	Lower estimate	Central estimate	Upper estimate
2013	£107,669	£343,714	£199,719
2014	£24,922	£180,788	£76,363
2015	£25,421	£184,404	£77,890
2016	£25,929	£188,092	£79,448
2017	£26,448	£191,854	£81,037
2018	£26,977	£195,691	£82,658
2019	£27,516	£199,605	£84,311
2020	£28,067	£203,597	£85,997
2021	£28,628	£207,669	£87,717
2022	£29,200	£211,822	£89,471
2023	£29,784	£216,058	£91,261
2024	£30,380	£220,380	£93,086
2025	£30,988	£224,787	£94,948

Discounting these costs by 3.5%, by multiplying each value by a discount factor[20], gives the following estimated costs.

Year	Lower estimate	Central estimate	Upper estimate
2013	£97,111	£310,011	£180,135
2014	£21,718	£157,546	£66,546
2015	£21,404	£155,263	£65,581
2016	£21,093	£153,013	£64,631
2017	£20,788	£150,795	£63,694
2018	£20,486	£148,610	£62,771
2019	£20,190	£146,456	£61,861
2020	£19,897	£144,334	£60,965
2021	£19,609	£142,242	£60,081
2022	£19,324	£140,180	£59,211
2023	£19,044	£138,149	£58,352
2024	£18,768	£136,146	£57,507
2025	£18,496	£134,173	£56,673

After inflating and discounting the estimated costs, the cumulative costs of Option 1 are estimated to be:

Year	Lower estimate	Central estimate	Upper estimate
2013	£97,111	£310,011	£180,135
2014	£118,830	£467,557	£246,681
2015	£140,233	£622,820	£312,262
2016	£161,327	£775,833	£376,893
2017	£182,114	£926,628	£440,587
2018	£202,601	£1,075,238	£503,358
2019	£222,790	£1,221,694	£565,219
2020	£242,687	£1,366,027	£626,184
2021	£262,296	£1,508,269	£686,266
2022	£281,620	£1,648,449	£745,476
2023	£300,665	£1,786,598	£803,828
2024	£319,433	£1,922,745	£861,335
2025	£337,929	£2,056,918	£918,008

[20] Discount factor = $\frac{1}{(1+d)^t}$ where d=discount rate and t= number of years since implementation in the base year (year 0).

A comparison of the estimated cumulative costs of Option 0 with Option 1 (Option 0 – Option 1), gives the estimated cumulative costs as follows. Note that the lowest estimate for Option 0 was compared with the lowest estimate for Option 1, with the same approach taken for the other estimates.

Year	Lower estimate for benefit of Option 1	Central estimate for benefit of Option 1	Upper estimate for benefit of Option 1
2013	-£67,566	-£94,832	-£112,365
2014	-£60,168	-£77,311	-£75,131
2015	-£52,876	-£60,045	-£38,436
2016	-£45,691	-£43,028	-£2,272
2017	-£38,609	-£26,258	£33,367
2018	-£31,630	-£9,731	£68,489
2019	-£24,753	£6,556	£103,103
2020	-£17,975	£22,608	£137,215
2021	-£11,295	£38,426	£170,833
2022	-£4,712	£54,016	£203,963
2023	£1,776	£69,379	£236,613
2024	£8,170	£84,520	£268,790
2025	**£14,471**	**£99,442**	**£300,501**

Appendix D Emissions information

The various emissions for the different scenarios have been estimated by:

For each vehicle class:

- Determine the fleet composition by Euro level for each year.
- Assume that 5% of non-OBD vehicles in each Euro 1+ at any one time are in a fail state and their emissions become the equivalent of the corresponding pre-Euro 1 vehicles.
- Assume that 2.5% of OBD vehicles in each Euro 1+ at any one time are in a fail state and their emissions become the equivalent of the corresponding pre-Euro 1 vehicles.
- Determine the modified fleet composition taking into account these failure rates.
- Estimate the annual mileage of each vehicle (km).
- Estimate the total number of kilometres covered by each Euro class in each year.
- Multiply the kilometres by the emission factor for that Euro class.
- Summate the emissions of the different Euro classes for each year.

As an illustration, the following tables show the CO emission calculations for medium and large (maximum speed is greater than 130 km/h) 2-wheel motorcycles.

To account for durability effects, the emission for each level are multiplied by the corresponding factor (1.0, 0.99 or 0.95) prior to summating.

Table 62: Fleet composition for 2 wheel motorcycles (> 130 km/h), showing modifications due to different failure rates and also typical mileages.

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Vehicle Registrations														
Pre-Euro 1		195985	179474	164355	150509	137830	126218	115585	105848	96931	88765	81288	74440	68169
Euro 1		166893	152834	139959	128168	117371	107483	98428	90136	82543	75589	69222	63390	58050
Euro 2		109642	100405	91947	84201	77108	70612	64663	59216	54227	49659	45476	41645	38136
Euro 3		417439	438740	401779	367932	336936	308552	282558	258755	236956	216994	198714	181974	166644
Euro 4		3765	22270	91919	155701	142584	130573	119573	109500	100275	91828	84092	77008	70520
Euro 5		0	0	3765	7212	81894	146521	205703	244841	224215	205327	188029	172189	157683
Euro 6		0	0	0	0	0	3765	7212	25427	98575	165561	226903	283078	334521
Sum		893723	893723	893723	893723	893723	893723	893723	893723	893723	893723	893723	893723	893723
Failure rates – assuming: 5% non-OBD vehicles in fail state. 2.5% OBD vehicles in fail state. Fails equivalent to Pre-Euro1														
Pre-Euro 1		230872	215187	200823	187670	175624	164500	154312	144606	134306	124874	116237	108327	101083
Euro 1	5.0%	158549	145192	132961	121760	111502	102109	93507	85630	78416	71810	65760	60221	55147
Euro 2	5.0%	104160	95385	87349	79991	73252	67081	61430	56255	51516	47176	43202	39562	36229
Euro 3	5.0%	396567	416803	381690	349535	320089	293124	268430	245817	225109	206145	188778	172875	158312
Euro 4	5.0%	3576	21156	87323	147916	135455	124044	113594	104025	95261	87236	79887	73157	66994
Euro 5	5.0%	0	0	3576	6851	77800	139195	195418	232599	213004	195060	178628	163580	149799
Euro 6 OBD	2.5%	0	0	0	0	0	3670	7032	24791	96110	161422	221231	276001	326158
Sum		893723	893723	893723	893723	893723	893723	893723	893723	893723	893723	893723	893723	893723
Failure rates – assuming: 5% non-OBD vehicles in fail state. No OBD. Fails equivalent to Pre-Euro1														
Pre-Euro 1		230872	215187	200823	187670	175624	164594	154492	145242	136771	129013	121909	115404	109446
Euro 1	5.0%	158549	145192	132961	121760	111502	102109	93507	85630	78416	71810	65760	60221	55147
Euro 2	5.0%	104160	95385	87349	79991	73252	67081	61430	56255	51516	47176	43202	39562	36229
Euro 3	5.0%	396567	416803	381690	349535	320089	293124	268430	245817	225109	206145	188778	172875	158312
Euro 4	5.0%	3576	21156	87323	147916	135455	124044	113594	104025	95261	87236	79887	73157	66994
Euro 5	5.0%	0	0	3576	6851	77800	139195	195418	232599	213004	195060	178628	163580	149799
Euro 6	5.0%	0	0	0	0	0	3576	6851	24155	93646	157283	215558	268924	317795
Sum		893723	893723	893723	893723	893723	893723	893723	893723	893723	893723	893723	893723	893723
Annual mileages		4092	4092	4092	4092	4092	4092	4092	4092	4092	4092	4092	4092	4092

Table 63: Annual distance covered (million km) by each Euro class for each year
(= number of vehicle * annual mileage)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Pre-Euro 1	944.73	880.55	821.77	767.95	718.66	673.14	631.45	591.73	549.58	510.99	475.64	443.28	413.63
Euro 1	648.78	594.13	544.08	498.24	456.27	417.83	382.63	350.4	320.88	293.85	269.09	246.42	225.66
Euro 2	426.22	390.32	357.44	327.32	299.75	274.5	251.37	230.2	210.8	193.05	176.78	161.89	148.25
Euro 3	1622.8	1705.6	1561.9	1430.3	1309.8	1199.5	1098.4	1005.9	921.15	843.55	772.49	707.41	647.81
Euro 4	14.634	86.572	357.33	605.28	554.29	507.59	464.83	425.67	389.81	356.97	326.9	299.36	274.14
Euro 5	0	0	14.634	28.036	318.36	569.59	799.65	951.8	871.62	798.19	730.95	669.37	612.98
Euro 6	0	0	0	0	0	15.019	28.773	101.45	393.29	660.54	905.28	1129.4	1334.6
Sum	3657.1	3657.1	3657.1	3657.1	3657.1	3657.1	3657.1	3657.1	3657.1	3657.1	3657.1	3657.1	3657.1

Table 64: CO emissions (tonnes) by each Euro class for each year
(= annual distance * emissions factor)

	Factor (g/km)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Pre-Euro 1	20.71	19568	18239	17021	15907	14886	13943	13079	12257	11384	10584	9852	9181.6	8567.7
Euro 1	13.06	8473.1	7759.3	7105.6	6507	5958.9	5456.9	4997.2	4576.2	4190.7	3837.6	3514.3	3218.3	2947.2
Euro 2	3.72	1584.2	1450.8	1328.6	1216.6	1114.1	1020.3	934.33	855.62	783.54	717.53	657.08	601.73	551.04
Euro 3	2.05	3329.2	3499.1	3204.3	2934.4	2687.2	2460.8	2253.5	2063.7	1889.8	1730.6	1584.8	1451.3	1329.1
Euro 4	2.05	30.023	177.61	733.09	1241.8	1137.2	1041.4	953.64	873.3	799.73	732.36	670.66	614.17	562.43
Euro 5	1.19	0	0	17.374	33.284	377.96	676.22	949.36	1130	1034.8	947.62	867.79	794.69	727.74
Euro 6	1.04	0	0	0	0	0	15.641	29.965	105.65	409.57	687.9	942.77	1176.2	1389.9
Total		32985	31126	29410	27840	26161	24614	23197	21861	20492	19238	18090	17038	16075

Appendix E Information gathering questionnaire

29th October 2010

By e-mail

Direct Tel: +44 (0)1344 770199
Fax: +44 (0)1344 770356
Email: mmccarthy@trl.co.uk

Dear Sir/Madam,

Re: Evaluating the UK impact of proposed changes to the approval of two- or three-wheeled vehicles

The European Commission (EC) has recently published a proposal[21] to alleviate a range of concerns associated with the provisions for the type-approval of new L category vehicles, including measures to:

- simplify the legal framework by replacing Directive 2002/24/EC and its separate directives with a single Regulation and a number of delegated and implementing acts
- Improve the technical requirements with the aim of reducing emissions, increasing the level of safety, dealing with new technologies and strengthening market surveillance.

The UK Department for Transport (DfT) have asked TRL to assess the implications of the proposals for the UK. This assessment requires TRL to consider quantitative costs and benefits of the proposals, as well as qualitatively identifying any impacts which cannot be reasonably estimated, or which cannot be monetised. In order to gather up to date information from key stakeholders, information is being sought regarding:

- Vehicle stock and/or new registrations for the UK (for the current L category vehicle fleet; please state year(s) of data provided) and, if possible broken down as far as possible by the categories proposed by the EC (see Annex 1, page 77 of proposal)

- Predictions for the future fleet to 2026, assuming the EC proposals are implemented at the planned dates (again, if possible, broken down as far as possible by the new registration categories)

- Any recent studies reporting on the effectiveness of ABS and CBS systems as measured by either retrospective accident analysis or Field Operational Trial data.

Any information regarding quantifiable costs and benefits or qualitative impacts of the proposals would be gratefully received. We would also appreciate any information available in response to the specific questions below:

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[21] http://ec.europa.eu/enterprise/sectors/automotive/files/com-2010-542_en.pdf

1. Assuming emission requirements from 2017 requiring compliance with Euro 5 (Euro 6 for L3e motorcycles):
    a. What are the estimated development costs in meeting these limits over and above the Industry commitment for the period to 2017?
    b. What will be the ongoing unit costs for any new components required to satisfy the limits?

2. Can you provide estimates for any increased vehicle development costs or increased test costs (and whether these are one –off or reoccurring costs) associated with :
    a. using revised WMTC for emissions testing from 2017
    b. new Evaporative emissions test
    c. Durability testing as proposed in Article 21
    d. new OBDI/II test

3. In-service testing is proposed to ensure that both emissions and functional safety are met throughout "normal life of the vehicles under normal conditions of use"
    a. What impacts to you foresee of this approach?
    b. Can any of these be quantified in monetary terms?

4. Is there any information available from the current fleet which quantifies the deterioration in emissions, or frequency and consequences of safety defects, of L category vehicles used on the road?

5. What is the expected effect of providing CO_2 emission and fuel consumption information to the consumer and to what extent to you think this will influence consumer purchasing choices and the future fleet?

6. From 2017, new vehicles in L1Be, L3, L5e, L6Ae and L7Ae will be required to have the first stage of an on-board diagnostics system. For vehicles in L6Be and L7Be this will be a requirement from 2019, with all new vehicles having this requirement by 2021.
    a. How many of these vehicles would currently comply with OBD1?
    b. How many would be estimated to be compliant by the dates relevant to each stage (2017, 2019, and 2021) without these requirements?
    c. What is the estimated per vehicle cost to make a non-compliant vehicle compliant with OBD1, assuming the economies of scale required to meet the requirements?

7. From 2019 new vehicles in L1Be, L3, L5e, L6Ae and L7Ae, in addition to OBD1, shall be (subject to a environmental cost-effectiveness study) required to have the second stage of an on-board diagnostics system (OBDII).
    a. What proportion of these vehicles would be estimated to be compliant by 2019 without these requirements?
    b. What is the estimated per vehicle cost to make a OBD1 vehicle compliant with OBD11, assuming the economies of scale required to meet the requirements?

8. Is there any data which quantifies the extent of tampering on the current UK fleet? Which vehicles are prone to tampering and are there any particular types of tampering can be identified?

9. How would you best provide anti-tampering prevention and what approximate costs (quantified per vehicle and the by the number of applicable vehicles) would be associated with this?

10. If you are a manufacturer, how many alternative fuel vehicles do you produce currently? How many do you estimate will be produced in:
    a. 2013?
    b. 2026?

11. What is your opinion on the proposal to add requirements for alternative fuel vehicles? Will this assist development in this area or stifle it?

12. Do you expect any impacts, either positive or negative, on the proposals to mandate permanent headlamp illumination or to repeal the 74Kw power limit?

13. How many current L3e motorcycles are fitted (i.e. as standard or as fitted option) with ABS or CBS?
    a. In 2017 how many L3e motorcycles in the A1 subcategory do you expect to be fitted with ABS or CBS?
    b. In 2017 how many L3e motorcycles in the A2/3 subcategories do you expect to be fitted with ABS?
    c. Assuming the Industry commitment and current progress toward this, what do you estimate the system costs to be in 2017:
        i. For ABS or CBS on L3e-A1
        ii. For ABS on L3e-A2/3

14. What is your opinion on legislative simplification? Do you think that referring to the UN/ECE Regulations for the technical requirements will have any benefit? Can this be quantified in monetary terms?

15. If you are a manufacturer, to what extent do you use the SVA scheme for current approvals; for which category of machines and how many per year?

16. The proposal introduces the option for small series approval with limits of between 20 and 100 vehicles for each type sold throughout the EU. Does this option offer a viable alternative to existing approval routes? Are the numbers involved adequate?

17. Are there any impacts (positive or negative) quantified as far as possible, on the proposed re-categorisation of L category vehicles? Are there any increase in costs (if so please quantify as far as possible)

18. Manufacturers will be required to make available repair and maintenance information (Chapter XVI). What will be the additional costs for manufacturers? How will this benefit those involved in servicing?

19. Vehicle manufacturers will also be required to provide information intended for manufacturers of components and separate technical components (Article 59). What will be the additional costs for manufacturers? How will this benefit those involved in servicing or supplying spare parts?

20. Off road quadricycles have been excluded. If you manufacturer off-road quadricycles, what are the quantified impacts of this?

21. Distributors and importers will have the same responsibilities as the manufacturer with respect to responsibility for a vehicle, system, component or separate technical unit (Article 14). What will the additional cost be to "re-badging" operations in the UK?

22. Importers, distributors and manufacturers will be required to appoint a representative to liaise with type approval authority. What additional costs are foreseen here?

23. If you are an approval authority or enforcement agency, do you expect any additional cost associated with the proposals outlined in Article 48 in addition to those already required under Article 20 of EC Regulation 765/2008 and if so, can this be quantified?

24. What impacts are expected from Article 52 which requires systems or components which may have a significant risk to functional safety or environmental emissions, to be approved by an approval authority?
    a. What would the approximate approval costs be to a supplier per component?
    b. What would be the cost to the approval authority?

25. Do you foresee any problems associated with the various timings for the introduction of technical requirements, e.g. 2017 for ABS, dates for emissions, etc.

26. Do you foresee any impacts for end-users in changes to maintenance costs or how easily bikes can be customised? What are your views on mandatory advanced braking, the repeal of the maximum power limits and controls on emissions?

As a final request, I would also like to re-iterate the general request for further information regarding:

- Vehicle stock and/or new registrations for the UK (for the current L category vehicle fleet; please state year(s) of data provided) and, if possible broken down as far as possible by the new registration categories proposed by the EC
- Predictions for the future fleet to 2026, assuming the EC proposals are implemented at the planned dates (again, if possible, broken down as far as possible by the new registration categories)
- Any recent studies reporting on the effectiveness of ABS and CBS systems as measured by either retrospective accident analysis or Field Operational Trial data.

We will be collecting responses to this letter until **18th November 2010**, so please send us any relevant information by that date. We appreciate that this is a short timescale in which to solicit responses and would be very grateful of responses as soon as possible to mmccarthy@trl.co.uk. If you have any questions regarding this request for information, or would like to discuss the information that has been requested, please feel free to contact myself or one of my colleagues listed below:

- Iain Knight - iknight@trl.co.uk +44 (0)1344770079; or
- Tim Gibson - tgibson@trl.co.uk +44 (0)1344770681.

Yours faithfully,

Mike McCarthy
mmccarthy@trl.co.uk+44 (0)1344770199

Appendix F Information gathering

The information gathering letter was sent to the following stakeholders:

- Motorcycle Industry Association (MCIA)
- Vehicle Certification Agency (VCA)
- Vehicle and Operator Services Agency (VOSA)
- Norton Motorcycles
- Triumph Motorcycles
- Honda Motorcycles
- CCM Motorcycles
- British Motorcyclist's Federation (BMF)
- Motorcycle Action Group (MAG)
- BRAKE
- All Terrain Vehicle Industry European Association (ATVEA)
- European Quadricycle League (EQUAL)
- Aixam-Mega
- ACEM
- Federation of European Motorcyclists' Associations (FEMA)

Of these, responses were received from MCIA (combining responses from Industry: Triumph, Honda, Norton, CCM and some existing information from ACEM), VOSA, VCA, and BMF. Follow up telephone calls were made with MCIA, VCA and also to those Stakeholders who did not provide responses to the information gathering questions within the required timeframe.

Appendix G Advanced braking literature review

The EC has proposed mandatory fitment of either ABS or CBS to motorcycles and/or mopeds for machines of a certain engine capacity ranges, with ABS on PTWs[22] with cylinder capacity greater than $125cm^3$ and advanced brake systems (combined brake systems and/or anti-lock brake systems) on motorcycles greater than $50cm^3$ and less than or equal to $125cm^3$. In order to assess the impacts of this proposal a range of information is required. This includes a review of literature to evaluate casualty reduction effects within the UK and the effectiveness of the systems proposed.

There has been substantial research undertaken into the potential benefit of advanced braking system. This includes various studies of accident data, field trials and large scale cost/benefit analyses. TRL conducted a review of literature available regarded advanced braking systems Robinson *et al.* (2009). The following literature review includes the documents reviewed as part of Robinson *et al.* (2009) and literature published since.

A study conducted by the Austrian Road Safety Board (Vavryn and Winkelbauer, 2005) aimed to qualify and quantify how ABS improves brake handling of the average motorcycle rider in an emergency braking manoeuvre. The participants of the study included both new license holders and experienced riders taken to be representative of the Austrian riding population. The study found that, for motorcycles not equipped with ABS, experienced motorcycle riders achieved an average braking deceleration of about 6.6 ms^{-2}, while novices, after six hours of training, achieved an average of $5.7ms^{-2}$. After an introduction to ABS and a few minutes practice, experienced riders were able to achieve an average deceleration of $7.8ms^{-2}$ and novices an average of $7.7ms^{-2}$ when using a motorcycle equipped with ABS. The report also stated that riders of motorcycles fitted with ABS are able to improve their brake performance immediately after receiving instructions on correct ABS brake handling. The report recommended that ABS should be mandatory equipment for every powered two-wheeler.

Sporner and Kramlich (2000) used in-depth investigation of 610 accidents which showed that in 65% of all accidents between motorcycles and cars, the motorcycle rider was able to brake before the collision. In 19% of these cases the rider fell off before the collision. On average, they concluded that about 55% of the 610 motorcycle accidents could be positively influenced by ABS.

A European Transport Safety Council (2001) paper also quotes the Sporner and Kramlich (2000) report, stating that ABS could reduce the number of accident victims by at least 10%. As a result the ETSC recommended that ABS should be mandatory for motorcycles and this measure was placed third on their list of priorities for legislation.

Gwehenberger *et al.* (2004) studied 200 serious accidents to investigate the effectiveness of ABS. They found that ABS stabilises the braking process, shortens the braking distance and prevents the front wheel from over-braking, thus preventing dangerous falls whilst braking. They found that ABS ensures less effort intensive braking for the motorcycle rider, particularly during limit and emergency braking scenarios. Overall they predicted that ABS could avoid between 8% and 17% of all serious motorcycle accidents. The authors also stated that rider training is required order to achieve the maximum advantages of ABS.

Two studies by McCarthy and Chinn (1998 and 1999) investigated ABS and its effect on BMW motorcycle accidents. The first study provided inconclusive results due to data limitations; primarily a very small sample size of ABS related accidents, with only 37 fatal and serious cases. The later report, with a larger sample size, found that the proportion of casualties from ABS-equipped machines that were fatal or serious were, on

[22] Powered two-wheelers

average, about 3% lower than from non-ABS equipped machines. The proportion of impacts that were to the front of the motorcycle was, on average, 8% lower for ABS-equipped machines when compared to non-ABS machines. The study also found that casualties from ABS-equipped machines were about 5% higher than that of non-ABS machines in poor road conditions (e.g. wet, snow, ice or flood). It was reasoned that this result was likely to have been influenced by factors such as rider behaviour and characteristics of the motorcycles in the sample, rather than a reflection of poor ABS performance in these road conditions. The proportion of casualties on ABS-equipped machines at or near road junctions was about 2% lower than for those on non-ABS equipped machines.

Furthermore, two large scale cost benefit studies have been undertaken. One was on behalf of the International Motorcycle Manufacturers Association (IMMA) and conducted by Dynamic Research Inc. (Kebschull and Zeller, 2007 & 2008), the other was completed by the University of Cologne (Baum *et al.*, 2007).

Kebschull and Zellner (2007 & 2008) used data collected from European accidents using the MAIDS[23] accident study (data collected between 2000 and 2004) and for the USA using the research by Hurt *et al.* (1981). This study included mopeds as well as motorcycles; TRL consider that the benefit of advanced braking systems are lower for mopeds due to the types of accidents they are involved in and the lower average travel speeds. The in-depth data from each of these sources was used to create computer simulations of each accident. A total of 921 European accidents and 900 American accidents were simulated, each one with and without ABS fitted to the motorcycle. Three ABS configurations were examined; front ABS only, rear ABS only and independent front and rear ABS. The study found that all types of ABS had a 'low effectiveness', and had costs much higher than for other 'low effectiveness' vehicle safety measures. This led to the report determining that ABS is not a cost effective safety measure.

In contrast, Baum *et al.* (2007) assumed that ABS is effective in 85% of all accidents that involve a downfall, and that a rider is twice as likely to be fatally injured in a downfall[24] rather than a non-downfall accident. Benefit-cost ratios for two effectiveness levels were calculated; low and high. Low effectiveness only assessed the potential for injury mitigation for fatally injured riders in downfall accidents. The low effectiveness assessment assumed that ABS is 85% effective at preventing downfall accidents, with the casualty injury level being reduced from a fatal to a serious. The high effectiveness scenario considered the avoidance of accidents. It was assumed that fatalities, severe injuries and slight injuries were reduced to non-injured in the relevant group of accidents (those with downfall). The authors stated that both of these scenarios underestimate the effectiveness of ABS because it is not possible to assess the implications of the reduction in impact speed that ABS could provide. The high effectiveness scenario was stated to be the more realistic because it considered a wider range of casualty severities than the low effectiveness scenario. The benefit to cost ratio for the high effectiveness system was estimated to be between 4.6 and 4.9, while the benefit to cost ratio for the low effectiveness system was estimated to be between 1.7 and 1.8.

These two papers are fundamentally different in the way they approached the issue of ABS effectiveness; Kebschull and Zellner (2007 & 2008) used an arguably more robust case by case approach to assess the effect of ABS, while Baum *et al.* (2007) applied a single effectiveness value to groups of accidents considered to be influenced by ABS. Kebschull and Zellner (2007 & 2008) considered accidents from USA and Europe, but the former group of data was very old (27 years). The European data was taken from the more recent MAIDS study (although this data was also over 5 years old) which collected in-depth samples from five countries: Spain, Italy, Germany, France and Holland. This data was not representative of the national accident situation for each of these countries.

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[23] Motorcycle Accident In-Depth Study

[24] Downfall accidents are defined as accidents in which the motorcycle fell to the ground prior to impact

Each accident was reconstructed using a numerical model to determine whether ABS would influence the accident outcome. Kebschull and Zellner (2007) considered the effectiveness across all types of motorcycle accident. However, they did not consider that ABS could provide a benefit in accidents where the limit of braking had not been evidentially achieved. It is not clear how Kebschull and Zellner (2007 & 2008) determined the start of the braking event for input into the model, since the rider may have applied the brakes in advance of wheel lock and physical evidence being left at an accident scene. Research shows that riders may be able to brake more efficiently with ABS, and this may allow then to apply a greater brake force earlier in the braking event. For example, practical research comparing the braking of riders with and without ABS carried out by Winkelbauer (2005) showed that both experienced and novice riders were able to reduce their stopping distance when riding a motorcycle fitted with ABS compared to a standard motorcycle.

Kebschull and Zellner (2008) stated that a full ABS system is estimated to costs €539. Information was obtained from the internet which shows retail costs of €350 for a Yamaha (2008) ABS system, and between €635 and €822 for BMW motorcycles (2008). Baum *et al.* (2007) estimated the effectiveness of ABS based upon a literature review which resulted in effectiveness for ABS of 85% for its target population (downfall accidents). In a similar way to Kebschull and Zellner (2007), Baum *et al.* (2007) did not take into account the reduction in stopping distance that a rider is able to achieve when riding a motorcycle fitted with ABS, and only considered that ABS would be effective if the rider fell off the motorcycle during braking prior to the accident. The study used much lower manufacturer costs of €150 instead of end user costs in its reports. As the literature review has shown, there have been two recent cost/benefit analyses conducted. However, there appears to be a large variation in the assumptions made during the analyses, particularly in relation to the 'target population' of accidents in which ABS is likely to have an influence, the effectiveness of the braking system in these accidents, and the cost of the advanced braking system, be it ABS or a combined braking system with ABS.

Bayly *et al.* (2006) investigated Intelligent Transport Systems and Motorcycle Safety and outlined the expected behaviour in comparison to accident types found in Australia. However, this report did not make any estimates of the actual effectiveness of ABS. The report is limited to defining the target population only.

McCarthy *et al.* (2008) compared the potential influence of a wide range of active safety systems for PTWs. Preventing wheel lock using ABS was ranked number 6 from a list of 43 wide-ranging functional requirements which were not assessed for technical feasibility. The analysis was based on case reviews of 60 accidents recorded either in the UK OTS database or the COST327 database. The sample consisted of accidents of all severities, but was relatively small and was not representative of national statistics, by type or severity of accident.

Rizzi *et al.* (2009) set out to evaluate the effectiveness of ABS on motorcycles in reducing real-life crashes and injuries in Sweden. For this two methods were used the first used in-depth accident analysis on 164 accidents. This found that 14% of the accidents would have been avoided if ABS was fitted, a further 16% would have been influenced with ABS having a possible influence in a further 22% of all accidents. The second method used an induced exposure approach. This approach found that ABS had 41% effectiveness in all crashes with injury excluding head-on collisions, 43% effectiveness in crashes at intersections, its 54% effective in all severe and fatal crashes excluding head-on collisions and is 71% effective in severe and fatal collisions at intersections.

Roll *et al.* (2009) used data collected by DEKRA from attended accident scenes similar to data collected in the UK by the OTS project. The DEKRA PTW database contains 350 cases from 1996-2007. 51 of these cases were selected for the study. In 43% of the studied cases, the braked PTW became unstable (through over braking) and hits the ground before a collision with a third party. Roll *et al.* (2009) felt that a system incorporating several advanced braking systems would give the best benefit these include CBS, ABS, brake pre-fill and brake assist. This incorporated with good rider instruction could result in a dramatic reduction in collision speed. The authors did not do any work in estimated the potential benefits as a result of the reduction in collision speed.

Teoh (2010) compared the fatal crash rates per registrations of motorcycles with and without ABS. This was achieved by identifying motorcycles for which ABS was optional equipment and could be identified as present by the vehicle identification number. The study found 375 fewer fatal motorcycle crashes per 10,000 registered vehicle years for ABS models than for their non-ABS versions.

Smith *et al.* (2009) reviewed literature to identify effectiveness values for ABS and CBS advanced braking systems. This included the research described above, as well as additional studies and newly published work. The following table summarises the information identified in relation to the effectiveness of ABS.

Effectiveness of ABS identified from the literature

Effectiveness	Source	Region	Study type	Sample size
85% of all downfall accidents with downfall before initial impact	Baum *et al.* (2007) based on a predictive study.	Germany	Predictive	
Approximately 10% of motorbike accidents involving injury can be avoided or positively influenced	Sporner *et al.* (2000,2002,2004) cited in Gwehenberger (2006) describe the dangers of braking with conventional braking systems and the avoidance potential of ABS in several studies based on the GDV accident database.	Germany	Predictive	
Avoids 8%-17% of serious motorbike accidents	Gwehenberger *et al.* (2006). Results of analysis of 200 serious accidents by Allianz Center of Technology. Extrapolated to Germany would result in around 100 deaths and more than 1,000 serious injuries avoided a year	Germany	Predictive – case by case subjective	200 accidents
Net injury benefit 1%-3% of all casualties	Kebschull and Zellner (2007 &2008) conducted a series of computer simulations based on data collected in the MAIDS (2004) and Hurt *et al.* (1981) studies. Several configurations of ABS were simulated.	USA and Europe	Predictive case by case computer modelling	1800 accidents

Effectiveness	Source	Region	Study type	Sample size
55% of Austrian motorcycle accidents could be avoided or positively influenced by ABS.	Vavryn and Winkelbauer (2004)	Austria and Germany	Predictive	
Increase in braking performance observed of novice and experienced test riders from 5.7ms^{-2} to 7.7ms^{-2} for novice riders and 6.6ms^{-2} to 7.8ms^{-2} for experienced riders	Vavryn and Winkelbauer (2004)	Austria	Human factors study	47 novice riders and 134 experienced riders
ABS reduces risk of riders being thrown from the bike. May lead to a reduction in forward collision and off-road crashes.	Bayly *et al.* (2006)	Australia	Unknown	Unknown
3% reduction in fatal and serious casualties	McCarthy and Chinn (1999)	UK	Retrospective	
ABS was ranked 6th from a list of 43 functional requirements (not adjusted for technical feasibility)	McCarthy *et al.* (2008), review of GB OTS/COST327 cases for PISa project	UK and Europe	Subjective case-by-case Predictive	60
Avoids 2.4% of all accidents, 12.1% of fatal, 11.7% serious and causes an increase of 2.1% of slight	Gail *et al.* (2009)	Europe	unknown	unknown
Reduces fatal motorcycle crashes per 10,000 registered vehicle years by 37%	Teoh (2010)	USA	Retrospective	321
38% for all crashes with personal injury and 48% on severe and fatal crashes	Rizzi *et al.* (2009)	Sweden	Retrospective	164
Would directly affect the outcome of 43% of studied crashes effectiveness estimates not made	Roll *et al.* (2009)	Germany	Predictive	51