Listavia International Consultants

Independent Transport Initiative

Volume Four:

Reduction of Road Transport Pollution and Congestion in the United Kingdom

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1 INTRODUCTION

1.1 Background

1.1.1 The World's climate is changing rapidly, due to **atmospheric pollution** caused by human activities, In Summer 2000, the North pole ice-cap melted, creating a mile wide hole in the ice. Global warming will cause the Earth's ice-caps to melt by 2100.

1.1.2. Although first world countries, such as Britain and the United Sates of America, are committed to reducing their greenhouse gas emissions by 6% to 8% by 2012 *(Kyoto Agreement 1997)*, only Britain is likely to anywhere near meet this target. The USA is predicted to increase its emissions by 15%, in that period. Moreover, there is no agreement on reductions after 2001.

Temperatures could rise within 50 years to a point at which a "runaway" greenhouse effect could not be prevented *(Hadley Centre – Meteorological Office climate change unit).*

1.1.3 The world must cut emissions to below 60% of the 1990 levels by 2050, to have any hope of avoiding the worst effects of climate change.

(IPCC – Intergovernmental Panel on Climate Change).

1.1.4 Carbon Dioxide (CO_2) is by far the most significant greenhouse gas. It is widely recognised by the first world countries that the present levels of consumption of carbon fuels (petrol and diesel) by road transport cannot be allowed to continue. The private motorist now accounts for over 50% of the total energy consumption in the UK.

1.1.5 It is also recognised that **traffic congestion** has reached unsustainable levels and that uncontrolled growth of road transport cannot be allowed to continue. It is more recently recognised that road congestion must actually be reduced, in many areas.

1.14 The UK Government's Integrated Transport White Paper, and subsequent Transport Bill (Transport Act 2000) fail to put forward viable strategies for the essential reduction of congestion and further reduction of pollution and contains fundamental flaws and omissions which this Transport Initiative sets out to address.

1.2 Scope of the Report

The scope of this report is as follows:-

1.2.1 To consider, the 18th Royal Commission on Environmental Pollution, the New Labour Government's Transport Green Paper and Integrated Transport White Paper (July 1998) and subsequent Transport Bill (Transport Act 2000).

1.2.2 To consider the methods available for reducing **road congestion** and propose a "best option".

1.2.3 To consider the methods available for reducing **environmental pollution** from road transport and propose a "best option"

1.2.4 Note : Rail, marine and air transport are outside the scope of Report.

2 TRANSPORT BILL (Transport Act 2000)

The Transport Bill, shortly to become the Transport Act 2000 is based on the Integrated Transport White Paper, which in turn was the product of the report and recommendations of the 18th Royal Commission on Environmental Pollution and New Labour's 1997 Transport Green Paper.

2.1 The 18th Royal Commission on Environmental Pollution

2.1.1 The approach and recommendations of the Royal Commission were flawed.

2.1.2 The Commission failed to address and recommend the control of energy consumption by vehicular traffic, in spite of the fact that energy control is clearly a viable (and possibly essential) method of reducing both congestion and pollution.

2.1.3 This failure apparently reflects a desire to avoid confrontations with the vested interests of powerful multi-national oil and vehicle manufacturing companies and with politically unpopular legislation.

(Possible Omissions from the Recommendations of the 18th Royal Commission on Environmental Pollution - Marcus Enoch)

2.2 Transport Green Paper

2.2.1 The 1997 New Labour Transport Green Paper - 'Developing an integrated transport policy - an invitation to contribute ' purported to be an invitation to open consultation. It has caused major and deep concern to many professional engineers whose thinking is unbiased by political dogmas and expediencies. Their input was largely ignored.

In effect, the Paper only permitted discussion within the constraints of recommendations made by the Royal Commission and the DETR (Department of the Environment, Transport and the Regions)

2.2.2 There were omissions and errors in the Green Paper, which presented a highly political and unprofessional approach towards dealing with the real transport problems confronting motorists the United Kingdom.

2.2.3 The Green Paper's foreword purported to "give people a real choice for meeting their transport needs".

This failed to recognise that people have already chosen overwhelmingly to use the private car over all other forms of non-specialised transport

2.2.4 The reasons for this choice are obvious : the private car is the only form of transport that can carry old and young, healthy and disabled, protected from the elements, at any time of the day and night, from any starting point to any destination to anywhere where there is a road, segregated from other people and risk of attack, insult mugging and rape.

The car is the only practical form of transport that is not limited and delayed by timetable restraints, and is able to carry personal belongings loaded into it piecemeal at the travellers' will and convenience.

2.2.5 The foreword presented the assumption that it is necessary to make "better arrangements for walkers and cyclists ", without presenting any supporting facts. Referring to Chart 2 p.6 it is clear that cycling presents an insignificant and declining proportion of passenger km. Pedestrian statistics were not presented in the Green Paper at all. No attempt has been made to address the serious limitations and adverse safety factors which constrain the use of the bicycle as a viable means of transport *(app. 11.8 & 11.9).*

2.2.6 The foreword advocated a "more environmentally sustainable transport system", whereas the present system is not environmentally sustainable.

2.2.7 The foreword claimed that ". . .others, in Europe and elsewhere are already moving in this direction . . *(of making things better for people and goods on the move)* ", but failed to say in what way.

2.2.8 P.4 par. 2 stated that the Governments Objective's include ". . . an inclusive society . . . " This is virtually meaningless. Other such words and phrases in the Paper include 'New Deal', ' 21st Century ', 'Quality Partnerships'.

2.2.9 The statements under par. 5 are unsupported and highly questionable. Traffic levels in 20 years time are not forecastable because they depend on too many variables and unknowns. The number of licensed drivers is approaching its natural maximum and the major factor contributing to increased traffic in the future will be increase in the average distance driven by motorists.

2.2.10 The statement that ". . . .people are denied real choice . . . " is simply untrue. People have had an unrestricted choice for over 40 years, and

the decline in the use of public transport set against the vast increase in the use of the car , shows beyond doubt that the car has been freely chosen by the vast majority of the UK population as their primary means of transport.

2.2.11 Par. 8 indicates a highly authoritarian decision to coerce people into using non-preferred methods of transport, such as cycling and walking (and perhaps even river boats) irrespective of peoples wishes, needs or capabilities.

2.2.12 Par.9 " the provision of transport infrastructure" does not define the provider. It may be assumed to be the State, and this indicates a pre-conceived intention to spend tax-payers money on transport modes already rejected by the vast majority of the population. This is confirmed by the sinister phrase "appropriate enforcement regimes to support these policies". So much for free choice.

2.2.13 The stated intention to " . . . encourage the use of public transport rather than the car . . . " is meaningless political cant.

Public transport and cars are different methods of transport, performing differing functions. They are not simple alternatives to each other.

The car performs the functions listed under par. 2.2.4 above, whereas public transport has few fixed starting points and destinations, does not segregate people and is only intermittently available.

The development of the private car has progressively freed more and more people from the severe limitations imposed by public transport and bicycles for decades.

The car is a major advance over all other forms of personal transport

2.2.14 The fundamental problem which the paper does not address, is that the volume of traffic on the roads must be reduced without reducing the essential freedom for cars to move from place to place without restriction.

2.2.15 Paras. 15 & 16 ignore the fundamental restraints imposed by all forms public transport, and glosses over these by these use of meaningless phrases such as "seamless journeys ".

2.2.16 Par. 19 the statement that " . . . the bus is vastly under-utilised . . .", demonstrates that people do not wish to use buses. The Paper could

equally have pointed out that there are too many buses, and proposed that the numbers should be reduced because they are under-utilised.

2.2.17 Para 20. presents the assumption that priorities must be given to certain road users. However, all partisan priorities disenfranchise others.

Disenfranchisement creates social tensions, and the Green Paper should have given due consideration to reducing or eliminating the essential unfairness of priorities, rather than increasing them.

The private motorist has suffered creeping disenfranchisement by successive Governments over many years.

2.2.18 Par. 21 talks of " . . .reducing congestion and pollution by attracting people out of their cars . . . ". Again, this avoids the obvious point that people have freely chosen to use the car over all other modes of transport. The word "attracting" is misleading, and should be read as "forcing".

2.2.19 The Green Paper makes no reference to the fact that advances in the design of hydrocarbon fuels to reduce their harmful chemical contents, and increased fuel burning efficiency in vehicle engines have already been very successful in reducing the amount of atmospheric pollution emitted by road vehicles. This success is effectively being masked by the overall increase in energy consumption by road traffic.

2.2.20 The Green Paper also ignores the growing success of new low pollution technologies, particularly the growing use of use of Natural Gas and the prospects for Hydrogen as fuels.

2.2.21 It is of major concern that the Government approach as set out in the Green Paper effectively rules out any intention to consider more effective funding of alternative fuel technologies by the State.

2.2.22 The Green Paper appears to be a thinly disguised statement of New Labour's pre-formed intention to impose penal increases in taxation and to further socialist dogma by intervention and disenfranchisement.

2.2.23 The Green Paper effectively ruled out by omission, any discussion on the control of energy input into the transport system as a whole. By doing so, the New Labour Government has continued the process, started by the Royal Commission, of stifling any proper or balanced discussion on transport energy controls.

2.2.24 Although the Green Paper made no specific mention as to how the Government's interventionist programme would be funded, it was clear from the outset that the primary motivation behind the documents is to raise more taxation, and to do very little to solve the real transport problems.

2.2.25 The Green Paper was not the open consultative initiative that it purported to be.

2.3 Transport White Paper

2.3.1 The Integrated Transport White Paper's foreword says " . . . we need to improve public transport and reduce dependence on the car . . .". There is no logical foundation whatever for this statement; it compounds the myth that cars and public transport are straightforward alternatives, which they are not.

It further underlines the intention of the Labour Government to reinforce socialist intervention rather than solve the transport problems.

2.3.2 The Paper recognises that "the numbers of people owning cars will continue to grow" and then goes on to state "More bus lanes, properly enforced will make buses quicker and more reliable"

This represents a decision to take road space away from the private motorist and give it to buses - without compensating the motorists in any way for the road space they has paid for and then lost. Where are the existing cars meant to go, never mind the additional ones ?

2.3.3 The Paper says "we want more priority for public transport". This is a clear statement of Labour's intention to further disenfranchise motorists.

2.3.4 The White Paper says "we need to reduce the rate of road traffic growth ". This is clearly insufficient We actually need to reduce overall traffic levels, especially at peak periods.

2.3.5 The White Paper says that the new Strategic Rail Authority "will bring vision to the privatised railway" - which means absolutely nothing, except further public expenditure on yet another unnecessary quango.

2.3.6 The White Paper contains many hints of state expenditure (to be paid for by increased taxation ?). This expenditure is largely unquantified and includes 'more and better buses',' special funding for buses',' Strategic Rail Authority', ' New Deal' etc.,

2.3.7 No un-subsidised railway operator can make a profit. The fundamental reason for this is the huge cost of investment, maintenance and operation of fixed track and signalling systems.

(Rail Transport in the United Kingdom - EUC/ssm/191/1997/445026)

2.3.8 Transport is essentially a matter of logistics and engineering, not politics; neither of these appear to have been properly addressed by the DETR, and their Report on responses to the Green Paper appears highly selective.

(DETR Report : A summary of Opinions Sept 1998)

2.3.9 In summary, the implementation of many measures set out in the White Paper will seriously inconvenience the vast majority of the travelling public, will cost everyone more in increased taxation and charges, but will do virtually noting to stop the increase in congestion and pollution.

On the contrary, the rather confused strategy it presents fails utterly to tackle the fundamental problems in a socially acceptable way, and will allow the miseries caused by ever-increasing traffic congestion to continue unabated.

2.4 Transport Bill (Transport Act 2000)

Part Two - Local Transport plans and bus strategies

2.4.1 The following comments refer to Part Two of the Transport Bill (as amended on re-commitment to the House of Lords Session 1999-2000), insofar as it affects Road Transport in the UK.

2.4.2 Part Two of the Bill section 107, 108 requires local government to produce and update transport plans, (which most already do) and to provide transport facilities (buses, trams etc.) for anyone travelling within or through the locality area that wants it. For "carry out their functions so as to implement those policies" may be read as "supply the facilities . . . ". This includes facilities for freight and pedestrians.

2.4.3 Sections 109, 110 requires that local government develops "bus strategies" to "meet such of the transport requirements of persons within the authority's area as the authority consider should be met by such services." Local government is required to supply "such additional facilities and services . . . .required "in carrying out any functions of theirs as a local education authority or any social services functions"

2.4.4 Under section 111, local authorities must implement "alteration and replacement of such plans . . . as altered or replaced . . . . by the Secretary of State".

2.4.5 Section 113 imposes “quality partnership bus schemes” as a duty on local authorities. In essence this gives local authorities rights to impose “particular standards” by “bringing benefits to persons using those services . . . reduce or limit traffic congestion and reduce noise and air pollution.” As all these requirements and specific facilities (as far as this Bill defines them), are already in place under existing law, it is difficult to see what this section adds to existing legislation, other than the opportunity for increasing bureaucratic regulation of an already over-burdened industry.

2.4.6 Section 110 to 124 imposes “quality contract” legislation, the essential content of which is also in existence and available to all the parties set down in this section.

2.4.7 The Bill (section 132) directly places buses under central government “The appropriate national authority may by regulations make further provision . . ”.

2.4.8 Under section 134 - 142 “A local transport authority, or two or more such authorities acting jointly, may make a ticketing scheme covering the whole or any part of their area . . . .” This is direct re-regulation of buses by the back door.

2.4.8 <u>The legislation imposed by This Bill in relation to buses, is simply re-regulation by another name.</u>

2.4.9 Section 143 says “ The relevant national authority may by regulations make provision for . . . the imposition by approved local authorities of penalty charges in respect of bus lane contraventions, and the payment of such penalty charges.” This effectively denies motorists the right to drive on roadway for which they have paid and will continue to pay for through the road fund licence, fuel and other related taxes. Experiments in segregated bus-lane operation have not by any means proved conclusively that they are either desirable or effective.

2.4.10 This legislation empowers local authorities to close roads currently used by other motorists wherever they wish, and to raise fines revenue from those exercising a reasonable right to drive on the public highway.

2.4.11 The legislation changes offences which have commonly been treated as civil offences , into “criminal offences triable summarily and punishable with a fine”. These “offences” are not properly defined within the Bill, contrary to established criminal law in the United Kingdom.

2.4.12 152. Schedule 10 contains provision applying a competition test in relation to the exercise of functions relating to quality partnership schemes, ticketing schemes and subsidised local services.

Road User Charging (Part Three Chapter One)

2.4.13 The following comments refer to Part Three of the Transport Bill (as amended on re-commitment to the House of Lords Session 1999-2000), insofar as it affects Road Transport in the UK.

2.4.14 The Bill (section 162) gives sweeping powers to "local traffic authorities . . ." and "the appropriate national authority . . ." whatever that means, to charge, effectively without restriction and at will, "in respect of the use or keeping of motor vehicles on roads. . . ".

2.4.15 A charging scheme, including trunk road charging schemes (tolls) may only need be "desirable for the purpose of directly or indirectly facilitating the achievement of policies in the charging authorities' local transport plans . . .", for it to be implemented. This takes no account of the fact that less than 25% of transport taxation revenue is used to meet transport costs *(ref. 5.4 of this Report).*

2..4.16 London has been made a special case. "A joint local-London charging scheme shall not come into force unless the order making it has been submitted to and confirmed by the Greater London Authority . . .".

2.4.17 The Bill allows for the arbitrary imposition of "documents to be displayed while a motor vehicle is on a road in respect of which charges are imposed, or equipment to be carried in or fitted to a motor vehicle . . . ".

2..4.18 Enforcement of charging schemes, is by means of draconian penalty charges. (Section 172). There is no allowance whatever for mitigating circumstances to be considered, and "a person guilty of an offence ", (with respect to payment), "is liable on summary conviction to "a fine not exceeding level 5 on the standard scale, or imprisonment for a term not exceeding six months, or to both, and "examination, entry, search and seizure".

These penalties are arbitrary and go far beyond the bounds of reasonable penalties; they effectively criminalise the motorist under a huge variety of individual circumstances, and give wide sweeping new powers of entry to private and commercial premises to local authorities.

Charging schemes are the imposition of further taxation without justification

2.4.19 The Bill (section 174) seeks to extend the use of immobilisation equipment as defined in section 104 of the Road Traffic Regulation Act 1984, fines and penalties including the "sale or destruction of motor vehicles not released ". As noted in this Report (ref . . . .) the denial of the use of personal equipment such as a private car, in circumstances in which the person denied is placed in personal danger (such as in the case of a woman alone late at night), is tantamount to assault.

This Bill misses the opportunity to curb the excesses of extortion, blackmail and physical threat commonly practiced by those who immobilise vehicles. This is a serious omission.

2..4.20 The provisions of this Chapter of the Bill are substantially aimed at raising additional penalty revenues from motorists. There is no provision for statutory duties of public authorities in respect of providing adequate parking space for motorists, and in the absence of ECAPS or equivalent curbs on the energy consumed by motor traffic, there should have been..

Workplace Parking Levy (Part Three Chapter Two)

2.4.20 This chapter of the Bill was purportedly put forward originally as a measure intended to reduce the parking of vehicles in city centers and in particular Greater London. No, or no believable studies have been carried out which show that there will be any change whatever in the amount of saturation parking in these areas, brought about by workplace parking levies. This is purely a revenue raising measure, offering no relief of congestion or reduction in pollution.

2.4.21 The Bill makes no effort to hide the fact that this measure is being put in place solely to create yet another colossal source of captive revenue from the motorist. (*Section 177)*

2.4.22 The restriction implied by "A local licensing scheme may only be made if it appears desirable for the purpose of directly or indirectly facilitating the achievement of policies in the licensing authority's local transport plan.", effectively means that any local authority can introduce a licence and the levy at will.

2.4.23 Section 181 says that "For the purposes of this Part a workplace parking place is provided at any premises at any time if a parking place provided at the premises is at that time occupied by a motor vehicle (other than an exempt vehicle) used . . . by a relevant person, by an employee, agent, supplier, business customer or business visitor of a relevant person, by a pupil or student attending a course of education or training provided by a relevant person, or where a body whose affairs are controlled by its members is a relevant person, by a member of the body engaged in the carrying on of any business of the body, for attending a place at which the relevant person carries on business at or in the vicinity of the premises."

That is an all encompassing definition which includes individuals living and working at home on their own private property. Simply, it means that if an individual working form home wishes to avoid paying for the privilege of parking on his own land, he must move his vehicle and park it on the public highway, even though he has made provision (to the benefit of other road users) not to do so. This is clearly wrong and unjust, and the bill is seriously flawed in this respect..

2.4.24 The Bill fails to define workplace parking places, or list any statutory exemptions .

2.4.25 Section 189 confers on local authorities sweeping powers of rights of entry into virtually every property and premises, commercial and private, at which a person may be working, where the authority "has reason to believe that workplace parking places are being provided at any premises in the licensing area.". "a person authorised . . . to enter any premises shall, if so required, produce evidence of his authority before so entering. ", and "a person commits an offence if he intentionally obstructs a person exercising any power conferred on him . . ."

2.4.26 The provisions of this Chapter of the Bill enable, and indeed require, local authorities to apply penal taxation to individuals who park their vehicles off the highway, and confers on them powers of entry and search normally only extant in dictatorships and police states.

This Chapter is contrary to the common concepts of British Justice, and is likely to prove unacceptable and unworkable in practice.

2.4.27 In summary, the road traffic provisions of the Transport Act 2000 offer no identifiable reductions in road traffic congestion and pollution, and

they introduce re-regulation of buses, and

they will substantially raise the costs of running buses, so leading to higher fares, and

they are intended to raise further revenue from the already over-taxed motorist, and

they introduce draconian powers of entry and search on local authorities, far beyond established concept's of individuals rights and freedoms, and

they are likely to lead to vehicles being parked on the roads, which would otherwise have been parked on commercial and private land.

2.4.28 The White Paper stated New Labour's clear intention to increase taxation on motorists. To sugar the pill it indicates that all this increased tax increases will be expended solely on transport, whereas all or at least most of this tax increase should be met from the 75% of taxes already raised on motorists which is used by central government for expenditure wholly unrelated to transport.

The Transport Bill does not require all such revenue to be spent on transport. This is a serious omission.

2.4.29 The Transport Bill fails to address further taxation bias in favour of NG fuels to accelerate the change from petroleum to NG and Hydrogen fuels. This is a serious omission. *(ref. 7.4.1. of this Report)*

2.4.30 Other sections of the Transport Bill are dealt with under the appropriate Chapters of this Transport Initiative

3 THE KEY PROBLEMS

3.1 Energy Consumption

The primary requirement for reducing motor transport gross energy consumption from cars running on fossil fuels is to reduce their overall energy consumption. That is, to increase the efficiency of fuel usage in relation to passenger distance travelled, which can be done in various ways, including :-.

- increasing the **energy efficiency** of motor vehicle engines

- increasing the average number of people carried in each vehicle *(current average is taken as 1.6 people per car - DETR)*

- **limiting the amount of energy** (fuel) motorists are permitted to buy (Energy Control at Point of Sale (ECAPS).

3.2 Energy Efficiency

3.2.1 The energy density of a fuel is normally expressed in megajoules per kilogram ($MJ.kg^{-1}$) .

Petrol and diesel energy density is approximately $47MJ.kg^{--1}$. Electric batteries only achieve about $0.43MJ.kg^{-1}$ usable energy *(app. 11.3)*. This means that batteries are more than 100 times as heavy as petroleum fuels, so battery powered electric vehicles are not serious alternatives to the vast majority of road transport petrol and diesel engined vehicles.

3.2.2 With a net energy density of approximately $113MJ.kg^{-1}$, Hydrogen (H_2) is a zero emission fuel and the front runner as the ideal fuel of the future. Natural Gas (NG) offers a logical stepping stone between hydrocarbon and Hydrogen fuels *(app. 11.8)*

In the short term, there is no fuel technology which is fully developed to the point where it can take over from petroleum fuels, with the possible exception of Natural Gas *(app. 11.7).*

3.2.1 A petrol/diesel engined car converts approximately 30% of the energy in the fuel to tractive effort *(app. 11 6).* The remainder is wasted as heat, part burned and unburned fuel, emitted into the atmosphere.

Increasing this efficiency percentage is recognised by the Royal Commission as being a key factor in reducing pollution.

This potential for increased efficiency is already being tackled vigorously and with considerable success by the motor vehicle and oil industries, under the impetus of market competition and international statutory obligations on pollution reduction.

3.2.2 Energy efficiency is being increased by various methods including :-

- increasing the fuel efficiency of vehicle engines
- reducing the rolling and wind resistance coefficients of vehicles
- changing to alternative cleaner fuels

Increasing energy efficiency directly results in lower pollution levels. Other methods of reducing pollution include :-

- cleaning the exhaust output by catalytic purifies and scrubbing (which actually decreases energy efficiency)
- reducing pollutants in hydrocarbon fuels

3.2.3 Steps taken to increase energy efficiency have brought a real slight reduction in atmospheric pollution from motor vehicles in the UK, in spite of the relentless increase in overall traffic levels, and its consequential increase in gross energy consumption.

However, although good progress has been made so far, the increase in efficiency will become progressively more difficult, will inevitably slow down and pollution will again start to increase, unless additional measures are taken. The Royal Commission says that the motor industry must produce " . . . an increase in average fuel efficiency of new cars of 40% between 1990 and 2005". However, there is no known method by which a 76% fuel efficiency can be achieved, *(ref 3.1.1*) and to set such an arbitrary target is greatly over-optimistic

(Transport Report 18/1 Jan/Feb 1995)

3.2.4 The above considerations of the energy efficiency of motor vehicle transport do not take into account the total energy audit or "smelt to scrap" costs of vehicles, nor of the energy used in constructing, operating and repairing roads and their associated services. There is insufficient correlation between such audits as have been attempted, for them to be regarded as sources of usable data for this Report.

3.3 Energy Control

3.3.1 Year on year, the consumption of fossil fuels in private cars and commercial highway vehicles is increasing. Since the periods of rationing during and following the Second World War, no British Government has tackled the increase in petrol and diesel consumption by the **direct method** of limiting the amount of fuel (energy) people are permitted to buy.

3.3.2 **Indirect methods,** which have been implemented by successive Governments, including increased taxation, disenfranchisement and draconian fines for all manner of "offences", have failed to slow down the year on year increases in gross energy consumption.

3.3.3 In consequence, the costs and taxation imposed on motorists have reached absurdly high levels in relation to the actual expenditure demands, while traffic congestion has grown to absurdly high levels.

3.3.4 The phrase **'petrol rationing'** is an anathema to the British public, often being perceived in terms of post war austerity. Successive Governments have shied away from considering this method of controlling consumption objectively, or even debating the possibility openly.

However, a moderate control by rationing (Energy Control at Point of Sale - ECAPS) could reduce the overall consumption of energy by road transport, without seriously inconveniencing the motorist.

It is likely that most motorists would willingly reduce their travelling by a small percentage in return for major reductions in congestion and pollution, if they were persuaded to consider the proposition objectively.

3.3.5 Politicians who faced the tough task of persuading the public to embrace ECAPS, would also face the opposition of powerful multi-national oil companies, and other vested interests.

3.4 Pollution

3.4.1 The reduction and eventual elimination of harmful pollutants from vehicle exhausts is essential for the well-being of life on Earth and standards are in place and under constant review *(ref. World Health Organisation air quality guidelines)*

3.4.2 Natural Gas (NG) emits very much less harmful pollutants than hydrocarbon fuels, and Hydrogen (H_2) used as a fuel produces virtually no harmful pollutants at all.

3.4.3 The urgency of the need to reduce CO_2 and other greenhouse gas emissions, including water vapour, is less certain that the need to reduce harmful pollutants *(app. 11.2)* .

3.5 Congestion

3.5.1 There are approximately 20.486 million cars in the UK. On average, less than 5% of these (1.02 million) are travelling at any one time. There would be no little or no congestion if this was actually the case.

However, high peak time usage (7.3 million estimated) and high concentrations of traffic in urban areas and 'hot-spot' intersections cause daily peaks of congestion of varying time scales, at wholly unacceptable levels.

3.5.2 Successive Governments have developed the road network in the UK to a level beyond which further major development is both impractical and

environmentally unacceptable. Many say it has already gone much too far and that only developments already under way should be completed. Throughout these major developments, road congestion has steadily increased, so that it is now obvious that limitations on the volumes of traffic must be applied, particularly at peak periods and in key locations.

3.5.3 ECAPS would tend to reduce 'hot-spot hot-time' congestion, because car sharing for commuters and school and shopping runs would tend to increase, without the need for further Government intervention.

3.5.4 General congestion is a major contributor to the inefficient use of fuel, is socially unpleasant, and leads to dangerously traffic densities, particularly on high speed roads and motorways.

4 PRIVATE CARS

4.1 UK Road Vehicle Fleet

The UK road vehicle fleet has been estimated as follows :-

Vehicle	**km x 10^3 pa**	
Public service	107,000	
Light vans	2,142,000	
Goods lorries	394,000	
Farmers vehicles	40,000	
Cars	20,478,000	
Duty exempt vehicles	1,005,000	
TOTAL:	**24,166,000**	*****

(against 520 x 10^6 vehicles world-wide)*

(National Travel Survey - 1986)

4.2 Private Car Ownership

Ownership of cars by private individuals is limited only by their desire and ability to buy them. An individual can own a vehicle whether or not holding a licence to drive, and whether or not the vehicle is licensed to be driven on the public highway.

An individual may own any number of cars without restriction.

ECAPS would not affect this freedom. However, the use of the road as a personal garage needs addressing urgently, and there is some case to be made for requiring vehicle owners to prove cars are normally garaged off the highway *(par. 9.2.2. of this report).*

4.3 Vehicle Identity

Cars are not single entities, identifiable in the same way as a human being, although they are commonly regarded as such by owners. Commonly, cars are registered by chassis and engine numbers to which the registration plate numbers relate.

Car registration numbers do not directly identity the drivers of vehicles; they are policing aids which lead only indirectly to the identity of the registered owner or keeper of a vehicle. They are also used as sales boosting aids, and status symbols as “cherished numbers”.

There is a case to be made for driving license numbers (by means of smart card ignition keys, for example) to be directly displayed on vehicles. This would directly identify the driver , make policing of the roads easier and tend to reduce transport related crimes.

(The details of this scheme are under development and outside the scope of this Report)

4.4 Private Car Usage

4.4.1 Distances Travelled by Car

Statistics are available from various sources and studies. These do not always agree. *(app. 11.6)*

In this Report car annual distance travelled is taken as 18,500km (11,490 miles) average *(author's best estimate)*, and the average occupancy is taken as 1.6 pass. per car *(DETR-1998)*

These figures are not necessarily definitive. The average British resident now travels over 6,800 miles a year, an increase of six per cent since 1990. Car (including van and lorry) travel has continued to grow, and now accounts for 81 per cent of total annual mileage. However the largest growth over the period has been in travel by taxi/minicab (up 47 per cent).

(Transport Statistics Great Britain 2001 - 27th edition)

4.4.2 It is also useful to note that car average engine capacity is 1.473 litres. *(From DTP statistics)*

4.4.3 The above statistics cannot be relied upon to give the average distance driven by an individual driver, because a car may be driven sequentially by any number of licensed drivers, without restriction *(app. 11.1.1)*

4.4.4 However, on average, private cars stand idle for more than 95% of the time, are therefore driven on average for less than 1.2 hours per day

(NB 5% time usage would indicate an average speed of only 27mph. on the above figures. DETR put forward 33mph)

4.4.5 The distance driven by an individual driver is limited by his/her ability to drive for long periods as well as his/her needs to make non-local journeys. In the absence of usable figures for UK active driving licences it is convenient to assume that the above averages relate to drivers.

Then it can be taken that the estimated daily average distance which individual licensees drive is 51km (32 miles)

Non-driving licence holders must always travel with a licensed drivers (if travelling by car), so the essential requirement is to reduce the driver km/yr.) *(app. 11.1)*

It is the distance driven by the individual licensed driver which provides the relevant usable statistic in considering the control of energy consumption in private motoring.

This statistic has yet to be assessed.

4.4.6 The only way to control the driver km/yr is to limit the amount of fuel the licensed driver can buy (ECAPS). This can most readily be administered by the use of smart-card technology

4.4.7 Drivers will try to increase their fuel efficiency, so that they can travel further within the ECAPS restraint. Ways to achieve this include, higher mpg (smaller) cars, more fuel efficient cars, car-sharing (particular by commuters), increased use of public transport where possible, shared school runs, fewer shopping trips and careful assessment of the necessity for journeys - in fact all the desirable effects being pursued by Government initiatives.

The resulting lower congestion levels will tend to increase fuel efficiency, and ECAPS allowances will then need to be adjusted downwards to maintain an acceptable congestion status quo.

4.4.8 It should be noted that ECAPS may not solve peak congestion problems, and other (interventionist) measures may also be necessary, including tolls or other restrictions at congestion ‘hot-spots’.

5 CONTROLS

5.1 Control by Statute

5.1.1 The Road Traffic Act (1974) imposed a duty on local authorities to promote road safety and the Road Traffic Act (1984) gave them powers to implement traffic management measures relating to speed, movement and parking. Many regulations such as Local Authority Traffic Orders, and the Road Traffic Act (1991) which transferred the management of on-street parking from the Metropolitan Police to the London Boroughs, have resulted in a flood of ill thought out local remedies enforced by arbitrary draconian fines.

5.1.2 The **Transport Bill** states the Governments intention to impose further statutory duties along the above lines on Local Government. However the bulk of these "new" duties already exist, and the motive for the Bill's approach appears to be to give local government further statutory powers and duties to raise additional transport taxes through the pending Traffic Act 2000.

(Government White Paper - Modern Local Government In Touch with the People and Transport Bill)

While the Transport White Paper rightly recognised that limitations must be applied to the use of the private motor car, it fails to grasp or even address the nettle of input energy control, and instead has continued along the discredited path of intervention and higher taxation.

5.1.3 In the absence of any commonly agreed strategy, many local highway authorities have implemented one-off local controls on the movement of private cars, including :-

Parking restrictions - Resident parking - Selective parking permits

Minimum car occupancy fines - resulting in absurd anomalies and injustices

Traffic calming - humps, chicanes and bottlenecks

Disabled drivers-only parking and access

One way and gyratory systems - these nearly always force the traffic to travel further, often twice the distance they would have travelled on

unrestricted roads, so simply perpetuating the congestion they are intended to reduce.

Wheel Clamping and Towing Away - essentially blackmail and extortion and socially grossly offensive. These are acts tantamount to physical assault on those dependent on the availability of the vehicle for their personal safety and well-being

Untaxed Car Crushing - proposed but not yet implemented - effectively theft by the State; unacceptable behaviour in a civilised society.

5.1.4 Speed Limits

Speed limits were originally imposed as a safety measure. They are now being widely imposed to reduce traffic flows and persuade motorists to seek alternative routes. This is another form of disenfranchisement and has brought speed limits, particularly very low ones, into gross disrepute.

Speed limits have always been arbitrary impositions, commonly balanced against individual judgement and conditions by the exercise of common sense discretion by the police. It is anomalous, for example, to impose the same limit both ways on a hill, or in both wet and dry conditions, and the exercise of discretion by the police has been essential in maintaining a respect for speed limits.

However, excessive speeding, defined as driving too fast for the prevailing circumstances, by an ever increasing proportion of motorists, is now widely perceived to be out of hand, and there is a good case for fining every driver who breaks the speed limits, irrespective of the circumstances.

The imposition of very low speed limits in some urban areas is being used to prevent traffic from using certain roads altogether, and this is a clear misuse of speed limits.

Generally road vehicles run at peak energy efficiency when travelling at a steady speed of approximately 88kmh (55mph), and many speed limits could be set to take this environmental factor into account.

5.1.5 Tachographs

The introduction of HGV time limiting tachographs was a clear recognition that drivers cannot safely perform indefinitely without

breaks. An average time capability of drivers of 4 hours continuous driving has been variously calculated to be an appropriate bench-mark.

There is no such limitation placed on the private motorist, and yet large numbers of accidents are caused by car drivers falling asleep at the wheel *(Driving Standards Agency)* . However, the implementation and administration of tachographs for the private motorist would be complex, extremely costly, easy to de-fraud, and extremely offensive to most drivers.

However, ECAPS would tend to limit the number of hours a licensee could drive, without the necessity for further Government intervention, and would tend to reduce accidents caused by over-tiredness.

5.1.6 **Driving licence**

It has been suggested that the number of driving licences issued should be limited as a means of controlling congestion and pollution; this has generally been discounted as unfair and unworkable, because it would convert a perceived right for all into a privilege for few..

However, the present driving licence format is out-dated. Licences should be smart cards, carrying positive identification of the licensees, positive confirmation of valid insurance and response records for ECAPS. *(par. 7.5 of this Report)*

Smart card licences might also carry coded data to replace ignition keys, so that licensees could code their vehicles to respond only to their licence and no other, so preventing unlicensed or uninsured persons from driving, and greatly increasing the security of vehicles against drive-away theft. Driving licence numbers could be displayed electronically on cars, as a supplement to, or replacement of car number plates.

(current developments in smart card technology are being reviewed in Volume Six of this Initiative)

5.1.7 **Policing**

Automatic speed traps are regarded as offensive by motorists because they remove police discretion and individual mitigation. For example, new, more cost efficient speed trap cameras produced by Peek Traffic, a British based division of Thermopower, an American technology giant, are opposed by Liberty, the civil rights campaign group.

ECAPS would tend to cause drivers to drive at fuel-economical speeds, particularly on long journeys, which would reduce the extreme speeding (80mph plus) now so prevalent on UK motorways

Central Government has proposed fining drivers who remain stationary with their engines running. No consideration appears to have been given to the consequent heavy drain on batteries caused by repeated engine starting, and the large numbers of breakdowns this would be bound to cause.

(Times: Drivers face Fines Department of the Environment introducing new regulations)

5.1.8 **Elderly Drivers**

It has been claimed that elderly drivers cause road-rage incidents, and should therefore be disenfranchised from driving over a certain age.

Debate on this point has been inconclusive so far. However, insurance companies generally quote lower premiums for the over fifty-fives, which strongly indicates that older drivers are generally safer.

It is generally perceived that driving licences should be withdrawn only when drivers' skills and abilities are impaired, which does not occur at any specific age.

(The Times: Oldmobiles roll up for grey drivers and elderly drivers who "cause road rage incidents")

5.1.9 **Traffic calming**

Road Humps can damage houses (and vehicles) and cause accidents and are therefore probably already illegal. *(Studies of damage by TRL*)

Drivers should be able to rely on speed limits indicating that the road structure and layout is safe within he limits. Local Government often install these traffic calming measures without reducing speed limits. This is a practice which should be discontinued.

5.1.9 **Availability of parking**

It has been proposed that parking spaces in towns and cities, offices and supermarkets should be reduced, and/or taxed to dissuade motorists from using them. *(Greenpeace 1998)* This measure is being introduced by the current Transport Bill, and is unsupported by any evidence that

motorists will be so dissuaded. This is gross interventionism which could adversely affect a wide range of business and private interests, including property values.

Approximately 7.3 million cars out of the total 20.5 million stock are on the road at peak times. Therefore, approximately 13.5 million cars are parked at any time, and perhaps 18 million are parked overnight. More off-road car parking is needed, not less. The dearth of parking spaces has led to unreasonably high car park charges and gross congestion, particularly in urban and suburban areas.

5.2 Control by Disenfranchisement

5.2.1 Successive Governments have failed to control energy use. In consequence many national and local 'alternative medicine quack remedies' have been introduced which are both irksome and grossly unfair on road users

By far the worst of these is disenfranchisement of the driving licensee, by such measures as :-.

Closure of roads to private cars - buses and taxis only. The Transport Act 2000 is likely to lead to large numbers of road closures.

Dedicated Lanes Bus and taxi lanes, cycle lanes

Pedestrian only zones - the closure of roads which continue to be paid for by the motorist is obviously unjust

Car-sharing lanes - *(ref: Leeds Council - A647*) in which only cars with more than one occupant and buses may use the lanes. Driver-only occupancy in these lanes is subject to fixed penalty (£200) fines.

Closure of entire areas of countryside to through traffic has also been seriously considered in some cases (villages between Dorking, Surrey and London (Gatwick) Airport).

5.2.2 Control by disenfranchisement reduces the basic advantages of the car, and should be kept to a minimum

5.3 Control by Congestion

5.3.1 Successive Governments have permitted congestion to occur, which greatly restricts the movement of individual motorists and produces gridlock in extreme conditions.

5.3.2 In many cases, it appears that police and local authorities tacitly condone congestion caused by parking as a means of limiting traffic flows and speeds, through narrow and secondary roads. (The biased term "rat-running" has been coined to imply misuse or bad behaviour by drivers who have the good sense to use the most efficient road routes available to them).

5.3.3 Control by congestion is an abdication of responsibility by both. Local and National Government

5.4 Control by Taxation

5.4.1 Successive UK governments have abandoned the essential morality of transport taxation, which is to use taxes raised from motoring solely to meet the costs of motoring. Less than 25% of the tax raised by vehicle road fund licensing (taxing) and fuel taxation are used for meeting the costs of motoring.

The New Labour Government's promise to raise further taxes on motorists on the basis that all of the increase will be spent on transport, neatly masks the misdirection of existing transport taxation revenues, and passes the problem to Local Government. This will put up local taxation (Council Tax) on everyone, whether or not they are car users.

5.4.2 Central Governments have repeatedly imposed additional taxation on motorists on the ill-founded pretext that it will reduce congestion and pollution. In practice it does neither.

5.4.3 **The White Paper** - states New Labour's clear intention to increase taxation on motorists. To sugar the pill it indicates that all this increased tax increases will be expended solely on transport, whereas all or at least most of this tax increase should be met from the 75% of taxes already raised on motorists which is used by central government for expenditure wholly unrelated to transport.

5.4.4 Taxing the motorist to pay for other services is openly advocated. For example, it has been seriously proposed to triple motoring taxes to pay the health costs of suffering, premature deaths and illnesses allegedly caused by transport pollution; this has been quantified at £11 billion p.a.

(Source: Professor Pearce - Centre for Social and Economic Research on the Global Environment)

(*Greenpeace "Tax it All" commentary . . . .)*

5.4.5 The New Labour Government has concluded that taxing drivers is essential to cut city traffic, and proposes to tax company car spaces, substantially raise fuel taxes, and increase the road fund licence tax for larger capacity cars.

(The Times :Minister John Prescott talks of 30% growth in car use by 2010 - Transport white paper to be published in May 1998)

5.4.6 Over 80% of the price of petrol is direct and indirect tax. In consequence motorists in the UK pay more for their fuel than any other developed country. In the USA, for example, petrol costs approximately 60p per gallon at the pump against £3.40 in the UK.

5.4.7 The increase of fuel and other motoring taxation has had no measurable effect on the consumption of fuel or the overall increase in private motoring in the past. There is no evidence to suggest it will do so in the future.

5.4.8 The taxing of cars by the road fund licence "tax disc" method has fallen into disrepute because the amount paid by a car owner bears no direct relationship to the use he makes of the roads or of the wear and tear he causes. There is no logical justification for example, in taxing every car owned by a single owner, because he can only drive one car at a time. Moreover, the "tax disc" tax bears no relationship to the mileage that the driver covers.

The Government's view *(Royal Commission)* is that vehicle excise duty for heavy vehicles should be graduated, with vehicles with the cleanest engines paying a reduced rate, which would encourage the use of electric buses in urban areas.

The Labour Government introduced differential taxation in April 1999 according to car engine capacity, ostensibly to reduce pollution.

This measure ignores the different distances driven by the owners of cars. A low-mileage driver of a 4.5 litre energy-efficient car may use less fuel and cause less pollution than a high mileage driver of a 1.5 litre energy-inefficient car.

This measure is an unfair means of increasing tax revenues. It is a cynical use of populist socialist envy, and is unlikely to result in any significant or measurable reduction in environmental pollution.

5.4.9 This widely evaded tax has fallen into disrepute and should be abolished, so saving the attendant administration and policing costs and eliminating the present very high levels of evasion.

The tax should be replaced by an additional tax on fuel, also administered through the ECAPS smart card.

This would provide a further incentive to reduce fuel consumption and greatly reduce or eliminate evasion. It would also be fair.

It may be necessary to examine special needs groups (e.g. rural communities, business travellers etc.) However, the basic principle of ECAPS is to keep differentials to a minimum, while being fair to all road users.

(Ref: Volume Six of this Initiative - Energy Control at Point of Sale EUC/ssm/191/1997/445031)

5.4.10 **Vehicle costs** - import duty, VAT, capital run down and company car taxation affect the prices of vehicles. It has not been shown that taxation in these areas has any significant effect on congestion or pollution.

5.4.11 **Tolls -** except where tolls have a specific application clearly identifiable to the motorists, such as the Severn Bridge and at congestion hot-spots, motorists rightly resent having to pay yet again for roads already built with their money, which they have already paid to use through the excise licence and taxation.

There is no evidence to show that traffic would be reduced by the introduction of widespread tolls. However, it is certain that tolls tend to divert traffic to other roads which are more liable to congestion.

Tolls should be used sparingly, in conjunction with ECAPS, to reduce congestion at hot spots. Tolls should <u>not</u> be applied however, where traffic will take evasive action by diverting to alternative, less suitable routes.

6 'ALTERNATIVE' TRANSPORT'

6.1 Development of Transport

6.1.1 Canal transport was an advance over horse drawn vehicles for goods transport, and steam railways superseded horse drawn canal transport for carrying both goods and people. Buses and coaches brought transport to many people before the widespread use of the car.

6.1.2 In turn, the development of the motor car and the road infrastructure has superseded the use of buses and coaches, except for localised and specialised services for special needs and minorities. The private car is a major advance over all other modes of personal transport. The essence of the car is its ability to transport anyone without restriction from any place to any other at any time, with their personal goods *(par. 2.2.4)*.

It is totally unrealistic for the UK Government to consider turning back the clock by forcing peopled to reverse such a fundamental technical and social development

6.1.3 Since its introduction the bicycle has always been a specialised form of transport for minority groups *(ref. section 6.3 and app 11.4).*

To promote an increase in the use of bicycles is grossly irresponsible.

6.2 Road Transport

Available road transport modes include : -

6.2.1 **Buses -** run to fixed routes, schedules and stops.

Except where a passenger is fortunate enough to have stops at his staring point and destination, he requires other modes of transport at each end of the bus journey. Buses do not generally run at energy efficient speeds, and stand with engines idling at stops and terminals.

Dedicated bus lanes, like cycle lanes, disenfranchise motorists by reducing their road space and increase traffic congestion and pollution.

Average bus occupancy is very low and declining and the consumption of energy per passenger km (MJ/pass.km^{-1}) is very high.

Electric (battery) buses are energy inefficient and produce greater pollution (at the power production plant) than IC engined vehicles.

Trolley buses (operating on direct power pick up at higher voltages than battery vehicles) are more energy efficient but still less efficient than IC engined vehicles.

The main advantage of electric vehicles is that the pollution they produce is removed from the streets to the power stations where centralised control of emissions is possible. Trolley buses and trams, which draw their power at higher voltages directly from the main power supply are more energy efficient than vehicles which introduce the high energy losses associated with charging and discharging batteries.

The Labour Government's declared intent to force motorists to travel by bus instead of car has little prospect of succeeding, would increase pollution and congestion, is ill-advised and should be abandoned.

6.2.2 **Trams and Rapid Transit -**

The above notes on buses also apply to these modes of transport, except where dedicated trackways, separate from the public roads are used. The infrastructure costs of transit schemes are very high, and because there are no guarantees on usage levels, they can only be made commercially viable by including waste-to-energy schemes. Even then, Government subsidy by NFO (non-fossil fuel) subsidies are essential

(Guildford Rapid Transit Scheme 1998 : Trams and Transit schemes are covered in Volume Three of the Independent Transport Initiative)

6.2.3 **Taxis**

Taxis appear to be under-rated in the White Paper. The taxi incorporates all the advantages of the car, *(par.2.2.4)* and it does not need parking space. The taxi is the mode of transport closest to being a practical alternative to the car.

Self drive place-to-place taxis *(Citycars)*, which the driver picks up when required and leaves at his destination have been tried in some European cities. Their viability has yet to be proved.

The extension of the use of taxis instead of cars in large urban areas can ease congestion by reducing on-street car parking.

6.2.4 **Motor Cycle**

The motor cycle's main advantage over other forms of motor traffic is its narrow width, enabling it to pass and thread through other traffic more easily than four wheeled vehicles. It is relatively easy to park.

Apart from the necessity to balance it and the exposure to the weather, the motor cycle embodies most of the key attributes of the car.

6.3 Bicycle

6.3.1 The speed differential between the bicycle and the car causes large numbers of overtaking manoeuvres. Second only to speeding, overtaking is the largest single cause of road accidents in the UK.

6.3.2 A car travelling at 48 kmh (30mph) overtaking a cyclist travelling at 24 kmh (15 mph) requires a road distance of at least 60 metres, and must pull out at least one car's width from the kerb to pass safely. On many roads this is only possible if there is no oncoming traffic. This is inconvenient but not necessarily dangerous. However, high levels of motor traffic produce a continuous oncoming traffic flow, so that to overtake, the motorist must pass too close to the cyclist. To simply stay behind the cyclist is not a reasonable option.

In busy traffic, segregation of cyclists from motorists is the only safe answer, but unless separate cycle ways with complex underpasses at junctions and roundabouts are built, cycle lanes and mixed traffic crossways are necessary, because traffic jams caused by cyclists crossing the roadway prevent the motorist from using the road space that he has paid for.

Dedicated cycle lanes increase traffic congestion, so it is not surprising that frustrated motorists ignore road markings and drive in the cycle lanes.

6.3.3 The use of bicycles has been falling consistently in real terms since the nineteen fifties (24×10^6km pa in 1949 down to 4.5×10^6km pa in 1995), and even more so in comparative terms with all other road traffic (37% in 1949 to 1% in 1995).

6.3.4 Cycling in adverse weather conditions increases the required safe-path width, and bicycles cannot be adequately lit *(app 11.5).* Bicycle brakes are less effective than motorised transport brakes, particular in the wet.

Cyclists can and do cause accidents to motorists, yet are not required to carry any third party or other insurance, nor do they pay any road fund excise duty; this is patently unfair to motorists and pedestrians.

There is an increasing tendency for cyclists to ride without lights, ride the wrong way up one-way streets and to travel on footpaths. Cyclists largely get away with flouting the law, because they carry no number plate or other visible identification.

6.3.5 The increase in cycling as being promoted by the Labour Government White Paper would tend to slow other traffic down to energy-inefficient speeds, so increasing both pollution and congestion. Large groups of cyclists (bunching) can and do present impassable barriers which could completely disenfranchise motorists - obviously an absurd situation.

To actively promote an increase on the use of the bicycle is totally unrealistic, and grossly irresponsible on safety, congestion and pollution grounds.

There is a strong case for promoting a reduction of cycling, and for introducing proper controls including registration and insurance on cyclists in line with those already applied to motorists.

6.4 Rail Transport

(Rail Transport is outside the scope of this Report. However, the following should be considered when considering Rail in relation to Road Transport. - Ref; Volume One of this Initiative ' Rail Transport in the United Kingdom')

6.4.1 Passenger carrying trains cannot make a profit because of the high costs of maintaining tracks, switches and signalling.

6.4.2 Passenger carrying wagons are based on goods wagon technology, meant to carry freight loads. In consequence it is possible to pack people into passenger wagons like sardines without overloading the trains of tracks. This is already done to an absurd degree in an endeavour to increase fare revenues and cope with rush-hour commuting.

6.4.3 In spite of the over-crowding (and its consequent adverse safety implications) the declared New Labour policy is to force more people to use trains, by taxing and/or excluding cars from city centres (particularly London), and by other measures.

(Ref: Green Paper on Transport)

6.4.4 Modern technological advances in guided buses which could replace trains and carry a much higher passenger flow in proper comfort and make a profit, has so far largely been ignored by the UK Government.

(Ref: Service Tunnel Transport System - Eurotunnel - Listavia International)

6.4.5 Trains cannot carry passengers from start to finish of their journeys, because they are restricted to fixed routes, stops and terminals. Passengers commonly need supplementary transport at one or both ends of their journeys.

6.5 Other Transport Modes

6.5.1 Walking

The DETR paper on walking *'Developing a Strategy for Walking'* is one of the silliest documents on Transport to be issued by the DETR in recent times. It is a subjective document, clearly written to support the biased intention of Government to "curb the use of the car".

It states that "walking is the only mode available to everyone (other than people with severe mobility and impairment) " which is obviously not true. Walking is the most restrictive mode of transport, because it is slow, uses up personal energy, significant loads cannot be carried, it is insecure, and subject to weather conditions. It is also extremely limited in range. Generally people wish to travel further than 'within walking distance', and as quickly as possible.

Wheeled transport was invented to overcome the severe limit on the speed man can travel imposed by nature's inability to develop a continuously rotating joint.

The amount of travel undertaken by man before the advent of wheeled vehicles was remarkably high. *(Norbert Ohler ' The Medieval Traveller' Boydell & Brewer')* Man has always needed to travel further than he can walk, and the horse and then motor vehicle have freed him to do so. The car has freed mankind from the time-consuming arduous labour of walking.

6.5.2 **Roller blades**

Four-wheeled roller skates are an inefficient as a means of transport because they require excessive muscular effort from the human body to produce useful tractive effort.

Ice skates overcome this problem by efficiently converting rise and fall of the skater's body under gravity into horizontal movement. This is best achieved by the use of 'outside edging', a technique not easily achieved on roller skates. Outside edging maximises muscular effort to give maximum tractive effort for minimum energy burn. Unfortunately the high energy efficiency of the ice skate is confined to the ice-rink.

Roller blades, however, enable the ice-skater's energy-efficient techniques to be used on any reasonably smooth surface

Roller blades are probably the most energy efficient method yet devised for human beings to travel under their own power on wheels.

If the bicycle were to be invented now, it would be regarded as an eccentric invention, and would certainly not be allowed onto the roadway in present traffic conditions. Similarly, the roller blade is not generally regarded as a serious mode of transport. Yet similar advances such as sailing surfboards and microlight aircraft have been widely accepted.

The roller blade is worthy of consideration as a serious mode of transport, but public perception and attitude will probably prevent it from being taken seriously.

However, it should be noted that speeds of 30mph are possible, and roller-blades require far less energy than cycling. Dedicated roller-blade lanes are in use in some cities *(e.g. Vancouver)*

7 THE RIGHT ANSWERS

7.1 Petroleum Fuels

7.1.1 The UK fuel consumption (petrol and diesel) for private motoring is currently estimated to be 22.42×10^6 tonnes (*app. 11.6).*

The average energy density of petrol / diesel is 46.8MJ/kg The conversion efficiency of petrol into energy by internal combustion engines was approximately 30%. The average consumptions for private and company cars has been estimated to be 36.81 and 33.75 miles per gallon (mpg) respectively. Company car engines are on average of large capacity than privately owned cars.

(Transport and Road Research Laboratory - Watson, 1989)

Petroleum fuels produce high levels of pollutants and greenhouse gas emissions. Alternative cleaner fuels for road transport are being actively developed.

7.2 Alternative Fuels

7.2.1 Electric Battery

Petroleum fuels have useful energy densities over 100 times that of batteries *(app.11.3).*

Past Governments' enthusiasm and support for the development of battery powered vehicles has not produced the hoped for alternative to petroleum fuels.

Battery power is environmentally clean at the point of use, and electric drives are quieter than internal combustion engines. It has a limited viable application for local deliveries and short trips and for larger vehicles such as dedicated trackways electric rapid transit, for which opportunity charging is an integral part of the duty cycle, to reduce the main disadvantage of battery power - the weight and bulk of the batteries carried.

Government subsidies to assist in the development of battery powered vehicles has not produced the hoped for energy density breakthrough's anticipated in the nineteen sixties and seventies.

(ref: Volume Three of this Initiative ' Rapid Transit Initiatives in the United Kingdom')

7.2.2 **Natural Gas (NG)**

Natural gas powered vehicles (NGVs) easily meet or surpass the relevant EC limits for all three regulated components in tail pipe gases, in the urban environment. *(app. 11.7)*

Natural Gas is the ideal bridge to the eventual change over to Hydrogen as a fuel.

Natural gas is already in use as a fuel powering 750,000 vehicles world-wide and is helping reduce pollution from oil. It is a viable alternative to fossil fuels, and merits substantial Government financial support.

The UK Government should not fail to support more promising technologies, particularly Natural Gas and Hydrogen fuels, as a result of the negative experience of supporting and subsiding battery development *(app. 11.3)*.

7.2.3 **Hydrogen (H_2) as a Fuel**

Hydrogen as a fuel offers the greatest prize of all known fuels. It produces zero pollution and is available everywhere on Earth in unlimited quantities. H_2 can be produced by solar hydrolysis where it is required, eliminating fuel transportation costs *(app. 11.8 & 11.9)*

The enormous advantages to be gained by changing from Hydrocarbon fuels to Hydrogen are:-

- virtual elimination of harmful emissions
- energy efficiency of 60% plus
- unlimited supply
- can be produced by hydrolysis from solar power
- can be produced where required (cutting out transport and distribution costs)
- reduced engine wear
- no drilling, refining storage and distribution energy required

Changing to Hydrogen

Adding 2% to 5% H_2 to petrol / diesel / natural gas engines results in substantial reductions in pollution and improves combustion efficiency and performance. Hydrogen can be combined with gasoline, ethanol, methanol, or natural gas; just adding 5% hydrogen to the gasoline-air mixture in an internal combustion engine (ICE) could reduce nitrogen oxide emissions by 30% to 40%.

It is necessary to develop safe (probably hydride) storage for H_2 and O_2 to give a comparable energy density to that of petrol and diesel.

The High Capacity Hydrogen Storage Demonstrator (HCHS) achieves an energy storage density for hydrogen of more than 200 Whr/kg at atmospheric pressure by using reversible metal hydride technology and an advanced, light weight storage vessel.

Hydrolysis

A way forward under serious investigation towards cheap Hydrogen fuel for everyone is the development of efficient, low cost solar-hydrolisers and distribution equipment.

The cost of hydrolisers is commercially viable *(app. 11.9)*

Hydrolyser and storage facilities can be installed economically in peoples homes.

Hydrogen would cost less than the equivalent petrol/diesel fuels *(app. 11.9)*

A further cost advantage would be gained because H_2 causes much less engine wear than petrol or diesel.

Surplus H_2 could be stored and used for domestic heating, offering further cost savings. The waste Oxygen output from the Hydroliser would also have some value

The emission output from Hydrogen burnt in conventional internal combustion engines is simply water vapour.

Further development

Fuel cells and submerged-burning hydrox boilers are being developed for powering vehicles. Hydrox reactions can be entirely pollution-free

Again the end product is water - which is also the input for the solar hydrolysis.

The H_2 technologies described above is either current or in advanced stages of development and should be actively encouraged and supported by Government research funding and other subsidies

7.3 Control by Speed Limitation

7.3.1 During the oil crises of the nineteen eighties, a 50mph speed limit was applied nationally in the UK, in order to reduce fuel consumption. This had some effect, but the main effect was to make the roads safer for users.

7.3.2 The improvements in car design have led to a general perception that speed limits are now too low for the modern motorist. In particular the widespread application of 20 and 30 mph speed limits to many roads, where 40 mph is a safe speed, has resulted in the limit falling into disrepute.

The speed limit is largely maintained to deal with the lowest common denominator level of driving skill and character, which is irksome and unfair to the majority of normally skilled and attentive motorists.

7.3.3 Air resistance drag increases proportion to the square of the speed of a car. Optimum energy efficient speeds are approximately 89kmh (55 mph)

In the interests of both economy and safety the 70mph speed limit could be reduced to 55mph. However, it is unlikely to be accepted or observed by the majority of motorists.

7.4 Control By Price & Taxation

7.4.1 Fuel pricing.

Natural gas costs £25-50 per Giga Joule inclusive of distribution and is subject to Customs and Excise duty of 33.l4 pence per kilogram ($p.kg^{-1}$) when used as a road fuel The rates for diesel petrol is approximately $31.32p.kg^{-1}$

UK petrol and diesel duties are set at or near EC statutory minimums. whereas natural gas duty is set at four times the minimum level per litre.

The adoption of the spirit of the directive would set duty for natural gas at around 7.8 $p.kg^{-1}$.

All fuels for transportation use are subject to VAT. This is applied at the standard rate to the base fuel price and the Customs and Excise duty.

There is scope for fairer pricing and taxation. *(NGVA)*

A taxation bias in favour of NG fuels would accelerate the highly desirable change from petroleum to NG and Hydrogen fuels.

7.4.2 **By Taxation**

It is now widely acknowledged that the very high levels of taxation levied on petroleum fuels and motoring in general have failed to curb congestion and pollution.

7.5 Control of Energy Consumption

7.5.1 The control by Government of road transport energy consumption is the only available measure that could reduce traffic congestion and pollution fairly, without negating the major technical advance in travelling, namely the car. *(see section 8 of this Report)*

7.5.2 Control of Energy Consumption at Point of Sale, (ECAPS) is a viable method of reducing congestion and energy pollution and warrants serious consideration *(see section 8 of this report)*

8 ENERGY CONTROL

8.1 Control of Energy at Point of Sale (ECAPS)

Effective control of fuel/energy consumption at point-of-sale should not depend upon the individual skills, knowledge or integrity of the seller and the buyer (parties). The essential elements of control included the following :-

Buyers record of entitlement to purchase
Buyers identification
Buyers driving licence permit
Sellers equipment to process the control automatically
Elimination of Fraud

8.1.1 **Technologies**

The obvious technology for controlling fuel purchase at point of sale is that of the smart-card.

The normal driving licence could be replaced with a 'driving permit smart card ', identified to the legitimate owner by licence number, photograph and pin number. The card would record the quantities of fuel purchased by the licensee on a count-down to zero basis.

8.1.2 The petrol station equipment should be able to read the licensee's identification to a central database, and the quantity of fuel purchased read to the card. The card would limit the amount of fuel purchased on a real time / flow rate limit basis. The limit would be set by Government and adjusted as required.

8.1.2 The smart card would operate as the vehicle ignition key, and the car number plate could be illuminated with the smart card number, this would directly identify the licence holder with the car he was driving.

The identification of the driver would then be made certain by the card, and only the card holder could buy the fuel and start the vehicle.

8.1.3 A modest decrease in the permitted fuel rate would lead to an increase in average traffic speeds as congestion was reduced, particularly in urban areas. This would lead to an increase in the mileage a motorist could obtain from his fuel limit, and so tend towards increasing the congestion again. By further reducing the fuel limit this negative feedback effect could be controlled, so that energy efficiency was balanced against the need to keep traffic moving.

8.2 Effects of ECAPS on Commuting, School & Shopping Journeys

8.2.1 Faced with Energy Control at Point of Sale drivers would seek to conserve fuel by using more energy efficient (smaller) engined cars, and share commuting, school and shopping runs whenever possible. These are exactly the actions which are necessary to reduce congestion and pollution.

8.2.2 Excessive motoring, e.g. by company travellers, commuters travelling into and out of London every day, housewives making many trips to shops when one more organised trip would do, mothers collecting children from school without sharing school runs, would be reduced.

8.3 Effects on Car Sharing

Under ECAPS, car sharing by licensees would become widespread, so reducing the number of cars in urban areas, where commuting is commonplace. Some transfer to buses in urban areas may also take place (the only environment in which public road transport can work effectively).

8.4 Effects on Congestion and Pollution

8.4.1 Drivers would quickly learn to be careful not to exceed their entitlement, exactly as they have learnt not to run their fuel tanks dry. A reduction of say 5% in overall travel distance would greatly relieve congestion, so enabling vehicles to be more energy efficient, and so tend to increase their range on given amounts of fuel.

As motorists would tend to buy smaller and more energy efficient cars, the traffic mileage would again tend to increase By further reducing the fuel purchase limits, this negative feedback effect could be counteracted until a balance was reached at which drivers would encounter congestion free roads, and much lower pollution in return for a slight decrease in their overall travel distances.

8.4.2 The Government would set and monitor a central database limit from time to time with sufficient notice to prevent stranding problems.

8.4.3 The motorist would retain a free choice as to whether to own a large high consumption vehicle or a small low consumption vehicle or both.

8.4.4 Congestion would decrease. It would only require a small percentage reduction in peak and heavy traffic to free up many congested roads, enabling motorists to enjoy the freedom to travel in reasonable time to their destinations.

8.4.5 The burning of fuel in stationary traffic jams and crawling traffic would be reduced without the need for intrusive legislation requiring motorists turn off their engines when in dense traffic, dual occupancy lanes and disenfranchisement.

8.5 Effects on Vehicle Sales

8.5.1 Energy control on vehicle sales is likely to increase the sales of small energy efficient vehicles. Motorists who prefer larger cars for longer journeys would be likely to own small cars for local trips, and keep their larger cars for occasional long trip use.

8.5.2 The great majority of car sales are made to replace worn out stock. ECAPS would not significantly affect replacement sales, but is likely to increase overall new sales, particularly for smaller, energy efficient vehicles.

8.6 Balance of Payments

8.6.1 The UK Balance of Payments and PSBR are greatly affected by the import and export of oil and petroleum fuels. ECAPS would give Government control of this effects, which would tend towards a positive Balance of Payments and a reduction in PSBR, simply by being applied.

8.7 Political Effects

8.7.1 The Political Party which has the courage and good sense to recognise that Energy Control at Point of Sale is essential, will face the tough task of selling it to a motoring public whose concept of such measures is coloured by memories of the tough austerity of the post war petrol rationing years.

8.7.2 The United Kingdom is gradually facing up to the principle of such controls in for example the water supply industry, to give everyone a fair shares of limited resources. Road space and breathable air are such limited resources, and there is no logical argument for failing to put controls in place for these resources also.

8.7.3 The alternative easy way out is to follow the ineffective policies now promoted by New Labour in the Government White Paper, which will not reduce congestion or pollution, but only increase the anger and frustration already being suffered by road users and non-users alike, and will sustain the high levels of pollution affecting health and damaging plant and wild life.

8.7.4 The introduction of ECAPS would reduce traffic congestion to a level set and controlled by Government, reduce atmospheric pollution and greenhouse gas emissions, accelerate the trend towards the use of smaller, energy efficient cars, reduce the gross consumption of energy, lead to more efficient use of cars by reducing journeys and car sharing, reduce the need for disenfranchement road users, be fair to all road users and make cycling safer.

ECAPS would also accelerate the trend towards the use of electric and other non-polluting fuels not subject to ECAPS in cars, and in particular the use of Hydrogen as a fuel.

<u>ECAPS would render the interventionist policies in the Government White Paper unnecessary and irrelevant, while maintaining the essential freedom to travel anywhere by car.</u>

9 MATTERS ARISING

9.1 Fraud

9.1.1 The details of Smart Card technology control are outside the scope of this Report. It is known that second generation cards now introduced by financial institutions have higher levels of security against fraud than the simple magnetic strip cards now in widespread use.

9.1.2 A driver who had a private car and drives other vehicles commercially might have two cards, one for private use and one for commercial use.

9.1.3 Because commercial vehicles also use petrol and diesel fuel, it may be necessary to prevent a motorist from putting his commercial quota into his private car. It might be made necessary to swipe the card at the pump, before fuel is available, so it is sensible to consider segregating pumps able to supply commercial fuel from those able to supply private fuel.

Private cars would not have access to commercial pumps, and this could be policed by CCTV and/or dedicated pump technology.

9.1.4 "Fingerprinting" fuel to distinguish between private petrol and commercial petrol was first applied by dyeing commercial petrol in the 1940's in the UK. There were widespread abuses, because positive detection by sampling was the only sure method of checking to see whether a private car fuel tank contained commercial dyed petrol. The use of dyed commercial diesel for non-highway use is still practised.

(*The details of setting up and administering ECAPS is the subject of a separate study and outside the scope of this Report.)*

9.2 On-street Parking

9.2.1 ECAPS is not likely to significantly affect car ownership. However the reduced use of cars by licensees and a tendency to use taxis instead of cars is likely to reduce away-from-base parking.

9.2.2 It is essentially unfair that motorists who park their cars off the road on their own premises or on private land should be disenfranchised by car owners who use the street as their garage at their own premises.

The car owner has paid to use all the roads, not to extend land ownership to roadside properties in order to provide householders with permanent parking spaces.

The practice of residential parking permits was brought in to prevent non-residents from parking on the highway in preference to the residents who have no off-road parking.

Priority parking and obstructive parking are abuses which should be reduced by policing and statute

ECAPS would tend to reduce these abuses.

9.3 Speed Limits

9.3.1 A re-assessment of speed limits would be required once the desired traffic reductions had been implemented by the introduction of ECAPS. The popular warning phrase "Speed kills" is unhelpful. It is errors of judgement, which often includes what speeds are safe and what are not, which lead to serious accidents.

9.3.2 The circumstance in which drivers' judgements can be made correctly have been greatly diminished by traffic congestion, particularly on motorways. Reducing the congestion would reverse this effect, and it may be there would be a case for increasing some speed limits, in line with some other European Countries.

9.3.3 Consideration should be given to reducing the top speed limit to 55mph to improve safety and increase energy efficiency of traffic, particularly on motorways.

9.4 Bicycles

The existing laws on cycling should be more diligently applied. Reduction of traffic congestion would produce a safer environment for cyclists, but cycling should not be encouraged because of the intrinsic conflicts between motor traffic and bicycles *(ref. 6.3 of this Report)*

9.5 Driving Licence

9.5.1 The UK driving test does not examine anything more than the most basic skills and knowledge necessary for driving a car. It does not include motorway driving, night driving, driving in adverse weather conditions or skid control.

9.5.2 The kinetic energy of a vehicle is proportional to the square of the speed. The kinetic energy at 60mph is four times that at 30mph. Simple written statements of necessary minimum stopping distances against

speeds are learnt by rote and repeated verbally to examiners, but human beings' natural awareness of the relationship between kinetic energy and speed is limited to walking and running.

Therefore drivers commonly drive too close to the car in front and only the most experienced and careful drivers allow anywhere near sufficient distances stopping distances. Even when they do so, other drivers overtake them and fill the space they have left, particularly at high speeds on motorways.

Consideration should be giving to making speed/distance warning instruments mandatory in all road vehicles.

9.5.3 Driving licences are issued for life, and there is no minimum distance per annum requirement so that a licensee who does no driving for say ten years can go straight out onto a motorway, without restriction. ECAPS offers a means of monitoring licence usage if or when the question of lapsed drivers is considered further.

10 CONCLUSIONS AND RECOMMENDATIONS

10.1 Congestion Reduction

10.1.1 The proposals in the Transport White Paper would not achieve more than marginal effects on congestion.

10.1.2 The Transport Act 2000 makes no apparent provisions for the reduction congestion. The increase of segregated bus and cycle lanes will increase congestion. The Act's main effects on toad transport will be to raise substantial additional revenues from the already overtaxed motorist, and to re-regulate the buses.

10.1.3 ECAPS of hydrocarbon fuels is essential to the reduction of traffic congestion in the immediate term.

10.1.4 Reduction in traffic congestion without destroying the essential attributes and advantages of car travel can only be achieved by the introduction of ECAPS

10.2 Pollution Reduction

10.2.1 Although the reduction in pollution brought about by increased energy efficiency has kept pace with the increase in road traffic, they will not continue to do so.

10.2.3 The development of NG fuel in the medium term and Hydrogen fuel in the long term is essential to the reduction of pollution and needs the maximum possible support and encouragement from the Government.

10.2.4 There are at present and for the medium term foreseeable future no realistic alternatives to the private motor car for personal transport which is equally available to all travellers.

10.2.5 ECAPS of petroleum fuels is essential to the continued reduction of pollution in the immediate term, and would bring congestion and pollution from road transport under control, to the benefit of everyone.

10.2.6 ECAPS alone will not completely resolve congestion at peak times and traffic 'hot-spots'. Tolls at strictly limited locations may be necessary.

10.2.7 On-road long term parking is a major problem, which must be addressed. More off-road car-parking facilities are needed, not less.

10.3 Recommendations

10.3.1 ECAPS should be implemented as soon as possible, utilising smart card driving licence technology.

10.3.2 Substantial Government research and development subsidies and further differential taxation should be used to advance NG and Hydrogen fuel technologies.

10.3.3 The interventionist remedies introduced in the Transport Act 2000, particularly those which are aimed at reducing the freedom of the car to go from place to place, should be abandoned. Wheel clamping should be properly controlled and limited.

10.3.5 Cycling should be made subject to the same laws on registration, insurance, lighting and Highway Code as all other road traffic. Prioritising and promoting cycling as a serious mode of transport to the detriment of motor traffic should be abandoned.

10.3.6 Consideration should be giving to making speed/distance warning instruments mandatory in all road vehicles.

10.3.7 Tolls should be used sparingly, in conjunction with ECAPS, to reduce congestion at peak times and at intersection and high traffic density 'hot spots'.

10.3.8 Off-road long term and overnight car parking should be promoted and or enforced by the provision of more car parking space, particularly in urban areas.

10.3.9 The road fund licence ("tax disc") should be discontinued.

10.4 Further Studies

10.4.1 The Royal Commission's findings and recommendations should be fully re-examined by impartial Engineers and Experts.

10.4.2 An independent study into the implementation of ECAPS by smart card technology is already in hand
(LICON - ECAPS 1998-99)

10.4.3 An independent study on third party liability insurance, registration and identification of cyclists should be undertaken

11 APPENDICES

11.1 Driving Licence And Car Occupancy

UK full driving licences total 32.53 million of which is 30.1 million are substantive. There are a further 5.1 million provisional licences. These figures are unreliable because licences are issued for life and notification of cessation of use through death, old age, emigration, infirmity or simple disuse are not definitively recorded. Estimates of the licences in active (active licences) vary between 28 and 29.5 million.
(National Traffic Survey - unpublished)

Estimates on the projected growth of active driving licence licences in the UK by 2020 vary from 34 million to 44 million. Clearly there are many sociological and financial factors which will affect the number of active licences.

Estimates of passenger kilometres (pass.km) are obtain by using vehicle kilometres (veh.km) taken from traffic census results and multiplying by occupancy rates, currently estimated to be 1.6 persons
(Department of Transport April 1998)

11.2 Carbon Dioxide Emissions

Mankind's total energy consumption is 80GJ/yr (800×10^9 Joules per annum) approx. This is more than ten times the consumption in 1850.

Nature supplies some 200 billion tonnes of CO_2 annually into the atmosphere, from biomass and volcanic activity, whereas man supplies only 7 billion tonnes ($7{,}045 \times 10^6$ tonnes). However, it is now widely understood that even small additional CO_2 emission is sufficient to melt the ice-caps and tip the green-house effect into a runaway situation, with catastrophic results for life on Earth.

The UK contributes 8.9% of man's total of CO_2 emissions (i.e. 627×10^6 tonnes) , of which road transport contributes 16% (98×10^6 tonnes)

Research is increasingly showing that man is a significant contributor to recent perceived rises in global atmospheric temperature. However, it is possible that natural compensatory factors (stabilising tendencies) may reduce or cancel out man's small contribution of CO_2 towards the green house effect.

(Electrical Power Engineering Systems - K.S.V. Thorogood)

11.3 Battery Power

Conventional lead-acid batteries in common use have a maximum energy density of 150Wh (0.54MJ.kg^{-1}), only 80% (0.43MJ.kg^{-1}) of which can be usefully discharged.

(conversions: 1kWh = 3.6MJ : 1MJ = 0.278kWh)

Sodium Sulphur batteries (up to 200Wh.kg^{-1}) and Aluminium batteries (up to 300Wh.kg^{-1}) are available, but they have various disadvantages rendering them largely impractical as vehicle energy sources.

(Service Tunnel Transport System - 1986 et seq. - Licon)

11.4 Bicycle Energy Consumption

The total energy burn over 24 hours of a reasonably fit adult person who is neither losing nor gaining weight is approximately proportional to their food calorie intake and their bodily efficiency in converting this to energy.

For example : an adult producing 2,400 kCal usable energy per day from food intake, has a gross energy burn potential of up to:-

$(2.4 \times 10^6 \times 4.2)/(24 \times 60 \times 60) = 117$ Watts mean power
(N.B 1 food calorie is 1 kilocalorie (kCal))

A male athlete may consume as much as 4,000 kcal in twenty-four hours and burn most of this off as direct muscular work, so achieving 195 Watts mean power. This may be burnt at a peak rate as high as 1.5kW or more (sprinter) or more slowly over a long distance run (marathon).

However, not all this energy is covered into useful mechanical work. A significant proportion of this energy is used by the brain, nervous system, vital organs and for generating body heat. Therefore such calculations are only useful to indicate a maximum possible power output limit.

For normally fit people the maximum heart rate is approximately 220 minus age in years. Tests carried out at a permissible heart rate of 70% of maximum heart rate for 30 minute duration rides applied in the following tests.-

Tests on human cycling abilities carried out using instrumented exercise bicycles give the following broad band capabilities :-

Fit boy or girl ten years old,
total burn 200 kcals in 30 minutes
i.e. 4.2 x 200 x 10^3 / 30 x 60 = 465 Watts mean power

Healthy fit man 20 to 25 years old
total burn 400kcals in 30 minutes
4.2 x 400 x 10^3 / 30 x 60 = 933 Watts mean power.

Healthy fit woman 20 to 25 years old
total burn 350 kcals in 30 minutes
i.e. 4.2 x 350 x 10^3/30 x 60 = 817 Watts mean power

Overweight (not obese) middle aged man
total burn 130 kcals in 30 minutes
i.e. 4.2 x 130 x 10^3 / 30 x 60 = 303 Watts mean power

These tests commonly show that at least double the cyclist's mean burn rate is required to produce a power output sufficient to propel a bicycle and rider in still air at a speeds above 15kmh.

Cycling, even moderate distances and at slow speeds, is an aerobic exercise, which considerably increases the heart rate and burn rate.

Cycling has to be done on a regular basis in order to be an effective means of transport, and can only be undertaking by a dedicated minority.

11.5 Bicycle Lights

Car lights are commonly :-

Tail lights / side lights	-	5 Watts
Stop lights	-	21 Watts
Head lights	-	60 Watts

Front side-lights were originally the minimum lights required by law to make vehicles visible and to mark their extremities at night. Legislation now requires dipped headlights at night as the minimum requirement.

Bicycles lights to BS AU 155 are:-

Front light - 2 Watts

	-	weight 400 grams including 2/150 gram - 1.1 volt batteries / bulb 0.85 amp w.4 volt..
Rear Light	-	1.14 Watts
	-	weight 300 grams with 2/100gram batteries // bulb 0.42 amps / 2.7 volt.

These lights will only burn at their rated brightness for less than one hour.

A cyclist would need to generate an additional 65Watts (by dynamo) or carry batteries capable of sustaining 65 Watts for a reasonable period to make bicycle lights equivalent to the minimum statutory lighting on cars.

Dynamos which only keep lights alight while the bicycle is moving and whose power output and light brightness are proportional to bicycle speed are clearly dangerous, energy consuming and no longer acceptable.

It is not technically feasible to provide safe or adequate lighting on bicycles for night riding

11.6 Petrol and Diesel

Car distance per annum

Average private car distances per annum have been variously estimated by government agencies and independent bodies (1998) at between 12,880km to 24,150km (8,000 to 15,000) miles per annum.

The following (1986) data was also considered:-

	Household owned	**Company owned**
Business Use	7	67
Commuting	37	81
Other Private Use	86	111
Total Miles/week	**130**	**259**
Miles per annum	**6,760**	**13,468**

11% of cars are company cars, 89% are privately owned
(National Travel Survey, 1986, unpublished data)

From the above:

Each car travels on average 7,498 miles* or 12,074 km p.a. in 1986

*Passenger mileage per year has also been quoted as low as 5,000 miles per passenger per annum for 1986) *(Dep't. Environment & Transport)*

In this Report the UK car average distance is taken to be: - 18,500km p.a. (11,489 miles p.a.)

Total number of cars registered UK - 20.478×10^6
Made up as: -
Company cars in UK - 11%
Private cars in UK - 89%

Average car engine capacity - 1.432 litres
UK Petrol consumption (mainly private cars)
22.42×10^6 tonnes. p.a. (1996) *(Dept of Transport & Environment)*

Total energy burned by cars p.a.

$22.42 \times 10^9 \times 46.8 \times 10^6 = 1,049 \times 10^9$ MJ consumed pa.

Total energy used by cars p.a for traction:

Medium sized car (50kW rating) applies an approximate tractive effort of 0.8kN at $80kmh^{-1}$ (50mph). That is, it runs at 17.8kW at 80kmh. This is at or near its most economical, energy efficient speed.

(Marks Handbook)

Energy use for traction: -
$20.478 \times 10^6 \times 0.8 \times 10^3 \times 18,500 \times 10^3 = 303.1 \times 10^9$ MJ pa

Energy efficiency of car:

Car energy efficiency = $303.1 \times 10^2 / 1,049 =$ **30 %** approx. (petrol)

Total distance travelled by cars p.a. : -

$20.478 \times 10^6 \times 18.5 \times 10^3 = 387,843 \times 10^6$ km p.a.

(***Note:*** *alternative figures are as follows:-*
Company cars - 414km (259 miles) per week
Private cars - 208km (130 miles) per week
(Source - Greenpeace) giving :-
Total UK distance cars :
$20.478 \times 10^6 \times 52 \times (.11 \times 414 + .89 \times 208) = 245,620 \times 10^6$ km p.a.)

Petrol/ diesel:

Energy density	-	$46.8MJkg^{-1}$
Engine efficiency	-	30%

Note: Approximately 36% of petroleum fuel input energy wasted is radiated heat and exhaust gas heat. Approximately 34% is wasted as unburned fuel.

The significant technical advances in the reduction of pollution are related to reductions in unburned fuel, by means of catalytic exhaust purifiers, and lean-burn engine technology.

Burning fuel is intrinsically endothermic, so efficiencies above 60% are extremely difficult to achieve.

Cars total fuel consumption p.a.:

(petrol specific density = 0.75) den
(Dept of Energy & transport figure 22.42Mt p.a. inclusive)

22.42×10^6 tonnes p.a. = $(22.42 \times 10^9) / 0.75 = 29.9 \times 10^9$ litres p.a

Fuel consumption per car:

$(29.9 \times 10^9)/(20.478 \times 10^6) = 1.46 \times 10^3$ litres per car p.a.

Fuel consumption is $(18.5 \times 10^3)/ (1.46 \times 10^3) = 12.67$km/litre

(conversion 1 km = 0.621 miles)

12.67 x 0.621 x 4.56 = **35.77 mpg**

This is slightly higher than the DETR figure of 33mpg, but is a reasonable approximation (N.B. USA statutory minimum for cars is 27.5 mpg)

11.7 Natural Gas

Compared with petroleum powered vehicles, natural gas powered vehicles (NGVs) reduce CO_2 by 76%, NOx by 83%, other hydrocarbons by 88% ground level ozone by 90%, and eliminate emissions of benzene and lead.

Natural gas gives extremely low particulate emissions, and eliminates the lead and black smoke exhaust fumes common to petroleum powered vehicles.

(Natural Gas Vehicle Association - NGVA)

11.8 Hydrogen

General data

In conventional internal combustion engines, H_2 produces no CO (poisonous Carbon monoxide), CO_2 , (Carbon dioxide - greenhouse effect gas), SO_2 (in atmosphere forms H_2 SO_4 Sulphuric acid rain), Hydrocarbons (oily smoke, soot etc.) or Particulates, (traces come from the lubrication only) and only insignificant trace levels of NOx. (Oxides of Nitrogen

H_2 calorific value 10.22 $MJ.m^{-3}$ net, 12.10 $MJ.m^{-3}$ gross *(Kemps)*.

Air density	= 1.293$kg.m^{-3}$ at NTP.
H_2 specific density	= 0.07
H_2 - 0.07 x 1.293	= 0.0905 $kg.m^{-3}$ at NTP
H_2 Energy density (net)	= 10.22/0.0905 = 113 $MJ.kg^{-1}$
H_2 Energy density (gross)	= 12.10/0.0905 = 134 $MJkg^{-1}$
IC Engine efficiency on H_2	= 60% (Hydrogen)
Photovoltaic cell efficiency	= 20%
Hydrolysis efficiency E	= 75%

Fuel consumption per car:

(Tractive effort 0.8kN : 18,500km p.a.)

$(0.8 \times 10^3 \times 18.5 \times 10^6) / (113 \times 10^6 \times 0.6)$ = 218 kg H_2 per car p.a.

If all cars ran on Hydrogen the total fuel consumption would be

:

$20.478 \times 10^6 \times 218 \times 10^{-3}$ = **4.47 Mt (mega tonnes) H_2 p.a.**

(To replace 22.4Mt petrol/diesel, which includes light vans, motor cycles etc. would therefore require 5.4Mt H_2 p.a.)

Car powered by Solar generated Hydrogen

Hydrogen can be generated in a number of ways. Solar energy is the most readily available power source.

The domestic generation of Hydrogen from solar energy is a viable method of fuelling cars, and could decrease the UK's dependence on oil imports dramatically, while eliminating traffic pollution from cars, and greatly improving the UK Balance of Payments.

Taking 230kg H_2 per car p.a. (including surplus for compression etc.)

A 50kW car running at a 60% energy conversion efficiency (for Hydrogen) needs an input of 83.3 kWh per day (as Hydrogen) to run it for 1 hour per day at 50kmh (50 km average per car per day).

To produce this energy (as Hydrogen), a hydrolyser with an energy efficiency of 75% requires 112 kWh (electricity) input per day from a photo-voltaic solar panel.

Photo-voltaic cells commonly reach 12% to 15% efficiency and state-of-the art cells reach 25% to 33%. *(Swiss Federal Institute of Technology)*

Taking the efficiency of the Photo-voltaic panel to be 20%, the panel requires 556 kWh solar energy input

Available solar energy reaching the earth's surface is taken as $200W.m^{-2}$

A solar input panel power averages about $200Wm^{-2}$ (4.8 kWh per day) in the UK. *(Kemps and Marks)*

Therefore a $116m^2$ panel would suffice (i.e. approx. 36ft x 36ft panel). This is a reasonable size to be installed on the roof of medium to large domestic dwelling.

Hydrogen storage capacity would be decided in accordance with likely variations in daily consumption by the individual motorist, and seasonal variations in solar energy supply.

Technical problems being addressed

Weight of Hydrogen storage system (using metallic hydride storage). This is achieved at little or no pressure and its volume is less than if it were a super-cooled liquid. However, energy density at present is only 200 $Whkg^{-1}$ using hydride storage

Volume of storage (using pressurised tanks), which require energy for compression and maintenance against leakage.

Cryogenic storage - requires continuous refrigeration which wastes energy and venting which can be dangerous.

Speed of refuelling - not insuperable

11.9 Hydrogen Economies

The installation of panels, hydrolyser, storage and compression system have been estimated at £20,000 including 5-year maintenance. Economies of mass production are estimated to reduce this to under £8,000. *(Pegg and Karlsson - Fuel from Water' - 1998)*

Hydrogen cost:

Assuming 230kg H_2 p.a. / 18,500km p.a. / 10 year lease purchase
H_2 costs 8,000 x 10^2/(18,500 x 10) = 4.32p per km

Unleaded premium petrol currently costs 75 pence per litre,

36 mpg = 36 /(0.621 x 4.546) = 12.7 km / litre

So Petrol costs 75/12.7 = 5.9 pence per km

On present costs Hydrogen would be marginally cheaper than petrol

Hydrogen causes a lower engine wear rate than petrol, so there would also be a reduced capital run-down gain, because cars would last longer.

Government Subsidies

Because the development of mass production technology, efficient on-board storage and the capital costs of installation and car conversion are expensive, the change to H_2 as a car fuel will require UK Government support and investment.

The photo-voltaic cell efficiency need to be increased (already being developed in USA Japan and Germany), to reduce the size of the solar panel, to make installations feasible in medium-sized and smaller properties. Efficiencies as high as 33% are being claimed.

On-board vehicle storage efficiency also needs increasing. Again this is being actively pursued with Government assistance in several developed countries.

For example :A recent project *(source: South Dakota University project)* for a vehicle using 30kW for 2.5 hrs requires 5.08kg H_2 which in turn required 440 litres storage at 2,000 psi . Alternatively cryogenic storage reduced storage to 91 litres, but required continuous temperature sustaining energy and dangerous venting. 75kWh stored by Hydride at 200Whkg^{-1} would have weighed more than 375kg .

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