RESEARCH INTO REDUCING GREENHOUSE GAS EMISSIONS FROM HEAVY DUTY VEHICLES
THE ROLE OF THE EUROPEAN COMMISSION

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1. INTRODUCTION

Reducing the emissions of greenhouse gases (GHG) is a priority for the European Commission (EC), which requires wide ranging efforts within the road transport sector. Importantly, Heavy Duty Vehicles (HDVs) could have a prominent role to play. HDVs have not been the subject of any detailed analysis until now. One reason for this may be that the HDV market is perceived to be motivated by fuel efficiency to a much larger extent than that for private car users; given that for many applications the fuel cost is a large component of the total operating cost and HDVs are almost exclusively operated in a commercial context. Therefore, the conventional wisdom is that, generally, cost-effective options for saving fuel are likely to have been already identified and put in place by the market, and that policy intervention is not necessary. There are however signs that the market may not be fully effective in realising the optimum potential of fuel efficiency that can be reached in this sector, despite the fact that such increased efficiency would represent a true win-win situation as it would save money for operators while reducing GHG emissions and the dependence on fossil fuels.

Activities from around the world, (Freight Best Practice, WestStart/CalStart, Japanese Fuel Efficiency Standards), appear to hold the potential of improving the fuel efficiency of HDVs in their respective areas of operation. Therefore, it seems appropriate to investigate the potential of such activities also in the EU. This means researching and assessing the state of the art and the likely future possibilities to make HDV operations more fuel efficient in the EU, and identifying any appropriate measures that could be taken at, or influenced by, the EU level in order to reach this goal.

Therefore, in late 2006, Faber Maunsell, along with its partners NEA, CSST and Newcastle University were appointed by the European Commission to carry out research into measures and policies that could help reduce GHG emissions from HDVs. The outputs of the project will provide a platform on which to develop potential policy instruments to be implemented by the European Commission to help meet its obligations to minimise the negative impacts of climate change.

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2. OBJECTIVES OF THE PROJECT

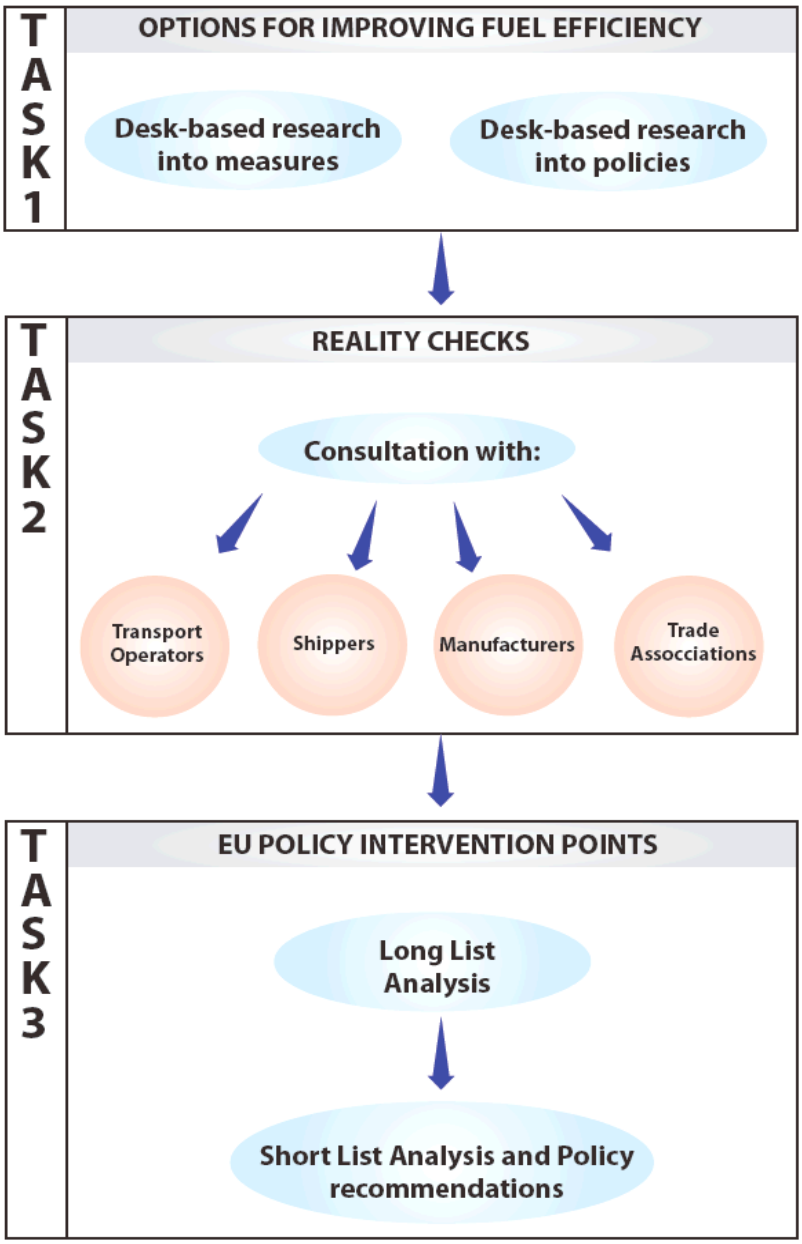
The objectives of the project were threefold:

- To identify unexploited potentials for reducing the fuel use in HDVs, looking both at short-term and longer-term options;
- To verify with stakeholders that these potentials really exist; and
- To identify possible interventions at the EU level to help realise these potentials.

3. PROJECT METHODOLOGY

To meet the objectives of the project a clear and defined methodology was essential from the outset. The diagram, overleaf, illustrates the methodology:

Figure 1: Project Methodology



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4. TASK 1: OPTIONS FOR IMPROVING FUEL EFFICIENCY

Task 1 entailed carrying out a survey of possible options to improve the fuel economy of HDVs. These surveys distinguish between concrete measures that operators or shippers can take, from the policies that policy makers can take to make these measures a reality. The desk based research survey included the following aspects for potential measures:

- Long-distance freight transport;
- Freight Distribution;
- Various Urban Applications such as refuse trucks and service vehicles;
- Long-distance passenger transport;
- Urban Buses; and
- Any other relevant application area.

The research also included the following types of measure:

- Performance Management and Fuel Management Systems;
- Information Technology Systems;
- Driver Training;
- Vehicle Specification & Aerodynamics;
- Operational Modifications;
- Vehicle Maintenance;
- Improvements in Propulsion Technology; and
- Alternative Fuels.

Additionally, the following time horizons were also considered:

- Short-term actions that can be implemented immediately or that are commercially available today;
- Medium-term actions that could become operational within 10 years; and
- Longer-term options

The desk based research survey included the following aspects for potential policy instruments:

- Location: instruments already in place in Member States and outside the EU:
- Type of organisation: instruments put in place by governmental and non-governmental bodies;
- Status: existing, planned or discussed in the literature;
- Type of instrument: regulatory, incentives and information campaigns.

This desk based research exercise was extremely valuable to the outputs of the project and created the foundation on which to formulate educated assumptions and conclusions. The measure and policy research enabled the project team to decipher options that have a real potential to reduce GHG emissions on a European scale. On consolidating the information gained from Task 1, the project team then utilised these findings to inform Task 2.

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5. TASK 2: REALITY CHECKS

Once the information gained from Task 1 was analysed it was tested with a representative sample of industry stakeholders to ensure its accuracy and to collect further relevant information. This was an extremely important part of the project, as we actively sought to find out what industry is currently doing to improve efficiency and reduce GHG emissions. In total the team consulted 16 transport operators, 5 vehicle manufacturers, 4 shippers and 6 trade associations. A semi structured questionnaire was used as the basis of the discussions, allowing both the consistency of results and the ability to react flexibly to stakeholders evidence and information. The information gained from the industry partners covered the following aspects:

- Current status: Is the industry partner already applying any measures as contained in the list established in Task 1? Is the industry partner applying any measure not contained in the list? What is the experience with the measure currently applied? What has been the cost and the result in terms of fuel saving? Have any measures been tried and abandoned, and if so, why?
- Planned or considered measures: Is the industry partner considering applying any measures in the near future? When? Is this already decided? If not, what does the decision depend on?
- Awareness: are there any measures in the list that the industry partner has not been aware of?
- Non-financial aspects: are there any issues with any of the measures apart from costs and savings that are relevant for the practical use value (e.g. implications for maintenance etc).
- Obstacles: are there any measures that the industry partner would consider attractive but that cannot be taken for some reason? What are those obstacles? How could they be overcome?
- Myths: are there any measures in the list that are good in theory but that the industry partner finds impractical? Why? Could they be adapted to become practical? If so, how?
- Policy instruments: is the industry partner aware of any policy instruments such as incentive programmes, best practice programmes, regulations or other instruments aimed at spreading the take-up of fuel saving measures? What is the experience with these? What policy instruments would be workable?
- Any other relevant aspects.

Based on the results of this field work, the list of options was then revised and validated. The new list was then reviewed and agreed by the Commissions peer group.

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6. TASK 3: EU POLICY INTERVENTION POINTS

An analysis of possible policy instruments was then carried out, taking into account the outputs of Tasks 1 and 2 to determine realistic and validated recommendations. The precise format of carrying out the analysis quantified, as far as possible, the fuel savings and reductions in GHG emissions that could be achieved by implementing the recommended policy instruments. However, the wide scope of the project and range of areas considered has often made it difficult to generalise numeric estimates. Additionally, the overall cost and usefulness of different measures has also been considered along with a range of other issues.

Task 3 was divided into two separate stages:

- The creation of a comprehensive policy options list (long list); and
- The creation of a short list of recommended policy instruments.

Firstly, a "long list" of policy recommendations was created, taking into account the previous identified measures from Task 1. The main emphasis of this paper is to focus on the "long list" of options, as these have been validated and ratified by the European Commission.

7. "LONG-LIST" CRITERIA

Following the completion of Task 2, it was agreed that the scope of the long list assessment would need to be practical within the scope of the work, but at the same time provide sufficiently detailed information to allow for the selection of a sub set of options that could be subject to a more detailed analysis (such as considering in more detail how they could be implemented by the EC). The project team built upon these initial criterions and established the following framework (Figure 2):

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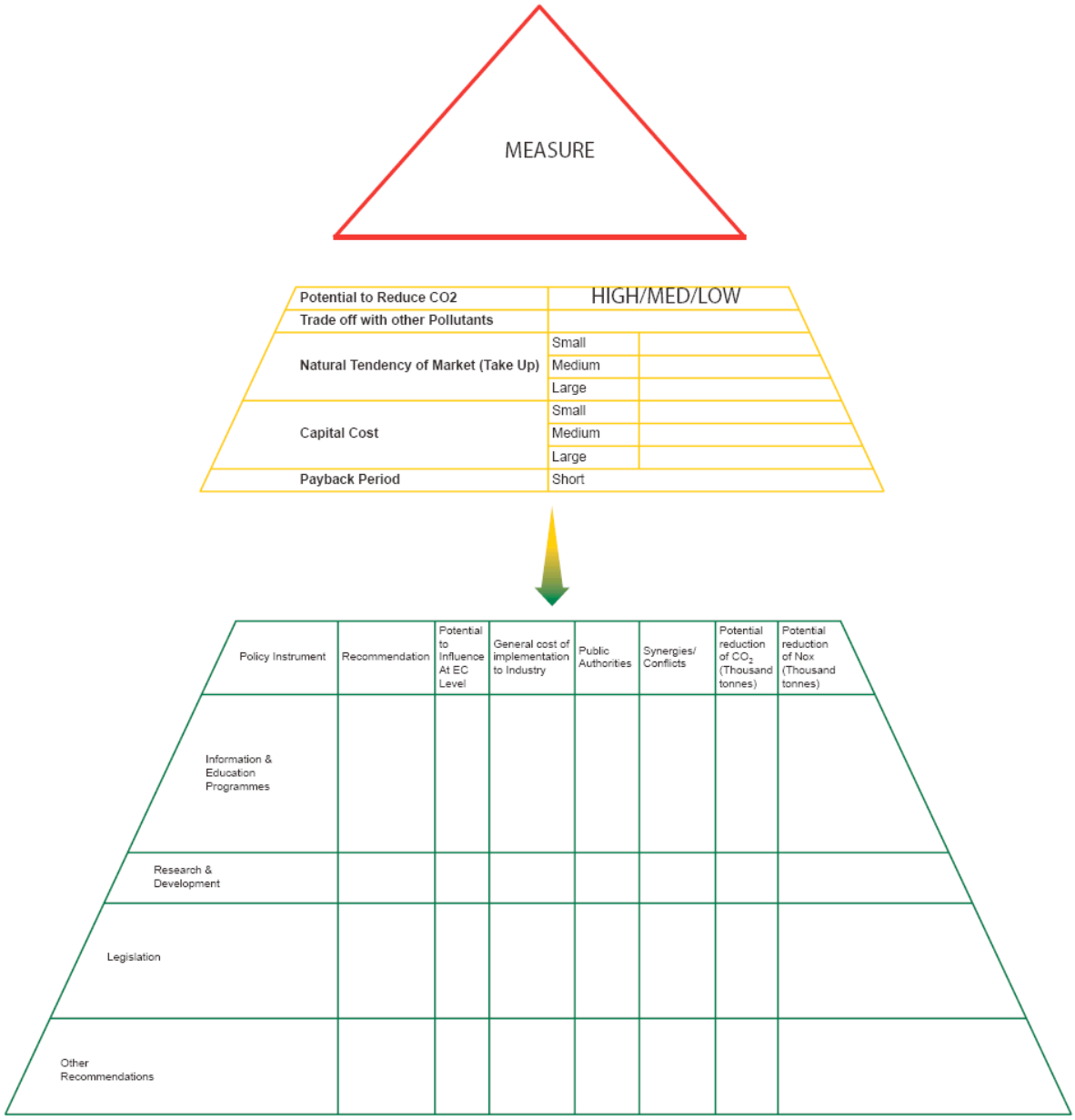

Figure 2 Framework Test

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The criteria, boundaries and ranges are explained as follows:

7.1 Potential to Reduce GHG Emissions

This criterion illustrates the potential of the chosen measure to reduce GHG. As each measure consists of several concepts and products, a broad range has been adopted. The wide scope of the project and the complexity of the subject area meant that it has not been possible to provide specific quantitative estimates of the effects of different measures, and hence a range of potential savings have been adopted here. These are “LOW 0-2%”, “MED 2-5%” and “HIGH 5%+”. These estimates are based upon results from desk based research undertaken as part of Task 1, industry interviews undertaken within Task 2, team member’s expert knowledge and research currently being undertaken by the UK Freight Best Practice Programme[1]. For practical reasons the figures in this report have been assessed ‘per unit’ (i.e. vehicle, driver, etc) rather than savings across the industry as a whole.

7.2 *Trade Off with Pollutants*

An important point for consideration is that of trade offs with other air quality pollutants. This section considers whether the reduction in GHG increases or decreases harmful gases such as NOx. If the measure simply reduces fuel usage then these pollutants will also be reduced by the same percentage of CO_2.

7.3 Tendency of the Market (Take Up)

It was also appropriate to consider the likely tendency of the market to uptake measures without intervention from the EC. As it would not be possible to accurately state this without detailed European wide market research on each measure, we have relied on a broad assessment of likely take up among different sized transport operators. Three transport operator categories were used - Small (<10 vehicles), Medium (10-50 vehicles) and Large operators (>50 vehicles). The assessment of overall take up is based on feedback from the reality checks and the project teams’ specialist knowledge, and is relatively subjective, yet sufficient for the purposes of selecting a short list. This section evaluates perceived take up of industry as of now and therefore does not take account of any future possible developments (e.g. some measures that may currently be in early stages of development could in fact have high levels of take up in the future without intervention in the meantime).

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7.4 Capital Cost

Using the same definitions for company size, we undertook a broad assessment of the cost of each of the measures. Therefore, we have estimated the following annual costs per vehicle (or, where appropriate, costs per driver, or overall business cost) (Euros); LOW (0-300), MED (300-600) and HIGH (600+). The actual cost to a company is difficult to determine due to the fact that a number of applications may exist within a single measure area, and also the fact that costs are likely to vary considerably by operational and sector type.

7.5 Payback Period

Another important criterion to consider, from a commercial perspective, is the predicted payback period of the measure. The following categories have been used; SHORT (0-2 years), MED (2-5 years) and LONG (5+ years). Payback estimates for HDV operators only relate to the cost of implementation, and other continuous costs have not been evaluated within the framework (i.e. re-training of drivers on an annual basis).

7.6 Type and recommended policy instrument

This assessment considers the policy instruments reviewed during Task 1, and how they might be used to achieve take up of different fuel saving measures. Options available within 4 different categories have been considered - Information and Education programmes, Research and Development, Legislation and Other Recommendations (e.g. subsidies, etc). By understanding the possibilities within each policy category, the EC can make an informed decision on which measures to take forward and examine them in more detail in order to produce a final short list of policy actions. It is worth noting that within this section we have only considered actions that we feel are realistic for the EC to implement.

7.7 Potential to Influence at EU Level

This criterion seeks to determine the relevance different actions have to the overall remit of the EC. These are categorised in terms of LOW, MED and HIGH. Measures which have been categorised as “HIGH” are those that appear to be closely aligned with the EC’s responsibilities.

7.8 General Cost of implementation to Industry

This criterion seeks to identify the general cost that the type of policy instrument would create for the transport industry. For the purposes of developing the long list, these have been expressed in general terms rather than in monetary values (see capital cost for likely impacts that the overall measure may have on industry). In this regard, both real immediate benefits and industrial changes are considered. For example, if a driver training

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information and education programme were launched, then the cost of implementation would be LOW because there would be no obligation on operators to make changes to the way their business operates and they could choose to train as many drivers as they wish. A labelling strategy on the other hand may be considered to have a MED cost as it would not directly impact on the majority of the industry (operators) but would have an impact on vehicle manufacturers. The majority of regulatory options considered as part of this task generally have a MED-HIGH cost on industry, but benefits would be likely to be generated from the initial investment over a longer period of time. The implementation of policies involving research and development or education is likely to have no immediate cost implications for industry, though this would obviously have a cost for the EC, but would see benefits in the short term.

7.9 Cost to Public Authorities

This criterion describes the cost of the action to public authorities, (which may be the EC member states or a combination of the two). Legislative actions are generally considered HIGH-MED cost, voluntary or "soft" measures are likely to have less of a monetary burden on the Community (but may also be less effective in achieving change). These are indicative only and the client will effectively validate our assumptions for this indicator.

7.10 Synergies/Conflicts

This section highlights possible conflicts and synergies of policy instruments, (either already implemented or suggested in this project). Additionally, consideration is given to the possible conflicts that arise with EC principles, such as anti-competitiveness and impacts on specific industry sectors.

8. OVERALL POTENTIAL TO REDUCE GHG EMISSIONS

Ultimately, this criterion is one of the most important and summarises the overall potential benefit of the policy action to reduce both CO_2 and NOx. Where appropriate the benefits have been quantified using the methodology below. These potential percentage savings have been derived by the original research carried out within Task 1 in conjunction with additional supporting findings.

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Table 1 Potential Savings of each Measure

% Saving for Implementing	IT Systems*	Driver Training*	Vehicle Specification & Aerodynamics*	Vehicle Maintenance*	Performance/Fuel Management*	Operational Modification*
Long Distance HGV	7.5%	6%	13%	5%	5%	2%
Urban HGV	7.5%	6%	3%	5%	5%	2%
Long Distance Bus	0%	6%	7%	5%	5%	0%
Urban Bus	0%	6%	1%	5%	5%	0%

* IT systems – Savings have been used from the initial research from Task 1 and "The Decoupling of Road Freight Transport and Economic Growth Trends in the UK: An Explanatory Analysis, October 2006. This publication states an average estimated saving of a 5-10% reduction in distance travelled could be achieved by using CVRS applications. Therefore, a 7.5% saving has been assumed. It was assumed that no savings would result in bus companies using IT systems as the routes are generally fixed.

* Driver Training – Initial research from Task 1 and recommendations from 196 Freight Best Practice site specific advice visits.

*Aerodynamics – Initial research from Task 1 and the Freight Best Practice Ready Reckoner was also used, which assumes that the savings above would be achieved if all the relevant aerodynamics were adopted. It also assumes that there is a 70:20:10 split between motorway, rural and urban applications in long distance operations (40 tonne artics) and a respective 10:20:70 split for urban applications (7.5 tonne rigids).

* Vehicle Maintenance – Average savings calculated from initial research carried out in Task 1.

* Performance/Fuel Management – Savings based on initial research from Task 1 and the UK Freight Best Practice Programme's Fuel Management Guide.

*Operational Modification – Savings based on initial research from Task 1 as well as the "Reducing the External Costs of the Domestic Transportation of Food by the Food Industry - Scoping Study"[2].

Having established potential saving percentages for an indicative quantitative assessment, the report can determine the baseline methodologies for each type of policy recommendation.

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8.1 Best Practice Programme

To provide an estimate of the benefits that a Best Practice Programme can create for each measure we must firstly determine the areas in which the programme influenced most and the percentage of vehicle KM influenced by such a programme. To create an estimate of the areas influenced within the programme we assumed the following proportional split between application areas:

Table 2 Proportional Representation of the Popularity of Freight Best Practice Guides

Proportional Representation of the Popularity of Freight Best Practice Guides	
Maintenance	2%
Driver Training	37%
Aerodynamics	8%
IT Systems	5%
Performance/Fuel Management	40%
Operational Modification	8%

Secondly, an independent impact assessment of the UK's Freight Best Programme stated that 29% of English vehicle km were influenced by the programme, which we have assumed can be split between the following headings as appropriate to the workings above:

Table 3 Percentage of Vehicle Kilometres influenced

	IT Systems	Driver Training	Vehicle Specification & Aerodynamics	Vehicle Maintenance	Performance/ Fuel Management	Operational Modification
% of Vehicle KM influenced	1.4%	10.6%	2.2%	0.6%	11.7%	2.4%

The total benefit was then calculated by multiplying this by the estimated percentage savings for each of the vehicle groups in Table 1 above. This was then weighted using the Impact Assessment estimate that 0.5% of total English HGV CO2 was saved to provide the following:

Table 4 Percentage Saving on Total European Vehicle Parc

% Saving on Total European Vehicle Parc	IT Systems	Driver Training	Vehicle Specification & Aerodynamics	Vehicle Maintenance	Performance/Fuel Management	Operational Modification
NOx	0.02%	0.20%	0.07%	0.01%	0.18%	0.01%

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CO2	0.03%	0.20%	0.08%	0.01%	0.18%	0.01%

It was estimated that total EU CO_2 for HDV is approximately 206,661 thousand tonnes and total EU NOx is approximately 1,203 thousand tonnes. This estimate was calculated using total EU vehicle km (Eurostat), the age bands of vehicles (Eurostat) and an estimate of g/km for the different engine bands (UK National Atmospheric Emissions Inventory).

8.2 Legislation

When estimating the potential saving that an Act of Legislation will generate, we assume the uptake of specific measures will increase to 100%, as everyone will be required to comply with the law. It is therefore essential to determine the adoption of measures prior to legislation, in order to identify the net benefit any new legislation will create. It is important to state that due to the lack of information on this subject a professional judgement has to be adopted.

Table 5 Current Take Up Estimates

Measure	Current Proportions	
	Long Distance	**Urban**
Aerodynamics		
Cab Roof Deflector	81%	64%
Air Dam	88%	69%
Cab Side Edge Turning vanes	71%	60%
Tractor Side Panels	26%	16%
Trailer Front Fairing	8%	2%
Trailer Side Skirts	13%	10%
Driver Training	35%	28%
IT Systems	50%	30%
Performance/Fuel Management	35%	28%
Preventative Maintenance	50%	50%

The total benefit is then calculated using the assumptions and savings for each vehicle groups, detailed earlier. This provides us with the following percentage savings on the European vehicle parc:

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Table 6 Percentage Saving on Total European Vehicle Parc

% Saving on Total European Vehicle Parc	IT Systems	Driver Training	Vehicle Specification & Aerodynamics	Vehicle Maintenance	Performance/Fuel Management
NOx	3.2%	4.0%	4.9%	2.5%	3.3%
CO_2	2.9%	4.0%	4.5%	2.5%	3.3%

8.3 Other Recommendations

In addition to legislation and a best practice programme, there are several other policy instrument options available. The EC could implement tax incentives for operators to adopt more IT systems. However, this is seen as outside of the remit of the EC and could conflict with other national laws and policies. However, we have assumed that an extra 10% of companies would take up IT systems if a tax incentive was provided. This assumption is based on a Freight Transport Association study which showed that approximately 30% of companies say that cost is the biggest factor in not purchasing IT systems.

The EC could also provide subsidies for providing training for a limited number of companies across Europe. We have assumed that the approximate savings from a state funded programme would be potentially 3.8%. The UK SAFED programme trained 5,244 drivers, representing approximately 3% of the UK annual HGV km. It is important to state that savings would depend on how many drivers would be funded to carry out such a programme as we have assumed the same proportion would be trained as the UK.

9 INDIVIDUAL MEASURES ANALYSIS

As the last sections outlined the criteria used to test the measures and potential actions that the EC could implement, this section now explores the potential savings of reducing CO_2 and NOx in HDVs.

It should be stressed at the outset that all potential actions could play a positive role in reducing GHG emissions. It is also important to understand that within a measure there are a series of 'micro' measures that can be adopted (e.g. within telematics there are various different IT systems that achieve different goals). This stage of the project involved the consideration of policy actions that could be taken by the EC, and it would be appropriate to relate these to such individual measures.

Ultimately, successful policies should be seen as encouraging the take up of a number of related measures within the policy's remit. Hence each measure considered in the following section can be thought of as a 'bundle' of related fuel saving actions. There are likely to be policy actions that can stimulate the take up of a range of measures at once (e.g. information and education

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campaigns which could cover a wide range of areas). It is also important to note that some high level actions could be taken which would not relate to any specific group of measures (e.g. carbon trading). Additionally, it should also be noted that each measure, though analysed separately for the purposes of this project, can be integrated with other measures. For example, a performance management system can be integrated with IT systems and driver training. The following table illustrates a summary of the potential savings:

Table 7: Summary of Potential Savings

Type of Action	Measure Area	Possible Policy Action	Overall potential to reduce CO2 (thousand tonnes)	Overall potential to reduce NOx (thousand tonnes)
Information & Education Programme	Performance/Fuel Management; Improvements in Propulsion Tech; Driver Training; Vehicle Maintenance; Vehicle Spec and Aerodynamics; IT Systems, Operational Modification	EU Freight Industry Best Practice Programme which could be integrated with STEER. The magnitude of information and diversity of the programme can be altered once set up.	**891**	**5.2**
Research & Development	Performance/Fuel Management	Research to establish external benchmarks for different transport operators across Europe	**N/A**	**N/A**
	IT Systems	Research into Different Systems and trial tests (including mapping & routing research (Galileo))	**N/A**	**N/A**
	Improvements in Propulsion Technology	Continued research into the efficiency and potential of development of HDV engines (eg hybrids)	**N/A**	**N/A**
	Vehicle Maintenance	Research Projects that test the Co2 savings from different Preventative	**N/A**	**N/A**

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Type of Action	Measure Area	Possible Policy Action	Overall potential to reduce CO2 (thousand tonnes)	Overall potential to reduce NOx (thousand tonnes)
		Maintenance Techniques		
	Vehicle Specification & Aerodynamics	Further research into Aerodynamics, testing different applications with different operations.	**N/A**	**N/A**
	Vehicle Specification & Aerodynamics	Research into light weight materials.	**N/A**	**N/A**
Legislation	Performance/Fuel Management	Legislate to make a certain degree of performance/fuel management mandatory for transport operators across Europe	**6,862**	**40**
	IT Systems	Legislation to make certain forms of technology mandatory (i.e. telematics, route planners. Etc)	**10,123**	**55**
	Driver Training	Amend Training Directive to increase the baseline standards of training (i.e. in order to obtain a licence)	**8,235**	**48**
	Operational Modification	Continued research into supply chain efficiency research.	**N/A**	**N/A**
	Operational Modification	Funding of regional/urban demonstrations and pilots (e.g. Consolidation centres)	**N/A**	**N/A**
	Improvements in Propulsion Technology	Fuel Efficiency Standard (to be considered as element with Emissions standards)	**Med/High**	**Med/High**

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Type of Action	Measure Area	Possible Policy Action	Overall potential to reduce CO2 (thousand tonnes)	Overall potential to reduce NOx (thousand tonnes)
	Improvements in Propulsion Technology	Labelling legislation requiring manufacturers to label HDV engines according to fuel efficiency standards	**Med/High**	**Med/High**
	Vehicle Maintenance	Change Maintenance requirements to raise the standard of compulsory preventative maintenance	**5,167**	**30**
Other Recommendations	IT Systems	Tax Incentives for Operators to adopt IT systems	**201**	**1.1**
	Driver Training	Subsidies for proving training for a limited number of companies.	**468**	**2.7**

10 Indirect Policies that could have an Impact on the Reduction of Greenhouse Gas Emissions in HDV

In addition to the identified measures above and the possible actions that could be undertaken by the EC within each of the measure categories, it is important to note that there are a number of other less direct policy actions that could achieve the aim of reducing GHG emissions in HDVs. It has been determined that the majority of these are long term and generally beyond the direct scope of this project, however it is important that the role they could play is properly acknowledged.

Firstly, there are a variety of taxation based policies that could be used in a variety of scenarios to make certain fuel saving measures more attractive and therefore stimulate a growth in uptake. However, these have not been considered in this work on the basis that these would be likely to prove to be difficult to implement without the agreement of all member states. It is also our understanding that minimum levels of diesel excise between members states is currently under review by the EC, with the aim of raising them to a level comparable to that of petrol. Such taxation measures would need to be considered in vast detail to determine their applicability to effectively reduce GHG in HDVs.

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Alternatively, the Carbon Trading scheme that has been launched could be adapted to include GHG emissions from transport. In principle this policy could be a very effective method of encouraging take up of fuel savings in commercial transport operations. However, as the scheme is very much in its infancy, such an option would require consideration that is beyond the scope of this project, and hence has not been analysed in detail here.

Our research has also highlighted that reductions in speed limits for HDVs could also reduce greenhouse gas emissions, and have recently been proposed by the Federation Nationale Des Transport Routiers (FNTR) in France. Although speed limits are determined by Member States, Directive 2002/85/EC sets restrictions for speed limiters which must be fitted to all passenger vehicles with more than 8 seats, and goods vehicles exceeding 3.5 tonnes. These limits are 100 km and 90 km respectively. It would be possible to reduce this limit and hence GHG emissions on the basis that vehicles often operate more efficiently at lower speeds. As this proposal does not readily fit into the measure areas in the subsequent sections of this report, it is treated here as an indirect policy. This would require legislative change, and could be opposed by significant sections of the freight industry. The potential benefits of this policy have not been considered in detail in this project, but they are viewed as potentially lower than other policy actions that have been considered.

11 TASK 3: NEXT STEPS

There are a series of evaluated long list options that have demonstrable benefits in reducing GHG emissions in HDVs but that would be difficult for the EC to influence independently, either through legislation or through education. However an education and behavioural change programme, embracing a number of these individual components, was considered as being worthy of evaluation on the shortlist and for further consideration by the Commission.

The only comparable policy instrument that has been applied and assessed in a quantitative manner is the English Freight Best Practice (FBP) programme, which is funded by the Department for Transport. This programme researches and then communicates operational efficiency measures to the operators of HGVs in England and now Wales. Although FBP is aimed solely at HGV operators many of the principles and measures could be applied to buses.

Another significant area where GHG emissions might be reduced in HDVs is through a European wide engine efficiency labelling scheme. As this is a measure that has not been implemented previously in a manner that allows an accurate prediction of benefit, it is not possible to carry out a quantitative assessment.

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The possible implementation of a labelling scheme will be a progressive process which could entail the following three steps:

- **Step 1**: Labelling of the CO_2 emissions from HDV engines as recorded by a standardised test procedure
- **Step 2:** Labelling of entire vehicles predicting the overall efficiency of a whole vehicle combination in operation
- **Step 3**: Labelling of vehicle components (such as superstructures, trailers and semi trailers)

There may also be the possibility of converting the labelling scheme to an efficiency standard if the evidence of success of the labelling scheme supports such a move.

12 CONCLUSION

This paper has outlined an initial list of policy instruments that the EC could implement to reduce GHG emissions from HDVs. It is worth noting that all actions/instruments considered as part of this work could play a positive role in improving environmental sustainability within commercial road transport operations. We have provided a generalised view of the potential benefit that each action may have, based on its overall potential to reduce GHG emissions.

Each type of action is likely to have significant trade offs in terms of overall reductions in GHG emissions, costs to society and industry. For instance, a combined information and education programme would be relatively inexpensive and may be a logical first step to encourage change, but its voluntary nature means it may not be as effective as other options in the longer term. Legislation is likely to be expensive to implement, may have a high cost to industry but could result in very significant long term reductions in emissions. Research and development is undertaken by industry irrespective of Government intervention, however the EC could play a minor but very positive role in a range of areas such as helping improve propulsion and IT systems and vehicle light weighting and aerodynamics.

The draft final report has recently been submitted to the European Commission and therefore this paper cannot conclude on the outcomes of the project. However, what ever the outcome it will be a positive move in the direction of reducing GHG emissions in HDV on a European scale.

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NOTES

[1] Fuel Efficiency Research – Ready Reckoner Project, Chrysanthos Pelekanos, Freight Best Practice, 2006, Forthcoming

[2] DEFRA, Reducing the External Costs of the Domestic Transportation of Food by the Food Industry - Scoping Study, http://statistics.defra.gov.uk/esg/reports/costfoodtransport/DEFRA_One%20page%20summery_SR_09%20MAY.pdf

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