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Approval and market surveillance of two- or three-wheeled vehicles and quadricycles - Impact Assessment of IMCO Compromise Amendments

STUDY

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Approval and market surveillance of two- or three-wheeled vehicles and quadricycles

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POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

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Abstract

This study is a three-part impact assessment of amendments proposed by the IMCO Committee to three measures contained in the European Commission's proposal for a "Regulation on the approval and market surveillance of two- or three-wheeled vehicles and quadricycles". The first part concerns the fitting of an anti-lock braking system (ABS), the second part concerns On-Board Diagnostic systems (OBD), the third part the speeding-up of the introduction of subsequent stages of European emission standards for L-category vehicles.

IP/A/IMCO/NT/2011-21 February 2012

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I - Enhanced functional safety requirements

STUDY

Abstract

The study assesses the impact of a) the requirement to fit anti-blocking systems (ABS) to existing types of motorvehicles (entire category L3e); b) the obligation to fit ABS to low-performance motorcycles (category L3e - A1) and c) bringing it forward by one year for new types of two-wheel motorcycles (category L3e).

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LIST OF ABBREVIATIONS

ABS	Anti-lock Braking System
ACEM	Association des Constructeurs Européens de Motocycles
CBS	Combined Braking System
EC	European Commission
EP	European Parliament
EU	European Union
FEMA	Federation of European Motorcyclists Associations
NPV	Net Present Value
PI	Positive Ignition
PTW	Powered Two-Wheeler
TRL	Transport Research Laboratory

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1. INTRODUCTION

This study is the first of a three-part assessment of amendments proposed by the European Parliament (EP) to three measures contained in the EC's 'Proposal for a Regulation on the approval and market surveillance of two- or three-wheel vehicles and quadricycles'[1].

The impact assessment builds upon the comprehensive impact assessment on the Proposal compiled by the European Commission (EC)[2], but is narrower in focus, taking the measures contained in the EC's Proposal as the baseline scenario. Only the differences between the EC's original proposal and the IMCO Compromise are considered in this impact assessment.

The impact assessment further draws on existing research not considered in the EC's impact assessment and consultations with interested parties, including:

- the association of the European motorcycle industry (ACEM)
- individual motorcycle manufacturers and suppliers; and
- the Federation of European Motorcyclists Associations (FEMA).

The report is organised as follows:

1. Summary of the proposed measures and statement of the object of the impact assessment

2. Summary of the impacts of the proposed measure and selection of the primary impacts to be analysed in detail

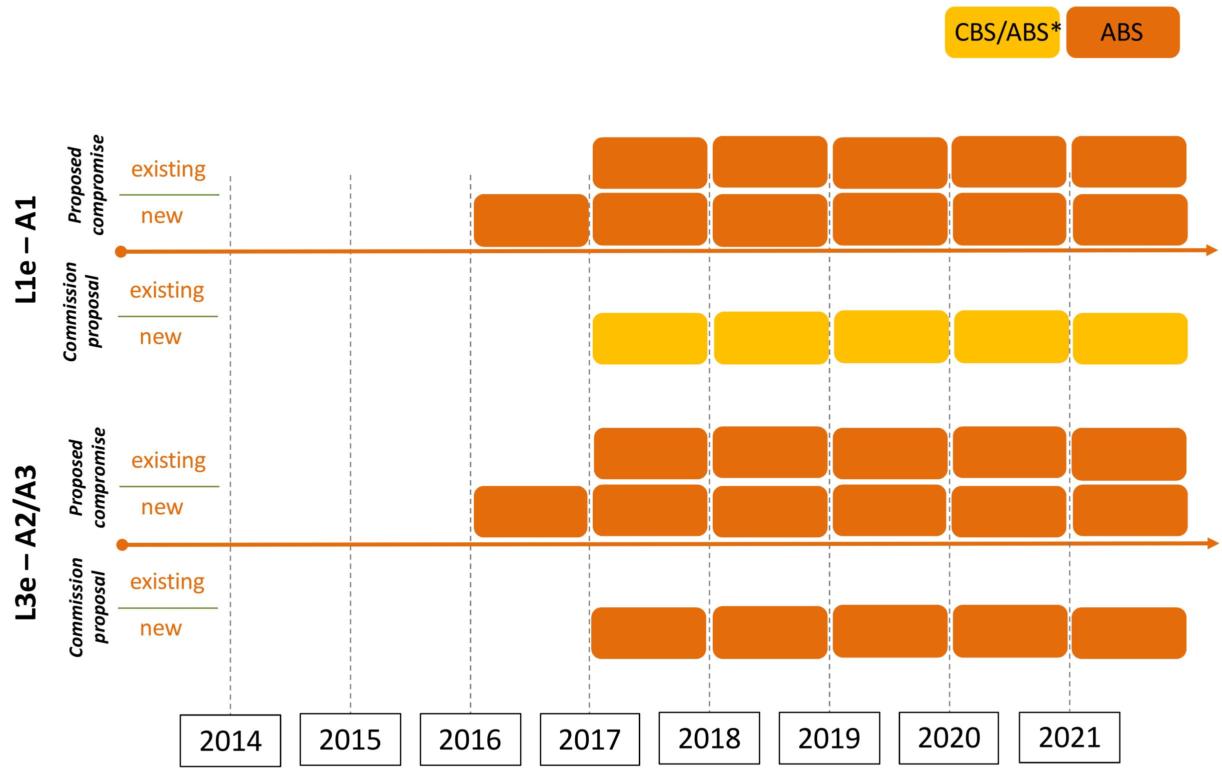
3. Cost-benefit analysis of the selected impacts

[1] COM(2010) 542 final, 4 October 2010.
[2] SEC(2010) 1152, 4 October 2010.

2. SUMMARY OF THE PROPOSED MEASURE

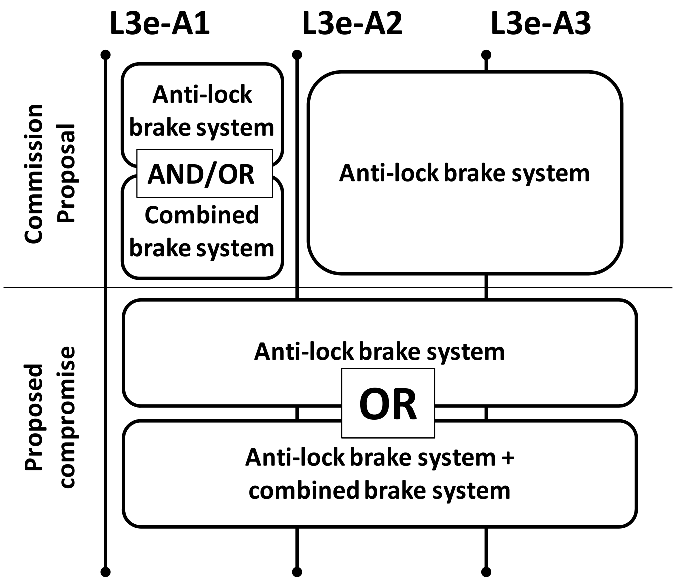
According to the IMCO Compromise, new types of motorcycles (low, medium and high performance[3]) have to be equipped with an anti-lock braking system (ABS) from 2016. The vehicle manufacturers are free to fit supplemental combined brake systems (CBS) in addition to the obligatory ABS. ABS will become compulsory from 2017 for existing types of vehicles as well.

Figure 1: Summary of the proposed measure



*

[3] See Annex I for definitions.



Source: London Economics

Under the original EC proposals, ABS would only be required for medium- and high-performance motorcycles. For low-performance motorcycles, manufacturers would have the option to fit either ABS or CBS, or both. Furthermore, the requirement for new vehicles would have come into force a year later in 2017.

2.1. Scope of the impact assessment

The impact assessment is focused on three issues:

- the extension of the requirement to fit ABS to existing types of motorcycles (entire category L3e);
- the extension of the requirement to fit ABS to low-performance motorcycles (category L3e - A1); and
- the introduction of the ABS requirement for new vehicles one year earlier than originally proposed for categories L3e - A2 and A3, i.e., in 2016 for the entire category L3e.

The baseline scenario with which the proposed measure has to be compared is thus characterised by the option to fit CBS only on low-performance motorcycles and to introduce the measure one year later for new vehicle types. In addition, the effect of voluntary consumer demand for non-obligatory ABS and industry commitments regarding ABS installation need to be taken into account: even though under the status quo ABS will not be obligatory for vehicles in category L3e - A1, a certain number will nonetheless be equipped with ABS.

The difference in the timing of the implementation under the proposed measure compared with the baseline scenario results under the assumption of a positive discount rate in a higher net present value (NPV) of costs and benefits associated with the measure.

3. SUMMARY OF THE IMPACTS OF THE PROPOSED MEASURE

This section briefly discusses the impacts of the proposed measure that have been identified in the EC's initial impact assessment. Based on the EC's work, we evaluate the significance of the individual impacts and their relevance for the impact assessment.

Other, minor and higher-order impacts, such as effects on competition in the aftermarket, can be imagined, but are excluded from the discussion as they are highly speculative. Also excluded are costs that are exactly balanced by commensurate benefits elsewhere in the system such as increased revenues for manufacturers of ABS components that are equivalent to the increased costs incurred by vehicle manufacturers (and consumers, if costs are passed on). Furthermore, some impacts are very abstract, which makes them difficult to quantify. Examples include the lack of technology neutrality of the proposed measure (compulsory ABS), which is normatively undesirable, but has consequences that are difficult to foresee (e.g., cutting off certain areas of research into vehicle technology); or the increased complexity of legislation on the technical requirements for ABS for motorcycles, which carries costs in terms of administrative process, among other things.

In the following section costs and benefits are discussed in turn. The list of impacts is based on Annex XII of the EC's initial impact assessment.

3.1. Costs of the proposed measure

3.1.1. Manufacturer costs

The proposed measure imposes costs on manufacturers by requiring them to fit ABS on motorcycles, which under the status quo, only CBS would be fitted. According to the motorcycle manufacturers association ACEM, the cost of CBS is about 50% of the cost of ABS, which is estimated at around €500 per vehicle.

Part of the manufacturer costs could include an initial price increase for components following the introduction of mandatory ABS. Such price increases could result under competitive conditions from increased demand given an upwards-sloping supply curve (reflecting technical constraints in the production process, scarcity of inputs, etc.).

The low production runs of motorcycles (the best-selling models typically sell less than 20,000 units) mean that economies of scale are not available at a level comparable to that of mass-produced cars. Low-volume producers (SMEs) are likely to face higher relative costs than higher volume producers.

Costs can be prohibitive when it comes to existing types of motorcycles. The frame of a motorcycle offers less space than the frame of a car and balance considerations are more critical. Fitting new components on frames that were not designed to accommodate them is difficult and sometimes impossible.

The table below shows the cost of ABS as a percentage of average vehicle prices. The costs of ABS are sizeable when compared with the average price of a vehicle, especially where category L3e – A1 is concerned. In addition, it should be taken into account that smaller motorcycle manufacturers are likely to be disproportionately affected by any cost increase, as it is spread over sometimes very small numbers of units produced (small manufacturers often produce fewer than 1,000 vehicles per type per year).

Table 1: Potential impact of ABS on end-user prices

Vehicle category*	L3-A1	L3-A2 / A3
Observations	17	21
Average price per vehicle (€)	2,837	8,994
Cost of ABS (€500) as % of average price	17.6%	5.6%

Note: Average prices per vehicle category (excluding cost of ABS/CBS) for the 38 best-selling models in category L3e were taken from the talian Magazine "Due Ruote", January 2012, published by Domus. Average prices for the entire market are likely to be lower for vehicles in sub-category L3-A1, where competition is more fragmented. * See Annex I for definitions.

Source: London Economics based on ACEM data

3.1.2. Environmental costs

Fitting ABS has environmental costs that are as a result of higher vehicle weight (including the weight mass of the ABS device plus 'secondary mass' (i.e., mass associated with supporting the device, e.g., added structural strength, brake and tyre capacity, etc.[4]). Greater mass increases fuel consumption and hence emissions, as well as wear on tyres, suspensions etc. Kebschull and Zellner (2008) estimate that current ABS units add 1.5 kg to the mass of a motorcycle and that this increases average fuel consumption and vehicle emissions by 1% (assuming an average motorcycle with rider weighs 250 kg).

However, data provided by component manufacturer Bosch shows that ABS units continue to decrease in mass, with current (2010) models weighing as little as 0.7 kg. The impact on emissions is therefore unlikely to be substantial, even though it is going to be proportionately greater for motorcycles in category L3e – A1, which are typically lighter, so that any added weight represents a greater proportional weight increase.

3.1.3. Demand effect of increased price of vehicles reduces quality of the vehicle stock

A higher price of motorcycles fitted with ABS induces a demand effect: some current owners of motorcycles will react to a price increase by postponing the replacement of their old vehicle, while some first-time buyers will opt for a second-hand motorcycle instead of a new one. Overall, this has the effect of increasing the average age of the vehicle stock (note that this is to some extent counteracted by consumers entering the market for motorcycles for the first time as a result of increased rider safety; see below). Other factors being equal, an older vehicle stock can be expected to produce more emissions and more accidents on average compared to a newer vehicle stock.

The strength of this effect depends primarily on the price elasticity of demand for new motorcycles (as well as the safety/emissions differential between old and new motorcycles). This elasticity is unknown, but can be expected to be higher for customers of low-performance motorcycles (category L3e – A1) that are cheaper (so that the added cost of ABS represents a greater proportion of the overall price), and are often used by a more price-sensitive customer segment.

[4] See Kebschull and Zellner (2008).

3.1.4. Negative safety impacts

ABS on low-traction surfaces

In conditions of low traction (off-road) ABS can increase stopping distance. In greater detail, in these conditions, to achieve the maximum level of deceleration, the rider has to modulate the front brake around the point of wheel-lock. However, current anti-lock braking systems detect imminent wheel-lock and automatically decrease braking force, resulting in greater-than optimal stopping distance (i.e. a longer stopping distance).

However, two reasons suggest that the negative impact on accidents and casualties will be limited: first, off-road usage represents a very small fraction of total distance driven by motorcycles. Secondly, technical solutions to the problems associated with off-road use of ABS are currently being developed[5]. As such, we consider this impact to be negligible.

ABS in certain motorcycle-specific accident configurations

ABS potentially has a negative impact on rider safety in certain accident configurations that are specific to motorcycle accidents: in certain accident situations, falling off and being separated from the motorcycle results in less severe injuries than impacting and obstacle while still in control of the vehicle, albeit at reduced speed.

However, such 'downfall' accidents have been shown to result in greater casualties overall[6], which suggests that the number of cases in which the absence of ABS would have increased rider safety is very limited. Nonetheless, it should be noted that motorcycle accidents differ from car accidents in this regard, which means that lessons based on the experience with ABS in cars are not always directly applicable to motorcycles.

Overconfidence of riders of ABS-equipped motorcycles

The risk of accidents could be increased due to overconfidence of riders of motorcycles fitted with ABS or a misunderstanding of the capabilities of ABS (substitute for CBS). An underestimation of stopping distance at a given speed or misconceptions about the set of situations in which ABS is effective might lead individual riders to adopt a less safe riding style. While plausible, this effect can be mitigated through education measures and can be expected to be temporary. Inexperienced riders are more likely to suffer from overconfidence, but at the same time new riders will be trained on ABS-equipped motorcycles, which results in a better understanding of the capabilities of ABS. Moreover, no plausible evidence has been found documenting such an effect for other safety measures (obligatory wearing of helmets, seatbelt laws for cars, etc.), which might be expected to have fostered overconfidence in a similar way.

Substitution of ABS for CBS

Making ABS compulsory and removing the possibility to fit (only) CBS instead is likely to lead to CBS being fitted on fewer vehicles in category L3e - A1, where the cost of fitting both systems typically represents a greater proportion of the overall price of the vehicle than for medium and high-performance motorcycles.

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[5] "Antilock Motorcycle Brakes Go Off-Road". *Wired*, 9 November 2011. Available at http://bit.ly/sp9MTG [accessed 17 January 2012].

[6] As cited in the TRL study (p. 21), Baum et al. (2007) find that a rider in a downfall accident is twice as likely to be fatally injured.

CBS can enhance safety in situations in which ABS is not effective, including in bends and at lower speeds. Arguably, the effects of CBS are especially beneficial in the case of category L3e - A1 vehicles (the majority of which are scooters[7]) that are more likely to be used:

- by novice riders;
- at low speeds;
- in an urban environment.

Accidents and injuries that could avoided and mitigated by CBS, assuming a certain level of substitution between ABS and CBS in category L3e –A1, have to be netted out to isolate the effect of the proposed measure.

In summary, there are some potential negative impacts of ABS on rider safety. However, the severity of most of these impacts appears limited and not a major determinant of the overall impact of the proposed measure. In the case of off-road braking performance and downfall accidents, only a small minority of accidents is likely to be negatively affected. Equally, reckless riding behaviour induced by overconfidence is likely to affect only a minority of mostly inexperienced riders and can be mitigated by training and education.

The effect of substituting ABS for CBS is potentially more serious as the two systems are not substitutes when it comes to effectiveness in avoiding and mitigating accidents and injuries: in certain accident situations, only ABS can protect the rider, in others only CBS, but there is no overlap between the two types of accidents. Empirical analysis of the relative frequency of the different scenarios and the effectiveness of the two systems in each is needed to quantify the effect.

3.2. Benefits of the proposed measure

3.2.1. Avoidance or mitigation of accidents and casualties

ABS is the only technical solution that directly monitors and prevents wheel-locking. In certain emergency situations, ABS can help motorcycle riders to achieve faster deceleration. In particular, the braking performance of inexperienced riders can be raised to that of experienced riders.

ABS can prevent downfalls in emergency braking situations. Downfall accidents have been shown to carry a particularly high risk of fatal injury[8]. Finally, ABS may increase riders' confidence in applying higher braking pressures, thereby shortening the stopping distance.

ABS helps to avoid or mitigate accidents and casualties. However, it is not effective in all motorcycle accidents. According to accident data from the MAIDS database, in 40% of accidents, no evasive action is taken at all[9]. As described above, there are other accident configurations in which ABS is not effective and in some of these CBS might be effective.

The assessment of the proposed measure thus depends on the accident/casualty mitigation performance of ABS compared with CBS for vehicles in category L3e – A1 only.

[7] 70% according to ACEM statistics.
[8] See footnote 6 above.
[9] Kebschull and Zellner (2008).

3.2.2. Insurance costs to consumers

A second-order effect of the reduced risk of motorcycle accidents is reduced insurance premiums for users of motorcycles. This assumes a competitive insurance market in which premiums accurately reflect risk (otherwise it could be imagined that insurers simply increase premiums for old motorcycles not fitted with ABS). The extent of this impact depends on the extent of the risk reduction as well as on the methods used by insurers to calculate premiums. It is possible to quantify the effect, but this would require a detailed analysis of insurance providers' premiums as well as the competitive situation in the Member States.

3.2.3. Increased demand for motorcycles

People who are currently dissuaded from buying motorcycles because of safety concerns could be tempted into the market if all motorcycles were fitted with ABS. Whether the proposed measure will have this effect depends on the perception that ABS is a least as effective as CBS. Whether there is a net increase in demand depends further on the price elasticity of demand for motorcycles (see above).

3.2.4. Revenue and employment in supplier industry

The direct revenue accruing to the supplier industry from increased sales of ABS is already accounted for in the assessment framework through the higher end-user prices of motorcycles fitted with ABS. Any potential net benefit is therefore due to multiplier effects arising from the induced income effect of additional revenues in the supplier industry.

The scale of this benefit therefore depends on the size of the multiplier and the extent to which the supplier industry, i.e., manufacturers of ABS and auxiliary systems, is located in Europe. The size of the multiplier in the motorcycle supplier industry – if it exists – is unknown. In addition, while Europe is home some major manufacturers of ABS, others exist outside Europe, so that any potential benefit is not fully captured inside the EU. We consider it likely that the benefit to the European economy due to multiplier effects at the level of ABS manufacturers is negligible.

Table 2: Summary of impacts

Impact	Assessment
Manufacturer costs	Potentially serious
Environmental costs	Likely negligible
Demand effect of increased price of vehicles reduces quality of the vehicle stock	Likely small in sub-categories A2/A3
Negative safety impacts	Likely small except potentially for CBS substitution
Avoidance or mitigation of accidents and casualties	Significant, but more uncertain in sub-category A1
Insurance costs to consumers	Potentially significant
Increased demand for motorcycles	Likely small
Revenue and employment in supplier industry	Benefit dependent on multiplier effect, likely small

Source: London Economics

3.3. Primary impacts of the proposed measure

The selection of the factors to be analysed in greater detail for this impact assessment starts with the identification of the primary impacts based on the conclusions of the EC's impact assessment.[10] The EC's impact assessment evaluated five different policy options regarding the regulation of ABS for motorcycles.

Table 3: Policy options assessed by the EC

Option No.	Description
1*	No change
2**	**Anti-lock Brake Systems on all PTW**
3***	**Anti-lock Brake Systems on PTWs with cylinder capacity >125cm^3 and Advanced Brake Systems (Combined Brake System (CBS) and/or Anti-lock Brake Systems (ABS)) on motorcycles with 50cm^3 < cylinder capacity <= 125cm^3**
4	To make mandatory the fitting of Advanced Brake Systems (Combined Brake System (CBS) and/or Anti-lock Braking Systems) on those motorcycles which conform to the performance criteria defined by the A2 driving licence . Obligatory fitting of Anti-lock Brake Systems on all other L3 class motorcycles
5	Industry self-regulation proposal

Note: * equivalent with Option A in the TRL report; ** roughly equivalent with Option B in the TRL report: All PTWs with engine capacity > 125 cm^3 to be fitted with ABS from 2011; *** roughly equivalent with Option C in the TRL report: All PTWs with engine capacity > 125 cm^3 to be fitted with ABS and advanced braking systems (ABS or CBS) on motorcycles with cylinder capacity > 50 cm^3 and ≤125 cm^3,
Source: SEC(2010) 1152

While the scope of the measures envisaged under these options is wider (all PTW instead of category L3e vehicles only in Option 2), the EC's assessment provides a solid basis for selecting the impact of the proposed measure on accident and casualty mitigation as the most important impact to be considered. In their qualitative conclusions on the different options[11], the EC finds differences between options 2 and 3 only with regard to two of the impacts: both the long term-societal and economic benefits arising from accident mitigation and the direct effect of lives saved and heavy injuries prevented are evaluated as "much better" under Option 2 but only "better" under Option 3 compared with the status quo (Option 1, "no change"). The benefits associated with the avoidance or mitigation of accidents and casualties will thus be the first main impact to be analysed in greater detail in the next section.

While the EC's qualitative assessment finds no difference between Options 2 and 3 when it comes to manufacturer costs[12], information provided by the association of European motorcycle manufacturers (ACEM) suggests that the proposed measure's impact on costs could be underestimated and thus deserves further analysis.

[10] SEC(2010) 1152, 4 October 2010, Annex XVI.
[11] SEC(2010) 1152, Annex XVI.
[12] "Manufacturing and development cost of PTWs equipped with Anti0lock Brake Systems, poissibly passed on to consumers (possible price increase)" is considered as "worse" than Option 1 under both Option 2 and Option 3.

CALCULATION OF COSTS AND BENEFITS

This section contains the assessment of the two main impacts identified in the above: the impact of fitting ABS, potentially instead, rather than in addition to CBS on vehicles in category L3e – A1[13]; and the costs of fitting ABS over the cost of fitting CBS. The NPV of the difference between the benefits in terms of increased safety and the cost of fitting ABS is then added to the NPV of the difference between costs and benefits of ABS for vehicles in categories L3e – A2 and A3 in 2016 to get the NPV of the proposed measure. More precisely, the steps in the calculation are as follows:

1. Determine the cost of fitting all vehicles of new types sold from 2016 **and** of existing types from 2017 in categories L3e - A2 and L3e - A3 with ABS.

2. Determine the savings from reduced accidents (i.e., the number of accidents these new type vehicles in L3e - A2 and A3 are no longer involved in/the casualties mitigated).

3. Calculate the NPV as of 2012 of the difference between the costs (1) and benefits (2).

4. Determine the cost of fitting vehicles of new types sold from 2016 **and** of existing types sold from 2017 in category L3e – A1 with ABS.

5. Determine the savings from reduced accidents (i.e., the number of accidents these vehicles are no longer involved in but add the costs of accidents that now take place because CBS is not fitted anymore) in every year 2016-2021.

6. Calculate the NPV as of 2012 of the difference between the two flows.

7. The NPV of the proposed measure is the sum of (3) and (6).

3.4. Inflation and discount rate

Costs and benefits are assessed in NPV terms, which requires the selection of an appropriate discount rate. We use a standard discount rate of 4% per year as recommended in the EC's 2009 Impact Assessment Guidelines[14].

Prices are subject to inflation. In line with the assumption made in the TRL report, we apply a constant rate of inflation of 2% per year.

3.5. (1) cost of proposed measure for categories L3e-A2/A3

ACEM estimates the average cost of fitting ABS on motorcycles at €500, based on observed price differences between models currently sold with and without ABS[15]. This is in line with the values reported by Kebschull and Zellner (2008) and used in the TRL report[16]. However, the cost figures are disputed. Specifically, it is argued that economies of scale that become

[13] From 2016 on vehicles of new types and from 2017 on all types in the category.
[14] SEC(2009) 92, 15 January 2009.
[15] ACEM recognise that there is large variation in ABS costs, depending mainly on production volumes.
[16] TRL report, Table 11, p. 25. The "best estimate" is given as €539.

available if ABS becomes mandatory reduce costs very substantially, to between €100 and €150[17]. The vehicle manufacturers dispute this, arguing that economies of scale are not large (given low production volumes) and have been exploited to a degree already (the TRL report assumes that 55% of newly registered motorcycles in 2012 come with at least optional ABS[18]). We regard €500 as the more plausible figure for our purpose:

- it is based on current (2011) observations from actual price lists;
- economies of scale are uncertain and likely highly variable across models.

Determining the number of vehicles sold in 2016 requires projections of registrations into the future. Owing to the difficulty of this task, the TRL report used a constant of 1.8 million registrations per year[19]. However, there has been a steep decline in the demand for motorcycles over the last few years (25% according to ACEM), which should be taken into account. Estimates of market growth that reflect current market trends are available from a 2012 study commissioned by ACEM and carried out by EMISIA[20] (see table below).

Table 4: Estimated annual market growth

Year	Growth in the motorcycle market
2011	-8%
2012	-5%
2013	-2%
2014	+5%
2015-2030	+2%

Source: EMISIA (2012)

We use these figures on market growth under the assumption that scrappage is constant, so that growth in the market is due to new registrations alone. This leads to an estimate of approximately 992,000 new registrations of motorcycles in 2016. Like the TRL report, we assume that 70% of these (~695,000) will be vehicles in categories L3e – A2 and A3.

It further needs to be taken into account that a certain number of motorcycles are already available with ABS, either as standard or optional[21], and that the penetration rate of ABS would increase organically even in the absence of regulation. The TRL report projects the organic adoption rate of advanced braking systems (ABS and CBS, with ABS fitted on motorcycles with engine capacity > 125 cm^3) based on the ACEM commitment to offer 75% of motorcycles with optional advanced braking systems by 2015. It is further assumed that initially 20% of consumers voluntarily choose models with advanced braking systems, rising to 41% by 2021. This means that in 2016, 521,000 (75%) newly registered motorcycles (A2/A3) would be offered with ABS and that 125,000 ABS-equipped motorcycles would be bought in the absence of the proposed measure. Of these 20% are assumed to be of new types. Subtracting the number of new-type vehicles already sold

[17] The TRL report, based on Baum et al. (2007), estimates economies of scale result in substantially lower ABS costs: €100 (minimum), €150 (best estimate), €200 (maximum). See Table 14, p. 28 of the TRL report. The European Association of Automotive Suppliers (CLEPA) argues that a cost of €100 per vehicle is realistic.
[18] TRL report, Table 12, p. 26.
[19] TRL report, p. 24.
[20] EMISIA (2012)
[21] See for example this list of available motorcycle models with ABS either fitted as standard or optional (Australia): http://bit.ly/xHNWyW [accessed 17 January 2012].

with ABS from the total number of new-type vehicles sold per year gives an estimate of the number of vehicles that would be affected by the proposed measure: the calculation, shown in Table 5, results in an estimate of 114,000 motorcycles affected by the proposed measure in 2016 (these are the new types that would not already be fitted with ABS).

In addition, ABS becomes mandatory for existing types also from 2017 onwards. Existing types are expected to make up 80% of new registrations in each year. However, the organic growth in ABS equipped vehicles again needs to be taken into account. It is assumed that the number of vehicles sold with ABS in the previous year (which include new and existing types, which both by definition become existing types in the current year) is an approximation of the number of vehicles of existing types that are already sold with ABS in the current year. Subtracting the number of ABS-equipped vehicles in the previous year from the number of existing-type vehicles sold in the current year thus gives an estimate of the number of vehicles of existing types affected by the proposed measure from 2017. Multiplying the number of affected vehicles by the cost of ABS per vehicle provides an estimate of the total annual cost of the proposed measure. The net present (2012) value of the cost stream over the period is calculated by applying the standard discount rate of 4%. The calculations show the cost of the proposed measure of around €1 billion over the period 2012-2021.

Table 5: (1) cost of ABS in categories L3e - A2 and L3e - A3

Year	New regis-trations[1)]	of which >125 cm^3 [2)]	Vehicles sold with ABS under status quo[3)]	Vehicles affected by the proposed measure[4)]	Average cost of ABS per vehicle[5)] (€)	Total cost (€m)	NPV (2012) @ 4% discount rate (€m)
2011	975,759	683,031			500		-€1,127m
2012	926,971	648,880			510		
2013	908,432	635,902			520		
2014	953,853	667,697			531		
2015	972,930	681,051			541		
2016	**992,389**	**694,672**	**125,041**	**113,926**	**552**	**62.9**	
2017	1,012,237	708,566	143,485	441,811	563	248.8	
2018	1,032,481	722,737	162,616	434,705	574	249.7	
2019	1,053,131	737,192	182,455	427,138	586	250.2	
2020	1,074,194	751,935	208,662	419,093	598	250.4	
2021	1,095,677	766,974	235,845	404,917	609	246.8	

Note: 1) Based on ACEM registration figures for 2010 and projected using growth estimates by EMISIA (2012). 2) 70% of total as per TRL report. 3) assuming 24% adoption rate in 2016, rising to 41% by 2021, and 75% availability (ACEM commitment to be achieved by 2015); see TRL report, Table 12, p. 26. 4) 2016: new types

assumed = 20% of new registrations; from 2017: existing types assumed = 80% of new registrations; vehicles affected by the proposed measure from 2017 are newly registered existing types minus the number of vehicles sold with ABS under status quo in the previous year (= vehicles of existing types that already have ABS in the current year) 5) assuming 2% annual inflation (€500 in 2011).
Source: London Economics

3.6. (2) benefits of proposed measure for categories L3e-A2/A3

We have identified the role of ABS in avoiding and mitigating casualties and accidents as the main benefit of the proposed measure. The cost of motorcycle accidents are a composite of various factors, including:

- Costs associated with injuries and deaths, which include[22]:
    - Loss of output due to injury (expected loss of earnings, plus non-wage payments made by employers).
    - Ambulance costs and the costs of hospital treatment.
    - The human costs of casualties (pain, grief and suffering to the casualty, relatives and friends, as well as intrinsic loss of enjoyment of life in the case of fatalities).
- Adjacent costs of the accident such as:
    - Costs of damage to vehicles and property.
    - Police costs and administrative costs of accident insurance.

For the sake of simplicity, we concentrate on the direct costs of casualties. However, as the TRL study points out that "the national values used for casualty valuation vary throughout Member States".[23] The authors base their estimates on the valuations applied by Baum et al. (2007) as follows:

Table 6: Casualty valuation applied in the TRL Study, based on Baum et al. (2007)

Casualty type	Valuation
Fatal	**€1,000,000**
Serious	**€100,000**
Slight	**€15,000**

Source: TRL report, based on Baum et al. (2007).

We use the same valuations, while noting that the monetary value assigned to casualties is to some degree arbitrary and depends on the methodologies and assumptions used[24]. This is an important caveat, as the valuation of casualties has a critical impact on the cost estimation. However, we also note that the valuations used in the TRL study appear conservative.

[22] This list is based on Department for Transport (2011). *Reported Road Casualties in Great Britain: 2010 Annual Report*. Available at : http://bit.ly/zHYkdc [accessed 16 January 2012].
[23] Robinson et al. (2009), p. 30.
[24] See Kebschull and Zellner (2008), Annex B.

The UK Department of Transport, for example, assigns values of around €1.9 million, €215,000 and €17,000 respectively to fatal, serious and slight casualties in road accidents[25].

The effectiveness of ABS in mitigating the impact of motorcycle accidents is subject of profound disagreements. Various studies using different data and different methodologies have come to substantially different conclusions. A detailed assessment of the strengths and weaknesses of these studies lies beyond the scope of this impact assessment.

As a pragmatic solution, we take the best estimate reported in the TRL study, namely that ABS is effective in influencing the outcome (i.e., either avoiding or mitigating casualties) in 18% of fatal motorcycle accidents[26]. Again for simplicity, we analyse a scenario in which ABS is effective in avoiding fatal accidents, ignoring the potential for mitigating or avoiding non-fatal accidents.

Using data from the TRL report, we calculate the number of fatalities per motorcycle. We use fleet and ABS penetration estimates for 2011[27]. According to this data, 6.2% of the entire motorcycle fleet (including sub-category A1) were equipped with ABS in 2011. We assume that only vehicles in sub-categories A2 and A3 (which make up 70% of the fleet) were actually fitted with ABS in 2011, so that ABS penetration rate in those sub-categories is 8.9%. Accident statistics show that motorcycles in sub-categories A1 and A2 account for 80% of all fatal accidents, 4,414 out of a total of 5,518.

These include accidents involving ABS-equipped motorcycles as well as motorcycles without ABS. If all A2/A3 motorcycles were fitted with ABS, 18% of casualties would be avoided; but since only 8.9% are fitted with ABS, only 1.6% of casualties are avoided. The number of casualties if the whole fleet didn't have ABS is thus 4,486, of which 72 (1.6%) are currently avoided because of the presence of 8.9% ABS-equipped motorcycles in the fleet. This results in a fatality rate of 0.30 per 1,000 vehicles without ABS and 0.24 per 1,000 vehicles with ABS (with a fully ABS-equipped fleet, 18% of 4,486, i.e., 807 fatal accidents are avoided).

Based on the fatality rates per vehicle and the projected numbers of vehicles that would not be fitted with ABS but for the proposed measure (Table 5), we can calculate the number of deaths avoided because of the proposed measure in each year by multiplying the number of ABS-equipped and non- ABS-equipped vehicles in the two scenarios by the respective number of death per vehicle. The difference in fatalities is the net benefit of the proposed measure (note that the figures are cumulative, we assume all vehicles registered from 2016 onwards stay in the fleet until 2021). The results of this calculation are show in Table 7.

[25] Based on £ figures for June 2009 (converted using the ECB Euro foreign exchange reference rates as at 16 January 2012). See Table 1 in Department for Transport (2011). *Reported Road Casualties in Great Britain: 2010 Annual Report*. Available at : http://bit.ly/zHYkdc [accessed 16 January 2012]. Note that the value of avoiding an accident is typically greater than the value of avoiding a casualty, as most accidents involve more than one casualty (and injury accidents are classified according to the most severe casualty).

[26] TRL report, Table 19, p. 30,

[27] Ibid., Table 20, p. 31, assuming the projection for 2011 is the most accurate. Note that the 2011 value is still a projection as the TRL report appeared in 2009. We further assume that the number of fatal accidents per vehicle is independent of fleet size (fleet size projections in the TRL report are likely to be outdated).

Table 7: Deaths avoided due to the proposed measure

Year	Fatalities* under status quo (A)	Fatalities* under the proposed measure (B)	Net effect of the proposed measure: Fatalities avoided / mitigated (A-B)
2016	34	28	**6**
2017	165	136	**30**
2018	295	242	**53**
2019	422	346	**76**
2020	546	448	**98**
2021	667	547	**120**

Note: Fatalities caused by vehicles affected by the proposed measure, not the whole fleet.
Source: London Economics

Using the valuations shown in Table 6, the effect of the proposed measure on A2 and A3 type vehicles can be monetised. This is shown in the table below, which shows the costs avoided in each year up to 2021, taking into account the inflation of casualty costs, as well as the net present value of the total avoided costs. Again, it is assumed that all the motorcycles that enter the fleet equipped with ABS from 2016 onwards stay in the fleet until 2021. It should be noted that the three different scenarios are not additive; in the "fatality avoided" scenario, what would have been fatal accident do not result in any costs, in the scenario "fatality mitigated to serious injury", all fatalities become serious injuries, etc. The 'fatality avoided' scenario thus represents the maximum and the 'fatality mitigated to slight injury' scenario the minimum possible impact. Given the stochastic nature of the effect of ABS on accident outcomes, the true cost savings associated with avoided and mitigated deaths lies somewhere in the range shown in Table 8.

Table 8: (4) monetised benefits of ABS in categories L3e–A2 / A3

Year	Savings from fatalities avoided (€)	Savings from fatalities mitigated to serious injury (€)	Savings from fatalities mitigated to light injury (€)
2016	6,736,691	673,669	101,050
2017	33,519,145	3,351,915	502,787
2018	60,933,004	6,093,300	913,995
2019	88,955,140	8,895,514	1,334,327
2020	117,558,917	11,755,892	1,763,384
2021	146,345,747	14,634,575	2,195,186
NPV	**€ 379,960,397**	**€ 37,996,040**	**€ 5,699,406**

Note: * applying an inflation rate of 2% to the valuation in Table 6.
Source: London Economics

3.7. (3) NPV of proposed measure for categories L3e-A2 / A3

The net costs of the proposed measure arising from a) the earlier introduction of mandatory ABS for vehicles in categories L3e - A2 and A3 and b) the extension of the ABS requirement to existing vehicles in those two sub-categories can be obtained by subtracting the costs (manufacturer costs from fitting additional vehicles with ABS) calculated in Table 5 from the benefits (savings from avoided and mitigated fatalities) calculated in Table 8. As explained above, the impact of the proposed measure depends on the effectiveness of ABS in converting fatal injuries to less severe injuries or avoiding injuries altogether, so the three different scenarios shown in Table 9 delineate the range of possible outcomes.

Table 9: NPV of benefits

Effect of ABS	NPV of costs avoided (A)	NPV of costs incurred (B)	Net costs (A+B)
Fatality avoided	**€380m**	**-€1,127m**	**-€ 747m**
Fatality mitigated to serious injury	**€38m**		**-€ 1,089m**
Fatality mitigated to slight injury	**€5.7m**		**-€ 1,121m**

Source: London Economics

KEY FINDINGS: L3e – A2/A3

- ABS is effective in avoiding and/or mitigating fatal accidents involving motorcycles. Based on previous research we estimate a fatality rate of 0.30 per 1,000 vehicles without ABS and 0.24 per 1,000 vehicles with ABS.
- Using assumptions about the manufacturer cost of ABS (€500 per vehicle), updated estimates of the growth of the motorcycle fleet over the period 2016-2021, the organic increase in the number of ABS-equipped vehicles and the split between new and existing types of vehicles (20:80), the cost of the proposed measure for vehicles in categories L3e - A2 and A3 is estimated at around €1.1 billion in NPV terms.
- 95% of the cost is due to the extension of the ABS requirement to existing types of vehicles in categories A2 and A3.
- The difference in fatality rates between vehicles with and without ABS results in 383 fatalities either avoided or mitigated due to the proposed measure over the period 2016-2021.
- Under the most optimistic assumptions (all fatalities are avoided, resulting in costs of €1 million avoided in each case), the total costs avoided by the proposed measure are €380 million.
- The net cost of the proposed measure is between €747 million and €1.1 billion, depending on the assumed effectiveness of ABS.

3.8. (4) cost of proposed measure for category L3e-A1

The final component of the impact of the proposed measure is the impact of the requirement to fit ABS on light motorcycles (category L3e-A1). To estimate the impact, the same approach outlined above for motorcycles in the higher performance categories is applied. Two main differences of regarding vehicles in the A1 category need to be taken into account:

- the lower likelihood of light motorcycles being involved in fatal accidents;
- the use of CBS on light motorcycles, a technology with a different impact on fatality rates compared with ABS and a lower cost per vehicle (€250).

The following table shows the calculations analogous to those displayed in Table 5 above. Category L3e-A1 is assumed to account for 30% of new registrations (as in the TRL report). As before, a constant proportion of 20% of vehicles of new types is assumed throughout the period. The projected new registrations are based on current ACEM fleet figures and fleet growth rate estimates as in Table 4. It is assumed that CBS, rather than ABS, will be fitted on vehicles in category L3e-A1 in the absence of the proposed measure.

Table 10: (4) cost of ABS in categories L3e–A1

Year	New regis-trations[1)]	of which <125 cm^3 [2)]	Vehicles sold with CBS under status quo[3)]	Vehicles affected by the proposed measure[4)]	Average cost of ABS per vehicle[5)]	Total ad-ditional cost[6)] (€m)	NPV in 2012 @ 4% discount rate (2016-2021)
2011	975,759	292,728	29,273				
2012	926,971	278,091	30,590				
2013	908,432	272,529	32,704				
2014	953,853	286,156	37,200				
2015	972,930	291,879	45,971				
2016	992,389	297,717	53,589	59,543	552	32.9	€763.5m
2017	1,012,237	303,671	61,493	303,671	563 (282)	157.4	
2018	1,032,481	309,744	69,692	309,744	574 (287)	164.1	
2019	1,053,131	315,939	78,195	315,939	586 (293)	171.2	
2020	1,074,194	322,258	89,427	322,258	598 (299)	178.7	
2021	1,095,677	328,703	101,076	328,703	609 (305)	186.5	

Note: 1) Based on ACEM registration figures for 2010 and projected using growth estimates by EMISIA (2012). 2) 30% of total as per TRL report. 3) new registrations; assuming adoption rate and availability as per TRL report, Table 12. 4) assuming new types = 20% of new registrations + all new and existing vehicles from 2017. 5) assuming 2% annual inflation (€500 in 2011) + from 2017: numbers in brackets are the net cost of the proposed measures for the vehicles that would have had to be fitted with CBS under the status quo (50% of the cost of ABS). 6) In 2016, the additional costs are simply the cost of fitting ABS on all new-type vehicles in category L3e-A1. From 2017, the additional costs are the costs of fitting all vehicle types with ABS minus the cost of CBS for the new type vehicles that were not already sold with CBS through organic demand (which would have been incurred under the status quo).
Source: London Economics

3.9. (5) benefit of proposed measure for category L3e-A1

As pointed out above, we accept the estimates of ABS and CBS in the TRL report for vehicles in categories L3e-A2 and L3e-A3, but we note that they are likely biased upwards when it comes to low-performance motorcycles (which include 125 cm^3 scooters). In particular, the studies on the effectiveness of ABS that are evaluated in the TRL report[28] are based on northern European countries with a higher proportion of motorcycles in the higher performance categories and different usage patterns (see the discussion about the safety impacts of ABS above). The only study cited in the TRL report that reviews accident

[28] Based on Smith (2009), see TRL report, Table 10, p. 23.

data from Spain and Italy (which, together with Germany, form the top 3 EU Member States in terms of motorcycle fleet size), Kebschull and Zellner (2008) find a much lower effectiveness (net injury benefits for 1-3% of all casualties) than that cited as the "best estimate" by the authors of the TRL report. A detailed review of the evidence on the effectiveness of ABS for low-performance motorcycles and the relative merits of ABS versus CBS is beyond the scope of this study. We therefore note a caveat, but proceed to use the effectiveness estimates from the TRL report: 18% casualty mitigation for ABS and 8% for CBS.

A calculation analogous to the one for ABS described above yields a rate of fatalities for category L3e-A1 vehicles equipped with CBS of 0.16 per 1,000 vehicles, compared with 0.17 per 1,000 vehicles for vehicles without CBS (or ABS). The estimated fatality rate for ABS-equipped vehicles in sub-category A1 is 0.14 per 1,000 vehicles.

Based on the fatality rates per vehicle, projections on new registration and the assumption of a share of new type vehicles of 20%, we can calculate the number of deaths avoided because of the proposed measure in each year as follows (as before, note that the figures are cumulative, we assume all vehicles registered from 2016 onwards stay in the fleet until 2021). In 2016, fatalities under the status quo are the fatalities caused by newly registered vehicles of new types, where 18% are voluntarily CBS-equipped, while fatalities under the proposed measure are fatalities caused by new-type vehicles if all of them are equipped with ABS. From 2017, fatalities under the status quo are fatalities caused by new-type vehicles, all of which are fitted with CBS, plus fatalities caused by existing type-vehicles, some of which are fitted with CBS voluntarily. We assume that the number of existing-type vehicles equipped with CBS voluntarily is the number of all new registrations equipped with CBS voluntarily in the previous year. The rest of the existing-type vehicles do not have advanced braking systems of any kind. The number of fatalities under the proposed measure is the number of fatalities if all new registrations are equipped with ABS.

Table 11: Deaths avoided due to the proposed measure

Year	Fatalities* under status quo (A)	Fatalities* under the proposed measure (B)	Net effect of the proposed measure: Fatalities avoided / mitigated (A-B)
2016	10	8	**2**
2017	62	51	**11**
2018	115	94	**21**
2019	169	139	**30**
2020	224	184	**40**
2021	280	230	**50**

Note: Fatalities caused by vehicles affected by the proposed measure, not the whole fleet.
Source: London Economics

Using the same cost assumptions as before, the monetary benefit (savings due to avoided/mitigated casualties) are as follows:

Table 12: (4) monetised benefits of ABS in category L3e–A1

Year	Savings from fatalities avoided (€)	Savings from fatalities mitigated to serious injury (€)	Savings from fatalities mitigated to light injury (€)
2016	1,939,693	193,969	29,095
2017	12,552,942	1,255,294	188,294
2018	23,722,489	2,372,249	355,837
2019	35,469,998	3,547,000	532,050
2020	48,275,030	4,827,503	724,125
2021	61,699,935	6,169,993	925,499
NPV	**€ 153,321,010**	**€ 15,332,101**	**€ 2,299,815**

Note: * applying an inflation rate of 2% to the valuation in Table 6.
Source: London Economics

3.10. (6) NPV of proposed measure for category L3e-A1

As before, the NPV of the costs incurred due to the implementation of the proposed measure depends on the assumptions about the effectiveness of ABS in converting fatal injuries to less severe injuries or avoiding injuries altogether. The range of potential costs is as follows:

Table 13: NPV of benefits

Effect of ABS	NPV of costs avoided	NPV of costs incurred	Net costs/benefit
Fatality avoided	**€153.2m**	**-€763.5m**	**-€ 610.3m**
Fatality mitigated to serious injury	**€15.3m**		**-€ 748.2m**
Fatality mitigated to slight injury	**€2.3m**		**-€ 761.2m**

Source: London Economics

KEY FINDINGS: L3e – A1

- Based on previous research we estimate a fatality rate of 0.16 per 1,000 vehicles with CBS, and 0.14 per 1,000 vehicles with ABS for vehicles in category L3e-A1.
- Using assumptions about the manufacturer cost of ABS (€500 per vehicle), updated estimates of the growth of the motorcycle fleet over the period 2016-2021, the organic increase in the number of ABS-equipped vehicles and the split between new and existing types of vehicles (20:80), the cost of the proposed measure for vehicles in categories L3e – A1 is estimated at around €764 million in NPV terms.
- 96% of the cost is due to the extension of the ABS requirement to existing types of vehicles from 2017.
- Per vehicle, the cost of ABS represents on average 18% of the price of a motorcycle in category L3e-A1.
- The difference in fatality rates between vehicles with and without ABS results in 155 fatalities either avoided or mitigated due to the proposed measure over the period 2016-2021.
- Under the most optimistic assumptions (all fatalities are avoided, resulting in costs of €1 million avoided in each case), the total costs avoided by the proposed measure are €153 million.
- The net cost of the proposed measure ranges from €610 million to a cost of €761 million, depending on the assumed effectiveness of ABS.

3.11. (7) NPV of proposed measure

Overall, the proposed measure is expected to result in considerable net costs. The table below shows the overall assessment based on the preceding calculations. It should also be noted that looking at the individual measures envisaged by IMCO separately may understate the cost of the combined measures, especially if the timing of individual requirements that necessitate type approval is not aligned, thus resulting in the need for repeated type approval processes.

Table 14: Overall NPV of the proposed measure

Effect of ABS	NPV of proposed measure*
Fatality avoided	-€ 1,357m
Fatality mitigated to serious injury	-€ 1,837m
Fatality mitigated to slight injury	-€ 1,883m

Note: This is the sum of the net costs/benefits reported in Table 9 and Table 12.
Source: London Economics

REFERENCES

- Robinson, T. L., McCarthy, M., Pitcher, M., Gibson, T. and Visvikis, C. (2009). Evaluating the impact of possible new measures concerning category L vehicles. Report to the European Commission, DG Enterprise and Industry. ('TRL Report')

- Commission (EC), 'Proposal for a European Parliament and Council Regulation on the approval and market surveillance of two- or three-wheel vehicles and quadricycles' COM(2010) 542 final, 4 October 2010.

- Commission (EC), 'Impact Assessment Guidelines' SEC(2009) 92, 15 January 2009.

- Baum, H., Geissler, T. and Westerkamp, U. (2008). "Cost-benefit analysis for ABS of motorcycles," Final report, Institute for Transport Economics at the University of Cologne, July 2007.

ANNEX 1: VEHICLE CATEGORY DEFINITIONS

Category	Category name	Common classification criteria
L3e	Two-wheel motorcycle	(1) two wheels and powered by propulsion as listed under Article 4(3) of COM(2010) 542 final[29]; (2) engine capacity > 50 cm3 if a PI engine forms part of the vehicle's propulsion configuration; (3) maximum design speed > 45 km/h; and (4) maximum continuous rated power[30] > 4 kW
Sub-categories	**Sub-category name**	**Supplemental sub-classification criteria:**
L3e - A1	Low-performance motorcycle	(5) engine capacity ≤ 125 cm^3; (6) maximum continuous rated power[30] ≤ 11 kW; (7) power[30] / weight ratio ≤ 0.1 kW/kg
L3e - A2	Medium-performance motorcycle	(5) maximum continuous rated power[30] ≤ 35 kW; (6) power[30] / weight ratio ≤ 0.2 kW/kg; and (7) not derived from a vehicle equipped with an engine of more than double its power[30]
L3e - A3	High-performance motorcycle	(5) any other vehicle of the L3e category that cannot be classified according to the performance criteria of subcategories A1 or A2

Source: COM(2010) 542 final, Annex I; available at: http://bit.ly/zPjyqA [accessed 11 January 2012]

[29] Available at: http://bit.ly/zPjyqA [accessed 11 January 2012].
[30] The power limits are based on maximum continuous rated power independent of the vehicle's propulsion configuration.

ANNEX 2: ABS/CBS DEFINTIONS (FROM TRL REPORT)

Anti-lock braking system (ABS)

"Anti-lock braking systems (ABS) monitor the speed at which the wheels are rotating and rapidly modulate the brake pressure when imminent wheel lock is detected in order to increase effective braking and prevent the deceleration being dictated by the sliding friction between tyre and road. ABS is the only technical solution which directly monitors and prevents wheel locking and has been shown in test conditions to result in generally higher braking decelerations by maintaining the wheel slip such that friction is above the level provided by locked wheels. Preventing wheel lock under emergency braking provides the rider with increased confidence to apply higher brake forces."[31]

Combined braking system (CBS)

"Combined braking systems (CBS) are used to ensure that the correct braking distribution is applied regardless of which brake is activated; currently the rider must use two separate mechanisms to operate the front and rear brakes. The use of CBS allows one mechanism to operate both brakes (in a similar way to that of a passenger car). The primary aim of this system is to appropriately distribute the braking effort between the front and rear wheels. Compared with rider-controlled distribution of braking between the front and the rear, CBS reduces the chances of wheel lock and instability occurring at less than the maximum level of deceleration. For example, if a rider applied the rear brake very hard, without using the front brake, the rear wheel could lock and cause instability at a level of deceleration considerably less than half the maximum achievable. CBS can prevent such a situation but cannot prevent wheel lock when the rider applies the single brake control harder than required to produce maximum deceleration."

[31] Robinson et al. (2009), p. 19.

ANNEX 3: IMCO PROPOSALS

Amendment 144

Proposal for a regulation
Annex VIII – column 2 – row 2

Text proposed by the Commission	*Amendment*
Four years after the date referred to *in the second subparagraph of* Article 82.	***Two*** years after the date referred to in Article 82*(2)*.

Amendment 145

Proposal for a regulation
Annex VIII – column 3– row 2

Text proposed by the Commission	*Amendment*
(a) new motorcycles of the L3e–A1 subcategory which are sold, registered and entering into service are to be equipped with ***either*** an anti-lock ***or a*** combined brake system ***or both types of advanced brake systems,*** at the choice of the vehicle manufacturer;	***New types of*** motorcycles of the L3e–A1**,** ***L3e-A2 and L3e-A3*** subcategory which are sold, registered and entering into service are to be equipped with an anti-lock ***brake system or an anti-lock brake and a supplemental*** combined brake system, at the choice of the vehicle manufacturer**.**
(b) new motorcycles of subcategories L3e–A2 and L3e–A3 which are sold, registered and entering into service to be equipped with an anti-lock brake system.	

Amendment 146

Proposal for a regulation
Annex VIII – column 2 – row 2 a (new)

Text proposed by the Commission	*Amendment*
	Three years after the date referred to in Article 82(2).

Amendment 147

Proposal for a regulation
Annex VIII – column 3 – row 2 a (new)

Text proposed by the Commission	*Amendment*
	Existing types of motorcycles of L3e–A1, L3e-A2 and L3e–A3 subcategory which are sold, registered and entering into service are to be equipped with an anti-lock brake system or an anti-lock brake and a supplemental combined brake system, at the choice of the vehicle manufacturer.

EUROPEAN PARLIAMENT

DIRECTORATE GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

Impact assessment of EP amendments to the 'Proposal for a Regulation on the approval and market surveillance of two- or three-wheel vehicles and quadricycles' II – On-board diagnostic system (OBD)

STUDY

Abstract
The study assesses the impact of propsed measures increase and speed up the adoption of on-board diagnostic (OBD) systems for L-category vehicles.

IP/A/IMCO/NT/2011-21
PE 475.091

February 2012
EN

Contents

LIST OF ABBREVIATIONS

ACEM Association des Constructeurs Européens de Motocycles

AECC Association for Emissions Control by Catalyst

EC European Commission

EP European Parliament

EU European Union

FEMA Federation of European Motorcyclists Associations

LAT Laboratory of Applied Thermodynamics (Aristotle University of Thessaloniki)

NPV Net Present Value

OBD On-Board Diagnostic system

PI Positive Ignition

PTW Powered Two-Wheeler

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

This study is the second of a three-part assessment of amendments proposed by the European Parliament (EP) to three measures contained in the EC's 'Proposal for a Regulation on the approval and market surveillance of two- or three-wheel vehicles and quadricycles'[1].

The impact assessment builds upon the comprehensive impact assessment on the Proposal compiled by the European Commission (EC)[2], but is narrower in focus, taking the measures contained in the EC's Proposal as the baseline scenario. Only the differences between the EC's original proposal and the Imco compromise text are considered in this impact assessment.

The impact assessment further draws on existing research not considered in the EC's impact assessment and consultations with interested parties, including:

- The association of the European motorcycle industry (ACEM);
- individual manufacturers of motorcycles and/or components;
- the Association for Emissions Control by Catalyst (AECC); and
- the Federation of European Motorcyclists Associations (FEMA).

The report is organised as follows:

1. Summary of the proposed measures and statement of the object of the impact assessment
2. Summary of the impacts of the proposed measure and selection of the primary impacts to be analysed in detail
3. Cost-benefit analysis of the selected impacts

[1] COM(2010) 542 final, 4 October 2010.
[2] SEC(2010) 1152, 4 October 2010.

2. SUMMARY OF THE PROPOSED MEASURE

From 2016 onwards, new motorcycles[3], powered tricycles[4] and on-road quads[5] will have to be equipped with an on-board diagnostic (OBD[6]) system that monitors and reports on electric circuit continuity, shorted and open electric circuits and circuit rationality of the engine and vehicle management systems (first-stage OBD, OBD I). This means the changes will be introduced one year earlier than originally envisaged.

Moreover, from 2017, OBD I will also be required for all existing types of motorcycles, powered tricycles and on-road quads. The IMCO compromise thus expands the scope of the requirement form “all new vehicles” to “all existing types of vehicles”.

OBD II, the second stage of an on-board diagnostic system, which, in addition to OBD I, monitors not only complete failures but also deterioration of systems, components or separate technical units during vehicle life, will be required for new motorcycles, powered tricycles and on-road quads from 2020 and for existing types from 2021. The Commission proposal would introduce the requirement for new vehicles only in 2021 and not extend it to existing types.

New mini cars[7] and all-terrain vehicles[8] will be required to be equipped with OBD I from 2019. This requirement will be extended to all existing types of vehicles in those categories in 2020. This latter requirement exceeds the requirement of the original Commission proposal, which would apply only to new vehicles and did not apply to all-terrain vehicles.

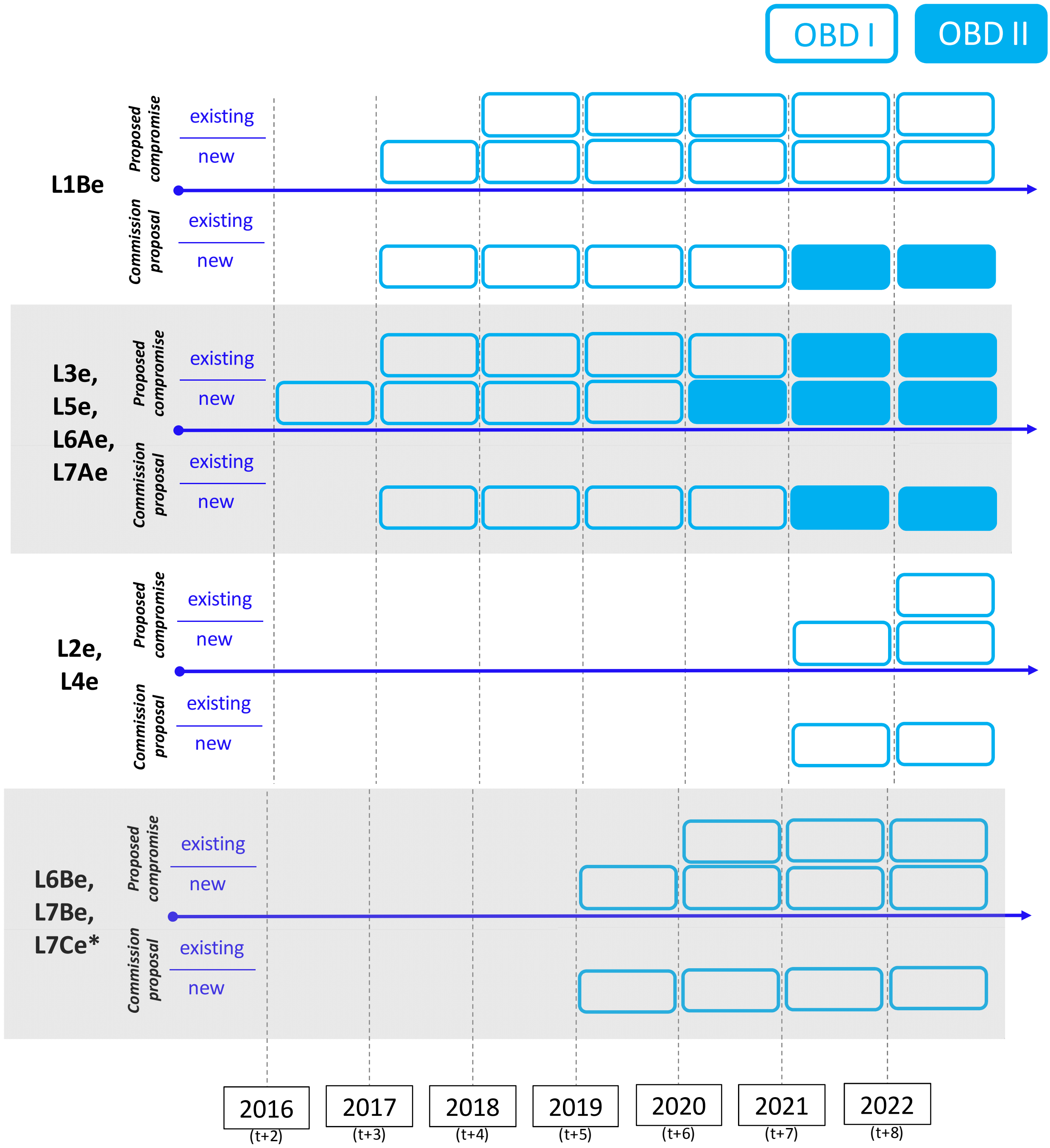
New mopeds[9] will require OBD I from 2017 onwards, and existing types of mopeds from 2018. The extension of the requirement to all existing types of mopeds in 2018 was not envisaged in the Commission proposal. However, the Commission proposal would instead make OBD II compulsory for mopeds from 2021.

Finally, three-wheel mopeds[10] and motorcycles with side-cars[11] will require OBD I to be fitted from 2021 for new types and from 2022 for existing types. Previously, OBD I was planned to start in 2021 and continue for new types only to 2022.

See overleaf for a graphical summary of the measures concerning OBD systems.

[3] Category L3e
[4] Category L5e
[5] Category L6Ae (light) and category L7Ae (heavy)
[6] For the definitions of OBD I and II, see Annex 2.
[7] Categories L6Be (light) and L7Be (heavy)
[8] Category L7Ce
[9] Category L1Be
[10] Category L2e
[11] Category L4e

Figure 1: Summary of the proposed measure



Source: London Economics

2.1. Scope of the impact assessment

The proposed measure is concerned with the extension of OBD requirements for all vehicles in category L. However, we limit the scope of the impact assessment to vehicles in categories L1Be and L3e, noting that they comprise the overwhelming majority of L-category vehicles in Europe and thus would largely determine any impacts of the proposed measure.

The impact assessment therefore focuses on:

- the extension of the requirement to fit OBD I to new types of motorcycles (category L3e) from 2016 and to existing types from 2017; and OBD II to new types from 2020 and existing types from 2021;
- the extension of the requirement to fit OBD I to existing types of mopeds (category L1Be) from 2018; and
- the removal of the requirement fit OBD II to new types of mopeds (category L1Be).

The proposed measure thus differs from the baseline scenario in terms of both the timing of the extensions of the OBD requirements, the OBD stage required (I or II) and the scope in terms of types of vehicles affected (new vs. existing types).

3. SUMMARY OF THE IMPACTS OF THE PROPOSED MEASURE

This section briefly discusses the impacts of the proposed measure that have been identified in the EC's initial impact assessment. Based on the EC's work, we evaluate the significance of the individual impacts and their relevance for the impact assessment.

Various impacts of the proposed measure that have been identified in the EC's impact assessment are inherently difficult to analyse as they rely on assumptions about rider behaviour that are impossible to verify. Both positive and negative impacts are affected, including the cost of riders' ignoring warning lights and riders being dissuaded from modifying their bikes in such a way as to increase emissions and safety risk. We regard these impacts as too uncertain to be validly assessed. Other impacts are difficult to measure (such as the increased complexity of legislation) or highly speculative (such as the impact on innovation in vehicle technology).

In the following section costs and benefits are discussed in turn. The list of impacts is based on Annex XI of the EC's initial impact assessment.

3.1. Costs of the proposed measure

3.1.1. Manufacturer costs

The proposed measure imposes costs on manufacturers by requiring them to fit OBD on motorcycles on which under the status quo OBD would be fitted later or not at all (existing types).

Consultations with the motorcycle industry revealed that costs for OBD systems are relatively low (around €10 per vehicle) for OBD I. For OBD II, costs are higher (around €18 to €74 per vehicle). The main driver of the higher costs of OBD II is the need for oxygen sensors (to measure catalyst performance). In each case, the cost estimates do not include the cost of the initial inclusion of the system where it was not originally in the vehicle's engine management system.

One point raised by the industry specifically in relation to OBD II is that there is only one technological option available to implement misfire detection in OBD II. This technology is patented, resulting in licensing costs and potential legal costs.

In general, OBD costs are highly variable across models. In particular, while some manufacturers are already producing vehicles compliant with the proposed measure, other models come only with partial or rudimentary OBD systems, while some current models have no OBD systems at all. While OBD systems are already relatively common for motorcycles (category L3e), this is not the case for the many niche vehicles in category L that would be affected by the proposed measure.

A particular issue is also the lack of standardisation among OBD systems currently deployed in L-category vehicles. A requirement for a standardised OBD system forces manufacturers to invest in a new system, even if the original system is equally effective (or even superior).

While it has been argued that OBD I is a "commodity product", manufacturers argue that OBD systems used on cars are generally not suitable for motorcycles and that OBD I systems for motorcycles would require their own supplier base. Moreover, some development costs would have to be incurred to make OBD systems usable on motorcycles. The LAT report remarked in 2009 that "OBD technology is not yet mature for immediate introduction"[12] and that its introduction is "associated with significant investment and development costs"[13]. However, note that the EC's impact assessment states that the cost assumptions in the LAT report were considered "much too high" and therefore discarded[14].

In summary, there is no doubt that OBD systems represent a real cost to manufacturers. At the same time, the level of cost is disputed and appears to be relatively low on a per-vehicle basis, at least for OBD I. Note that this also implies that demand effects due to increased vehicle prices are likely to be negligible.

3.1.2. Costs for the aftermarket

The proposed measure carries potential costs for the aftermarket, as repairers need to purchase diagnostic tools and potentially also invest in training how to use them. These costs are likely to represent a greater burden for small, independent repairers.

However, the independent repairer segment for L-category vehicles is very small, so that any impact can be expected to be small in absolute terms. More importantly, OBD systems may also reduce repairer costs, as other approaches to fault detection may be more time-consuming. The overall effect of the proposed measures thus seems uncertain and probably small.

3.2. Benefits of the proposed measure

3.2.1. Reduction of vehicle emissions

Reducing vehicle emissions is the main object of the proposed measure and is likely to represent the most important benefit. OBD systems help to reduce emissions because, as the EC's impact assessment points out: "If an emission-relevant component or system were to fail suddenly or slowly degrades beyond acceptable levels, a clean vehicle may turn into a highly polluting vehicle. In such cases, the driver will ideally need to be informed quickly, to take the vehicle to the garage at the next opportunity and have it repaired"[15]

The impact of OBD systems on emissions is indirect: the systems don't monitor emissions, but instead monitor circuit continuity and system integrity of the fuel and air metering devices, the charging system, the coolant temperature sensor, the lambda sensor etc. (OBD I)[16]. OBD2 additionally monitors the catalyst performance and misfiring. If a fault is detected, the system alerts the rider via a Malfunction Indicator Lamp (MIL). That the vehicle's environmental performance is restored depends on the rider acting upon the alert and getting the vehicle repaired.

The emission reductions that the proposed measure would bring about are difficult to predict as they depend on user interaction with the system (acting upon the automatic warning generated by the system), rather than the system itself. A given rate of OBD deployment in the fleet of L-category vehicles thus does not translate directly into a certain level of emission reduction.

[12] LAT report, p. 20.
[13] Ibid., p. 23.
[14] SEC(2010) 1152, p. 102.
[15] Ibid, p. 20.
[16] LAT report, p. 103.

More importantly, given the behavioural aspect, it is not obvious that the effect of OBD deployment would remain constant over time (for example, competition/prices in the market for vehicle repairs, which are determined to a large degree independent of OBD deployment, will affect the timeliness and frequency of repairs and thus the fleet's emission performance in unforeseen ways). It should also be noted that analogies with the OBD systems deployed in cars are not likely to be informative, given the difference in engine performance characteristics.

However, there is no doubt that OBD addresses a serious problem with undetected faults that lead to increased emissions, even in new vehicles. A small-sample test (5 vehicles) conducted by AECC[17] showed that one of the five vehicles suffered from a fault that led to emissions exceeding the Euro 3 limits that a) would have been detected by OBD II and b), when fixed, led to the bike meeting the Euro 3 limits.

A detailed study of the likely effects of OBD on emissions is beyond the scope of this study. In the assessment of the impact, we refer instead to research undertaken by EMISIA (2012) on behalf of the vehicle manufacturers' association ACEM, which builds on and updates the LAT report commissioned by the EC.

3.2.2. Safety benefits

Some of the faults detected by OBD systems can have implications for vehicle safety, although the relationship between vehicle safety and the emission-related faults that the OBD systems are designed to detect may be indirect and/or coincidental. However, the fact that L-category vehicles are typically relatively simple machines (e.g., compared with cars) and that many faults/performance issues with safety implications are more immediately evident to the users of these vehicles than comparable faults would be for car users, suggests that this effect is likely to be smaller than in the case of cars.

3.2.3. Revenue and employment in the supplier industry and type approval authorities

The direct revenue accruing to the supplier industry from increased sales of OBD systems is already accounted for in the assessment framework through the higher end-user prices of motorcycles fitted with OBD. Any potential net benefit is therefore due to multiplier effects arising from the induced income effect of additional revenues in the supplier industry.

The scale of this benefit therefore depends on the size of the multiplier and the extent to which the supplier industry, i.e., manufacturers of OBD systems, is located in Europe. The size of the multiplier in the motorcycle supplier industry – if it exists – is unknown.

The EC's impact assessment further mentions revenue and employment for type approval authorities and testing laboratories. We note that the same caveats apply. We consider it likely that the benefit to the European economy due to multiplier effects is negligible.

3.2.4. Consumer benefits due to timely/efficient repairs/servicing

Under the assumptions that repair costs are lower if faults are detected immediately, OBD system can reduce the repair costs for users of L-category vehicles. The realisation of this benefit depends to some degree on the tolerance levels at which the OBD alerts the rider about faults. If the fault tolerance is set too low, repair bills for users might actually

[17] AECC (2012)

increase, as faults that would have been considered as non-critical without OBD are now repaired.

In addition, the efficiency of repairs can be increased by OBD systems, e.g., if the time spent to detect faults is reduced owing to the use of standardised diagnostic tools. The EC's impact assessment also mentions that OBD information can be substituted for other, more costly test procedures in certain cases. Against this stand the costs of the diagnostic tools themselves, which need to be recouped by the garage operator and can be passed on to the consumer.

It is likely that OBD will have some efficiency benefits when it comes to the repair of vehicles in category L. The extent of these benefits is difficult to quantify and car analogies are unlikely to apply.

3.2.5. Competition benefits in the aftermarket for L-category vehicles

The EC's impact assessment expects the increased use of OBD systems to have benefits in terms of competition in the market for vehicle repairs. Specifically, the EC considers that "standardised (ISO) malfunction and other diagnostic information is indispensible for independent repairers to efficiently and effectively repair a failure"[18]. In the EC's view, OBD thus removes a crucial barrier to effective competition, with benefits expected in particular for the independent aftermarket.

Even if the necessary tools and access to repair and maintenance information can be provided to independent repairers on an equal basis (as the EC intends), this benefit appears speculative. Only a more detailed market definition exercise could show whether independent repairers (of which there are relatively few) can be expected to compete with authorised repairers.

Table 1: Summary of impacts

Impact	Assessment
Manufacturer costs	Relatively small for OBD I, larger for OBD II
Costs for the aftermarket	Likely small
Reduction of vehicle emissions	Likely positive
Safety benefits	Likely positive, but small
Revenue and employment in the supplier industry and type approval authorities	Benefit dependent on multiplier effect, likely small
Consumer benefits due to timely/efficient repairs/servicing	Positive, difficult to quantify
Competition benefits in the aftermarket for L-category vehicles	Uncertain

Source: London Economics

[18] SEC(2010) 1152, p. 102.

3.3. Primary impacts of the proposed measure

In this impact assessment, we concentrate on the costs of the proposed measure to manufacturers. As explained in the preceding section, other potential impacts of the proposed measure are either considered to be negligible, too uncertain or impossible to analyse without additional research much beyond the terms of reference for this study.

On the benefits of the proposed measure, we report what our research has shown to be the most up-to-date results on the impact of the IMCO compromise on the emissions of PTWs. The new estimates, provided by the EMISIA[19] (University of Thessaloniki), co-authors of the LAT report, refer to the impact of the whole package of emission control measures envisaged in the PCT[20]. We consider this approach to be valid as consultations with the motorcycle industry suggested that the individual emission control measures are difficult to disentangle from an engineering perspective: implementing the individual measures (emission standards, OBD) as a package has substantial cost advantages as the development of engines and engine management systems (and any necessary modifications of the chassis design and auxiliary systems) can be undertaken in tandem.

Moreover, as will be seen below, the overall impact of the entire package of emission control measures is quite limited. Given the uncertainty that surrounds the impact of OBD on emissions, placing undue emphasis on effect sizes that are both uncertain and small in absolute terms could be misleading.

Finally, note that for reasons of data availability we analyse the impact of the proposed measure using data on vehicles in categories L1Be and L3e only, under the assumption that this provides a good approximation of the total impact.

[19] EMISIA (2012)
[20] I.e., including the measures on emission standards and durability requirements.

CALCULATION OF COSTS AND BENEFITS

This section contains the assessment of the two main impacts identified in the above section: the impact of extending the requirement for new and existing types of vehicles to be fitted with OBD systems and the impact on emissions covered by the European emission standards. For the latter, we do not attempt to monetize the benefits, but instead report the absolute reductions in emissions. For the former, we calculate the NPV of the proposed measure and its net benefit, i.e., the difference between the NPV of the EC's original proposal and the measure as specified in the IMCO compromise.

3.4. Inflation and discount rate

Costs and benefits are assessed in NPV terms, which requires the selection of an appropriate discount rate. We use a standard discount rate of 4% per year as recommended in the EC's 2009 Impact Assessment Guidelines[21].

Prices are subject to inflation. In line with the assumption made in the LAT report, we apply a constant rate of inflation of 2% per year from 2011.

3.5. Cost of the proposed measure

The cost of OBD systems is very difficult to quantify. Some current models have OBD systems in place, so no additional costs occur in relation to the proposed measure. Other models need more substantial redesign, resulting higher costs per vehicle.

We were advised by one manufacturer of a cost estimate for OBD I produced for the UK Department for Transport in 2003. At that time, the cost was estimated at £7, currently around €11[22] per vehicle. For OBD II, consultations with manufacturers suggested a cost per vehicle of $25-$100 (€18-€74, translated into a weighted average of €46 per vehicle). We use these estimates for our cost projections for the period 2012-2021 (taking into account the actual/predicted rate of inflation[23]).

The table below shows the cost of OBD I and OBD II as a percentage of average vehicle prices. Despite the apparently moderate costs, it should be taken into account that smaller motorcycle manufacturers are likely to be disproportionately affected by any cost increase, as it is spread over sometimes very small numbers of units produced (small manufacturers often produce fewer than 1,000 vehicles per type per year).

[21] SEC(2009) 92, 15 January 2009.
[22] Calculated using the average annual exchange rate in 2003, 0.69199 (source: Eurostat).
[23] For the period 2003-2010, costs were calculated using the EU-wide consumer price index (HCIP) for 'motor cycles, bicycles and animal drawn vehicles'; from 2011, a constant rate of inflation of 2% was assumed (as in the LAT report).

Table 2: Potential impact of OBD I and OBD II on end-user prices

Vehicle category*	L1-B	L3-A1	L3-A2/A3
Observations	12	17	21
Average price per vehicle (€)	1,690	2,837	8,994
Cost of OBD I (€11) as % of average price	0.7%	0.4%	0.1%
Cost of OBD I and II (€11+€46=€57) as % of average price	3.4%	2.0%	0.6%

Note: Average prices per vehicle category (excluding cost of ABS/CBS) for the 50 best-selling models were taken from the talian Magazine "Due Ruote", January 2012, published by Domus. The 50 PTW models represent 28% of the EU PTW market in 2011 (according to a compilation of national registrations data from EU National markets provided by ACEM). Average prices for the entire market are likely to be lower for vehicles in categories L1-B and L3-A1, where competition is more fragmented. * See Annex I for definitions.

Source: London Economics based on ACEM data

Our estimates of new registrations in the EU are based on figures provided by ACEM[24]. Estimates of market growth from 2011 that reflect current market trends are available from the EMISIA (2012) study.

Table 3: Estimated annual market growth

Year	Market growth motorcycles	Market growth mopeds
2011	**-8%**	**-8%**
2012	**-5%**	**-5%**
2013	**-2%**	**-2%**
2014	**+5%**	**+5%**
2015-2030	**+2%**	**-1%**

Source: EMISIA (2012)

We use these figures on market growth under the assumption that scrappage is constant, so that growth in the market is due to new registrations alone. New types of vehicles are assumed to represent 20% of new registrations in each year[25]. The projections for new registrations over the period 2016 (the year the proposed measure takes effect) to 2021 are shown in Table 4 on the next page.

[24] ACEM (2011). *Registrations and deliveries*. Available at: http://bit.ly/yJ8rwx [accessed 19 January 2012]. 2010 values for motorcycles in HU, IE, LT, PL and for mopeds in BE, GR, IE, LT, PL and SK were estimated using the 2009/2010 growth rate of Member States for which data was available. The EU estimates for mopeds are based on 22 Member States.

[25] This figure is a rough estimate based on desk research on manufacturers' model portfolios. Note that the % of new types fluctuates substantially across years and manufacturers.

Table 4: New registrations of mopeds and motorcycles 2016-2021

Vehicle type		2016	2017	2018	2019	2020	2021
L1Be	New types[1)]	198,970	202,950	207,009	211,149	215,372	219,679
	Existing types[2)]	795,882	811,799	828,035	844,596	861,488	878,718
L3e	New types[1)]	120,260	122,665	125,119	127,621	130,173	132,777
	Existing types[2)]	481,041	490,661	500,475	510,484	520,694	531,108
	Total	**1,596,153**	**1,628,076**	**1,660,637**	**1,693,850**	**1,727,727**	**1,762,282**

Note: 1) Assumed = 20% of new registrations. 2) Assumed = 80% of new registrations
Source: London Economics

On this basis, the effect of the proposed measure on mopeds is calculated by multiplying the number of new registrations of new and existing types by the cost of OBD I plus, where applicable, the cost of OBD II. The results for mopeds and motorcycles are shown separately (in Table 5 and Table 6 respectively). The NPV figures represent the current (2012) value of the cost stream up to 2021 after a discount factor of 4% per year is applied. The overall cost is calculated by adding up the cost figures from tables 4 and 5.

Table 5: Cost of the proposed measure (€): mopeds

Vehicle type		2016	2017	2018	2019	2020	2021
EC proposal	New types[1)]	0	-1,493,766	-1,554,115	-1,616,901	-1,682,224	-9,066,168
	Existing types[2)]	0	0	0	0	0	0
	Total	0	-1,493,766	-1,554,115	-1,616,901	-1,682,224	-9,066,168
A	**NPV (2012)[3)]**	**-€14,870,009**					
PCT	New types[1)]	0	-1,493,766	-1,554,115	-1,616,901	-1,682,224	-1,750,185
	Existing types[2)]	0	0	-6,216,458	-6,467,603	-6,728,894	-7,000,742
	Total	0	-1,493,766	-7,770,573	-8,084,504	-8,411,118	-8,750,927
B	**NPV (2012)[3)]**	**-€33,367,999**					

Note: 1) Assumed = 20% of new registrations. 2) Assumed = 80% of new registrations. 3) 4% discount rate.
Source: London Economics

Table 6: Cost of the proposed measure (€): motorcycles

Vehicle type	2016	2017	2018	2019	2020	2021

EC proposal	New types[1)]	0	-2,471,436	-2,571,282	-2,675,162	-2,783,238	-14,999,971
	Existing types[2)]	0	0	0	0	0	0
	Total	0	-2,471,436	-2,571,282	-2,675,162	-2,783,238	-14,999,971
C	**NPV (2012)[3)]**	**-€24,602,424**					
PCT	New types[1)]	-2,375,467	-2,471,436	-2,571,282	-2,675,162	-14,417,504	-14,999,971
	Existing types[2)]	0	-9,885,743	-10,285,127	-10,700,646	-11,132,952	-59,999,883
	Total	-2,375,467	-12,357,179	-12,856,409	-13,375,808	-25,550,456	-74,999,854
D	**NPV (2012) [3)]**	**-€136,564,329**					

Note: 1) Assumed = 20% of new registrations. 2) Assumed = 80% of new registrations. 3) 4% discount rate.
Source: London Economics

Adding up the NPVs for the two main types of L-category vehicles results in the following overall assessment of the net cost of the proposed measure in NPV terms (Table 7). The net cost here is the cost of the measure as proposed by the EC minus the cost of the PCT.

Table 7: Net cost of proposed measure

NPV EC proposal (A+C)*	NPV PCT (B+D)*	Net costs of proposed measure [(A+C)-(B+D)]
-39,472,433	**-169,932,328**	**-130,459,895**

Note: * Costs for mopeds + costs for motorcycles, see tables 4 and 5 above.
Source: London Economics

KEY FINDINGS

- The cost estimates are based on projected new registrations and assume 20% new types among new registrations in each year and of OBD I of €11 and of OBD II of €46 per vehicle on average in 2012.
- The extension of the requirement to fit OBD I to new types of motorcycles (category L3e) from 2016 results in additional costs of around €2.4 million.
- The extension of the requirement to fit OBD I to existing types of motorcycles (category L3e) from 2017 results in additional costs of around €10.7 million per year, around €54 million over the 2017-21 period.
- The extension of the requirement to fit OBD II to new types from 2020 and existing types from 2021 results in additional costs of €12 million and €48 million, respectively.

- The extension of the requirement to fit OBD I to existing types of mopeds (category L1Be) from 2018 results in additional costs of around €6.6 million per year, around €26 million over the 2018-21 period.

- The removal of the requirement fit OBD II to new types of mopeds (category L1Be) results in savings of around €7 million.

- In total, the proposed measure results in additional costs of €130 million in NPV terms.

- The main driver of the cost differential between the EC proposal and the IMCO compromise is the expansion of the OBD requirement to existing types of vehicles under the IMCO compromise.

3.6. Benefits of proposed measure

As explained above, we are not in a position to contribute original research on the environmental benefits of the proposed measure. We additionally caution against putting too much confidence in existing estimates given the apparent weakness of the causal link between OBD systems and vehicle emissions.

However, it is plausible that the installation of OBD systems on L-category vehicles will result in additional environmental benefits. As noted above, recent tests[26] have shown that OBD II can detect faults that result in emission increases and that such emission increases can be large, so that their timely repair results in substantially better emission performance over the vehicle's lifetime. Nonetheless, the evidence on the overall impact of OBD is very limited. To allow a tentative assessment of the relative importance of costs and benefits, we report here the impact of the entire package of emission control measures envisaged in the IMCO compromise as estimated by EMISIA (2012).

The analysis by EMISIA contrasts a "baseline scenario", which assumes only the emission impacts of Directive 97/24/EC (as amended); and two scenarios with more ambitious emission reduction measures. The packages analysed by EMISIA (see Annex 3) do not correspond exactly with the scope of the proposed measure we identified (see Figure 1 above), but is sufficiently similar to allow a meaningful assessment of the order of magnitude of the expected impact. In particular, the EMISIA "Reference Condition" includes OBD I for existing vehicle types (mopeds and motorcycles) from 2018 and OBD II for existing vehicle types from 2021, whereas our interpretation of the EC proposal contains no measures that apply to existing types. The OBD-related measures in the EMISIA "IMCO Intention" correspond to our IMCO compromise scenario.

Given a stricter reference scenario, the emission reductions following the implementation of the IMCO compromise measures estimated by EMISIA will be somewhat smaller than the reduction that would apply under our baseline scenario, although there is no reason to believe that this will affect the qualitative assessment of the proposed measure. Further assumptions underlying the EMISIA (2012) results are included in Annex 4.

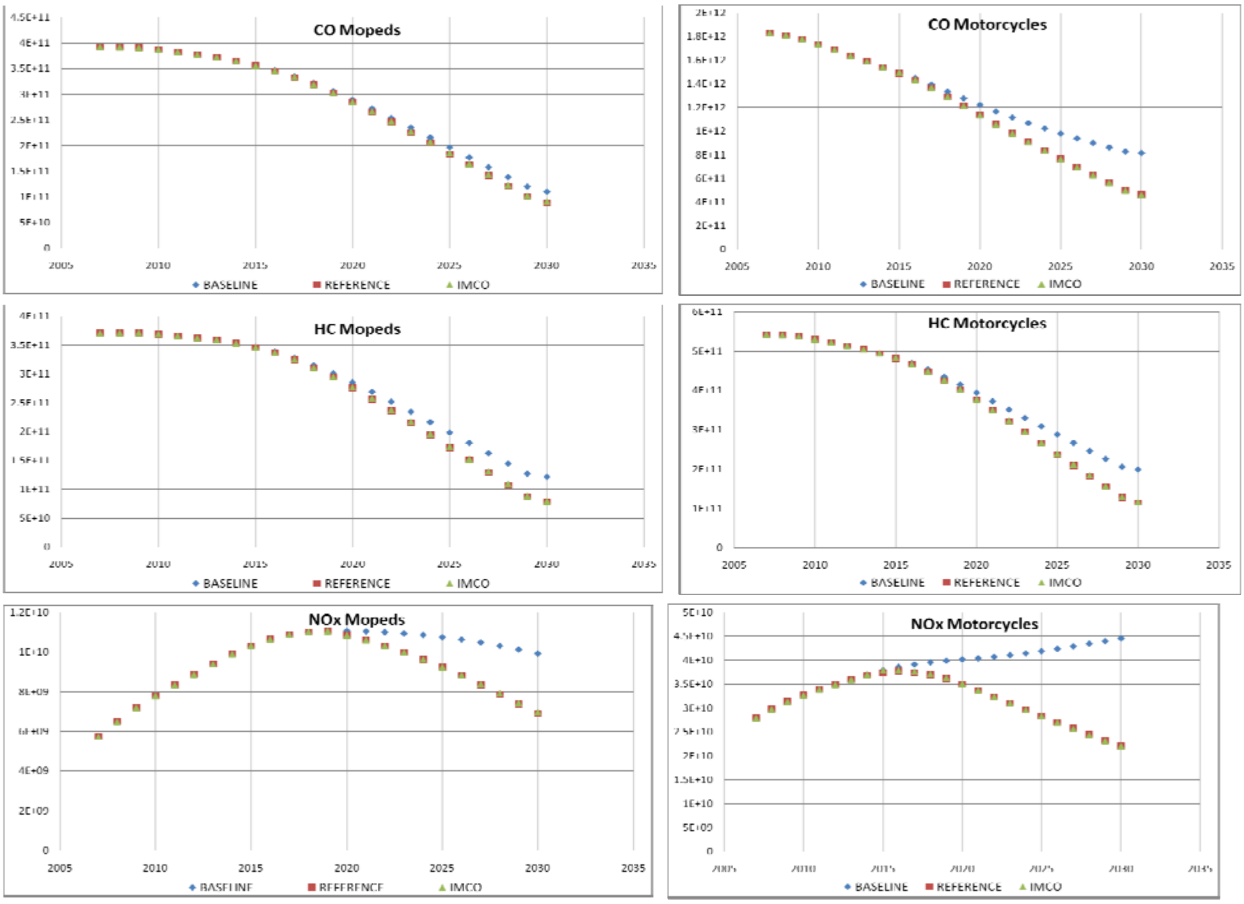
EMISIA (2012) uses assumptions on fleet size and composition up to 2030[27] to calculate the impact on the different pollutants controlled under the European emission standards[28]

[26] AECC (2012)

[27] Note that, while we use the EMISIA assumptions on fleet growth (Table 3), our projections of new registrations are not identical: we don't take into account changes in the scrappage rate and make somewhat different

for the three scenarios. These are shown in Figure 2. The main message of the EMISIA analysis is that the emission differences between the IMCO and the Reference scenario are barely visible.

Figure 2: Development of CO, HC, and NO_x emissions under the EMISIA (2012) scenarios



Source: EMISIA (2012)

The cumulative impact on emissions over the period 2014-2030 are summarised by EMISIA (2012) thus:

Table 8: Total emissions 2014-2030 (kt)

Pollutant	Reference	IMCO	Difference (%)
CO	16,836	16,839	0.018
HC	5,353	5,381	0.53
NO_x	535	536	0.26

Source: EMISIA (2012)

assumptions regarding the baseline figure for new registrations (based on ACEM delivery/registration statistics, see above.)

[28] EMISIA (2012) focuses on carbon monoxide (CO), nitrogen oxides (NO_x) and hydrocarbon (HC).

The figures indicate that the reductions over and above the "Reference Condition" that are achieved by the emission control measures envisaged by the IMCO compromise are minuscule. Even if we allow for a slightly larger impact (given the difference scope of the baseline scenario), the emission reduction that can be attributed to changes to the requirements regarding OBD systems for L-category vehicles would appear to be very small. For example, the 3 kt reduction in CO emissions and the 1 kt reduction in NO_x are equivalent to 0.04% and 0.03% respectively of the CO/NO_x emissions from road transport in the EU27[29].

3.7. Conclusions

The proposed measure would bring about benefits in terms of emission reductions and consumer benefits due to more timely and more efficient repairs vehicle repairs. However, the impact of the proposed measure on emissions appears small in absolute terms.

Additional benefits in terms of increased competition in the aftermarket, especially within the independent segment, which could benefit from standardised diagnostic information and the resulting increase in efficiency, seem plausible but uncertain. Given what little role independents are currently playing in the motorcycle aftermarket, this benefit should not be overstated.

On the cost side, we identified the direct cost of OBD systems to vehicle manufacturers as the largest factor. This includes the cost of the actual system as well as development costs. Based on a number of assumptions on the future development of vehicle registrations, the share of new versus existing types of vehicles and the costs of OBD I and OBD II systems, we derive a tentative estimate of the net cost of the proposed measure in NPV terms. The net cost of approximately €130 million is driven primarily by the extension of the requirement for OBD systems to existing types of vehicles.

[29] EEA, 2009 data, available at: http://bit.ly/xZ2sSK [accessed 23 January 2012].

REFERENCES

- AECC (2011). 'Particle emissions of powered two-wheelers'. Presentation at the *Cambridge Particles Meeting*, 13 May 2011.
- Commission (EC), 'Proposal for a European Parliament and Council Regulation on the approval and market surveillance of two- or three-wheel vehicles and quadricycles' COM(2010) 542 final, 4 October 2010.
- Commission (EC), 'Impact Assessment Guidelines' SEC(2009) 92, 15 January 2009.
- EMISIA (2012). *Impact of reference an IMCO intention PTW emission control packages.* Study on behalf of ACEM*.*
- 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.* Available at: http://bit.ly/zYBzpI [accessed 19 January 2012]. ('LAT Report')

ANNEX 1: VEHICLE CATEGORY DEFINITIONS

Category	Category name	Common classification criteria
L1e	Light two-wheel powered vehicle	(1) two wheels and powered by a propulsion as listed under Article 4(3) and (2) engine capacity ≤ 50 cm3 if a PI engine forms part of the vehicle's propulsion configuration.
Sub-categories	**Subcategory name**	**Supplemental sub-classification criteria:**
L1Ae	Powered cycle	(3) primary aim to aid pedalling and vehicle equipped with an auxiliary propulsion and (4) maximum design speed ≤ 25 km/h and (5) output of auxiliary propulsion is progressively reduced and finally cut off as vehicle reaches a speed of 25 km/h and (6) the auxiliary propulsion has a maximum continuous rated power[1] ≤ 1 kW and (7) powered three-wheel cycles complying with supplemental specific classification criteria (3), (4), (5) and (6) are classified as being technically equivalent to powered two-wheel cycles.
L1Be	Two-wheel moped	(3) maximum design speed ≤ 25 km/h and (4) maximum continuous rated power[1] ≤ 4 kW.

Category	Category name	Common classification criteria
L2e	Three-wheel moped	(1) three wheels and powered by a propulsion as listed under Article 4(3) and (2) engine capacity ≤ 50 cm3 if a PI engine forms part of the vehicle's propulsion configuration and (3) maximum design speed ≤ 45 km/h and (4) maximum continuous rated power[1] ≤ 4 kW.

Category	Category name	Common classification criteria
L3e[2]	Two-wheel motorcycle	(1) two wheels and powered by propulsion as listed under Article 4(3) and (2) engine capacity > 50 cm3 if a PI engine forms part of the vehicle's propulsion configuration and (3) maximum design speed > 45 km/h and (4) maximum continuous rated power[1] > 4 kW.
Sub-categories	**Subcategory name**	**Supplemental sub-classification criteria:**
L3e - A1	Low-performance motorcycle	(5) engine capacity ≤ 125 cm^3 and (6) maximum continuous rated power[1] ≤ 11 kW and (7) power[1] / weight ratio ≤ 0.1 kW/kg.
L3e - A2	Medium-performance motorcycle	(5) maximum continuous rated power[1] ≤ 35 kW and (6) power[1] / weight ratio ≤ 0.2 kW/kg and (7) not derived from a vehicle equipped with an engine of more than double its power[1].
L3e - A3	High-performance motorcycle	(5) any other vehicle of the L3e category that cannot be classified according to the performance criteria of subcategories A1 or A2.

Category	Category name	Common classification criteria
L4e	Two-wheel motorcycle with side-car	(1) base powered vehicle complying with the classification and sub classification criteria for L3e vehicles and (2) base powered vehicle equipped with a side-car.

Category	Category name	Common classification criteria
L5e	Powered tricycle	(1) three wheels and powered by a propulsion as listed under Article 4(3) and (2) if a PI combustion engine makes part of the vehicle's propulsion configuration: an engine capacity > 50 cm^3 and (3) maximum design speed > 45 km/h and (4) maximum continuous rated power[1] > 4 kW.
Sub-categories	**Subcategory name**	**Supplemental sub-classification criteria:**
L5Ae	Tricycle	(5) powered tricycles other than those complying with the specific classification criteria for commercial tricycles.
L5Be	Commercial Tricycle	(5) designed and used as commercial vehicles and characterised by an enclosed driving and passenger compartment accessible via two or more doors.
L5Be - U	Tricycles for utility purposes	(6) exclusively designed for the carriage of goods with an open or enclosed, virtually even and horizontal loading bed that meets one of the following criteria: (1) $length_{loading\ bed}$ x $width_{loading\ bed}$ > 0.3 x $Length_{vehicle}$ x $Width_{vehicle}$ or (2) an equivalent loading bed area as defined above used to install machines and/or equipment.
L5Be - P	Tricycle for passenger transport	(6) equipped with two, three or four passenger seating positions, including the seating position for the driver and all seating positions equipped with seat belts.

Category	Category name	Common classification criteria
L6e	Light quadricycle	(1) four wheels and powered by a propulsion as listed under Article 4(3) and (2) maximum design speed ≤ 45 km/h and (3) the mass in running order ≤ 350 kg, not including: (a) mass of batteries in case of a hybrid or fully electric propelled vehicle or (b) weight of gaseous-fuel system including tanks for gaseous fuel storage in the case of mono- , bi or multi-fuel vehicle or (c) weight of tank(s) to store compressed air in case of pre-compressed air propulsion.
Sub-categories	**Subcategory name**	**Supplemental sub-classification criteria:**
L6Ae	Light on-road quad	(4) category L6e vehicles not complying with the special categorisation criteria for sub category L6Be vehicles and (5) maximum continuous rated power[1] ≤ 4 kW and (6) engine capacity ≤ 50 cm3 if a PI engine forms part of the vehicle's propulsion configuration.
L6Be	Light mini-car	(4) enclosed driving and passenger compartment accessible via two or more doors and (5) maximum continuous rated power[1] ≤ 6 kW and (6) engine capacity ≤ 50 cm3 if a PI engine forms part of the vehicle's propulsion configuration and (7) $Length_{vehicle}$ x $Width_{vehicle}$ ≤ 4.4 m^2 with a maximum $Width_{vehicle}$ ≤ 1.5 m.
L6Be - U	Light mini-cars for utility purposes	(8) exclusively designed for the carriage of goods with an open or enclosed, virtually even and horizontal loading bed that meets one of the following criteria: (a) $length_{loading\ bed}$ x $width_{loading\ bed}$ > 0.3 x $Length_{vehicle}$ x $Width_{vehicle}$ or (b) an equivalent loading bed area as defined above used to install machines and/or equipment.
L6Be - P	Light mini-car for passenger transport	(8) vehicles mainly designed and used for passenger transport, characterised by being equipped with two passenger seating positions, including the seating position for the driver, and both seating positions equipped with seat belts.

Category	Category name	Common classification criteria
L7e	Heavy quadricycle	(1) four wheels and powered by a propulsion as listed under Article 4(3) and (2) maximum design speed > 45 km/h and (3) mass in running order: (a) ≤ 400 kg for transport of passengers; (b) ≤ 550 kg for transport of goods. The mass in running order does not include: (1) mass of the batteries in the case of a hybrid or fully electric-propelled vehicle or (2) weight of a gaseous-fuel system including tanks for gaseous fuel storage in the case of mono- , bi- or multi-fuel vehicles or (3) weight of tank(s) to store compressed air in the case of pre-compressed air propulsion; (4) maximum continuous rated power[(1)] ≤ 15 kW.
Sub-categories	Subcategory name	Supplemental sub-classification criteria:
L7Ae	Heavy on-road quad	(5) category L7e vehicles not complying with the specific criteria for subcategory L7Be vehicles and (6) equipped with one or two passenger seating positions, including the seating position for the rider.
L7Be	Heavy mini-car	(5) enclosed driving and passenger compartment accessible via two or more doors and (6) equipped with two, three or four passenger seating positions, including the seating position for the rider.
L7Be - U	Heavy mini-car for utility purposes	(7) exclusively designed for the carriage of goods with an open or enclosed, virtually even and horizontal loading bed that meets one of the following criteria: (a) $length_{loading\ bed}$ x $width_{loading\ bed}$ > 0.3 x $Length_{vehicle}$ x $Width_{vehicle}$ or (b) an equivalent loading bed area as defined above used to install machines and/or equipment.
L7Be - P	Heavy mini-car for passenger transport	(7) vehicles mainly designed and used for passenger transport, characterised by being equipped with less than or equal to four passenger seating positions, including the seating position for the driver and all seating positions being equipped with seat belts.

(1) The power limits in Annex I are based on maximum continuous rated power independent of the vehicle's propulsion configuration.

(2) sub-classification of an L3e vehicle according to whether it has a design vehicle speed of less than or equal to 130 km/h or more than 130 km/h is independent of its sub-classification into the propulsion performance classes A1 (although not likely to achieve 130 km/h), A2 or A3.

Source: COM(2010) 542 final, Annex I; available at: http://bit.ly/zPjyqA [accessed 11 January 2012]

ANNEX 2: OBD I/II DEFINITIONS

First-stage on-board diagnostic (OBD) system – OBD I

"the first stage of an on-board diagnostic (OBD) system which monitors and reports on electric circuit continuity, shorted and open electric circuits and circuit rationality of the engine and vehicle management systems".

Second-stage on-board diagnostic (OBD) system – OBD II

"The second stage of an on-board diagnostic system (OBD II) which, in addition to OBD I, monitors not only complete failures but also deterioration of systems, components or separate technical units during vehicle life (...)"

ANNEX 3: SCENARIOS ANALYSED IN EMISIA (2012)

Table 9: EMISIA (2012) Reference Condition

PTW timeline	2014 (new TAs) / 2015 (new REGs)	2017 (new TAs) / 2018 (new REGs)	2020 (new TAs) / 2021 (new REGs)
Moped	Euro 3 CO at idling Crankcase emissions Durability CO2	Euro 4 CO at idling Crankcase emissions Durability CO2 OBD1	Euro 5 CO at idling Crankcase emissions Durability CO2 OBD2 Evaporative C2
Motorcycles	Euro 4 CO at idling Crankcase emissions Durability CO2	Euro 5 CO at idling Crankcase emissions Durability CO2 OBD1 Evaporative C1	Euro 6 CO at idling Crankcase emissions Durability CO2 OBD2 Evaporative C2

Source: EMISIA (2012)

Table 10: EMISIA (2012) IMCO Intention

Moped timeline	2014 (new TAs) / 2015 (new REGs)	2017 (new TAs) / 2018 (new REGs)	2020 (new TAs) / 2021 (new REGs)
Moped	Euro 3	Euro 4 CO at idling Crankcase emissions Durability CO2 OBD1	Euro 5 CO at idling Crankcase emissions Durability CO2 OBD1 Evaporative C2
Motorcycle timeline	**2014 (new TAs) / 2015 (new REGs)**	**2016 (new TAs) / 2017 (new REGs)**	**2020 (new TAs) / 2021 (new REGs)**
Motorcycles		Euro 5* CO at idling Crankcase emissions Durability	Euro 6 CO at idling Crankcase emissions Durability

		CO_2 OBD1 Evaporative C1	CO_2 OBD2 Evaporative C2

Source: EMISIA (2012)

ANNEX 4: FURTHER ASSUMPTIONS IN EMISIA (2012)

Table 11: Reductions due to emission limits - motorcycles

Motorcycles			Category	(Euro 4, 5, 6) / (Euro 3)				
				CO	HC	NOx	PM	CO2
REFERENCE	Euro 4	(2 stroke)	MOT 2 stroke	0,75	0,75	0,76	0,75	1
	Euro 4	<150 cc	MOT < 150 cc	0,75	0,75	0,76	0,75	1
	Euro 4	>150 cc, Vmax<130 km/h	MOT 250 - 750 cc	0,75	0,75	0,76	0,75	1
	Euro 4	>150 cc, Vmax>=130 km/h	MOT > 750 cc	0,75	0,76	0,77	0,76	1
	Euro 5	(2 stroke)	MOT 2 stroke	0,44	0,51	0,41	0,51	1
	Euro 5	<150 cc	MOT < 150 cc	0,44	0,51	0,41	0,51	1
	Euro 5	>150 cc, Vmax<130 km/h	MOT 250 - 750 cc	0,44	0,51	0,41	0,51	1
	Euro 5	>150 cc, Vmax>=130 km/h	MOT > 750 cc	0,44	0,52	0,41	0,52	1
	Euro 6	(2 stroke)	MOT 2 stroke	0,38	0,13	0,35	0,13	1
	Euro 6	<150 cc	MOT < 150 cc	0,38	0,13	0,35	0,13	1
	Euro 6	>150 cc, Vmax<130 km/h	MOT 250 - 750 cc	0,38	0,13	0,35	0,13	1
	Euro 6	>150 cc, Vmax>=130 km/h	MOT > 750 cc	0,38	0,30	0,27	0,30	1
IMCO INTENTION	Euro 4	(2 stroke)	MOT 2 stroke	1,00	1,00	1,00	1,00	1
	Euro 4	<150 cc	MOT < 150 cc	1,00	1,00	1,00	1,00	1
	Euro 4	>150 cc, Vmax<130 km/h	MOT 250 - 750 cc	1,00	1,00	1,00	1,00	1
	Euro 4	>150 cc, Vmax>=130 km/h	MOT > 750 cc	1,00	1,00	1,00	1,00	1
	Euro 5	(2 stroke)	MOT 2 stroke	0,38	0,51	0,41	0,51	1
	Euro 5	<150 cc	MOT < 150 cc	0,38	0,51	0,41	0,51	1
	Euro 5	>150 cc, Vmax<130 km/h	MOT 250 - 750 cc	0,38	0,51	0,41	0,51	1
	Euro 5	>150 cc, Vmax>=130 km/h	MOT > 750 cc	0,38	0,52	0,41	0,52	1
	Euro 6	(2 stroke)	MOT 2 stroke	0,38	0,13	0,35	0,13	1
	Euro 6	<150 cc	MOT < 150 cc	0,38	0,13	0,35	0,13	1
	Euro 6	>150 cc, Vmax<130 km/h	MOT 250 - 750 cc	0,38	0,13	0,35	0,13	1
	Euro 6	>150 cc, Vmax>=130 km/h	MOT > 750 cc	0,38	0,30	0,27	0,30	1

Source: EMISIA (2012)

Table 12: Reductions due to emission limits – mopeds

Mopeds < 50 cc			Category	(Euro 3, 4, 5) / (Euro 2)				
				CO	HC	NOx	PM	CO2
REFERENCE	Euro 3	2W	Mopeds < 50 cc	0,77	0,77	1,00	0,77	0,87
	Euro 4			0,77	0,47	1,00	0,47	0,87
	Euro 5			0,77	0,07	0,36	0,07	0,7
IMCO INTENTION	Euro 3	2W	Mopeds < 50 cc	0,77	0,77	1,00	0,77	0,87
	Euro 4			0,77	0,47	1,00	0,47	0,87
	Euro 5			0,77	0,07	0,36	0,07	0,7

Source: EMISIA (2012)

Durability

- Baseline: All vehicles assumed to degrade by 20% over the durability mileage distance
- Reference: All vehicles assumed to degrade by 10% over the durability mileage distance
- IMCO Intention: Similar to reference with the exception of Euro 3 mopeds that degrade by 20% over the durability mileage distance
- Durability mileage per category / technology as in voted document

OBD I

- It is assumed to identify minor and moderate malfunctions
- DG ENTR Study data on:

- Frequency of malfunctions according to vehicle age
- Probability shares between minor and moderate malfunctions
- Impact of malfunction on emission increase

OBD II

- In addition to OBD1, it can recognize catalyst malfunction (twin lambda sensor principle)
- Catalyst malfunction assumed to lead to 9 times higher emissions than base emissions
- Only 10% of total malfunctions assumed to relate to catalyst performance

ANNEX 5: IMCO COMPROMISE PROPOSAL

Amendment 49

Proposal for a regulation
Article 19

Text proposed by the Commission	*Amendment*
1. ***Four*** years after the date referred to in ***the second subparagraph of*** Article 82, all new vehicles in subcategories ***L1Be,*** L3e, L5e, L6Ae and L7Ae shall be equipped with the first stage of an on-board diagnostic (OBD) system which monitors and reports on electric circuit continuity, shorted and open electric circuits and circuit rationality of the engine and vehicle management systems (OBD I).	1. ***Two*** years after the date referred to in Article 82***(2)***, all new vehicles in subcategories L3e, L5e, L6Ae and L7Ae shall be equipped with the first stage of an on-board diagnostic (OBD) system which monitors and reports on electric circuit continuity, shorted and open electric circuits and circuit rationality of the engine and vehicle management systems (OBD I).
	2. Three years after the date referred to in Article 82(2), all new vehicles in subcategory L1Be and all existing types of vehicles in subcategories L3e, L5e, L6Ae and L7Ae shall be equipped with OBD I.
	3. Four years after the date referred to in Article 82(2), all existing types of vehicles in subcategory L1Be shall be equipped with OBD I.
	4. Five years after the date referred to in Article 82(2), all new vehicles in subcategories L6Be, L7Be and L7Ce shall be equipped with OBD I.
2. Six years after the date referred to in ***the second subparagraph of*** Article 82, all ***new*** vehicles in subcategories L6Be ***and*** L7Be shall be equipped with OBD I.	***5.*** Six years after the date referred to in Article 82***(2)***, all ***existing types of*** vehicles in subcategories L6Be**,** L7Be and ***L7Ce*** shall be equipped with OBD I.
	6. Seven years after the date referred to in Article 82(2), all new vehicles shall be equipped with OBD I.
3. Eight years after the date referred to in ***the second subparagraph of*** Article 82, all ***new*** vehicles shall be equipped with OBD I.	***7.*** Eight years after the date referred to in Article 82***(2)***, all ***existing types of*** vehicles shall be equipped with OBD I.
4. Following confirmation in a decision	***8.*** Following confirmation in a decision

adopted by the Commission in accordance with Article 21(4), ***eight*** years after the date referred to in ***the second subparagraph of*** Article 82, all new vehicles in (sub-)categories ***L1Be,*** L3e, L5e, L6Ae and L7Ae shall in addition also be equipped with the second stage of an on-board diagnostic system (OBD II) which, in addition to OBD I, monitors not only complete failures but also deterioration of systems, components or separate technical units during vehicle life under the condition that its cost-effectiveness is proven in the environmental effect study referred to in *article* 21(4) and (5).	adopted by the Commission in accordance with Article 21(4), ***six*** years after the date referred to in Article 82***(2)***, all new vehicles in (sub-)categories L3e, L5e, L6Ae and L7Ae shall also be equipped with the second stage of an on-board diagnostic system (OBD II) which, in addition to OBD I, monitors not only complete failures but also deterioration of systems, components or separate technical units during vehicle life under the condition that its cost-effectiveness is proven in the environmental effect study referred to in *Article* 21(4) and (5).
	9. Following confirmation in a decision adopted by the Commission in accordance with Article 21(4), seven years after the date referred to in Article 82(2), all existing types of vehicles in (sub-) categories L3e, L5e, L6Ae and L7Ae shall also be equipped with OBD II which, in addition to OBD I, monitors not only complete failures but also deterioration of systems, components or separate technical units during vehicle life under the condition that its cost-effectiveness is proven in the environmental effect study referred to in Article 21(4) and (5).
5. The detailed OBD emission thresholds are laid down in Annex VI(B).	***10.*** The detailed OBD emission thresholds are laid down in Annex VI(B).
6. Powers are conferred on the Commission ***to adopt***, in accordance with Article 76***, 77 and 78 a delegated act laying*** down the detailed technical requirements related to ***on-board diagnostics***, including functional ***OBD*** requirements and test procedures ***for the subjects listed in paragraphs 1 to 5*** in order to ensure a high level of functional safety, environmental protection and the same standardised level of access to repair and maintenance information for all vehicle repairers.	***11. The*** Commission ***shall***, ***by means of a delegated act*** in accordance with Article 76, ***lay*** down the detailed technical requirements related to ***OBD***, including functional requirements and test procedures in order to ensure a high level of functional safety, environmental protection and the same standardised level of access to repair and maintenance information for all vehicle repairers.

EUROPEAN PARLIAMENT

DIRECTORATE GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

Impact assessment of EP amendments to the 'Proposal for a Regulation on the approval and market surveillance of two- or three-wheel vehicles and quadricycles'
III – Timetable for emission standards

STUDY

Abstract
The study assesses the impact of propsed measures to speed up the introduction of subsequent stages of European emission standards for L-category vehicles

IP/A/IMCO/NT/2011-21 February 2012
PE 475.091 EN

CONTENTS

LIST OF ABBREVIATIONS

ACEM Association des Constructeurs Européens de Motocycles

AECC Association for Emissions Control by Catalyst

EC European Commission

EES European Emission Standards

EP European Parliament

EU European Union

FEMA Federation of European Motorcyclists Associations

LAT Laboratory of Applied Thermodynamics (Aristotle University of Thessaloniki)

NPV Net Present Value

OBD On-Board Diagnostic system

PI Positive Ignition

PTW Powered Two-Wheeler

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1. INTRODUCTION

This study is the third of a three-part assessment of amendments proposed by the European Parliament (EP) to three measures contained in the European Commission's (EC) 'Proposal for a Regulation on the approval and market surveillance of two- or three-wheel vehicles and quadricycles'[1].

The impact assessment builds upon the comprehensive impact assessment on the Proposal compiled by the EC[2], but is narrower in focus, taking the measures contained in the EC's Proposal as the baseline scenario. Only the differences between the EC's original proposal and the IMCO Compromise are considered in this impact assessment.

The impact assessment further draws on existing research not considered in the EC's impact assessment and consultations with interested parties, including:

- The association of the European motorcycle industry (ACEM);
- individual manufacturers of motorcycles and/or components;
- the Association for Emissions Control by Catalyst (AECC); and
- the Federation of European Motorcyclists Associations (FEMA).

The report is organised as follows:

1. Summary of the proposed measures and statement of the object of the impact assessment

2. Summary of the impacts of the proposed measure and selection of the primary impacts to be analysed in detail

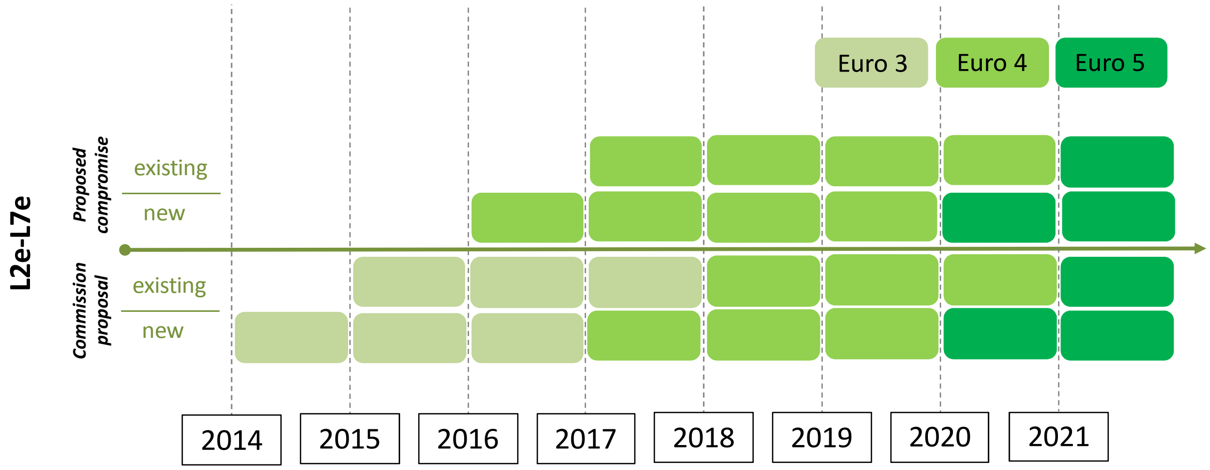
3. Cost-benefit analysis of the selected impacts

[1] COM(2010) 542 final, 4 October 2010.
[2] SEC(2010) 1152, 4 October 2010.

2. SUMMARY OF THE PROPOSED MEASURE

Under the EP's compromise proposal, the Euro 4 emission standard will be compulsory from 2016 for new types and from 2017 for existing types of two-wheel motorcycles, tricycles and quadricycles (vehicles in categories L2e-L7e). In each case, this brings the introduction of the more stringent EES forward by one year compared with the timetable that was foreseen in the original Commission proposal. In addition, the intermediate Euro 3 step will be dropped under the proposal. The graphical summary of the proposed measure is shown below.

Figure 1: summary of the proposed measure



Source: London Economics

2.1. Scope of the impact assessment

The proposed measure advances the requirement to adhere to the Euro 4 emission standard for most vehicle types in category L by one year while at the same time removing the requirement for mandatory Euro 3. The scope of this impact assessment is therefore very narrow: the main difference to the baseline scenario (the EC's original proposal) is a change in timing of the introduction of the stricter Euro 4 emission standard. The other difference, the removal of the Euro 3 step is minor in comparison.

For the most part, we will restrict the scope of our analysis to vehicles in category L3e (motorcycles), for which good data on new registrations and projections for the development of the fleet up to 2030 are available. As the LAT report points out, "tri- and quadricycles are a special category corresponding to a very small portion of the total vehicle fleet" [3]. Even though registrations of these types of vehicles show an upward trend, we regard them as negligible in their impact on overall emissions.

[3] LAT report, p. 119.

3. SUMMARY OF THE IMPACTS OF THE PROPOSED MEASURE

This section briefly discusses the impacts of the proposed measure. We evaluate the significance of the individual impacts and their relevance for the impact assessment. In the following section costs and benefits are discussed in turn. The list of impacts is based on the EC's initial impact assessment as well as the LAT report.

3.1. Costs of the proposed measure

3.1.1. Manufacturer costs

The proposed measure means that the cost of making L-category vehicles conform to the Euro 4 emission standard starts being incurred one year earlier than under the EC's original proposals. This increases the NPV of the introduction of the emission standards. On the other hand, the obligation to make vehicles conform to the Euro 3 standard is dropped. This may reduce the cost of the proposed measure somewhat. However, our consultations reveal that the cost of Euro 3 (where vehicles are not already compliant) is considerably lower than the cost of Euro 4, so that the impact of this part of the proposed measure is expected to be negligible.

As the LAT report explains, "for motorcycles, both engine and aftertreatment measures will be required to move technology beyond Euro 3. Several engine measures will have to be further promoted such as optimized fuel injection timing, air exchange improvement, combustion chamber designs to reduce fuel/lube oil interactions and crevice volume above the piston spacer, injectors with reduced sac volume, etc. Without diminishing the value of the reductions that can be achieved by engine measures, most of the reductions will be achieved by enhanced aftertreatment control, similar to the gasoline passenger car shift from Euro 4 to Euro 5. In principle, this would again mean the use of a pre-catalyst for fast light-off, together with a larger and/or more efficient main catalyst. More precise lambda control will also be required. The use of secondary air injection may also be required for some of the models to be offered, and this will depend on the specifications of the vehicle and the manufacturer considered. In any case, no 2S engines are foreseen to be viable at post Euro 3 level, except perhaps in some few niche applications with very limited audience" [4].

Consultations with manufacturers yielded no clear picture of what level of costs is to be expected from the proposed measure. However, the general view seems to be that a move from Euro 3 to Euro 4 can be achieved quite easily (larger cost increases are expected for the move to Euro 5, which is outside the scope of this assessment). Beyond that, a precise quantification of costs appears extremely difficult. According to manufacturers, the crucial issue is whether a complete redesign of specific engine families becomes necessary, or whether more minor adjustments (sometimes limited to programming changes in the engine control system) suffice to comply with the standard.

Manufacturers also note that the modifications necessary to comply with the Euro 4 standard are most cost-effectively undertaken in conjunction with other measures that form part of the emission control package of the proposed Regulation, namely the inclusion of OBD systems, requirements for durability testing, etc.

[4] LAT report, p. 69.

Given the uncertainty associated with cost estimates for upgrading motorcycles to Euro 4, we caution against assigning too much weight to such estimates in the overall assessment of the proposed measure. However, in order to provide a quantitative estimate, we use a per-vehicle cost of €40-€70 (€50 on average), which is the cost of a three-way catalyst as proposed in the LAT report for scenarios 2 and 3 as a baseline estimate[5]. The table below shows the cost of Euro 4 as a percentage of average vehicle prices. Despite the apparently moderate costs, it should be taken into account that smaller motorcycle manufacturers are likely to be disproportionately affected by any cost increase, as it is spread over sometimes very small numbers of units produced (small manufacturers often produce fewer than 1,000 vehicles per type per year).

Table 1: Potential impact of Euro 4 on end-user prices

Vehicle category*	L1-B	L3-A1	L3-A2/A3
Observations	12	17	21
Average price per vehicle (€)	1,690	2,837	8,994
Cost of Euro 4 as % of average price	3.0%	1.8%	0.6%

Note: Average prices per vehicle category (excluding cost of ABS/CBS) for the 50 best-selling models were taken from the italian Magazine "Due Ruote", January 2012, published by Domus. The 50 PTW models represent 28% of the EU PTW market in 2011 (according to a compilation of national registrations data from EU National markets provided by ACEM). Average prices for the entire market are likely to be lower for vehicles in categories L1-B and L3-A1, where competition is more fragmented. * See Annex I for definitions.

Source: London Economics based on ACEM data

3.2. Benefits of the proposed measure

3.2.1. Reduction of vehicle emissions

A reduction in emissions is the direct impact of the earlier move to Euro 4. Specifically this related to a reduction in the pollutants controlled under the European emission standards for motorcycles, namely carbon monoxide (CO), total hydrocarbons (THC), nitrogen oxide (NO_x) and particulate matter (PM). The total reduction in emission that the introduction of the Euro 4 standard would bring about is impossible to quantify exactly, as it depends on the replacement rate of the fleet, vehicle kilometres of old vs. new motorcycles and the emission performance of the vehicles that are retired compared with the new Euro 4 compliant vehicles that enter the fleet for the first time. However, we assume a relatively large reduction in per-vehicle emissions from an older vehicle to a Euro 4 compliant vehicle is realistic. Based on the proposed threshold levels for Euro 3 (discarded in the IMCO compromise) and Euro 4 (as amended by the IMCO compromise), we estimate an average reduction across the different types of emissions of around 30% (see table below). However, even such large reductions per new vehicle have no great effect on overall emissions of the fleet of L-category vehicles in absolute terms, as new registrations account for < 1% of the total fleet in each year.

[5] In the LAT report, this excludes additional engine tuning costs, which apply per engine family. The per-vehicle costs for scenarios 2 and 3 lie in between the costs for scenario 1 (€30-€40 per vehicle + calibration costs per engine family) and scenario 4 (€135-€225 + calibration costs per engine family).

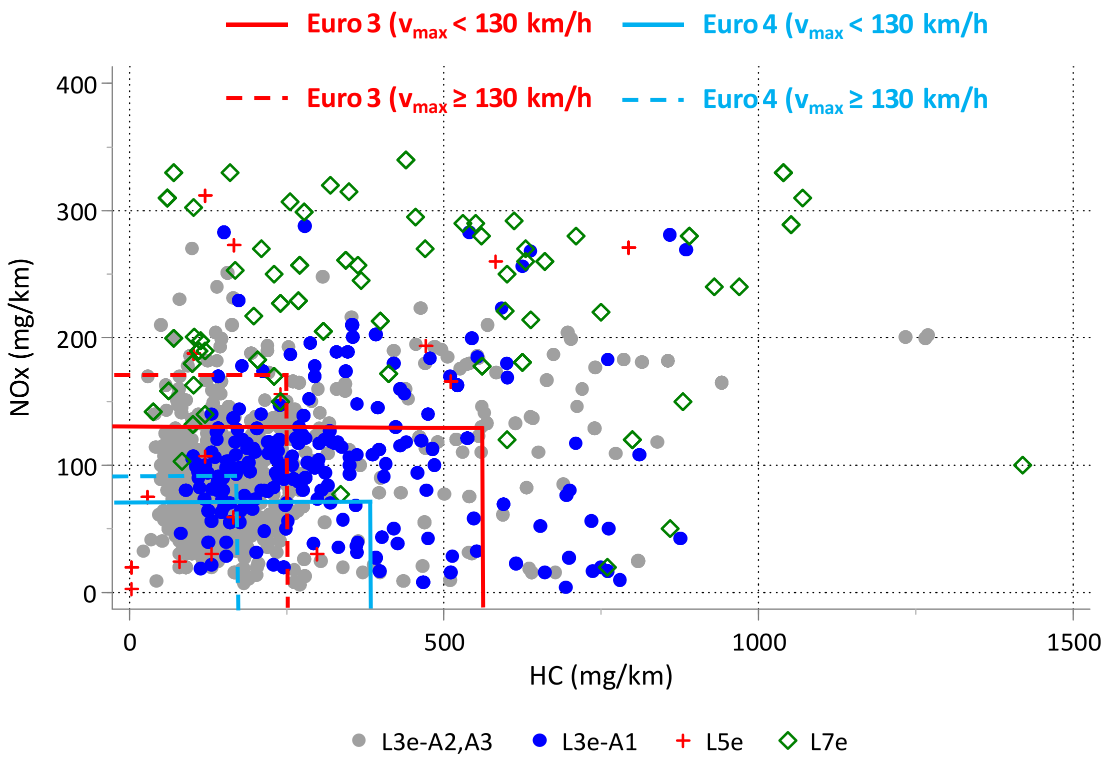
Table 2: Illustration of % reductions in emission limits from Euro 3* to Euro 4**

Vehicle category***	Mass of carbon monoxide (CO)	Mass of total hydrocarbons (THC)	Mass of oxides of nitrogen (NO_x)	Mass of particulate Matter (PM)
L1Ae	0.0%	0.0%	-46.2%	-
L1Be	0.0%	-	-	-
L2e	-45.7%	-	-	-
L3e	-49.2%	-32.1%	-46.2%	-
L4e	-49.2%	-32.1%	-46.2%	
L5Ae	-49.2%	-32.1%	-46.2%	
L7Ae (PI, vmax ≥ 130 km/h)	-49.2%	-32.0%	-47.1%	-
L5Be (CI/ Hybrid Tricycle)	0.0%	-33.3%	-15.4%	-20.0%
L6Ae	-45.7%			
L6Be	0.0%	-33.3%	-15.4%	-20.0%
L7Be	-	-	-	-
Average	**-28.8%**	**-27.9%**	**-37.5%**	**-20.0%**

Note: Emission limits as in the EC proposal, discarded in the PCT. ** As amended by the PCT. *** See Annex I for definitions.
Source: London Economics based on ANNEX VI of the consolidated version of the EC proposal (PCT)

The following figure shows that the Euro 4 limits specified in the IMCO compromise are binding for many types of vehicles in category L, in particular those in sub-category L7e. However, a large number of vehicles, in particular in category L3e, are already Euro 4 compliant. The evidence from Germany that is presented in the figure also shows that Euro 3 compliance is already very widespread for the most common vehicle types.

Figure 2: Emission measurements for 3,034 types of L-category vehicles

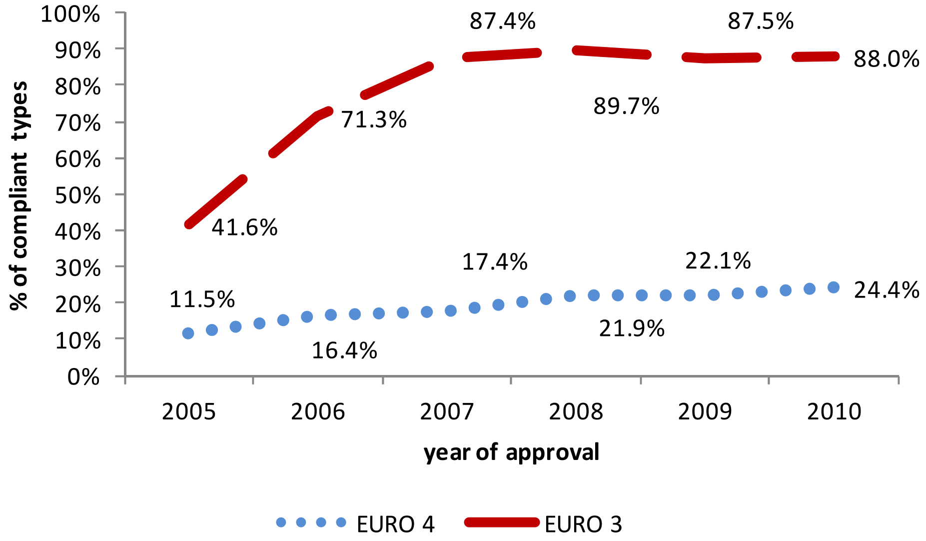


Note: Based on 3,034 observations of type approvals in Germany between 2003 and 2011. 25 observations with NO_x >400 mg/km and HC > 1,500 mg/km are not reported. Euro 4 and Euro 3 emission limits are shown for vehicles in categories L3e, L4e, L5Ae and L7Ae.
Source: London Economics, German Federal Motor Transport Authority (KBA)

In fact, a look at the proportion of vehicles in categories L3e-A2 and A3 that are compliant with the Euro 3 and Euro 4 standards shows that a significant proportion of vehicle types approved in Germany already meet the standards specified in the IMCO compromise. Moreover, the proportion of compliant vehicles has been increasing steadily over recent years, at a rate of 4 percentage points each year between 2005 and 2010 (Euro 4). There is markedly less Euro 4 compliance in other vehicle categories (on average 6% of tested[6] vehicle types in category L3e-A1 between 2006 and 2010; Euro 3 compliance over the same period was 66%).

[6] Applying the standards for vehicles with maximum speed ≤ 130 km/h: CO ≤ 1000, HC ≤ 170 and NO_x ≤ 90.

Figure 3: Proportion of compliant vehicle types in category L3e-A2/A3 by year of approval



Note: Vehicles were classed as Euro 4 compliant if test emissions are CO ≤ 1,000 mg/km, HC ≤ 170 mg/km and NO_x ≤ 90 mg/km and as Euro 3 compliant if test emissions are CO ≤ 1,970 mg/km, HC ≤ 250 mg/km and NO_x ≤ 170 mg/km.
Source: London Economics, German Federal Motor Transport Authority (KBA)

Another effect that has to be considered, however, is that the increased cost of Euro 4 compliant vehicles under the proposed measure may reduce demand for such vehicles (that is, consumer demand, as opposed to manufacturers' willingness to bring Euro 4 compliant types to market), thus potentially resulting in an increase in average fleet age and therefore a larger proportion of older, more polluting vehicles on the road. While this effect is likely to be present in some form, we would expect it to be small given the relatively low expected price of a Euro 4 upgrade compared with the overall cost of a vehicle in the affected sub-categories of category L (see Table 1 above).

3.2.2. Increased competitiveness of European motorcycle manufacturers/OEMs

Speeding up the development of motorcycle engines with lower emissions could confer an important competitive advantage on European manufacturers. Such a first-mover advantage can increase international competitiveness of European companies, especially in emerging markets, where transport-related emissions are increasingly the subject of policy interventions. As the LAT report mentions, "proposal of standards at Euro 4 level are expected to also exert more pressure on Asian authorities to control national fleets"[7]. However, there is a downside risk of loss of competitiveness if other countries don't follow down the route towards more stringent emission standards for L-category vehicles.

Independent of any specific regulation, emission standards may contribute to innovation in engine design more broadly, thereby strengthening the technological basis of the motorcycle industry in Europe. Overall, such benefits appear plausible and could be substantial. However, they are difficult to measure and even harder to quantify.

[7] LAT report, p. 17.

3.2.3. Revenue and employment in the supplier industry

Related to the previous benefit of increased investment/innovation in engine technology is an increase in revenues for the supplier industry, which is likely to experience in an increase in demand from manufacturers who need more advanced, likely more complex engine designs. However, this benefit is likely to be relatively weak at the Euro 4 stage, which, according to manufacturers, can be reached largely without extensive engine redesign.

Table 3: Summary of impacts

Impact	Assessment
Manufacturer costs	Likely moderate for Euro 4, but highly variable
Reduction of vehicle emissions	Substantial for new vehicles
Increased competitiveness of European industry	Potentially substantial
Revenue and employment in the supplier industry and type approval authorities	Benefit dependent on multiplier effect, likely small

Source: London Economics

3.3. Primary impacts of the proposed measure

In this impact assessment we concentrate on the costs of the proposed measure to manufacturers. For reasons of data availability we analyse the impact of the proposed measure using data on vehicles in categories L3e only, under the assumption that this provides a good approximation of the total impact.

As explained in the preceding section, other potential impacts of the proposed measure are either considered to be negligible, too uncertain or impossible to analyse without additional research much beyond the terms of reference for this study.

On the benefits of the proposed measure, uncertainty over the impact of the Euro 4 standard on its own on fleet vehicle emissions preclude a precise assessment based on existing information. We further note that the desirability of escalating emission standards for the European road transport sector is taken as given and not subject of this impact assessment.

Finally, it should be emphasised that the introduction of a Euro 4 emission standard for L-category vehicles should not be viewed in isolation, but as part of a package of measures aimed at controlling the emissions. The cost-effectiveness of individual measures (such as the introduction of binding emission limits for engines) might give a misleading impression of the overall impact of a package of measures, where costs and benefits are distributed unequally across the various measures.

CALCULATION OF COSTS AND BENEFITS

This section assesses the manufacturer costs of the proposed measure. We calculate the NPV of the proposed measure and its net benefit, i.e., the difference between the NPV of the EC's original proposal and the measure as specified in the IMCO compromise.

We do not attempt to assess the emission reduction impact of bringing forward the introduction of a Euro 4 standard for motorcycles. In particular the absence of information on actual emissions prevented by introducing Euro 4 and the wider impact of a reduction in emissions precludes an assessment that is at the same time simple, meaningful and short. We reiterate that any reduction in emissions from category L vehicles is desirable; but that a measure that reduces emissions of newly registered vehicles one year earlier than would otherwise be the case on its own does not have a substantial impact. Even assuming a per-vehicle reduction of 30% of pollutants (CO, HC, NO_x, PM), the very small proportion of new vehicles in the overall fleet in any given year seems to adding to this the uncertainty of actual emission reductions that would be achieved renders futile any attempt at ad hoc quantification.

3.4. Inflation and discount rate

Costs and benefits are assessed in NPV terms, which requires the selection of an appropriate discount rate. We use a standard discount rate of 4% per year as recommended in the EC's 2009 Impact Assessment Guidelines[8].

Prices are subject to inflation. In line with the assumption made in the LAT report, we apply a constant rate of inflation of 2% per year from 2011.

3.5. Cost of the proposed measure

The cost is the cost of upgrading new vehicles to Euro 4 in 2016 plus the cost of upgrading existing vehicles to Euro 4 in 2017, taking into account inflation and projected vehicle registrations and assuming a constant 0:80 split between new and existing vehicles in each year[9].

Our estimates of new registrations in the EU are based on figures provided by ACEM[10]. Estimates of market growth from 2011 that reflect current market trends are available from the EMISIA[11] (2012) study.

[8] SEC(2009) 92, 15 January 2009.

[9] This is an indicative figure based on the observed model portfolios of major manufacturers and limited industry data.

[10] ACEM (2011). *Registrations and deliveries*. Available at: http://bit.ly/yJ8rwx [accessed 19 January 2012]. 2010 values for motorcycles in HU, IE, LT, PL and for mopeds in BE, GR, IE, LT, PL and SK were estimated using the 2009/2010 growth rate of Member States for which data was available. The EU estimates for mopeds are based on 22 Member States.

[11] EMISIA (2012)

Table 4: Estimated annual market growth

Year	Market growth motorcycles
2011	-8%
2012	-5%
2013	-2%
2014	+5%
2015-2030	+2%

Source: EMISIA (2012)

We use these figures on market growth under the assumption that scrappage is constant, so that growth in the market is due to new registrations alone. New types of vehicles are assumed to represent 20% of new registrations in each year[12]. The projections for new registrations for 2016 and 2017 (the years affected by the proposed measure) are shown below.

Table 5: New registrations of motorcycles 2016-17

Vehicle type		2016	2017
L3e	New types[1)] (non-compliant[2)])	198,970 (149,228)	202,950 (152,212)
	Existing types[3)]	795,882	811,799
	Total	**994,852**	**1,014,749**

Note: 1) Assumed = 20% of new registrations. 2) Assumed = 75% of new types.
3) Assumed = 80% of new registrations
Source: London Economics

On this basis, the effect of the proposed measure on mopeds is calculated by multiplying the number of new registrations of new and existing types which are not already Euro 4 compliant by the average cost (variable cost) of upgrading a vehicle to Euro 4. As shown above (Figure 3), up to a quarter of new vehicle types are already Euro 4 compliant. While this proportion can be expected to increase up to 2016/17, we use a 25% compliance rate as a conservative estimate. We do not attempt to quantify the proportion of compliant vehicles among existing types, which means that our figures overstate somewhat the cost of upgrading existing types to Euro 4.

[12] This figure is a rough estimate based on desk research on manufacturers' model portfolios. Note that the % of new types fluctuates substantially across years and manufacturers.

Table 6: Cost of the proposed measure: motorcycles

Vehicle type		2016	2017
EC proposal	New types1)	-	-€2,571,237
	Existing types2)	-	-
	Total	**-**	**-€2,571,237**
(A)	**NPV (2012)3)**	**-€2,560,993**	
IMCO	New types1)	-€2,471,393	-€2,571,237
	Existing types2)	-	-€13,713,266
	Total	**-€2,471,393**	**-€16,284,504**
(B)	**NPV (2012) 3)**	**-€18,616,552**	

Note: 1) Assumed = 20% of new registrations of non-compliant types. 2) Assumed = 80% of new registrations. 3) 4% discount rate.
Source: London Economics

This results in the following overall assessment of the net cost of the proposed measure in NPV terms:

Table 7: Net cost of proposed measure

NPV EC proposal (A)	NPV PCT (B)	Net costs of proposed measure (B-A)
-€2,560,993	**-€18,616,552**	**-€16,055,559**

Source: London Economics

KEY FINDINGS

- The proposed measure results in additional costs of €16 million.
- The cost estimate is based on projected new registrations and assumes 20% new types among new registrations in each year and 25% of new types already compliant with Euro 4.
- The impact of the omission of the Euro 3 step is considered negligible and is not quantified.

3.6. Benefits of proposed measure

As explained above, we are not in a position to present a quantitative estimate of the environmental benefits of the proposed measure. The evidence shows that the measure will have a real impact on emissions, as a large majority of vehicle types in the affected categories do not currently comply with the Euro 4 standard. However, there has been a marked increase in compliant types over recent years. Based on evidence from Germany, we estimate that almost a quarter of new vehicle types in the higher-powered motorcycle categories (L3e-A2 and A3) were Euro 4 compliant in 2010. This reduces the impact of the proposed measure. The impact of the removal of the Euro 3 step is judged to be even smaller in comparison, given that widespread compliance is already observed.

3.7. Conclusions

The proposed measure would bring about benefits in terms of emission reductions. However, the impact of the proposed measure on emissions is likely to be small in absolute terms.

Additional benefits in terms of a more internationally competitive European motorcycle industry, especially in the light of increasing interest in emission standards in emerging economies, seem plausible but are difficult to predict. However, the benefits could be substantial. While the technological requirements of advancing to Euro 4 are relatively modest, more substantial innovation can be expected to occur with progressively more rigorous European emission standards.

On the cost side, we identified the direct cost to vehicle manufacturers of upgrading to Euro 4 as the crucial factor. At the Euro 4 stage, this includes mainly the cost of adapting existing engine designs through changes to the engine management system. Based on a number of assumptions on the future development of vehicle registrations, the share of new vs. existing types of vehicles and the average (variable) cost of Euro 4 upgrades, we derive a tentative estimate of the net cost of the proposed measure in NPV terms. The net cost of the proposed measure is approximately €16 million.

REFERENCES

- AECC (2011). 'Particle emissions of powered two-wheelers'. Presentation at the *Cambridge Particles Meeting*, 13 May 2011.

- Commission (EC), 'Proposal for a European Parliament and Council Regulation on the approval and market surveillance of two- or three-wheel vehicles and quadricycles' COM(2010) 542 final, 4 October 2010.

- Commission (EC), 'Impact Assessment Guidelines' SEC(2009) 92, 15 January 2009.

- EMISIA (2012). *Impact of reference an IMCO intention PTW emission control packages.* Study on behalf of ACEM.

- 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.* Available at: http://bit.ly/zYBzpI [accessed 19 January 2012]. ('LAT Report')

ANNEX 1: VEHICLE CATEGORY DEFINITIONS

Category	Category name	Common classification criteria
L1e	Light two-wheel powered vehicle	(1) two wheels and powered by a propulsion as listed under Article 4(3) and (2) engine capacity ≤ 50 cm3 if a PI engine forms part of the vehicle's propulsion configuration.
Sub-categories	**Subcategory name**	**Supplemental sub-classification criteria:**
L1Ae	Powered cycle	(3) primary aim to aid pedalling and vehicle equipped with an auxiliary propulsion and (4) maximum design speed ≤ 25 km/h and (5) output of auxiliary propulsion is progressively reduced and finally cut off as vehicle reaches a speed of 25 km/h and (6) the auxiliary propulsion has a maximum continuous rated power(1) ≤ 1 kW and (7) powered three-wheel cycles complying with supplemental specific classification criteria (3), (4), (5) and (6) are classified as being technically equivalent to powered two-wheel cycles.
L1Be	Two-wheel moped	(3) maximum design speed ≤ 25 km/h and (4) maximum continuous rated power(1) ≤ 4 kW.

Category	Category name	Common classification criteria
L2e	Three-wheel moped	(1) three wheels and powered by a propulsion as listed under Article 4(3) and (2) engine capacity ≤ 50 cm3 if a PI engine forms part of the vehicle's propulsion configuration and (3) maximum design speed ≤ 45 km/h and (4) maximum continuous rated power(1) ≤ 4 kW.

Category	Category name	Common classification criteria
L3e(2)	Two-wheel motorcycle	(1) two wheels and powered by propulsion as listed under Article 4(3) and (2) engine capacity > 50 cm3 if a PI engine forms part of the vehicle's propulsion configuration and (3) maximum design speed > 45 km/h and (4) maximum continuous rated power(1) > 4 kW.
Sub-categories	**Subcategory name**	**Supplemental sub-classification criteria:**
L3e - A1	Low-performance motorcycle	(5) engine capacity ≤ 125 cm^3 and (6) maximum continuous rated power(1) ≤ 11 kW and (7) power(1) / weight ratio ≤ 0.1 kW/kg.
L3e - A2	Medium-performance motorcycle	(5) maximum continuous rated power(1) ≤ 35 kW and (6) power(1) / weight ratio ≤ 0.2 kW/kg and (7) not derived from a vehicle equipped with an engine of more than double its power(1).
L3e - A3	High-performance motorcycle	(5) any other vehicle of the L3e category that cannot be classified according to the performance criteria of subcategories A1 or A2.

Category	Category name	Common classification criteria
L4e	Two-wheel motorcycle with side-car	(1) base powered vehicle complying with the classification and sub classification criteria for L3e vehicles and (2) base powered vehicle equipped with a side-car.

Category	Category name	Common classification criteria
L5e	Powered tricycle	(1) three wheels and powered by a propulsion as listed under Article 4(3) and (2) if a PI combustion engine makes part of the vehicle's propulsion configuration: an engine capacity > 50 cm^3 and (3) maximum design speed > 45 km/h and (4) maximum continuous rated power(1) > 4 kW.
Sub-categories	**Subcategory name**	**Supplemental sub-classification criteria:**
L5Ae	Tricycle	(5) powered tricycles other than those complying with the specific classification criteria for commercial tricycles.
L5Be	Commercial Tricycle	(5) designed and used as commercial vehicles and characterised by an enclosed driving and passenger compartment accessible via two or more doors.
L5Be - U	Tricycles for utility purposes	(6) exclusively designed for the carriage of goods with an open or enclosed, virtually even and horizontal loading bed that meets one of the following criteria: (1) $length_{loading\ bed}$ x $width_{loading\ bed}$ > 0.3 x $Length_{vehicle}$ x $Width_{vehicle}$ or (2) an equivalent loading bed area as defined above used to install machines and/or equipment.
L5Be - P	Tricycle for passenger transport	(6) equipped with two, three or four passenger seating positions, including the seating position for the driver and all seating positions equipped with seat belts.

Category	Category name	Common classification criteria
L6e	Light quadricycle	(1) four wheels and powered by a propulsion as listed under Article 4(3) and (2) maximum design speed ≤ 45 km/h and (3) the mass in running order ≤ 350 kg, not including: (a) mass of batteries in case of a hybrid or fully electric propelled vehicle or (b) weight of gaseous-fuel system including tanks for gaseous fuel storage in the case of mono- , bi or multi-fuel vehicle or (c) weight of tank(s) to store compressed air in case of pre-compressed air propulsion.
Sub-categories	**Subcategory name**	**Supplemental sub-classification criteria:**
L6Ae	Light on-road quad	(4) category L6e vehicles not complying with the special categorisation criteria for sub category L6Be vehicles and (5) maximum continuous rated power(1) ≤ 4 kW and (6) engine capacity ≤ 50 cm3 if a PI engine forms part of the vehicle's propulsion configuration.
L6Be	Light mini-car	(4) enclosed driving and passenger compartment accessible via two or more doors and (5) maximum continuous rated power(1) ≤ 6 kW and (6) engine capacity ≤ 50 cm3 if a PI engine forms part of the vehicle's propulsion configuration and (7) $Length_{vehicle}$ x $Width_{vehicle}$ ≤ 4.4 m^2 with a maximum $Width_{vehicle}$ ≤ 1.5 m.
L6Be - U	Light mini-cars for utility purposes	(8) exclusively designed for the carriage of goods with an open or enclosed, virtually even and horizontal loading bed that meets one of the following criteria: (a) $length_{loading\ bed}$ x $width_{loading\ bed}$ > 0.3 x $Length_{vehicle}$ x $Width_{vehicle}$ or (b) an equivalent loading bed area as defined above used to install machines and/or equipment.
L6Be - P	Light mini-car for passenger transport	(8) vehicles mainly designed and used for passenger transport, characterised by being equipped with two passenger seating positions, including the seating position for the driver, and both seating positions equipped with seat belts.

Category	Category name	Common classification criteria
L7e	Heavy quadricycle	(1) four wheels and powered by a propulsion as listed under Article 4(3) and (2) maximum design speed > 45 km/h and (3) mass in running order: (a) ≤ 400 kg for transport of passengers; (b) ≤ 550 kg for transport of goods. The mass in running order does not include: (1) mass of the batteries in the case of a hybrid or fully electric-propelled vehicle or (2) weight of a gaseous-fuel system including tanks for gaseous fuel storage in the case of mono- , bi- or multi-fuel vehicles or (3) weight of tank(s) to store compressed air in the case of pre-compressed air propulsion; (4) maximum continuous rated power[(1)] ≤ 15 kW.
Sub-categories	**Subcategory name**	**Supplemental sub-classification criteria:**
L7Ae	Heavy on-road quad	(5) category L7e vehicles not complying with the specific criteria for subcategory L7Be vehicles and (6) equipped with one or two passenger seating positions, including the seating position for the rider.
L7Be	Heavy mini-car	(5) enclosed driving and passenger compartment accessible via two or more doors and (6) equipped with two, three or four passenger seating positions, including the seating position for the rider.
L7Be - U	Heavy mini-car for utility purposes	(7) exclusively designed for the carriage of goods with an open or enclosed, virtually even and horizontal loading bed that meets one of the following criteria: (a) $length_{loading\ bed}$ x $width_{loading\ bed}$ > 0.3 x $Length_{vehicle}$ x $Width_{vehicle}$ or (b) an equivalent loading bed area as defined above used to install machines and/or equipment.
L7Be - P	Heavy mini-car for passenger transport	(7) vehicles mainly designed and used for passenger transport, characterised by being equipped with less than or equal to four passenger seating positions, including the seating position for the driver and all seating positions being equipped with seat belts.

(1) The power limits in Annex I are based on maximum continuous rated power independent of the vehicle's propulsion configuration.

(2) sub-classification of an L3e vehicle according to whether it has a design vehicle speed of less than or equal to 130 km/h or more than 130 km/h is independent of its sub-classification into the propulsion performance classes A1 (although not likely to achieve 130 km/h), A2 or A3.

Source: COM(2010) 542 final, Annex I; available at: http://bit.ly/zPjyqA [accessed 11 January 2012]

ANNEX 2: IMCO COMPROMISE

Amendment 126

Proposal for a regulation
Annex IV

Text proposed by the Commission

Vehicle category	Euro level	Enforcement dates		
		New types of vehicles Optional	New types of vehicles Obligatory	Existing types of vehicles
L1e – L7e	Euro 3[(4)]	***1 July 2013***	1 January 2014	1 January 2015
	Euro 4[(5)]	***1 January 2015***	1 January 2017	1 January 2018
	Euro 5[(6)]	***1 January 2018[(7)]***	1 January 2020[(7)]	1 January 2021[(7)]

Amendment

L1Be	Euro 3[(4)]		1 January 2014	1 January 2015
	Euro 4[(5)]		1 January 2017	1 January 2018
	Euro 5[(6)]		1 January 2020[(7)]	1 January 2021[(7)]
L2e — L7e	***Euro 3[(4)]***			
	Euro 4[(5)]		***1 January 2016***	***1 January 2017***
	Euro 5[(6)]		***1 January 2020[(7)]***	***1 January 2021[(7)]***

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Approval and market surveillance of two- or three-wheeled vehicles and quadricycles