3DAYCAR PROGRAMME

Environmental Regulation
and the OTD process

by

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## CONTENTS

**EXECUTIVE SUMMARY ................................................................................................................... 5**

### 1.0 INTRODUCTION ................................................................................................................ ....... 7

1.1 ENVIRONMENTAL LEGISLATION AS AN INHIBITOR TO INNOVATION .............................. 7
1.2 ENVIRONMENTAL LEGISLATION AND THE 3DAYCar ......................................................... 9
1.3 ENVIRONMENTAL LEGISLATION. THE PERSPECTIVE OF OTHER COUNTRIES ..................... 11

### 2.0 THE RESEARCH QUESTION ............................................................................................... 12

2.1 THE RESEARCH STRUCTURE ............................................................................................. 12
2.2 LITERATURE REVIEW AND INTERVIEW SURVEY ............................................................... 12

### 3.0 ENVIRONMENTAL LEGISLATION AFFECTING THE AUTOMOTIVE SECTOR ... 13

3.1 EMISSIONS TO AIR AND WATER ......................................................................................... 13
3.2 WASTE AND RECYCLING .................................................................................................... 13
3.3 GREENHOUSE EMISSIONS – GLOBAL WARMING ................................................................. 14
3.4 TRANSPORT ....................................................................................................................... 14
3.5 PLANNING.......................................................................................................................... 14

### 4.0 THE IMPACTS OF THE LEGISLATION ON PRODUCING AND DISTRIBUTING CARS IN THE UK .................................................................................................................... 16

4.1 INTRODUCTION TO THE 3 MAIN STAGES ........................................................................... 16
4.2 IMPACTS ON SUPPLIERS AND OTHER UPSTREAM ACTIVITY ........................................... 17
   4.2.1 Costs ..................................................................................................................... 17
   4.2.2 Transportation ............................................................................................................ 17
   4.2.3 Manufacturing ............................................................................................................. 18
   4.2.4 Conclusions............................................................................................................... 20
4.3 MANUFACTURING AND ASSEMBLING THE NEW CAR ........................................................ 21
   4.3.1 Costs ..................................................................................................................... 21
   4.3.2 Inbound logistics ......................................................................................................... 23
   4.3.3 Production ................................................................................................................ 23
   4.3.4 Paintshop ................................................................................................................. 24
   4.3.5 Outbound logistics ....................................................................................................... 25
4.4 THE IMPACTS ON DISTRIBUTION ACTIVITY ....................................................................... 27
   4.4.1 Costs ..................................................................................................................... 27
   4.4.2 Transportation ............................................................................................................ 28
   4.4.3 Storage and handling ................................................................................................. 29
   4.4.4 Conclusions............................................................................................................... 30
4.5 THE LABOUR RELATIONS FACTOR .................................................................................... 31

### 5.0 CONCLUSIONS......................................................................................................................... 32

5.1 THE KEY IMPACTS OF ENVIRONMENTAL LEGISLATION ON A 3DAYCar .......................... 32
5.2 3DAYCar DRAFT ENVIRONMENTAL POLICY FRAMEWORK ............................................. 32

**REFERENCES..................................................................................................................................... 34**
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The contents of this report are intended for Sponsors of the 3DayCar programme only. If specific information relating to facts and figures are required the reader is advised to contact the author.
Executive Summary

Environmental legislation and related policy measures can have a number of impacts on firms. These range from limiting operating hours to increasing overhead costs. Costs related to environmental legislation in the automotive sector constitute a significant percentage of turnover and can be divided into those relating to meeting product standards, such as fuel economy and emissions, and those relating to business operations and processes. R&D costs in the automotive sector for product development are very large, partly due to regulation of product standards. Costs related to regulated business processes are not as significant, amounting to 1% of turnover. However, they are driving changes in business practices to the extent that companies are implementing systems to reduce the cost of both managing compliance and environmental effects.

This study takes a life cycle approach, looking at the major stages in a product’s life including supply of components, vehicle assembly and distribution. Each of these stages has been reviewed with regard to environmental legislation which is likely to significantly affect the achievement of a 3DayCar, namely transportation; waste & recycling; energy; emissions and planning.

The study has been based on 24 semi-structured interviews with industry representatives from 3DayCar sponsors, industry experts and persons associated with environmental legislation. Data has been gathered relating to legislative requirements, costs of compliance and impacts on production in terms of flexibility and lead-time.

The main findings are:-

- If the environmental tax burden rises too high, there is potential for vehicle manufacturers to source parts outside the UK. New regulations such as the Climate Change Levy and IPPC could lead to the price-competitiveness of the UK motor industry being affected. This tax burden is especially heavy for suppliers. A number of VMs have already stated their intention to source outside the UK if such costs rise too high. This potential to source overseas is obviously not desirable from an employment and overall economic viewpoint in the UK but also would increase lead-time and inventory for such components to the detriment of a 3DayCar.

- Those companies who have received accreditation for implementing environmental management systems such as ISO14001 should receive compensation in the form of lower environmental compliance costs and lower tax burdens.

- The 3DayCar requirement for small paint batches will make it more difficult to meet emission and waste legislation and will increase cost. This will force an early move from solvent to wholly water or powder-based paint, which has not been totally proven, or to alternative technologies such as paint-injected moulded panels.

- Planning and transport legislation will make car distribution more expensive and increase the difficulty of achieving a one day distribution lead time within the 3DayCar. Transport planners are looking at local implementation. This will inevitably impact on cost and lead to restrictions such as lower speed limits and limited access to some central urban areas, especially during high traffic periods and to residential areas at night.

Planning regulation is increasingly concentrating on the traffic implications of new developments and their potential contribution to local employment. Both inbound and outbound logistics could be affected, particularly developments such as distribution centres, where a large amount of space is used with little employment potential. However, 3DayCar would not require any significant levels of stock and such sites would become transhipment centres, likely to be viewed more favourably. The development of supplier hubs is also likely to be affected, but planning authorities are always more amenable where the potential security of large numbers of local jobs is involved.
• There are opportunities to reduce the impact of legislation such as the ‘End-of Life Vehicle’ Directive, through the adoption of an integrated supply chain approach which accommodates new and end of life product, both in terms of terms of components and vehicles.

The main impacts of legislation for the environment are related to higher operating costs incurred in complying with increasingly stringent emissions levels and resource conservation. There are some areas where a 3DayCar will make compliance more expensive and more difficult to meet with current methods. Overall, however, there is little to suggest that these environmental problems are insurmountable. If a 3DayCar strategy adopts an integrated and green approach, the impacts are likely to be small.
1.0 Introduction

1.1 Environmental legislation as an inhibitor to innovation

Decisions within firms/manufacturers are variously affected by external actors, including consumers, stakeholders, regulators, governments and, to some extent, the wider society. Regulation is commonly put in place to prevent firms from implementing strategies that benefit direct stakeholders at the expense of the wider society, e.g. local residents. Environmental regulation is enforced to prevent firms from compromising specific shared resources including land, air, water which affect the quality of life - in other words the wider societal needs. It is important to understand to what extent this kind of regulation pushes company decisions in different directions to natural commercial forces.

For example, planning regulation can prevent firms from operating at night, so preventing extra shift work from achieving productivity gains. On the other hand, the requirements of regulation in terms of emission levels can result in cost savings due to fuel efficiency improvements. The relationship is not always clear and trade-offs are often required between a firm’s commercial objectives and regulatory requirements. Legislation in terms of implementing policy direction can also take different forms. These include direct regulation of processes through licensing of their operations, but also fiscal measures such as taxation of resource use and disposal. As a result, potential impacts are not always clearly defined.

How does regulation impact on firms?

Environmental legislation only makes up part of the regulatory pressure, but in the automotive sector it is a significant factor.

![Diagram of factors determining the effects of environmental legislation on the automotive industry](image-url)

Figure 1: Factors which determine the effects of environmental legislation on the automotive industry (adapted from CBI, 1994).

Figure 1 shows that the effects of environmental legislation on a company are determined by a number of different factors. The particular profile of factors for a given company will determine what kind of impact results from the implementation of legislation.
Environment’s impact on costs

The cost of legal compliance reduces resources available for increasing productivity, but there is no agreement as to the severity of its incidence. In the USA, it is thought that environmental regulations contributed to a 30% decrease in industrial productivity in the 70s and 80s (Ray, 1993). Despite this, according to a large survey of the manufacturing sector in the USA by Miller and McKinney (1998), compliance with environmental regulation has led only to a moderate increase in production costs, with no adverse effect on product quality. One point to note here is that there were a number of instances where the production lead time was actually increased although details have not been given. An EU-commissioned study found that environmental costs are not a decisive factor for European industries at 1-2% of overall production costs (EC, 1996). This is supported by a DETR-commissioned study in 1997 (by Ecotec 1998) where environmental expenditure costs across all industry sectors were estimated around 2.4% of turnover. This highlights the current lower impact of legislation in the EU, compared with the US. (80% of UK legislation derives from the EU).

Arnold (1995) propagates the view that if a firm’s compliance cost exceeds 5% of its revenue then this constitutes a significant impact. On the other hand, some research points to the potential competitive advantage to be gained, particularly in the long term and particularly for larger organisations. Notwithstanding 5% additional production costs equivalent to 1% of turnover, compliance has led to accelerated product development and time to market, giving advantages to first movers in some sectors (Wubben 1999). However, where profits are at best marginal in a sector like the production of motor vehicles in the UK, a 1% of turnover extra cost is undoubtedly significant.

How do firms deal with regulatory pressure?

Despite the problems encountered when complying with legislation, they are increasingly being overcome. In fact, complying to environmental legislation is being seen as an area of profit potential by many companies including a consortium between Volvo, ICI, Unilever, Monsanto, Deutsche Bank and Electrolux (FT 28/4/99). The number of companies achieving certification for their environmental management systems (EMS) is increasing at a steady rate that is predicted to peak at 300% within the next few years. This is due, in part, to increasing pressure from manufacturers to require their suppliers to obtain certification. Vauxhall, Honda, Rover, Ford and recently Nissan are particularly involved in this (Ends Report 279 Apr 98). Qualification for certification is continually re-assessed in line with new legislation. The movement in uptake of EMS by vehicle manufacturers, green suppliers and other associated business demonstrates the increasing importance of these factors. Environmental compliance can now be seen as a selling factor alongside guarantees of quality and the right price, although obviously not yet as important.

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1 Figures relating to chemicals sector, but paint and coating suppliers specifically (compliance to VOC Regs etc)
2 Environmental Management Systems in this case are independently verified by a competent body to ensure compliance to environmental regulations and improvement takes place.
1.2 Environmental Legislation and the 3DayCar

“We face over a million articles of environmental law” – Professor Werner Pollman at Daimler Benz (SustainAbility, 1998).

Why does this research programme consider environmental legislation?

Government funded research is subject to a number of guidelines. Research funded by the DTI and related departments is subject to requirements that it should be set in the context of compliance with regulation, and optimisation of life-cycles where appropriate. Thus a basis has been set for exploring the market concept of a 3DayCar in terms of environmental responsibility and specific compliance with regulation and policy trends. Section 5.2 outlines a proposal for such a framework.

Policy trends affect R&D and operational compliance costs in the automotive sector

The costs for compliance tend to come into the general costs for environmental measures as a whole. However, legislation that increases cost to the plant or the organisation will inevitably affect its competitiveness and higher costs are likely to be passed onto the customer. This may or may not be in conflict with the cost objectives of a flexible short lead-time system. An example of typical overall costs to a significant global automotive player is shown in Figure 2. This company has also put $800 million into R&D to research alternative power sources for vehicles, including fuel cell technology. Legislation has certainly influenced the spend in such areas.

The life cycle approach to identifying impacts

To understand where legislation has an impact, a life cycle approach has been taken which will be further developed in this research programme. For the present, the main objective of this section of the programme is to identify what the main items of legislation are which affect the environmental dimensions of the new supply system. This can be on any aspect, from raw material right through to delivery to the customer. It must be noted, however, that 80% of the energy impact of the car is caused by customer use, and a further 5% from the disposal route. Only 15% of a vehicle’s actual...
energy impact relates to the supply, production and distribution stages of a vehicle within the product life-cycle. Other impacts, such as waste, are higher in the supply and production stages though (USCAR 1999).

The use phase impacts will become less dominant as further developments in vehicle efficiency are adopted (hybrid, bi-fuel, electric vehicles, etc). New materials utilising plastics and aluminium consume far more energy in their production; so the balance of impacts will shift to the production stages of the product lifecycle over the next decade (Keoleian 1998).

The opening stage of the life cycle divides into the component supply end (upstream from the vehicle assembler), the assembly and manufacturing process and the distribution process. Component supply can be further subdivided into manufacturing processes, raw material extraction (for steel and aluminium, oils, fluids etc), packaging of components and transport of materials.

Life cycle assessment (LCA) is an approach which has been spearheaded by Volvo in recent years with their Environmental Priority Score (EPS) system, but is limited to this niche producer. However, the take-over by Ford may produce wider application. Wolfgang Reitzle has already stated that Ford cars will pass through the Volvo safety systems (Burt FT 18/8/99). Clearly, companies that fit into different sections of the life cycle will be affected differently by the same environmental legislation. Each of these companies is likely to have a unique profile of factors as shown in Figure 1. Therefore, a rigorous examination of these impacts would require great detail about any particular company. However, only a general picture of trends across the areas shown in Figure 3 is required for the purpose of this study.

Scope of studying legislation impacts

Taking into account these issues, the scope of 3DayCar and legislative pressures, it is possible to discount a number of the factors affecting quality of life as unlikely to be significant. These include: extraction of minerals; oil refinery; 3rd and 4th tier activity and processing of metals and plastics from end of life vehicles. This leaves the following environment legislation relating to:

Figure 3: Diagram showing scope of environmental legislation on new car supply processes and the likely impact area of a 3DayCar (note some impact on raw material and disposal & recycling).
• Transportation – components and completed vehicles.
• Recycling – end of life vehicles and packaging
• Waste – packaging, hazardous (paint plant sludge etc), and material disposal
• Energy - taxes on fuels and electricity
• Emissions – from processes and product

The three sections of the new vehicle life cycle will be examined using these dimensions. This will demonstrate how environmental legislation (and broader policy considerations) could impact on the way a 3DayCar will be produced in the UK and determine what trends in these areas might be likely within the project’s timeframe.

There is a short section on Labour (See 4.5) but, in general, socio-economic legislation concerning employees, economic growth and social investment, and other quality of life factors, will be subject to further research.

1.3 Environmental Legislation. The perspective of other countries.

The countries that have progressed environmental initiatives furthest are Germany, Sweden and the Netherlands. They are well ahead, both of EU legislation and of other EU member states.

In Germany the Waste Producer Responsibility Act requires businesses to provide an inventory of all waste they produce. VW are requiring all their German dealers to separate and measure this waste in accordance with the act (VW Environmental Report 1997). German vehicle manufacturers, under the auspices of the VDA, have a number of voluntary agreements relating to the takeback of old cars free of charge! Vehicle manufacturers in Germany have agreed to cut CO2 emissions, although little action has been seen so far (Remming et al, 1997).

The Swedish authorities will soon be adding a further 30 kronor to the vehicle tax to pay for their commitment to process responsibility and to recycle vehicles to the required level. EU legislators wish all costs to be borne by manufacturers, so consumers effectively pay twice, once for a recyclable new vehicle and again in tax for old vehicles that cannot be recycled.

Policy is being developed in Holland to ensure that large companies implement the ‘Internal Corporate System of Environmental Care’. This is basically a management system which is currently voluntary in the UK. (Mandatory implementation for all Dutch companies is due in 2000 - Cramer, 1996). There is a growing trend in the Netherlands for Government to look into the Factor 4 philosophy for resource use. This is a popular European idea involving ‘doubling wealth whilst halving resource use’ and could be interpreted as an ultimate lean goal!. It is increasingly likely to request organisations to consider this factor in their strategic outlook. How this could be given legislative effect is not clear.

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3 This relates to cars, 12 years old – when average is 13.5 yrs old, but have positive value at this age so agreement reflects no change from business as usual.
2.0 The Research Question

The aim of this research is to understand whether environmental legislation and general policy has any adverse impact on the processes involved in producing a 3DayCar. This study takes an overview, rather than focusing on any areas which may not be significant in the achievement of a 3DayCar. Rapid ordering and delivery requires increased flexibility as well as shortened lead-times and so the research focuses on the effect on these two areas.

2.1 The Research Structure

A literature review has been carried out to understand current and expected legislation and policy trends which are environmental in nature and are likely to impact on the automotive sector in a significant fashion.

Interviews with sponsor environmental representatives, particularly from UK manufacturing plants, have been undertaken to understand whether current and pending legislation has a significant impact on manufacturing capability. The representatives chosen were involved in the co-ordination of ISO14001 (the Environmental Management System standard) for which all plants except one had certification. They therefore had a good understanding of the whole spectrum of plant activities and how legislation impacted on them. Interviews have also been undertaken with industry experts from academia, environmental law firms, industry groups, legislators and other supply chain players.

2.2 Literature review and interview survey

Overall literature was taken from as wide a source base as possible to give a broad perspective on a field where coherent understanding of all aspects has not been previously researched.

Interviews with sponsors

The common interview structure for the sponsor companies covered the following areas (see Appendix II for list of 12 interviewees).

- General background information
- Legislation
- Costs of compliance
- Impacts on production – flexibility and lead-time
- Further research at the sponsor

The impact of future legislation cannot be objectively measured as it depends on the recipients’ knowledge and opinion of a future state. However, this is a relative measure and does give guidance for the future. The section on compliance costs uses cost banding on an exponential scale to cover a large range at the expense of reducing the precision of the answer.

Other interviews with industry experts (see Appendix III for a list of interviewees).

12 interviews were based round semi-structured discussions on the impact of environmental legislation on the automotive industry generally and 3DayCar issues specifically. The effect of trends in regulation on current and future systems was included in the interviews.
3.0 Environmental Legislation affecting the automotive sector

This section outlines the key environmental legislation affecting the 3DayCar process from supply, through manufacture and delivery of new cars. The aim is to describe the main requirements of this legislation particularly as they relate to all supply chain activities. A list of relevant legislation is detailed in Appendix I.

3.1 Emissions to air and water

Air emissions are primarily regulated under the Environmental Protection Act of 1990. Part I of this Act identifies activities which must be strictly controlled. Heavy industrial processes such as steel production, chemical production and fuel refinery are Part A processes and must have IPPC permission. Part B processes, such as engine casting and vehicle painting, require authority to operate from local authorities or councils. Guidance notes are published for these processes: operators are expected to conform to these guidelines and any emission standards or limits set within them. Any charges are set on the basis of the size and emissions level of the installation.

The IPPC Directive from Europe will soon be implemented in the UK and this means that all installations with Part A processes and some Part B processes, such as vehicle painting, will have to conform. This regulation is more comprehensive, covering energy use, waste, noise, water and air emissions. Europe will also set standards to be met by IPPC installations, called Environmental Quality Standards (EQS) which are likely to be more strict than current UK standards. Costs for compliance will rise with this regulation.

In addition, the VOC Directive will bring in tighter emission standards for high solvent users such as vehicle paint shops.

While the IPPC covers water emissions, there is already a substantial suite of Acts and Regulations with which automotive sector companies must comply, such as the Water Industry Act, Water Resources Act and the Trade Effluent Regulations. This legislation sets up charges and controls processes for releasing any effluent, and sets limits for any substances such as heavy metals, solvents, and solids in the emission. These are likely to be tighter and more expensive with IPPC and EQS.

Emissions from transport are being tackled through the EURO standards for vehicle type approval. Improved efficiency is being gained through conventional methods and alternative fuel such as CNG is being trialled to assess its viability in reducing air emissions from trucks.

3.2 Waste and recycling

Waste is controlled under the Environmental Protection Act 1990 Part B, whereby companies must exercise a Duty of Care for all waste which is handled and leaves the site. The company is responsible for what happens to the waste even when another party is in receipt of it. Costs relate to proper handling, registration of carriers and licensing for management and disposal sites. Companies are charged for carriage and disposal and policy aims to reduce quantities by making landfill disposal more expensive. The Special Waste Regulations (1996) stipulate that specific hazardous waste (solvents, oils, heavy metals etc) must be treated before disposal and these are generally much more expensive to dispose of due to limits set on landfilling. The Landfill Directive (pending) reduces the scope for land-filling of waste, including tyres and liquid wastes - again raising disposal costs.

The Producer Responsibility Regulations or Packaging Regulations of 1997 state that packaging must be recovered or replaced by re-useable containers. More and more packaging will have to be re-useable and hazardous types will be phased out.

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4 Integrated Pollution Control
5 Integrated Pollution, Prevention and Control
The End-of-Life Vehicle (ELV) Directive requires that vehicles be taken back free of charge by manufacturers and that 85% of material is recovered by 2006, rising to 95% by 2012. Costs are to be borne by the manufacturer and are likely to be £312million per annum (DTI 1999) – more than 3 times the total of all other environmental regulation in the sector. In 2006, all ELVs must be recovered by 85% irrespective of whether they were designed for this or not. Currently 75% is recycled; the additional 25% is generally automotive shredder residue (ASR) including plastics, fabric and rubber. Due to the difficulty in recycling ASR, the Directive states that energy gained through combustion can be included in the 85% recovery target.

### 3.3 Greenhouse emissions – global warming

The key activity affecting greenhouse emissions is the use of energy. Whilst nuclear power, solar, wind and hydro-electric sources reduce the problem by not producing CO₂, these are only minor UK energy sources compared to fossil fuels such as oil, coal and gas which contribute to vast amounts of CO₂ and other greenhouse gases released into the atmosphere. Greenhouse gases such as CO₂ cause global warming due to their insulating effect in the atmosphere, trapping heat.

In order to reduce the impact of this energy use, the Government has increased taxes on fossil fuel based energy. The most recent development here is the Climate Change Levy, which will result in a 6% rise in electricity and gas prices to industry (UK Environment News June 1999). Although it is supposed to be a revenue-neutral tax by giving a rebate on NIC6 paid out, high energy use industries with low labour forces will be significantly affected. Negotiations are currently underway with the SMMT to reduce the impact on the automotive sector (SMMT Press Release 21/7/99).

Other fuel costs such as petrol and diesel will also increase, even though the fuel duty escalator has ended, but the VED or road tax banding will be extended to encourage more fuel-efficient trucks.

### 3.4 Transport

The Road Traffic Act of 1997 began to tackle the issue of traffic reduction and placed the emphasis on local authorities to reduce congestion in key areas. The Transport Bill (1st December 1999) brought the ideas of the Traffic Act into a clearer action. The main clauses in this Bill affecting the automotive sector are local transport plans, road user charging schemes, both locally and for trunk roads; and the establishment of a Strategic Rail Authority. The local transport plans will enable local authorities to implement schemes to curb traffic congestion. Such schemes will include restricted access to urban centres, in terms of type of vehicle, times for access and charging for access to urban areas. It will also give support for Quality Partnerships where freight is consolidated outside urban areas for more efficient delivery. More tunnels and bridges will have tolls as a result of this bill. The general aims of the Strategic Rail Authority are to ensure that rail is competitive against road. The Bill is currently being debated in the House of Commons and it will be sometime before it has an impact.

Fuel pricing is also intended to reduce road user traffic, but in the commercial sector this is only likely to increase operating costs generally. The Sustainable Distribution Strategy (White Paper) demonstrates how distribution can become less transport-intensive and how the impact of such transport as is necessary can be reduced. The emphasis here is on collaboration between makes and more efficient use of current road infrastructure to move goods.

### 3.5 Planning

The main legislation affecting planning is the Town and Country Planning Act 1990. This sets conditions for approving and operating a development. New developments must conform to various standards stipulated in related Planning Policy Guidance Notes, which give details about the types of

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6 National Insurance Contributions
7 Vehicle Excise Duty
restrictions placed on activities. So a planning authority can set operating hours restrictions on traffic and parking, noise and other conditions affecting local amenity. For certain new developments such as a car factory, an Environmental Impact Assessment must be carried out and recommendations implemented.

Planning Policy Guidance Note 13 has recently been revised to reflect the concern for transport growth, and sets guidelines on the types of development that could result in large volumes of traffic. The guidelines explain how to reduce the impacts of a factory, warehouse or distribution centre which fits this category. New developments will be expected to include green transport plans to reduce transport activities related to the site, including employee transport and goods transport (Johnston 1998).
4.0 The impacts of the legislation on producing and distributing cars in the UK

4.1 Introduction to the 3 main stages

The three stages covered are:

- Upstream component production
- Vehicle production
- Distribution of the vehicle

The upstream activity associated with a 3DayCar potentially includes the activities of raw material extraction, processing, secondary processing and a large number of processes required to reach a recognisable product in relation to the automotive sector. The question that has to be answered, is whether the bulk of regulation has a significant impact on activities such as the control of mining activities and material recovery processes and whether this translates into an impact on the feasibility of a 3DayCar. The upper tiers of suppliers have in fact been examined, since it is here that impacts on a 3DayCar will be relevant. The types of processes occurring at these stages tend to be more environmentally benign than pure material processing. For example, the main impacts of producing a driveshaft are energy use, use of steel, use of machining lubricants, waste metal and lubricants, minimal emissions for heat treatment and transport of the product from the plant. Clearly this is less significant than the extraction and treatment of bauxite to produce aluminium.

Looking at actual vehicle production, the boundaries between internal and outsourced activities are becoming increasingly blurred. For the purpose of this report the author has generalised about the types of activities carried out at the assembly plant. Therefore, the impact of legislation concentrates primarily on the following activities: inbound parts/component delivery and storage; engine production (casting, assembly and dressing); stamping; pressing; welding; painting; general assembly; inspection/testing and outbound despatch. All of these activities involve environmental aspects to varying degrees. Emissions related to engine casting and paintshop processes have the most significance. Most processes, including general assembly, produce wastes; but the main hazardous wastes are associated with paint.

The third area examined is distribution of the new vehicle. This covers the process from gate release to storage in a compound, movement between compounds and movement from compounds to dealers and customers. Transport is becoming more and more of a significant environmental issue and legislation could have a major impact on 3DayCar costs.
4.2 Impacts on suppliers and other upstream activity

4.2.1 Costs

Environmental legislation affects all such companies and service providers in various ways. Many component suppliers are required to demonstrate to their customers that they comply with this type of legislation and have implemented the necessary measures. Clearly, this increases supplier costs in terms of resources, and further developments in legislation are likely to increase these demands. The costs of compliance are still fairly low, but developments such as the Climate Change Levy have significant impacts and are not generally included in compliance cost reporting.

Figure 4: Chart 1 shows compliance cost as a percentage of turnover and chart 2 showing average compliance costs across a number of component and 1st tier supply companies per annum.

The survey found that there is a wide range of cost impacts on suppliers from <0.5% to 3% of turnover (Figure 4) and the impact strictly depends on the type of operations involved.

Regulation of process industries at the raw material end of the supply chain is particularly prevalent; but as material flows down to first tier suppliers, the impact of this regulation tends to decrease. The main industries which are directly affected by regulation from a process perspective are: iron smelting; forging; casting; polymer and plastic processing; aluminium extraction and processing; electronics manufacturing; oil and chemical processing (vehicle fluids for braking, cooling, etc). These types of industry are commonly subject to more expensive and less flexible regulations; reflecting their less flexible processes. For example, in the iron and steel industry the costs are up to 5% of turnover. This is due to the expenditure on controlling particulates (heavy metals), gases including NOx and SOx, waste water and solid wastes (OECD 1997). There is no evidence that this has actually made the industry less competitive globally; it is generally well balanced with material, labour and financial expenses (and the UK has some of the lowest labour and financial expense costs). Production at this level tends to be in large batches for economies of scale (an example being steel coils), together with minimisation of emissions and discharges. Therefore production in small quantities is often resisted.

4.2.2 Transportation

One of the key concepts of lean production systems is Just In Time delivery – right product, right place, right time. For a true order-pull system, material, parts and components need to be delivered more frequently to each stage of the process, right through to the manufacturer assembly line. Clearly, this has implications for the amount of traffic on the roads.

100% reliability of delivery is the objective of such systems, but this is vulnerable to increased congestion. With both transport costs and traffic density rising, the efficiency of transportation will become increasingly important. Research has shown that the resource requirements of JIT can actually
have adverse environmental impacts. The great challenge to industry is to make JIT sustainable (McKinnon 1999, Workgroup 2000 1993 and Baum 1994). However, Nissan has shown how this can be countered by utilising planned consolidation at cross-docking points for line haul. Nissan purports to have saved 7 million transport miles compared with direct delivery.

Figure 5: Demonstration of miles saved by Nissan re-engineered inbound logistics system (Nissan 1999).

The most common impediments to logistics transport are traffic congestion, border delays, traffic bans, strikes/blockages and speed restrictions (Hague Consulting, 1998). These contribute 5% to transport costs overall. Clearly these constraints have differing impacts but must be taken into account in any tightening of delivery lead-times.

Restrictions on night deliveries and truck numbers, together with specified routing, are common in planning conditions. So more frequent truck deliveries at night may not be possible in some cases. However, supplier parks can get round many of these problems. For example, Ford has implemented these at Valencia, Saarlouis, Palmela and one is planned for Cologne. The types of product supplied through parts include engines, dashboard, trim parts and exhausts, all delivered by conveyor systems to the assembly lines. The holding of stocks at these points reduces the risk of non-delivery. Space for development can be difficult to find considering the location of many assembly plants (out of town or near a green belt, e.g. Ryton, Swindon, Sunderland, Cowley, Dagenham and Longbridge). This can often put transport limitations on new developments. There are opportunities to use some of the inventory space at UK manufacturing plants, which can be thought of as a kind of land banking.

Despite these constraints, this study found no specific instances where supply was significantly limited by regulations or environmental parameters such as congestion. However, additional safety stocks may be held to overcome such problems. Although only typically constituting 3-4% of production costs (Strutynski 1995), the costs for transport are bound to rise and become an important element in the supply chain with fuel costs increasingly significant. There has always been an awareness of the risks involved, and this influences the decisions made on allocation of inventory in terms of safety stocks.

4.2.3 Manufacturing

Emissions

The likelihood that new car emissions legislation could impact on the ability of component suppliers to deal with order to delivery of a car in three days appears low. However, increasing restrictions on end of tailpipe emissions means that there is further work to be done on powertrain efficiency and exhaust emission control. The introduction of new technology suppliers (for hybrid, fuel cell or electric vehicles) may create risks although this is not seen as significant in this study.
There are areas further down the supply chain which are subject to air emissions legislation. For example, in the aluminium industry, anode baking is the biggest UK source of PAHs. New air quality standards (Ends Report 286 Nov 98) controlling the emission levels are likely to raise costs significantly for these UK-sourced materials used in engine castings or panels.

**Waste and Recycling**

Apart from the end of life directive, waste legislation is unlikely to have a significant effect on the component supply upstream of the vehicle manufacturers, except in the one area of packaging which will have to be re-useable in nature and not disposable. Impacts of this regulation include the reduction of vehicle loading utilisation for backhaul logistics. Returned packaging uses up valuable transport space and thus restricts back-hauling opportunity (Andersen et al 1998).

Overall, waste disposal is likely to become significantly more expensive as alternatives to landfilling will have to be found by reducing wastes at source or recycling and recovering any wastes which do arise.

Although the ELV Directive does not directly apply to component suppliers, it will lead to VMs imposing material and design standards on their suppliers. This is already being carried out by most vehicle manufacturers. The main imposition will be the labelling of products relative to their recyclability, and restrictions on the use of certain substances. The suppliers may be coerced into producing easily recycled compenentry, which is itself made of recycled material. For example the Ford Focus uses recycled materials in a number of areas such as heater AC housings, sound deadening material and fuse boxes (Ford 1998).

The vehicle manufacturers will be responsible for the cost of disassembly (and eventual recovery of material and energy). Therefore components should be easily disassembled and have a relatively high residual value to make the process economic.

The growing trend in modular supply strategies could be affected by recycling legislation. Modules are designed to fit easily and quickly and any extraction of these modules for disassembly purposes can be destructive in nature (such as ‘snap-in’ assembly). If the residual value of componentry is to be preserved a method of non-destructive removal must be found. This could be in conflict with easy-to-fit modules. Modules tend also to be composite in nature, comprising many different materials (an instrument panel typically contains 15 different plastic resins [68% of module] and 2 metals [32% of module]) and are themselves very difficult to recycle (Keoleian 1998).

**Energy**

Energy use by upstream suppliers is not considered to be a particular hindrance to rapid production and delivery of product to customers. However, a number of points should be made.

If the supplier strategy to meet the 3DayCar is related to holding excess safety stock to deal with fluctuations in demand, then storage overheads are likely to increase. Indeed, there is already a trend towards satellite depots which have capacity to expand. This is partly driven by environmental legislation and increased customer pressure (Valente 1994). Energy taxation is likely to increase the cost of factory overheads in terms of increased heating and lighting bills. Together with more space requirement, the component supplier will have to bear increases in the cost of inventory. The extent to which build-to-order systems can eliminate current excess stock in the process will determine the overall movement in stocking costs.

If build-to-order systems are to be used to meet the true customer demand (actual vehicle order demand rather than forecast demand 3 months ahead), then there is a risk of sub-optimisation of the plant capacity. This means that costs of overhead per production unit are significantly higher at times of low demand. High energy cost industries include the aluminium and chemical sectors, so

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8 Polycyclic Aromatic Hydrocarbons – known for their potential as carcinogenic hazards to local populations.
alternative materials may be more costly. There is the risk, therefore, that environmental legislation will significantly increase energy costs for a flexible, as opposed to an inflexible production strategy. This would mainly be borne by component suppliers.

In an extreme case, the Climate Change Levy could impact very strongly on the UK supply base. Ford, Rover and Vauxhall have all stated that they would consider sourcing outside the UK if it is implemented in its current form (Morgan, 1999). This appears likely, given the current high cost of the pound. This would clearly have a significant implication for a 3DayCar if distances, and therefore times, are increased. An increased component inventory in the UK would be required.

4.2.4 Conclusions

The impact of environmental regulation on the UK suppliers to assembly plants tends to be in terms of cost. This is a significant factor, as vehicle manufacturers are generally requiring incremental cost reduction each year. If environmental legislation introduces a significant burden on UK suppliers, a tendency might develop for manufacturers to source where the regulatory, and hence cost, pressure is lower (in ‘pollution havens’ such as Eastern Europe, or even further). There is as yet no evidence that this is actually occurring, but the risk does exist.

The trend in sourcing from other countries may cause some problems for a 3DayCar due to increased stock requirements to deal with greater delivery insecurity and longer transport lead-times. Some suppliers from other countries are subject to conditions that could limit the daily output or delivery performance for these products. For example, weekend lorry bans existing in Europe are a limitation on suppliers. Transport costs are likely to increase with further taxation and this should be built into future cost scenarios, given the increased focus on transportation in the 3DayCar.
4.3 Manufacturing and assembling the new car

Introduction

The high cost of materials in the car means that the waste that is produced is often recycled. This is the case with metal off-cuts from the stamping process and swarf from machining of engine parts. However, there are a number of areas that do put a significant burden on the environment. The main pieces of legislation affecting car plants relate to wastes and emissions, and drive the need for efficient use of resources in the stamping, painting and surface treatment processes to minimise the expense of dealing with waste product. This takes the form of metal off-cuts, waste paint sludge, treatment of air pollutants from the paint plant or effluent sludge. An example of environmental impacts and typical values are shown in Figure 6. These are normalised per vehicle, which is common practice and shows that production efficiencies are closely related to volume.

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<tbody>
<tr>
<td>Energy use</td>
<td>650kWh/car</td>
<td>1715 kwh/car</td>
<td>1.7 T CO2/car</td>
<td>16 mill BTU/car</td>
<td>7700 kWh/car</td>
<td>2300 kWh/car - total</td>
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<tr>
<td>Water Use</td>
<td>3000l/car</td>
<td>5673l/car</td>
<td>6000 l/car</td>
<td>-</td>
<td>12000 l/car</td>
<td>2175 l/car - total</td>
<td></td>
</tr>
<tr>
<td>Landfill disposal</td>
<td>25kg/car</td>
<td>16 kg/car</td>
<td>8 kg haz / car</td>
<td>-</td>
<td>29 kg haz / car</td>
<td>5.2 kg haz / car - total</td>
<td></td>
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<tr>
<td>VOC emissions</td>
<td>-</td>
<td>5.8kg/car</td>
<td>-</td>
<td>-</td>
<td>2.3 kg / car</td>
<td>3.2 kg / car - 5 - 8 kg/car</td>
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All the vehicle manufacturers interviewed (with one exception), had gained ISO14001, an environmental management standard. This demonstrates independent verification of compliance to environmental legislation and general environmental improvement. Companies that have obtained this standard are required to keep a record of all environmental legislation. Therefore, an understanding of which legislation has an impact was relatively straightforward.

4.3.1 Costs

One area that is not well understood is the cost associated with environmental compliance activity. Although there is an understanding of specific abatement equipment cost, operation licence and waste treatment and disposal costs, there is little understanding of general running costs. This includes the labour content of operations, such as monitoring and measuring that are required by law. It is still relatively uncommon to find companies in any industry which carry out full environmental costing, including activity based costing approaches, and so this finding is not a particular surprise (Bennett, Hughes and James 1999). This approach would give an accurate picture of the true environmental costs (and savings). Only one company was recorded as beginning to institute an environmental accounting system. As a result of this, the costing information is rather general, as demonstrated in Figure 7. The range of costs are from around 1 to 10 million per annum for investment and around £1million for running costs (this was based on a sample of 5 motor manufacturers with similar operations, although larger costs did coincide with greater vehicle output).
The costs for 3DayCar UK sponsors tallies with the industry cost generally agreed at c.1% turnover, although investment costs are likely to be in the lower range and can vary from year to year (£1 to 5 million per annum). A study by Ecotec (1998) on environmental expenditure in industry found that the motor vehicle manufacturing sector spent £81 million in 1997 on environmental protection. This is equivalent to 1% of turnover of the industry (details in Appendix III). This figure could be underestimated, since there is no cost accounting approach for environmental expenditure; and because so much is tied into overhead costs that a good estimate is all that can be hoped for (OECD 1997). Most of these costs are within the areas of complying with solid waste treatment, water discharges and air emissions as shown in Figure 8.

Figure 7: Chart showing range of environmental compliance costs at 3DayCar UK manufacturing sites per annum

Figure 8: Chart showing breakdown of environmental costs in the motor vehicle production sector (Ecotec 1998).
Cost savings can be made at source or in the recycling of waste material. Altering processes to use more benign substances such as water-based paints or solvent free degreasers can reduce air and water emissions. As one respondent said, “the aim is to achieve cost-neutral environmental compliance”.

4.3.2 Inbound logistics

Transportation issues at the assembly plant level relate to the receipt of goods from 1st tier suppliers, employee transport to work and distribution of product from the plant. Goods inward activity varies between transport on conveyor belts from on-site or Supplier Park based companies, milkround collection delivery to line-side, or just direct delivery to the plant warehouse. These daily or hourly picking orders are fulfilled either by electric trucks, normal lorries or train wagon vehicles. As long as these activities occur within the site or industrial park boundaries, legislation has a limited effect. However, once there is reliance on the surrounding transport infrastructure, legislation starts to exert significant pressure.

From the perspective of a 3DayCar, most legal constraints will be local in nature and depend on the traffic conditions related to the assembly plant. As most plants are out of town, close to major trunk routes and the road infrastructure, in many cases there would be no requirement to limit the volume of traffic entering the site. Road-pricing initiatives may make it more expensive to deliver to these locations. For factories close to urban road networks, it is possible to restrict the movement of vehicles from the factory, their density, and which routes can be utilised. However, with many local people employed by these plants, local authorities are more likely to accommodate favourable changes in the transport situation.

4.3.3 Production

The main emissions related to non-paint related activity are from engine casting and the boiler-house. A 3DayCar would not significantly affect these activities although smaller batches of engine blocks could impact on casting emissions due to abatement equipment efficiency loss.

Updated packaging regulations will put greater pressure on suppliers to use re-usable packaging when delivering to the plant. In many cases the use of re-useable packaging is easier to deal with and involves less time in the unpacking and disposal process. These developments may speed the process of getting components/parts to the line quicker as well as reducing the landfill waste bill.

ELV legislation will mean that by 2001 all new vehicles must be 85% recoverable at the end of their life. Perhaps more significantly, all previous models must be 85% recovered by 2006. The cost of this recovery is likely to sit firmly with the vehicle manufacturer. Inevitably, this will increase costs as the VM must pay for transport from dealers or customers to dismantlers and subsidise the expensive sorting and transport of material processes. One manufacturer anticipates costs of £28 million for free-take back, with total take-back costs up to £228million for the UK (Ends Report 289, 1999). The ‘German Car Makers Association’ (VDA) estimates that costs to comply with this legislation for Europe’s 160 million cars, of which 40% are German-made, would be DM20bn, (Ends Daily, 26/7/99). Vehicle manufacturers in Germany have said they will take court action against paying for free take-back due to the excessive costs (Burt, 1999). The current trend towards use of plastics and composites will make this more expensive as shown by the Scandinavian project involving Volvo and partners, ECRIS (1998). How this will be financed and which parties are to be involved has yet to be seen (dealers, logistics operators, assembly plants, dismantlers, raw material suppliers?). Industry may be able to share the costs between a number of parties.

How ELV regulation will impact on manufacturing flexibility and build to order systems is unclear, except that overall costs are likely to increase. However, utilising transporters that deliver new vehicles to the dealer and take back end of life vehicles will assist in optimising vehicle space

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9 Recoverable refers to recycling the material and recovering any energy from the waste arising.
utilisation and minimise additional costs. Much greater changes are required in the ELV infrastructure and cost accounting systems to incentivise recycling in the current situation (Keoleian 1998).

Energy use in many plants is often expressed in terms of units of production or sales (See Figure 6). As productivity declines the relative energy usage increases. With a very flexible production system it may not be possible or desirable to have full plant utilisation. At times of low product demand, normalised energy use will be higher (kWh/car, refer to Fig 6). The implication of having variable plant utilisation to meet demand may be significant in terms of cost per unit. The SMMT has estimated that the climate change levy could cost the industry 20% more in energy, resulting in a possible 3% increase on the factory gate price (SMMT Press Release, 21/7/99).

4.3.4 Paintshop

The survey found that from an environmental point of view, the paint plant is the biggest problem for vehicle manufacturers. In particular, the paint plant is a major source of emissions of VOCs, which contribute significantly to the production of ground level ozone and respiratory health problems, as well as being implicated as a carcinogen. It has a direct impact on the local community and as such is of considerable concern to local authorities. New IPPC regulation will generally be more extensive and expensive than previous regulation. The survey found that all the UK vehicle manufacturers sampled would require changes to meet these regulations. These will increase costs, especially in terms of monitoring and recording.

Total authorisation costs for a new regulated process such as vehicle body painting can be from £2 to £3 million. Since the paint plant is up to a quarter of the cost of a typical assembly plant, it can be seen that environmental compliance is a major cost (Howes et al, 1997). Furthermore, ninety percent of the cost of compliance is capital investment in monitoring and abatement technology. For example, BMW spent DM300million on rebuilding their Dingolfing paint plant to use solvent-free powder based clearcoat applications, partly driven by the legislative need to significantly reduce the VOC emissions (Ends Report 1999).

Efficient use of plant is important with VOCs measurements on the per car basis. (For instance Vauxhall at 5.8kg, which is about average, compares with the known lowest of <2kg per car at Volvo Gothenburg, given that all their metallic paint is waterborne). As this is an annual mass balance calculation there is some day to day flexibility, meaning that emissions levels do not have to be constant. However, reducing batch sizes and increasing the number of changeovers may increase these annual levels. For example, one company stated that to move from batch sizes of just over 1 to 4 would save £500,000 in solvent costs per annum, as well as significantly reducing solvent emission. Another commented that a mix of the water and solvent approaches also caused many scheduling problems.

The EU VOC Directive will make alternative paint technologies more viable economically (Ends June 1999). Even completely different colouring applications may prove more useful and cost-effective; in-mould painting of plastics utilised on the MCC Smart is a case in point, although life cycle impacts have not yet been assessed. This idea is further developed in the Technology stream.

Hazardous wastes of particular concern are those from the paint plant resulting from overspray and cleaning of paint/treatment jets and baths, which is typically 25% of the plant hazardous waste (Vauxhall Environmental Report 1998). Current operation of paint plants leads to optimum batch sizes that balance out the elements of cost of paint, cleaning solvents, labour and time for colour changes, together with waste and emissions minimisation. The cost of cleaning out pipes on water-based paint per changeover is stated as more than twice that for solvent based cleaning. This concern

10 After delivery of (a) new vehicle/s to retail outlet, ELVs at the outlet could be taken to registered dismantlers in the area, thus utilising already paid for truck space.

11 Volatile Organic Compound
was raised by more than one of the UK manufacturers. If smaller batch sizes are required for the 3DayCar, waste volume will also increase. Toyota has attempted to reduce the negative impact of this by using solvent cleaning but reducing solvent use in paint application. This has improved changeover times and reduced waste (Automotive New Europe 27/9/99). These issues are discussed further in the 3DayCar Paint Plant Survey.

Other than for paint, the survey found that although waste was a cost to business it was not considered a constraint in terms of impacts on process flexibility or times.

There are clear trade-offs in many of these areas. If paint emissions are to rise due to smaller batch sizes, then further abatement equipment must be commissioned to maintain reduced emission levels. This type of equipment is energy-intensive, so energy levels could rise. Similarly, if water-based paints are to become commonly used to meet ever tighter emissions levels, then rapid drying times require more energy intensive ovens and again energy requirements increase significantly. One argument is that harmful emissions directly affect local communities and their reduction should therefore be given priority over energy use and short batch size efficiency. The impact of energy use can be minimised by sourcing from renewables such as wind or hydro-electric power as opposed to non-renewable fossil sources such as coal and gas but at present this is more expensive still. This is still relatively uncommon, although Ford uses photovoltaics for heating some US plants (Ford Motor Company, 1998). Other emissions associated with energy use can be controlled at source. This serves as an argument for reducing emissions at the expense of increasing energy use.

4.3.5 Outbound logistics

Transport of new cars out of the factory will depend on the mode of transport (i.e. at Rover and Land Rover much of the output is directed onto the rail network for European supply). Plants on the continent, including those of Ford and VW, make more use the rail network to ship completed vehicles out of the factories than do their UK counterparts. Collaboration between brands occurs on the rail network with, for example, Ford, BMW and Opel sharing trains (Holweg). This is by far the most environmentally benign method, but further examination of the downstream distribution systems needs to take place before overall benefits can be understood. In the UK market, the vast majority of internal movements are by road (Kiff 1997).

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4.3.6 Conclusions

- The main impact of environmental legislation on the vehicle assembly process is cost, typically £1-5 million in annual investment and £1 million in running costs. However, current accounting systems are not developed sufficiently to determine the costs; and possible savings from initiatives such as recycling are not included.

- Smaller paint batches are ideally required for the 3DayCar, but these raise costs and make compliance with emission legislation more difficult. The main alternative to solvent-based paint, namely water-based, is yet to be proven in terms of small batches; as is the feasibility of quick changeover and drying times at an acceptable cost and quality.

- Planning and transport legislation presents little problem to UK VMs now or in future, although noise and nuisance legislation will become stricter.

- Employment and economic multiplier issues are a positive benefit to communities around assembly plants. Local authorities, who are the main regulators for environmental legislation, make trade-offs (influenced by central Government) between this factor and the achievement of acceptable environmental quality.
4.4 The impacts on distribution activity

Introduction

New car distribution (including delivery to the customer) is a key area in the total supply chain, whose environmental impact has been almost completely ignored by VMs. The survey found that environmental management strategies in general had not included transportation issues within the scope of ISO14001. In one case the fuel efficiency of the fleet was mentioned, but this measure is not likely to include outbound services which are contracted out. There was some evidence that other manufacturers were beginning to look at the distribution network. The lack of attention to distribution reflects low awareness of its negative impact, compared with that derived from other activities. The national sales companies and manufacturers have not identified this element of their operations as significant except in one crucial area: marketing and advertising. Some clear mistakes have already contributed to damaging the credibility of VMs to manage environmental issues in this area (Ends report 286 1998). As this area is closer to the customer, demonstration of compliance with legislation and the adoption of best practice may have benefits in terms of corporate image, and should not be neglected.

4.4.1 Costs

Global warming and greenhouse gas emissions are directly related to fuel economy. As the use of fuel is a major cost to transportation (around 25%), this section starts with an assessment of fuel efficiency and related CO₂ emissions.

With fuel consumption being a major cause of CO₂ production, the UK Government will be looking for a significant rationalisation of the transportation of goods. Less than 2% of total vehicle life cycle CO₂ emissions are attributable to transportation in the production and distribution stages (Toyota 1998 & Volkswagen 1998). Transport of the new vehicle is much less significant than upstream transport energy use from suppliers, but it can harm corporate image if not handled efficiently.

The White Paper ‘Sustainable Distribution’ raises most of the issues to be tackled (DETR³ 1999). The main emphasis in the white paper is a shift from road to rail. Although there is little chance that public authorities can force companies to use rail links, it is increasingly likely that pricing structures will make rail more attractive (CfIT 1999).

Policy makers now understand the important role of efficient logistics in reducing the fuel cost of transportation activities, and particularly the importance of collaboration between firms in a supply chain in terms of information for planning and sharing resources (McKinnon 1999). Potential savings through better logistics operations have been demonstrated and the Government sees no need to reduce the burden in terms of fuel duty if gains can be made through more efficient operations. One study found that raising payloads by 20% could reduce CO₂ by 13%. However the banning of 3-4 axle lorries from towns (allowing only small 2 axle trucks) may increase CO₂ emissions by 21% due to lower load efficiencies. The use of urban transhipment centres to consolidate loads into towns may increase CO₂ levels by 13% (Browne and Allen, 1998). Policy will certainly take these facts into account.

Road pricing does have more support generally than fuel price increases. Although it will increase transport costs, it is a fairer system of reducing congestion. Fairness would be further improved if road taxes are reviewed and bear a closer relationship to fuel efficiency. This is being discussed in the current parliamentary session. Road pricing will affect mainly urban areas (with the exception of tunnels and bridges) and uptake will be slow since local authorities will only be empowered to do this from 2004. Dealer transfers are thought to have significant inefficiencies and added costs (Kiff, 1997). Dealer transfers are mainly local and their costs will rise. In most networks dealer transfers account for less than 10% of sales; but abnormally high levels of inter-dealer transfers in a few franchises raises the average to 15%. Although distribution centres have reduced this source of sales during the 1990s, they are still significant. A 3DayCar should remove this cost, generating an environmental...
benefit. Transport costs attributable to fuel duty, charging and other systems are likely to increase over the foreseeable future.

A 3DayCar will reduce loading efficiencies with a one-day delivery maximum time. So cost increases will occur with quick response delivery systems, further exacerbated by fuel price increases and road user charging, unless consolidation is achieved elsewhere through rail or collaboration between franchises on road.

**4.4.2 Transportation**

Government is increasingly looking to the transport industry to decouple traffic growth from economic growth. Figure 9 shows how freight transport is currently in opposition to this aim. Legislative constraints on transportation are manifold. If systems are to provide a more rapid and responsive delivery of new vehicles to the customer, these constraints must be identified. Delivery to dealerships could be restricted in some cases. This is within the power of the local highway authorities, but these bodies are reluctant to legislate against commercial operations, especially if they are becoming more efficient. The preference will be to legislate against the private car user, in order to reduce traffic volume. However, if practices in the dealership are to be extended - e.g. 24-hour operation to collect/receive vehicles - then local operating agreements could have to be modified. At present, urban areas tend to major on the risk of residential disturbance.

![Graph showing growth in freight traffic over last 10 years set to continue. DETR 1999.](image)

Out-of-town freight transfer stations for urban goods delivery are still a long way off, although there has been some implementation on the Continent. Local transport plans do not currently consider this option, although there is evidence that Quality Partnerships, a form of collaboration to gain more efficient urban delivery and cut congestion, have been tried to varying degrees of success.

Home delivery is one of many options in maintaining customer service levels, but local authorities are still unsure of the real benefits. It has been suggested that customers will not forgo a trip, but will instead replace the necessary shopping visit with an unnecessary browsing visit (Cairn, 1998); in which case the environmental benefits will shrink to nothing. This should be borne in mind, as local authorities will have a major influence in the wholesale take-up of this option. In terms of quality of life, who wouldn’t want more time to pursue leisure activities as opposed to collecting goods from retail outlets (although collecting new car could be an exception)? But who would want an empty 11-car transporter rattling up their cul-de-sac? More socially acceptable alternatives need to be sought in order to make this a viable option.
Emissions

The most significant operations are the movement of vehicles, using car transporters from the factory to distribution compounds, and from these to dealerships in urban areas. HGVs are a significant source of emissions and are forecast to become the primary source of both PM$_{10}$ (see Figure 10) and NO$_x$ emissions from road transport (DETR, 1999).

![Figure 10: Particulate emissions (PM10) from vehicle types – main emissions from diesel vans and HGVs. DETR 1999.](image)

Attention is likely to move from cars to trucks in the near future. This will focus on how pollution can be minimised through technological developments such as retrofitting catalytic converters, and more local solutions such as traffic management schemes. The EURO standards are increasingly being tightened up and this will influence the logistics fleet in terms of emissions. Already the industry uses the Reduced Pollution Certificate to gain a VED rebate (FTA 1999). The limits this sets will soon be made tighter, forcing operators to fit exhaust treatment to meet these standards and qualify for the rebate. In future, new technology and alternative fuels will be implemented. These include CNG used by Tibbett and Britten (of which Axial is part) in the FMCG sector (Tibbett and Britten, 1998). In Milan, due to urban restriction zones, DHL are delivering using electric vans (using converted GM Rascals and Seat Marbellas – EC 1995) to minimise the pollution impact of delivery. It is unclear whether this will occur in the UK, although some London boroughs are considering restricted zones with access only to ‘low emission’ vehicles. (CfIT, 2000). This would make delivery to urban dealers even more difficult.

4.4.3 Storage and handling

Non-transport-related activities present few significant sources of emissions to the environment. There are no major material processing operations and no significant industrial operations that emit pollutants apart from de-waxing and vehicle respraying.

The producer responsibility defined under the packaging regulations ensures that more and more companies require the product delivered in returnable containers. Packaging regulations do not currently apply to cars, since in almost all cases they are not packaged. If they are covered in future to obviate the need for PDI at the dealer, re-usable packages will be required. Wax as a protective layer is used less and less. Non-water-based waxes will be more difficult and expensive to dispose of and the preference will be to reduce their use. The plastic covering sometimes used on new cars will be viewed as packaging and will be subject to legislation, meaning that it will soon have to be recycled.

The local authorities also have control over planning applications. An increase in distribution compounds within the 3DayCar solution could meet resistance from the LAs who are not especially enamoured of low-employment density land usage. They much prefer retail or housing use. A reduction in the size of DCs would be viewed more favourably and would fit with lean distribution systems.
ELV legislation could mean that dealerships have more of a responsibility in the recycling of vehicles from 2006. It is still unclear what role dealers would have in this system of free take-back, but the end of block exemption may mean that manufacturers have less of an influence over dealer processes and disposal methods. However, the CARE group has identified dealers as a possible link in the chain to help manage the process in terms of routing ELVs through the correct channels (CARE 1999). In France, up to 20% of ELVs originate from dealerships and a further 20% from independent garages (PSA, 1999). A Toyota-type system could operate in which Toyota’s own metal company deals with ELVs (with an 87% recycling rate), but this relies less on markets as Toyota owns many of the players involved. This is not the case in the UK, where independents dominate, with a consequent lower recycling rate (75%).

If dealerships were to get involved in end of life vehicle dismantling then they would be subject to the Waste Management Licensing Regulations (under Environmental Protection Act 1990). Some dealerships, such as Volvo’s, may adopt comprehensive waste management practices that are required to register for ISO14001. Volkswagen already requires its German dealers to return batteries, tyres, plastic components and other parts replaced during servicing to regional distribution centres using existing logistics arrangements (VW 1997). This is to expand to 15 waste groups for national logistics control, as part of the German Waste Management and Product Recycling Act, which is far more stringent than the comparable UK regulations.

An example of the problems to be faced is the 2003 European Landfill Directive, banning tyres from landfill. This will be very difficult to implement under the current situation, as in the UK there is no effective logistical process for moving tyres (40kg per vehicle). What is clear from both ACORD and CARE is that a rationalisation of the vehicle dismantling sector is taking place to ensure proper treatment of vehicles in terms of minimising the impacts of polluting wastes and maximising the recoverability rates. This is being instigated from initial collection of the vehicle through to the re-manufacturing of parts. Energy recovery is occurring through using ASR waste in steel blast furnaces. It is clear that legislation is driving these changes, but costs are rising as a result and efficiencies need to be found for the processes to be viable. Building up batch sizes is the key, not one-piece flow!

**4.4.4 Conclusions**

Overall it appears that the area posing the most significant risk to 3DayCar is transportation legislation, which imposes planning constraints and impediments such as restrictions and speed limits. How these challenges are dealt with depends on the costs incurred and the will to provide a sustainable solution to problems. Better utilisation of transport vehicles through collaboration and movement to rail will be encouraged. Lean logistics and JIT will have to be balanced with rising fuel costs, road user charging, restrictions on driving hours and pressures on urban deliveries. The prevalence of distribution centres should also be examined and questioned, partly due to their negative image but also in respect of their role in the truly lean distribution system which a 3DayCar would mean.
4.5 The labour relations factor

Labour law

One of the key issues relating to the new vehicle order to delivery process is that of labour. In the UK, the automotive sector employs 330,000 workers in vehicle manufacturing and component production. The contribution of the automotive sector to UK GDP is 5.5%, or £40 billion per annum. It is thus key for the Government to achieve the right mix of policy measures between protecting the rights of employees and sustaining the industry as a net benefit for the economy.

The issue of labour law in the manufacturing sector centres round a number of points. These relate to working time (such as the 48 Hour Directive from EU), the types of contracts which are acceptable (zero hour, annualised hours etc) and the consultation process for any changes in work practice and redundancy. More emphasis has now been put on the ability of unions to achieve an effective agreement on labour issues. Despite the way Japanese-inspired work practices have been met with resistance by the ‘craft unions’, the model has begun to change. The development of innovative collective bargaining agreements whereby manufacturers (particularly in the automotive sector) have guaranteed employment in exchange for the elimination of closely defined boundaries to tasks (job demarcation) has meant that flexibility is now built into the workforce (Ruysseveldt, 1995). Many other companies in the UK have now followed the way in which Nissan revolutionised the traditional union organisation, with single union representation. Clear benefits from this have followed for workers and company alike. The focus is now the individual firm’s workers and not the national membership as a disparate whole. As stated by Lansbury (1997) the adoption of lean is most likely where Government policies allow competition access to domestic markets, and promote high labour standards and democratic/co-operative labour relations. This is clearly the case in the UK.

The view of flexible labour by the unions and the TUC

Overall the trade unions are in favour of flexibility, but not at the expense of the quality of working life. They accept the importance of flexibility, but want voluntary agreements, where the workers have a choice; with flexibility for taking time off, control over hours worked and good advance notice of any changes. Is the 3DayCar required flexibility possible in the UK? If change in working hours of 25% or more is required at less than one day’s notice, then this may not provide a good basis for agreement. The 3DayCar might not necessarily demand this level of flexibility; but will require a significant movement in current practices.

Possible options

One of the keys to flexible labour is having the workers agree to a system, which is mutually beneficial (TUC 1998). It is likely that there would be great resistance to working hour policies that dictated to the workers that their shift hours could go up or down, depending on demand, at very short notice. Clearly there is a relationship between the amount of notice given and the number of hours affected. The closer to the build time, the less fluctuation in working time would be acceptable to the workers. Even if the workers could see the orders coming into the plant, it would not give them sufficient time to cope with large changes in working time. Therefore any greater change in demand may require supplementary workers or functional redeployment during these times, whilst actual demand can be buffered by other segmented orders. How close this can get to an acceptable demand variation, and what is meant by true demand, are questions to be answered.

Further work in the Environment stream will examine these issues and the impact a 3DayCar could have on labour relations, employment and the general societal issues affected.
5.0 Conclusions

5.1 The key impacts of environmental legislation on a 3DayCar.

The major impacts of environmental legislation on the ability to achieve a 3DayCar are transportation constraints and the waste and emission problems in relation to the requirement to produce in small batches. This is epitomised by the paint shop, where increasingly stringent standards and taxes on emissions are forcing changes in the type of paint used and even the process of producing a vehicle, away from the use of traditional paint shops to paint-injected moulded panels.

Environmental considerations are forcing significant changes to the process as well as the product in the motor industry. The risk is that these generate sufficient incremental costs in the UK compared to non-European markets, that manufacturers decide to source components from abroad. This would not only be bad for the UK economy, it would add lead time and inventory to the detriment of the achievement of the 3DayCar.

5.2 3DayCar Draft Environmental Policy Framework

The process framework for ordering, manufacturing and delivering a 3DayCar should not compromise environmental legislation trends. So in order to avoid conflicts, the programme must deliver a solution which addresses the following issues. These could form a basis for a strategic environmental policy for new car supply systems.

SUPPLY OF MATERIAL AND COMPONENTS
- Minimise emissions from industrial processes
- Optimise energy use if full plant utilisation is not possible
- Minimise the congestion, emissions and energy use impact of JIT delivery systems

VEHICLE MANUFACTURING AND ASSEMBLY
- Ensure that VOC limits can be met by implementing part water-based paint systems
- Reduce hazardous waste from paint changeover processes
- Optimise energy use if full plant utilisation is not possible
- Minimise other wastes and emissions where processes are modified

DISTRIBUTION
- Minimise the energy requirements of rapid delivery systems
- Minimise other transportation impacts related to rapid delivery systems, such as emissions, congestion, noise and nuisance (especially related to night-time activity).
- Minimise the use of land for non-intensive operations, such as distribution centres, or maximise use of distribution centres in terms of space utilisation and employment.
- Minimise impact of distribution centres in terms of emissions, noise and nuisance.
- Minimise the impact of dealers or retail outlets on local amenities and residents
OTHER RELATED AREAS

- Optimise compliance to End of Life Vehicle Directive and ACORD/CARE targets

In order to assess whether a 3DayCar could conform to this policy statement, the next research in the environmental stream will address mechanisms for measuring and predicting impacts in order to develop a tool for minimising the environmental implications of a 3DayCar.
References


Burt², T. Financial Times. (Employment in the automotive sector). – see cuttings


Burt⁴, T. At the wheel of four car brands. Interview with Wolfgang Reitzle. Financial Times. 18/8/99.


Final report to the DETR. London.


Ends. BMW makes further inroads on solvent use in paint processes. *The Ends Report* Apr 1999


Ends Daily. *Costs to comply with scrap vehicles directive* 22/7/99


Kochan, Lansbury and MacDuffie (1997) *After Lean Production*.


Volkswagen AG. *Environmental Report 1997.*


# Appendix I – Current and Future legislation

This list is not intended to be comprehensive and only an indicator of the kind of legislation affecting the Automotive sector processes.

<table>
<thead>
<tr>
<th>NAME OF REGULATION, DIRECTIVE ETC</th>
<th>ACTIVITIES AFFECTED</th>
<th>YEAR INTRODUCED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality Standards Regulations</td>
<td>Set European standards of air quality for specific pollutants such as CO, NOx, Sox, O, heavy metals and hydrocarbons. Industrial activity must not compromise an area’s ability to meet these standards.</td>
<td>1989</td>
</tr>
<tr>
<td>Clean Air Act</td>
<td>Cannot emit dark or black smoke from an industrial site.</td>
<td>1993</td>
</tr>
<tr>
<td>Control of Pollution Act</td>
<td>Control of pollution incidents such as leaks and spills from industrial sites.</td>
<td></td>
</tr>
<tr>
<td>Controlled Waste Regulations</td>
<td>All controlled wastes must be disposed of according to Duty of Care guidelines.</td>
<td>1992</td>
</tr>
<tr>
<td>Control of Asbestos at Work Regulations</td>
<td>Ensure that risk of contamination from asbestos is eliminated.</td>
<td>1987</td>
</tr>
<tr>
<td>End of life Vehicle Directive</td>
<td>Disposal of cars at the end of life – dealer takeback, design for recycling to reduce costs. Recyclable materials to be used in new vehicles from 2001 (must be economically feasible) – design for disassembly, does it help assembly or not?</td>
<td>TBC</td>
</tr>
<tr>
<td>Environment Act</td>
<td>Mainly deals with contaminated land issues – particularly for responsibility of remedial actions and older sites.</td>
<td>1995</td>
</tr>
<tr>
<td>Environmental Protection Act Part 1 (Part A and B processes)</td>
<td>List all prescribed processes and sets limits for emissions from these. Affects most process industries, engine plants, paint shops, storage of fuels etc.</td>
<td>1990</td>
</tr>
<tr>
<td>Environmental Protection Act Part 2</td>
<td>Outlines waste management requirements and Duty of Care.</td>
<td>1990</td>
</tr>
<tr>
<td>Environmental Protection Act Part 3</td>
<td>Other pollution not affected by Part 1 (Pt A&amp;B) process requirements as well as statutory nuisance</td>
<td>1990</td>
</tr>
<tr>
<td>Groundwater Regulations</td>
<td>Must have licence to dump polluting substances onto land. Describes 2 lists of substance types.</td>
<td>1998</td>
</tr>
<tr>
<td>Health and Safety – various acts including COSHH regulations</td>
<td>Covers storage and handling of hazardous substances.</td>
<td></td>
</tr>
<tr>
<td>National Parks and Access to the Countryside Act</td>
<td>Protection of Local nature Reserves</td>
<td>1949</td>
</tr>
<tr>
<td>Regulation</td>
<td>Text</td>
<td>Date</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Producer Responsibility Obligations (Packaging Waste) Regulations</td>
<td>Packaging of product and subsequent recycling of this increase amount recycled – use re-usable packaging – potentially more rapid supplier products to line</td>
<td>1997</td>
</tr>
<tr>
<td>Road Traffic Act</td>
<td>Transportation of goods to from plants – limits on delivery times and volumes etc locally controlled. Road pricing to discourage congestion – positive impact. Basically reduce future urban traffic.</td>
<td>1997</td>
</tr>
<tr>
<td>Safety Standards</td>
<td>Further vehicle complexity for assembly and weight</td>
<td></td>
</tr>
<tr>
<td>Special Waste Regulations</td>
<td>Disposal of hazardous waste – paint shop sludge, engine plant sludge, surface treatment chemicals – segregation and disposal procedures required.</td>
<td>1996</td>
</tr>
<tr>
<td>Town and Country Planning (Assessment of Environmental Effects) Regulations 1988</td>
<td>Any new development which fall into the schedule (including construction of motor vehicles) must comply by providing an environmental impact statement of effects due to new development</td>
<td>1988</td>
</tr>
<tr>
<td>Town and Country Planning Act</td>
<td>Sets out framework for setting planning controls of any developments in terms of not having detrimental impact on local amenity and other local issues.</td>
<td>1990</td>
</tr>
<tr>
<td>Trade Effluents (Prescribed Processes and Substances) Regulation</td>
<td>Must have a licence to discharge any liquids to sewage systems and their volume and type is restricted</td>
<td>1992</td>
</tr>
<tr>
<td>Waste Management Regulations</td>
<td>Disposal of plant waste – segregation by plant personnel.</td>
<td>1994</td>
</tr>
<tr>
<td>Water Industries Act</td>
<td>States what can be release to sewers in terms of effluent, so affect plant waste treatment discharges (limits quality and quantity)</td>
<td>1991</td>
</tr>
<tr>
<td>Water Resources Act</td>
<td>Controls discharges to any controlled waters such as streams, rivers, canals, lakes, groundwater etc. Must not release any polluting substances to these waters.</td>
<td>1991</td>
</tr>
<tr>
<td>Wildlife and Countryside Act and Conservation Regulations (amendments)</td>
<td>Species and habitats that must be protected under EU and International law</td>
<td>1981 and 1994</td>
</tr>
<tr>
<td><strong>PENDING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto-oil Directive</td>
<td>Ensure new cars can use low emission fuels – i.e. low sulphur diesel etc. Also ensure that engine management systems in place to warn drivers of possible emission failures.</td>
<td>2000</td>
</tr>
<tr>
<td>Global Warming/Climate Change Levy</td>
<td>Any energy intensive process will be more expensive i.e. pressing, automated assembly, warehousing – cost offset by NIC reduction, but is it enough?</td>
<td>1999-2000</td>
</tr>
<tr>
<td>Landfill Directive</td>
<td>Eliminates co-disposal – cannot put liquid waste into landfill – i.e. paint sludges, oily wastes etc from production. More stringent reduction targets for landfilled waste (site based) drive to produce less process waste. No tyre disposal.</td>
<td>1999-2000</td>
</tr>
<tr>
<td>PAH Air Quality Standard</td>
<td>Aluminium production – reduce emission levels</td>
<td>TBC</td>
</tr>
<tr>
<td>PPG13 – Planning Guidance – Highway considerations</td>
<td>Putting restrictions of new developments in terms of traffic volumes and use – warehousing, satellite stores/assembly plants, expanding dealerships etc</td>
<td>1999</td>
</tr>
</tbody>
</table>
### European Policy and regulatory framework of the Common Transport Policy

<table>
<thead>
<tr>
<th>Directive/Proposal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOC Directive – EC communication COM(96)538</td>
<td>Paint shop air emissions – reduce emission levels</td>
</tr>
<tr>
<td>Green Paper on Fair and efficient pricing, 1995.</td>
<td>Looks at the pricing regime, Eurovignettes, tolls, etc</td>
</tr>
<tr>
<td>White Paper on the Future of the Common Transport Policy, 1992.</td>
<td>Review of how the CTP will meets the needs of other transport trends – intermodality, sustainability etc</td>
</tr>
<tr>
<td>White Paper: Fair payment of Infrastructure Use: A phased approach to a common transport infrastructure charging framework in the EU, COM(98)466 final, of 22 July 1998.</td>
<td>Sets out how the EU can implement a fair pricing regime across the whole network, changing the way that charges are made</td>
</tr>
</tbody>
</table>

### US Regulations typically affecting US automotive plants

<table>
<thead>
<tr>
<th>Act/Regulation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic Energy Act (AEA)</td>
<td></td>
</tr>
<tr>
<td>Clean Air Act (CAA)</td>
<td>Emissions from vehicle and plants</td>
</tr>
<tr>
<td>Clean Water Act (CWA)</td>
<td>Water emissions from plants</td>
</tr>
<tr>
<td>Comprehensive Environmental Response Compensation and Liability Act (CERCLA)(Other than Superfund)</td>
<td>Incidents, accidents etc</td>
</tr>
<tr>
<td>Resource Conservation and Recovery Act (RCRA)</td>
<td>Material use and recycling</td>
</tr>
<tr>
<td>Superfund Amendment and Reauthorisation Act (SARA)</td>
<td>Contaminated sites etc</td>
</tr>
<tr>
<td>Toxic Substance Control Act (TSCA)</td>
<td>Hazardous substances etc</td>
</tr>
</tbody>
</table>
Appendix II - Interviewees

Sponsor Interviewees
1. Mike Godfrey – Honda Swindon – Senior Engineer
2. Kari Andrews - Ford Dagenham – Environmental Engineer
3. John Dodson - Vauxhall Ellesmere Port – EMS representative
4. E.V. Wilkinson – Vauxhall Ellesmere Port – Chief Process Engineer
5. Linda Barker - Nissan Sunderland – Environmental Co-ordinator
6. Julie Heads – Nissan Senior Controller logistics
7. Mike Adams - Peugeot Ryton– Environmental Manager
8. Richard Dyson – Peugeot Coventry– Supply and Distribution Manager
9. Stuart Howlett – TI Group, Bundy – Environmental Manager
10. John Gregory – Axial

Other Industry and subject experts
1. Paul Everitt - SMMT – Head of Policy
2. Oxford City Council – Senior Planner
3. Oxford County Council – Senior Transport Planner
4. Edinburgh City Council – Planner (Transport Planning)
5. Bath City Council – Planner (Transport Planning)
6. Dr S.Madhavan - University of Westminster – Director of Centre for Business and Environment
7. Dr. Tony Whiteing - University of Huddersfield – Transport and Logistics Research Unit
8. Dr B.Bixby - Oxford Brookes University – Senior Lecturer in Transport Planning
9. Reg Harman - Institute of Transport and Logistics – Head of Policy
10. Verity Kidd - Cameron McKenna – Environmental Law firm
11. Ashley Roberts – DTI
12. Ceri Vitalis - DTI
Appendix III – UK motor vehicle sector (SIC 34) environmental costs

<table>
<thead>
<tr>
<th></th>
<th>Water</th>
<th>Air</th>
<th>Solid waste</th>
<th>Soil and land</th>
<th>Noise</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating cost (£'000s)</td>
<td>19841</td>
<td>7315</td>
<td>32953</td>
<td>2110</td>
<td>1355</td>
<td>3270</td>
<td>66843</td>
</tr>
<tr>
<td>Capital cost (£'000s)</td>
<td>2574</td>
<td>8856</td>
<td>1673</td>
<td>1636</td>
<td>508</td>
<td>0</td>
<td>14648</td>
</tr>
<tr>
<td>Total (£'000s)</td>
<td>22415</td>
<td>16171</td>
<td>34626</td>
<td>3146</td>
<td>1863</td>
<td>3270</td>
<td>81491</td>
</tr>
<tr>
<td>Percentage</td>
<td>27%</td>
<td>20%</td>
<td>42%</td>
<td>4%</td>
<td>2%</td>
<td>4%</td>
<td>99%</td>
</tr>
</tbody>
</table>

GDP as turnover calculated as £9,319million.

Total costs as percentage of turnover = 0.9% not including indirect costs.

Comparison of percentage environmental expenditure against turnover with other sectors

<table>
<thead>
<tr>
<th>Sector</th>
<th>Electrical</th>
<th>Motor vehicles</th>
<th>Other transport equipment</th>
<th>Fabricated metals</th>
<th>Plastics</th>
<th>Energy</th>
<th>Chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of turnover</td>
<td>0.4%</td>
<td>0.9%</td>
<td>1.5%</td>
<td>1.1%</td>
<td>2.5%</td>
<td>2.6%</td>
<td>5.5%</td>
</tr>
</tbody>
</table>