The Greening of the Car Industry ?

Final Year Dissertation

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To Bo Hasin and Sym Lef
without whom... etc.

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PREFACE

The earth has been orbiting the Sun for millions of years. Its geography has altered over those millions of years, continents have split or merged in a continuous melting of rock, water, sand and ice. Yet the earths' surface has seen nothing like the rate of geographical change of the last hundred years. Nothing that you'd notice looking down from an orbiting satellite, no great continental shifts. However, increase the magnification and these changes become more apparent, they blend insidiously into the contours of the earth itself, leaving a grid-like structure of lines enveloping most continents but especially those in the northern hemisphere. Increase the magnification again and little objects are visible racing along these lines - never veering from them - although in the areas where the grid is more concentrated these objects sit in long lines for long periods of time. The inhabitants of the earth have indeed been busy this last hundred years.

Introduction

INTRODUCTION

For several years prior to 1984 American satellites had been measuring the appearance of a hole, each Antarctic spring in the atmosphere ozone layer. However the computers, up until 1984 were not programmed to accept this aberrant data. Today everyone is aware of the hole in the ozone layer. In the early 70's scientists had warned that the ozone layer could be eroded by chlorofluorocarbons (CFC's) but nobody realised how quickly this erosion was going to take place. Although the size of the hole fluctuated from year to year, in 1987 it was as deep as Mount Everest and covered an area as large as the entire United States.

For thousands of years man has altered his surroundings to suit his needs - Northern Europe was once all woodland - yet it is alterations made over the last
2 hundred years with the dawning of the Industrial Revolution that are having the greatest effect. The depletion of the ozone layer is one of many environmental effects that man has brought about on this planet. Global warming, the melting of the polar ice-caps, the destruction of the rain forests, acid rain, all are familiar phrases.

The Industrial Revolution brought with it a new way of life. New inventions were constantly being patented. One of these was the internal combustion engine. When Heinrich Daimler and Carl Benz joined this engine to a horse-less carriage they probably couldn't have imagined the sociological and psychological effects this would have on the human race. As Aldous Huxley remarked, the only new sensation of the twentieth century was 'speed', this the car brought in abundance as it matured, but of greater importance was the personal mobility it brought. It opened up the continents of Europe and North America to anybody with access to a car, which was a great many years after Henry Ford introduced the production line to the industrial world. The average working man could now afford to buy his family's personal freedom. We have had a love affair with the car ever since. However, this is now coming to an end.

In this new age of environmental enlightenment the car is being targeted as one of the main villains in the destruction of the 'Earth' and with good reason it would appear. The car's effect on the planet is extensive and multi-layered. The simplest way to explain it is to split it up into 3 main areas each of which can be subsequently broken down for a more extensive analysis.
The three areas are:-

1. PRODUCTION AND DESTRUCTION
2. SERVICE LIFE
3. INFRASTRUCTURE

PRODUCTION AND DESTRUCTION

A car is made up of many different materials - steel, iron, aluminium, copper, rubber, glass, various plastics, etc. - each of which has to be either extracted from the earth by mining or manufactured by mixing together other materials that would have been mined. This requires energy, energy which would have been produced by a power station or on-site generator, both of which release pollutants such as sulphur dioxide, carbon dioxide, hydrocarbons, nitrogen oxide and trace amounts of other pollutants. Carbon dioxide is a greenhouse and so contributes to global warming. The action of sunlight on nitrogen oxide and hydrocarbons produces ozone. The ozone layer lies in the stratosphere between 15 and 35 kilometres (10 and 21 miles) above the surface of the 'Earth'. Ozone released on the ground will stay at ground-level where it contributes to smog and because it retains heat it is a factor in global warming. Nitrogen oxide along with sulphur dioxide are constituents of acid rain. Production related pollution is also caused in the manufacture of parts and assembly of the automobile - chlorofluorocarbons are given off during painting of the car. After production the car is ready for service which is on average 10 years.

When the car reaches the end of its life cycle it is scrapped. This basically means being crushed and dumped into a landfill site. So the valuable materials mined at considerable expense (energy and pollution wise) are then returned to the 'Earth' in a dispersed manner meaning they are irretrievable for further manufacture. The production and destruction of the car requires 10% to 15% of the total energy a car will use in its life.

SERVICE LIFE

It is during its service life that an automobile is at its most harmful to the environment. Emitting from the exhaust is carbon dioxide, carbon monoxide, nitrogen oxide, hydrocarbons, lead (only applies to cars not using unleaded fuel), sulphur dioxide, particulates, formaldehyde, asbestos and ozone.

Carbon dioxide abundance makes it the most significant 'greenhouse' gas, with levels higher now than at any time for 160,000 years. 15% to 25% of this gas comes from motor vehicles. Carbon monoxide which comes almost entirely from transport is responsible for between 20% and 40% of global warming. Nitrogen oxide - smog and acid rain producer - comes predominately from motor vehicles. Approximately 35% of all European trees have been badly damaged by acid rain. Cars are the greatest cause of smog in the world's cities. Then there is the damage done to people through human or mechanical error while in control of a car; over 250,000 people are killed on the roads of the world each year with personal injury accidents claiming 24 million.

INFRASTRUCTURE

In order for cars to travel from place to place there must be roads to put them on. 45 million new cars take to the world's roads each year - the car population is growing at a faster rate than the human one, room must be made for them. Highway System takes up 43,000 miles. In downtown Los Angeles two-thirds of the land area is devoted to the parking and movement of automobiles. In Chicago, Detroit and Minneapolis nearly half the city land is devoted to cars. In Europe the figures are not so bad, on average 19% of urban land is for car use. In terms of parking it has been calculated (by taking the entire stock of car parking and dividing by the number of registered cars) that each car requires 372 square metres, 3 times the size of the average home.

The building of new roads has the following effects on its environs.

a. It takes land away from other existing and potential land uses.
b. Destroys floral and fauna communities and migration routes.
c. Severs existing land uses and human communities.
d. Alters ground and surface water courses and their content.
e. Visually intrudes on a landscape or townscape.
f. The cars travelling on the new roads bring noise pollution and vibration.
g. Finally and most importantly roads, especially modern multi-lanes motorways - require vast amounts of materials for their construction. These materials include cement, stone, gravel, slag, oil, wood and steel.

Urban environmental design is done with the smooth flow of traffic in mind, which is detrimental to pedestrians, cyclists and architecture. Auto-erosion is a term that has been coined lately, cars (especially in Europe) are destroying ancient ruins and beautiful old buildings. One has only to walk around Dublin to see all the great buildings such as the G.P.O. and Trinity College whose facades have been blackened by pollutants from cars.

A great deal of environmental damage is being perpetrated in the name of mobility. Sitting in a car surrounded by hundreds of other cars also has a dehumanising effect by cutting off communication between people who are only a few metres away from each other but in different sound-proof boxes. The automobile which once promised a dazzling world of freedom and convenience is now dragging car dependent societies down into a nightmare of air pollution and traffic congestion as well as making them increasingly reliant on ever-depleting supplies of fossil fuels. But car companies are fighting back as European President of General Motors, Robert J Eaton recently declared 'We firmly believe that the fate and continued prosperity of our industry will greatly depend on whether we are able to make the automobile co-exist in harmony with the world we live in.'

This is a view expressed by all motor company bosses. It is a view forced upon them by public pressure and political intervention.

In a recent interview David Rothwell, founding member of Design Ecologique (an environmentally conscious design consultancy) said that the only reason car companies are turning 'green' is because they are being forced to by new and proposed government legislation. This aside, however, the fact is that car companies are adopting environmental policies to combat the automobiles detrimental effects. In subsequent chapters the automobile industry's solutions will be evaluated. Is enough being done?

Is it being done quickly enough? Is it really possible for the car to live in harmony with the world?

These are the questions that will be addressed in this thesis.

Chapter One

CHAPTER 1

PRODUCTION AND DESTRUCTION

The car is a major consumer of raw materials. In 1987 in the U.S. for example, motor vehicle products consumed, as a proportion of total U.S. consumption, 74.4% of natural rubber, 54.5% of the lead, 46.5% of the synthetic rubber,
43% of the malleable iron, 39.5% of the platinum, 30% of the zinc, 15.7% of the aluminium, 14.8% of the steel, 10.2% of the copper, and 0.3% of the cotton. In 1986, 6 million tonnes of steel were consumed in automobile manufacture and although the use of steel in car manufacture is decreasing, 60% of steel produced in 1988 was used for automobile construction. Steel manufacture in itself is 'resource hungry' and for every tonne of finished steel nearly 3.5 tonnes of raw material is required. With this vast amount of material resources put into the car industry it is then thrown away when the car has reached the end of its useful life.

Each year in Germany two million cars go to the scrap yard or are just dumped. The car population in Germany is potentially at about 30 million and with an average car type scan of 10 years. By the year 2000 over 3 million cars a year will be dumped. Naturally enough the German government is concerned about this frightening statistic and is forcing the German motor industry (already far greater than most) to clean up its act. This entails the cars being scientifically taken apart at the end of their useful life and their components reused, recycled and made into new cars. BMW and Volkswagen have already set up pilot recycling projects to determine ways of making cars that are more easily taken apart and of making their components more readily recyclable.

The French PSA group made up of Peugeot and Citroen are also progressing in this area. The latest car from each have their plastic components marked for easier identification. Also by using only a limited number of types of plastic PSA is claiming that these cars are 100% recyclable.

However, this is just the inception of a new generation of recyclable motor car. What about the millions of cars already on the roads that haven't been designed with such foresight? The steel which contributes to 70% - 75% can be recycled from these cars. It is the remaining 25% to 30% - various plastics and laminated windscreen glass - that is stretching the minds of the industry's scientists.

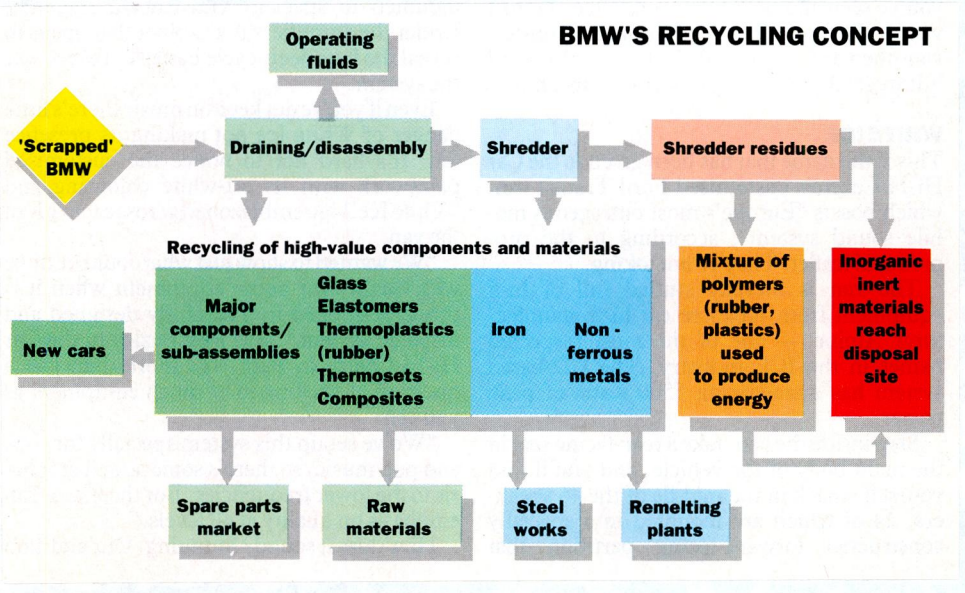
Dr. Siegfried Brudgam is in charge of Volkswagens recycling research and as he points out recycling is a fast-moving science; one year ago recycling fibre reinforced plastics was considered impossible, now we foresee greater use of the material in the quest for weight reduction since processes to recycle it have evolved in the last twelve months.

The PSA group has collaborated with a cement maker to use the non recyclable material from old cars in a new special road surface. This material consists of plastics and textiles (40%), rubber (30%), glass (13%) and 'earth' (15%). This is treated to become energy-producing raw material to replace unconventional fossil fuels in cement making. The residue left after it is burnt is used for a special road surface material which it is claimed generates 3 decibels less noise than conventional dressings.

It must be pointed out that these are all still pilot schemes being done by the car companies mentioned - it is in no way a reflection on the car industry as a whole. However, a step in the right direction in the CARMAT project which was established in 1987. With PSA as programmed leader the aim is to unite
14 companies in the chemical, glass and steel industries and design right from scratch and efficient, silent, safe and economical car using new composite and metallic materials.

RECAP (Recycling of Automobile Plastics) involves PSA, Fiat and chemical companies, EMMAMT and ICI and was initiated in 1990. PSA's directors of vehicle production say that Renault and VAG (Volkswagen, Audi and Seat) are also to join.

Recycling is very much 'flavour of the month' with car companies at the moment, but there is no guarantee that the car companies will expand their recycling operations (still only a handful of pilot schemes) if it doesn't prove profitable. The trend is towards lighter cars (to improve fuel consumption) which means using new lightweight materials such as 'carbon fibre' and 'kevlar'. These 'composite' materials are impossible to recycle but car companies will use them as meeting the immediate fuel consumption targets is of greater priority - or else the car will not be allowed on the road.



Chapter Two

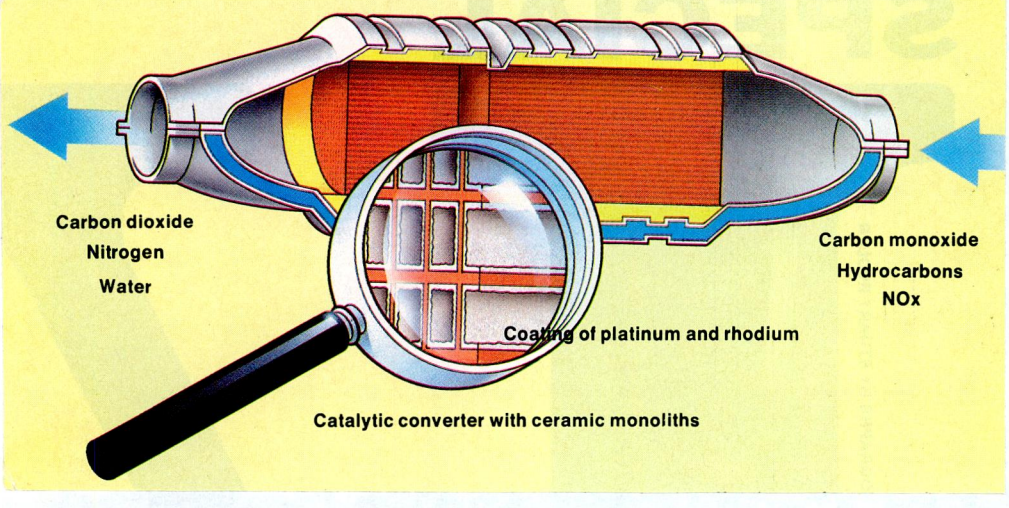
CHAPTER 2

SERVICE LIFE OF A CAR.

Catalytic Converter

By December 1992 all new cars sold in Europe must be fitted with catalytic converters as said down by EC regulations. In the United States, California began its fight for clean air as early as 1947. In 1959 the first standards for air quality and motor vehicle emissions were established. Over the next 15 years, great strides were made by engine manufactures to lower emissions. However, with the introduction in 1975 of standards calling for even lower emissions, the fitting of catalytic converters to production vehicles was the only answer to enable these standards to be met. It has taken over 15 years for Europe to adopt this device.

What is a catalytic converter?



The combustion of petrol in an engine is a simple enough chemical reaction. Petrol consists of hydrocarbons, chemical compounds made up solely of the elements hydrogen and carbon, which burn in oxygen to produce carbon dioxide and water (H_2O). Unfortunately, combustion isn't complete, especially near the cylinder walls and in inaccessible parts of the combustion chamber, where some of the carbon combines only partially with oxygen to produce carbon monoxide. Some completely unburned hydrocarbons escape too, if the mixture is too rich or the engine misfires. Finally, if the combustion temperature is very hot, nitrogen (in the air entering the combustion chamber) will combine with oxygen to form oxides of nitrogen which, as has already been mentioned, form smog in sunlight and acid rain in moisture, not to mention contributing to skin irritability.

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So we have three major pollutants; Hydrocarbon (HC), Carbon Monoxide (CO) and oxides of Nitrogen (NO_X) . Careful design and control of the engine can reduce them greatly, but not completely, not least because when the engine is at its most efficient and CO and HC are low, it burns hot and so NO_X is at its most abundant.

Hence catalytic converters, catalysis is where a material, usually a metal, facilitates a chemical reaction but is not part of that reaction, so is not used up. The simplest car exhaust catalysts are oxidation cats as seen on U.S. vehicles from 1975 on. The actual catalytic metals are Platinum and Rhodium. Two reactions take place in the converter: CO is oxidised to Carbon Dioxide and HC to Water and Carbon Dioxide. But this does nothing about NO_X, hence the modern three way catalytic converter, wherein the NO_X reacts with some of the CO to produce pure Nitrogen and Carbon Dioxide.

So the catalytic converter is seen by most governments and car companies as a major step towards a 'greener' automobile. Yet a motoring journalist, Geoff Howard, wrote an article in 'Car Magazine' - September 1990, entitled 'Why Cats won't Work'. This article had a number of very telling points. Firstly and most obviously, the catalytic converter reduced the amount of pollutants being emitted but it increased the Carbon Dioxide emissions, the principal gas in the greenhouse effect.

Secondly, the annual consumption of the rare and noble metal platinum used as the primary element for the catalyst bed, will rise by more than 30 tonnes in Europe alone, which at the anticipated commodity price of around $500 per troy ounce will feed more than £300 million a year into South Africa, where most of the world's platinum deposits are located and where black workers are still being exploited today.

Thirdly few made it clear that adding a catalyst would increase fuel use by up to 12%.

So what is really at the bottom of the catalyst Revolution?

It is an increasing marketing pressure to maintain a healthy demand for new cars by the established process of planned obsolescence: ie. fitting expensive catalysts and control systems with a life expectancy of only 50,000 miles which are required to operate effectively during an annual vehicle inspection and which cost so much that the cars economic life is shortened.

As Howard states 'Very few manufacturers are prepared to put their hands on their hearts and predict that their emissions, control equipment will exceed the statutory U.S. 50,000 miles durability limit by much of a margin, so the chances are that most cars in the future will be scrapped earlier, as they already are in the catalyst markets of the USA and Japan.'

More important than the emission levels achieved when new are the emissions over a cars running life. If a catalytic converter is not operating properly its emissions will rise by between 1,000 and 2,000 percent. Catalyst-equipped vehicles may not indicate very clearly that there is an operating fault. In fact performance of the engine would more than likely improve, so the incentive to get the vehicle fixed may not exist unless new legislation on in-service emission standards is introduced. So having been hailed as a major solution to car emissions the catalytic converter simply replaces one problem with another more general one, air pollution with global warming.

Alternative Fuels

In June 1990 President George Bush offered a packed White House pressroom the promise of a 'reconciliation of the environment and the automobile'.

He planned to do this over the next 15 years by filling American roads with millions of cars running on 'alternative' fuels. This would appear to be a much more positive idea than the catalytic converter, by replacing petrol and diesel with some cleaner alternative. In particular, as the Environmental Protection Agency (EPA) Administrator William K. Reilly explained to the press, the use of one fuel, Methanol would bring 'very significant pollution reduction advantages'.

Methanol is the choice of the Bush administration because it is attractive to American car companies, Ford and General Motors have developed Methanol- burning cars. It is a liquid-like gasoline, that could be used in modified gasoline vehicles and ,in theory, could offer significant air quality benefits. Whether methanol will deliver those benefits in use is doubtful.

Methanol is the centrepiece in the Presidents ozone reduction program. An alcohol fuel, it is made most cheaply from natural gas. It can also be made from coal, wood or agricultural wastes although at a much higher cost.

Pure methanol (usually called M100) only evaporates at or above 52 degrees Fahrenheit, which makes cold-weather starting difficult, since liquid methanol won't ignite. For this reason, methanol is usually used in a 15% gasoline blend called M85. There are many pilot schemes throughout the US running cars driven by M85. In this form methanol would reduce hydrocarbons (low level ozone producer) by 30% but would produce the same amount of Carbon Monoxide and Carbon Dioxide. The EPA projects that future vehicles running on M100 will emit 80% less hydrocarbons that their gasoline contemporaries. Such estimates are based however, on incomplete emissions data from a few prototype vehicles and do not take into account some already-developed technical improvements in gasoline-vehicle pollution control. More significantly the EPA make their case for methanol based on the use of M100 despite the fact that technical problems will ensure that M100 is not used in significant quantities for a decade or more. M85 will be the methanol fuel for the foreseeable future.

So the advantages of methanol are minimal - if even that. Vehicles running on methanol also emit much more formaldehyde (a smog forming toxic air pollutant and animal carcinogen) than gasoline vehicles.

Underlying the debate over methanol and air quality is a more basic question. Will drivers of flexible fuel vehicles choose methanol? Most methanol vehicles will be designed to run on gasoline as well until methanol becomes widely available, allowing for long-distance travel. Because methanol has a lower energy content then gasoline, a car owner would need to refuel twice as often, and methanol will cost more than gasoline per gallon.

Overall the air-quality benefits of using methanol appear marginal, and extremely costly in comparison to other methods of improving air quality. A 1989 Congressional Office of Technology Assessment study of urban ozone pollution found methanol to be the most expensive of 11 methods of reducing hydrocarbon emissions.

Another 'alternative fuel' is ethanol. Pure ethanol made from sugar-cane powers about a third of all the vehicles in Brazil. In the US all major fuels is a blend of gasoline and 10% corn-derived ethanol. Ethanol/gasoline blends can reduce carbon monoxide emissions, but at the cost of increased hydrocarbons. Little is known on the air quality effects of using pure ethanol but at the moment this would only be a concern for Brazil as this is the only country using it on a large scale. Today's ethanol programs suffer from dismal economics. Governments subsidies prop up programs in the U.S. and Brazil. In the U.S. at today's corn prices and without subsidies, ethanol could only compete if gasoline doubled in price. Even if it were economical, ethanol's inherent disadvantage is that it is made from food crops or from crops grown on land that could be used for food. At current levels of agricultural production and energy consumption there is simply not enough grain to fuel the world. The entire world corn crop would, if converted to ethanol, meet only 17% of global gasoline demand.

Vehicles that run on natural gas or methane, offer savings ozone by producing hydrocarbons (better than methanol and ethanol) but at the cost of increased emissions of nitrogen oxides. Scientists believe this can be overcome but more research is needed into low emission/high efficiency natural-gas engines.

Methane is usually stored in vehicles as a compressed gas in high pressure tanks. It can also be stored as a liquid in lighter, more compact, vacuum insulated tanks. Its disadvantages are the extra weight of storage tanks, slow refuelling and a limited range. As with the other alternative fuels it doesn't emit less carbon dioxide than a normal gasoline engine.

Significant declines in greenhouse emissions from transportation fuels will only be possible if fuel efficiency climbs rapidly or non-fossil fuel alternatives replace petroleum. The alternative fuels discussed, like the catalytic converter, replace one problem with another. However, there are better solutions than these already discussed, solutions that have been around as long as the internal combustion engine itself. These will be discussed in the next chapter.

Chapter Three

CHAPTER 3

THE ELECTRIC CAR

'If it was red, emblazoned with graphics, I think my adrenalin might have been persuaded to move - but it looks exactly the same as the piece of plastic I'd laughed at years before'.

NICKI CARTER, AUTOCAR AND MOTOR, 2/1/91

With the arrival in 1985 of the Sinclair C5 many thought a new age in transport had arrived. The little one-man electric powered trike had a top speed of 15 miles per hour and a battery range of 25 miles with a back-up system consisting of pedals; should the rider get caught out with a dead battery he/she could pedal home.

Quickly as the C5 came on the scene, its demise was twice as fast. Why did it fail? Simply put, it was because it tried to be ' all things to all men '; Sinclair wanted anyone from the age of 12 years and upwards to be able to use it without a license or crash-helmet. This necessitated an extremely low top speed of 15 miles per hour to satisfy government legislation on motor-driven vehicles. Anybody could climb onto a bike and average 20 miles per hour, so there was no way cyclists were going to spend 100% more money (the RRP in 1985 was £400) on a machine that only went 75% as fast as a bike. As for motoring commuters, there was no way they would be seen dead in a machine with such a faulty top speed even if rush hour traffic averages only 5 miles per hour. Besides, upon reading motoring journals of the day, a person would develop a phobia towards being seen in a C5, the quote at the beginning of the chapter is a good indicator of motoring journalists attitude towards the C5.

Car companies are pouring unprecedented amounts of money into electric car research; this is due in no small part to the State of California. California, taken in isolation, is the seventh largest car market in the world, yet it has no indigenous car industry, so Californians feel they can decide their future without the axe-grinding of the Detroit Big Three - General Motors, Ford and Chrysler. This future involves clean air. In 1988 the Los Angeles Vehicle Initiative got underway, this aimed to get 10,000 electric vehicles onto the streets of Los Angeles - the most motocentric city in the world - by 1995. A competition was held and a car proposal by a specially formed Swedish company, Clean Air Transport, was selected for backing by the city. Los Angeles provided £4 million help with development for the car, and some tempting incentives for customs too. For a start, a $50 (£30) levy will probably be charged on every petrol car sold, to finance the programme. There will be no sales tax on electric cars, and their owners will get 2.5% discounts from their entire electricity bills. Electric cars will have free parking and unrestricted use of special 'diamond' commuter lanes on the freeways. Already all new buildings in the Los Angeles basin have to have charging points in their parking spaces.

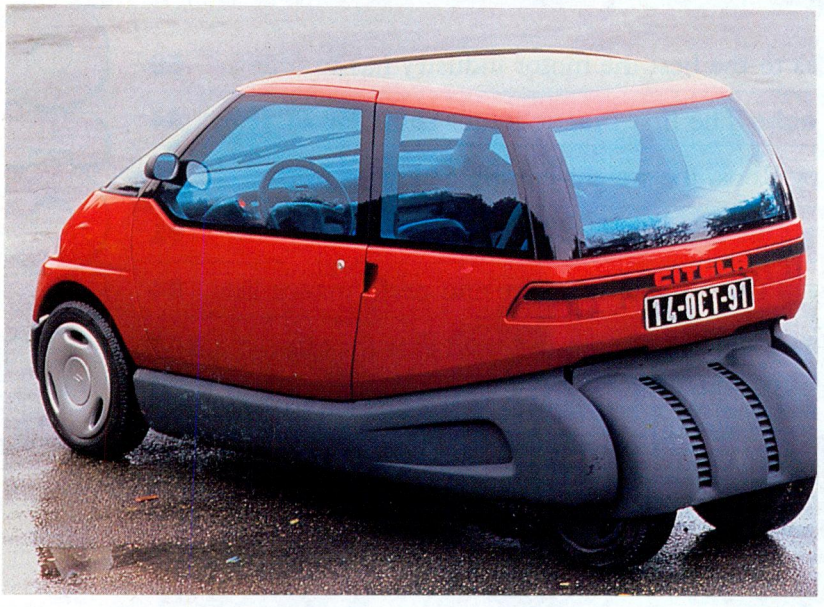
The car that Clean Air Transport have come up with is called the 'Clean Air LA301'.

4. Clean Air LA 301.

It is a hybrid car with both a 32kw electric motor and a 660cc four-cylinder petrol engine. The petrol engine serves to extend the range of the car so the driver is never stuck with flat batteries. Even with the engine kept shut off, the range on an eight hour charge is at least 40 miles, enough for at least 90% of the journeys in the Los Angeles basin. The 'Clean Airs' top speed of 70mph is entirely acceptable for California freeways. Because this car utilises a petrol engine - if only partly -, there will still be pollution emissions, but it is intended to meet California's Ultra Low Emissions Vehicle (ULEV) standard. No other car has yet managed that.

There's an even tougher hurdle to climb eventually; the Zero Emissions Vehicle standard - fully electric, in other words. By 1997 2% of all cars sold in California must be ULEV's and the next year a further 2% must be ZEV's. The proportions rise substantially from then on. Car companies are being forced to invest in electric power by Government pressure; besides California, Germany is going to ban petrol and diesel engined vehicles from entering some town centres within the next 12 to 24 months.

A number of car companies already have electric vehicles concepts on test. The BMW E1, shown for the first time at this years Frankfurt motor show has a top speed of 75mph and a range between charges of 155 miles, However its Sodium Sulphur (Na S) batteries would cost about £17,000 a set and would only last between one and two years. The General Motors 'Impact' and the Nissan 'Future Electric Vehicle' (FEV) look very similar and indeed have similar performance figures (top speed 50mph, range 150 miles), but again the restricting factor is the price and durability of the batteries.



9. Citroen Citela.

Citroen has, since its inception been one of the most innovative motor companies in the world and the area of the electrically driven car is no exception. The Citroen 'Citela' is the prototype for what could become the world's first truly viable electric city car when it goes into production in the mid-ninties. Viability, for Citroen means four seats, a 70mph top speed, a 130 mile range, a two hour recharging time and a network of on-streed recharging points in Europe's major cities. But most importantly, Citroen promises that the 'Citela' will cost no more than a budget small car. Citroen has used nickel-cadmium batteries. The batteries don't rob the car of luggage space or rear seats as with other electric vehicles (GW 'Impact', Nissan 'FEV'); due to using them as part of the stress bearing central frame. Citroen also claims the batteries have a usable life of 100,000 miles - the previous best being 30,000 miles. The batteries aren't bought, but leased to the car owner by the car company and when returned the potentially harmful cadmium is recycled.

Electric cars would appear to be a major breakthrough in the 'greening' of the automobile but they only make sense if the energy they consume is supplied by clean (instead of coal or oil) power sources. If there was such a thing as safe nuclear power, all our energy problems would be solved in a flash. It could be argued that it is better to have the pollution being emitted from one source (oil burning power station) rather than hundreds of thousands (ie. car tailpipes), that way it could be filtered more easily, but this doesn't do anything about solving the space problem.

Instead of cities choking with fossil-fuel burning vehicles they will instead by choking with electric cars of a similar size, using just as much of the Earth's resources in their manufacture. A new phenomenon arising out of this lack of space in cities is the 'Gridlock'. The 'Gridlock' emerged for the first time in Los Angeles in the late seventies; it occurs when the grids of roads become jammed at a series of junctions, meaning that cars cannot escape. The jam then feeds back, blocking more junctions and hence causing further jams. The size of the Gridlock is dependent only on the number of cars feeding into the jam and how quickly the police can close the roads leading into it.

PUBLIC TRANSPORT

The only solution to traffic congestion is public transport. Indeed it addresses all the environmental problem far better than the modern motor car. 80% of car journeys made are 'driver only' journeys. By filling a standard double-decker bus, 25 feet long, with 60 drivers approximately 900 feet of road will be freed of cars. Trains are even more space efficient; a modern suburban railway can carry 70,000 passengers per hour per track, whereas a road would require 13 times the space to carry the same number of people. Rail possesses certain inherent characteristics which mean that nearly 40% less propulsive energy is required than for a road vehicle of the same total weight moving at the same speed. These include the lower rolling resistance between steel wheels and steel rails than between rubber tyres and road surfaces, and the lower aerodynamic resistance generated by railway vehicles. Rail vehicles because they travel along a guided path make far fewer unintended speed changes or stops (both of which will dissipate energy) than road vehicles. These facts have been taken from a book called 'Wrong Side of the Tracks' which compares rail and private car transport. There is no contest. As already mentioned in the introduction over 250,000 people are killed on the world's roads annually but rail deaths are unlikely to reach 5 figures. The car's service life pales in comparison with that of the train or bus, both of which will be expected to run for between 25 and 40 years with regular servicing while the car will not last for more that ten years. With both Britain and Ireland investing heavily in roads, the respective politicians are showing an incredible lack of foresight and they are passing on a legacy of chaos and congestion.

Chapter Four

CHAPTER 4

INFRASTRUCTURE

250,000 people are killed on the world's roads each year, with personal injury accidents claiming 20-40 million. This is a frightening statistic but one that reflects the sheer breadth of the world's road network. The car population is growing at a faster rate than the human one and no more space is being given over to the motor car. The M25, a 130 mile orbital ring road around London was only completed in the last five years, yet already it is too small for the volume of traffic using it , with traffic jams due to accidents being a frequent occurrence. Plans are afoot to add an extra two lanes to each side of the road. This would mean destroying much more of the surrounding countryside, some parts of which are nature reserves (no one believes it can be prevented).

Britain and Ireland are the only two EC countries spending more money on private transport rather than on public transport. The long established right to travel has become a freedom working against its own interests. It impacts the environment to an unprecedented extent and with the present private transport policy this condition will worsen before any improvement takes place. Uninhibited movement creates a demand for more infrastructure, which simply exacerbates the problem through the satisfaction of some suppressed demand.

The sheer width of motorway corridors means that present-day demands for their land quantitatively transcends what was taken for roads in the past. In the U.S. each year, oil spills 20 times the Exxon Valdez oil spill fall on roadsides or down drains and can contaminate aquifers and rivers. Used oil is considerably more toxic, and carcinogenic than the Exxon crude: 1 gallon can contaminate 1 million gallons of fresh water. Besides the indirect damage to wildlife due to pollutants, between 30 and 70 million Birds are killed each year on British roads, and 47,000 Badgers. In the US 1 million wild animals a day are killed on roads. This is too large a price to pay in the name of mobility.

INDUSTRY

Doctor Claire Holman is an independent specialist on the motor industry and the environment. She gained a PhD in atmosphere chemistry in the late 70's with a study of the formation of ozone at ground level. Along with other environmentalists, she believes that because of pollution and congestion, the environment cannot sustain car growth at the rate it has in the past.

The car industry is almost totally reactive rather than proactive. Dr. Holman says 'If legislation is there, it meets it because it has to', this is a view also shared by Designer David Rothwell 'The industry has objected to much new legislation, not just in Europe but in the U.S. as well. Manufacturers produce nice glossy brochures on the environment but

when it comes down to it, these companies are involved in lobbying government to ensure emission standards aren't too strict. The industry spends too much energy resisting proposals without considering that there might be something behind them'.

Dr. Holman admits that there are exceptions, 'Companies like Volkswagen, Mercedes and Volvo have been proactive in their environmental stance. But even Volvo and Mercedes do not make small cars and have no intention of doing so. They're still stuck into the traditional view that since their proven product range makes money, why should they change?'

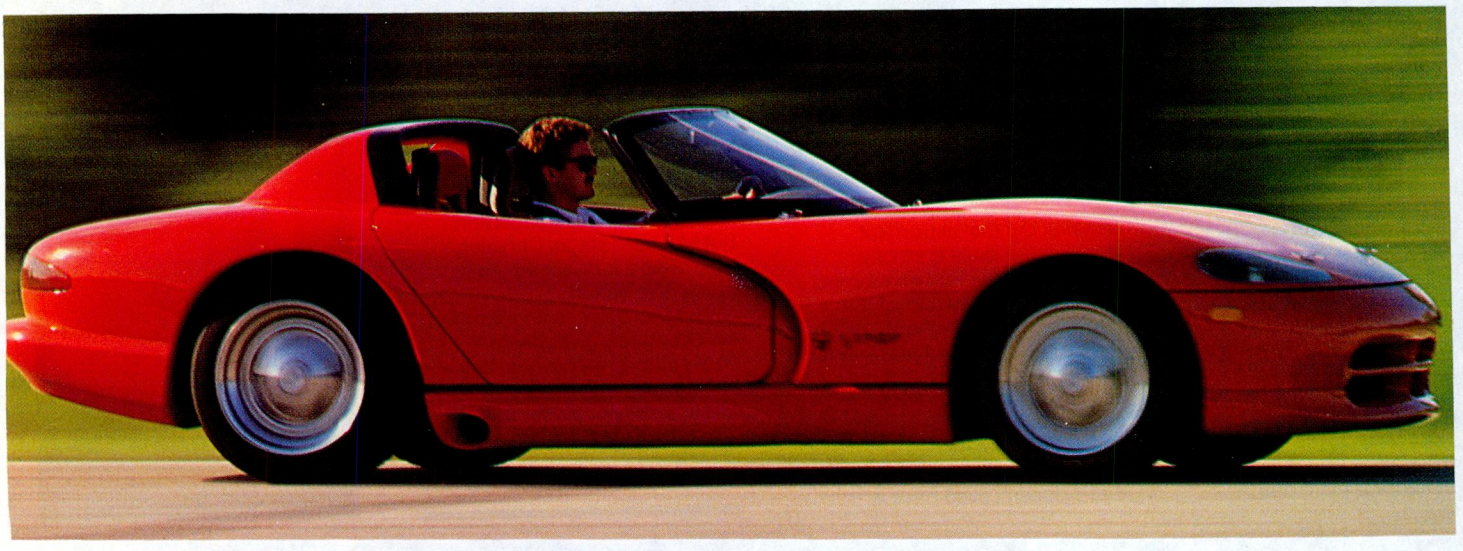
This is a very important point because car companies are answerable to their shareholders and the shareholders want profits, therefore a company will not take a risk if profits are attainable without a risk, especially now in a time of recession. Car companies are not benevolent, they will not pump money into environmental research unless legislation forces it upon them, but governments can only do so much. In the twentieth century the real wielders of power are the multi-national corporations. In the 'Fortune Five Hundred' 23 of the 50 richest corporations in world are either car companies or petroleum companies. The 4 richest corporations in order of wealth are General Motors, Royal Duth/Shell Group, Exxon and Ford. These are the most powerful companies in the world and to accuse them of conspiring to hold up the environmental lobby would not be beyond the reasons of fact. It certainly would not be the first such conspiracy. A conspiracy revealed by the U.S. Senate, did it's utmost to impose the private automobile in North America. Starting in 1932, General Motors, Exxon and Firestone, among others, plotted together to buy out and eliminate 100 tramway companies in 45 U.S. cities. This lead to a tripling of car sales and the reduction in the number of mass transit passengers of 3 billion. During legal proceedings before the U.S. Senate Anti-Trust Committee, the guilty companies were fined a grand total of $5,000 for their criminal activities. It is interesting to note that most of the solar research facilities have been brought out by car or oil companies.

Car companies may someday come up with 'the green running car', zero emissions, long service life, energy efficient and totally recyclable but they would want to produce just as many, if not more units than they are making today. This would mean just as much demand for new roads and parking space so increasing infrastructure. Therefore we would continue to destroy the earth in order to queue on motorways in our clean running cars at rush hour. Cities would still be choked by cars, in Rio De Janerio the rush hour has now become a 14 hour daily event and in Tokyo it lasts for 12 hours or more.

It is not in the car industry's best interests to go 'green' because it means vast amounts of money in research to come up with a vehicle, that they would be expected to produce much less of by today's standards, while governments investigate large scale public transport policies. The question is will the industry allow this to happen?

CHAPTER 5

SOCIETY



The illustration is of the Chrysler Dodge Viper which has two seats, 400 horsepower and the widest tyres yet to be fitted to a production car. This is a sports car in the tradition of the old fashioned, gas guzzler of the American motor cars heyday. It will reach 60 miles per hour from standstill in under 4 seconds, with a top speed of 165mph. The ten cylinder engine isn't the best that technology has to offer, in fact it doesn't even come close. The engine is lifted straight from a truck in the Chrysler range and does a paltry fifteen miles per gallon.

This car was shown by Chrysler as a concept car at motor shows around the world in 1989. A concept to show off the styling studio's creativity. A concept Chrysler had no intention of building. However, demand for its outrageously macho looks was so strong that they have felt compelled to produce it. Full scale production (3,000 units a year) begins early next year, 1993. Critics have damned it as an irresponsible throw-back to the 1960's. To them it represents everything that is egocentric and wasteful in American culture. It would seen that no matter how illogical or environmentally dubious this car is, people are still prepared to buy it. The evidence from Chryslers marketing strategy is that Americans want to reexperience the sixties. Indeed the company says that as well as American dealers, European dealers are clamouring for the car as well, which the weak dollar makes a bargain compared with European sports cars.

This is only one of a number of events that have come as a 'backlash' to a 'green' automotive movement still very much in its infancy.

Pedestrianised areas in the centres of towns and cities (extremely prevalent in Europe) became fashionable in the United States about 15 years ago. Some 200 were created across the states, billed as the answer to town-centre direction. But most Americans voted with their accelerator pedals and headed for the suburban 'strips' and drive-ins. The Chamber of Commerce recently discovered a good way to revive business is to reopen

the pedestrian precincts to cars. The town of Ploughkeepsie in New York has recently opened up its centre to cars.

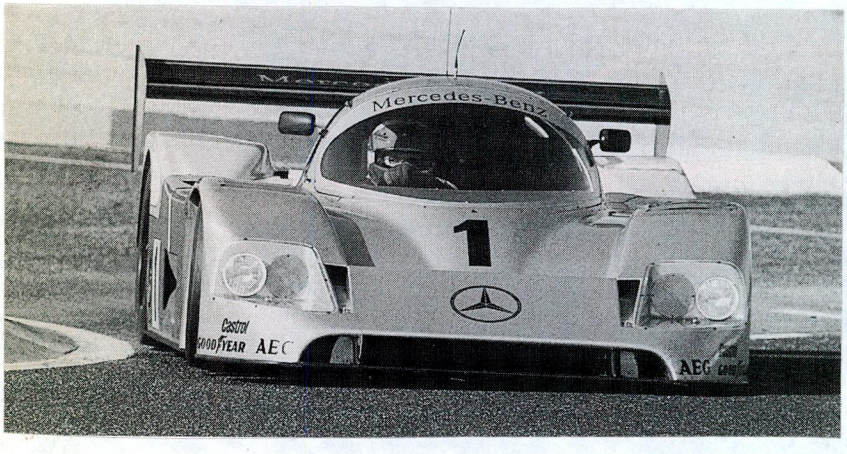
Kathryn La Vanche of the Ploughkeepsie Partnership says that they have already seen very positive results, especially when parking is free.

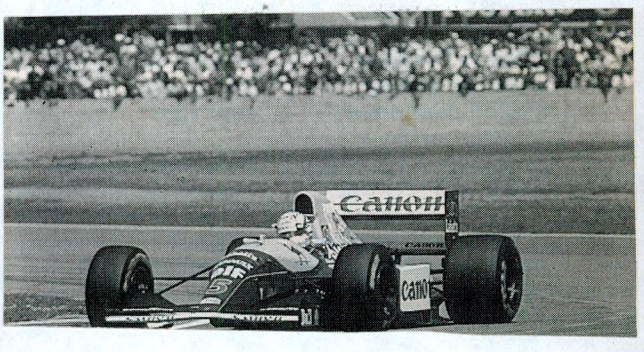
Robert Lutz the President of Chrysler, claims that his Viper is responding to much the same market forces.

Many of the environmental solutions being approved by car companies such as small capacity engines, the electric car, mini urban cars and the catalytic converter (which impedes performance) are seen by many as the emasculation of the motor car. The car is losing its power and its presence.

The car is not just a mode of transport, if it were, quick decisive steps could be taken to curb its excesses. Instead besides transportation it is also an expression of personality, social standing, aspirations, sexual prowess and wealth. It is deeply ingrained on the western psyche. As Stephen Bayley points out in his book 'Sex, Drink and Fast Cars', 'A fast car demonstrates professional success and sexual prowess'. It is for this reason that car companies are involved in motor sport.

Motor sport comes in many different guises, rallying, sports car racing, dragster racing, hill climbing, off-road racing and motor-racing - Formula 1, F3,000 and others. The two most popular are Formula 1 motor racing and prototype sports car (Group C) racing.





Both of these involve outlays of hugh sums of money by car manufacturers wishing to compete. They also involve nearly every car manufacturer in the world. Here is a list of the companies involved in each:

Formula 1	Group C
Ferrari-Fiat	Mercedes
Renault	Peugeot
Honda	Jaguar
Yamaha	Mazda
Ford Porshe	Toyota
Lamborguini	Nissan

An average formula 1 team would expect to spend around £30 million during each racing season. This does not include out of season research and development which could be just as staggering. Both Ferrari (owned by Fiat) and Honda have unlimited budget policies as approved by their boards, 'win at all costs' being their motto. Yet why would a company such as Honda whose commercial range of cars consists mostly of sensible family hatchbacks and saloons, commit themselves so heavily to a sport that is nothing short of eco-terrorism?

The racing cars in Formula 1 have large capacity high performance engines which run on heavily leaded fuel cocktails, averaging about 3 miles to the gallon. They propel the single cramped occupant to 1 hundred miles per hour in 3 seconds on incredibly wide tyres which sometimes only last about 20 laps of a circuit (a third of a race distance). The chassis is made of high tech lightweight materials such as carbon fibre and kevler (impossible to recycle). Research and development beneficial to road cars is the usual reason for Formula 1 involvement, yet a company like Honda does not have any car remotely like its raving monster. The design parameters just do not coincide adequately to justify involvement.

Companies are involved in motor racing for one reason which becomes obvious when viewing one of the races, advertising. A company such as Honda can advertise its road cars as the paragons of environmentalism while people see its racing car success as a very good reason for buying their completely dissimilar road vehicles.

Racing car advertising is very brash and eye catching as is the nature of the sport, but it is in the advertising of production cars that companies are at their most sophisticated. Taking the latest television advert by Opel (a European subsidery of General Motors) for its ASTRA as a prime example of subliminal advertising. In this advertisement we view (from above) an *ASTRA* traveling through bush green countryside and forestland. There is no talk of performance figures, only beautiful music (Brian Eno 'Another Green World') and a reassuring voice telling the viewer about the automatically adjusting seatbelts, the cars overall safety capabilities, spaciousness and the catalytic converteras standard. Also it is a clear open road with no other vehicles in sight. It is the justification of car and senic environment more than anything else that will create in the viewer's mind an image of the new *ASTRA* as a 'green' car. Yet this car is no 'greener' than any other car in its class. People would wrongly think they were making a special effort for the Earth in buying this car. It is this sort of subliminal advertising that is giving the general public a false impression of the scale of the environmental problems cars cause. Modern society is technologically rather than environmentally driven; the general concensus is that technology will solve the problems it created in the first place. However, this is not the case, at least not at the rate of change the car industry is employing. It is still very much 'business as usual' with minor headaches caused by governmental legislation. Time is running out for the human race, and the car, although not getting us from A to B very quickly is propelling us at ever greater speed in air-conditioned comfort towards AN ENVIRONMENTAL D-DAY!

Chapter Five

Conclusion

CONCLUSION

No matter what man endeavours to do, he invariably has some effect on his environment, the car industry having a very visible and widespread influence on everything it comes into contact with.

Chapter 1 illustrated the conflict for car companies between the short-term goal of meeting future emissions standards and the long-term goal of protecting the limited natural resources available.This dicotomy will not be solved by car companies insisting on keeping production of cars at their present levels, if indeed this problem is actually solvable at all.

Chapter 2 showed the catalytic converter to be a placebo in terms of reducing emissions;car buyers may feel that they are doing their bit for the green movement with a cat. equipped car, but any reductions in carbon monoxide, hydrocarbons and nitrogen oxide are more than offset by the increase in carbon dioxide and more importantly the shorter life-span of the vehicle. What is really farcicle is the fact that catalytic converters are now law. With an expensive converter having a much shorter life-span than a modern motor car, the door is being opened for the car industry to produce even more cars argueing that it is for the good of the environment.
Alternative fuels are another non-starter, none of which discussed had any clear advantages over petrol as regards the "Earth".To pour vast amounts of research money into these options would not be a good idea as they could be seen as nothing but a stopgap.

Chapter 3 dealt with the electric car and public transport. The combination of these two are the only real option available for travelling distances in the future. Trains or buses for long distances and small electric vehicles for getting to the more inaccessible places. With the necessary electric power from wind, wave, solar or some other renewable power source. Short distances should be done by either cycling or walking. Public transport has a bad name but that is because it is severely under funded in most European countries. We have simply never experienced a well funded system that isn't playing second fiddle to a more powerful road lobby.

The road lobby is made up of the companies involved in car infrastructure and industry as discussed in Chapter 4. As discussed these are the most powerful companies in the world and there is no way that they are going to let the motor car be phased out or significantly reduced in numbers no matter how bad the

consequences, they simply have too much to lose.

The human race is heading towards two crises; one of energy and the second, the environment.The car is a major contributor to both.The production process today requires more energy and materials than at any other time in the history of the motor car. As already mentioned the car population is growing faster than the human one and will continue to do so; any gains made in pollution control and fuel economy are offset by the ever increasing number of cars on the roads of the world. The car industry is not doing enough to clean up it's act, indeed that's exactly what it is, an act. Car companies already have the blueprints for cars they will be producing in five to ten years time - depending on how the present model is doing - and they are no different in concept to the ones on the road today.

There will be no great leaps in design or technology. The British Car Industry quoted in Autocar and Motor (12/6/91) quoted a rise in fuel consunption of 2.9% by the year 2000! This figure is pathetic, and Joe Public will continue to be led blindfolded swayed by advertising and sophisticated marketing into buying one of these pseudo-green machines, and governments will continue to support the road lobby, who give very generous party donations.
With California as the prime example, people will not act until the problem comes to rest in their own backyard and by then it will be far too late.

Is it possible for the car to live in harmony with the environment? No, it is not possible with the vehicles we know today or with the industry that runs it. Action to curb the car's excess' are being taken but they are too little, too late.

Man has changed his environment drastically in the interest of mobility and in the process has dug himself a rather large hole, which could send him the way of the dinosaur.

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